TIME ALLOCATION IN *ALOUATTA PALLIATA*

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Abstract. For howler monkeys, non-foraging behavior such as movement and alertness take time away from feeding and resting. Therefore, these obligate behaviors come at a cost to the individual. We hypothesized that adult males and females with young would bear these costs, since the males are concerned with group protection and the adult females with juveniles are responsible for the care of their young. We recorded the time allocated to feeding, resting, moving, and alertness over 21.5 hours of observation with two troops of 12 and 13 individuals. Females with juveniles spent more time alert and less time resting than did lone females. Similarly, males were more alert and rested less frequently than lone females. Females with young showed a trend toward feeding less frequently than lone females. It is possible that these females compensate for this relative decrease in feeding by feeding more efficiently on more nutritious food sources.

Key Words: primate behavior, howler monkeys

INTRODUCTION

Long-term studies of Howler Monkeys *(A.palliata)* in a free-ranging group in Costa Rica indicate that mothers experience stress in caring for their infants (Clarke 1990). The costs associated with parenting should lead to differences in daily time budgets in which females with infant should spend more time alert and less time resting and feeding than females without infants. Likewise, for males who are considered to be more involved in group protection, they must be more alert and would be expected to spend more time looking up (scanning) than would females. We hypothesize that male howlers, charged with the protection of the troop, will spend more time alert than the females.

METHODS

This study was conducted in Palo Verde National Park in Costa Rica on 13-14 January, 1997. The evening before our observation period we located two troops of howler monkeys--one east of the OTS Biological Station near a grove of mango trees, and the other near the Ojo de Agua (watering hole). The next day, the mango troop was easily located and observations began at 06:00. The watering hole troop had moved slightly and was located by following their distinctive "howls". Observations on this troop began at 06:30.

After locating the two troops, we observed them for 20 min before beginning observations. We took care throughout the day to stay quiet and avoid excessive movement which might disturb them.

Howler activity was divided into four categories: feeding (eating or manipulation of leaves or fruit), resting (sedentary, not alert), alert (awake, scanning, vigilant), and moving (traveling between or within a tree). Due to the practical limitations of continuously recording activity changes, we used discrete 10 min focal samples, and recorded the what we estimated to be the majority action of the individual within that period. Since observation of each member of the troop during each time interval was impossible, we recorded data in each troop for two females with young, two females without young, and two males.

Observations continued until 17:00, and between the two groups we compiled a total of 1290 minutes (21.5 hours) of observations. We compiled the 10 minute intervals into hour increments by taking the majority action during that time, and used paired t-tests to compare the time allocation among the different categories of gender and status (females with infants, lone females, and males).

RESULTS

We compared mean percent daily activity in the four activity classes (alertness, feeding, resting, and movement) for females with infants, lone females, and male *A. palliata* (Fig. 1).

Both lone males and females with infants spent more time alert than lone females [mean difference (md)=4.0%, tpaired=1.91, df=22, P=0.0693 and md=8.0%, tpaired=3.45, df=22, P=0.0023, respectively].

Females with infants spent less time resting than lone females (md=-5.8%, tpaired=2.15, df=22, P=0.0426). Males also spent less time resting than did lone females (md=-5.1%, tpaired=1.91, df=22, P=0.0695).

Our data provided little evidence that females with infants spent less time feeding than lone females (md=-5.4%, t=1.74, df=22, P=0.0961). There was no significant difference in time spent feeding between lone males and lone females (md=2.2%, tpaired=0.76, df=22, P=0.458).

Time spent in motion did not significantly differ among the three howler classes.

Lone males and females with young did not significantly differ in time allocated to any of the four activity classes.

DISCUSSION

Analysis of our observations of the two troops of *Alouatta palliata* indicate that there are costs associated with being a male or a mother. Both females with juveniles and males rested less and were more alert than the females without juveniles. The females with juveniles care for the young, carrying and breast-feeding them. The males protect the troop and the troop's territory. Apparently, these duties cannot be sufficiently accomplished in a time budget that allows for more rest. Since the females with juveniles must care for the young, they have less time to spend in other daily activities. Similarly, the males must be more alert and active to protect the troop, and therefore cannot rest as much as the females without juveniles.

The contrast in results between this and a previous study (Bird et al. 1996) reflects methodological differences in the two studies. We studied behavior from 0600 to 1700 while the Bird, et al. (1996) study assessed time budgets only before 0830. Howler troops feed mainly in the early morning, rest extensively during the day, and resume activity in the late afternoon. (Glander, 1981, Janzen, 1993) An analysis which only examines early morning activity cannot claim to represent the proportion of time spent in overall activity for the day. Howler troops feed as actively in the afternoon as they do in the morning (Milton, 1980). Thus by not following afternoon activity, the study misses another time period where the mothers and males may be preoccupied with their duties instead of eating or resting. In addition, in terms of rest, the greatest differences between the different categories of monkeys would occur during the day, when the females without juveniles would rest while the mothers and males were more active. Also, it may be that not all of the troops spend their day resting. The Ojo de Agua troop did not cease moving and feeding at 0830, but instead continued until 1000 and then spent nearly three hours throughout the day in movement or feeding. Therefore the opportunity cost of energy gain may continue throughout the day, rather than in a single morning feeding period.

That a mother may be spending less time feeding and more time being alert seems counterintuitive--the monkeys are taking in less energy but using more energy in breast feeding, carrying young, and alertness. Feeding in more valuable patches increases the efficiency of foraging, and in this way mothers may afford increased responsibilities. It is possible that the mother resolves this less energy/higher activity conflict by feeding on younger, more nutritious leaves or otherwise foraging more efficiently. However, further studies investigating the type of foliage consumed by the different classes of monkeys could help explain how the females with juveniles meet their energy demands despite their decreased feeding time.

The common belief about the daily lifestyle of *A. palliata* is that the monkeys are active and feeding early in the morning and the afternoon, then spend the day in a sedentary lifestyle. (Glander, 1981, Janzen, 1993, Milton, 1980) However, our observations did not correspond to this daily pattern. The Ojo de Agua troop spent the expected early morning period feeding and moving, but the rest of the day was split into a series of approximately hour long periods alternating between rest and activity. Late-afternoon activity was limited, and the group ceased movement for the day by 1515. In contrast, the Mango troop more closely followed the expected *A. palliata* daily schedule consisting of early morning feeding, a day-long resting period, and a busy late afternoon of feeding and movement which lasted until 1730. Further behavioral observations of the troops would be interesting to see if this contrast in daily trends continues because it is a stark contrast to what is commonly accepted as *A. palliata* daily behavior. In addition, there may be a reason for the higher activity of the Ojo de Agua troop, such as a better territory or higher food quality within their territory.

As a final point of interest, the Ojo de Agua troop spent their day moving in a directed motion, spanning an estimated 3/4 of a mile precisely following a stream bed. The monkeys followed this stream bed even along a short section where the stream had gone dry. Comparison of the vegetation along the stream bed may help explain why this daily migration pattern occurs. It may be that the trees nearest the stream have the highest canopy and offer predator escape. It

could also be that the trees have leaves with a higher leaf water content, or fruit for a longer period of time, thus offering more nutritional value to the monkeys than trees farther from the stream.

In former study Bird et. al. 1996 reported that there was no significant difference in the activity time budgets between adult males, females without young, and mothers with young. We felt that this study was inadequate and that a subsequent study was in order for several reasons: 1) the duration and time of day of this study was inconsistent, 2) data analysis suggests a high degree of variance due to differences in individual troops, sites, and activity throughout the day, and 3) the previous study analyzed observational data from a limited and unrepresentative sampling period.

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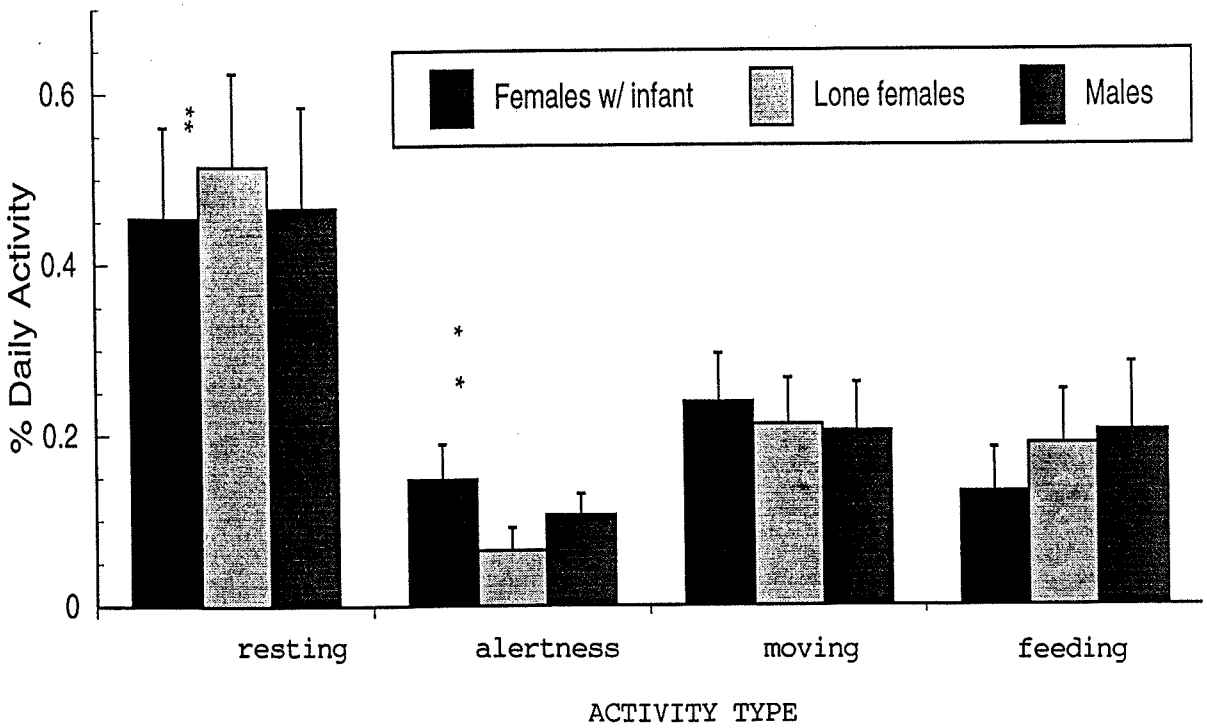

FIG.1. Comparison of average daily time allocations of three classes of A.palliata on January 14, 1997 in Palo Verde National Park. Sample size=24 monkeys. Asterisk (*) indicates statistical significance.