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Research Article

Social Behavior and Personality Patterns of Captive African Elephants

—Alison Jeffrey

When I was young, I had a holographic trading card of a cheetah with facts about the species on the back. As I moved the card, the cheetah appeared to sprint through the lush grass, which fascinated me. That was probably my first exposure to any wild animals. I grew up in a city, but quickly fell in love with the local zoo. Years later, I decided to major in biomedical science at the University of New Hampshire because I was intrigued by anatomy and physiology. I learned about the different health professions I could pursue and discovered the vast number of possibilities that the veterinary profession offers: how many different species I could work with, the disciplines I could specialize in, and the places I could go.

During the summer after my sophomore year, I found myself back at a zoo, this time on the other side of the fence as an intern at Southwick's Zoo in Mendon, Massachusetts, caring for the animals and educating visitors about them. Poppy, the African pygmy hedgehog, and Pickles, the African crested porcupine, quickly became my favorites. Working with these species further fueled my lifelong dream of visiting the wilds of Africa—a dream that came true in the summer of 2016.

Through the Hamel Center for Undergraduate Research, I received an International Research Opportunities Program (IROP) grant to study African elephants (*Loxodonta africana*) in South Africa. My study posed two main questions about the social behaviors of a herd of captive elephants: 1. How do social behaviors among captive elephants vary throughout the day on an hourly time scale, and how is this related to age? 2. Are handler perceptions of elephant personality an accurate predictor of social behavior?

My research took place in the western cape of South Africa with the African Elephant Research Unit (AERU) at Knysna Elephant Park (KEP). The



The author recording notes at the AERU.

role of AERU is to conduct behavioral and physiological research to influence the best management of captive elephants, so my research goals aligned well with the organization.

My initial travels to Africa spanned three days and two nights. I said goodbye to my parents amid a river of tears in Boston and slept the night over the Atlantic. After a nine-hour layover in Germany, I boarded another plane for South Africa. I didn't sleep a wink that night, but I did get to watch the stars turn into a sunrise. When the plane's map showed that we were flying over the Sahara Desert, I was so excited that I cried. Once I landed, it was a two-hour drive to what would be my home for nine weeks. I was beyond exhausted, but the combination of ocean, mountains, palm trees, and pine trees all in the same place, side by side, blew my mind. It took me a whole week to recover from the jet lag, but I could not have chosen a more welcoming place to spend the summer. The volunteers at the elephant park greeted me with big smiles and offers to carry in luggage. All I wanted to do was sleep, but before I did, I got to watch the "ellies" come home for the night, backdropped against the most vibrant sunset I had ever seen.

Social Behavior in African Elephants

African elephants are native to many parts of Africa, including South Africa. However, due to the expansion of human populations and habitat destruction, the land available to elephants has been greatly diminished. Many national parks have been established to offer elephants a safe place to live in an effort to preserve the vulnerable species. Furthermore, private parks, such as KEP, allow people to visit and interact with free-roaming elephants. KEP provides about 200 acres for the elephants to roam and perform natural behaviors, with the central goal of someday returning them to the wild. Trained handlers accompany the elephants throughout the day at KEP in order to keep volunteers and tourists safe when they are close to these large, wild animals.

In the wild, elephants live in family groupings of a dozen or more individuals, made up of related females and young males (Shulte 2006; Vidya and Sukumar 2005). The oldest female in the family acts as the matriarch and guides the other adults and offspring in daily life and in times of hardship (McComb et al. 2001). After males reach young adulthood, between nine and eighteen years of age, they leave the family herd to roam with bachelor herds of mature bulls. The females remain with the herd through maturity (Vidya and Sukumar 2005).



A group of elephants socialize at the African Elephant Research Unit (AERU), near Knysna, South Africa.

Elephants typically have very strong social bonds within and among these family groups (Moss and Poole 1983). Individuals interact often within groups, and do so particularly through play behaviors between all ages. Chasing, mounting, wrestling, and sparring are all considered to be part of play behavior (Lee 1986). When closely bonded elephants are separated, even for brief periods of time, upon being reunited they display very intense greeting

ceremonies, which involve lots of trunk interactions, vocalizations, urination, defecation, and secretion from their temporal glands, which are small glands unique to elephants located on either side of the head between the eyes and ears (Moss and Poole 1983). Young adult females rely on older adults to learn mothering skills and they often help to care for the younger calves (Douglas-Hamilton 1972).

Affiliative, or friendly, social interactions, such as one elephant touching its trunk to another, occur mostly between mother and offspring or between calves, and these interactions typically peak during the early morning, midafternoon, and early evening hours (Horback et al. 2014). Along with affiliative interactions, less frequent agonistic, or hostile, interactions do occur through playful, competitive, or dominant displays of aggression (Douglas-Hamilton 1972). Agonistic behaviors, such as one elephant charging at another, are typically used by older adults to assert their dominance (Lee 1986), or between young calves or juveniles (Horback et al. 2014). As elephants mature, males more frequently perform agonistic social behaviors than females (Douglas-Hamilton 1972). Agonistic social interactions between any age and sex class occur most often in the early morning and late evening hours (Horback et al. 2014).

The social interactions and dominance hierarchy between individuals of a herd depend upon many factors, including maternal lineage, age, sex, and personality traits of the elephants, or, in other words, the characteristics that each elephant portrays. A personality is made up of qualities such as leadership, playfulness, gentleness, popularity, and predictability of each elephant (Lee and Moss 2012). In previous studies, human evaluation of personality traits indicated that the presence of certain traits was predictive of specific social behaviors in wild African elephants and captive African elephants in America (Freeman et al. 2010; Lee and Moss 2012). In other words, elephants of certain personality types could be predicted to interact with other elephants in certain patterns. Since elephant behavior is deeply rooted in sociality, the overall herd dynamic would be dependent upon the personalities of individual elephants in the herd.

Captive elephant herds are usually composed of fewer, unrelated elephants, with a skew towards older adults (Shulte 2000). Even if there is not a matriarch, the herd typically has a dominance hierarchy based on the size, age, temperament, and experience of each elephant (Shulte 2006). This was true at KEP, as the study herd was comprised of five unrelated elephants and just one mother-daughter pair. All elephants either were rescued from the wild after cull operations or injuries, or were born to elephants already living at KEP. The oldest female in the study herd was, at just twenty-six year old, a young matriarch, compared to the age of the matriarch in most wild herds.

Based on previously published research, I hypothesized that the rates of socializing across all ages would be greatest in the morning and evening hours and that juvenile elephants would have higher rates of play interactions throughout the day than the young adult and adult elephants. In addition, I hypothesized that there would be a strong positive correlation between the elephant handlers' ratings of reported behavioral tendencies and the frequency and type of observed social behaviors of the captive elephants.

Research Process

After my weeklong orientation, which was run by AERU staff and consisted of training on elephant identification, data collection, and field safety, I collected data four days each week. On these days, I spent about six hours in the field observing the herd of seven elephants. The timing of these observations alternated between “Day A” and “Day B.” Day A observations took place from approximately 9:00 to 11:00 a.m. and 1:00 to 3:00 p.m. Day B observations took place from approximately 11:00 a.m. to 1:00 p.m. and 3:00 to 4:00 p.m. I used this alternating pattern so that I could observe the elephants at all times of day without having to observe for seven consecutive hours. I recorded every time two or more elephants interacted with each other. I spent one day a week entering my data from the previous days into my master data sheet in Microsoft Excel.

The research herd was made up of two adult females (Sally, age 26, and Nandi, 23), two young adult females (Thandi, 12, and Keisha, 12), two juvenile males (Shungu, 9, and Mashudu, 8), and one juvenile female (Thato, 8). During the day, the elephants had controlled free roam of the park, such that they could wander and eat what they wanted to, but the handlers prevented them from going into areas where they might jeopardize the safety of researchers, tourists, and the park boundaries. The elephants interacted with tourists, researchers, volunteers, and handlers between 7:30 a.m. and 5:30 p.m. From 7:30 to 9:00 a.m. and 4:00 to 5:30 p.m., the elephants participated in tourist rides and specific interactions. Thus, I collected data between 9:00 a.m. and 4:00 p.m. when the herd was free roaming.

During data collection, I recorded all the affiliative, agonistic, and ambiguous social interactions and indicated which elephants were involved in each interaction. For each data collection session, I also recorded the location in the park; the temperature, wind speed, and weather conditions; tourist presence; and whether any elephants were out of sight.

For the most part, being out in the field with the other researchers and handlers was enjoyable. We watched the elephants on foot and wherever they went, we followed, even if that meant traipsing through brambles on the side of a hill. We always had a handler with us in the field, so by the end of the summer I got to know them all well, and learned so much about each of their native African cultures. The biggest challenge I faced in collecting data was dealing with the weather, which was cold (with high temperatures usually around 50 degrees Fahrenheit), windy, and often rainy, consistent with the winter season in South Africa. It took almost my entire research period to devise a system to keep my data sheets dry and prevent my ink from running on rainy days. In the end, I purchased a clear poncho that I could put over myself and my clipboard, which worked well to waterproof my data.

When I was not in the field observing the elephants, I surveyed the elephant handlers regarding their perceptions of the elephants’ social behaviors and personality. The handlers were from various African nations, including South Africa, Zimbabwe, and Malawi, and were employed by KEP at the time of survey. Their years of experience working with elephants ranged from 5 to 18 years. The survey (see Appendix) included questions about elephant dominance, activity levels, boldness, confidence, curiosity, sociability, and aggressiveness (Rossman 2015). The survey required each

handler to rank the seven elephants in the herd from least fitting of each personality trait to most fitting. Because most of the handlers were not familiar with using ranking systems, especially to categorize the elephants, this system prevented the guides from ranking all the elephants equally or neutrally. Many of the handlers found it challenging to give each elephant a different rating, because they often felt that multiple elephants were characterized by the same trait equally. However, I encouraged them to fill out the survey exactly as directed in order to get comparable data, and after some reluctance, they all did so.

Daily Social Behavior

The hypothesis that rates of social behavior across all age groups of African elephants would be greatest in the morning and lowest in the afternoon was confirmed. I found that total social behavior rates were highest at 11:00 a.m. and lowest at 2:00 p.m. (Figure 1). However, because I did not measure rates of social behavior later than 4:00 p.m., patterns of social behavior during evening hours were not determined.

The peak in total social behavior at 11:00 a.m. can be explained by the mirroring peak in agonistic behavior at the same time (Figure 2). In addition, the lowest rate of total social behavior at 2:00 p.m. was mirrored by a significantly low rate of agonistic behavior. Affiliative social behavior rates shared a similar peak in the morning at 10:00 a.m. and low in the early afternoon at 12:00 p.m. (Figure 3). These patterns reflect previous studies, which have found that wild African elephants display increased rest and lower levels of activity during midday than in the morning or evening (Guy 1976; Wyatt and Eltringham 1974).

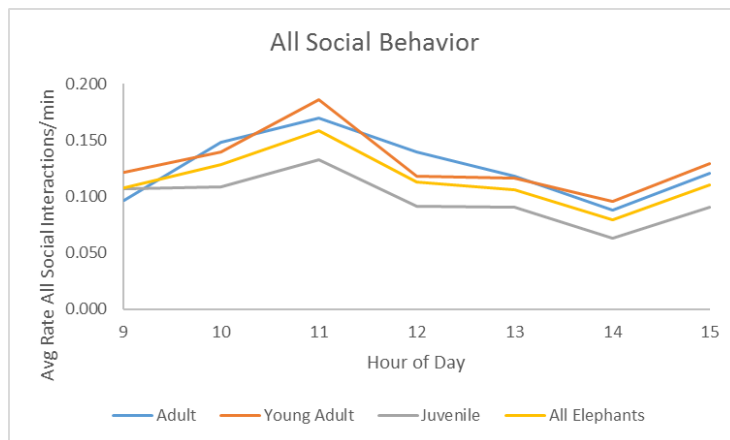


Figure 1. Average rate of total social behaviors during each hour of the day for adult, young adult, and juvenile age groups. Total social behavior rates were highest at 11:00 am and lowest at 2:00 pm.

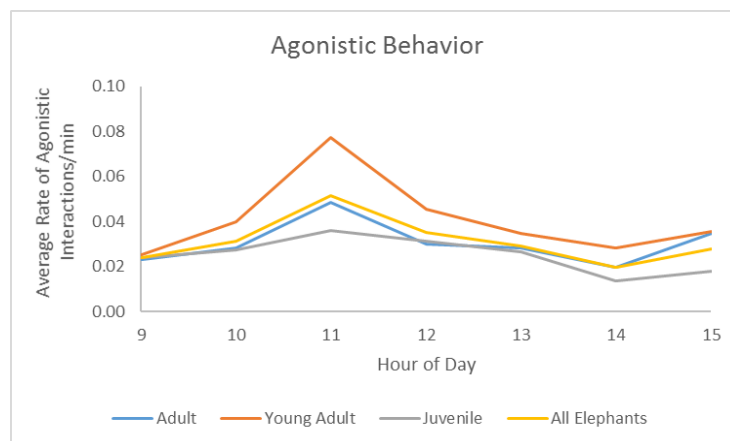


Figure 2: Average rate of agonistic social behaviors during each hour of the day for adult, young adult, and juvenile age groups. Agonistic social behavior rates peaked in the morning at 11:00 am and were lowest in the early afternoon at 2:00 pm. The adult and young adult elephants displayed a higher rate of agonistic social behavior throughout the day than the juvenile elephants.

Although the sample sizes of each age group (juvenile, young adult, and adult) were too small to statistically analyze the difference in social behavior rates between them during the study, several trends can be noted. The adult and young adult elephants displayed a higher rate of both affiliative and agonistic social behavior throughout the day than the juvenile elephants (Figures 2 and 3). The higher rate of agonistic behaviors performed by adults and young adults than by juveniles could be explained by the inclusion of dominance behaviors in the agonistic behavior category. Dominance in the hierarchy of a wild African elephant herd typically follows age and sex order: the oldest females rank highest in dominance, and the youngest males rank lowest (Vidya and Sukumar 2005). Because

the dominance hierarchy is a form of social structure, and therefore requires the initiation of social interactions to maintain, this study data indicates that captive African elephants also maintain this similar dominance hierarchy.

In regard to affiliative behaviors, most positive social interactions between elephants are between a mother and her calf (Horback et al. 2014). The mother-daughter pair of elephants in the study herd were in the adult and young adult age groups, respectively. The higher rate of affiliative behaviors performed by these age groups could be linked to this maternal-offspring bond. In contrast to juveniles' lower rates of affiliative and agonistic social behavior throughout the day, juveniles were observed to initiate play or sparring at the highest rate, followed by young adults, and then adults (Figure 4). This trend is consistent with the observation by Lee and Moss that total time spent playing decreases as elephants age in the wild (2014).

Inherent to the nature of collecting data on living beings, there was no way to collect purely independent data points on the influence of one elephant's behavior on another. Therefore, it was important to look at the influence of the elephants' social behavior on others in the herd. However, according to the data collected, the only strong significant

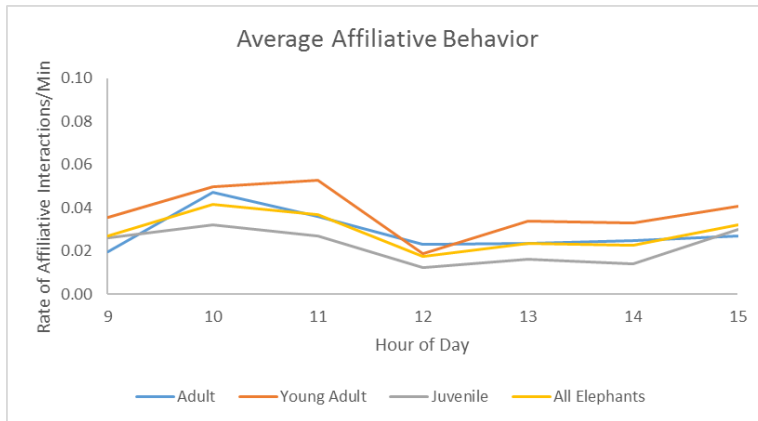


Figure 3: Average rate of affiliative social behaviors during each hour of the day for adult, young adult, and juvenile age groups. Affiliative social behavior rates peaked in the morning at 10:00 am and were lowest in the early afternoon at 12:00 pm. The adult and young adult elephants displayed a higher rate of affiliative social behavior throughout the day than the juvenile elephants.

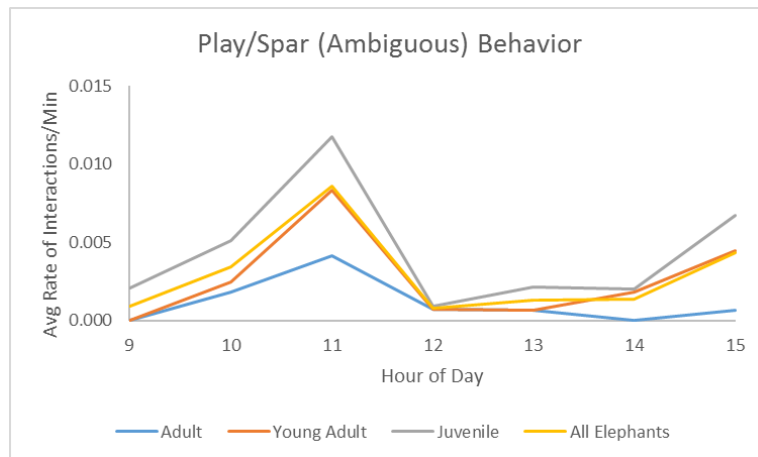


Figure 4: Average rate of play/spar (ambiguous) social behaviors during each hour of the day for adult, young adult, and juvenile age groups. In contrast to juveniles' lower rates of affiliative and agonistic social behavior throughout the day, juveniles were observed to initiate the highest rate of play or spar initiation, followed by young adults, and then adults.

positive correlation between social behaviors exhibited by one individual on another was between the two male juvenile elephants. This suggests that male juvenile elephants are more likely to interact with each other and more likely to influence each other's social behaviors than any other age group. This agrees with the idea that younger elephants, especially young male elephants, tend to play together and interact with peers at a higher rate than with other, non-mother elephants (Lee 1986).

Elephant Personality Survey

My hypothesis that personality ratings by handlers would significantly correlate with observed social behavior was not supported in full. However, there was a statistically significant positive correlation between handler rankings of activity levels and observed agonistic behavior rates. This unexpected result could indicate that elephants that perform more agonistic behaviors are perceived by the elephant handlers as more active. Many agonistic behaviors, such as pushing, charging, displacing, barging, and chasing, do require the elephant to move, whereas many affiliative behaviors, such as trunk interactions, are stationary, which could justify this correlation.

There was also an unexpected statistically significant correlation between exploration, aggressiveness, and dominance survey rankings. Elephants that were ranked highly in one of these personality traits were also likely to be rated highly in the other two. This personality type could be categorized as "dominant." Therefore, it appears that an elephant perceived to have a grouping of particular personality traits can predict a certain overall behavior type in captive African elephants. However, further data about elephant personalities needs to be collected in order to confirm this pattern.

What Does This Mean for the Elephants?

The results of this study give insight into the best management practices for African elephants in captivity, with special consideration for their pattern of social behavior. Since the elephants are most socially active at 11:00 a.m., it is important to allow for maximum social interactions around this time of day by informing handlers so they can be sure to accommodate this during tourist visits. In addition, it is important for a herd of captive African elephants to consist of a wide range of ages, from young to mature adults. This allows the younger elephants to learn discipline and social skills from the older members of the herd. Since maternal-offspring bonds are exceptionally strong, it is important to prevent any separation of related adults and juveniles. It is also beneficial for a captive herd to maintain multiple juveniles together, because when given a choice of which elephants to interact with, juveniles are more likely to initiate interactions with each other than with other age groups.

While working in the field had its disadvantages, the perks of doing this research definitely outweighed them. I worked with many people from South Africa, Zimbabwe, Europe, and different parts of America. Talking to the elephant handlers, volunteers, and other research students during lulls in data recording gave me a unique cultural comparative lesson and opened my mind to many different views of life.

Leaving South Africa in August was just as tear filled as leaving America had been in June. I had made a home at KEP, with a family of amazing people from all over the world, and leaving any home is always hard. Leaving Africa left me with the yearning to return there, and to explore the rest of the world. This project solidified my passion for working with wild animals and for following a career path combining veterinary medicine with wildlife conservation and international travel.

I am beyond thankful for numerous people on the University of New Hampshire (UNH) campus and at AERU in South Africa for helping me to make this research possible. I would not have been able to conduct my research without the support I received from the Hamel Center for Undergraduate Research and the generous IROP grant awarded to me, funded by my donors, Mr. Dana Hamel, Mr. Frank and Ms. Patricia Noonan, and Mr. John and Mrs. Marjorie Beyersdorf. I would like to thank my UNH mentors, Dr. Drew Conroy and Dr. Vanessa Grunkemeyer, who helped me to develop the idea and have supported me throughout this whole project. I am thankful for the mentoring of UNH professor Rebecca Warner during my statistical analysis. I am also grateful to everyone at AERU, especially Clare Padfield and Dr. Debbie Young, for welcoming me to study the elephants at Knysna Elephant Park and supporting me through my research.

Appendix

Elephant personality survey administered to elephant handlers at KEP (adapted from Rossman 2015).

1. List the elephants in order of their status in the hierarchy, or how dominant the elephant is. 7 means this elephant is most dominant (the matriarch), 1 means this elephant is least dominant in the social hierarchy.
2. List the elephants in order of how confident they are in their everyday lives. 7 means this elephant is most confident, 1 means this elephant is least confident (most shy). (Shyness-boldness: "reaction to any risky situation, but not new situations")
3. List the elephants in order of how curious they are about something new. (Something they've never seen before, or a place they've never been before). 7 means this elephant is most curious about new things, 1 means this elephant is least curious about new things, or avoids new things. (Exploration-avoidance: "reaction to a new situation")
4. List the elephants in order of how active they are. (What are their general activity levels, how much do they move around). 7 means this elephant is most active, 1 means this elephant is least active.
5. List the elephants in order of how friendly they are with other elephants, or how much they like to socialize with other elephants. 7 means this elephant is most friendly, 1 means this elephant is least friendly. (Sociability: "reaction to presence or absence of conspecifics")
6. List the elephants in order of their how likely they are to be aggressive towards other elephants. This includes dominance and discipline, but not sparring and playing. 7 means this elephant is most aggressive, 1 means this elephant is least aggressive towards other elephants. (Aggressiveness: "aggressive reactions towards conspecifics")
7. How long have you worked with elephants (total)?
8. Have you worked with elephants anywhere else? If so, where?
9. Do you have more experience with any individual elephants than others?

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Author and Mentor Bios

Alison Jeffrey, a senior from Lincoln, Rhode Island is a biomedical science major concentrating in medical and veterinary sciences. A member of the University Honors Program, Alison will graduate in May 2017 with a bachelor of science degree. After graduation, Alison will attend veterinary school with the long-term goal of practicing wildlife and zoo medicine. Alison "thoroughly enjoyed" her International Research Opportunities Program project during the summer of 2016 and describes her

time living in South Africa as “beyond amazing.” Highlights of her project included making “so many unexpected friendships and connections throughout the whole process” and gaining “the tools to learn more about the behaviors of all types of species.” Alison incorporated her research into her honors thesis and enjoyed the opportunity to write for *Inquiry*, where she could share experiences beyond the formal research. Alison looks forward to presenting her research at the Undergraduate Research Conference at the University of New Hampshire and at the Posters on the Hill conference in Washington, DC.

Vanessa Grunkemeyer is a lecturer in animal science at the University of New Hampshire, where she has worked since 2015. As a veterinary specialist, her training and experience span the medicine and surgery of exotic pet, minor agricultural, zoo, and wildlife species, with expertise in avian medicine and surgery. She has acted as a clinical mentor before, and Alison is her first undergraduate research mentee. Dr. Grunkemeyer enjoyed seeing Alison’s “enthusiasm for both the study and the research process” and found this experience to be a “wonderful introduction” to the many undergraduate research programs offered through the Hamel Center. She views writing for *Inquiry* as a valuable experience for an aspiring veterinarian, noting that “decisions regarding animal care often hinge on how effectively veterinarians can communicate.”

Andrew Conroy, a professor of applied animal science and integrated agriculture within the Thompson School of Applied Science, is in his twenty-eighth year at the University of New Hampshire. Professor Conroy’s specialty is cattle (including beef, dairy, and working oxen) but he has extensive experience with other livestock and with animal handling and behavior. He has conducted research in Africa, including research with pastoral people in Tanzania and in Namibia. In 2008, Professor Conroy spent a year in Namibia as a Fulbright Scholar. While there, he investigated various organizations where international students could do internships or supervised research projects. This knowledge has allowed him to mentor a variety of students. He has mentored sixteen undergraduate researchers since 2003. Dr. Conroy was very impressed by Alison’s “absolute dedication, careful preparation, and willingness to listen to advice.” He notes that her perseverance as she developed her IROP proposal “truly made her stand out in a long line of students who tell me they want to go to Africa.”

Debbie Young and **Clare Padfield**, MSc, mentored Alison at the African Elephant Research Unit (AERU), located near Knysna, South Africa. Dr. Young is AERU’s director, and Ms. Padfield is AERU’s research officer. Alison contacted them when she was looking for a site for her International Research Opportunities Program (IROP) research project for summer 2016. AERU hosts several student researchers each year, so Dr. Young and Ms. Padfield knew just how to help Alison develop her project so that it met her interests and research requirements. Dr. Young oversaw the project, advised on what would be feasible and useful, and provided expert advice on elephant behavior. Ms. Padfield provided “on the ground” support for Alison as she developed her research methods, learned field techniques, and analyzed her data. Both commend Alison’s work at AERU and describe her as “dedicated, thoughtful, and very positive.” They note: “As well as being committed to her project and using her time well, she didn’t hesitate to offer to help with other research tasks and hands-on work whenever she had the opportunity.”