

Project Summary

For my project, Exploring the Relationships Between Stressors and Cortisol in Captive and Wild Sifakas (a type of lemur), my aim was to examine how stressors (e.g., competition over space and resources) influence daily activity budgets (i.e., what the lemurs did in a given day and how often). By coupling my research from the Madagascar study abroad program over the summer with research conducted at the Duke Lemur Center over winter break, I was able to observe behaviors and collect fecal samples from both wild and captive sifakas. My main research questions were 1) How does competitiveness impact the activity budgets and cortisol production of sifakas between environments (wild vs. captive)? 2) How does competitiveness impact the activity budgets and cortisol production of sifakas within environments (smaller vs. larger groups)? 3) Given the increased responsibility of females (e.g., territory defense and nursing/care of infants), there should be a significant difference between the activity budgets and cortisol production between sexes.

Data collection throughout the study was two-fold: behavioral and hormonal. Behavioral data collection consisted of instantaneous sampling of behavior type, height from ground, and nearest neighbor at 5-minute intervals and continuous sampling consisting of the same variables plus the duration of each behavior (measured in seconds). Behavior was divided into 9 separate categories: alert, aggression, feeding, grooming, self-grooming, scent-marking, traveling, resting, and out of sight. Of these 9, alert, aggression, feeding, grooming, self-grooming, and traveling were the behavioral foci because alert, feeding, and travel reflect the competition over resources (e.g., space and food) whereas aggression, grooming, and self-grooming reflect the anti/prosocial behavior that arises out of said competition (or lack thereof). It is important to note that for the category of aggression, any aggressive behavior, even minute (e.g., swatting) was counted in this category. Moreover, in cases of traveling, neither nearest neighbor nor distance from the ground were recorded because in these moments, both are constantly changing. All instances in which subjects were out of sight were not included in analyses.

Hormonal data, specifically cortisol production, was derived from fecal samples collected throughout the study. For the wild sifakas, samples were collected in the field, packaged in aluminum foil, placed in individual zip lock bags, and marked with subject, date, and time of sample. Due to a lack of refrigeration, samples were oven-dried by campfire. Since sample size varied, the drying process ranged from 1 to 3 days. Upon placement in aluminum foil, samples were flattened to hasten the drying process and ensure even hormonal distribution. Wild sifakas yielded 26 samples that were stored until processing in the United States. The captive samples were dried using a Gourmia GFD1650 Food Dehydrator; however, given the consistent heat and smaller feces size, drying lasted only 12 to 18 hours in this setting. The captive sifakas produced 21 samples, producing a total of 47 samples.

Given the different amounts of time observed between the two populations, I examined behaviors (aggression, grooming, self-grooming, feeding, traveling, and alert) as average daily activity budget and the average hourly activity budget per day. All other behaviors were significantly different between wild and captive sifakas (as daily percentages, total daily counts, and average hourly counts) except daily percentage of self-grooming and average feeding counts per hour. These findings mean that captivity affected both the duration and range of behaviors exhibited by the sifakas. Additionally, the behavioral analysis also revealed that the captive sifakas spent more time near one another which is not surprising given their reduced range; however, the two captive groups differed significantly with the amount of time spent directly next to another sifaka. An independent-samples t-test indicated that scores were not significantly different between wild and captive sifakas, $t(45) = 0.113$, $p = 0.91$, $d = 0.03$, nor between sexes, $t(45) = 1.16$, $p = 0.25$, $d = 0.34$. Given these findings, further research is needed to determine if insignificance is due to there truly being no difference between these populations or due to small sample size.

The findings of this study were two-fold, with behavioral and hormonal data yielding contrasting results. While the behavioral analyses demonstrated a meaningful change in the per hour

daily activity budgets of captive lemurs compared to wild lemurs, the hormonal analysis did not show a significant difference in cortisol production between these two groups. The significance of the change in the activity budget, specifically the change in feeding and aggression, reflect the way the captive sifakas were fed. This group quickly burned through their food, especially fresh vegetation as opposed to their dried food, referred to as 'monkey chow,' and the bouts of aggression reflect the occasional dispute over which individual gets to eat the fresh vegetation, with males often approaching females for want of their food and females responding with hostility.

The hormonal analysis did not show significant differences in cortisol production between environments and sexes. These results are due to a small sample size ($n = 47$). It is worth noting that the results were approaching a trend ($p = 0.25$) for a difference between sexes despite this small sample size. These findings coincide with past literature, which found a trend for sex in cortisol production. Clearly, when considering the meaningful change in behavior between these two groups and the possibility of a difference in hormone production between sexes, further research is necessary to determine the relationships between activity budget and hormone production.

Accomplishments

Overall, I feel that I accomplished my goals. While my project had its own specific goals/hypotheses, my overarching goal was to create a project that was fun, challenging, and rewarding. My main accomplishment was to complete a project that fulfilled my requirements for Anthropology Department Honors and a capstone project for University Honors, in addition to another capstone project for my Psychology major. This project fulfilled both goals, which was incredibly rewarding, and I take immense pride in accomplishment. Furthermore, according to Dr. Cisneros in the Honors Program, I am the only person to do two capstone projects, so I am especially proud of this task. Although it obvious, performing these tasks was incredibly challenging, especially with multiple deadlines soon approaching and finals just around the corner. Another aspect that made the project challenging was waiting for the cortisol analysis; however, the Endocrinology Lab at Brookfield Zoo

was incredibly accommodating, and I would not be able to accomplish my goals without their support, so I am immensely indebted to their staff, especially Jocelyn Bryant, the head of the Endocrinology Lab.

As for the last goal of being fun, this project also accomplished that task as well. I appreciate the opportunity to take my education in my own hands and expand my education beyond that of the classroom. Additionally, through my study abroad program, I had countless experiences that I will always remember and carry with me throughout my life. In the beginning of our field school, we took part in lectures at the University of Antananarivo and witnessed the world's largest collection of subfossils. After this, we spent ten days at Drs. Irwin and Samonds' study site following lemur groups and recording their behaviors working alongside three Malagasy students working on their master's degrees. While I must admit, this was not an easy task, but it was incredibly rewarding. We also visited two different zoos and got to witness lemurs in an up-close and personal setting. The last day of field work consisted of digging for subfossils and while this was not the focus of my research, it was a cool opportunity and one most Anthropology students could only imagine. Personally, the research I conducted in Madagascar taught me a great deal about the day-to-day lifestyle of sifakas and it acted as a pilot study for my Senior Honors Thesis/SEF project.

However, while all of this was incredibly insightful and educational for me, it will not be the one thing that resonates with me the longest. No, for me the one thing I will always remember was the day we spent handing out vitamins and clothes to the families of our Malagasy guides and members of the surrounding communities. It felt great to show our appreciation to the families of those that assisted us with our research. It also made me more aware of all the privileges we have here in the U.S. and grateful that we could help those that do not have the same privileges and opportunities. The look on those grateful women and children will follow me wherever I go and makes me happy that I took part in just a small part of all the philanthropy Drs. Irwin and Samonds conduct through their NGO, Sadabe.

Lastly, having the chance to conduct research at the world-renowned Duke Lemur Center was incredibly rewarding and educational. The research team was experienced in working with students to accomplish their personal research goals, although having an undergrad conduct research was slightly less common. Dr. Erin Ehmke and Erin Shaw were vital in me being able to conduct my research and they both made the process incredibly easy. It was an interesting change of pace to show up at a new location and be permitted to conduct research with little direct supervision. I found the whole experience new and exciting. So, again, I would like to thank OSEEL for assisting in my funding for this project. I could not have been able to have all these wonderful experiences in Madagascar and at the Duke Lemur Center without the assistance of OSEEL and I hope that your organization can help future students achieve their dreams of traveling abroad as you have with mine.

Impact of the SEF

The SEF made my research possible and it gave me vital insight into how funding and research is conducted in the 'real world' so to speak. Going through the SEF process taught me about the importance of protocol, namely going through the processes of SEF approval, IACUC approval, laboratory training for the Office of Research Compliance, and the bimonthly updates for OSEEL taught me that no process of conducting research is ever easy, but it also taught me that these means make the result that much more rewarding.

Lastly, I would like to thank all the people that made my research possible in addition to the SEF. I would like to thank Dr. Mitchell Irwin, Dr. Karen Samonds, and Jean-Luc Raharison for their continued efforts of conservation, education, and philanthropy through their organization, Sadabe. I would like to thank my guides, Benja and Maro, for assisting with wild data collection. I would like to thank Dr. Erin Ehmke and Erin Shaw for facilitating with research at Duke University. Finally, my research was made possible through the NIU Study Abroad Program and the NIU Student Engagement Fund by means of the Kitterle Memorial Scholarship. Again, thank you so much for this unique opportunity.