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Differential trapping success for small mammals using pitfall and standard cage traps in a woodland savannah region of southwestern Brazil

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Abstract

This study aimed to compare the efficacy of different trapping methodologies for sampling small mammals, consisting of trap type (pitfall, Sherman, and wire traps) and position (ground and understorey) in the Cerrado biome of Brazil. Five fragments of woodland savannah were selected for the study. We captured a total of 364 individuals of 14 species of small mammals. Pitfall traps sampled all 14 species (100%), whereas ground cage traps sampled 8 species (57%), and arboreal traps sampled 5 species (36%). The sampling methodologies gave significantly different results, particularly between pitfall and cage traps, and between ground and arboreal cage traps. However, the comparison between Sherman and wire traps indicated no significant difference, although abundance has been higher for wire cages. Our study confirms the high success rate for pitfall traps now in the Cerrado biome and suggests combinations of trapping methodologies for surveying mammalian diversity.

Keywords: Cerrado biome; *Cryptonanus agricolai*; *Monodelphis kunsi*; *Thylamys macrurus*; Sherman trap efficacy.

Introduction

Brazil is one the most species-rich countries in the world, harboring nearly 650 species of mammals (Myers et al. 2000, Reis et al. 2006). Small non-volant mammals ($\leq$1 kg) comprise a substantial number (44%) of the overall species richness of mammals in the country (Emmons and Feer 1997, Eisenberg and Redford 1999). This high faunal diversity is, in part, related to the presence of different biomes in the country, including tropical rainforests and savannahs. The Brazilian physiognomies are peculiar because of their patterns of heterogeneity and complexity, afforded by large biomes such as the Amazon and the Cerrado (Myers et al. 2000).

Small mammal species are widely distributed in these biomes, with many cases of endemicity and functional adaptations (Fonseca et al. 1996). One of the most interesting challenges is how to survey such a diversity of small mammals. This becomes more important when considering the continuing discoveries of new species of mammals, particularly the smaller species in South America (Patterson 2001). Many methods for trapping small mammals are used, including the use of non-wire Sherman, wire traps such as the Tomahawk type, owl pellets, and carnivore scats (Torre et al. 2004, Monteiro-Filho and Graipel 2006). Although pitfall traps have been used in temperate regions of the world for sampling small mammals (Nicolas and Colyn 2006), the use of pitfall traps for this purpose in the Neotropics is recent (Umetsu et al. 2006), similar to Africa (Nicolas and Colyn 2006, Gambalemoke et al. 2008). In fact, cage traps such as Sherman and wire types have been extensively used in systematic and ecological studies involving small mammals at an increasing rate in the past decades in South America (Charles-Dominique et al. 1981, August 1983, Mares et al. 1986, Malcolm 1991, Bonvicino et al. 1996, Caceres et al. 2007), but pitfall traps have only been used in recent years (Voss and Emmons 1996, Umetsu et al. 2006). However, in Brazil, one of the richest countries in the world, ecological studies focusing on small mammals have been preferentially conducted in the eastern Brazilian Atlantic Forest (Pardini et al. 2005), with a relatively small effort in the remaining biomes of Brazil. Similarly, studies comparing the efficacy of sampling non-volant small mammals using different trapping methodologies are rather abundant in the Atlantic and even in the Amazon Forests (Malcolm 1991, Voss and Emmons 1996, Vieira and Monteiro-Filho 2003, Vieira et al. 2004, Lambert et al. 2005, Santos-Filho et al. 2006, Umetsu et al. 2006), but nearly absent in the Cerrado biome, which has been considered a hotspot (Myers et al. 2000). Exceptions include the studies of Lyra-Jorge and Pivello (2001) and Caceres et al. (2008) which have used pitfall traps with small buckets (0.37×0.41 m or 30 l) and short 4-m driving fences (the first study). Such studies carried out in South America have revealed that pitfall traps are better at surveying small, cryptic species and lighter individuals.

Furthermore, no study has compared different types of cage traps such as the Sherman and wire traps when evaluating small mammal communities in the Cerrado biome. In America, efficacy of Sherman traps has been evaluated by comparing them with wire mesh (O'Farrell et al. 1994) and snap traps (Wiener and Smith 1972, Woodman et al. 1996), and results have shown that wire and snap traps are more efficient in sampling small mammals. By contrast, arboreal surveys have been recommended to be a better survey of small mammal communities because they can reveal species that rarely descend to the ground (Malcolm 1991, Vieira and Monteiro-Filho 2003).

In view of these considerations, we aimed to compare the efficacy of different trapping methodologies for small-mammal sampling, consisting of pitfall and standard cage traps (Sherman and wire types) and different positions of cage traps (on the ground and in the understorey) in a savannah region of the Cerrado biome, in Brazil. Based on the cited studies comparing sampling methodologies to survey small mammals in South America and our empirical observations, we expected that pitfall traps will survey more species than baited cage traps, that wire traps will survey higher numbers of species and individuals than Sherman traps, and that arboreal cage traps will capture some arboreal species with regard to cage traps functioning on the ground level.

Materials and methods

Study area

The forested savannah fragments studied are located in the southwestern region of Brazil, in the state of Mato Grosso do Sul (Dois Irmãos do Buriti and Terenos municipalities), at central coordinates 20°30′ S and 55°18′ W. The physiognomy studied was a woodland savannah (''cerradão''), which is an arboreal physiognomy within the Cerrado biome (Veloso et al. 1991). The area is located in the Paraguay River basin, at altitudes from 245 to 275 m a.s.l. The climate is highly seasonal, with a marked dry and cold season (April to September, with mean temperatures usually below 25°C, and rainfall that can be zero), and a wet and warm season (October to March, with mean temperatures usually above 30°C, and high rainfall, usually exceeding 1000 mm). The minimum temperature varied from 14.0°C to 21.5°C in the area during the study (N.C. Caceres personal observation). Five fragments of woodland savannah, of different sizes (40–600 ha), were selected for the study, being considered as replicates. All of them are surrounded by a matrix of pasture, with two main watercourses nearby (Aquidauana and Cachoeirão rivers). Fragment sizes in the region are usually no larger than 1000 ha, and fragments of 40–200 ha are most common. Isolation distances among fragments ranged from 100 m to 1.7 km. Evidence of cattle was rare in the fragments selected, because most were surrounded by fences, and no edge effect was detected on the small mammal fauna (R.P. Nápoli and N.C. Caceres unpublished data). All the fragments are composed of primary forest, but with different degrees of perturbation (mainly fire, abundant bamboos, and invasive exotic species such as *Brachiaria* sp.).

Animal sampling

For sampling small mammals in the fragments, three methods were used: (1) pitfall traps, (2) wire traps or Sherman traps at ground level, and (3) wire traps or Sherman traps at arboreal level (1.5–2 m). Two grids of cage traps were used in each fragment, except for the smallest fragment (40 ha) where one grid was installed. Pitfall traps were distributed in three transect lines per fragment, except for the smallest one in which two lines were installed.

Ground-level grids were established, one in the interior (7 lines×7 columns format=49 traps) and another on the edge of each fragment (9×5 format=45 traps; with an elongated format to make possible a trapping grid be set up to 100 m from the edge). Each trap (wire mesh or Sherman) was spaced 20 m from the next in any direction in a grid. For pitfalls, 10 buckets (108 l) were spaced 10 m from each other in the same line, and were connected by a black plastic fence (110 m in total length and 50 cm high) to guide animals to the buckets. There were usually (for four fragments) 94 ground cage traps versus 30 buckets installed per fragment. Sherman (40×12×12 cm) and wire national (40×16×16 cm) traps (proportion 1:1) were alternately positioned at ground level in the grids, except for the smallest fragment in which only wire mesh traps were used. On average, eight arboreal traps (1.5–2 m in height and spaced at least 20 m from each other) were installed in each grid for trapping arboreal species. Sherman and wire traps were randomly used in this arboreal effort. The bait was a mixture of pumpkin, bacon, codfish liver oil, and peanut butter, used in both the ground and arboreal traps.

In the interior of a fragment, each of the two transect lines of pitfalls was installed in opposite directions regarding the cage trap grid, both at least 200 m distant from the grid. A given cage trap grid in the forest interior was positioned 120 m apart from its correspondent cage trap grid installed in the forest edge, and a given transect line of pitfall in the interior was positioned 190 m apart from its edge correspondent, which was positioned 10 m from the edge limit. Transect lines of pitfall were arranged parallel to the edge. As an exception, in the smaller 40-ha fragment, only the forest interior was sampled with two transect lines of pitfalls and one cage trap grid.

Captures for each of the three methods occurred between August 2003 and July 2004, with trapping extending for 5–15 days. Fragments were sampled on 5–10 days during the dry and cold season, and on 10–15 days during the wet and warm season (see Caceres et al. 2010), because we expected that capture rates will be improved in the warm season (Carmignotto 2005). Cage traps and pitfalls were simultaneously used in each pair of fragments. Most animals captured were marked by holes in the ears, and released, and some of them were collected for karyological determination, species identification (see Bonvicino et al. 2002), and voucher specimens. Voucher specimens for most species (particularly those of smaller size and of unresolved systematics) were housed at the Federal University of Santa Maria (Mammal Collection, UFSM), Brazil (see Table 1 for numbers of voucher species).

Table 1 Records of occurrence and abundance of small mammals in five fragments of woodland savannah in southwestern Brazil, as shown by different trapping methods.

Species/effort	Mean mass	Ground cage traps		Total ground cage traps (8915)	Pitfall traps (2100)	Understorey cage traps (850)
		Sherman (3600)	Wire (3600)			
Marsupials						
Cryptonanus agricolai (Moojen 1943)[4]	22.0	0	0	0	2	1
Didelphis albiventris Lund, 1840	380.3	1[a]	13[b]	21[a]	2[b]	2
Gracilinanus agilis (Burmeister 1854)[7]	29.3	2	6	12[a]	7[a]	9*
Monodelphis domestica (Wagner 1842)[2]	66.6	3	4	9[a]	9[a]	0
Monodelphis kunsi (Pine 1975)[4]	11.8	0	0	0	8	0
Thylamys macrurus (Olfers 1818)[10]	42.6	11[a]	38[b]	72[a]	22[b]	7
Rodents						
Calomys callidus (Thomas 1916)[10,**]	26.6	6[a]	6[a]	17[a]	94[b]	0
Cerradomys scotti (Langguth and Bonvicino 2002)[5]	67.0	1	0	1	3	0
Hylaeamys megacephalus (Fischer 1814)	46.5	0	0	0	1	0
Necromys lasiurus (Lund 1841)[1]	55.0	0	0	0	1	0
Oligoryzomys fornesi (Massoia 1973)[1]	10.0	0	0	0	1	0
Rhipidomys macrurus (Gervais 1855)[10]	70.3	3	2	6	2	3*
Thrichomys pachyurus (Wagner 1854)[6]	257.4	9[a]	38[b]	50[a]	1[b]	0
Lagomorphs						
Sylvilagus brasiliensis (Linnaeus 1758)	400.0	0	0	0	1	0
Total		36	107	188	154	22

Because four fragments were used for comparison of ground cage trap types (Sherman vs wire traps), partial and total results for cage traps are different. Numbers after authorities indicate the number of voucher specimens collected. Body mass (in g) includes all first captures. Effort in trap-night is given in parentheses. Different letters indicate a significant difference between paired methods ($p<0.01$; G-test), except for understorey. Arboreality was tested using the Binomial test ($p<0.01$; indicated by asterisk *) for species captured in the understorey (against ground cage traps) with a minimum of three captures. **2n=48.

Data analyses

For each fragment, we recorded the total number of individuals captured per species (abundance), the species composition (presence and absence), and capture success (as the number of individuals captured divided by the total effort, multiplied by 100) for each trapping method.

For comparison between cage-trap types, four fragments were used (80–600 ha), provided that in the 40-ha fragment only wire traps were used. For comparison among ground, arboreal, and pitfall traps, all five fragments were used. Randomization (t-test) and non-parametric (G, Binomial, and Mann-Whitney) tests were used for these comparisons, which require no assumption of normality or homogeneity in variance of the data. We tested the significance of the collection effort for cage and pitfall traps by calculating expected species accumulation curves based on samples; total species richness was estimated by using Jack 1 and 2 estimators; the statistical package used was EstimateS (version 8.2, R.K. Colwell, http://purl.oclc.org/estimates).

We examined the variation of the first captures of small mammals among trapping methods through the t-test for testing between cage types, and pitfall and cage traps, both via randomization testing (1000 runs as permutation; each species was considered as a response variable, which is possible by the Monte Carlo statistic). A sampling unit was established as each group of trapping grids or transect lines per forest fragment. Two types of analyses were performed: for the abundance effects (computing Euclidean distances between sampling units) and for species-composition effects (computing Sorensen as a measure of resemblance between sampling units). For this latter purpose, data in the sampling units (grids or transect lines within fragments) were transformed to presence-absence data to assess species-composition effects. We used the sum of squares between groups (Qb statistics) as the test criterion (Pillar and Orlóci 1996). The t-test comparing groups of sampling units by randomization was performed using the statistical software Multiv, version 2.4 (Pillar 2006).

To test the null hypothesis of the no difference in abundance of species between trapping methods, the G-test was used for testing abundances of each particular species, except for the arboreal trapping method for which the sampling effort was different. Only species with a minimum of 10 individuals sampled were used.

Arboreality was tested by using a Binomial test for species captured in the understorey with a minimum of three individuals captured, being tested against the number of individuals trapped in ground cage traps. The Binomial test takes into consideration the unequal sampling effort, which was suitable for testing arboreal versus ground cage traps because the effort for the understorey was lower than that for the ground level.

The Mann-Whitney test was used to compare the weights of species trapped (first captures) under different trapping methods (pitfall and ground cage traps) and for which a minimum of three individuals captured had been obtained for each method.

The Bioestat version 3.0 statistical software was used for G, Binomial, and Mann-Whitney tests (Ayres et al. 2003).

Results

We captured a total of 363 individuals of 14 species of small mammals. A total of 153 individuals and 14 species (100% of all species) were sampled from an effort of 2100 trap-nights using pitfalls (7.5% trap success), 188 individuals and eight species (57% of all richness) were sampled from an effort of 8915 trap-nights using ground cage traps (2.2% trap success), and 22 individuals and five species (36% of all species) were sampled from an effort of 850 trap-nights (2.5% trap success) using arboreal cage traps (Table 1).

Results from analytical calculations generating species accumulation curves based on samples revealed that pitfall traps are far from sampling all species in the region, but, by contrast, cage traps are limited in sampling all small-mammal species; an asymptote was rapidly reached in this case, and with low species richness (Figure 1). Therefore, estimates of species richness for cage traps (Mao Tau: 10.0±0.0; Jackknife 1: 10.0±0.0; Jackknife 2: 10.0±0.0) were lower than those for pitfall traps (Mao Tau: 14.0±2.6; Jackknife 1: 20.4±3.3; Jackknife 2: 24.3±0.0).

In the comparison between trap types, 107 individuals and seven species were sampled from an effort of 3600 trap-nights using wire traps, and 36 individuals and eight species from an effort of 3600 trap-nights using Sherman traps (Table 1).

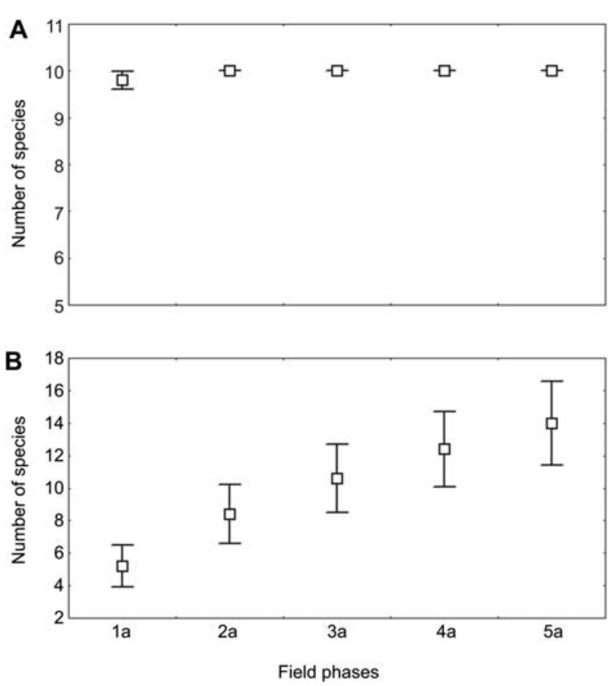

Figure 1 Sample-based species accumulation curves showing expected species accumulation curves for the two main methods treated in this study, cage traps (A) and pitfall traps (B), in woodland savannah remnants in southwestern Brazil. Number of species (mean±SD) versus number of field phases is shown. Note that the asymptote is easily reached for cage-trap effort (A).

In the comparison between cage-trap types (wire and Sherman), when focusing on abundance, there was no significant difference between the successes of the two systems (t-test, Q=210, p=0.08), although there were particular differences in the capture rates of *Didelphis albiventris*, *Thylamys macrurus*, and *Thrichomys pachyurus*, which were captured significantly more often in wire traps (G-test, p<0.01 for all species) than in Sherman traps. Although wire traps averaged more individuals per species (19.0±21.3) than Sherman traps (4.5±3.8), Sherman traps revealed one species more than wire traps (*Cerradomys scotti*). Hence, when focusing on species composition, there was no significant difference between the two trap types (t-test, Q=0.694, p=0.205) (Table 1).

In the analysis testing the other two capture methods, pitfall and ground cage traps, there were significant differences among them for abundance (t-test, Q=1168, p=0.014) and species-composition (t-test, Q=0.883, p=0.044) approaches. The difference in species-composition, favoring pitfall traps, occurred mainly because of the exclusive trapping of small rodent species (e.g., *Hylaeamys megacephalus*, *Necromys lasiurus*, and *Oligoryzomys fornesi*) and the lagomorph *Sylvilagus brasiliensis*, but more importantly the marsupial *Monodelphis kunsi*, which was captured several times and exclusively by pitfall traps (Table 1).

The Binomial test revealed that the species *Gracilinanus agilis* and *Rhipidomys macrurus* were significantly trapped in arboreal traps than the ground traps (p<0.01, Table 1).

There was a general tendency for lighter individuals to be caught in pitfall traps, which was more evident for rodent species. Thus, *Calomys callidus* had a mean weight in pitfalls (24.9±11.0 g; n=83) significantly lower than in cage traps (33.9±13.3 g; n=15) (Mann-Whitney test, U=375.0, p=0.015), and the single young individual of *T. pachyurus* trapped in a pitfall trap had a weight (140 g) among the lowest for the species in the entire study (range: 80–517 g; n=39 individuals measured). There was no effect of seasonality for body mass in *C. callidus* (Mann-Whitney test, U=691.0, $n_{\text{dry season}}$=77, $n_{\text{wet season}}$=19, p=0.710). However, some larger marsupial species showed different tendencies, being either captured equally (e.g., *G. agilis*; 36.3±8.5 g, n=5, in pitfalls; 35.6±4.1 g, n=11, in cage traps; Mann-Whitney test, U=22.0, p=0.533) or having heavier individuals trapped in pitfall traps, e.g., the sole case of *Thylamys macrurus* (50.4±17.6 g, n=17, in pitfalls; 40.3±15.0 g, n=54, in cage traps; Mann-Whitney test, U=280.0, p=0.016) (Figure 2). Moreover, there was an effect of seasonality for *T. macrurus* (Mann-Whitney test, U=222.5, $n_{\text{dry season}}$=44, $n_{\text{wet season}}$=29, p<0.001), with heavier individuals occurring more in the dry season (49.3±12.4 g vs 30.1±16.7 g). In the comparison between ground and arboreal cage traps, there was no significant difference between weights for *G. agilis* (35.6±4.1 g, n=11, at ground level; 33.8±6.9 g, n=8, at arboreal level; Mann-Whitney test, U=41.0, p=0.804).

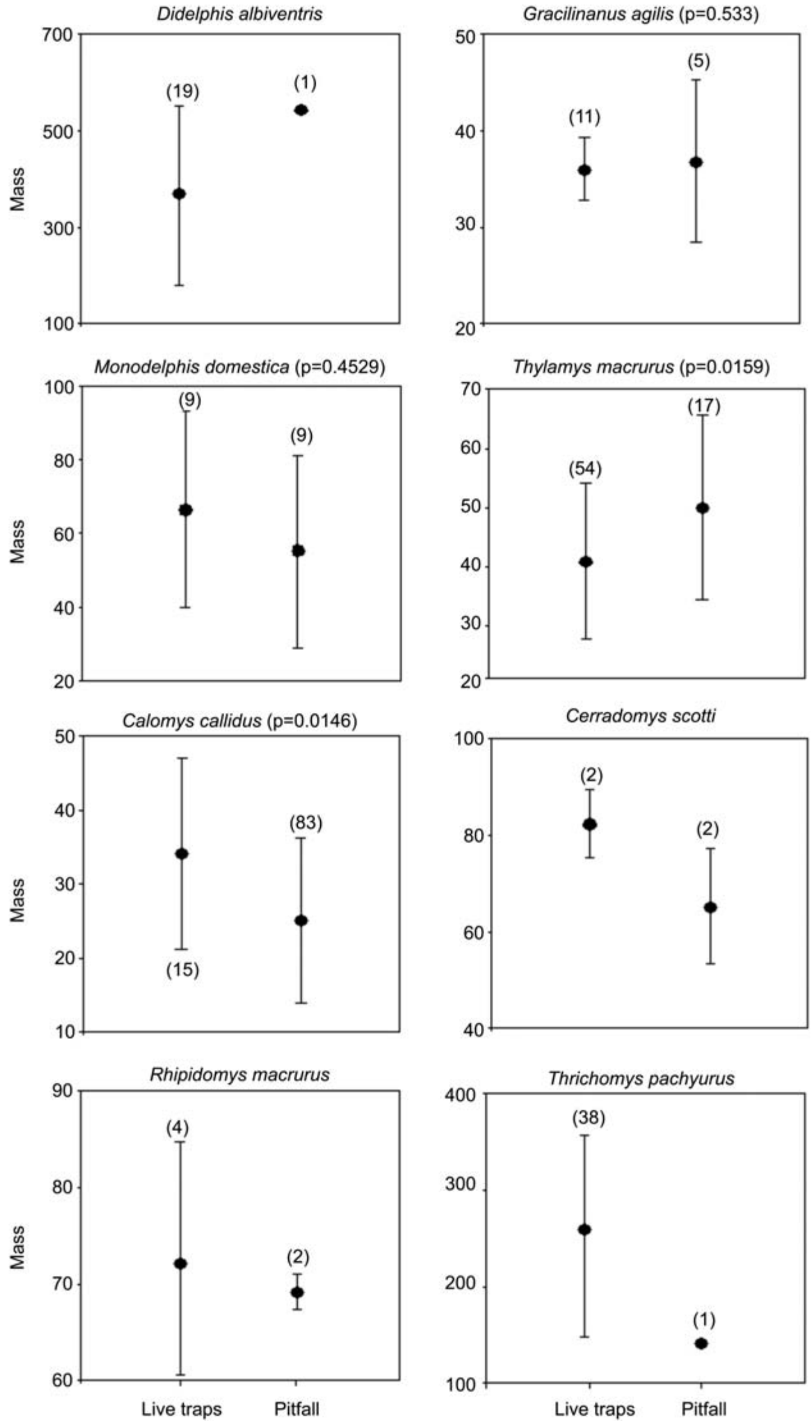

Figure 2 Mean (point) and standard deviation (bar) of body mass (g) of captured individuals and results of the Mann-Whitney test comparing mass of individuals captured in cage traps and pitfall traps in fragments of woodland savannah in southwestern Brazil. Some species were not analyzed by the Mann-Whitney test because the minimum of three individuals was not attained in one of the trapping methods. The number of individuals included in the analyses is given in parentheses.

Discussion

Our main results showed that there were important differences regarding sampling small mammals in this savannah region, particularly between pitfall and ground cage traps. In this study, pitfall traps caught more species (43%) than the wire and Sherman traps combined; in fact, pitfalls sampled all species sampled by cage traps, but not all species were sampled by cage traps. In agreement with our results, in the Atlantic Forest pitfalls have captured approximately three times the number of species per site when compared to cage traps (Umetsu et al. 2006), emphasizing the importance of pitfall traps for sampling small mammals in ecological studies in the Neotropics. Our estimates for pitfall generated by Jackknife indicated that 20–24 species are expected in the region, being that only 10 species were expected by using standard cage traps. Our species accumulation curves also corroborated this, showing that a limited number of species are sampled by cage traps, and that species richness revealed by pitfalls is underestimated.

In tropical South America, pitfall traps have sampled small-bodied, rarer, or cryptic species that are usually not captured by Sherman or wire traps (Voss and Emmons 1996, Santos-Filho et al. 2006, Umetsu et al. 2006), this being extrapolated for other regions of the world (Block et al. 1998, Nicolas and Colyn 2006, Gambalemoke et al. 2008). This was particularly important for the small marsupial *M. kunsi* (9.5–15.0 g) in the study area, which is rarely sampled in surveys (Eisenberg and Redford 1999) in the Cerrado biome. Small mammals lighter than 40 g are usually trapped more efficiently in pitfall traps elsewhere, such as *Oligoryzomys nigripes* (Olfers 1818) ($\approx$17 g) and *Calomys tener* (Winge 1837) (20 g) (Lyra-Jorge and Pivello 2001, Umetsu et al. 2006), in agreement with our data. Six out of 14 species (particularly the smaller ones) were trapped only in pitfall traps here, when compared to ground-cage traps. Another approach involving captures in pitfall traps is the trapping of significant numbers of lighter, young individuals (Lyra-Jorge and Pivello 2001, Umetsu et al. 2006), which occurred in our study area particularly for rodents. This was clearer for *Calomys callidus* for which a large number of young was trapped in pitfalls, independent of season effect (Table 1, Figure 2).

Data obtained in an eastern Cerrado region (Lyra-Jorge and Pivello 2001) reveal a rather different result; cage traps were more efficient than pitfalls in sampling small mammal richness. That study emphasized cage traps per capture station, using pitfall traps in lower numbers (4 buckets vs 17 cage traps per station), had short discontinuous 4-m fences, and, more importantly, had buckets with a too-small size ($\approx$20 l; see also Santos-Filho et al. 2006). With this design, small mammals were surely capable of escaping more easily from these small buckets (as noted by the authors). In addition, they were certainly less effectively trapped with discontinuous, short fences, and a smaller number of buckets per station. Our effort and results for pitfalls (2100 vs 216 trap-nights by Lyra-Jorge and Pivello 2001) in the Cerrado biome were more appropriate for an adequate survey of small mammals regarding species composition and abundance, because our methodology included large buckets (108 l) and continuous, longer 10-m spaced fences between buckets. The methodology used by Umetsu et al. (2006) for pitfalls in the Atlantic Forest was similar to ours in the Cerrado biome, except that smaller, medium-sized 60-l buckets were used in that region.

The efficacy of pitfall traps of different bucket volumes and fence types is still unknown. We hypothesize that when used with large buckets ($\geq$60 l) plus long or continuous fences, pitfall traps will be much more effective in sampling small mammals.

In comparing the efficacy of the two types of cage traps (wire and Sherman), there was no significant difference between the two systems under the two analyses performed (species composition and abundance). However, care should be taken because the wire type tended to sample more individuals than the Sherman type, and thus this system can be indicated for short-term ecological studies or surveys, because there is usually a positive association between abundance and species richness (Mauffrey et al. 2007). Indeed, O'Farrell et al. (1994) reported that wire-mesh cages were effective in sampling small mammals in many habitats of California when compared with the Sherman trap.

For instance, we noted that wire cage traps favored the capture of larger species (such as *Didelphis albiventris*, *Thrichomys pachyurus*, and *Thylamys macrurus*). We consider here the smaller volume of the Sherman type, which, although with the same length, had the other dimensions slightly smaller than the wire type. This untested difference could have been crucial for trapping the larger species cited above in wire traps. Unfortunately, the few studies comparing wire and Sherman traps have used cage traps of different sizes (on average 23 cm in length for Sherman and 40 cm for wire traps) (Lambert et al. 2005, Santos-Filho et al. 2006), which makes comparisons difficult.

Wire traps can be very efficient but their overall success will depend on other factors such as bait type, mesh size, and trigger device (Monteiro-Filho and Graipel 2006). Additionally in our study, the attractiveness of bait through the wire-trap mesh could have been important for these differential abundance rates, in which animals would be more olfactory-visually oriented to the trap. And, we postulate that there would be some type of trap-shy effect regarding the Sherman, enclosed-box model (O'Farrell et al. 1994), negatively affecting the small-mammal trapping, because we can understand our statistical result of the comparison of both systems as marginally significant for abundance ($p=0.08$). Wire type resulted in four times more individuals than the Sherman type in our study.

Although we devoted less effort to sample small mammals in the forest understorey, by controlling the differential effort, the binomial test revealed that *Gracilinanus agilis* and *Rhipidomys macrurus* were trapped significantly more in the arboreal stratum of the woodland savannah. These species belong to genera that are recognized as mostly arboreal in adjacent rainforest biomes (Malcolm 1991, Vieira and Monteiro-Filho 2003, Lambert et al. 2005). Such result was confirmed for *R. macrurus* in the study region (Hannibal and Caceres 2010). Although these arboreal species had also been sampled in pitfalls in our area of woodland savannah, the effectiveness of sampling small, arboreal mammal species using pitfalls in other regions or biomes is uncertain (Voss and Emmons 1996, Santos-Filho et al. 2006, Umetsu et al. 2006), just because these agile species should be easily able to escape from buckets. Therefore, the complementary use of pitfall traps and arboreal cage traps is thought to be efficient to evaluate the Neotropical small-mammal diversity.

In conclusion, pitfall traps collected 43% more species than the standard cage traps tested in our study area in the southern Cerrado biome and were therefore fundamental to evaluate the diversity of small mammals. Cage-trap type and arboreal position are complementarily important for measuring species composition and abundance of Neotropical small mammals. Although there was no significant difference between wire and Sherman traps in this study, captures in abundance are favored by using the wire-mesh type.

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