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Predation on Small Mammals by Capuchin Monkeys, *Cebus cay*

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Introduction

Capuchin monkeys forage opportunistically and exploit highly diverse feeding resources that encompass a wide variety of vegetables and animal prey, including reproductive and non-reproductive plant parts, invertebrates and small vertebrates (Terborgh, 1983; Fedigan, 1990). Vertebrate prey includes birds, eggs, lizards, frogs, young coatis, bats, rodents and even other monkeys (Izawa, 1978; Newcomer and De Farcy, 1985; Fedigan, 1990; Galetti, 1990; Rose, 1997; Ferreira *et al.*, 2002; Resende *et al.,* 2003; Fragaszy *et al.*, 2004; Sampaio and Ferrari, 2005). The foraging patterns of capuchin monkeys involve strenuous and persistent activity, search for hidden prey, manual dexterity and an explorative approach (Fedigan, 1990; Janson and Boinski, 1992; Fragaszy *et al.*, 2004), but little is known regarding how they find and kill their prey. Here we report the behavior of *Cebus cay* (Illiger, 1815) (*Cebus libidinosus* sensu Groves, 2001; Rylands *et al.*, 2005) preying upon arboreal rodents (*Rhipidomys* sp.2 *sensu* Tribe, 1996) trapped during a study on small mammal population ecology.

Methods and Study Site

During a capture-mark-recapture study of small rodents and marsupials, the researchers were frequently followed by a group of capuchin monkeys. On these occasions, the monkeys' behaviors were recorded *ad libitum* (Altmann, 1974). Trapping sessions, lasting from six to ten days, were conducted every month from March to August 2006 using live-traps. The study was conducted in Cabeceira do Prata Private Reserve, state of Mato Grosso do Sul, central Brazil (21° 27' S; 56° 26' W), an area of 307.5 ha covered with seasonal forest and cerrado (Brazilian Savanna). The region has a dry season from May to September and a wet season from October to April. The Reserve is intensely visited throughout the year by tourists, who walk in small, guided groups through the forest. There is no direct interaction between the animals and the tourists. However, reserve officers keep artificial feeding sites along the trails, baited daily with corn to attract animals to facilitate wildlife watching. All observations reported here were conducted in an area of seasonal alluvial forest that is cut by a tourist trail.

Results and Discussion

From the first fieldwork session in March 2006, the traps attracted the attention of capuchin monkeys, who began to follow the trapping activities almost every day. The first observation involved a capuchin running after another animal in the forest canopy on the morning of March 3rd. It was not possible to identify the chased animal, which was the size of an opossum (*Didelphis albiventris* Lund, 1840) and had a long and naked tail. The outcome of this interaction was not observed. On March 21st at around 7:00 a.m., a juvenile capuchin was found vocalizing loudly, trapped inside a trap set on the ground. Other capuchins were watching nearby when it was released. On April 19th a male climbing mouse, *Rhipidomys* sp. (weight = 65 g), was captured by a capuchin just after it was released from the trap. On this occasion the group of capuchins observed the activities of the researchers from canopy branches at a distance of about 10 m. When the rodent was released a subadult capuchin quickly approached, grabbed it as it climbed a tree in the understory, and killed it using the craniocervical bite, a widespread killing strategy adopted by other primate genera (Steklis and King, 1978). The monkey remained in the understory for about 2 minutes, licking the blood from the neck of the prey and looking at the researchers, before moving to the canopy. It was not possible to observe whether it ate the prey or not. This incident took place after a 28-day interval between trapping activities, a time when the traps had remained closed.

On August 25th another male *Rhipidomys* sp. (weight = 105 g) was captured by an adult male capuchin after the rodent was released from a trap. As in the previous case, capuchins observed the researchers from a distance, and when the rodent was released, one individual quickly approached. At this time, the capuchin chased the rodent on understory branches, but the *Rhipidomys* fell to the ground and hid inside a hole in a fallen log. The capuchin descended to the forest floor, extracted the rodent from the log and took it to a branch about 3 m above the ground (Figure 1a). The rodent didn't attempt to escape. The monkey killed

the prey with a craniocervical bite, licked its neck and face, ripped out a piece of flesh and ate it (Figure 1b). Then, the capuchin took it to the canopy where no further observation was possible. In both of these predation events the hunter was at a distance of at least 5 m from its group members and no interaction with the other capuchins was recorded. In addition to these events, we recorded 12 cases of attacks on the trapped rodents, with traps either on the forest floor or on branches in the understory. Seven attacks resulted in tail and ear mutilation, but these rodents survived. In the remaining five attacks the rodents were killed. Although it was not possible to identify the actors of these attacks, capuchin monkeys are the major suspects. It is intriguing that only rodents (total number of captures = 496) were attacked, although 166 captures of the small marsupial *Gracilinanus agilis* (Burmeister, 1854) were also made.

The differences in the activity rhythm of capuchins and *Rhipidomys* rodents suggest these nocturnal small mammals were opportunistically hunted by the monkeys as a side-effect of the trapping procedures. The ability to search in branch holes, though, is noteworthy and did not seem to depend on the research activity at the site. There is no food scarcity at the study site, owing to human provisioning, so it is unlikely that hunger stimulated the quick learning that allowed the exploitation of this "new" prey item. These observations are evidence of the curious and opportunistic nature of *Cebus cay,* even though it is not known how widespread this behavior was among group members.

Figure 1. Capuchin monkey (*Cebus cay*) (a) handling and (b) eating a captured rodent (*Rhipidomys* sp.) on August 25th, 2006.

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Object Manipulation in a Captive Group of Capuchin Monkeys (*Cebus nigritus*)

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Introduction

Capuchin monkeys (*Cebus* spp.) exploit embedded resources by using foraging strategies that involve several levels of object manipulation, from the simple tearing apart strips of wood to get access to invertebrates to the use of stones as tools (hammer and anvil) to break and open nuts (Ottoni & Mannu 2001; Fragaszy *et al.* 2004; Moura & Lee 2004; Waga *et al.* 2006). Tool use or the use of a detached object as an extension or functional part of the body to modify the position of another object (Beck 1980; Panger 2007) has been reported in wild, semi-captive and captive capuchins (Visalberghi 1990; Fragaszy *et al.* 2004).

Cognitively more complex than tool use, tool making involves a modification of the physical structure of the tool to improve its efficiency, a behavior that requires an understanding of cause-and-effect (Beck 1980). Among primates, tool making has only been reported for great apes (chimpanzees, orangutans and gorillas; Boesch & Boesch 1990; Fontaine *et al.* 1995; van Schaik *et al.* 2003), including humans. Recently, however, Bortolini & Bicca-Marques (2007) observed opportunistically a putative spontaneous event of tool making by a captive adult female *Cebus nigritus* in the Sapucaia do Sul Zoological Park, state of Rio Grande do Sul, Brazil. These authors state that if capuchins can make tools, the cognitive difference between them and the great apes, lineages separated for at least 30 million years, is smaller than previously thought (Bortolini & Bicca-Marques 2007). Because Bortolini & Bicca-Marques (2007) were not able to record the context prior to this event and what happened after it, therefore compromising the interpretation of its meaning, in this research we investigate object manipulation behaviors by the same study group aiming at recording additional cases of capuchin tool making.

Methods

A group of five capuchin monkeys (adult females Chief and Matilda, adult male Black and juvenile males Sem-topete and Trainer) living in an enclosure (7.0 × 7.7 × 2.9 m) enriched with sand, twigs, ropes and a wood-made wheel in the Sapucaia do Sul Zoological Park, state of Rio Grande do Sul, Brazil, was observed between April and September 2008. Matilda is the individual whose tool-related behavior was reported by Bortolini & Bicca-Marques (2007). Data collection by the behavior sampling method with continuous recording (Martin & Bateson 1993) was conducted from 08:00–08:30 to 13:00–13:30 once a week. Object manipulation was classified into banging (the act of pounding an object against a surface or another object), washing (partial or total immersion of an object in water), scrubbing (the act of rubbing an object against a surface), handling (the act of just touching or holding an object) and biting (the act of biting an object). Events of food banging, washing and scrubbing were included in the analysis, whereas those of handling and biting were not included.

The study was divided into two 50-h stages. In the first stage there was no supplementation of objects to the monkeys besides those normally found in the enclosure, whereas 15 pieces of branch (30 to 40 cm in length) and five stones (6 to 7 cm in diameter) were supplemented before each observation session and removed at the end of the day in the second stage. The frequency of each type of object manipulation during each stage was compared among individuals by the chi-square test and the total individual frequency of object manipulation events was compared between stages by the Student t test considering a level of significance of 0.05 using the software BioEstat 5.0 (Ayres *et al.* 2007).

Results

Sixty two events of object manipulation (48% banging, 26% washing, 19% handling and 6% scrubbing) were recorded during the first stage, resulting in a rate of 1.2 events per hour. Most of these events involved food items (n = 44). Supplementation with branches and stones in the second stage produced a significant increase in the frequency of object manipulation (428 events: 68% handling, 25% biting and 8% banging; $t = 2.138$, $df = 4$, $p = 0.042$) or a rate of 8.6 events per hour, and a substantial decrease in the number of events involving food items (n = 4). Object manipulation differed among individuals in both stages (1^{st}: $\chi^2 = 13.559$, $df = 4$, $p = 0.008$; 2^{nd}: $\chi^2 = 210.570$, $df = 4$,