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# **Furniture Usage and Activity Budgets of Captive Black and White Ruffed Lemurs (*Varecia variegata variegata*) and Ring-Tailed Lemurs (*Lemur catta*) at Bramble Park Zoo, Watertown, South Dakota**

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## **ABSTRACT**

A behavioral study was conducted on the black and white ruffed lemurs and ring-tailed lemurs at Bramble Park Zoo in summer 2004 to determine if the furniture in the exhibit was sufficient to enable them to display their natural behaviors. The study was performed using a time sampling method of one minute, and ten hours of data was gathered. Both species of lemur spent a significant portion of the observed time resting, more so than has been found in wild populations of lemurs. The time spent foraging (.33% and 2.5% for the ruffed lemurs and 2.1% for the ring-tails) and the time spent displaying locomotion behaviors (1.6% and 7.0% for the ruffed lemurs and 4.45% for the ring-tails) were found to be lower in the captive lemurs compared to data for wild lemurs (~30-40% foraging and 17% locomotion behaviors). Black and white ruffed lemurs, which are primarily arboreal in the wild, spent a majority of time on the ground. The ring-tailed lemurs, a semi-terrestrial species, spent around 50% of the time in the tree and around 40% of time on the ground, which is similar to ring-tailed lemurs in the wild; however, most of that time was spent resting rather than foraging or displaying locomotion behaviors. Several ideas pertaining to furniture modifications and food presentation methods were suggested as a means to increase natural behaviors as well as decrease the amount of time spent resting.

## **INTRODUCTION/BACKGROUND**

The black and white ruffed lemur (*Varecia variegata variegata*) and ring-tailed lemur (*Lemur catta*) are primates native to the island of Madagascar located off the southeastern coast of Africa. Lemurs are a type of primate known as prosimian, meaning “pre-monkey,” indicating that these species are primitive versions of primates (Berger, 1985). While black and white ruffed and ring-tailed lemurs are in the same family, Lemuridae, and do share some behavior traits, there are distinctive differences in their natural behaviors.

Black and white ruffed lemurs in the wild are arboreal, spending most of their time in upper layers of the canopy. While the locomotion of these lemurs is more cautious compared with other lemur species, they are agile on the ground and in trees, walking or running on large branches and leaping between trees. Black and white ruffed lemurs are a crepuscular species and usually sleep for a large part of the day (Macdonald, 1984). Black and white ruffed lemurs can be seen “sunbathing” during the day, lying stretched out in the sunlight. Black and white ruffed lemurs are mainly frugivores, as 92% of their diet consists of fruit (Britt, 2000). This species also eats leaves and nectar as well (Britt and Iambana, 2003). Black and white ruffed lemurs display several unique postures when feeding, with the most interesting being their ability to hang upside-down by their feet to reach food on small branches (Konstant et al., 1994). In both black and white ruffed lemurs and ring-tailed lemurs, females are dominant over males, and there is usually one dominant matriarch in a group (Macdonald, 1984). Social interactions, such as grooming and vocalization, are very important in both species for establishing bonds within a group. All lemurs have a “tooth comb,” located where the lower incisors are, as well as a “toilet claw,” located on the second digit of the back foot, both of which are used for grooming. Black and white ruffed lemurs communicate mainly through vocalizations, and 12 different calls have been recorded in this species, many of which are alarmingly loud (McLennan and Pappas, 2003a).

Ring-tailed lemurs are the most terrestrial of all lemur species, frequently using the ground for traveling and foraging (Macdonald 1984). Ring-tailed lemurs are diurnal and sunbathe during the day in a meditation-like position with their arms outstretched. Wild ring-tailed lemurs spend a large portion of their day foraging and feeding on the ground, and can cover up to 900-1000 meters per day (Konstant et al., 1994). Ring-tailed lemurs rely on scent more than vocalizations for communication. All ring-tailed lemurs have scent glands on their wrists, chests, and feet, and males have an extra gland located in their armpits. While the females of this species can be fierce fighters, the males are less aggressive. Instead of fighting, males will rub their tails on their wrist glands and then wave their tail at their opponent, “throwing” their scent at them. This is known as a “stink fight” and is a unique behavior of the ring-tailed lemur (McLennan and Pappas, 2003b). There are also about 22 different calls that these lemurs make, including grunting, howling and purring (Macedonia, 1993).

Both lemur species are listed as endangered and many zoos and wildlife reserves are working to increase the numbers of these lemurs (Nowak, 1999). A central objective of zoos with primate species is to ensure that their exhibits are as naturalistic as possible, providing a replication of natural habitat, while at the same time enabling the public to view the animals. While size of the enclosure can be a factor in limiting certain types of natural behaviors as well as increasing stereotypic behaviors, the idea of functional space is more commonly considered. Functional space is “the space that animals use rather than the total amount of space (Beckley et al., 1994).” Many animals utilize more space in their enclosures than just the size of the cage, especially primate species. Placing furniture in an exhibit, which can include branches, ropes, swings, and rocks, can further increase existing functional space as well as increase natural behaviors of many different primate species, including lemurs.

For this study, furniture usage along with behaviors displayed by the two species of lemurs was examined. The purpose of the study was to determine if furniture in the cage allowed captive lemurs to exhibit behaviors normally found in wild lemurs. These two species were chosen for this experiment because the lemur cage did not seem to match with their behavioral needs. General information about each of the five lemurs studied includes (courtesy of the Bramble Park Zoo):

*Phoebe (V. v. variegata)*

- 29 year old female (all black face)
- Date of Birth: 5-19-1975
- Place of birth: Duke Primate Center
- Date of Acquisition by Bramble Park Zoo: 4-20-1987

*Gwen (V. v. variegata)*

- Phoebe's daughter (white on face)
- 17 year old female
- Date of Birth: 5-11-1987
- Place of Birth: Duke Primate Center
- Date of Acquisition by Bramble Park Zoo: 4-20-1987

*Josh (L. catta)*

- 8 year old male
- Date of Birth: 4-15-1996
- Place of Birth: St. Catherine's Wildlife Center
- Date of Acquisition by Bramble Park Zoo: 7-21-1999

*Ossabaw (L. catta)*

- 14 year old male
- Date of Birth: 3-22-1990
- Place of Birth: St. Catherine's Wildlife Center
- Date of Acquisition by Bramble Park Zoo: 7-21-1999

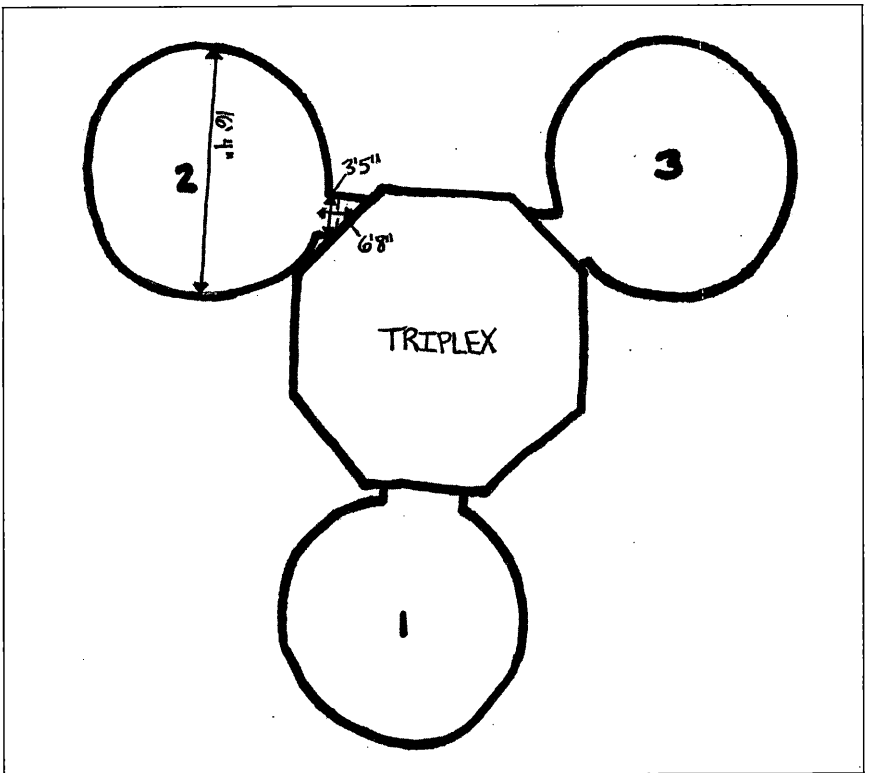
*McQueen (L. catta)*

- 6 year old male
- Date of Birth: 3-12-1998
- Place of Birth: St. Catherine's Wildlife Center
- Date of Acquisition by Bramble Park Zoo: 7-21-1999

## STUDY AREA

I conducted this project during summer 2004 while on internship at the Bramble Park Zoo, an AZA accredited zoo in Watertown, South Dakota. Both lemur species were

housed together in one exhibit. There were two female black and white ruffed lemurs and three male ring-tailed lemurs living in the exhibit. The exhibit is connected to a building known as the Triplex (Figure 1), as are two other exhibits, both of which also house primates. While there is an indoor area for the lemurs, I focused only on the outdoor area. The outdoor exhibit consists of a circular section of grass surrounded by a thin circular area of cement. Vertical and horizontal bars surround the outer edges of the cage and there is a small section near the door where bars are used as roofing instead of the solid roof which covers the rest of the exhibit. In the grass portion of the exhibit, there are two large rocks which sit close together near the inside door, and a large tree with several branches reaching to the top of the exhibit. For this study, I grouped the tree branches based on size: one large limb, five medium limbs, and nine small limbs (Figure 2). There were also several locations on the tree where two branches split from each other and these areas were designated as a branched V.



**Figure 1.** The Triplex layout at Bramble Park Zoo in Watertown, South Dakota. Area 2 is the black and white and ring-tailed lemur enclosure. Measurements of the circular area, which is the outdoor portion of the exhibit, are given.



**Figure 2.** Photograph of the lemur exhibit at Bramble Park Zoo in Watertown, South Dakota from a front view looking towards the Triplex building (in the background).

## METHODS

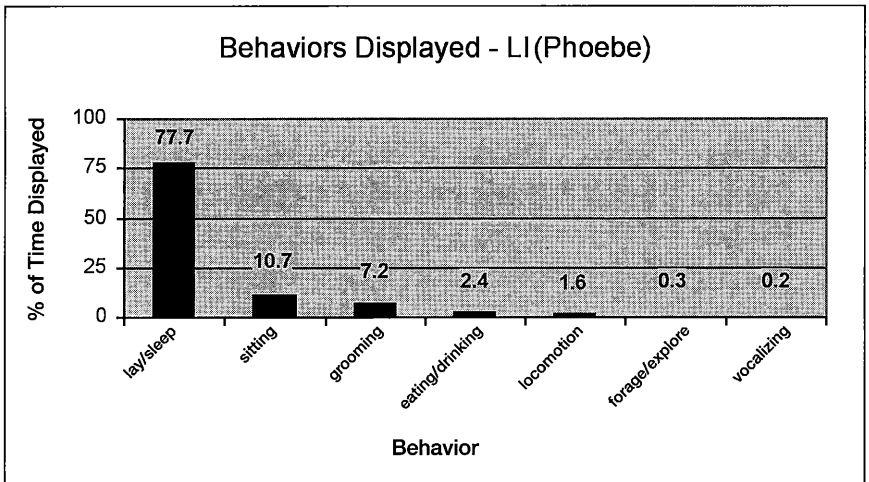
I conducted a total of 20 observations, each lasting for 30 minutes and gathered a total of 600 minutes of data. The method of observation I used was scanning, or instantaneous sampling, where I devised a chart to record what each lemur was doing and what furniture they were using at a time interval of one minute. The observation periods were scattered throughout the day, ranging from as early as

6:30 A.M. to 8:30 P.M. to ensure that data was collected during the active periods for both lemur species.

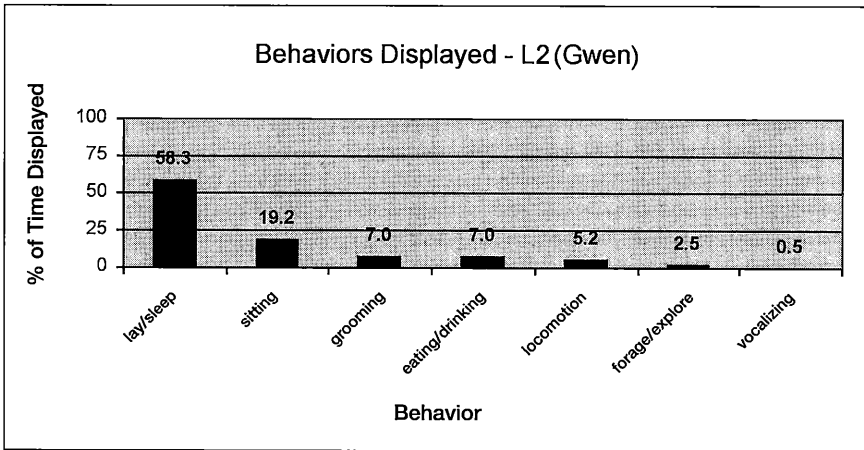
During every 30-minute observation period, I would stand outside the lemur exhibit and observe which furniture they were on as well as what behavior they were displaying. Each minute, the behavior displayed by the five lemurs and the furniture they were utilizing was recorded. There were six broad categories of furniture (tree, ropes, ground, rocks, outer cage and inside). There were eleven broad categories of behaviors including laying/sleeping, sitting, eating, foraging, grooming, locomotion, drinking, fighting, vocalizing, scent marking, and urinating/defecating. The locomotion category was further categorized as walking, running, swinging, climbing, hanging and leaping. Each lemur was designated a letter and number: L1 was given to the older female black and white ruffed lemur, Phoebe, L2 was designated to her daughter, Gwen, and R1-3 were assigned for the ring-tailed lemurs. Because I was not able to tell the three male ring-tailed lemurs apart, they were randomly given a letter and number (R1-R3) each observation period, and then all of their data was pooled, for 1800 minutes of information. Following each observation, the data was counted and put into groupings of furniture used and behaviors displayed on that furniture.

## RESULTS

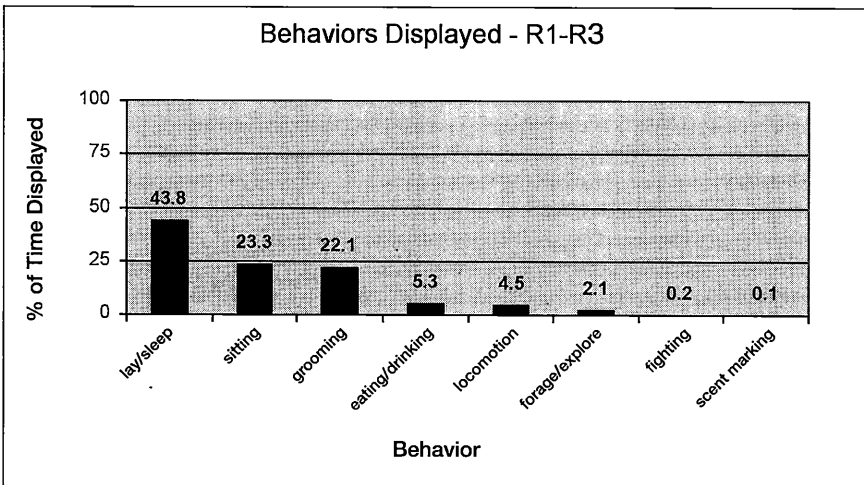
All five lemurs spent a large portion of time resting (either laying/sleeping or sitting) during the study. L1 spent 77.7% of the time resting (Figure 3), while L2 spent 58.3% of the time resting (Figure 4). R1-R3 spent 43.8% of the time resting (Figure 5). Grooming (both self-grooming and reciprocal grooming) was the second most common behavior observed in both lemur species. L1 and L2 spent 7.2% and 7.0% of the time grooming. R1-R3 spent 22.1% of the observed time grooming. L2 spent 7.0% of the time displaying several locomotion behaviors, which included walking, leaping, climbing and hanging, and spent 5.2% of the time eating. R1-R3 displayed locomotion behaviors 4.5% of the time and spent 5.1% of the time eating. L1 displayed both locomotion and eating behaviors less frequently than the other lemurs, at 2.4% and 1.6%, respectively. Other behaviors observed included foraging/exploring, vocalizing, stink fighting and scent marking; however, the occurrence of these behaviors was low.



**Figure 3.** Percent of time specific behaviors were displayed by L1 (black and white ruffed lemur Phoebe (*Varecia variegata*)) at Bramble Park Zoo, summer 2004. A time sampling method of 1 minute was used to gather data.



**Figure 4.** Percent of time specific behaviors were displayed by L2 (black and white ruffed lemur Gwen (*Varecia variegata*)) at Bramble Park Zoo, summer 2004. A time sampling method of 1 minute was used to gather data.

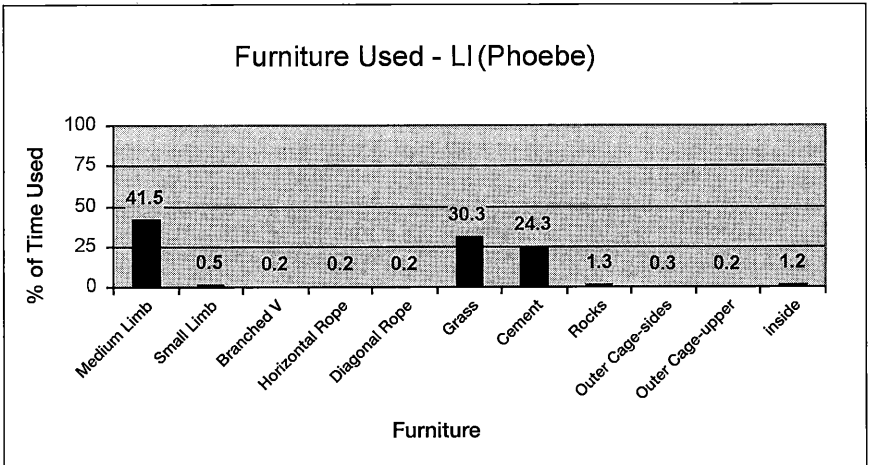


**Figure 5.** Percent of time specific behaviors were displayed by R1-R3 (ring-tailed lemurs (*Lemur catta*)) at Bramble Park Zoo, summer 2004. A time sampling method of 1 minute was used to gather data.



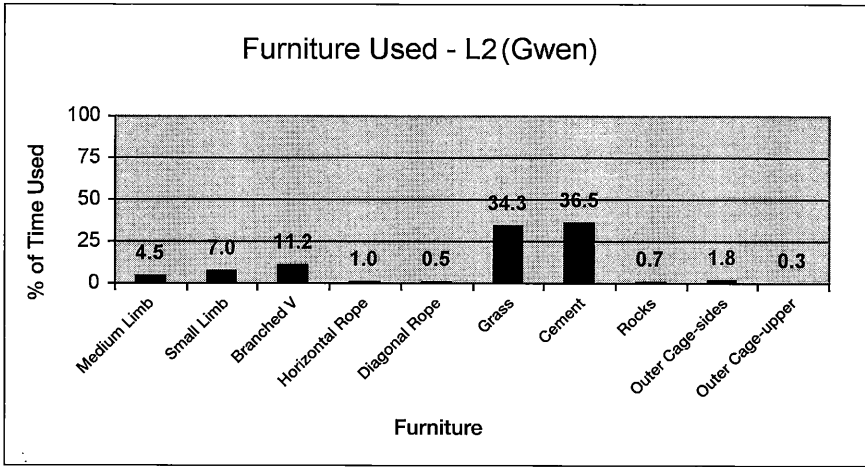
Wild black and white ruffed lemurs spend about 44% of their day resting, 30% feeding and foraging, 17% traveling, and 9% involved in social interactions, such as grooming, scent marking and vocalization (McLennan and Pappas, 2003a). Studies at Berenty Reserve in Madagascar found that wild ring-tailed lemurs spend about 31% of the day foraging, 50% resting (including grooming), and 13% traveling (Kieth-Lucas et al., 1999). Wild ring-tailed lemurs spend around 40% of their day on the ground, during which they are mostly active, either searching for food or traveling through their territory (McLennan and Pappas, 2003b).

L1 and L2 spent most of their time on the ground in the exhibit (54.6% and 70.8%) (Figure 6 & 7). L1 also spent a significant portion of time (41.5%) on a specific medium limb of the tree. The furniture used most by R1-R3 (Figure 8) was the tree (47.8% on the large limb), and only 30% of their time was spent on the ground. Each piece of furniture or area in the exhibit was utilized by the lemurs to some extent, except for the vertical rope, which was never used during the 600 minutes of observation time.

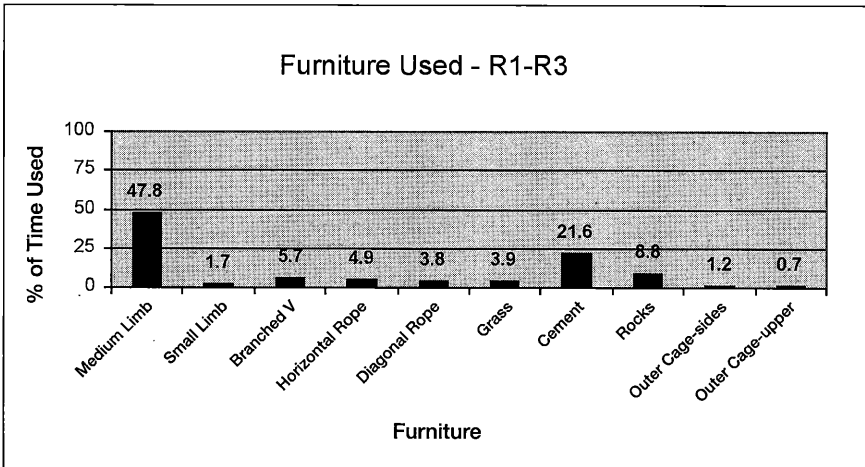


**Figure 6.** Percent of time exhibit furniture was used by L1 (black and white ruffed lemur Phoebe (*Varecia variegata*)) at Bramble Park Zoo, summer 2004. A time sampling method of 1 minute was used to gather data.

\*Note: Phoebe was Inside 1.2% of the observation time



**Figure 7.** Percent of time exhibit furniture was used by L2 (black and white ruffed lemur Gwen (*Varecia variegata*)) at Bramble Park Zoo, summer 2004. A time sampling method of 1 minute was used to gather data.



**Figure 8.** Percent of time exhibit furniture was used by R1-R3 (ring-tailed lemurs (*Lemur catta*)) at Bramble Park Zoo, summer 2004. A time sampling method of 1 minute was used to gather data.

## DISCUSSION

Both lemur species spent most of the time resting, while only a small portion of their time was spent displaying locomotion behaviors and foraging or feeding behaviors. Wild lemurs generally spend more time feeding, foraging and traveling, and less time resting, than I observed for the captive lemurs at the zoo. L1 spent more time resting than the other lemurs; however, in her case this does not appear to be out of the ordinary given her age (29 years old). The average life span for this species of lemur is between 15-20 years in the wild and around 20 years in captivity (McLennan and Pappas, 2003a). L2 also spent a slightly more time resting than wild lemurs, which also may be due to her age (17 years). In comparison with the data for wild black and white ruffed lemurs, the foraging/feeding and traveling (locomotion) of the captive lemurs were considerably different. However, the time spent displaying social interactions (grooming) in L1 and L2 was similar to that of wild lemurs. For both L1 and L2, behaviors other than resting were displayed more often on the ground than in the tree.

R1-R3 spent a large percentage of time resting, but spent more time grooming than L1 or L2. In most cases, this grooming was reciprocal grooming between two or all three of the lemurs, unlike L1 and L2 in which the grooming was largely self-grooming. In comparison to data for wild ring-tailed lemurs, the captive lemurs spent more time resting (including grooming) and much less time foraging. The percentage of time spent moving around the exhibit (traveling) was also less than that in the wild lemurs. R1-R3 spent almost half of the study time on top of the one large tree limb (this limb was never used by the ruffed lemurs during the observational period), and around 30% of their time on the ground, which correlates fairly closely to data from the Duke Primate Center. However, only a small percentage of their time spent on the ground was spent foraging or moving around (locomotion behaviors).

## CONCLUSION

The differences between the observed behaviors of the two captive species of lemurs compared to the activity budgets for these species in the wild indicate that changes in the layout of exhibit furniture could be made in an attempt to promote more natural behaviors. Several studies have shown that more natural environments, such as island exhibits, enable and encourage lemur species to exhibit more natural behaviors (Britt, 1997; Kieth et al., 1999; Kerridge, 1997). Currently, the only branches available to lemurs are on the tree and most extend to the top of the exhibit and are fairly similar in dimension. It may be beneficial to change the branches to a more complex and natural arrangement that mimics the three-dimensional complexity of a tree canopy. The feeding methods could also be altered to promote more natural behaviors, such as locomotion and feeding, since there is little ground area available in the exhibit. Generally at the zoo, food is placed in a pile on the grass or cement, which does not encourage much foraging behavior. Possible food presentation methods could include hanging individual food items or baskets of food from branches and ropes at various heights, hiding food in

crevices of branches and elsewhere in the exhibit, and placing or planting browse in the enclosure (Elder, Primate Zookeeper, St. Paul's Como Zoo, written communication). These ideas for furniture modifications and food presentation may be advantageous in promoting more natural behaviors in the two species of lemurs at the Bramble Park Zoo, and may be especially helpful in decreasing the amount of time spent resting.

## ACKNOWLEDGEMENTS

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