Neotropical Primates 5(3): 77-78.

Miranda, J. 1996. Edición, introducción y notas del Sumario de la natural historia de las Indias. In: Fernández de Oviedo, G. *Sumario de la Natural Historia de las Indias*. pp. 7-74. Biblioteca Americana - Fondo de Cultura Económica, México.

Moynihan, M. 1976. *The New World Primates: Adaptive Radiation and the Evolution of Social Behavior, Language, and Intelligence*. Princeton University Press, Princeton, NJ.

Panger, M. 1998. Object-use in free-ranging white-faced capuchins (*Cebus capucinus*) in Costa Rica. *Am. J. Phys. Anthropol.* 106: 311-321.

Visalberghi, E. 1990. Tool use in *Cebus*. *Folia Primatol.* 54: 146-154.

Vertebrate Predation in Common Marmosets

Leslie Digby
Cláudio Embirussu Barreto

Marmosets are sometimes characterized as "gumivores" or "gumivore-insectivores" (Rylands and de Faria, 1993). This is a fitting description given that some species may spend as much as much as 70% of their feeding budget on gums and maintaining tree gouges (*Callithrix penicillata*; Fonseca and Lacher, 1984, *C. jacchus*; unpubl. data). Similarly, marmoset species spend between 24-30% of their overall activity budget foraging for insects (Rylands and de Faria, 1993). However, in addition to these key food items, marmosets exploit a wide variety of different food sources, including fruits, seeds, flowers, fungi, nectar, spiders, snails, and vertebrate prey (Stevenson and Rylands, 1984; Ferrari *et al.*, 1996). It is the ability to adopt an opportunistic and varied diet that, in part, allows marmosets to survive in such habitats as the highly unpredictable *caatinga* (dry thorn scrub) and *cerrado* (bush savanna), in addition to rich coastal and Amazonian forests.

Here we focus on the role of vertebrate prey in the diet of the common marmoset *(Callithrix jacchus)*. Three common marmoset groups were studied for a total of 36 "group-months" at EFLEX-IBAMA, an experimental forestry station at Nísia Floresta, Rio Grande do Norte, Brazil. Two groups occupied ranges in a 70 ha Atlantic forest reserve, while the third lived in a plantation area. Data were collected using both 30-minute focal-animal samples (during periods when there were no infants less than 2 months old) and all-day scan sampling using a 5-minute interval (when infants were present). Rare behaviors, including vertebrate predation, were recorded *ad libitum* (for details see Digby and Barreto, 1993).

Vertebrate predation was rare in common marmosets, resulting in less than 0.1% of all feeding records (0.6% of all animal prey records). Nevertheless, marmosets were seen eating a wide variety of vertebrate prey, including lizards (n = 1), tree frogs (n = 1), bird's eggs (n = 2 nests), nestlings (n = 1), and infant mammals (n = 1).

The predation of an infant mammal is of particular note as it is the only case reported, that I am aware of, in the wild. It was flesh colored, almost hairless, and estimated to have been 3-4cm long, not including its long tail, and was probably a rodent, but more specific identification was impossible as the head had already been consumed when first sighted. The remainder of the corpse was eaten within a couple of minutes of the first sighting. During the consumption of this prey item, other group members vocalized excitedly and tried, without success, to steal a part of the infant mammal for themselves. Though this is the first mammalian predation by a callitrichid reported for a free ranging marmoset group, at least three captive studies have noted that callitrichids will readily eat infant mice that are fed to them (*C. jacchus* - Stevenson and Poole, 1976; *L. rosalia*: Brown and Mack, 1978; *Callimico goeldii:* Heltne, 1981). Both the wild and captive marmosets eat the head of the prey item first. Craniocervical bites are the typical method of killing used by marmosets (and most mammals) to subdue relatively large prey (Steklis and King, 1978; pers. obs.).

The consumption of lizards and frogs is widespread among callitrichids (see Table 1), but the extent to which they are preyed upon varies between species. Neyman (1978) observed a single predation on a frog in 750 hours of observation of the cotton-top tamarin, *Saguinus oedipus*, and Yoneda (1984) recorded saddle-backed tamarins, *S. fuscicollis,* eating just one frog and one lizard over the course of six months. Similarly, lizards and frogs are only rarely eaten by common marmosets. Alonso and Langguth (1989) observed predation on lizards on three occasions over 13 months, and Maier *et al.* (1982) a single lizard predation during 100 hours of observation. In contrast, frogs and lizards constitute almost 16% of the animal diet of the buffy-headed marmosets, *C. flaviceps* (Ferrari 1988; n = 195 lizards and frogs over a 13 month period). Terborgh's (1983) study of tamarins in Peru indicates that interspecific variation in predation can occur even in sympatric species which presumably have similar access to prey items. He reported that 13% of the saddle-back tamarin diet was comprised of frogs and lizards compared to only 2% for the emperor tamarin, *S. imperator*. Stephen Ferrari (pers. comm.) is currently making a detailed analysis of interspecific variation in vertebrate predation by marmosets and tamarins.

The consumption of lizards, frogs, and small mammals appears to be rare and opportunistic in common marmosets. In contrast, the hunting of bird's eggs and nestlings, though also rare, appears to be more deliberate. Marmosets were seen on 10 different occasions to seek out and inspect bird nests (typically those of caciques, *Cacicus cela*, and kiskadees, *Pitangus sulphuratus*). On several occasions, one group member after another would approach and inspect a nest, sometimes manipulating openings in order to look inside. Kiskadees, caciques, gnatcatchers (*Polioptila plumbea*), and other birds were observed mobbing marmoset groups on at least seven occa-

Table 1. Vertebrate Predation in Callitrichid Primates.

Species	Frogs	Lizards	Nestling birds	Bird's eggs	Mammals	Reference
Callithrix jacchus	x	x	x	x	x	This study, Alonso & Langguth (1989), Maier *et al.* (1982)
C. flaviceps	x	x	x	x		Ferrari (1988)
C. kuhlii	x	x				Rylands (1989)
C. intermedia	x	x				Stevenson & Rylands (1988)
C. aurita				x		Muskin (1984)
Saguinus fuscicollis	x	x				Terborgh (1983), Yoneda (1984), Peres (1993)
S. mystax		x				Peres 1993
S. f. illigeri	x	x				Soini (1987)
S. imperator	x					Terborgh (1983)
S. oedipus	x					Neyman (1978)
S. geoffroyi		x				Dawson (1976) in Sussman & Kinzey (1984)
Leontopithecus rosalia	x	x		x		Coimbra-Filho & Mittermeier (1973), Dietz *et al.* (1997)

sions, suggesting that the marmosets were recognized predators of the eggs and young of these species. Predation upon bird's eggs and nestlings appears to be less widespread across the Callitrichidae, with only buffy-headed marmosets, buffy-tufted ear marmosets (*C. aurita*) and golden lion tamarins reported as consuming this type of prey (Ferrari, 1988; Muskin, 1984; Dietz *et al.*, 1997).

Vertebrate predation has been described for a number of primate species (Butynski, 1982) and appears relatively widespread among the callitrichids (Table 1), although its importance in terms of their diet is not currently understood. A more thorough reporting and description of vertebrate predation (and its possible correlates) will contribute yet another important piece to the callitrichid puzzle. The ability to exploit a wide range of food sources, again exemplifies the impressive flexibility of the marmosets and tamarins.

Acknowledgments: We thank Stephen Ferrari, Maria Emília Yamamoto, Fátima Arruda, Peter Rodman and the folks at UFRN and EFLEX-IBAMA for their help with various aspects of this project. Research was funded by the National Science Foundation, the Wenner-Gren Foundation for Anthropological Research, and the University of California at Davis.

Leslie Digby, Department of Biological Anthropology and Anatomy, Duke University, Box 90383, Durham, NC 27704, USA, and **Cláudio Embirussu Barreto**, Coordenação de Ciências Biomédicas, OCIDEMNTE-7CDE, Alameda Praia de Tambaú, Qd. F, Lote 16, Itapuá, 41.000-000 Salvador, Bahia, Brazil.

References

Alonso, A. and Langguth, A. 1989. Ecologia e comportamento de *Callithrix jacchus* (Primates: Callitrichidae) numa ilha de floresta Atlântica. *Rev. Nordestina Biol.* 6(2): 105-137.

Brown, K. and Mack, D. S. 1978. Food sharing among captive *Leontopithecus rosalia*. *Folia Primatol.* 29: 268-290.

Butynski, T. M. 1982. Vertebrate predation by primates: a review of hunting patterns and prey. *J. Hum. Evol.* 11: 421-430.

Coimbra-Filho, A. F. and Mittermeier, R. A. 1973. Distribution and ecology of the genus *Leontopithecus* Lesson 1840 in Brazil. *Primates* 14(1): 47-66.

Dietz, J. M., Peres, C. A. and Pinder, L. 1997. Foraging ecology and use of space in wild golden lion tamarins (*Leontopithecus rosalia*). *Am. J. Primatol.* 41: 289-305.

Digby, L. J. and Barreto, C. E. 1996. Activity and ranging patterns in common marmosets (*Callithrix jacchus*): implications for reproductive strategies. In: *Adaptive Radiations of Neotropical Primates.* M. A. Norconk, A. L. Rosenberger and P. A. Garber (eds.), pp.173-185. Plenum Press, New York.

Ferrari, S. F. 1988. The Behaviour and Ecology of the Buffy-Headed Marmoset, *Callithrix flaviceps* (O. Thomas, 1903). Ph.D., University College London.

Ferrari, S. F., Corrêa, H. K. M. and Coutinho, P. E. G. 1996. Ecology of the "southern" marmosets (*Callithrix aurita* and *Callithrix flaviceps*): How different, how similar? In: *Adaptive Radiations of Neotropical Primates.* M. A. Norconk, A. L. Rosenberger and P. A. Garber (eds.), pp.157-171. Plenum Press, New York.

Fonseca, G. A. B. and Lacher, T. E. 1984. Exudate feeding by *Callithrix jacchus penicillata* in semideciduous woodland (cerradão) in central Brazil. *Primates* 25: 441-450.

Heltne, P. G., Wojcik, J. F. and Pook. A. G. 1981. Goeldi's monkey, genus *Callimico*. In: *Ecology and Behavior of Neotropical Primates, Vol. 1*, A. F. Coimbra-Filho and R. A. Mittermeier (eds.), pp.169-209. Academia Brasileira de Ciências, Rio de Janeiro.

Maier, W., Alonso, C. and Langguth, A. 1982. Field observations on *Callithrix jacchus jacchus* L. *Z. Saugertierkunde* 47: 334-346.

Muskin, A. 1984. Preliminary field observations of *Callithrix aurita* (Callitrichinae, Cebidae). In: *A Primatologia no Brasil*, M. T. de Mello (ed.), pp.79-82. Sociedade Brasileira de Primatologia, Brasília.

Neyman, P. F. 1978. Aspects of the ecology and social organization of free-ranging cotton-top tamarins (*Saguinus oedipus*) and the conservation status of the species. In: *The Biology and Conservation of the Callitrichidae*, D. G. Kleiman (ed.), pp.39-72. Smithsonian Institution Press, Washington, D.C.

Peres, C. A. 1993. Diet and feeding ecology of saddleback (*Saguinus fuscicollis*) and moustached (*Saguinus mystax*) tamarins in an Amazonian terra firme forest. *J. Zool.* 230: 567-592.

Rylands, A. B. 1989. Sympatric Brazilian callitrichids: the black tufted-ear marmoset, *Callithrix kuhli*, and the

golden-headed lion tamarin, *Leontopithecus chrysomelas*. *J. Hum. Evol.* 18: 679-695.

Rylands, A. B. and Faria D. S. de. 1993. Habitats, feeding ecology, and home range size in the genus *Callithrix*. In: *Marmosets and Tamarins: Systematics, Behaviour, and Ecology*, A. B. Rylands (ed.), pp.262-272. Oxford University Press, Oxford.

Soini, P. 1987. Ecology of the saddle-back tamarin *Saguinus fuscicollis illigeri* on the Río Pacaya, north-eastern Peru. *Folia Primatol.* 49: 11-32.

Steklis, H. D. and G. E. King 1978. The craniocervical killing bite: toward an ethology of primate predatory behavior. *J. Hum. Evol.* 7:567-581.

Stevenson, M. F. and Poole, T. B. 1976. An ethogram of the common marmoset *(Callithrix jacchus jacchus)*: general behaviour repertoire. *Anim. Behav.* 24: 428-451.

Stevenson, M. F. and Rylands, A. B. 1988. The marmosets, genus *Callithrix*. In: *Ecology and Behavior of Neotropical Primates, Vol. 2*. R. A. Mittermeier, A. B. Rylands, A. F. Coimbra-Filho and G. A. B. da Fonseca (eds.), pp.131-222. World Wildlife Fund, Washington, D.C.

Sussman, R. W. and Kinzey W. G. 1984. The ecological role of the Callitrichidae. *Am. J. Phys. Anthropol.* 64: 419-449.

Terborgh, J. 1983. *Five New World Primates: A Study in Comparative Ecology*. Princeton University Press, Princeton, NJ.

Yoneda, M. 1984. Ecological study of the saddle-backed tamarin (*Saguinus fuscicollis*) in northern Bolivia. *Primates* 25(1): 1-12.

News

Feeding Ecology of *Callithrix aurita* in a Forest Fragment of Minas Gerais

A Master's thesis entitled "Feeding Ecology of the Buffy-Tufted-Ear Marmoset, *Callithrix aurita* (Callitrichidae, Primates) in a Forest Fragment" was defended on 5 August 1998, by Milene Moura Martins at the Paulista State University (UNESP/Rio Claro). The study was supervised by Dr. Nivar Gobbi and Dr. Eleonore Z. F. Setz. It was sponsored by the Brazilian Higher Education Authority (CAPES), Brasília, and Fundação MB/FUNCAMP, Campinas. The following is a summary of the thesis.

This study, carried out from October 1994 to September 1995, focused on the seasonality of feeding behavior of a group of four buffy-tufted-ear marmosets (*Callithrix aurita*). The study site was a semideciduous 17-ha forest fragment located in Fazenda Lagoa, in the municipality of Monte Belo, in the south of the state of Minas Gerais (21°23'S, 46°15'W). Two physiognomically distinct regions were found in the fragment: the northeast (flat, sunny and dry) and the south (steep, shadowy and moist). Each region was divided in two sub-regions: edge and interior. The edge was defined as the outermost 40m strip and the interior the remaining area. Data on feeding behavior were collected by scan sampling at five-minute intervals. Each scan lasted one minute. The identity and activity of each visible individual and the location of the group were recorded. Invertebrate abundance was estimated monthly using sweep nets (about 120m) and pit-fall traps (n = 5) in each sub-region.

A total of 79 days (305.4 hours) was spent in direct observation of the group. A total of 8,240 records were obtained in 3,416 scans. Average annual activity pattern was: traveling (41%), resting (33%), foraging (8%), feeding (6%) and social activities (12%). There was no significant difference between seasons. The main foods were gums (46%), invertebrates (22%) and fruits (11%). Leguminosae, Meliaceae, Moraceae and Cactaceae were the main plant families in the diet. *Acacia paniculata* (Leguminosae), an abundant liana, was the main gum source, representing 83% of gum feeding time. Of 12 fruiting species, the highest ranking consumed was *Maclura tinctoria* (Moraceae), a small, many-seeded berry. Caterpillars were the invertebrate item most preyed upon, followed by katydids. Among food resources, only fruits were consumed significantly more in the wet season than in the dry season. The monthly predation rate on caterpillars was positively correlated with the availability of large larvae (>2 cm long). Associations between marmosets and *Labidus* sp. (Ecitoninae, Formicidae) army ants were recorded only during the drier months.

The group occupied a home range of 16.5 ha and traveled a mean daily distance of 986 meters. There was no seasonal variation in either. The northeast region was used more in comparison to the southern region, with a higher concentration of quadrats with >2% of occupation records in both seasons. Spatial distribution of foraging records was not associated with invertebrate abundance. Sub-regions presenting high invertebrate abundance (moist interior in the wet season and moist edge in the dry season) were not used more for foraging than others with lower abundance. The spatial distribution of the small number of fruiting trees had little influence on the pattern of space use while the distribution of *Acacia paniculata* (n = 67 and 61) seemed to be the main factor determining ranging.

The study demonstrated the buffy-tufted-ear marmoset's ability to exploit abundant (*Acacia* gum) and temporary (fruits, insects) foads. Edge habitats presented higher invertebrate biomass, corroborating other studies (Buskirk and Buskirk, 1976; Fowler *et al.*, 1983), but, in this study, it was not associated with the spatial distribution of foraging activities. Furthermore, local environmental conditions are very important in the definition of intra-specific differences in feeding ecology of *C. aurita* groups (see Ferrari *et al.*, 1996).

Milene M. Martins, Departamento de Zoologia, Instituto de Biologia, Universidade Estadual de Campinas (UNICAMP), 13083-970 Campinas, São Paulo, Brazil.