

PREY FORAGING BEHAVIOR, SEASONALITY AND
TIME-BUDGETS IN BLACK LION TAMARINS, *Leontopithecus*
chrysopygus (MIKAN 1823) (MAMMALIA, CALLITRICHIDAE)

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ABSTRACT

Foraging behavior, seasonality and time-budgets in the Black Lion Tamarin (*L. chrysopygus*) was observed in the Caetetus Ecological Station, South-eastern Brazil, during 83 days between November 1988 to October 1990. For the full dry season we found that animal prey represented 11.2% of the black lion tamarin diet, while during the wet season they represented 1.9%. Foraging behavior made up 19.8% of their total activity in the dry season and only 12.8% in the wet season. These results point out that animal prey are relatively more important during the dry season, due to reduced availability of other resources, e.g. fruits, and that a greater foraging effort is required when a larger proportion of the diet is animal prey.

Key words: *Leontopithecus chrysopygus*, foraging behavior, seasonality, time-budgets, Callitrichidae.

RESUMO

**Comportamento de forrageio por presas, sazonalidade e orçamento temporário das
atividades do mico-leão-preto, *Leontopithecus chrysopygus* (Mikan 1823)
(Mammalia, Callitrichidae)**

O comportamento de forrageio por presas, a sazonalidade e o orçamento temporal das atividades do mico-leão-preto (*L. chrysopygus*) foram observados na Estação Ecológica dos Caetetus, sudeste do Brasil, durante 83 dias, entre novembro de 1988 e outubro de 1990. Para toda a estação seca, observou-se que as presas animais representaram 11,2% da dieta do mico-leão-preto, enquanto na estação chuvosa elas foram responsáveis apenas por 1,9%. O comportamento de forrageio por presas compreendeu 19,8% de sua atividade total na estação seca e 12,8% na estação chuvosa. Esses resultados indicam que as presas animais são relativamente mais importantes durante a estação seca, devido à redução na disponibilidade de outros recursos, como frutos, e que o maior esforço de forrageio é exigido quando a maior proporção da dieta é composta por presa animal.

Palavras-chave: *Leontopithecus chrysopygus*, comportamento de forrageio, sazonalidade, orçamento temporário, Callitrichidae.

INTRODUCTION

The black lion tamarin, *Leontopithecus chrysopygus* Mikan 1823, is one of the endemic and

highly endangered primate species from the Atlantic Forest of South-eastern Brazil (Coimbra-Filho, 1976). It is the only lion tamarin (genus *Leontopithecus*) which does not inhabit a restricted

region of coastal rainforest (Rylands, 1993). Its range extends inland as far as 500 km, on the drier, more seasonal tablelands (the Planalto) of São Paulo State. This region has a distinct dry season, and the original vegetation cover, of which less than 10% remains (Victor, 1975), consists primarily of broad-leaved semideciduous tropical forest (Torres de Assumpção, 1983).

Lion tamarins are considered primarily insectivores and frugivores (Coimbra-Filho & Mittermeier, 1977; Rylands, 1993; Passos, 1999), and in the wild they consume mostly fruits, exudates, animal prey and nectar. Animal prey make up a relatively small proportion of the diet and are costly to obtain, but its nutritional value make it an essential component of their diet (Peres, 1986). In this note, we present our observations on prey foraging. We then compare them with studies of other lion tamarin species and discuss some of the unique aspects of black lion tamarin foraging in relation to the seasonal variability within their endemic range and their time-budgets.

MATERIAL AND METHODS

We studied the foraging behavior of a group of black lion tamarins at the 2,179 ha Caetetus Ecological Station in South-central São Paulo State, Brazil. Caetetus Ecological Station is an isolated patch of semideciduous mesophytic forest. The climate of the region has a well-defined seasonality with the dry season from April to September (35-75 mm), a wet season from October to March (120-200 mm) and annual rainfall averages between 1,000-1,600 mm.

We observed the group from November 1988 to June 1989 and April to October 1990, following the same group for 83 days. The studies included observations from both the wet and dry seasons. The group ranged from 7 to 5 individuals and their activities were recorded by daily scan sampling at 15 minute intervals. The group was followed using radiotelemetry and five categories of behavior were quantified through scan sampling: traveling, resting, foraging for animal prey, feeding and "others".

RESULTS AND DISCUSSION

The behavior used by *L. chrysopygus* to locate and capture animal prey was manipulative, specific-site foraging as described by Rylands

(1993). The black lion tamarins used a wide variety of microhabitats (Passos & Keuroghlian, 1999), searched in among dry palm leaves, twigs, under loose bark, in tree cavities of all sizes, and in moss patches and epiphytes. More than half of foraging records are in the middle layers of the forest between 8 to 15 meters (Passos, 1994).

An analysis of the diurnal time budget of a group of black lion tamarins, showed that 68% of the foraging occurred in the afternoon. More prey were captured during the afternoon as well (n = 21 total prey items), suggesting that the increase in foraging effort was associated with searching and capturing animals.

The tamarins at the Caetetus Ecological Station showed an increase in animal prey consumption during the transitional months from the end of the dry season to the beginning of the wet season, 1.6% to 5.0%, respectively. The beginning of the wet season is a period when the abundance and activity of certain insects increases, e.g. tettigoniids, numerous homopterans, isopterans (termites) and formicids (ants) (Wolda, 1978; pers. obs.). Intensified prey foraging and/or increased capture success by the tamarins may accompany this period and explain the observed pattern. In addition, frogs became very active after the rains began. They were absent from the diet of the tamarins toward the end of the dry season, but composed 0.6% during the first month of the wet season.

For the full dry season (April to September) at the Caetetus Ecological Station, we found that animal prey represented 11.2% of the black lion tamarin diet, while during the wet season (October to March) they represented 1.9% of the diet. In addition, foraging behavior made up 19.8% of their total activity in the dry season and only 12.8% in the wet season. These results point out: 1. that animal prey are relatively more important during the dry season, due to reduced availability of other resources, e.g. fruits, and 2. that a greater foraging effort is required when a larger proportion of the diet is animal prey.

Seasonal differences in the use of animal prey were not apparent for other lion tamarin species (Peres, 1986; Rylands, 1989). Temporal differences have been found for the black lion tamarins, but studies have produced conflicting results (Keuroghlian, 1990; Passos, 1992; Valladares-Padua, 1993). Two of the black lion tamarin groups studied by Valladares-Padua (1993) at the Morro do Diabo

State Park showed a wet season increase in animal prey foraging, while the other two groups did not show seasonal differences, i.e. monthly variability was just as pronounced as seasonal changes. He attributed the wet season increases to declines in fruit resources and peaks of insect abundance.

Physiognomic, areal and local weather differences between the two reserves, which affect seasonal prey abundance, may explain the conflicting results above. The Caetetus Ecological Station is situated above 500 m of altitude on the edge of a plateau, while the much larger (15 times) Morro do Diabo State Park is on the flood plain of a large river, the Paranapanema, below 350 m of altitude. Dry season rainstorms, which have a strong effect on insect cycles (Wolda, 1978), are often patchy events on the Planalto, reaching some regions, but not others. Despite forest similarities, we expect that animal prey trends are highly variable within and between seasons, and may frequently be different for these two reserves.

However, the study of Valladares-Padua (1993) and our data indicated that the prey foraging of at least *L. chrysopygus* was quite variable. Black lion tamarins used a wide variety of microhabitats (Passos & Keuroghlian, 1999) and forest types (Valladares-Padua, 1993), and their foraging habits appeared to be adjusted to the daily, monthly, and seasonal cycles of prey availability (this study), different of the other lion tamarin species (Peres, 1986; Rylands, 1989).

From 19% to 31% of the animal prey foraging by *L. rosalia* (Peres, 1986) and nearly

50% by *L. chrysomelas* (Rylands, 1989) occurred on bromeliads. This suggests that these tamarins have relatively specialized prey foraging behavior. Although comparable data were not collected for *L. chrysopygus*, their prey foraging effort appeared to be distributed more evenly among the available microhabitats. The forests in their range do not have a single, abundant microhabitat where animal prey are located consistently, and as a consequence, the black lion tamarins may need to search regularly in a variety of locations.

If searching several types of microhabitats for animal prey in a mixture of forest types requires greater effort, then, as observed by Passos & Keuroghlian (1999), black lion tamarins should spend less time resting than other lion tamarins (Table 1, see inactivity). Similarly, in a comparison of two callitrichid species, Terborgh (1983) reported that the emperor tamarin (*Saguinus imperator*) spent more time foraging for insects and as a result rested less than the saddleback tamarin (*Saguinus fuscicollis*). Valladares-Padua (1993) reported inactivity as the dominant component of the black lion tamarin time budget (Table 1), and the levels reported by Valladares-Padua were much higher than those for other lion tamarins. We believe that the divergent results of our studies were due to methodological differences in defining and identifying inactivity, or can represent that the activity patterns at least in *L. chrysopygus* was quite variable (see Table 1).

The regular use of a variety of spatially dispersed foraging sites (Passos & Keuroghlian, 1999) should also be associated with relatively large area requirements.

TABLE 1

Activity-inactivity budgets of lion tamarins (*Leontopithecus* spp.). Percent values are shown for observations of total activity, inactivity and animal prey foraging (a subdivision of total activity).*

Species	Activity category			N. of groups	Source
	Total activity	Inactivity	Foraging		
<i>L. chrysopygus</i>	83.0-86.2	13.8-17.0	13.2-18.3	1	This study
<i>L. chrysopygus</i>	30.0-47.0	53.0-70.0	3.0	4	Valladares-Padua (1993)
<i>L. rosalia</i>	73.3	26.7	12.4	1	Peres (1986)
<i>L. chrysomelas</i>	80.0	20.0	13.0	1	Rylands (1989)

* To allow comparison, we have presented inactivity as the sum of resting and social activities for Peres (1986) and Rylands (1989). This was not possible for the data presented by Valladares-Padua (1993), so the inactivity shown for his study do not include social activities.

For example, folivorous-frugivorous howler monkeys, e.g. *Alouatta palliata* (Milton, 1980), which forage among a limited number of sites have home ranges of approximately 30 ha, while omnivorous, wide-ranging capuchin monkeys, e.g. *Cebus albifrons* (Terborgh, 1983), have home ranges of 150 ha or more. As shown in Table 2, black lion tamarins have larger home ranges than other lion tamarins, but mean daily ranges are similar.

These observations of *L. chrysopygus* point out: 1. the relatively even use of a variety of microhabitats for foraging; 2. temporal adjustments of foraging behavior and diet to available resources; 3. minimal rest; and 4. large area requirements, when considered in combination and compared

with other lion tamarins, describe a species adapted to seasonal environment. Survival in this environment will be closely linked to the efficient use of temporally and spatially clumped resources of varying quality, principally fruits and animal prey. The home range size will also be influenced by other biological characteristics such as biomass, group size and density, and other factors.

The larger body size of the black lion tamarin in comparison to the other lion tamarins (Lorini & Persson, 1990), may be a factor related to the use of a larger home range. However, the seasonality of the region and their foraging behavior appear to be other factors influencing their ranging behavior.

TABLE 2
Mean daily range (m) and home range (ha) estimates for the lion tamarins (*Leontopithecus* spp.).

Species	Mean daily range (m)	Home range (ha)	N. of groups	Source
<i>L. chrysopygus</i>	1,977-2,289	> 118	1	This study
<i>L. chrysopygus</i>		66-133	2	Carvalho & Carvalho (1989)
<i>L. chrysopygus</i>	1,362-2,088	113-199	4	Valladares-Padua (1993)
<i>L. rosalia</i>	1,339-1,533	36-67	7	Dietz <i>et al.</i> (1997)
<i>L. chrysomelas</i>		66-86	4	Dietz <i>et al.</i> (1994)
<i>L. chrysomelas</i>	1,552-1,954	36	1	Rylands (1989, 1993)

The unique aspects of their prey foraging behavior will be important to consider for the conservation of black lion tamarins (Rylands, 1993). Future investigations should attempt to identify the use and value of particular microhabitats, or more likely a diversity of microhabitats, to successful prey foraging and the fulfillment of nutritional requirements. The availability of prey monthly and seasonally and in different regions should also be quantified to determine their importance in local behavioral patterns (Rylands, 1993).

The observations which show that the foraging behavior of *L. chrysopygus* is more flexible than that of its congeners (Passos & Keuroghlian, 1999; Valladares-Padua, 1993; this study) may at first appear to simplify management strategies. However, the broad-leaved semideciduous forests of its range have been disproportionately destroyed

in South-eastern Brazil leaving most of the surviving populations in highly disturbed habitat remnants (Coimbra-Filho, 1976; Valladares-Padua, 1993). In addition, the black lion tamarins have relatively large area requirements, and, as indicated above, the carrying capacity of their environment may be relatively low in certain regions and at certain times of the year. Therefore, conservation units must not only incorporate sufficient area for the ranging habits of the tamarins, but for the maintenance of habitat diversity as well.

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