Combining live trap and pitfall to survey terrestrial small mammals in savanna and forest habitats, in Brazil

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Analyses of small mammal communities rely on the quality of the collected data, and consequently on the ability to sample the community and on the efficiency of the trapping techniques employed. Several parameters influence mammal trapping success such as climate and seasonality, population density and life cycle, individual species characteristics, sex, age or size classes, and bait type (Gentry 1966; Smith and Blessing 1969; Janion and Wierzbowska 1970; Williams and Braun 1983; Alho et al. 1986; Willan 1986; Mengak and Guyrn 1987; Wilson et al. 1996). Therefore, the trapping technique must be adequate to all these parameters, as well discussed by Jones and colleagues (1996).

The ecology of small mammal populations is relatively well-known in temperate countries, where adequate techniques to sample each group have been established. The success of different trapping techniques to survey small mammals have been compared by several authors, in temperate ecosystems (Goodnight and Kastner 1942; Cockrum 1947; Smith et al. 1971; McNamara and Mellis 1972; Williams and Braun 1983; Mengak and Guyrn 1987). In tropical habitats however, much fewer of such comparisons are found in the literature (Stallings 1989; Woodman et al. 1996). In Brazil, the ecological knowledge of native small mammals started only by the 80’s with Alho’s and Fonseca’s studies (Alho 1978, 1981; Fonseca and Redford 1984) and studies on small mammals have traditionally been conducted using live traps (Mello 1980; Alho 1981; Bercher and Hanson 1983; Fonseca and Redford 1984; Alho and Pereira 1985; Alho et al. 1986; Marcés et al. 1989; Stallings 1989; Talamoni 1990, 1996; Vieira 1997; Talamoni and Dias 1999). The pitfall technique has been mostly used to sample reptiles and amphibians (Cechin and Martins in press) in Brazil but rarely for capturing mammals and the adequacy of capturing methods according to the taxonomic group is still being set up.

In the present study, we compare the efficiency of pitfall and “Tomahawk-type” live traps for sampling small mammals in contiguous savanna and forest habitats, in Brazil.

Study Area and Methods

This study was carried out in the Cerrado Pê-de-Gigante Reserve (21°37’30’S; 47°37’30’W), Santa Rita do Passa Quatro municipality, São Paulo State, Brazil. The Reserve comprises 1,225 ha, at altitudes ranging from 590 to 740 m (Pivello et al. 1998). The relief is gently rolling, formed by extensive and flat topped hills. Climate is tropical, with wet summers and dry winters, and annual rainfall around 1,400 mm.

The regional landscape is dominated by Eucalyptus spp and sugar-cane plantations and fragments of the original vegetation, composed mainly by cerrado (Brazilian savanna) forms, but also forest and grassy wet field patches. Inside the Reserve, semi-deciduous and gallery forest patches are found, but dense cerrado physiognomies prevail: the woodland cerrado (“cerradão”) and the typical cerrado (“cerrado sensu stricto”), small patches of the open cerrado forms (“campo cerrado” and “campo sujo”), dominated by grasses, also occur.

Small mammals (rodents and marsupials) were sampled during 12 monthly 3-day field campaigns (April 1997 to March 1998), simultaneously in five native vegetation types - gallery forest, grassy wet field, campo cerrado (open savanna), cerrado sensu stricto (typical cerrado) and semi-deciduous forest - as well as in an Eucalyptus spp plantation. We intended to sample only the small mammals which move over the ground, therefore, two types of traps were used: a conventional “Tomahawk-type” live trap, and pitfall stations.

In each of the six vegetation types, seventeen “Tomahawk-type” traps (0.35 x 0.17 m; mesh = 0.015 x 0.010 m) were placed on the ground, 25 m apart, following a track. They were scraped clean, baited and monitored at dusk and checked in the morning during 3 consecutive days. Various types of baits were tested, and the preferred one, which was adopted, consisted of a mixture containing peanut butter, industrialised dog food, corn flour, banana and canned fish over a piece of raw cassava. The use of raw cassava forced the animal to stay longer in the treacle, as is hard to chew. We also used to drop vegetable oil in the triggering device, after setting up the trap, to increase the effectiveness.

One pitfall station was installed in each vegetation type, which consisted of four buckets (0.37 x 0.41 m), buried into the soil, and linked by plastic drift fences (0.30 m x 4.00 m) to direct the animal to the buckets (following Mengak and Guyrn 1987; Jones et al. 1996). At dusk, the lids of the buckets were removed and the buckets were checked in the morning.
Most of the individuals captured alive were identified in the field, marked with ear perforations and then released. Re-captured individuals were not re-counted. Those of difficult identification, when alive, were taken to the laboratory for chromosome identification; the dead ones were compared with a reference collection and taxonomised. Voucher specimens were deposited at the "Museu de Zoologia da Universidade de São Paulo". The following measurements were taken from the individuals: total body size (head + body length), tail and hindfoot lengths.

To compare sampling efficiency of each type of trap according to the animal body size, the Mann-Whitney non-parametric test (Zar 1984), using the SPSS package (SPSS 1998) and the Jaccard index of similarity (Jongman et al. 1995) were employed.

Results and Discussion

Sampling effort summed 3,672 trapnights and 216 pitfall stations/day. In total, 126 animals were trapped, comprising 11 genera (6 of rodents and 4 of marsupials). The trapping success in "Tomahawk-type" live traps was 0.44 %, with 16 animals captured in 3,672 trapnights. In the pitfalls, 110 individuals were captured in 216 pitfall stations x day. Sometimes more than one individual was captured in a single bucket. The plateau of species richness (according to Longino and Colwell 1997) was reached after eight months considering the sum of species trapped in both pitfall and live trap, but it was much faster with the pitfalls (only two months) (Figure 1).

![Graph showing species accumulation curves for live traps and pitfalls.](image)

**Fig. 1.** Species accumulation curves using "Tomahawk-type" live traps and pitfalls (Cerrado de Gigante Reserve, 21’37’30”S, 47’37’30”W, Santa Rita do Passa Quatro, SP, Brazil).

Only 4 animals were re-captured: one individual of *Oligoryzomys nigripes*, one of *Calomys tener* and two of *Gracilinanus microtarsus*. *Oligoryzomys nigripes* was the most abundant species among the rodents and the most generalist species (72 individuals collected in total). It was also the smallest species, with a body size of around 6.2 cm (Table 1). *Calomys tener* was the second species in abundance (23 individuals sampled), and also the second smallest rodent sampled, with a body size of around 6.9 cm; it was found in all natural vegetation types (not trapped only in the Eucalyptus plantation). *Akodon montensis* (5 individuals) and *Nectomys squamipes* (3 individuals) came next in abundance; the latter was restricted to vegetation types directly influenced by water, as the gallery forest and the wet field. Four other rodent species were captured, represented by only one individual each (Table 1). The most abundant marsupial...
pials were *Gracilinanus microtarsus* (9 individuals) and *Didelphis albiventris* (7 individuals). The first is a very small species, with a body size of around 5.5 cm, while the second was the biggest of the species trapped (body size around 25.0 cm). Few individuals of the other marsupial species were captured (Table 1).

A clear relationship was found between body size and the trapping technique employed (Table 1; Figure 2). Species with an average body size smaller than 10 cm were most frequently taken in the pitfalls, while the larger ones (such as the rodent *Notomys squamipes* and the marsupial *Didelphis albiventris*) were all collected in "Tomahawk-type" live traps (Mann-Whitney U = 17.50; Z = -3.64; p < 0.01; Jaccard index of similarity = 0.17). *Akodon montensis* (average body size = 7.5 cm) was the only species captured in both pitfalls and live traps, although preferably in pitfalls (4 individuals captured in pitfalls vs. one in live trap).

![Graph: Comparison of number of captured animals between pitfalls and live traps](image)

Fig. 2. - Species and number of individuals sampled with "Tomahawk-type" live traps and pitfalls, and their respective body sizes.

In our study, the trapping success of "Tomahawk-type" live traps was very low (0.44%) compared with other studies conducted in temperate ecosystems (Goodnight and Koestner 1942; Gentry et al. 1966; Janion and Wierzbowska 1970; McManus and Nells 1972; Williams and Braun 1983). However, the results obtained in other savannas usually show trapping success to be low: 0.1% and 1.9% in Venezuelan savannas (August 1984 and Fonseca 1989); 3.5% in a Central Brazilian cerrado (Borchert and Hansen 1985) and 4.2% in the Brazilian pantanal (Lacher and Alho 1989). One reason for such a low trapping success was that the triggering mechanism of the "Tomahawk-type" traps used was not efficient enough for capturing very small and light animals, which were also able to escape through the mesh. Other authors have reported the same problem with small animals (McManus and Nells 1972; Slade et al. 1983; O'Farrel et al. 1994). The use of a piece of raw cassava as bait and the dropping of oil in the triggering device were attempts to increase trap efficiency, in the present study.

The pitfalls technique, although not commonly used in Brazil to sample small mammals showed to be very efficient and complementary to conventional live trapping. We could also capture rodents in the pitfalls, what is not a common news in the specific literature. However, pitfalls showed not to be adequate to capture the larger rodents or marsupials as they were able to jump from the bucket. Comparing the efficiency of pitfalls, snap traps and live traps in a temperate forest, Williams and Braun (1983) captured more species and a higher number of specimens of small mammals in the pitfalls proportionally to the conventional traps. In our case, more individuals although less species were captured in the pitfalls (Figure 1; Table 1).

An inconvenience of using pitfalls is their placement in the field, as the burying of the buckets in the soil and the fixing of drift fences demand a great physical effort. Still, pitfalls installation may become unfeasible in rocky or swampy soils. Besides being laborious, this procedure may impact the environment and the impact is directly proportional to the number and size of the buckets installed. As stressed by Cechin and Martins (in press), a cost-effectiveness of using pitfalls increase with longer sampling periods, as the major effort occurs during the installation phase.

In conclusion, we suggest that complementary trapping methods be always employed in the studies of small mammal communities in Brazil, in order to obtain a wider range of taxa, and thus, a better representation of the community.

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**NOTES**

Summer roost sites of *Myosotis brandti* (Eversman, 1845) (Chiroptera, Vespertilionidae) in eastern Poland

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Only short and unspecific information concerning the roosting ecology and status of *M. brandti* were published from Poland (Kowalski and Ruprecht 1981), making this species one of the poorest known among Polish bats. This note presents new data on the occurrence of *M. brandti* and its summer roosts in eastern Poland.

Data were collected in three areas situated in the Mazovia and Podlasie Lowland in eastern Poland (Fig. 1). In the Łużów Forest and Samogoszcz village (study areas

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Study areas: 1. Łużów Forest, 2. Samogoszcz village, 3. Białowieża Primeval Forest

Fig. 1. - Localisation of study areas