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DEMOGRAPHY OF A GROUP OF TUFTED CAPUCHIN MONKEYS (*CEBUS APELLA NIGRITUS*) AT THE ESTAÇÃO BIOLÓGICA DE CARATINGA, MINAS GERAIS, BRAZIL

Jessica Ward Lynch
José Rímoli

Introduction

Demographic variables play an important role in understanding primate behavioral ecology (Dunbar, 1987; Strier 1991, 1999a) and are crucial components of conservation biology strategies for species' management (Dobson and Lyles, 1989). While attention has focused on collecting demographic data on endangered species, it is also important to monitor demography of abundant and widespread species, both for comparison to those which are threatened (Hubbell and Foster, 1986) and for understanding dynamics among species in primate communities (Waser, 1987; Strier, 1999b). Long-term studies in the Amazon, the llanos of Venezuela, and Central America have yielded demographic information on groups of *Cebus apella* (Izawa, 1988, 1990, 1992, 1994a, 1994b, 1997), *C. olivaceus* (Robinson, 1988a, 1988b), and *C. capucinus* (Fedigan et al., 1996), but, until recently, there was no data available for the capuchin monkeys of the Atlantic forest in Brazil. Here we present information on group composition and membership

Table 1. Age-sex composition of a group of *Cebus apella nigritus* at the Estação Biológica de Caratinga, Minas

	July 95	Jan 96	July 96	Jan 97	July 97	Jan 98
AM	4	4	3	4	5	4
AF	7	7	7	6	6	7
SAM	3	3	2	2	1	1
SAF	0	0	1	2	6	4
JUV	10	10	11	10	6	6
INF	2	5	3	2	2	6
Total	26	29	27	26	26	28

AM=adult males, AF=adult females, SAM=subadult males, SAF=subadult females, JUV=juveniles, INF=infants. Age categories follow Izawa (1980).

dynamics of a group of tufted capuchin monkeys (*Cebus apella nigritus*) in a fragment of Atlantic forest at the Estação Biológica de Caratinga (EBC), in Minas Gerais, Brazil.

Methods

The Estação Biológica de Caratinga is a semi-deciduous forest fragment of 890 ha (see Strier, 1987, 1992; Ferrari, 1988, and Rímoli and Ades, 1997, for more information on the site). The study was carried out from June 1995 through August 1997. When possible, the study group was followed from daybreak to nightfall, and visual contact was made on more than 340 days. Group sizes of the capuchins at EBC ranged from approximately five to 30 individuals, although the smaller "groups" may have been subgroups of the larger ones (Lynch, 1999a, 1999b). Individuals were recognizable through pelage patterns and facial characteristics. Group membership was recorded daily. Data were collected *ad libitum* on births, emigrations, disappearances and changes in social structure. Follow-up censuses were conducted in November 1997 and January 1998.

Results

The study group ranged in size from 26-29 individuals, including 3-5 adult males, 6-7 adult females, 3-7 subadults, 6-11 juveniles, and 2-6 infants (Table 1). The mean sex ratio of adult males to females for the EBC group was 0.61 ± 0.135 (range 0.43-0.83), or one adult male per 1.65 adult females.

Group size and age-sex composition were relatively stable. However, over the 30-month study period, membership changed due to emigrations, births, and disappearances (Rímoli and Lynch, 1999). The alpha male was expelled following a take-over by the group's beta male. One adult female and two subadult males left the group and were later seen in other groups; two subadult females disappeared from the group and were not seen again. Thirteen infants were born during the study, five of which disappeared along with one juvenile. An analysis of infant mortality restricted to infants born during the study and followed for one year or until disappearance, indicated survivorship to one year as being

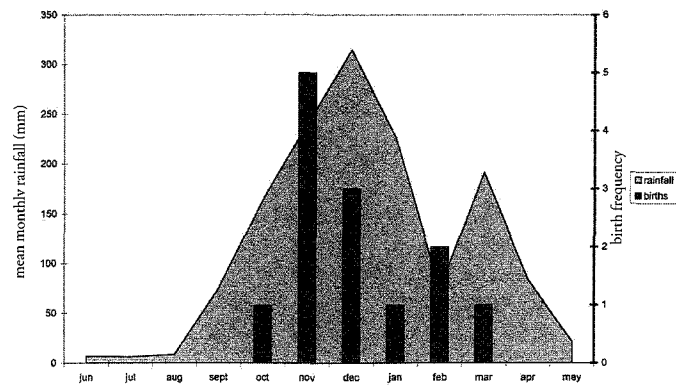


Figure 1. Capuchin births by month, compared to mean rainfall by month at EBC, from June 1995 to December 1997.

only 45% (four of nine infants). The disappearance of two of the infants occurred at the same time as the take-over of the group by the beta male. All births occurred during the rainy season, and there was a birth peak between October and March (Rímoli and Lynch, 1999). The total number of births by month (1995-1997) is compared to mean rainfall per calendar month for the same time period in Figure 1.

The interbirth interval (IBI) was 25 months for the one female with a surviving infant who gave birth a second time during the study. No second birth was recorded for another female with a surviving infant over 26 months. For the five IBIs in which the first infant died or disappeared, the mean IBI was 11.2 ± 1.79 months (range 9-14 months).

Discussion

Group size in the genus *Cebus* ranges from solitary individuals up to 50 or more (Figure 2). The Atlantic forest studies of *Cebus apella nigritus* extend the upper range of *Cebus apella* group size. *C. a. nigritus* grouping patterns appear more similar to those of *C. olivaceus* and *C. capucinus* than to some Amazonian *C. apella* populations (Janson, 1985), or to the heavily hunted populations of *C. apella margaritae* (see Sanz and Márquez, 1994) on Margarita Island, Venezuela, and *C. xanthosternos* (see Pinto and Tavares, 1993) in southern Bahia, Brazil.

Interbirth intervals at EBC were similar to those reported for capuchins at other sites (Table 2). The range for IBIs are overlapping for all capuchin species, and as with other capuchins, the loss of an infant allows EBC females to decrease their IBI by about one year.

Capuchin births at EBC were concentrated in the wet season. This suggests that infants are born during a period of relative food abundance, since the rainy season is characterized by a high number of fruiting and flowering trees (Lopes and Andrade, 1986; Ferrari, 1988; Strier, 1991; Rímoli and Ades, 1997), as well as an increase in the number of available insects (Ferrari, 1988). *C. apella nigritus* at Iguazú, Argentina also have a birth season from October to February, during the

Table 2. Interbirth intervals for the genus *Cebus*.

Species	Mean IBI in months after infant survival (n of IBIs; range)	Mean IBI in months after infant loss (n of IBIs; range)	Source
<i>C. apella</i>	25 (n=1)	11.2 ± 1.8 (n=5; 9-14)	Present study
<i>C. apella</i>	25.6 ± 3.8 (n=10; 21-35)	15.5 ± 5.9 (n=4; 9-21)	Izawa, 1988, 1990, 1992, 1994a, 1994b, 1997
<i>C. apella</i>	22	Not reported	Robinson & Janson, 1987
<i>C. albifrons</i>	18	Not reported	Robinson & Janson, 1987
<i>C. capucinus</i>	26.9 (n=23)	16.0 (n=2)	Fedigan & Rose, 1995
<i>C. capucinus</i>	22 (n=7; 12.5-34)	10.7 (n=3; 9.8-11.3)	Perry, 1995
<i>C. olivaceus</i>	26	Not reported	Robinson & Janson, 1987

Note: IBIs reported in Robinson and Janson, 1987.

peak availability of fruits and insects (di Bitetti, 1997). Late dry and early rainy season births are most frequent in *Cebus apella* in Colombia (Izawa, 1988, 1990, 1992, 1994a, 1994b, 1997) and Peru (Janson, 1985). In *C. olivaceus*, births are most common at the end of the dry season and the beginning of the wet season (Robinson, 1988a). By contrast, in Panama and Costa Rica, *C. capucinus* births occur throughout the year and may be more common in the dry season (Oppenheimer, 1982; Robinson and Janson, 1987; Fedigan and Rose, 1995).

Fifty-five percent of capuchin infants died in their first year in the EBC group. This is the highest rate of infant mortality reported for capuchins. In comparison *Cebus apella* in Colombia has 19% infant mortality in the first year (Izawa, 1988, 1990, 1992, 1994a, 1994b, 1997), *C. capucinus* has 29% (Fedigan *et al.*, 1996) and *C. olivaceus*, 19.4% (Robinson, 1988a). In fact, a wide comparison of infant mortality across primate taxa suggests that the rate at EBC is unusually high (see Robinson, 1988a for summary). However, Costa Rican squirrel monkeys (*Saimiri oerstedii*) have shown a similarly high rate of infant mortality, due to avian predation (Boinski, 1987).

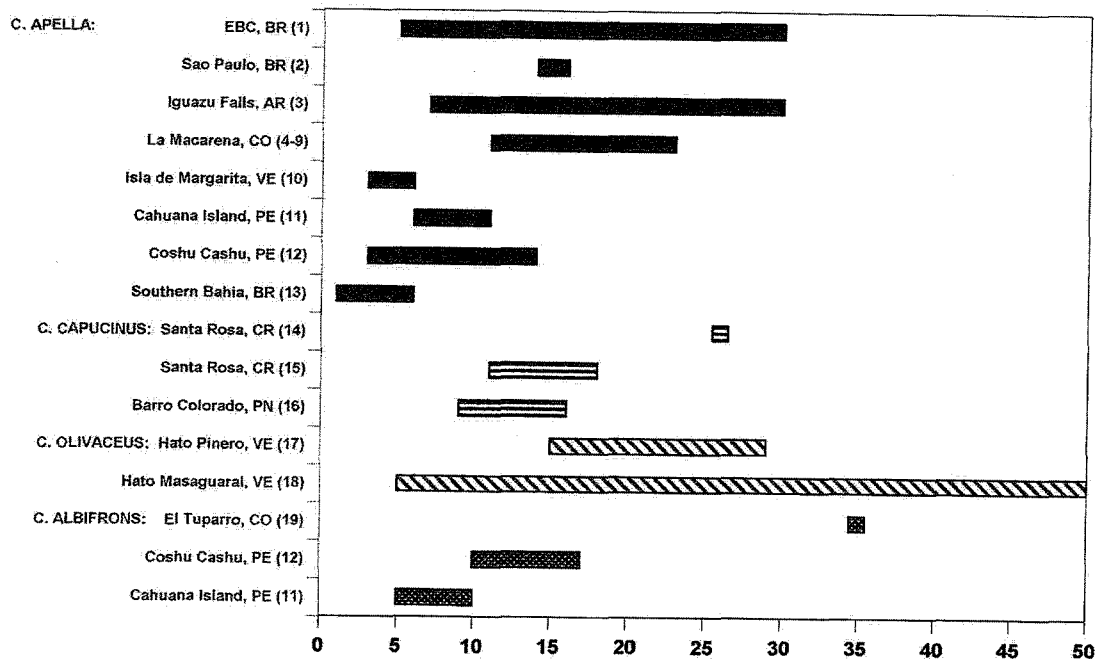


Figure 2. Group size within the genus *Cebus*.

BR=Brazil, AR=Argentina, CO=Colombia, VE=Venezuela, PE=Peru, CR=Costa Rica, PN=Panama

All bars are ranges in group size except 2, 14, and 19 which are mean group size. 14 underestimates variation in group size as it is the range of MEAN group size for the population. (1) present study (2) Izar, 1999 (3) Janson, 1996 (4-9) Izawa, 1988, 1990, 1992, 1994a, 1994b, 1997 (10) Sanz and Marquez, 1994 (11) Soini, 1986 (12) Janson, 1985 (13) Pinto and Tavares, 1993 (14) Chapman, 1990 (15) Fedigan *et al.*, 1996 (16) Phillips, 1994 (17) Miller, 1996 (18) Robinson, 1998a (19) DeFler, 1979. Early reports of capuchin group size are summarized in Freese and Oppenheimer, 1981.

Infant mortality in the EBC group may be the result of a combination of factors. Predators at EBC include tayras (*Eira barbara*), coatimundis (*Nasua nasua*), ocelots (*Felis pardalis*), hawks (*Buteo* spp.), caracaras (*Polyborus plancus*) and vultures (*Sarcoramphus papa* and *Coragyps atratus*), as well as semi-feral dogs. Capuchins give strenuous alarms and threats and will change travel patterns in response to tayras, hawks and dogs. When these predators are present, capuchin females will often carry large infants or juveniles that are otherwise independent (Rímoli and Lynch, unpubl. data). While there may be fewer predator species at EBC than at other field sites in more continuous forest, capuchins at EBC may be more restricted in their ability to escape from predators because it is a forest fragment. Capuchins at EBC use edge habitat and venture out into corn and sugar cane fields (Rímoli and Ferrari, 1997), which may put them at higher risk to both aerial and terrestrial predators.

Intragroup dynamics may also contribute to infant mortality. The instability of the group during the take-over period in May 1996 coincided with the disappearance of two infants. Although infanticide was not witnessed in this study, infanticide has occurred in the same context in other *Cebus* species (*C. olivaceus*, Valderrama *et al.*, 1990; *C. capucinus*, Fedigan *et al.*, 1996). One difference at EBC was that the take-over occurred from within the group; the alpha male lost his position to a beta male who had been with the group for at least one year. In *C. capucinus* (Fedigan *et al.*, 1996), and in fact in the vast majority of observed infanticides among primates in general (see review in Struhsaker and Leland, 1987), it is usually new males entering the group that are associated with male take-overs and infanticide. Calculating conception dates (using a gestation length of 149-158 days, from Robinson and Janson, 1987) for the individuals that disappeared in the year after the new male was already in power, one infant and one young juvenile would have already been conceived before the take-over had occurred. This may be more evidence for an infanticide hypothesis. However, another two infants, both lost from the group in March 1997, had been conceived after the new alpha male was in place. These two infants were last seen two months before the mating peak in May 1997. The females that lost these infants did mate and conceive again during that period. Interestingly, these were the two females that showed the most mating fidelity to the new alpha male during 1997. One, TE, mated exclusively with the alpha male, and the other, PT, was interrupted by the alpha male in her one witnessed copulation attempt with a subordinate male; all other sexually active adult females in the group had 3-4 mating partners (Lynch, 1998).

Subgrouping may be another potential risk factor for capuchin infants at EBC. The study group broke up into smaller subgroups on nearly half the observation days in the 1996-1997 season (Lynch, 1999a, 1999b). On at least one occasion during that time, a dependent infant was stranded for several hours in a subgroup different from his mother. Capuchin infants may be carried by group members other

than their mothers even in the first months of life; a young infant primarily dependent on mother's milk might be at serious risk of dehydration or starvation if separated from her in this way for one or more days.

Despite the fact that deforestation around EBC has restricted these primates from contact with a larger population for over 50 years (Strier, 1991), the high infant mortality within the group does not seem to be associated with inbreeding effects (Lande and Barrowclough, 1987). The capuchin monkeys here have never been reported to have obvious congenital defects. Further study of this and other groups at EBC will be needed to test whether the high infant mortality found in this study is an ongoing cost to groups of large size that split up into subgroups, a short-term phenomenon related to a change in the position of alpha male, a result of increased predator pressure in edge habitat, or some combination of these various social and ecological factors.

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Jessica Ward Lynch, Department of Anthropology, University of Wisconsin-Madison, 1180 Observatory Drive, Madison, WI 53706, USA, and José Rímoli, Universidade Federal do Pará, Centro de Ciências Biológicas, Caixa Postal 8607, 66075-150, Belém, Pará, Brasil.

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International cover only 1.4% of the Earth's land surface, but claim more than 60% of all plant and animal diversity. The mountain gorilla (*Gorilla beringei*) occurs in the Democratic Republic of Congo, Rwanda and Uganda). The hotspots and the critically endangered primate species occurring in them are as follows:

Madagascar and Indian Ocean Islands: Golden bamboo lemur (*Hapalemur aureus*), Lac Alaotra bamboo lemur (*H. griseus alaotrensis*), Perrier's sifaka (*Propithecus diadema perrieri*), the silky sifaka (*P. d. candidus*), and the golden-crowned sifaka (*P. tattersalli*).

Atlantic forest region: Golden lion tamarin (*Leontopithecus rosalia*), black lion tamarin (*L. chrysopygus*), black-faced lion tamarin (*L. caissara*), the buff-headed capuchin (*Cebus xanthosternos*), and the northern muriqui (*Brachyteles hypoxanthus*).

Tropical Andes: Yellow-tailed woolly monkey (*Lagothrix flavicauda*).

Guinean Forests of West Africa: Miss Waldron's red colobus (*Procolobus badius waldroni*), white-naped mangabey (*Cercocebus atys lunulatus*), Sclater's guenon (*Cercopithecus sclateri*), the drill (*Mandrillus leucophaeus*), and the Cross River gorilla (*Gorilla gorilla diehli*).

Eastern Arc Mountains and Coastal Forests of Tanzania and Kenya: Sanje mangabey (*Cercocebus galeritus sanjei*)

Indo-Burma: Delacour's langur (*Trachypithecus delacouri*), Cat Ba Island golden-headed langur (*T. poliocephalus*), grey-shanked douc langur (*Pygathrix nemaeus cinerea*), Tonkin snub-nosed monkey (*Rhinopithecus avunculus*) and Hainan gibbon (*Hylobates concolor hainanus*).

Sundaland: the Sumatran orangutan (*Pongo abelii*) and the Javan gibbon (*Hylobates moloch*).

Russell A. Mittermeier, William R. Konstant and Anthony B. Rylands, Conservation International, Suite 200, 2501 M Street NW, Washington, DC 20037, USA.

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THE PSG PRIMATE TAXONOMY WORKSHOP

What exactly is the diversity of primates that we need to conserve? Are there primate populations which are being ignored in worldwide conservation efforts just because they are not currently recognized as distinct taxa? These were two of the questions which stimulated the IUCN/SSC Primate Specialist Group (PSG) to hold a workshop, "Primate Taxonomy for

News

THE WORLD'S TOP 25 MOST ENDANGERED PRIMATES

A listing of the World's top 25 most endangered primates was published in the 17 January 2000 edition of *Time* magazine (pp.76-79). The list was prepared by Conservation International, Washington, DC, in collaboration with the IUCN/SSC Primate Specialist Group Chairman, Russell A. Mittermeier, and Deputy Chairmen, William R. Konstant and Anthony B. Rylands, and released at a press conference at the National Press Building, Washington, DC, on 10 January. The press release was also attended by Primate Specialist Group members Devra G. Kleiman (National Zoological Park, Washington, DC), Karen B. Strier (University of Wisconsin, Madison) and Thomas T. Struhsaker (Duke University, Durham, North Carolina).

Of the 25 primates listed, 24 are endemic to seven of the 25 biodiversity hotspots identified for priority conservation action by Conservation International (see Mittermeier *et al.*, 1999; Myers *et al.*, 2000). The hotspots identified by Conservation