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Daily activity period, home range and sleeping sites of golden lion tamarins (*Leontopithecus rosalia*) translocated to the União Biological Reserve, RJ-Brazil

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Abstract

Golden lion tamarins (*Leontopithecus rosalia*) are known to sleep in tree holes as a means of protection against predators. The aim of this study was to compare the activity period of the diurnal golden lion tamarins with the home range of each group, and the sleeping sites used by tamarins in the União Biological Reserve. Two groups (Geni and SJ2) were followed monthly from April 2003 to March 2004, for a total of 712 h. The daily distance and the home range of the groups were estimated, the trees used as sleeping sites were marked with numbered tags, and the habitat and the positions of the trees were mapped. During the study, the mean daily activity period was 10.30 h. The SJ2 group had a home range of 96.22 ha and 21 different sleeping sites, and the Geni group had a home range of 72.52 ha and nine different tree hole sleeping sites. The daily activity of golden lion tamarins varied seasonally and was associated with photoperiod and temperature. The size of the home range may be influenced by the occurrence and interaction with neighboring groups.

Keywords: conservation; daily activity; ecology; home range; *Leontopithecus rosalia*; primates; sleeping sites; South America.

Introduction

Food is an essential resource, and activities related to seeking and obtaining food are one of the principal determinants in activity patterns of primates (Brandão 1999). The differences in home range of primates are in part related to different metabolic needs of each species (Harvey and Clutton-Brock 1981). Among other characteristics, the body size of a primate determines its daily metabolic needs and the territory size needed (Terborgh 1983). Golden lion tamarins (*Leontopitheicus rosalia*) are small primates, weighing approximately 500 g, that live in groups (Coimbra-Filho 1969, Kierulff 2000), each with a home range, which may border on or overlap the range of neighboring groups (Procópio-de-Oliveira 2002). The home range of a group may be related to the temporal and spatial patterns of resource distribution (Terborgh 1983, Nunes 1996). The home range of *Leontopithecus* is related to vegetation and habitat structure (Peres 1986) and is larger than the home range of other genera of callitrichids, probably due to seasonal fruit production, opportunistic use of exudates and feeding on animal prey (Rylands 1993, Castro et al. 2000, Castro 2003). Golden lion tamarins were translocated to the União Biological Reserve between 1994 and 1996, and new groups were formed from translocated individuals (Kierulff 2000). Until the termination of this study the home range of the groups were still in expansion. In previous studies in the União Biological Reserve, home ranges of golden lion tamarin groups had an average area of 109.2 ha (Procópio-de-Oliveira 2002). This size is intermediary if compared to the *L. chrysopygus* area in the Caetetus Ecological Station and the *L. caissara* area (Kierulff et al. 2002).

L. rosalia sleeps in tree holes, tangles of vines and epiphytes (Coimbra-Filho 1969). The small diameter of the tree holes may protect against the entrance of predators larger than tamarins (Coimbra-Filho 1978).

The aim of this study was to present the results of the daily activity rhythm of golden lion tamarins translocated to the União Biological Reserve, to compare the home range of each group and the sleeping sites used to data from natural populations at the Poço das Antas Biological Reserve (PDABR).

Methods

Study site

This study took place in the União Biological Reserve (UBR) (22°27′36″ S, 42°02′15″ W), in the municipalities of Rio das Ostras and Casimiro de Abreu, in the state of Rio de Janeiro, Brazil. The reserve consists of an area of 3121 ha with approximately 2400 ha as forest. The climate in the region is seasonally hot and humid (Kleiman et al. 1988). The annual rainfall during the study period was 1876 mm, with an average temperature of 27.6°C. The dry season occurs from April to September, and the wet season from October to March. The UBR shows three types of habitat based on topographic and drainage systems: Swamp Forest, occurring in permanently water-saturated lowland areas; Lowland Forest, in areas of seasonal standing water; Hill Forest, at higher altitudes on the hills (Kierulff 2000).

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Data collection

Two groups of translocated golden lion tamarins (Geni and SJ2) were followed 3 days per month with radio-telemetry (receiver Telonics TR-4), from April 2003 to March 2004, for a total of 712 h (Geni for 300 h and SJ2 for 412 h). During the study period, the Geni group size ranged from 7 to 11 individuals, and the SJ2 group size varied from 8 to 13 individuals. The data from the two groups were combined for the analysis.

To estimate the daily path traveled and the groups home ranges, the position of each monitored group every 20 min (x and y coordinates) was plotted on a map of the UBR (scale 1:10,000). The positions were transformed to UTM (Universal Transversal of Mercator), and the home range was calculated using the Minimum Convex Polygon available in the Animal Movement Extension for Arc View GIS 3.2 (Environmental System Research Institute) (Hooge and Eichenlaub 1997). The Geni and SJ2 groups were followed from early morning when they left their sleeping site until entering a sleeping site at the end of the day. The tree holes used as sleeping sites were marked with colored flags, and the habitat and the positions were mapped.

Data analysis

The data from the daily activity and daily path traveled by each group were divided into dry and wet seasons, and the results were compared using the Wilcoxon test (Zar 1984). The distance traveled by each group was compared with the daily activity and with the distance between the sleeping site and the last tree visited by the tamarins (Spearman correlation test) (Zar 1984).

The home range of each group was compared with the mean home range for all groups in the UBR (109.2 ha) (Procópio-de-Oliveira 2002). The habitat types of sleeping trees were compared using the χ^2-test (Zar 1984).

Results

Daily activity

The average time the tamarins left the sleeping site (for the two groups) was 05:57 h (n=66 days) (Table 1), and the differences between dry and wet seasons were only significant for the SJ2 group (Geni: n=4, T=1, $p>0.05$; SJ2: n=5, T=0.00, $p<0.05$). The average hour when the groups returned to sleeping trees was 16:13 h (n=65 days), and the two groups showed no significant differences between dry and wet seasons (Geni: n=5, T=3, $p>0.05$; SJ2: n=4, T=0.00, $p>0.05$).

The mean daily activity was 10.30 h (n=57 days), with a minimum of 7.8 h in the winter and a maximum of 12.8 h in the summer. There were significant differences in daily activity between dry and wet seasons for the SJ2 and Geni groups (Geni: n=5, T=0.00, $p<0.05$; SJ2: n=5, T=0.00, $p<0.05$).

Ranging patterns and home range

The mean daily path traveled by the golden lion tamarins in the UBR from April 2003 to March 2004 was 1541.6±515.1 m (n=24 complete days) for the Geni group and 1502.3±396.4 m (n=33 complete days) for the SJ2 group ($\chi^2=0.48$, $p>0.05$). The distances traveled varied significantly among the months (Table 2), with the exception of September 2003. The mean monthly range for the Geni group was longer than the SJ2 group, but the difference was only significant for the wet season. The monthly range increased for both groups during the dry season, but the differences were not significant (Geni: n=54, T=3, p=0.5; SJ2: n=5, T=2, p=0.14).

The daily distance traveled by each group was not correlated with daily activity (Geni: n=25, r=0.27, p=0.19; SJ2: n=32, r=0.08, p=0.67) or with the distance between the sleeping site and the first tree visited by the tamarins at the beginning of the day (Geni: n=24, r=-0.34, p=0.105; SJ2: n=24, r=-0.29, p=0.16). The distance traveled by the Geni group was correlated with the distance between the last tree visited by the group and the sleeping place, but not for the SJ2 group (Geni: n=22, r=0.502, p=0.017; SJ2: n=29, r=0.0002, p=0.99).

During the study, the SJ2 group used a home range of 96.2 ha, similar to the mean of all groups in the UBR. The Geni group used an area of 72.5 ha, significantly different from that expected based on the UBR means ($\chi^2=12{,}321$, $p<0.001$).

Sleeping sites

The Geni group used nine different tree holes as sleeping sites (n=43 nights), most of them located in the hill forest (55.6%) (Figures 1 and 3). In addition, the holes in that habitat were used more frequently (86.0% of the nights), with a single hole being used for 32 nights (74.7%). During the study period, the same hole was used on 2 consecutive nights on seven different occasions, and 3 consecutive nights in four cases. The mean distance between holes used consecutively was 468±123 m (ranging from 0 to 574 m), and the mean distance between the holes and home range boundaries was 116.4±52 m (ranging from 64.6 to 213.3 m).

The SJ2 group used 21 different sleeping sites (n=51 nights) (Figures 2 and 3). The majority of the tree holes

Table 1 Daily activity of the Geni and SJ2 groups, from April 2003 to March 2004, in the União Biological Reserve, RJ-Brazil.

Activities	Geni	SJ2
Started activity	05:01 h (Nov/03)–06:37 h (Aug/03)	04:59 h (Nov/03)–06:42 h (Sep/03)
Stopped activity	14:00 h (Sept/03)–17:20 h (Feb/04)	15:30 h (Sep/03)–17:56 h (Feb/04)
Minimum period of activity	7.83 h (Sept/03)	9.28 h (Sept/03)
Maximum period of activity	11.5 h (Feb/04)	12.8 h (Dec/03)
Dry season (April/September)	9.35 h±55 min	10.18 h±33 min
Wet season (October/March)	10.15 h±40 min	11.7 h±45 min

Table 2 Mean daily distance (meters) traveled by the Geni and SJ2 groups, from April 2003 to March 2004, in the União Biological Reserve, RJ-Brazil.

Months	Geni group	SJ2 group	χ^2	p
April	1362.7	1689.6	34.8	<0.001
May	1767.1	1516.0	19.05	<0.001
June	1571.0			
July	2066.5	1693.0	36.91	<0.001
August	1802.7	1422.8	44.51	<0.001
September	1267.7	1351.3	2.60	n.s.
Average – dry season	1639.6±298.3	1534.5±154.6	3.41	n.s.
October	1741.4	1279.7	70.25	<0.001
November	971.7	1412.7	81.2	<0.001
December		1837.0		
January		972.0		
February	2270.6	1101.2	404.9	<0.001
March	1026.9	1518.7	94.6	<0.001
Average – wet season	1502.7±620.5	1353.5±309.6	7.69	<0.01

n.s., not significant.

and the highest frequency of use were located on the hill (90.5% of the holes and 92% of the nights). Two main tree holes were used as sleeping sites during 10 (19.6%) and 9 nights (17.6%), respectively. The same hole was used during 2 consecutive nights on five occasions and 3 consecutive nights only once. The mean distance between consecutive holes was 442±210 m (ranging from 0 to 907 m), and the mean distance between the holes and home range boundaries was 201.8±119.8 m (ranging from 0 to 446 m).

Both the Geni and SJ2 groups significantly preferred sleeping sites on the hill (Geni: χ^2=55.02, p<0.001; SJ2: χ^2=79.4, p<0.001). The mean distance between consecutive holes used by the Geni and SJ2 groups were very similar (χ^2=0.74, p>0.05), but the mean distance between the holes and the edge of the home range was significantly greater for the SJ2 group (χ^2=22.9, p<0.001).

The mean distance between the last fruit tree used and the tree hole sleeping sites was 178.6±126.8 m for the Geni group (ranging from 22 to 577 m) and 180.9±115 m (ranging from 14 to 411 m) for the SJ2 group. The distance from the sleeping site to the first feeding trees used the next morning varied from 0 to 830 m (mean distance=421.6±190.4) for the Geni group and from 50 to 880 m (mean distance=612.9±247.2 m) for the SJ2 group.

Discussion

Daily activity

The daily activity periods found in this study are in agreement with results of previous studies on golden lion tamarins in the UBR: 9–12 h (Kierulff 2000), 10.5 h (Lapenta 2002) and 10.5 h (Procópio de Oliveira 2002). Other species of the Callitrichidae are active approximately 8–12 h per day (Kleiman et al. 1988, Snowdon and Soini 1988, Soini 1988, Stevenson and Rylands 1988).

The daily activity of golden lion tamarins varies seasonally and is associated with photoperiod and temperature (Passos 1997, Lapenta 2002, Lapenta et al. 2003). These animals are more active in the wet season, due to the long days and hot temperatures.

Distance traveled and home range

Several factors can influence the distances covered by primates during the day, such as temperature, proximity of food sources, and abundance and size of resources (Passos 1997).

The daily distance traveled by the tamarins was not correlated with the daily activity period, nor did the day length influence it. Although the differences were not significant, the tamarins traveled long distances in the dry season when the days were shorter; this may be related

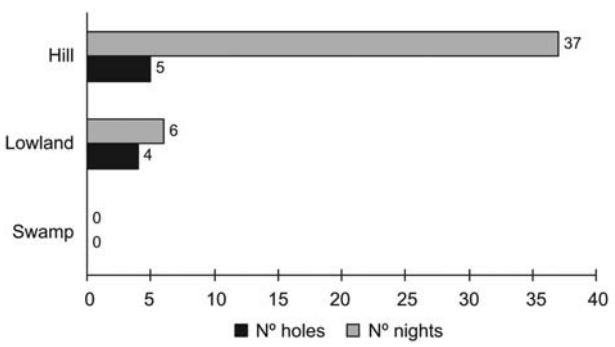

Figure 1 Sleeping sites and frequency of use by habitat of the Geni group in the União Biological Reserve, RJ-Brazil.

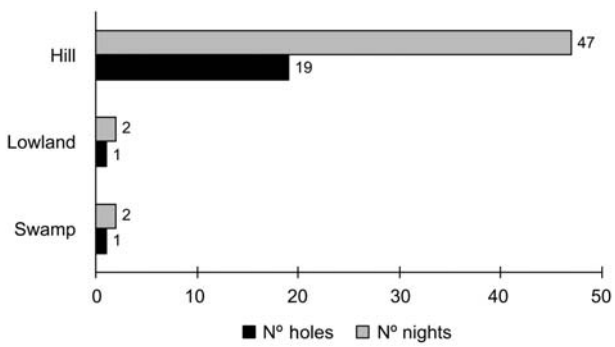

Figure 2 Sleeping sites and frequency of use by habitat of the SJ2 group in the União Biological Reserve, RJ-Brazil.

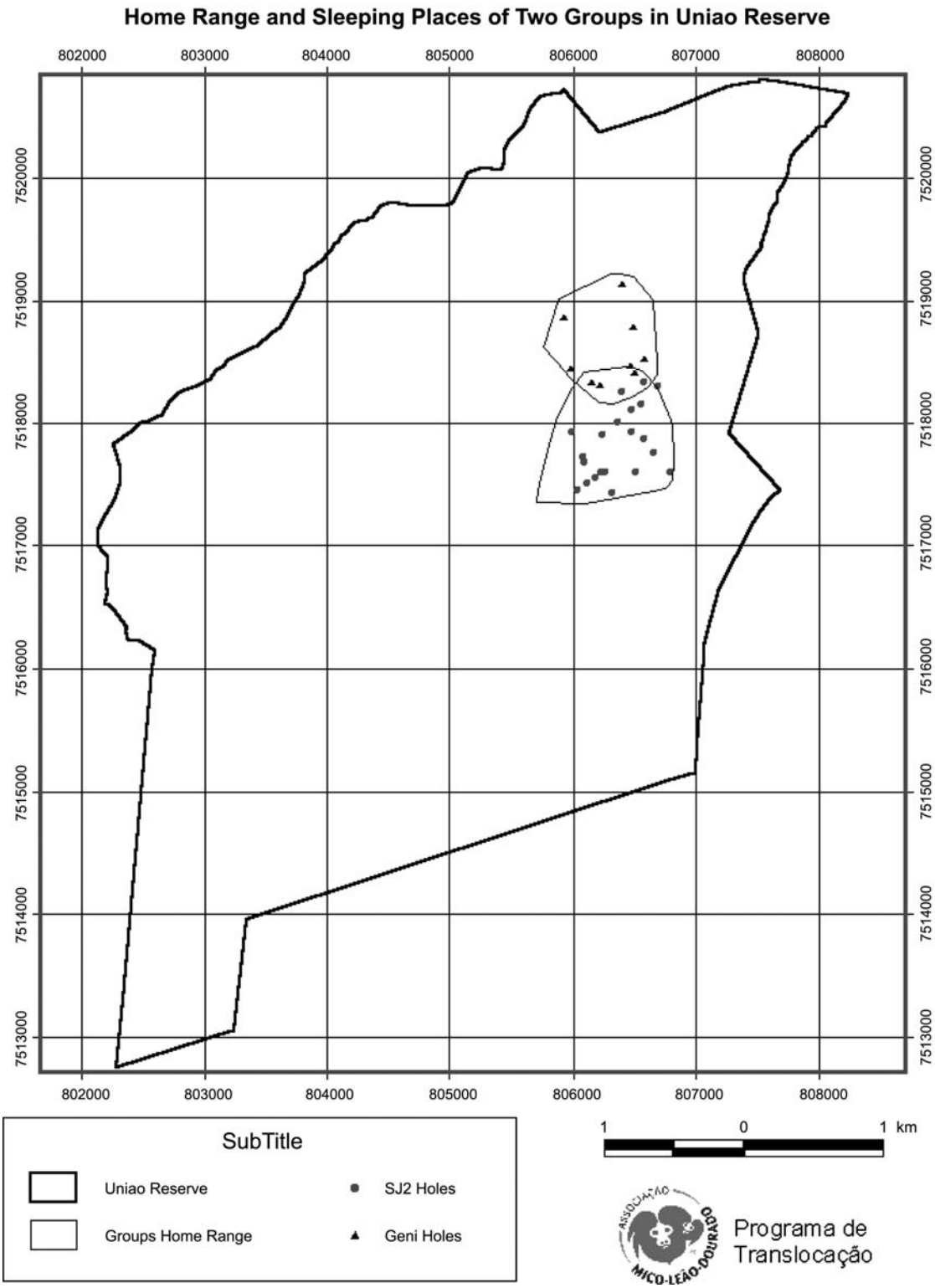

Figure 3 Home range and sleeping sites of the Geni and SJ2 groups, from April 2003 to March 2004, in the União Biological Reserve, RJ-Brazil.

to the distribution of feeding resources, with the shortest fruiting in the dry season. Nunes (1996) found that individual spider monkeys (*Ateles belzebuth belzebuth*) increased the daily path length in the wet season, because of the increase in the number of species in the diet of the study group. Other behaviors may also affect the daily path length; during the wet season the golden lion tamarins rest during the hottest hours of the day, engaging in social interactions among individuals and with the newborn offspring.

Contrary to Miller (2001) and Procópio de Oliveira (2002) in previous studies with *L. rosalia*, the group that traveled long daily distances did not show the largest home range. The Geni group traveled greater daily distances than the SJ2 group and used a shorter home range. The reason for these longer distances traveled is

because the group slept frequently in the same hole, occasionally at a distance from the place where the group fed and remained during the day.

In the PDABR, the mean daily path length for the two groups was 1,339 m and 1,553 m (Dietz et al. 1997). Those distances are similar with those found in this study, but in the PDABR, the mean home range area is smaller than the UBR (mean of 45.2 ha for seven groups) (Dietz et al. 1997).

According to Gaulin et al. (1980), primates in large groups need greater displacements to fulfill their feeding requirements, although there are exceptions (Isbell et al. 1999). In the UBR, Procópio de Oliveira (2002) found no correlation between number of individuals in a group of golden lion tamarins and the home range. In the PDABR, the home range size was correlated with group biomass but not group size (Dietz et al. 1997, Miller and Dietz 2005). Studies with callitrichids show that the group home range represents the occupation of a zone where feeding resources are of greater density (Prado 1999, Passamani and Rylands 2000). In the UBR, the golden lion tamarins travel pattern was related to feeding resource distribution (Procópio de Oliveira 2002). The habitat quality and the density of preferred trees were factors mainly responsible for the differences in habitat use by the groups (Kierulff 2000). According to Peres (1986), in the PDABR, the tamarins traveled over regular routes in areas of concentrated use with abundant and extended resources, but not when feeding on small and ephemeral fruits. The home range of a tamarin group includes different habitats to provide resources despite seasonal differences in each tree species production (Procópio de Oliveira 2002), but in the PDABR, the size of the home range was inversely related to the proportion of swamp habitat inside the group's area (Dietz et al. 1997).

The size of home range may be influenced by occurrence and interaction with neighbors (Peres 1986, Procópio de Oliveira 2002). The increase in neighboring groups with agonistic interactions may result in a retraction in range, and the absence of neighbors may provide an opportunity to expand the home range (Passos 1997).

The area traveled by the SJ2 group during this study is similar to the average of all groups found in the UBR by Procópio de Oliveira (2002), but the Geni group used a range smaller than expected according to the average. This result may be due to resource distribution and the influence of neighboring groups, because the home range area of the Geni group was surrounded by five groups (Procópio de Oliveira 2002) and overlapped with some of them.

Sleeping sites

The differences between study areas that result in different patterns of resource distribution and different home range sizes may be related to the choice of sleeping sites (Heymann 1995). *L. rosalia* used a variety of sleeping sites: tree holes, bamboo, vine tangles and bromeliads (Hankerson et al. 2007), but during this study the tamarins slept only in tree holes.

The structural characteristics of the tree and the surrounding area are important in the choice of a sleeping place by primates, and in the frequent use of those trees (Menezes 2004). Prado (1999) concluded that the small number of sleeping sites used by *L. caissara* on Superagüi Island during the study was a consequence of habitat quality. The choice of a tree for shelter may be related to many factors: protection from predators, protection against rain and cold, proximity of food and water resources, comfort, avoidance of ecto- and endoparasites, patterns of ranging and territoriality (Heymann 1995).

In the PDABR, Dietz et al. (1997) found a distance between consecutive holes used by tamarins varying from 179 to 210 m. These distances, smaller in comparison to the present study, are probably due to the small home range used by tamarin groups in that reserve, and because the União population is still expanding.

The preference of the Geni group for a single hole may be because of the specific tree characteristics. Often the group traveled for several consecutive days far away from this tree hole. On those days, the group would leave the tree hole at sunrise and return at sunset directly to the shelter, without feeding on fruits or insects or engaging in social activities. One of the advantages of using known holes is to reduce predation, but according to Heymann (1995), the patterns of use and reuse of sleeping sites on subsequent nights could facilitate predation on the primates. In a previous study, Procópio de Oliveira (2002) found no pronounced preference of the SJ2 group for any sleeping site, but the group slept more often on the hill and less frequently in swamp forest than expected by the proportion of habitats within the group's home range. The hole which was used nine times by the SJ2 group is located in a fig tree. In October 2003, the group entered the hole and afterwards, all individuals were observed leaving the shelter scratching themselves (S. Pinto, personal communication). Subsequently, the group began to use a hole near the fig tree (31.5 m distance), which had been used once during the study period. This hole was used on nine occasions over the next 4 months, and the SJ2 group only returned to the fig tree hole in March 2004. It seems possible that they changed their sleeping tree because of the presence of ants or bees. Nevertheless, the proximity of the two holes suggests that the choice of nest hole-site is related to the strategic location of the tree that permits the group to patrol the area and the feeding resources.

In addition, Procópio de Oliveira (2002) found more trees with holes in lowland forest, followed by hill and swamp habitats. During a long-term study in the PDABR, the tamarins preferred holes located on the hill forest (Hankerson et al. 2007). Raboy et al. (2004), studying golden headed lion tamarins (*L. chrysomelas*) in northeast Brazil, found that groups selected a tall forest for sleeping sites, but they were unable to distinguish if this was because of the preference for this habitat or the availability of sleeping trees.

The distribution of the sleeping sites within the home range of the tamarins groups in the UBR is not uniform (Kierulff 2000). Comparing the sleeping sites between the

two groups, we found that the holes used by the Geni group were located closer to the edge of their group home range than the holes used by the SJ2 group (Figure 3). Both groups used sleeping holes in overlapping areas of their home ranges, but the differences between them may occur because of the number of holes used by the SJ2 group, as they used holes at the borders and in the interior.

From an energetic standpoint, the distance from the last feeding tree visited in the afternoon to the sleeping site should be kept to a minimum (Heymann 1995). Nevertheless, the average distance traveled by golden lion tamarins from the last and first feeding site to the tree hole during this study were greater than those reported in other studies of this species. Heymann (1995), studying *Saguinus mystax* and *S. fuscicollis* in Peru, found an average travel distance of 44 m traveled. Kierulff (2000) studying the LB and SJ2 groups in the UBR found a mean distance of 108 m between sleeping and first and last feeding trees.

Studies of primates sleeping trees are important to characterize the habitat where the different taxa live. The availability of trees with holes is important to the survival of *Leontopithecus* (Kleiman et al. 1988). Coimbra-Filho (1978) revealed that the reduction in the abundance of trees of sufficient size with holes to shelter the golden lion tamarins have an important influence on tamarin populations. In areas where selective management and logging occur, the removal of dead trees may have a negative impact on these animals.

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References

Brandão, L.D. 1999. Distribuição altitudinal e ambiente preferencial de Callithrix aurita Humboldt, 1812 *(Callitrichidae, Primates)* na Estação Ecológica de Bananal, Serra da Bocaina, São Paulo, Brasil. Master thesis. Universidade de São Paulo, São Paulo. 96 pp.

Castro, C.S.S. 2003. Tamanho da área de vida e padrão de uso do espaço em sagüis, *Callithrix jacchus* (Linnaeus) (Primates, Callitrichidae). Rev. Bras. Zool. 20: 91–96.

Castro, C.S.S., A. Araújo, C. Alho and M.M. Dias-Filho. 2000. Influência da distribuição e disponibilidade dos frutos, na dieta e uso do espaço em sagüis-do-nordeste (*Callithrix jacchus*). In: (C. Alonso and A. Langguth, eds.) A Primatologia no Brasil. SBPr, Editora Universitária, João Pessoa, PB. 7: 65–80.

Coimbra-Filho, A.F. 1969. Mico-Leão, *Leontideus rosalia* (Linnaeus, 1766), situação atual da espécie no Brasil (Callitrichidae-Primates). Ann. Acad. Bras. Ciência 41 (Suppl.): 29–52.

Coimbra-Filho, A.F. 1978. Natural shelters of *Leontopithecus rosalia* and some ecological implications (Callitrichidae: Primates). In: (D.G. Kleiman, ed.) Biology and conservation of the Callitrichidae. Smithsonian Institution Press, Washington, DC. pp. 79–89.

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

Gaulin, S.J., D.H. Knight and C.K. Gaulin. 1980. Local variance in *Alouatta g*roup size and food availability on Barro Colorado Island. Biotropica 12: 137–143.

Hankerson, S.J., S.P. Franklin and J.M. Dietz. 2007. Tree and forest characteristics influence sleeping site choice by golden lion tamarins. Am. J. Primatol. 69: 976–988.

Harvey, P.H. and T.H. Clutton-Brock. 1981. Primate home-range size and metabolic needs. Behav. Ecol. Sociobiol. 8: 151–155.

Heymann, E.W. 1995. Sleeping habitats of tamarins, S*aguinus mystax* and *Saguinus fuscicollis* (Mammalia; Primate; Callitrichidae), in north-eastern Peru. J. Zool. 237: 211–226.

Hooge, P.N. and B. Eichenlaub. 1997. The animal movement program. Ver. 2.0. Alaska Biological Science Center, US Geological Survey, Anchorage, AK, USA.

Isbell, L.A., J.D. Pruetz, B.M. Nzuma and T.P. Young. 1999. Comparing measures of travel distances in primates: methodological considerations and socioecological implications. Am. J. Primatol. 48: 87–98.

Kierulff, M.C.M. 2000. Ecology and behaviour of translocated groups of golden lion tamarin (*Leontopithecus rosalia*). PhD. dissertation. Cambridge University, Cambridge. 388 pp.

Kierulff, M.C.M, B.E. Raboy, P. Procópio-de-Oliveira, K.E. Miller, F.C. Passos and F. Prado. 2002. Behavioral ecology of lion tamarins. In: (D.G. Kleiman and A.B. Rylands, eds.) Lion tamarins biology and conservation. Smithsonian Institution Press, Washington, DC. pp. 157–187.

Kleiman, D., R.J. Hoage and K.M. Green. 1988. The lion tamarins, genus *Leontopithecus*. In: (R.A Mittermeier, A.B. Rylands, A.F. Coimbra-Filho, G.A.B. Fonseca, eds.) Ecology and behaviour of neotropical primates II. World Wildlife Fund, Washington, DC. pp. 299–347.

Lapenta, M.J. 2002. O Mico-Leão-Dourado *(Leontopithecus rosalia)* como dispersor de sementes na Reserva Biológica União/IBAMA, Rio das Ostras, RJ. Master Thesis. University of São Paulo, São Paulo. 96 pp.

Lapenta, M.J., P. Procópio de Oliveira, M.C.M. Kierulff and J.C. Motta-Junior. 2003. Fruit exploitation by golden lion tamarins (*Leontopithecus rosalia*) in the União Biological Reserve, Rio das Ostas, RJ-Bazil. Mammalia 67: 41–46.

Menezes, M.O.T. 2004. The use of date palms (*Phoenix* sp.) as resting and sleeping sites by *Callithrix jacchus* in northeastern Brazil. Neotrop. Primates 12: 53–55.

Miller, K.E. 2001. Olfactory communication, feeding behaviors and energy budgets of wild golden lion tamarins (*Leontopithecus rosalia*). PhD. dissertation. University of Maryland, Washington DC.

Miller, K.E. and J.M. Dietz. 2005. Effects of individual and group characteristics on feeding behaviors in wild *Leontopithecus rosalia*. Int. J. Primatol. 26: 1291–1319.

Nunes, A. 1996. Foraging and ranging patterns in white-bellied spider monkeys. Folia Primatol. 65: 85–99.

Passamani, M. and A.B. Rylands. 2000. Home range of a Geoffroy's marmoset group, *Callithrix geoffroyi* (Primates, Callitrichidae) in south-eastern Brazil. Rev. Bras. Biol. 60: 275–281.

Passos, F.C. 1997. Padrão de atividades, dieta e uso do espaço em um grupo de mico-leão-preto (*Leontopithecus rosalia*) na

Estação Ecológica dos Caetetus, SP. PhD. thesis. Federal University of São Carlos, São Carlos. 100 pp.

Peres, C.A. 1986. Costs and benefits of territorial defense in the golden lion tamarin, *Leontopithecus rosalia*. MSc. thesis. University of Florida, Gainesville, FL.

Prado, F. 1999. Ecologia, comportamento e conservação do mico-leão-da-cara-preta (*Leontopithecus caissara*) no Parque Nacional do Superagui, Guaraqueçaba, PR. Master thesis. Universidade Estadual Paulista, Botucatu.

Procópio de Oliveira, P. 2002. Ecologia Alimentar, Dieta e Área de uso de Micos-Leões-Dourados Translocados e sua Relação com a Distribuição Espacial e Temporal de Recursos Alimentares na Reserva Biológica União-RJ. PhD. thesis. Federal University of Minas Gerais, Belo Horizonte. 234 pp.

Raboy, B.E., M.C. Christman and J.M. Dietz. 2004. The use of degraded and shade cocoa forests by endangered golden-headed lion tamarins *Leontopithecus chrysomelas*. Oryx 38: 75–83.

Rylands, A.B. 1993. The ecology of the lion tamarins, *Leontopithecus*: some intrageneric differences and comparisons with other Callitrichids. In: (A.B. Rylands, ed.) Marmosets and tamarins: systematics, behaviour and ecology. Oxford University Press, Oxford. pp. 296–313.

Snowdow, C.T. and P. Soini. 1988. The tamarins, genus *Saguinus*. In: (R.A Mittermeier, A.B. Rylands, A.F. Coimbra-Filho, G.A.B. Fonseca, eds.) Ecology and behavior of neotropical primates II. World Wildlife Fund, Washington, DC. pp. 223–298.

Soini, P. 1988. The pygmy marmoset, genus *Cebuella*. In: (R.A. Mittermeier, A.B. Rylands, A.F. Coimbra-Filho, G.A.B. Fonseca, eds.) Ecology and behavior of neotropical primates II. World Wildlife Fund, Washington, DC. pp. 79–129.

Stevenson, M.F. and A.B. Rylands. 1988. The marmosets, genus *Callithrix*. In: (R.A. Mittermeier, A.B. Rylands, A.F. Coimbra-Filho, G.A.B. Fonseca, eds.) Ecology and behavior of neotropical primates II. World Wildlife Fund, Washington, DC. pp. 131–222.

Terborgh, J. 1983. Five new world primates. A study in comparative ecology. Princeton University Press, Princeton, NJ. 260 pp.

Zar, J.H. 1984. Biostatistical analysis. 2nd ed. Prentice-Hall, Englewood Cliffs, NJ. 718 pp.