OXFORD
BROOKES
UNIVERSITY

Table of Contents

Letter from the Editors

Welcome to this special issue of the Canopy Journal, dedicated to exploring the invaluable contributions of women in the field of primatology. We celebrate the remarkable achievements, ground-breaking research, and enduring passion of female primatologists worldwide.

Throughout history, women have played pivotal roles in advancing our understanding of primate behaviour, ecology, and conservation. We commend the explementary work of women who have demonstrated their dedication and expertise in studying our closest relatives in the animal kingdom. This includes, but is in no way limited to, the pioneering work of Jane Goodall with chimpanzees in Gombe, the ground-breaking research of Dian Fossey with mountain gorillas, the work of Birutė Galdikas on Orangutans in Borneo, and the extensive research of lemurs in Madagascar by Alison Jolly.

In this issue, we showcase a diverse range of articles written by female primatologists of Oxford Brookes University, ranging from field studies in remote rainforests, to laboratory research, and the invaluable work in non-governmental organizations helping to fight the illegal wildlife trade.

As we reflect on the achievements of the past and look towards the future, we recognize the importance of fostering inclusivity and diversity within our discipline. By amplifying the voices and experiences of women in primatology, we strive to create a more equitable and inclusive scientific community that values and supports all researchers, regardless of gender. We hope that this special issue inspires future generations of researchers to continue pushing the boundaries of knowledge and conservation in the study of primates.

We would like to take this opportunity to thank the incredible women who are teaching the next generation of future primatologists and conservationists, including Professor Anna Nekaris, Dr Magdalena Svensson, Dr Susan Cheyne, and Professor Kate Hill, as well as the PhD students engaged in meaningful projects.

Enjoy exploring the fascinating world of primates through the lens of women in science!

Warm regards,

Lily, Jasmine, Casey and Marie-Laure

Letter from a Lecture

For this issue of Canopy the editors have put together a special issue highlighting and celebrating women in the field of primatology. It is impossible to talk about women in primatology without mentioning the ground breaking trio of primatologists that has become known as the Trimates; Jane Goodall, Dian Fossey, and Birutė Galdikas, as well as our great friend of the OBU Primatology Conservation group, the late Professor Alison Jolly, who was one of the first field primatologists ever. These women continue to inspire young primatologists and conservationists and have since been joined by many incredible female primatologists from around the world. Primatology is nowadays considered a very female dominated field and has been cited as a model discipline of "equal opportunity". The field of primatology indeed has a tradition of strong female role models and when looking at students on primatological degrees globally there tends to be a large majority of women. This can also be observed here at Oxford Brookes University, where since the start of the Primate Conservation MSc/MRes in 2000, we have had almost 600 students enrolled, of which 77% are women. Similar numbers are evident among our PhD students. These women come from 42 different countries, including 18 primate habitat countries, and the impact of their continued work in primatology, conservation and other environmental fields continues to be huge. These alumni have gone on to found their own NGOs and field sites and rescue centres across the world, becoming leading experts in their chosen fields, and campaigners against governments and tirelessly fight for causes such as ending the primate trade. They have expanded into working on conservation for not just primates, but also for example sloths, penguins and civets. You can read more about all the amazing work our alumni has gone on to do here: https://www.facebook.com/media/set/?set=a.1593114874032033&type=3. I am certain that many of the women having passed through our degrees will themselves become an inspiration for future primatologists, and that they will continue to do great work.

All this being said, even if primatology continues to be a heavily women-dominated field this does not mean that it is the perfect model discipline of equal opportunity it is said to be. Globally there may be a majority of female students, but if you look higher up on the career ladder, at professor level, the picture is in general the opposite. There are still many challenges to equality and inclusivity to be tackled, just as in any professional arena.

Reading through the articles put together by the editors for this Canopy issue really highlights the passion and determination of our female students and how many amazing conservationists we have seen coming through Oxford Brookes University. I am very proud of all of them, and I am excited to follow their continued work, and to see them and future primatologist women break through the current glass ceiling for women in primatology.

Dr Magdalena Svensson, Lab Technician and Associate Lecturer

A qualitative study on women in conservation: Menstruation in male-centric sites

Sarah Willits
Cohort 2022-2023
sarah.c.willits@gmail.com

There is strong evidence that women are regularly overlooked and underrepresented in many careers, especially science-based ones (Peng & Jaffe, 1979; Lynch & Nowosenetz, 2009; James *et al.,* 2023). There is a need for better gender equality within these different fields of work, research, and study, including within the discipline of conservation work. There is limited research on the potential problems women experience in conservation-based careers, and it is potentially beneficial to understand what one might expect as a new conservationist entering the field.

I conducted a qualitative study consisting of nine semi-structured interviews with women in conservation between the months of July and August 2023 via Zoom. The participants were selected with a range of different ages and experience levels (Table 1). The aims were to identify similar themes from participant interviews and better understand some of the potential problems that women who work in conservation might encounter.

There were several overlapping themes that the participants discussed in their interviews, resulting in eight commonalities. One such problem–and the focus of this paper–was menstruation in fieldwork settings. Four of the nine participants discussed how field sites were not tailored towards the needs of women and were often focused on the needs of men. A few of the interviewees brought attention to the taboos surrounding menstruation in the field.

This paper focuses on women in the field, but this issue affects more than cisgender women, and the intention is not to exclude other transgender, intersex, or nonbinary individuals who may also struggle from these challenges regarding menstruation (Goldblatt & Steele, 2019). Often these individuals are omitted from the literature, treating menstruation as only a "female experience" (Bobel, 2010; Frank, 2020; Nash, 2023). There is a need to create a more inclusive environment for "menstruators" who do not identify as women (Bobel, 2010; Nash, 2023). For the purpose of this paper, I will use the term women in discussion of menstruation, as the participants identified as women, and I did not interview other "menstruators." This is not to negate the fact that transgender, intersex, and non-binary people exist, and further research should be done on these individuals' experiences and the obstacles they may face as well.

A story shared by participant four demonstrates how there are often stigmas

Table 1. Participants' background information

Participant #	Age (<35 or >35 years)	Experience (<15 or >15 years)	Title	Species Group
1	>35	>15	NGO Director	Primates
2	<35	<15	Principal Research Officer	Freshwater Fish
3	<35	<15	Post Doc	Primates
4	>35	>15	Senior Landscape Ecologist	Bears, Pollinators
5	<35	<15	Animal Care Coordinator	Primates
6	<35	<15	PhD Student	Primates
7	>35	<15	Research Facilitator	Primates
8	>35	>15	Conservation Program Manager	Large Cats, Primates, Reptiles
9	>35	>15	PhD Student, Lecturer	Primates

around menstruation, and there is a lack of education for men and other non-menstruators in the field.

"The only thing that actually I was ever asked [by men was]...if we were worried that bears would sniff us out because of our period. Which was like, nope, not worried. And why would you be worried about that? It was kind of campfire talk. The other girls I don't think were very comfortable, and I definitely was the only one to say 'no' and 'not at all.' And why would this be a question that you are concerned about? Which kind of stopped it right there; they didn't engage further, and I don't necessarily think it was meant to be offensive" (Participant 4).

This "campfire talk" can be damaging to both men and women in the field. While having discussions about stigmatized topics, such as menstruation, is valuable, the spread of misinformation can create more harm than good. It is essential that accurate information is being shared in open discussions. In addition to the spread of misinformation, a lack of adequate education on biological processes can lead to negative attitudes towards topics like menstruation for both men and women (Bobel *et al.,* 2020).

Participant 4 also spoke more about how the men's question made some of the female staff uncomfortable. Viewing menstruation as a taboo and negative process creates barriers to open communication; this can often lead to women feeling shame when needing to speak about menstruation and their needs (Rierdan *et al.,* 1986; Mahon *et al.*, 2015). Growing up, boys are often excluded from conversations regarding menstruation, so they may gain knowledge in informal ways, which often includes inaccurate information or myths being shared (Bobel *et al.,* 2020). Reframing the ways in which we view menstruation and creating "an inclusive approach where men are equal partners ensures greater support and leads to successful empowerment of the whole community, especially women and girls" (Mahon *et al.*, 2015). Challenging these social taboos can change cultural norms and create a more equitable environment for women and men inside and outside of the field (Mahon *et al.,* 2015).

Ignoring important field preparation can create unpleasant situations for women, whether they are new individuals entering the field or those that have been in the field for a long time. Three of the women discussed the lack of preparation they felt entering the field and the lack of resources offered when at field sites.

"As a woman who has my period, I should be prepared for this--in terms of health and sanitation conditions--and no one could give me an easy answer. And I had to really work hard to find that information" (Participant 2).

"There are sort of practical things in the field…that you can tell no one's thought about it because there's not many women there…like women having periods and…no bin to put any sanitary products in. You can just tell it's normally men here and no one's thought about this stuff and you're just sort of feeling really awkward." (Participant 7).

"When you have your period. Little things like that are just never really discussed [and]…when I've supervised students in the field, you can tell they really want to ask these questions but don't feel comfortable. They don't know where to dispose of sanitary products. And just having that awareness, as an organization, I think is really important" (Participant 9).

These three individuals all argued for better preparation for women, as there is a gap on what to expect when entering the field. There is also a lack of policies or infrastructure in place in many workplaces to support menstruators (Nash, 2023). This lack of representation in policy-making, coupled with a lack of briefing before entering the field, puts them at a disadvantage (Nash, 2023). They are left trying to find ways to individually cope with menstruating, which can include changing menstrual products without privacy or adequate sanitation, improvising menstrual products when none are available or keeping menstrual products in their bodies for longer than recommended. "People who menstruate are compelled to uphold an oppressive system and patriarchal field culture in which menstruation is concealed," which can create additional psychological labour in an already physically taxing environment (Nash, 2023).

Field sites often lack the proper facilities for disposal of menstrual hygiene products, and women often "find it easier to adapt to the masculine field culture rather than changing it," which could include the use of contraceptives to suppress their menstrual cycles or feeling the need to be secretive or to conceal when they are menstruating (Nash, 2023). Hiding sanitary napkins or washing blood-stained garments at dusk, and drying cloth napkins under other clothes further enforces these stigmas (Fatimawati Adi Badiozaman *et al.*, 2023).

There is a need to create field sites and research stations that account for the needs of men, women, and non-binary individuals.

While there has been some progress for more equitable field research, there is still a need to reshape the historically male-centric and patriarchal system for fieldwork, which will allow for a better playing field for all involved (Bobel *et al.,* 2020; Nash, 2023). Further studies on other menstruators, could create a better picture of what they also experience. This, in turn, will help give insight to what changes need to happen to create a more inclusive environment for all.

REFERENCES

Bobel C (2010). *New Blood: Third-Wave Feminism and the Politics of Menstruation*. New Jersey: Rutgers University Press.

Bobel C *et al*. (2020). *The Palgrave Handbook of Critical Menstruation Studies*. London: Palgrave Macmillan.

Fatimawati Adi Badiozaman I *et al*. (2023). *Women Practicing Resilience, Self-Care and Wellbeing in Academia*. London: Routledge.

Frank SE (2020). Queering menstruation: Trans and non-binary identity and body politics. *Sociological Inquiry*, *90*(2): 371–404.

Goldblatt B & Steele L (2019). Bloody unfair: Inequality related to menstruation — Considering the role of discrimination Law. *Sydney Law Review*, *41*(3): 293–325.

James R. *et al.* (2023). Gender bias and inequity holds women back in their conservation careers. *Frontiers in Environmental Science*, *10*: 1056751.

Lynch I & Nowosenetz T (2009). An exploratory study of students' constructions of gender in science, engineering and technology. *Gender and Education*, *21*(5): 567–581.

Mahon T, Tripathy A & Singh N (2015). Putting the men into menstruation: The role of men and boys in community menstrual hygiene management. *Waterlines*, *34*(1): 7–14.

Nash M (2023). Breaking the silence around blood: managing menstruation during remote Antarctic fieldwork. *Gender, Place and Culture*, *30*(8): 1083–1103.

Peng S & Jaffe J (1979). Women who enter male-dominated fields of study in higher education. *American Educational Research Journal Summer*, *16*(3): 285–293.

Rierdan J, Koff E & Flaherty J (1986). Conceptions and misconceptions of menstruation. *Women and Health*, *10*(4): 33–45.

The positive effect of experiments on *Pan troglodytes* play in a sanctuary environment

Claire Mawdsley
Cohort 2019-2020
studiesprimates@gmail.com

The definition of play behaviour has been debated and analysed through numerous studies since the first modern theory of play was developed by Karl Groos in 1898. Since then, multiple interrelating hypotheses have been developed with no overall consensus being reached. All agree that play behaviour has a beneficial function, although the specific benefits to different species, age and sex groups, remains unclear. The hypotheses stated for the role of play are not mutually exclusive and include; training for the unexpected (Špinka *et al*., 2001), developing behaviours and skills to help achieve

reproductive success as an adult (Markus & Croft, 1995) and self and social- assessment (Adang, 1986; Špinka *et al*., 2001) amongst others.

Captive chimpanzees (*Pan troglodytes*), free from the stress of finding food, predators and other environmental impacts, typically play more than chimpanzees in the wild (Markus & Croft, 1995). In captivity play has been shown to; reduce abnormal behaviours, decrease stress levels, increase natural species-specific behaviours, strengthen social bonds between individuals with no familial connection, increase social competency and has been linked to previous successful releases of rehabilitated chimpanzees (e.g. Van Lawick-Goodall, 1968; Fagen, 1981; Markus & Croft, 1995).

Whilst social and solo play are easier to identify, object play is often confused with object exploration, manipulation and tool use with no clear-cut definition for these behaviours (Ramsey & McGrew, 2005). Chimpanzees *in situ* have been shown to play with a wide variety of objects including; branches, twigs, earth, grass, food, or discarded items which are then fought over for possession (Van Lawick-Goodall, 1968). In captivity, the range of items increases greatly from solely natural objects to include bottle-tops, food wrappers, plastic pieces, paper, string, a dead bird, hessian bags amongst others (Markus & Croft, 1995).

For my study, the factors influencing object play in captivity were investigated. Data were collected at Chimfunshi Wildlife Orphanage, (hereafter referred to as Chimfunshi) located in north-western Zambia, Africa. Subjects were 86 chimpanzees across three enclosures (Fig. 1). Enclosure E1 housed 25 chimpanzees, enclosure E2 contained 50 and enclosure E4 contained 11 individuals. Although all age categories were represented across the enclosures this was not evenly distributed. Chimpanzees could not see individuals in different enclosures due to fences, vegetation and distance, although they could hear vocalisations (Rawlings *et al.*, 2014).
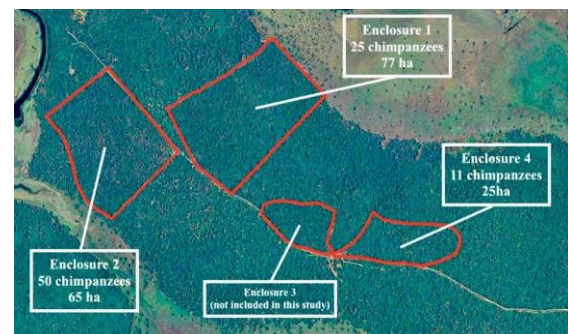
Figure 1. Map showing the location of enclosures at Chimfunshi Wildlife Orphanage in 2017 Updated from Van Leeuwen *et al*. 2018 (Google, 2020)

A generalised linear mixed model (GLMM), with binomial error distribution and logit link function, was used to answer my research question of what affects the frequency of object play. The GLMM has been utilised in similar behavioural studies (Rawlings *et al.*, 2014; van Leeuwen *et al.*, 2017) as it allows analysis of multiple variables with fixed and random effects

and shows if the effect of one variable is changed through interaction with another variable, which is key when studying behaviour.

One factor evaluated for influence on object play was the behavioural experiments conducted during data collection, as such experiments included the introduction of objects into the enclosures by researchers. The most frequent experiment introduced wooden balls for chimpanzees to manipulate for a peanut reward (Van Leeuwen *et al.*, 2013) a second experiment used peanuts to assess social groupings and tolerance in an area with a high-value food item (Cronin *et al.*, 2014). Another experiment included testing social tool use to obtain juice from dispensers by pressing buttons (Schweinfurth *et al.*, 2018).

Object play in enclosure E2 was higher than the next enclosure (E1), whilst the frequency of social and solo play was more similar. Should all play types have differed, the discrepancies could be explained by the higher population in E2 or the enclosure's higher number of immature chimpanzees compared to other enclosures. However, as it is only object play where the difference occurs, this implies another factor is influencing the higher frequency of object play in E2. This difference cannot be explained by environmental differences, as all enclosures consist of the same woodland and whilst enclosures vary in size (Fig. 1). Previous

studies at Chimfunshi have ruled out ecological influences, as well as genetic variation, for differences in behaviour between the groups (Rawlings *et al.*, 2014; van Leeuwen *et al.*, 2017).

The GLMM indicated that behavioural experiments influenced play but only in certain enclosures (E1, E2). This could be due to the different experiments for those enclosures (see Van Leeuwen *et al.*, 2013; Cronin *et al.*, 2014; Schweinfurth *et al.*, 2018) or the frequency of such experiments. To date, balls were only used in E1 and E2 whereas object manipulation was required for the experiment in E4 through the pressing of buttons rather than handling of independent objects (Schweinfurth *et al.*, 2018).

A wide variety of objects were used in play with natural objects outnumbering man-made in frequency, however, balls from the experiments were the second most frequently used play object in this study. The introduction of balls into enclosures was linked to the high frequency of object play in E2, with a high frequency of a ball being played with. However, E2 also had the highest number of different objects used in play compared to other enclosures, which cannot be explained by different natural objects being available, as all enclosures are in the same woodland. Many of the items played with were man-made items which could have been introduced either intentionally or accidentally by visitors or keepers.

Although there may be a higher number of foreign, man-made objects being introduced into E2, this is not necessarily the only reason for the high frequency of play as other enclosures had foreign objects present but play frequency with such objects was lower. It is possible that the high number of experiments in E2, which has seen an ongoing introduction of objects similar in size and shape to a regular food source, has led to an increase in object manipulation and object play by chimpanzees. This high level of object play has potentially influenced play with other foreign objects introduced into the enclosure. Whether the introduction of balls from the experiments has then led to object play with other novel items requires further research, but this would potentially explain the high rate of object play and objects used in E2.

Overall the presence or absence of experiments did affect the frequency of object play, more specifically for E1 than the other enclosures. Object play has been observed to decrease and even stop where objects are no longer considered novel in a range of other species including reptiles (Fagen, 1981). This could explain the difference found in object play frequency between E1 and E2, where the frequency is higher in E1 when an experiment is in progress, despite the higher overall frequency of object play in E2. E2 has a higher frequency of experiments which could potentially lead to the balls, which are thrown into the enclosure, becoming less novel and

interesting as a play object as time goes on. However, the sample size for E1 is quite small which does limit the analysis, a larger data set is required to confirm the strength of the relationship between the presence of experiments and the frequency of object play between the enclosures.

Play has extensively been shown as an incredibly valuable behaviour in chimpanzees as it increases natural species-specific behaviour, helps form cohesive groups from orphans with no familial bond and reduces abnormal behaviours; a vital part of the rehabilitation process (Van Lawick-Goodall, 1968; Fagen, 1981). Only cohesive groups of chimpanzees with natural species-specific behaviours should be considered for release if an opportunity arises. However, play is often reduced or absent in stressful situations such as a chimpanzee losing their family due to the pet and bushmeat trade or simply being in captivity, which may explain an absence or reduced frequency of play in sanctuaries (Markus & Croft, 1995). Therefore, a lack of play in orphaned chimpanzees is an issue with potentially long-term consequences faced by many sanctuaries.

Sanctuaries offer a unique opportunity for primate behavioural research as shown at Chimfunshi with multiple studies (Van Leeuwen *et al.*, 2013; Cronin *et al.*, 2014; Rawlings *et al.*, 2014; van Leeuwen *et al.*, 2017; Schweinfurth *et al.*, 2018). Whilst such research provides invaluable insights into

chimpanzee behaviour my study has shown that there is an additional positive outcome from research, especially research which utilises objects. Balls from research at Chimfunshi are frequently used in object play by chimpanzees of all ages. Whether this frequency decreases in time requires more research but my study has shown a higher frequency of play in the presence of research which can positively affect chimpanzees living in sanctuaries. Even when research does not include objects, play has been observed possibly as a result of the experiment as seen in social tool use research (Schweinfurth *et al.*, 2018).

Research on captive chimpanzees has historically been seen as detrimental to chimpanzees. My study has shown that modern behavioural research, especially those projects which utilises objects, positively effects play frequency in a sanctuary environment. As play is so key in the development of chimpanzees such research in captivity may lead to the eventual release of orphans in sanctuaries, providing a far greater effect on the conservation of chimpanzees than was previously realised.

REFERENCES

Adang OMJ (1986). Social development of chimpanzees: the role of social exploration. *The Individual and Society*, 101–108.

Cronin KA, Van Leeuwen EJ, Vreeman V & Haun DB (2014). Population-level variability in the social climates of four chimpanzee societies. *Evolution and Human Behavior*, 35(5): 389–396.

Fagen R (1981). *Animal Play Behavior*. Oxford: Oxford University Press.

Van Lawick-Goodall J (1968). The behaviour of free-living chimpanzees in the Gombe Stream Reserve. *Animal Behaviour Monographs,* 1: 161-IN12.

van Leeuwen EJC, Mundry R, Cronin KA, *et al.* (2017). Chimpanzee culture extends beyond matrilineal family units. *Current Biology*, 27(12): R588–R590.

van Leeuwen EJC, Cronin KA, Schütte S, *et al.* (2013). Chimpanzees (*Pan troglodytes*) flexibly adjust their behaviour in order to maximize payoffs, not to conform to majorities. *PLoS ONE*, 8(11): e80945.

van Leeuwen EJC, Cronin KA & Haun DBM (2018). Population-specific social dynamics in chimpanzees. *Proceedings of the National Academy of Sciences of the United States of America*, 115(45): 11393–11400.

Markus N & Croft DB (1995). Play behaviour and its effects on social development of common chimpanzees (*Pan troglodytes*). *Primates*, 36(2): 213–225.

Ramsey JK & McGrew WC (2005). Object play in great apes. In: Pellegrini AD & Smith PK (eds). The nature of play: Great Apes and *Humans*. New York: Guildford Press. pp. 89-138.

Rawlings B, Davila-Ross M & Boysen ST (2014). Semi-wild chimpanzees open hard-shelled fruits differently across communities. *Animal Cognition*, 17(4): 891–899.

Schweinfurth MK, DeTroy SE, Van Leeuwen EJ, *et al.* (2018). Spontaneous social tool use in chimpanzees (*Pan troglodytes*). *Journal of Comparative Psychology,* 132(4): 455.

Špinka M, Newberry RC & Bekoff M (2001). Mammalian play: training for the unexpected. *The Quarterly Review of Biology,* 76(2): 141–168.

Discovering new groups of coppery titi monkeys (*Plecturocebus cupreus*) at EBQB, Peru

Sarah Walker
Cohort 2021-2022
sarahwalker96@live.co.uk

Coppery titi monkeys are cryptic small-medium-sized monogamous neotropical primates found in the tropical forests of Peru and Brazil (Dolotovskaya *et al.*, 2019; Heymann *et al.*, 2019). They inhabit a range of habitat types including *terra firme* primary forest and secondary forest, preferring the lower 10 m of the strata (Bicca-Marques & Heymann, 2013). Vocal duetting is the primary form of vocalisation used by titi monkeys with the calls primarily occurring between 06:00-12:00 (Martinez & Wallace, 2021). Duets are a joint acoustic display conducted by two individuals with coordination of vocalisations either overlapping or alternating (Dolotovskaya & Heymann, 2022).

There are currently eight habituated groups at EBQB (Estacion Biologica Quebrada Blanco) which are included in behavioural and genetic studies which are run at the site. There are many signs that other groups reside in the area but no further efforts in habituation or identification of these groups have occurred. My study aimed to identify any new groups situated in the Northern area of the site to give insight into the population size at the site and provide additional groups for habituation

and use in the behavioural and genetic studies that occur at the site.

The study took place at EBQB in the Northeastern Peruvian lowland Amazonia, with an annual rainfall of <200 mm (Heymann *et al*. 2021). The site consists of *terra firme* primary tropical forest, with small patches of secondary forest due to selective logging in the 1990s and small swampy areas prone to seasonal flooding (Dolotovskaya, 2020; Heymann *et al.* 2021). The study took place between the 5th to 25th of July 2022.

The site was split into a grid system with cells of 270x270 m to represent the average home range for the species. Due to the presence of habituated groups at the site as well as unsuitable survey sites, nine cells situated in the north of the site were selected for surveying. Five random points were generated in each cell using QGIS, each separated by a minimum distance of 75 m to keep each survey location independent. At each of the five survey points, a playback of the coppery titi duet was emitted, and the call has been edited using Audacity© to dampen background noise and enhance the volume. The call was produced using a Sony SRS-XB23 Bluetooth speaker placed between 1.5-2 m

height in areas of sparse vegetation to allow the sound to travel.

At each site, the call was emitted followed by a five-minute wait period for a response before the call was replayed and a further five minutes waited. If a response was heard in the first playback the call was not repeated. If a vocal response occurred at any of the five points within a cell the site was marked as occupied regardless of if a visual sighting occurred. The direction and approximate distance of the vocal response were recorded and compared to the locations of the habituated groups to determine if the group is a new group or if the response is from a neighbouring habituated group. Distances were approximately recorded up to 50 m before being categorised as 50+ due to the difficulty in accurately assessing distance. Playback was conducted between 06:30-12:30, these times were chosen to limit to impact of unnatural calls and keep responses within to usual vocalisation time for this species (Bicca-Marques & Heymann, 2013). As this species of titi monkeys are not known to frequently duet in the rain, playbacks were only performed on days without rain. Each site was visited on three separate occasions to enhance the chances of detection.

Of the nine cells surveyed, five resulted in a vocal response from the target species at least one of the points surveyed. Figure 1 shows the cells where responses were heard and the direction the vocalisation came from.
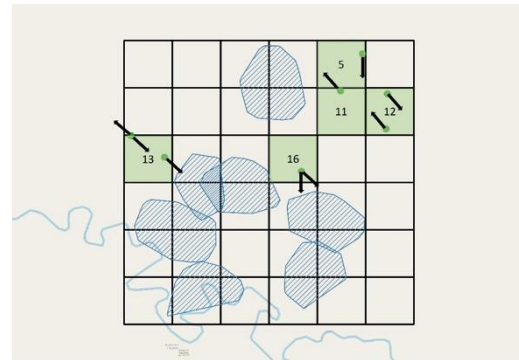
Figure 1. Map showing the cells where vocal responses to the playback were recorded. The green points represent the playback sites, and the arrows represent the direction that the vocalisation was heard. The map is orientated with the North at the top.

As the surveys were repeated on three separate occasions some points have multiple arrows, grid 16 also has multiple arrows due to two separate duets being heard after the playback. The lower points in both grids 12 and 13 had vocalisations heard over 50 m away meaning the responses were likely to fall outside of the survey cell. No vocalisation was recorded for habituated groups followed at the time when vocal responses were heard within each cell.

Figure 1 shows that both cells 13 and 16 had responses from the direction of habituated groups, whereas the remaining three cells had responses that appeared to occur within the bounds of the cells.

At face value, I can suggest that each of the five cells where a vocal response was recorded is home to a group of coppery titi monkeys. Cell 13 can be confirmed as having a group of at least three individuals due to a positive sighting of a male carrying an infant

following the playback. The other cells' occupancy has been determined solely through a vocal response with the distance and direction from which the vocalisations came from included in the decision. Although there is a lack of information on the range that the coppery titi money duet can be heard, other species have been suggested to have a range of 500 m for other titi monkeys and 250 m for humans to hear (Robinson, 1981; Kuijk *et al.*, 2015). With this information in mind, it allowed the playbacks to be mapped in comparison to the habituated groups to report on the likelihood that the group identified is a known habituated group. From the information provided in Figure 1, cells 13 and 16 had close borders to existing habituated groups with the direction of vocalisation coming from those groups. In the case of cell 16, there were two duets heard simultaneously suggesting that one response is likely to be from the habituated group but the other could be from a new habituated group. This can also be the case of grid 13 with one point indicating that the response could be from the habituated group it is close to, yet the other indicates to a group from within the cell or to the northeast of the cell which was outside of the survey area. The method used for this study was more directed at estimating occupancy as opposed to abundance and reporting the number of animals. For this to be obtained, a study into other titi monkey species have applied a

triangulation approach which allows the location that the call omitted from to be successfully pinpointed to ensure that the response did occur in the survey area (Aldrich *et al.,* 2008). This would provide more clarity and credibility to the group's locations suggested above.

The three remaining cells allow for a more accurate assumption that the vocalisations heard were of new groups. We can see from Figure 1 that cells 5, 11 and 12 were further from the habituated groups with the direction of vocalisations, suggesting they were not from these habituated groups. As the grid cells were close to the 7.2 ha average home range of the species, we can assume that the cells were independent and the vocalisations heard were not from the neighbouring cells, reducing the risk of the same group being counted in different cells (Martinez & Wallace, 2021). Again, the application of further studies using triangulation methods would provide a more accurate estimation of the groups within the study site and confirm or deny the group suggestions I have made through this study.

Ultimately understanding the distribution of new groups at the site would not only allow further habituation for behavioural and genetic studies but also provide useful information on population size to predict how the populations change at the site over time. As primate populations continue to decline it is important to have a clear understanding of

primate populations and the occupancy of species around the world (Kalan *et al.*, 2015; Estrada *et al.*, 2017).

REFERENCES

Aldrich BC, Molleson L & Nekaris KAI (2008). Vocalizations as a conservation tool: an auditory survey of the Andean titi monkey *Callicebus oenanthe* Thomas, 1924 (Mammalia: Primates: Pitheciidae) at Tarangue, Northern Peru. *Contributions to Zoology*, 77(1): 1–6.

Bicca-Marques JC & Heymann E (2013). Ecology and behaviour of titi monkeys (genus *Callicebus*). In: Veiga LM, Barnett AA, Ferrari SF & Norconk MA (eds). *Evolutionary Biology and Conservation of Titis, Sakis and Uacaris*. Cambridge: Cambridge University Press. pp. 196–207.

Dolotovskaya S (2020). Genetic and behavioral correlates of pair living in coppery titi monkeys (*Plecturocebus cupreus*). PhD Thesis. Georg-August-Universität Göttingen.

Dolotovskaya S & Heymann EW (2022). Coordinated singing in coppery titi monkeys (*Plecturocebus cupreus*): Resource or mate defense? *Frontiers in Ecology and Evolution*, 10: 898509.

Dolotovskaya S, Flores Amasifuen C, Haas CE *et al.* (2019). Active anti-predator behaviour of red titi monkeys (*Plecturocebus cupreus*). *Primate Biology*, 6(1): 59–64.

Estrada A, Garber PA, Rylands AB *et al*. (2017). Impending extinction crisis of the world's primates: Why primates matter. *Science Advances*, 3(1): e1600946.

Heymann EW, Dolotovskaya S & Herrera ERT (2021). Estación Biológica Quebrada Blanco. *Ecotropica*, 23(1/2): 1-4.

Heymann EW, Culot L, Knogge C *et al*. (2019). Small Neotropical primates promote the natural regeneration of anthropogenically disturbed areas. *Scientific Reports*, 9(1): 10356.

Kalan AK, Mundry R, Wagner OJJ *et al.* (2015). Towards the automated detection and occupancy estimation of primates using passive acoustic monitoring. *Ecological Indicators*, 54: 217-226.

Kuijk SM, García-Suikkanen C, Tello-Alvarado JC *et al.* (2015). Estimating population density of the San Martin titi monkey (*Callicebus oenanthe*) in Peru using vocalisations. *Folia Primatologica*, 86(6): 525–533.

Martinez J & Wallace RB (2021). An update on the distribution and abundance of the endemic and threatened Olalla's titi monkey (*Plecturocebus olallae*). *Primate Conservation*, (35): 13–20.

Robinson JG (1981). Vocal regulation of inter- and intragroup spacing during boundary encounters in the titi monkey, *Callicebus moloch*. *Primates*, 22(2): 161–172.

A preliminary investigation into the sleep patterns and factors influencing sleep of nocturnal and cathemeral lemurs

Celeste Williams
Cohort 2019-2020
cmwilliams2019@gmail.com

As an essential behaviour and one that is performed by every mammal studied thus far, there is still so much about sleep that is unknown (Piéron, 1913; Tobler, 2000; Schmidt, 2014). For years, studies have been conducted attempting to better understand the function of sleep and how mammals vary in their patterning of sleep. Specifically, mammals show great variation in their timing of sleep, and duration of sleep periods (Capellini *et al.*, 2008; McNamara *et al.,* 2008). Mammals may sleep predominantly during the night (diurnal), the day (nocturnal), or spread sleep and activity at various nearly equal periods throughout the day (cathemeral) (Tattersall, 1987).

Though sleep is universal among mammals, there is still a lack of understanding about this behaviour. Most of what is known about sleep comes from studies done on captive individuals (Rattenborg *et al.*, 2017). These captive studies no doubt provide insight into sleep, but it is difficult for these studies to understand exactly how natural factors influence species. In primates, relatively few studies have been done on sleep, be it in captivity or in the wild, with most studies focusing on activity.

Studies on primates have found ambient temperature, sunrise, sunset, and seasonality to be factors influencing the activity and sleep patterns of individuals. The cathemeral owl monkeys (*Aotus azarai azarai*) and cathemeral Lac Alaotra bamboo lemurs (*Hapalemur griseus alaotrensis*) were found to both increase nocturnal activity when ambient diurnal temperature increased (Fernandez-Duque 2003). In the wild, the nocturnal Javan slow loris (*Nycticebus javanicus*) demonstrated a highly synchronised patterning of activity and rest with sunrise and sunset (Reinhardt *et al.*, 2019). Blue-eyed black lemurs and collared brown lemurs were both shown to coordinate their activity pattern with changes in light levels from sunrise and sunset as well (Donati & Borgognini-Tarli, 2006).

My study utilised accelerometery data collected on the strictly nocturnal Madame Fleurette's sportive lemur (*Lepilemur fleuretae*), the cathemeral southern woolly lemur (*Avahi meridionalis*), and the cathemeral southern bamboo lemur (*Hapalemur meridionalis*) in order to examine how various environmental factors influenced their sleep behaviour, and to provide the first insight into sleep for these lemurs.

Accelerometery data for the sportive and woolly lemur was collected by Marco Campera at the Ampasy Research Station (S24°34'58'', E47°09'01) (Campera *et al.*, 2019a). Three woolly and two sportive lemurs were equipped with VHF collars (RI-2D, Holohil Systems Ltd) and high-frequency accelerometer tags (Axy-Depth, TechnoSmArt) (Campera *et al.*, 2019a). More information pertaining to the study site and attachment of collars and tags can be found in Campera *et al.* (2019a, 2019b). Data for the bamboo lemur was collected by Timothy Eppley in the Mandena littoral forest (S24°95', E46°99') located in southeast Madagascar. External radio-transmitters with archival tags (ARC400, Advanced Telemetry Systems, Isanti, MN, USA) were fitted to nine adult lemurs (Eppley *et al.*, 2015). More information pertaining to the study site and attachment of collars and tags can be found in Eppley *et al.* (2015).

Raw activity scores (sportive and woolly lemurs), proportional rate of activity (bamboo lemur), temperature, and sunrise/sunset times were extracted and analysed for each individual in MATLAB. Actigraphy analyses

were performed allowing for the activity and sleep across the 24 h day of each individual to be examined (Fig. 1). For my study, a raw activity score/ rate of activity of 0 was used as the initial arbitrary marker for sleep, representing complete immobility. With the survival curve analysis, I was able to determine and define sleep for each species by calculating the duration of complete immobility, and thus correcting for my initial assumption of 0 as inactivity. Group data will be presented in this study as mean ± standard error.
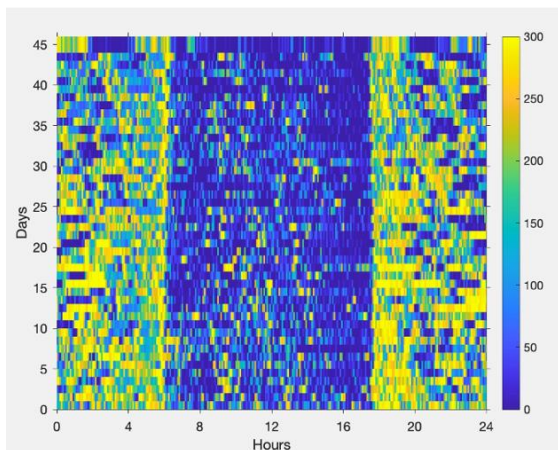
Figure 1. Actigraphy of an individual woolly lemur illustrating activity scores across the 24th day during the study period. The gradient score on the right correlates to activity score.

During the day woolly lemurs spent on average 6.77±0.33 hours active and 4.23±0.26 completely inactive, sportive lemurs 8.80±0.39 hours active and 2.47±0.23 hours completely inactive, and bamboo lemurs 11.81±0.13 hours active and 0.52±0.09 hours inactive. At night woolly lemurs spent on average 11.75±0.12 hours active and 1.04± 0.17 completely inactive, sportive lemurs 11.73±0.16 hours active and 0.98±0.02 completely inactive, and bamboo lemurs 8.87±0.25 hours were spent active and 2.80±0.21 hours inactive.

Survival curve analyses showed woolly lemurs rarely had sleep episodes lasting longer than 110 minutes without being interrupted, sportive lemurs rarely had episodes lasting longer than 80 minutes, and bamboo lemurs rarely had episodes lasting longer than 337 minutes.

Woolly lemur activity appeared to anticipate sunrise and sunset. Woolly lemur activity steadily decreased 30 minutes before sunrise and steadily increased about 27 minutes before sunset. Sportive lemurs appear to begin to sharply decrease activity 2+ hours before sunrise and almost immediately increase activity at sunset. Approximately 85 minutes before sunrise, bamboo lemurs began to drastically increase their activity and steadily decrease their activity levels in response to sunset. Sunrise and sunset did not appear to, however, directly bring about the onset or cessation of sleep for any species.

For bamboo lemurs, the influence of temperature was examined and a relationship between temperature and mean sleep bout duration did appear, with longer sleep bouts at temperatures less than 21.5°C (Fig. 2). Sleep episodes also tended to be longer when temperature was decreasing, but shorter when temperature was stable or increasing.
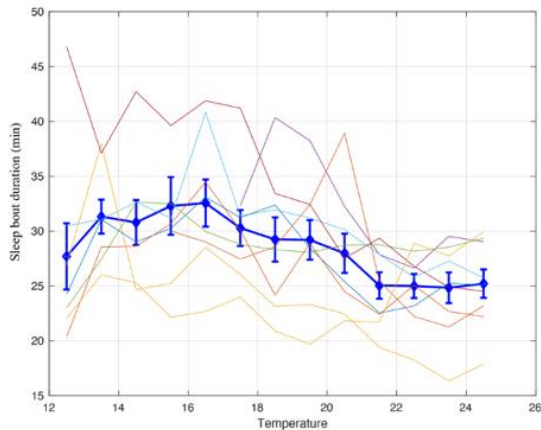
Figure 2. Relationship between sleep bout duration and temperature. Blue line represents group averages and multi-coloured lines each represent an individual.

My study allowed for a preliminary investigation into the potential influencers of sleep in wild cathemeral and nocturnal lemurs. The nocturnal sportive lemurs had the shortest sleep bouts, the woolly lemur a mix of short and long bouts, and the bamboo lemur possessed a more uniform bout length. The cathemeral lemurs tended to have longer uninterrupted sleep bouts in comparison to the sportive lemur. Sportive lemurs unexpectedly spent a lot of time active during the day, and even more time than the woolly lemur. There have been accounts of sportive lemur spending time performing behaviours such as grooming or vigilance during the day (Charles-Dominique & Hladik, 1971; Seiler *et al.,* 2013). Another possibility is that I used an activity rate/score of 0 as a marker for sleep. This may be limiting in that even minor movements or twitches during sleep were counted as active. This may well be a limitation of sleep studies using accelerometers and should be taken into account for future studies. All three lemur species appeared to have their activity levels heavily influenced by sunrise and sunset, though a direct relationship with sleep was difficult to examine. Again, this may be due to using 0 as a marker for sleep. For bamboo lemurs, the influence of temperature was evaluated, and a strong relationship appeared with lemurs tending to sleep for longer durations when temperatures were lower, and showing shorter sleep durations when temperature was stable or increasing.

These findings may also be of use for improving conservation efforts and captivity welfare for these lemurs. Knowing how temperature influenced bamboo lemurs, increases in temperature from climate change may lead to changes in sleep patterns and shorter sleep durations which may have negative consequences, as sleep may serve a variety of different functions ranging from restorative purposes to energy allocation (Berger & Phillips, 1993; Rechtschaffen, 1998; Siegel, 2005; Schmidt, 2014). This study can also give insight into how to properly house these species in captivity. For bamboo lemurs, establishments will likely want to keep their housing at a lower temperature in order to promote sleep. Additionally, for each species I examined how light levels affect them, and captive establishments may find this useful when attempting to provide them with the best housing and lighting.

REFERENCES

Berger R & Philips N (1993). Sleep and energy conservation. *Physiology,* 8(6): 276-281.

Campera M, Balestri M, Chimienti *et al.* (2019a). Temporal niche separation between the two ecologically similar nocturnal primates *Avahi meridionalis* and *Lepilemur fleuretae*. *Behavioural Ecology and Sociobiology*, 73(5): 1-12.

Campera M, Phelps M, Besnard F *et al*. (2019b). Does forest management and researchers' presence reduce hunting and forest exploitation by local communities in Tsitongambarika, south-east Madagascar? Oryx, 53(4): 677-686.

Capellini I, Barton RA, McNamara P *et al*. (2008). Phylogenetic analysis of the ecology and evolution of mammalian. *Evolution*, 62(7): 1764-1776.

Charles-Dominique P & Hladik CM (1971). Le lepilémur du sud de Madagascar: écologie, alimentation et vie sociale. *Revue D Ecologie-La Terre Et La Vie*, 1: 3-66.

Donati G & Borgognini-Tarli SM (2006). Influence of abiotic factors on cathemeral activity: The case of *Eulemur fulvus collaris* in the littoral forest of Madagascar. *Folia Primatologica*, 77(1-2): 104-122.

Eppley T, Ganzhorn J & Donati G (2015). Cathemerality in a small, folivorous primate: proximate control of diel activity in *Hapalemur meridionalis*. *Behavioral Ecology and Sociobiology*, 69(6): 991-1002.

Fernandez-Duque E (2003). Influences of moonlight, ambient temperature, and food availability on the diurnal and nocturnal activity of owl monkeys (*Aotus azarai*). *Behavioural Ecology and Sociobiology*, 54(5): 431-440.

McNamara P, Capellini I, Harris E *et al.* (2008). The phylogeny of sleep database: A new resource for sleep scientists. *The Open Sleep Journal*, 1: 11–14.

Piéron H (1913). *Le Probléme Physiologique du Sommeil*. Paris: Masson.

Rattenborg NC, de La Iglesia HO, Kempenaers B *et al.* (2017). Sleep research goes wild: new methods and approaches to investigate the ecology, evolution and functions of sleep. *Philosophical Transactions of the Royal Society of London*. *Series B, Biological Sciences*, 372(1734): 20160251.

Rechtschaffen A (1998). Current perspectives on the function of sleep. *Perspectives in Biology and Medicine,* 41(3): 359-390.

Reinhardt KD, Vyazovskiy VV, Hernandez-Aguilar RA *et al.* (2019). Environment shapes sleep patterns in a wild nocturnal primate. *Scientific Reports*, 9: 9939.

Schmidt MH (2014). The energy allocation function of sleep: a unifying theory of sleep, torpor, and continuous wakefulness. *Neuroscience and Biobehavioural Reviews*, 47: 122.

Seiler M, Schwitzer C & Holderied M (2013). Anti-predator behaviour of Sahamalaza sportive lemurs, *Lepilemur sahamalazensis*, at diurnal sleeping sites. *Contributions to Zoology,* 82(3): 131-143.

Siegel JM (2005). Clues to the function of mammalian sleep. *Nature,* 437: 1264-1271.

Tattersall I (1987). Cathemeral activity in primates: A definition. *Folia Primatologica,* 49(34): 200-202.

Tobler I (2000). Phylogeny of sleep regulation. In: Kryger MH *et al.* (eds.). *Principles and Practice of Sleep Medicine.* Philadelphia: W.B. Saunders. pp. 72-81.

Assessment of the rehabilitation process' success of a group of black-capped capuchins (*Sapajus apella apella*)

Camille Lasbleiz
Cohort 2018-2019
primateodyssey@gmail.com

The black-capped capuchin (*Sapajus apella apella*) occurring in the lower Amazonian

rainforest, is currently considered as Least Concerned by the IUCN Red List (Boubli *et al.*,

2018). Yet, this species is under some threats such as habitat reduction due to deforestation and hunting (Chapman & Peres, 2001; Fragaszy *et al.*, 2004; Parry *et al.*, 2009). Furthermore, the black capped capuchin is considered the most common pet primate species (Boubli *et al.*, 2018) suffering from the pet trade in its native countries, Europe, and the USA (Chapman & Peres, 2001; Fragaszy *et al.*, 2004; Lynch Alfaro *et al.*, 2014). There is an urgent need in reducing the custom of keeping capuchins as pets (Lynch Alfaro *et al.*, 2014). Rehabilitation and reintroduction (R&R) projects help mitigate the pet trade and these programmes are essential to conservation (Cheyne & Brulé, 2004).

From May to July 2019, I went to ONCA Wildlife Rescue, a Bolivian rehabilitation centre, in order to observe a group of 18 black-capped capuchins with the goal of assessing the success of their rehabilitation. This study would be the first step of a pre-release behavioural monitoring since such pre- and post-release monitoring is critical for R&R projects to be successful (Cheyne, 2009). The objectives of the project were to evaluate whether each individual of the group performed the same range and frequency of behaviours as their wild-raised counterparts (Cheyne, 2009); as well as to increase the knowledge available on the rehabilitation and release of this species (Cheyne, 2009; Lynch Alfaro *et al.*, 2014) while it is not yet threatened, preventing its current IUCN status to worsen.

A pilot study was carried out during the first week and a half of the project to design the data sheets as well as to complete the ethogram ONCA provided me with. That week also allowed the capuchins to accustom themselves to my presence and gave me some time to learn how to distinguish them. During the rest of the study 4-5 hours of behavioural data were collected on each individual of the group using the continuous focal sampling method (Altmann, 1974) with a total of 88 hours of data. The data were mainly collected from 8am to 5pm, in order to cover most of the range of behaviours that capuchins can exhibit during the day. Additional data were collected using the instantaneous focal sampling method every 5 minutes, also recording the estimated height of the individual from the ground. Finally, I recorded which individuals were present and absent from the capuchin area twice a day (morning and afternoon) with a total amount of 81 observation points. The total activity budget of each individual was calculated. The activity budgets were compared between individuals of the same age class in order to know if one or more individuals were behaving differently from the others. Housing conditions were also considered since most of the individuals of the group were free roaming in the "capuchin area", but four of

them spent at least some part of their day in a cage.

Based on data found in the literature, the study group size and composition are similar to those of wild groups of black-capped capuchins (Terborgh, 1983; Fragaszy *et al.*, 2004). Like wild capuchins, the individuals observed used almost all layers of the forest from the ground to the canopy (Fragaszy *et al.*, 2004). However, wild capuchins are mostly found in the middle of the canopy while the study subjects spent most of their time in the undergrowth between 0.1 and 5 m from the ground. The highest they were seen was in the lower part of the canopy, at 20 m height, which is the height of the highest trees composing the capuchin area. Thus, the data might be biased by this limiting factor. Furthermore, these data might also be explained by the fact that the study took place in the dry season, a period of food scarcity during which capuchins spend more time near the ground to forage (Siemers, 2000).

Encouraging factors for the release of the animals were observed, such as the significant time free-roaming individuals spent being out of sight in the jungle, as well as the means of the foraging/feeding, resting and social behaviours exhibited by all the individuals, that fit within the range of what has been found in the literature about tufted capuchins (Terborgh 1983; Fragaszy *et al.*, 2004). However, the capuchins housed at ONCA spent a lower percentage of their time

exhibiting locomotion than what has been found by other researchers (Zhang, 1995; Izar *et al.*, 2012) which could be due to the fact that moving in the trees while searching for food was considered as "foraging behaviour" in my study. The capuchins studied were provided with food covering half of their daily diet requirements. Overall, the wild food they were feeding on was similar to what has been found in previous studies about wild capuchins during the dry season such as palm nuts, fruits, leaves, stems, embedded insects and flowers (Terborgh, 1983; Zhang, 1995). The studied individuals exhibited typical foraging behaviour (active and destructive foraging) (Fragaszy *et al.*, 2004; Terborgh 1983) as well as typical quadrupedal locomotor behaviours such as walking, running, climbing, leaping, and clambering (Steudel, 2000).

Overall, the studied individuals performed their behaviours in a range and frequency similar to what can be observed in wild black-capped capuchins suggesting that their rehabilitation was successful. However, the capuchins that were housed differently from the free-roaming monkeys exhibited stereotypical behaviours (such as rocking and pacing) and performed more locomotive behaviours translating low welfare and stress (Bassett *et al.*, 2003) most probably due to their housing conditions.

Considering the small sample size of this study (maximum 5 hours of data per individual),

more behavioural data should be collected and more studies should be conducted, in the dry and wet season, on the diet and social behaviour of this group of capuchins in the capuchin area as well as in the jungle nearby in order to assess more deeply the success of the rehabilitation and determine whether the entire group is ready to be released into the wild. Finally, more publications on R&R programmes are needed, whether the outcomes were successful or unsuccessful (Lynch Alfaro *et al.*, 2014).

REFERENCES

Altmann J (1974). Observational study of behavior: sampling methods. *Behaviour* 49: 227–267.

Bassett L, Buchanan-Smith HM, McKinley J & Smith TE (2003). Effects of training on stress-related behavior of the common marmoset (*Callithrix jacchus*) in relation to coping with routine husbandry procedures. *Journal of Applied Animal Welfare Science,* 6(3): 221-233.

Boubli J, Alves S, Buss G *et al.* (2018). *Sapajus apella*. *The IUCN Red List of Threatened Species 2018*: e.T39949A70611337.

Chapman CA & Peres CA (2001). Primate conservation in the new millennium: the role of scientists. *Evolutionary Anthropology: Issues, News, and Reviews: Issues, News, and Reviews,* 10(1): 16-33.

Cheyne S (2009). Challenges and opportunities of primate rehabilitation - gibbons as a case study. *Endangered Species Research*, 9: 159-165.

Cheyne SM & Brulé A (2004). Adaptation of a captive-raised gibbon to the wild. *Folia Primatologica,* 75: 37-39.

Fragaszy DM, Visalberghi E & Fedigan LM (2004). *The Complete Capuchin: the Biology of the Genus Cebus*. Cambridge: Cambridge University Press.

Izar P, Verderane MP, Peternelli-dos-Santos L *et al*. (2012). Flexible and conservative features of social systems in tufted capuchin monkeys: comparing the socioecology of *Sapajus libidinosus* and *Sapajus nigritus*. *American Journal of Primatology,* 74: 315–331.

Lynch Alfaro JW, Izar P & Ferreira RG (2014). Capuchin monkey research priorities and urgent issues. *American Journal of Primatology*, 76: 705-720

Parry L, Barlow J & Peres CA (2009). Hunting for sustainability in tropical secondary forests. *Conservation Biology*, 23(5): 1270–1280.

Siemers BM (2000). Seasonal variation in food resource and forest strata use by brown capuchin monkeys (*Cebus apella*) in a disturbed forest fragment. *Folia Primatologica*, 71(3): 181–184.

Steudel K (2000). The physiology and energetics of movement: effects on individuals and groups. In: Boinski S & Garber P (eds). *On the Move: How and Why Animals Travel in Groups*. Chicago: University of Chicago Press. pp. 9-23

Terborgh J (1983). *Five New World Primates: a Study in Comparative Ecology*. Princeton, New Jersey: Princeton University Press.

Zhang SY (1995). Activity and ranging patterns in relation to fruit utilization by brown capuchins (*Cebus apella*) in French Guiana. *International Journal of Primatology,* 16: 489–507.

Gibbon vocalisation and ethical wildlife volunteering

Elizabeth Ascham
Cohort 2022-2023
bizzie.ascham@gmail.com

Seventy-five percentages of the approximated 512 primate species currently have declining populations (Chapman & Peres, 2021). The main threats to primate populations are

hunting, anthropogenic wildfires, habitat fragmentation, human population growth, and habitat loss and degradation (Chapman & Peres, 2021). Once these primate populations have been depleted by these primary threats, secondary threats such as legal and illegal trade in primates can have a huge impact on these dwindling populations (Nijman *et al.,* 2009). Some of these individuals taken from the wild are rescued and end up in rehabilitation centres. The hope of rehabilitation centres is that some of these individuals will be able to be rehabilitated and released into the wild. For this to be successful individuals must make the behavioural, physical, and physiological changes necessary to be able to survive and reproduce in the wild. For gibbons, a key consideration for their rehabilitation is the development of their species- and sex-specific calls, which are normally performed as part of a duet (Cheyne, 2009). Female gibbons produce a complex and variable part of the duet known as the great call (Terleph *et al.*, 2015). For the first part of my thesis, I compared the great calls of female lar gibbons (*Hylobates lar)* in a rehabilitation centre in Thailand with calls that I obtained from research carried out by Terleph *et al.* (2015) on lar gibbons in Khao Yai National Park, Thailand. This was to determine whether the gibbon song was affected by the gibbon being raised in captivity rather than with their family unit in the wild. For the second part of my thesis, I recorded non-song vocalisations of rehabilitant gibbons. Due to the complex, loud, and elaborate song of gibbons, non-song vocalisations have received little attention in the primate literature. Many other animals produce close-range calls to interact and communicate with other species members, whether regarding predator avoidance, food, signalling location, or defending their range. I analysed the non-song vocalisations produced by *Hylobates lar* and *Nomascus leucogenys* with the aim of adding to the limited database of gibbon non-song vocalisations.

Both the rehabilitant great call vocalisations and the non-song vocalisations were carried out at Wildlife Friends Foundation Thailand (WFFT). The Wildlife Rescue Centre provides care and shelter to 1,000s of wild animals that have been rescued from the illegal and legal wildlife trade with the aim, where feasible, of releasing them back into the wild. However, many animals will not be able to be returned to the wild so their goal is to provide them with an environment which is as close to what they would experience in the wild (Wildlife Friends Foundation Thailand, 2023). WFFT looks after around 70 gibbons from six different species: siamang (*Symphalangus syndactylus*), lar (*Hylobates lar*), agile (*H. agilis*), golden-cheeked (*Nomascus gabriellae*), pileated (*H. pileatus*), and white-cheeked (*N. leucogenys*). During my time researching gibbon vocalisations I also volunteered for the wildlife centre.

Volunteering at WFFT is hard but rewarding, starting at 6:30 in the morning and working until 17:00. Volunteers carry out food prep and feed out twice daily, make enrichments, clean enclosures, and other maintenance tasks. WFFT has a strict hands-off policy which means that none of the animals that we care for are volunteers allowed to touch or hand feed. There are a few exceptions including the rescued cats and dogs, an old and blind macaque who sometimes needs food handed to her otherwise she won't eat, and a brain-damaged cassowary who sometimes requires help to eat. This policy ensures that the animals experience a life that is as close to natural as possible and are not relying on humans to provide them with emotional support. This policy is also in place to ensure volunteer safety. Another important policy is that whenever volunteers prepare food, feed out, or are near animals, especially primates, they wear a face mask. This is important to reduce the risk of disease transmission to the primates, especially those who are already weak or sick, and to prevent diseases from passing from animals to humans.

WFFT is a very ethical wildlife rehabilitation centre, that puts the needs of the animals they care for above anything else. Volunteers are there to help provide care to these animals not to pet cute animals or to take pictures with them for posting on social media. Unfortunately, there are "animal sanctuaries" or "rehabilitant centres" out there which accept volunteers that do not put these policies in place. I have seen many companies whose websites or social media accounts show photos of volunteers or staff cuddling or playing with primates, often babies. These photos are used to entice people to come and volunteer with them as they will get the chance to cuddle and play with a cute baby primate. Not only does this mean that the animals at these sites are not getting the proper care and environment that they need but it is also giving people unrealistic views on how wild animals should live. Quite often it is easy to see posts on social media of animals in cruel conditions, in chains or small enclosures and see that as wrong. However, when these "sanctuaries" post photos like those mentioned earlier many people see it as acceptable because it is being done by people who have rescued these animals from worse conditions and are "reputable" centres. There are some exceptions where touching primates is necessary. Carrying out health checks and providing a surrogate parent for orphaned primates require contact. However, this should only be done by experienced individuals who are wearing masks and only when necessary. Photos of people holding primates should then not be posted on social media as this gives people an unrealistic expectation of what is natural, and disclosures should be made on any posts where animals are not in a natural environment. Sadly, there

are places where you can volunteer for animals that do not have ethical practices in place, and many people do not have sufficient information to know that the animals are not getting the best care they can. Unfortunately, even those who should have the required information and knowledge of primate behaviour and welfare still engage in practices which are not conducive to providing primates with optimal care and rehabilitation. For rehabilitation to be successful, animals should be provided with environments which are as close to natural as feasible with minimal interaction with humans. Even if the aim for these animals in care is not rehabilitation, then they should still be provided with suitable environments so that they can live in a way that is as close as they were meant to before humans took that away from them.

REFERENCES

Chapman CA & Peres CA (2021). Primate conservation: Lessons learned in the last 20 years can guide future efforts. *Evolutionary Anthropology*, 30(5): 345–361.

Cheyne SM (2009). Challenges and opportunities of primate rehabilitation—Gibbons as a case study. *Endangered Species Research*, 9: 159–165.

Nijman V, Martinez CY & Shephard CR (2009). Saved from trade: Donated and confiscated gibbons in zoos and rescue centres in Indonesia. *Endangered Species Research*, 9: 151–157.

Terleph TA, Malaivijitnond S & Reichard UH (2015). Lar gibbon (*Hylobates lar*) great call reveals individual caller identity. *American Journal of Primatology*, 77: 811–821.

Wildlife Friends Foundation Thailand (2023). About the WFFT Wildlife Rescue Centre. https://www.wfft.org/

Pathogen identification in captive primates' bones

Barbara Skender
Cohort 2016-2017
barbara.skender@gmail.com

Emerging infectious diseases represent a big threat for global health as well as for primate populations (Gillespie *et al*., 2008). Close human-primate interactions in captive conditions might provide an ideal environment for the pathogen transmission in both directions. The aim of my research project was to develop a technique for assessing the health condition and potential bacterial pathogens of primates through the analysis of bone tissue. Results of this research could serve as a starting point for development of a simple and economic pathogen analysis method that could be used in an environment with limited financial and material resources. I conducted this project from June to July 2017 in Mexico City, Mexico.

Many captive facilities have a shortage of staff educated to perform complex medical analysis, lack of professional equipment and materials to conduct the analysis as well as insufficient financial means to outsource the research to professional laboratories. Those facts served as main factors to try and develop a relatively simple, affordable method for analysing pathogens in dead primates. Having baseline data about health conditions of dead captive individuals can simplify and ease disease prevention strategies for live captive populations. I modified the pathogen analysis technique originally described by Gaul *et al.* (2015). By using histopathology techniques, I analysed decalcified liquid of bone and cartilage fragments of dead captive primates from osteological collections from universities and rescue centres, to determine the presence of pathogens. To my knowledge, up to this date, this method has not been used on primate bones.

Samples for this study included bone and cartilage fragments of the following species: howler monkey (*Alouatta* spp., n=3), black howler monkey (*A. pigra*, n=1), mantled howler monkey (*A. palliate*, n=2), squirrel monkey (*Saimiri* spp., n=6), spider monkey (*Ateles* spp., n=9), black-handed spider monkey (*A. geoffroyi*, n=12), macaque (*Macaca* spp., n=4), stump-tailed macaque (*M. arctoides*, n=3), pygmy marmoset (*Cebuella pygmaea*, n=1) and green monkey (*Chlorocebus sabaeus*, n=2). All subjects were

captive animals. Most specimens were confiscated animals from the illegal wildlife trade that after death became part of research osteological collections. Study subjects belonging to genus *Macaca* were all laboratory animals.

I decalcified the fragments in 10% EDTA for 15 days at room temperature. Upon the decalcification, I stained their centrifuged pellets to determine the presence of potential pathogens. I used the Brown and Brenn method (Luna, 1968) of Gram staining. Primary colour applied was crystal violet and secondary was fuchsine. I identified potential pathogens in the samples based on their morphological characteristics, using light microscopy.

Statistical analysis showed the significant difference (H=0.027, df=2, P<0.05) in decalcification rate and age of the study subjects from which samples were obtained, especially among juvenile and adult age groups (U=8.00, p=0.005, P1<0.015). There was no significance between decalcification rate and other factors tested (captive environment, skeletal tissue and decalcification rate). Overall, 10% EDTA showed as a successful decalcification agent for primate bones.

Gram staining of the samples revealed presence of both gram positive and negative cocci, potential causes of various infectious diseases. Gram-negative cocci, most likely belonging to genus *Moraxella*, were found in

one sample obtained from an adult stump-tailed macaque (Fig. 1). Gram-positive cocci, potentially *Staphylococcus aureus*, were found in two samples, obtained from an adult black-handed spider monkey (Fig. 2) and an adult macaque (*Macaca* spp., Fig. 3). Structures found in a sample of an infant howler monkey (*Alouatta* spp., Fig. 4) could potentially be pathogens from genus *Nocardia* and *Actynomices*, however to determine exact genera of the structure, more detailed chemical analysis should be conducted.
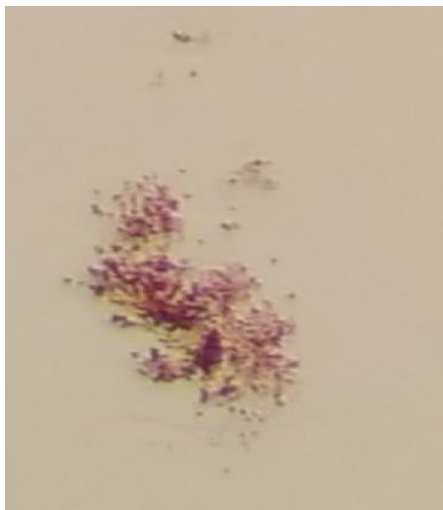

Figure 1. Results of cartilage fragments staining. Light microscopy, 100x. a. red coccoid structures from *M. articoides* bone sample.
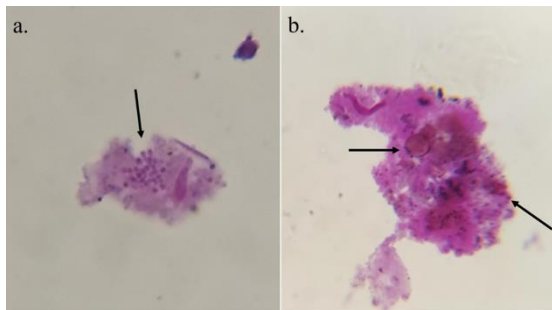
Figure 2. Blue-violet coccoid structures found in adult black-handed spider monkey (*Ateles geoffroyi*). Light microscopy, 100x. a. in clusters, b. surrounding red stained nuclei.
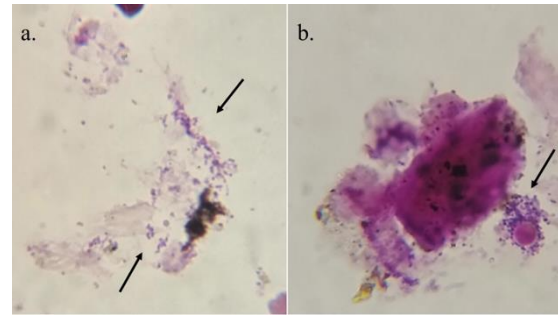
Figure 3. Blue-violet coccoid structures found in adult macaque (*Macaca* spp.). Light microscopy, 100x. a. in clusters, b. surrounding red stained nucleus.
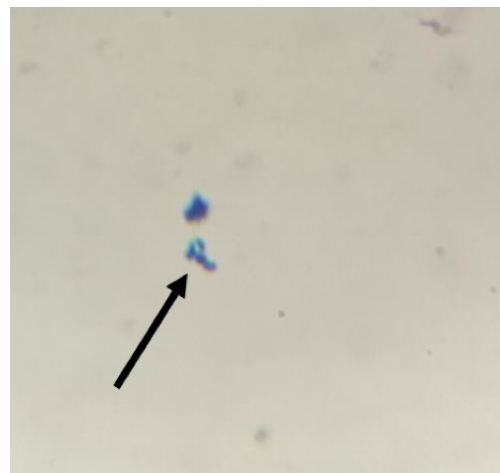
Figure 4. Blue coccoid structures found in infant howler monkey (*Alouatta* spp.). Light microscopy, 100x.

Presumed pathogens are stated as potential risk factors for intra- and inter- species pathogen transmission (Embers *et al.*, 2011; Hanley *et al.*, 2015). The method I developed was successful, even if it was done in the environment with the basic laboratory equipment and chemicals. Same procedure can be used for analysing both captive and wild primates' bones, no matter the post-mortem age of the bones. It can also serve for determining distribution of a pathogen within a population, or detecting potential pathogen carriers. It can be especially useful when all

other organic tissues decompose or are impacted by an external influence. It is important to state that the method shows only morphological differences between bacterial pathogens, such as shape, size and colour. Therefore, when designing similar types of studies, staining methods should be specific enough to determine pathogens of interest. Each step of this method should be performed in a sterile environment with minimum risk of contamination of samples.

REFERENCES

Embers ME *et al*. (2011). Characterization of a Moraxella species that causes Epistaxis in macaques. *Veterinary Microbiology*, 147(3–4): 367–375

Gaul JS, Winter E & Grossschmidt K (2015). Ancient pathogens in museal dry bone specimens: analysis of paleocytology and aDNA. *Wiener Medizinische Wochenschrift*, 165(7–8): 133–139.

Gillespie T, Nunn C & Leendertz F (2008). Integrative approaches to the study of primate infectious disease: Implications for biodiversity conservation and global health. *American Journal of Physical Anthropology*, (137). 53–69.

Hanley PW *et al*. (2015). Methicillin-resistant *Staphylococcus aureus* prevalence among captive chimpanzees, Texas, USA, 2012(1). *Emerging Infectious Diseases,* 21(12): 2158–2160.

Luna LG (1968). *Manual of Histologic Staining Methods of the Armed Forces Institute of Pathology*. New York: McGraw-Hill.

Surveying cryptic nocturnal mammals with motion-activated camera traps in Dzanga-Sangha National Park, Central African Republic

Annette Gunn
Cohort 2018-2019
nettygunn@hotmail.com

African nocturnal mammals are underrepresented in scientific research because they often occupy difficult habitats or regions and their cryptic behaviour renders them difficult to locate. Certain night-active savannah species are monitored regularly, such as leopards (*Panthera pardus*) and spotted hyenas (*Crocuta crocuta*), however the movements, behaviour and ecology of nocturnal species in dense habitats are rarely recorded, nor understood. Field researchers are continually measuring the success of various survey methods for studying cryptic nocturnal mammals, particularly primates, i.e. galagos (Galagidae), mouse lemurs (*Microcebus* spp.) and pottos (*Perodicticus* spp.). Methods have included occupancy surveys, capturing, direct and indirect observations and radio collaring, i.e. Javan slow loris (*Nycticebus javanicus*), although these can still be difficult to achieve and offer bias (Duckworth, 1998; Neilson *et al.*, 2018).

Motion-activated camera traps are a versatile and low-cost method for long and short-term studies to determine presence of species,

habitat use, behavioural ecology and species abundance in terrain that may not be easily accessible. They are valued for their importance in capturing elusive species for identification and monitoring, saving observer effort and time, while also avoiding bias through presence and disturbance (Rovero, 2006; O'Connell *et al.*, 2011; Neidballa *et al.*, 2015). Trials of arboreal camera traps in high canopies have been carried out in remote areas of the Peruvian Amazon and mountains of south-central Tanzania with overall success (Gregory *et al.*, 2014; Rovero *et al.*, 2014; Bowler *et al.*, 2017).

The nocturnal mammal community within the Dzanga-Sangha Protected Areas (APDS), southwestern Central African Republic, is relatively unknown, particularly regarding the stability of arboreal mammal populations. In 2018, one golden angwantibo (*Arctocebus aureus*), a notoriously cryptic species, was caught on camera trap within the Dzanga-Sangha National Park (Fuh T, Pers. Comm. 2019). I conducted an inventory-style survey to report on the nocturnal mammals in the APDS and used camera traps as one of my methods.

The APDS includes the Dzanga-Sangha Special Reserve, Dzanga-Ndoki National Park, pre-park buffer zones and the community hunting zone. The APDS has been protected by the World Wildlife Fund (WWF) since 1990 due to the large population of forest elephants (*Loxodonta cyclotis*) and western lowland gorillas (*Gorilla gorilla*). Cryptic mammals in the APDS include Milne-Edwards's pottos (*Perodicticus edwardsi*), African palm civets (*Nandinia binotata*), giant ground and tree pangolins (*Phataginus* and *Smutsia* spp.) and African golden cat (*Caracal aurata*).

I placed four motion activated Apeman 12MP 1080P Trail wildlife camera traps with infrared night vision and one Bushnell camera across six study sites (Fig. 1) to capture nocturnal mammal activity over 29 nights in the APDS to complement walking surveys. Cameras were positioned at 07:00–10:00 and 08:00–11:00, and at random places on trees between 1.23–18 m high, (mean height = 7.38 m) to seek arboreal nocturnal mammals (Rovero *et al.*, 2014). The cameras were moved every 1-3 days for 29 days, following methodology by Shannon *et al.* (2014) proposing regular movement would create better estimations for surveys of rare and elusive species and maximise detection. I checked the memory cards twice weekly and batteries were recharged every week. I used a passive sampling approach that did not use lures, such as sugar water, to attract animals to the camera sites.

Cameras were positioned unsystematically due to presence of elephants, the opportunistic discovery of potential sleeping sites or facing areas of continuous dense canopy, including a variation of substrate sizes. Cameras were set to record one photograph and one subsequent 10-second video, the time and date of the images and the temperature in Celsius (Jennings *et al.*, 2015).
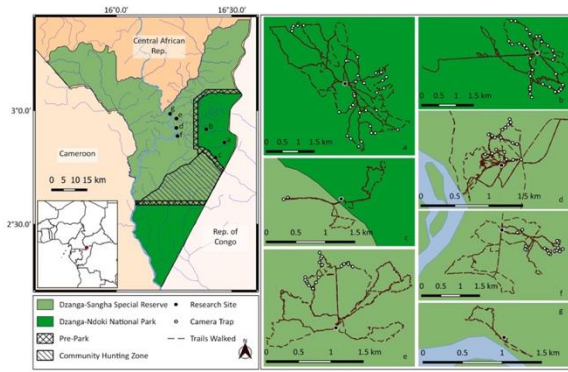
Figure 1. Map of Dzanga-Sangha Special Reserve, Central African Republic and locations of camps and camera traps in seven study sites: a) Bai Ho'kou forest camp; b) Mongambe forest camp; c) Kongana forest camp; d) Bayanga village; e) Mossapoula village; f) Yandoumbé village; g) Sangha Lodge (no cameras).

Camera footage was classified as nocturnal after sunset at 18:00 and before sunrise at 05:30. Camera locations were recorded using a Garmin hand-held GPS, then mapped in BaseCamp and presented in maps produced in QGIS 3.6.3.

Trapping effort across 29 nights (n=80 camera points) resulted in few images (Table 1). No images were captured at Kongana forest camp and cameras were not used at Sangha Lodge. A total of 16 nocturnal camera footage was taken, of which 11 images or videos showed animal activity across four sites. Nocturnal footage mainly displayed mammals, such as bats (*Chiroptera* spp., n=4) (Fig. 2b), one image each of a giant forest hog *(Hylochoerus meinertzhageni)* and a squirrel (*Paraxerus/ Protoxerus* spp.) and one image of an unidentified galago (*Sciurocheirus gabonensis/ Galagoides thomasi/ Galagoides demidovii*).

Cameras also recorded some diurnal species (n=24 images), such as moustached guenons

(*Cercopithecus cephus*, n=4; 09:47, 14:36, 14:41, 15:00) in Bayanga village and elephants (n= 2; 07:14) in Bai Ho'kou forest camp. Butterflies (*Lepidoptera* spp.) were recorded at three sites and five birds were recorded in the national park, including a vocalising red-billed dwarf hornbill (*Lophocerus camurus*) in Mongambe. Five diurnal squirrels (*Heliosciurus/ Paraxerus/ Protexurus* spp.) were filmed (n=3 in national park; n=2 in Bayanga village).

Study site	Total nocturnal images	Species captured	Time image captured (hour/minute)
Bai Ho'kou[#]	3	- Bat (*Chiroptera* spp.)[§]	01:21
		- Giant forest hog (*H. meinertzhageni*)[§] (Figure 2c)	21:28
		- Squirrel (*Paraxerus/ Protoxerus* spp.)[§]	23:03
Bayanga[¶]	4	- Moustached guenon (*C. cephus*)[†§]	18:18, 18:19
		- Galago (*Sciurocheirus/Galagoides* spp.)[†]	01:14
Mossapoula[¶]	3	- Bat (*Chiroptera* spp.)[§§] (Figure 2b)	03:34, 04:47
		- Moth (*Lepidoptera* spp.)[§]	18:33
Yandoumbé[¶]	1	- Bat (*Chiroptera* spp.)[§]	00:53

Table 1: Record of all photos (†) and videos (§) of nocturnal activity captured by motion-activated cameras within the Dzanga-Sangha National Park (#) and villages in the Dzanga-Sangha Protected Areas (APDS), Central African Republic across 29 nights.
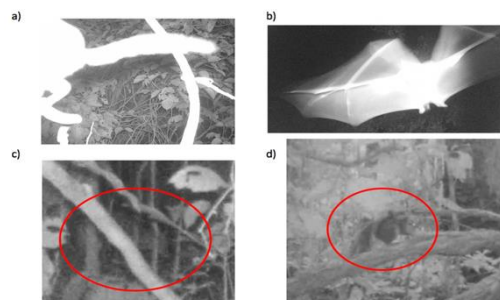
Figure 2. Camera trap footage of nocturnal mammals in Dzanga-Sangha Protected Areas, Central African Republic: a) Unidentified galago (*Sciurocheirus/ Galagoides* spp.); b) Bat (*Chiroptera* spp.); c) Giant forest hog (*Hylochoerus meinertzhageni*); d) Squirrel (*Paraxerus/ Protoxerus* spp.).

This was a short-term study with a very small sample size, though the results have shown that there is scope for using motion-activated cameras in detecting nocturnal mammals in

areas of dense forest. I believe that camera traps should be utilised for long-term studies on rare and elusive nocturnal mammals rather than short-term, because species such as pottos and angwantibos are very sensitive to novel objects in their environment and use their heightened olfactory senses to determine their nightly paths (Charles-Dominique, 1977; Dominy *et al.*, 2001). In contrast to Shannon, et al. (2014), it is likely that by moving the cameras and disturbing certain areas every 1-3 days, the more sensitive animals would be less inclined to approach or pass-by the cameras than if they became habituated to them over a longer time period.

Long-term camera trap studies of cryptic nocturnal mammals can allow for abundance estimates, identification of individuals and be used to estimate home ranges. Additionally, footage from camera traps may be used to increase public interest in species conservation action (Marshall & Wich, 2016). By maximising opportunities to find elusive species, it is possible for scientists to understand more about their populations, distribution and behavioural ecology. The IUCN Red List is updated regularly with the continual publication of data from field scientists (IUCN, 2019). Many of the night-active species in the APDS are listed as Least Concern, such as the golden angwantibo or blue duiker (*Philantomba monticola*), although the trends of many species' populations are known to be decreasing, or unknown, like the African palm civet (*N. binotata*) (Gaubert *et al.*, 2015). The pangolin species present in the APDS (*Phataginus tricuspis*, *Phataginus tetradactyla,* and *Smutsia gigantea*) are listed as Vulnerable (A4d) with declining populations (Waterman *et al.*, 2014).

Motion-activated camera traps can be used to capture cryptic nocturnal mammals, of which data can assist in accuracy of updated IUCN Red List assessments. Camera traps can be used in addition to walking surveys, behavioural observations and other methods.

This was one of few surveys to use camera traps to specifically investigate nocturnal mammals in the APDS, Central African Republic. This is an important region for biodiversity and there is a wealth of information to discover regarding nocturnal communities over future long-term studies, whether in the Central African Republic or in other understudied African forests.

REFERENCES

Bowler MT *et al.* (2017). Estimating mammalian species richness and occupancy in tropical forest canopies with arboreal camera traps. *Remote Sensing in Ecology and Conservation*, 3: 146-157.

Charles-Dominique P (1977). *Ecology and Behaviour of Nocturnal Primates: Prosimians of Equatorial West Africa*. New York: Columbia University Press.

Dominy NJ *et al.* (2001). Ecological importance of tricromatic vision to primates. *Nature*, 410: 363-366.

Duckworth JW (1998). The difficulty of estimating population densities of nocturnal forest mammals from transect counts of animals. *Journal of Zoology*, 246: 466-468.

Gaubert P *et al.* (2015). *Nandinia binotata*. The IUCN Red List of Threatened Species, e.T41589A45204645. Retrieved on 23/08/19.

Gregory T *et al.* (2014). Arboreal camera trapping: taking a proven method to new heights. *Methods in Ecology and Evolution*, 5: 443–451.

IUCN (2019). Red List of Threatened Species, Received on 14/01/19 from: https://www.iucnredlist.org.

Jennings AP *et al*. (2015). Diversity and occupancy of small carnivores within oil palm plantations in Central Sumatra, Indonesia. *Mammal Research*, 60: 181-188.

Marshall AJ & Wich SA (2016). Some future directions for primate conservation research. In: Wich SA & Marshall AJ (eds.). *An Introduction to Primate Conservation*, Oxford: Oxford University Press, pp. 287-296.

Neilson EW *et al.* (2018). Animal movement affects interpretation of occupancy models from camera-trap surveys of unmarked animals. *Ecosphere Journals*, 9 (1): 1-15.

Niedballa J *et al.* (2015). Defining habitat covariates in camera-trap based occupancy studies. *Scientific Reports*, 5: 1-10.

O'Connell AF *et al.* (2011). *Camera Traps in Animal Ecology, Methods and Analysis*. Japan: Springer.

Rovero F (2006). *Camera Trapping for Wildlife Research: Data in the Wild*. Exeter: Pelagic Publishing.

Rovero F *et al.* (2014). Estimating species richness and modelling habitat preferences of tropical forest mammals from camera trap data. *PLoS One*, 9(7): e103300.

Shannon G *et al.* (2014). Recommended survey designs for occupancy modelling using motion activated cameras: Insights from empirical wildlife data. *PeerJ*, 2: e532.

Waterman C *et al.* (2014). *Phataginus tricuspis.* The IUCN Red List of Threatened Species, e.T12767A45223135. Retrieved on 23/08/19.

2023-2024 Cohort of the MSc Primate Conservation

Come visit us on the web!
http://www.brookes.ac.uk/primates

𝕏 f @PrimConsOBU

@primate_conservation_obu