JOURNAL OF UNDERGRADUATE RESEARCH

Activity Patterns of Howler Monkeys in Captivity

Grant A. Dougherty

College of Liberal Arts and Sciences, University of Florida

Dr. Stephanie Bogart, Department of Anthropology

Abstract

Howler monkeys are a diurnal genus of New World monkey whose diet may impact their activity patterns. This study investigates this potential relationship by examining the activity patterns of black howler monkeys in captivity, where food is readily available, and whether this relationship is similar to existing data from wild populations of howler monkeys. Captive howler monkeys were found to spend 77.2% of their time resting, 7.0% foraging or feeding, and 13.2% traveling or locomoting. When compared to wild specimens, these findings suggest that captivity and easy access to food are associated with more time resting and less time feeding or foraging, with its effects on traveling and locomotion being inconclusive. This research sheds new light on both the impact of the environment on primate behavior and the welfare of primates in captivity. Future research should focus on investigating the effects of food accessibility on other primates in captivity to better understand how it influences their behavior and improve standards of captive primate care.

Keywords: howler monkey, primate, food access, behavior, diet, captivity

Introduction

Black howler monkeys (*Alouatta caraya*), also known as black-and-gold howler monkeys, are a diurnal species of New World monkey indigenous to the forests of central South America in Paraguay, southern Brazil, northern Argentina, and eastern Bolivia (Bicca-Marques, 2020). Howler monkeys spend most of their time in the trees, using quadrupedal locomotion to move across the tops of branches (“Black Howler Monkey”, 2018). A prehensile tail is a derived characteristic in this clade, which it uses like a fifth limb as it climbs and travels through the trees (“Black Howler Monkey”, 2018). Distinguishing them from all other genera of New World monkeys, howler monkeys are primarily folivorous, eating mostly leaves in addition to things like fruits, nuts, and flowers (Chiarello, 1993).

Influencing Factors on Activity

Howler monkeys are among the least active of the New World monkeys, spending as much as 70% of their day resting according to a report from the International Union for Conservation of Nature (Bicca-Marques, 2020). For comparison, spider monkeys, fellow members of the *Atelidae* family, spend anywhere from 24% to 63% of their time resting (Wallace, 2001). Wild capuchins, another New World monkey, spend anywhere from 4% to 25% of their time resting depending on the population studied (De Oliveira et al., 2014). Brown howler monkeys (*Alouatta guariba*) have been found to spend approximately 59% of their time resting (Jung et al., 2015). Guatemalan black howlers (*Alouatta pigra*) are found to spend on average 66% of their time resting, although this can be as high as 80% (Pavelka & Knopff, 2004). Black howler monkeys, the species of interest in this research, were found to spend somewhere between 58% to 66% of their time resting in the forests of northern Argentina (De Leon, 2019).

Research indicates that howler monkey diet and food quality may influence their behavior. It is traditionally understood that the inactivity of howlers that distinguish them from other New World monkeys may be a result of their equally unique folivorous diet of low-quality leaves (Bicca-Marques, 2020). This assumption has been disputed by researchers who found that howler monkeys in Belize that transitioned from a primarily florivorous diet to a higher quality frugivorous diet made no appreciable change in overall behavior (Pavelka & Knopff, 2004). Research from Argentina, however, found that higher leaf consumption was associated with increased resting time among howlers, supporting the traditional understanding of the matter (De Leon, 2019).

Research further suggests that habitat and access to food may impact primate behavioral patterns. Brown howler monkeys in harsh environments with limited access to food were observed to spend less time resting and more time traveling and feeding compared to those in less harsh habitats (Jung et al., 2015). Additionally, capuchins were found to be less active in captivity, spending less time foraging and feeding than their wild counterparts (Ross & Giller, 1988). Due to their relatively easy access to high-quality food, captive populations of howler monkeys may serve as an important source of information to better understand the relationship between food access and activity patterns. Spider monkeys in captivity were found to spend more time resting, less time foraging or feeding, and about as much time or more locomoting compared to their wild counterparts (Hargrave, 2019). Though there is research on the activity of several other primate species in captivity, there is currently a dearth of research on captive

howler monkey behavior. In this study, direct behavioral observations of captive black howler monkeys were collected to compare to wild populations using quantitative benchmarks based on wild howler monkey behavioral data from Jung et al. (2015). This study expects black howler monkeys in captivity to display behavioral patterns similar to those of their counterparts in less harsh habitats in the wild. Studying captive primates, especially those that may have received less attention in the literature, can help us better understand these animals in a variety of different contexts.

Methods

All observations for this research were conducted at Brevard Public Zoo on two black howler monkeys housed together, one female named "Maddie" and one male named "Stormy". Subjects were physically observed and were not video-recorded for this research. This research used instantaneous focal sampling, recording behaviors at thirty-second intervals during fifteen-minute samples for a total of thirty-one recordings per sample (Martin & Bateson, 2007, p. 53). If the focal subject was out of view for over seven consecutive minutes of instantaneous observations within a given focal sample, then the data were discarded and focus was shifted to the other subject if in view. All data were recorded during March of 2021 over a total of six separate days.

Data collection was distributed at different times of the day to ensure that a wide range of howler monkey behavior was observed. A total of four (female N = 2, male N = 2) focal samples were collected each of the six days. There were twelve focal samples (three hours) of recorded observations for each focal subject, or twenty-four focal samples (six hours) in total for the howler pair. An ethogram was created which defined how all observed howler monkey behavior was to be categorized and recorded (Table 1). All observations were taken by a single person, precluding the possibility of determining inter-observer reliability.

Table 1. Ethogram for recording black howler monkey behavior.

Behavior	Description
Foraging/Feeding	Eating, chewing, picking at, or possessing food.
Resting	Remaining in one place unless some other action is taking place like foraging/feeding, social interaction, etc. Howler monkeys scratching themselves or moving somewhat

	while remaining in one place are included as rest.
Locomotion/Travel	Includes instances when howler monkeys move from one point or location to another including climbing, knuckle-walking, and similar movement.
Social – Grooming	Instances when howler monkeys groom each other. Does not include self-grooming or self-scratching.
Social – Other	All social interactions between howler monkeys besides grooming fall under this category, including aggression.
Out of View	Not visible for observation, including partial visibility where it is impossible to determine their behavior because of an obfuscated view.
Other	All other actions or behaviors.

These data were analyzed to create an activity budget, test the hypothesis, and compare the results to other studies on howler monkey behavior. Student's *t*-tests were used to determine whether the differences between the results and the benchmarks laid out in the hypothesis were statistically significant. Specifically, black howler monkeys were expected to spend 60.0% or more of their time resting, 16.0% or less of their time foraging and feeding, and 15.0% or less of their time traveling or locomoting (see Jung et al., 2015).

Results

The captive Brevard monkeys showed similar behavioral patterns to wild howler monkeys in less harsh environments. Captive howler monkeys were expected to spend upwards of 60.0% of their time resting and were found to spend 77.2 ± 5.3% of their time resting (Table 2). Additionally, the Brevard monkeys spent 13.2 ± 3.0% locomoting or traveling and 7.0 ± 2.7% of their time foraging or feeding (Table 2). For both resting as well as foraging and feeding, the difference between the measured data and their respective benchmarks were both statistically significant and exceeded the standard error. The difference in time of traveling and locomotion from its benchmark was not statistically significant nor did it exceed the standard error.

The female and male howler monkeys spent approximately the same amount foraging and feeding (Table 2). However, the male subject was somewhat more active, spending 18.8% of his

time locomoting compared to 7.5% for the female, and only spent 69.6% of his time resting compared to 84.7% for the female.

Table 2. Black howler monkey activity budget (N = 24). Activity budgets at different times include data collected from both monkeys. Activity budgets of individual monkeys include data collected at all times. Overall ± SE are averages of all collected data plus or minus their respective standard error values.

	Foraging/Feeding %	Resting %	Locomotion/Travel %	Grooming %	Social – Other %	Other %
8 - 10 AM	4.0	70.2	23.4	0.0	0.0	2.0
10 AM - 12 PM	0.0	95.2	4.0	0.0	0.0	0.8
12 - 2 PM	5.6	83.1	4.0	0.0	0.0	1.6
2 – 4 PM	25.8	53.2	17.7	0.0	0.0	0.0
4 - 5 PM	2.4	91.1	6.5	0.0	0.0	0.0
Maddie (F)	6.7	84.7	7.5	0.0	0.0	0.8
Stormy (M)	7.3	69.6	18.8	0.0	0.0	1.3
Overall ± SE	7.0 ± 2.7	77.2 ± 5.3	13.2 ± 3.0	0.0 ± 0	0.0 ± 0.0	1.1 ± 0.4
SD	13	26	15	0	0	2

The activity of howler monkeys waxed and waned through the day. Figure 1 indicates the howler monkeys were most active between 2:00-4:00 PM, with only about half of their time spent resting. They were least active between 10:00 AM to 12:00 PM, spending 95.2% of their time resting (Figure 1). The howler monkeys are fed between 9:00-10:00 AM and 2:00-3:00 PM, and occasionally fed between 7:00-8:00 AM. Feeding times corresponded to when the howler monkeys were generally most active, particularly when they were reported foraging and feeding. Feeding behaviors were also reported outside these times, when they would interact with food enrichments or would pick up and eat leaves. The Brevard howlers were fed a combination of leafy greens and fruit.

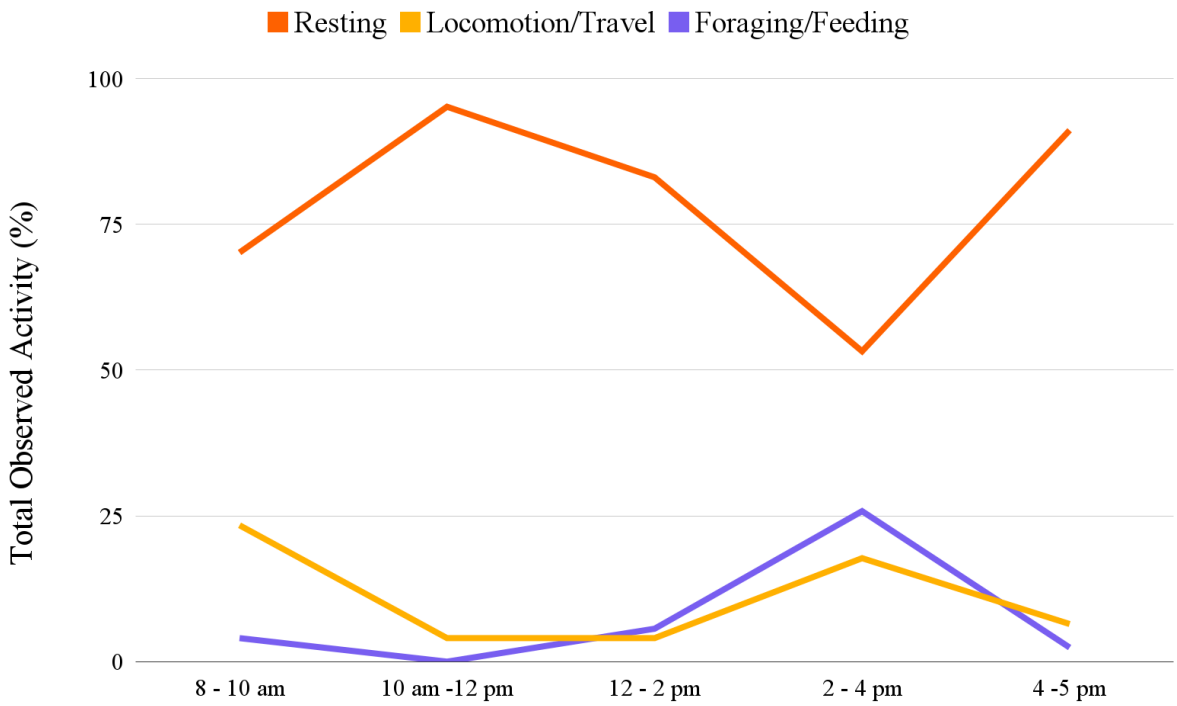

Figure 1. Total observed howler monkey daily activity (N = 24; orange = resting; yellow = locomotion/travel; purple = foraging/feeding).

Discussion

The results support the hypothesis that black howler monkeys in captivity will display behaviors similar to that of howler monkeys in less harsh habitats in the wild. Howler monkeys were expected to spend upwards of 60.0% of their time resting and were found to spend 77.2 ± 5.3% of their time resting. The Brevard monkeys were recorded to have only spent 7.0 ± 2.7% of their time foraging or feeding, meeting the 16.0% threshold. The difference in times for resting as well as foraging and feeding from their respective benchmarks in the hypothesis were found to be statistically significant using *t*-tests. Howlers were expected to spend less than 15.0% of their time locomoting or traveling which was observed to be 13.2 ± 3.0%. This difference was not found to be statistically significant using a *t*-test, making the results inconclusive.

The Brevard black howler monkeys spent higher than the average rate of resting compared howler monkey populations from the literature referenced in this paper, which generally varied from 58% to 70% (De Leon, 2019; Bicca-Marques, 2020). This may indicate that food accessibility, and captivity more broadly, can cause howler monkeys to display more sedentary

behavior. That being said, the degree of inactivity found among the study group in captivity may not be wholly uncharacteristic of their wild counterparts, as it is similar to the resting rates found among some Guatemalan black howlers which can be as high as 80% (Pavelka & Knopff, 2004). The results of this study are in line with findings from research on Black-handed spider monkeys in captivity, which found captive spider monkeys spend more time resting, less time foraging or feeding, and about the same amount of time locomoting compared to their wild counterparts (Hargrave, 2019). The small group size at Brevard Zoo may explain the apparent lack of social behavior observed in the study subjects when compared to their wild counterparts (Jung et al., 2015). Enrichment and feeding schedules likely play an important role in the activity patterns of the captive howler monkeys, particularly what times of the day they engage in foraging and feeding. Strategies to increase time spent foraging and socializing could be employed to better emulate conditions howler monkeys experience in the wild.

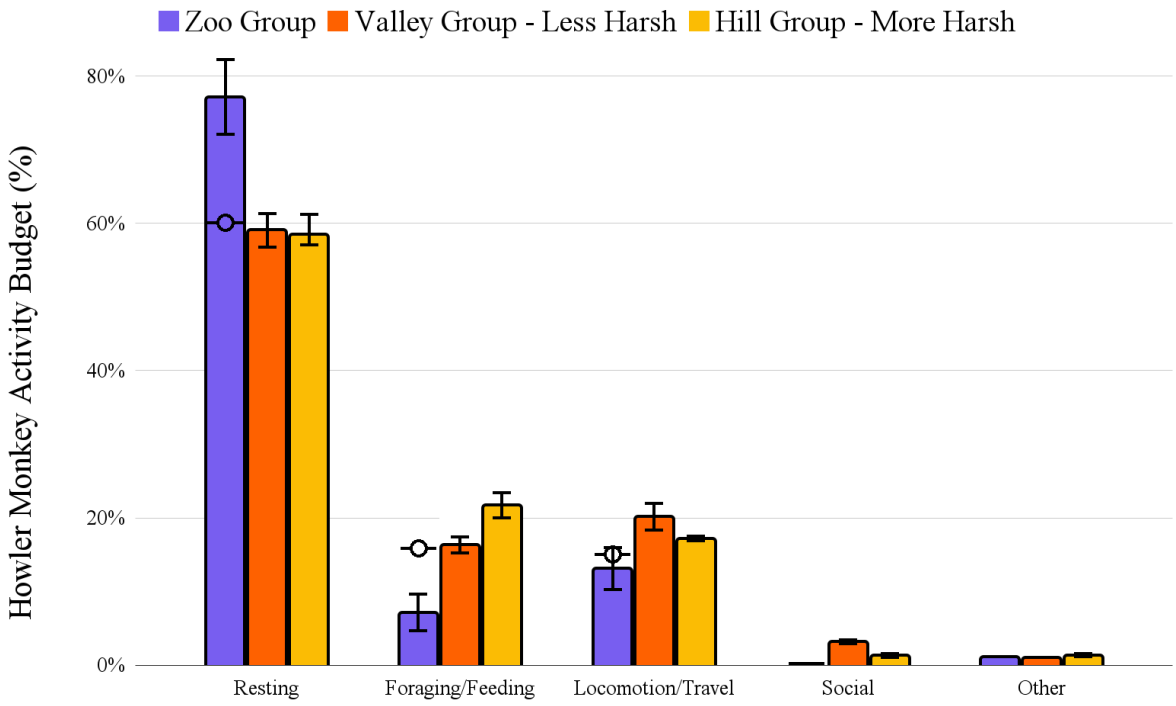

Figure 2. Captive black howler monkey activity budget (N = 24; purple) compared with wild howler monkeys from Jung et al. (2015). The "valley group" (orange) lived in a valley bottom where high-quality food was readily accessible while the "hill group" (yellow) resided in a harsher hillside environment where high-quality food was less accessible. Standard error bars are

shown and horizontal lines superimposed with a circle indicate the benchmarks from the hypothesis.

Limitations

This research was limited to only twenty-four focal samples (six hours) of observed behavior. The focus was on two individuals, making it difficult to generalize the results to the entire captive population, species, or genus. Inter-observer reliability could not be determined because there was only one observer. The scope of observation time for the howler monkeys was limited by the hours that the zoo was open. Differences in methods of data collection between this study and others on the subject limited the ability to compare results on howler monkey activity. In the case of research from Jung et al., data were collected using five-minute scans (scan sampling method) punctuated by fifteen-minute intervals done from as early as 5:15AM to as late as 6:15 PM (2015). This study used instantaneous focal sampling across fifteen-minute intervals done from as early as 8:00 AM to as late as 5:00 PM. This information should be considered when making comparisons between this research and pre-existing literature on the subject.

Conclusion

There is a relationship between the accessibility of food and the frequency and patterns of behavior of black howler monkeys. In captivity, these monkeys were found to spend more time resting and less time feeding or foraging than their wild counterparts, paralleling how howlers behave in less harsh habitats in the wild. This paper builds upon previous studies that found that howler monkeys with relatively easy access to food will spend more time resting and less time foraging. Future research should be done on the impact of food accessibility on howler monkeys and other primates in captivity. Such research should consider other factors of captivity that may impact primate activity including number of group members, climatic conditions, and size of enclosure. The impact of food accessibility and the broader effects of captivity are concerns researchers should seek to address not only for howler monkeys or primates, but for all animals kept in zoos.

Acknowledgements

Many thanks to Dr. Stephanie Bogart for her mentorship and Dr. Darby Proctor from the Florida Institute of Technology Department of Psychology for whom I was in association with during this research. Many thanks also to the Brevard Public Zoo for allowing me to conduct my

research and Director Kathleen Nichols for coordinating these arrangements and giving key information about the zoo.

References

Martin, P. R., & Bateson, P. P. G. (2007). Recording Methods. In *Measuring Behaviour: An Introductory Guide* (3rd ed., pp. 53–53). essay, Cambridge University Press.

Bicca-Marques, J. C., Alves, S. L., & Boubli, J. P. (2020). *Alouatta caraya, Black-and-gold Howler Monkey* (pp. 1-16, Rep.). International Union for Conservation of Nature.

Black howler monkey. Smithsonian's National Zoo. (2018, June 27). Retrieved February 24, 2021, from https://nationalzoo.si.edu/animals/black-Howler-monkey

Chiarello, A. G. (1993). Activity Pattern of the Brown Howler Monkey *Alouatta fusca*, Geoffroy 1812, in a forest fragment of southeastern Brazil. *Primates, 34*(3), 289-293. doi:10.1007/bf02382623

De Leon, C. R. (2019). *Ranging and Behavior of Black and Gold Howler Monkeys in Formosa, Argentina* (pp. 1-36, Publication). Library Map Prize.

De Oliveira, S. G., Lynch Alfaro, J. W., & Veiga, L. M. (2014). Activity Budget, Diet, and Habitat Use in the Critically Endangered Ka'apor Capuchin Monkey (Cebus kaapori) in Pará State, Brazil: A Preliminary Comparison to Other Capuchin Monkeys. *American Journal of Primatology*, *76*(10), 919–931. https://doi.org/10.1002/ajp.22277

Hargrave, Stephanie, "Activity Budgets and Behavior of Captive Black-handed Spider Monkeys (Ateles geoffroyi) at the Central Florida Zoo and Botanical Gardens" (2019) [Undergraduate Thesis, The University of Central Florida]. *Honors Undergraduate Theses*. 518. https://stars.library.ucf.edu/honorstheses/518

Jung, L., Mourthe, I., Grelle, C. E., Strier, K. B., & Boubli, J. P. (2015). Effects of Local Habitat Variation on the Behavioral Ecology of Two Sympatric Groups of Brown Howler Monkey (*Alouatta clamitans*). *PLoS ONE, 10*(7). doi:10.1371/journal.pone.0129789

Pavelka, M. S., & Knopff, K. H. (2004). Diet and Activity in Black Howler Monkeys (*Alouatta pigra*) in Southern Belize: Does Degree of Frugivory Influence Activity level? *Primates, 45*(2), 105-111. doi:10.1007/s10329-003-0072-6

Ross, R. A., & Giller, P. S. (1988). Observations on the activity patterns and social interactions of a captive group of black capped or Brown Capuchin Monkeys (*Cebus apella*). *Primates*, *29*(3), 307–317. https://doi.org/10.1007/bf02380954

Wallace, R. B. (2001). Diurnal activity budgets of black spider monkeys, Ateles Chamek, in a southern Amazonian tropical forest. *Neotropical Primates*, *9*(3), 101–107.