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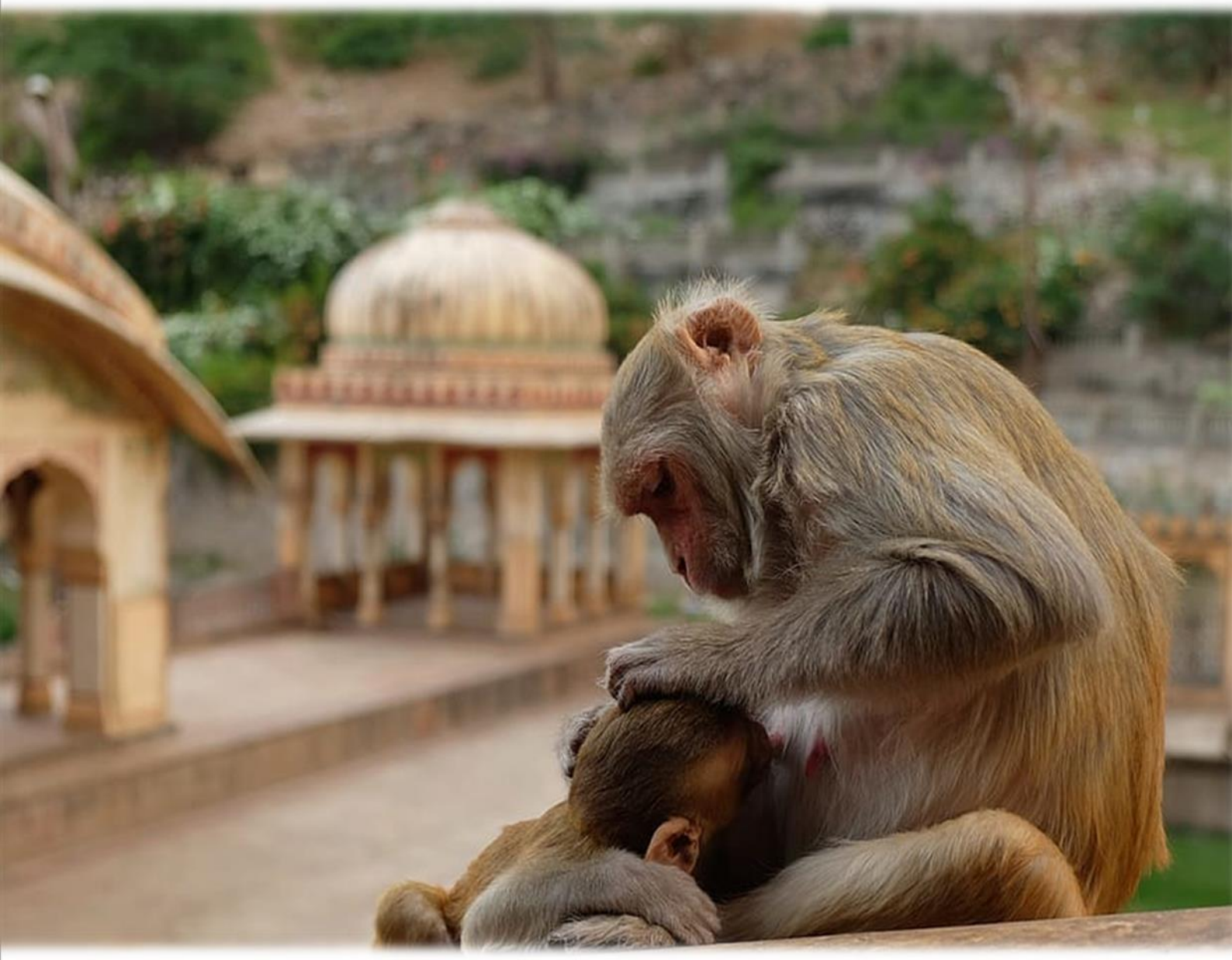

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Front Cover
Rhesus macaques (*Macaca mulatta*) at a temple in Jaipur, India. Photo free for commercial use.

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Letter from the Editors

Welcome to the spring edition of Canopy 2023, the in-house journal of the MSc in Primate Conservation at Oxford Brookes University. In this issue, we present a selection of studies that have been carried out over the past few years by alumni, as part of their Primate Conservation degree. Our selection all cover human-primate interaction and anthropology related topics. Given the phylogenetic proximity between human and non-human primates and their increasing cohabitation, we deemed this topic exciting and particularly relevant to primate conservation.

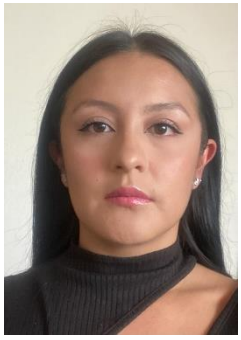
In some situations people-primate interaction can be problematic and human-primate proximity can lead to negative outcomes such as hunting, primates being considered as pest or crop-foraging issues occurring. In other situations, communities neighbouring primate populations can build positive relationships with the primates and co-exist effectively. Importantly, people living within primate ranges can genuinely help conservationists to understand more about human-primate interactions and tailor effective conservation strategies. Investigating conflicting human-primate interactions is also critical. Since they can have a drastic negative impact on primate populations, any attempt to protect primates without understanding interactions they have with neighbouring people is deemed to fail.

Human-primate interaction can also be considered in a broader way. Therefore, in this issue of Canopy we have included articles addressing this subject as a whole, from the use of primates in medicine to the evolutionary link between human and non-human primates. As humans and aspiring conservationists, we are fully part of the human-primate interaction and as such we have a role in ensuring there is no further decline of our primate relatives.

During our year on the Primate Conservation degree here at Oxford Brookes University, we have all been inspired by our lectures, our teachers and the many experiences we have been through, so we hope that you will feel the same when reading this new Canopy issue.

Best regards,

Yola Burger, Dayanna López and Lou Savigny


Letter from a Module Leader

When reading the selection of articles for this issue I was delighted to see the focus on the influence of humans on primate conservation across a very broad range of topics.

The contributions in this issue include some of our recent alumni as well as work carried out over the last 10 years. This work remains relevant to primate conservation to elucidate the complexities of the interactions between humans and non-human primates. The work presented ranges from fieldwork and desk-based studies and highlights the value of both approaches. Conservation (of all species not only primates) requires a range of skills and approaches to ensure we have the most complete set of data to inform conservation actions.

The selection of articles in this issue ranges from understanding our ancestor's behaviour (Bowen) to understanding how our positionality affects primate conservation in specific cases in Peru (Anca) and Brazil (Knoop). Looking at culture (Nilsen) and using this as a possible basis for assessing the impact of humans on primates and possible loss of culture (especially in rescue centres). On the health side both use of primates as traditional medicine and the cultural implications are important to document (Westwood) and a topic which will have much focus going forward is the effects (past and ongoing) of Covid-19 (Holl). Similarly, where there are regular interactions with non-human primates, accidental tourism, these interactions are essential to understand (du Trevou).

For me personally I see the deep importance of including people in the conversation about conservation, both those who live and work in primate habitats and those of us who do not. The links between primates, humans, culture and our shared history are important to understand but also to document. E.g. myths and legends about primates which may be lost if we do not write them down and preserve them for future generations. The local ecological knowledge is vital to understand the complex interactions between people and primates and how these vary over time, space, culture (ours and primates!) and to combine this into direct conservation actions.

Ultimately, I believe that humans are the causes of so many problems in primate conservation, but we can also be the source of the many solutions needed to tackle these issues.

But we do need good empirical science, from different disciplines, to ensure we are making the right decisions based on the best knowledge.

Dr Susan M Cheyne

Module Leader Primate Conservation: Apes in the Anthropocene and Captive Management & Rehabilitation

Primates as traditional medicine in Mihintale, Sri Lanka

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One of the greatest threats to primate species, with low populations, is hunting. In Africa, primates are often hunted for bushmeat, to either be sold at markets or for subsistence (Barnes, 2002; Vanthomme *et al*., 2010), a phenomena also encountered in Asia and America (Peres, 1990; Nijman, 2010). Primate species are particularly vulnerable to hunting due to their slow life histories, large bodies, and large social groups (Nasi *et al.,* 2008). The effectiveness of firearms has increased the efficiency of human hunters and threatens some animal species with extinction, for example, it is suspected that Miss Waldron's red colobus (*Procolobus badius waldroni*) became extinct due to hunting (Oates *et al*., 2000). Bushmeat hunting has been closely linked to poverty, due to its capacity to provide families with a secondary income and an important source of protein (Nasi *et al.,* 2011). Traditional medicines can be another cause for hunting. Indeed, primates are used for a vast array of treatments in many traditional medical systems (Alves *et al.,* 2010). Those used in traditional Chinese medicine are at particular risk due to the high demand and established trade routes. Nevertheless, hunting of certain species may be taboo or preferred, all of which will vary between communities and cultures (Ross *et al*., 1978; Colding & Folke, 2001). Furthermore, hunting primates do not only impact primate populations but negatively affect the forest ecosystem as well. Many primate species act as seed dispersers, as a result, a decline in their populations decreases the health of the forest overall (Nunez-Iturri *et al.,* 2008). Laws are often in place to protect endangered wildlife against hunting, but this does not always effectively reduce hunting levels because of the generally weak law enforcement and growing demands of products. In addition to this, human populations growth put pressure on natural resources and a weak law enforcement combined with a lack of prosecutions renders the practices effectively legal (Nasi *et al.,* 2008).

Mihintale Sanctuary, where the research was conducted, is located 11 miles from the ancient capital city of Sri Lanka; Anuradhapura. Situated in the central north of the country, it lays in the dry climatic zone. The vast majority of people living in the area are small-scale farmers and small business

owners. The habitat surrounding the 999 hectares big wildlife sanctuary is extremely degraded and fragmented.

Within the sanctuary is the religious and historic site and outside of the sanctuary dry, secondary forest is dispersed with villages and plantations, largely paddy fields. In this area, four species are present; toque macaque (*Macaca sinica*), grey langur (*Semnopithecus priam thersites*), purple-faced leaf monkey (*Trachypithecus vetulus*), and slender loris (*Loris lydekkerianus*). The toque macaques and grey langurs being the most commonly seen primates in the area.

Data collection occured between 2nd of June and 13th of July 2018. A boom in transitory population and dry conditions characterise this time of the year, which was expected to impact the behaviour of both the humans and the primates. Although dry weather conditions, vendors, farmers and primates benefited from seasonal fruits, such as mango and jackfruit, which were in season throughout June and July.

A translator was present for all interviews that were all conducted in Sinhalese. The translation went smoothly with all participants appearing to be comfortable with the method of communication. All participants were ethnically Sri Lankan and had lived in Sri Lanka for the majority of their lives. The interviews varied in length, with most interviews lasting between 20 to 30 minutes. Interviews with the villagers were conducted at their home, permission to enter the property was given verbally by the participant. Informed consent and permission to proceed with interviews were obtained immediately prior to the interview. Additional consent was gained for permission to audio records the interview. All participants gave their consent.

When most participants spoke about hunting, it was for subsistence or commercial gain. There was another, lesser-known, motivation for hunting in the area; hunting for products used in traditional medicine. One interview with the traditional local doctor (which is distinct from Ayurvedic medicine, also common in Sri Lanka) revealed that he used animal products in a variety of treatments. The products ranged from legal substances, such as cow's milk, to substrates taken from protected species, like a tiger. The doctor reported two uses of macaques, where the kidney and lungs are mixed into a medicine which was ingested by the patient to reduce swelling. These ingredients are collected only when required for immediate treatment. The traditional doctor was unclear as to why he did not store the animal products for future use. He implied that freshness was important, however, considering the illegal status of

using these species, at least part of the reason appears to be to avoid prosecution. The doctor admitted that he was aware that such practice was illegal and considered a “minus mark” in the Buddhist faith. He explained that the hunting is permissible because it is to heal a patient and not for personal gain. However, he employs a younger man to do the hunting for him. It could take up to two weeks as it is an illegal activity and therefore can be difficult. Despite this, when asked, "which are the hardest medicines to come by?” animal-based ingredients did not feature. Since the traditional doctor was practising in the area, it is presumed that, despite the reports of other participants, there is at least one individual still hunting within the sanctuary at the time of the interviews. I asked how the traditional doctor coped when he was unable to acquire an ingredient for a medicine, he responded with a brief story about the use of a tiger’s neck: “40 years ago the tigers are here. Then I use them as medicine, now no tigers. Because of that I use plants instead.” He went on to confirm that plant-based substitutes for many animal ingredients are possible, though they are not as effective.

The villagers were asked about their knowledge and experience with traditional medicine. All of them responded that they had used traditional medicine at least once. Two of the participants stated that they favoured using traditional medicine over western for any ailment. Most participants reported using both types and favouring one or the other for a particular illness. There was a consensus among the participants that traditional medicine was superior at treating physical injuries, particularly broken bones. They said that traditional medicine was able to completely heal a broken bone in anywhere between one hour to four days. The respondents preferred traditional medical methods as no cuts or incisions are made, and they claimed that there are never any side effects to the treatments, unlike in western medicine. The villagers were unable to tell me what the type of ingredients used for the medicines were, beyond that they were mainly plants and herbs. None seemed aware that wild animal products were ever used.

The Sri Lankan traditional medicine practice recorded in this study is consistent with those recorded in previous studies (Nahallage & Huffman, 2013). There are some notable differences such as the uses of primates as medicine that appears to be more limited in the area than previous studies would indicate. Only one use was cited (swelling) as opposed to five one found by Nahallage and Huffman (2013) in the northern central province. There was also no mention of lorises being used for traditional medicine, which has been found in previous studies (Nekaris & Jayewardene,

2004; Alves *et al*., 2010). The reason for that may be that the participating doctor does not personally use lorises or that it is not practised in the north central province (Nahallage & Huffman, 2013).

The variation found between mine and previous studies suggests that Sri Lankan traditional medicine is mutable and diverse. With uses of primates varying according to practitioners and specific regions, it is not clear what the threat to primates and other species is region to region. Whilst it is likely that offtake rates of hunting for traditional medicine remains low nationwide, it is possible that certain primate populations are, at least in part, in danger due to local variation and demand for treatments. Primates being used in traditional medicine is not unique to Sri Lanka, it is found in different countries across Asia, Africa, and the Americas (Alves *et al*., 2010). Indeed, traditional medicine is responsible for dramatic drops in the population of hunted species and is a driver in biodiversity loss. Increased enforcement of protective laws has been shown to reduce hunting and be effective at reducing the impact of traditional medicine on biodiversity loss (Wellsmith, 2011; N'goran *et al.,* 2012). I think that the strict and effective law enforcement has decreased the amount of hunting for traditional medicine in Mihintale Sanctuary. The fact that the doctor does not store any of the animal ingredients may be due to the threat of criminal charges. Thus, hunting only takes place when needed and this has reduced the take-off to the bare minimum. During the interview, the traditional doctor stated that he used plant alternatives to "tiger neck" to treat respiratory problems. He went on to say that alternatives are possible for substrates that are hard to obtain. For Sri Lankan traditional medicine, plant alternatives may provide relief for other species population. Other traditional forms of medicine may also be able to find alternatives for this purpose (Luo *et al.,* 2013). With targeted education and co-operative projects, this could provide a plausible solution, as all respondents had used traditional medicine at one point in their life.

The use of primates in traditional medicine at Mihintale does not currently threaten their populations. However, there is a chance that this is not the case everywhere in Sri Lanka. With variations in species and prevalence of use, it is possible that some primate populations are under pressure from traditional medicine use.

Although Buddhism fosters protective attitudes towards wildlife, its cosmology also forms the foundation of traditional medical practices. Thus, Buddhism contributes to both

the harvesting of primates as a resource and their protection. Further investigation into traditional medicine popularity and wildlife use across Sri Lanka would reveal if any wild population is under threat.

Mihintale can provide an excellent case study for conservationists involved in traditional medicine usage and research. The combination of law enforcement, alternative substrates, and cultural belief in the area has suppressed the use of primates in traditional medicine to low levels. If not managed, the use of traditional medicine may threaten populations of wildlife in fragmented forest areas in Sri Lanka. If the traditional medicine is likely to continue, along with its use of wild animal products, education programmes to inform use of wildlife in the medicine may generate public support for the prevention of over-harvesting and protections for wildlife.

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The effects of COVID-19 in primate range countries: Case studies in Sierra Leone and Uganda

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As conservation is a solution-oriented discipline, it is our responsibility to encourage and develop practices that mitigate the challenges it faces. This is particularly true in nonhuman primate range (hereafter referred to as primates) countries. Indeed, these areas are affected by the widening of the human-primate interface, increasing the frequency and severity of negative human-primate interactions. Local community involvement and support is therefore essential to creating effective primate conservation strategies (Madden, 2004).

The emergence of SARS-CoV-2 and the subsequent response to the COVID-19 pandemic have created new and unforeseen challenges in the research community, particularly in marginalised communities around the world (Buheji *et al.*, 2020). Shutdowns due to COVID-19 coupled with already limited conservation funding intensified existing restrictions that prevented researchers and practitioners from connecting and distributing resources (Sevelius *et al.*, 2020). Travel restrictions related to COVID-19, the closure of many universities, and the redirection of financial funds from funding agencies have had many consequences, including gaps in research and even project interruptions. Communities living in biodiverse landscapes of high conservation priority have also seen their resource flows impacted (Corlett *et al.*, 2020).

I explored the effects of the COVID-19 pandemic on conservation programs that use a community-centred approach to primate conservation in Sierra Leone and Uganda. These regions represent two demographics of marginalized communities living in poverty that have been heavily impacted by the COVID-19 pandemic, and that live in close proximity to vulnerable primate species.

The Pan Verus Project (PVP) in Sierra Leone was chosen because of the 2014-2015 Ebola outbreak, providing a unique foundation for public response to health crises. Meanwhile the Bulindi Chimpanzee and Community Project (BCCP) in Uganda, was chosen because of long-standing (16 years) research in an unprotected area with intense overlap of human farmland and eastern chimpanzee (*Pan troglodytes schweinfurthii*) populations.

Understanding the impacts of the COVID-19 pandemic on primate conservation efforts through the lens of poverty reduction strategies provides insight into how to improve the resilience of similar projects. This means focusing on the ability of a

conservation program to adapt to changing landscapes and pressures on the people involved, rather than on achieving biodiversity goals. This approach also allows for a deeper examination of the relationship between poverty alleviation and primate species conservation, as well as the path to more equitable conservation solutions.

I conducted semi-structured interviews consisting of open-ended questions with members of the PVP team in order to better understand their experience working throughout the COVID-19 pandemic. Interviews were conducted via voice messages to accommodate for poor network connectivity and occurred between the months of June and August 2022. All interviews were transcribed verbatim and coded for relevant and recurring themes. I used a systematic coding method involving primary, secondary, and tertiary codes that allowed for the varying level of detail provided by the respondents. Frequency data was calculated for each code to determine how often a theme was expressed within the group.

For the BCCP team I was advised by the director to create a questionnaire due to worsening network connectivity at their field site, and the inability for some members of the staff to understand my accent when speaking English. The questionnaire administered to the Bulindi staff was developed after completing the provisional analysis of the semi-structured interviews from the PVP sample. Key themes and perspectives demonstrated in PVP interview data were used as a guide to develop the questionnaire for BCCP staff. A mixed questionnaire of 11 questions was created, including both closed-ended and open-ended questions. The closed-ended questions were created using a Likert scale to reflect the various experiences of each participant throughout the COVID-19 pandemic. A PDF of the survey was sent to the BCCP director, and printed copies of the survey were distributed to staff members who wished to participate. Clear images of the completed questionnaires were then emailed to me for analysis. In a second time, median values were calculated for all Likert scale questions and written responses to open-ended questions were coded to identify relevant themes and patterns. Ethical clearance for my research was granted by Oxford Brookes University.

Responses from the PVP and BCCP teams demonstrated the ability of community-centred conservation programs to recover relatively quickly from the challenges presented during the COVID-19 pandemic. This shows how supporting local conservationists by providing tangible skills and resources to grow local capacity can alleviate the socioeconomic pressures acting on communities living alongside vulnerable primate species. Therefore, empowering resident conservationists to be stewards of

their own environments, and promoting community participation towards long lasting and resilient conservation agendas. By incorporating local community perspective throughout all stages from conception to implementation, conservation programs are able to reflect and adapt to the goals and needs of those communities who are directly impacted by the presence of primate populations. Thus, creating equitable and sustainable conservation solutions that serve local communities and the primate populations we wish to preserve.

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Ethnoprimatology in the Peruvian Amazon and the role of positionality

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In the Anthropocene, a proposed epoch defined by human impact on nature (Lewis & Maslin, 2015), conservation can only take place when considering human perspectives, motivations, needs, and cultures. Such approaches are of increasing importance under the growing human impact and the growing number of threatened non-human primates, our closest living relatives. Ethnoprimatology has emerged from the fields of Primatology and Anthropology, which makes it a rounded approach to studying human primate interactions and the complex relationships that affect their behaviour and ecology (Dore *et al*., 2017). In post-colonial societies, conservation initiatives are often seen as 'regimes' that exclude local communities, their knowledge systems and livelihoods, leading to negative sentiments towards conservation (Amir, 2019). While many primate conservation issues in the tropics are rooted in poverty (Estrada, 2013),

indigenous people and livelihoods are overlooked in this context too. The inclusion and understanding of local and indigenous communities, living in and around national parks, and protected or unprotected areas high in biodiversity are crucial for the conservation and protection of species.

The role indigenous people play in conservation through their reliance on and preservation of ecosystems is long known (Fernández-Llamazares *et al*., 2021). Concerning primate conservation, the protection of indigenous people and their lands was found crucial, as more than 71% of the world's primate ranges overlap with indigenous people's lands (Estrada *et al*., 2022). A good example of this overlap is the Amazon rainforest, one of the most biologically and culturally diverse places in the world, and an important place to study human primate interactions and the sociocultural context in which they occur. With a growing human population threatening this fragile ecosystem and one of its most important regenerating parties - primates - my study focused on human primate interactions in the upper Ucayali River, Peru. In my ethnoprimatological study, I focused on one of the largest groups in the Peruvian Amazon - the Shipibo.

I combined qualitative and quantitative methods, using line transects along with free listing, semi-structured interviews and participant observation to learn about primates from indigenous Shipibo and from surveys. My interviews focused on Shipibo food preferences and how they perceive the presence and depletion of wild animals in their environment. Doing so, instead of determining the local conservation issues myself, I let the local people define themselves; the changes they see in their environment and the reasons for it. Transect surveys were carried out near the indigenous Shipibo community, in which interviews were conducted. This study was the first to provide an overview of the cultural role primates hold in Shipibo culture. Despite increasing contact of indigenous Shipibo with modern society, primates remain important in their culture, mythology and subsistence. Primates are preferred species as pets and as food among the Shipibo, as in other Amazonian groups (Urbani & Lizarralde, 2020). However, this study documented severe depletion of medium-bodied primates and large-bodied primates likely driven to local extinction around the indigenous community.

Some of the threats to primates come from overhunting and the pet trade (Estrada *et al*., 2017), and these can be witnessed first-hand when studying primates and their interactions with humans. In this ethnoprimatological study, I not only witnessed these activities but also explored them. When studying interactions between humans and primates and trying to understand other people's experiences of our study subjects from a non-

conservation perspective, we often encounter conflicts. While descending into different cultural and social circumstances, our preconceptions play a role in our experience, from data collection to interpretation (Cardinal *et al*., 2022). While our positionality may mean we can't be completely unbiased, to overcome this challenge in the best possible way we need to reflect on these biases, how they came into play during our study and how they may have affected its outcomes (Moon *et al*., 2019).

Previous experience working with human participants from various cultures could not prepare me enough for the unique circumstances I witnessed in this study. As a conservationist, vegan, environmental activist, and primatologist, I experienced conflicts between different values and ideologies. Despite these being valuable observations in my study, together with my appreciation and respect for traditional practices and preservation of cultural heritage, my emotional difficulty witnessing these moments could have been perceived from my behaviour. Here I share some of the most powerful and conflicting experiences and reflections during my study.

Primates as food: When I saw primates hunted (Fig. 1), butchered, cooked and eaten, thoughts on how to stop this were always in my mind. These thoughts were not only a result of my positionality as a primatologist and conservationist but also as a vegan and my compassion for animals. But thinking about my ROLE as a conservationist and why I travelled all the way to interview these people and immerse myself in the community, I realised I was here to observe human primate interactions, learn about them and identify ways to reduce pressure on primate populations while respecting the local culture and people needs. As a part of my intention to participate and engage with the Shipibo ways of life and learn about their food preferences, I consumed the same food they consumed.

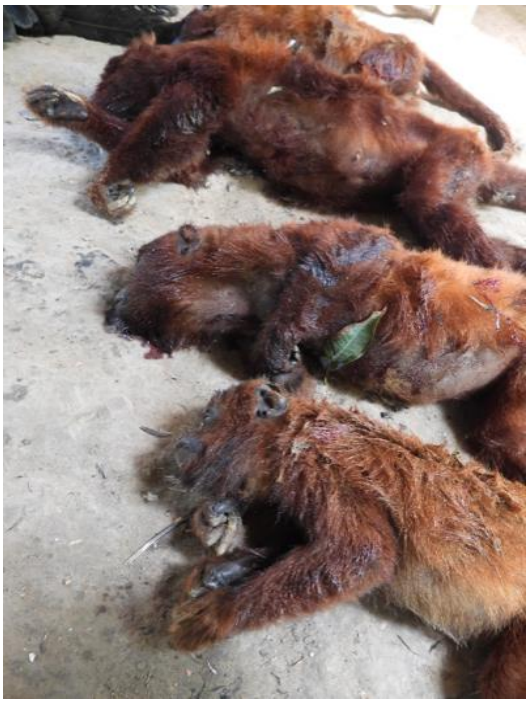

Figure 1. A family of *Alouatta seniculus* brought by hunters returning from a hunting trip.

Luckily, I wasn't confronted with having to eat primates. Despite families consuming it near me, it was never offered to me, as my interest in primates was acknowledged and obvious. This already means they assume I will not eat the food they consider 'their

culture' and this may influence their responses in interviews. With that in mind, this study showed that primates are an important and preferred species for consumption and bring valuable information to incorporate in future conservation strategies in the area.

Primates as pets: Seeing my study subjects used as pets and often in distress was not easy. Most of the pet primates I saw in the village and surrounding areas were tied with strings or chains, their movement was limited and they were usually in distress (Fig. 2). As a primatologist, I was able to tell these primates were in distress but the local people didn't see things the way I saw or did not care as much as I did. I heard a lot about primates that lasted as pets for only weeks or sometimes, months. This was painful for me, but pet primate keeping is a cultural costume that has been practiced for hundreds of years and pet primates are seen as important for women and children and as an adornment in the house that can improve the mood of people and be seen as a family member. Respecting the cultural uses of primates, I had to also look at the bigger picture, conserving primate populations and also learning the cultural importance of primates in order to engage the people with future conservation initiatives, and one of the cultural narratives is pet keeping.

Commercial hunting: During my study, I witnessed the purchasing of primate meat hunted commercially, which is illegal as a threat to biodiversity. As a researcher, it was not my place to report to the authorities about these issues but rather, to observe and remain impartial.

Figure 2. Top left: *Saguinus mystax*; Top right: *Ateles chamek*; Bottom left: *Plecturocebus discolor*; Bottom right: *Aotus nigriceps*.

Despite being an environmental activist, and a conservationist, enquiring about illegal activities could risk me and the community members that engage in them. However, by taking my role as a social scientist, I tried to learn more about the need for purchasing wild meat through daily conversations with community members. I learned that preferred animal species for consumption, such as large-bodied primates and other large mammals are scarce around the community, but can be found further upriver, where logging companies and other forestry concessions are. As many community

members don't have the time, means or own a boat to go for long hunting trips, they purchase meat from the people who work in these concessions. This gave me a better understanding of the motivations behind local commercial hunting and this could serve future approaches to find solutions and reduce commercial hunting of primates.

This study brought further evidence of primate depletion around indigenous communities in the Amazon and sheds light on the cultural context of an area rich in biodiversity and highlights the need for an inclusive ethnoprimatological approach to protect primates, preserve indigenous heritage and improve local livelihoods. Taking an ethnoprimatological approach with local communities and indigenous people must come with careful consideration. When studying human primate interactions in different sociocultural contexts, it is crucial to overcome our preconceptions as much as we can while still acknowledging we can never be completely unbiased. Reflecting on our research as conservationists and our positionality can help us understand not only the quality of our data but also what led to the interpretation of our results (Moon *et al*., 2019). With that in mind, we as conservationists should strive to get the best outcomes from our research, by alternating between our roles as conservation researchers and social scientists and with every step determine which role would lead to the best outcomes for our data. Reflections on our positionality provide transparency and can help both us and the readers of our work better interpret its results.

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An introduction to cultural behaviours in non-human primates

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In non-human primates, culture is described as the variance of gathered traditions, behaviours and adaptive information between groups of similar populations that is passed down from generation to generation (Danchin *et al.*, 2013; Musgrave *et al.*, 2016). Traits are considered to be cultural if it is shown by most or all individuals in the social group, or by several relevant individuals of the social group within one site and absent in other sites with similar ecology (van Schaik *et al.*, 2003).

Cultural behaviours range from materialistic traits such as constructing tools or shelter, food acquisition methods, communicative or social interactions (Sapolsky, 2006). These behavioural traits are transmitted between generations through social learning (Musgrave *et al.*, 2016). Social learning allows naive individuals the acquisition of adaptive behaviours more rapidly whilst avoiding costs such as time, energy and risks of predation during individual exploration (Vale *et al.*, 2021). Cultural behaviours and social learning can also be looked at as intimately linked as these behaviours are built upon members of new generations observing and acquiring the behaviours from their peers (Moore, 2013). There are many forms of social learning and for primates, imitation and observing others to acquire the necessary skill sets for survival (Fragaszy *et al.*, 2013). Young orangutans (*Pongo* spp.) will "peer", a form of attentive close-range watching of their mothers and then practice the behaviours afterwards to hone their skill sets (Schuppli *et al.*, 2016).

The transmission of cultural behaviours between individuals occur in three ways, horizontally among members of the same generation, obliquely from non-parental members of the previous generation or vertically between parent and offspring (Danchin *et al.*, 2013). Tufted capuchin monkeys (*Cebus apella*) have been known to choose their observational models based on dominance rank or age as these individuals are most likely to be proficient compared to socially close individuals (Coelho *et al.*, 2015). For most primates, vertical transmission is mostly common due to the mother-infant relationship during ontogeny (van de Waal, 2014). For vervet monkeys (*Chlorocebus aethiops*), females spend their life in the same group range, serving as the primary model for learning about foraging compared to males as they migrate between groups (van de Waal, 2014).

Chimpanzees (*Pan troglodytes*) are well documented and have the largest set of cultural behavioural examples with their

social and cognitive complexity and widespread population distribution across Africa (Sapolsky, 2006). Cultural differences can be seen among neighbouring communities during tool use, social customs and foraging styles (Luncz & Boesch, 2014). Immigrated female chimpanzees has also been found to change their behaviour over time and adapt to a new communities behavioural pattern for tool choice, thus retaining the local tradition of the social group (Luncz & Boesch, 2014).

During a study of chimpanzees' selection of hammers to crack the *Coula edulis* nut, three adjacent communities were found to have different preferences over stone and wooden hammer. In one group, large wooden hammers were used throughout the *Coula* season though stone hammers are predominantly used. Other groups would start with using stone hammers and gradually switch to wooden hammers as the nuts grew less resistant, with the one of these groups having a faster decline of stone hammers than the other (Luncz *et al.*, 2012).

The challenge of studying cultural behaviours in animals is to differentiate between comparisons done between populations separated by large geographical distances, that may also have different ecological and niche environments. With the exclusion of ecological and genetic variations as factors for different cultural behaviours between similar populations, many researchers have debated on what culture is in non-human animal species (Luncz *et al.*, 2012).

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Did *Homo erectus* eat other apes: A discussion on sympatry, predation and competition of extinct African apes

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Unlike orangutans (*Pongo* spp.) and bonobos (*Pan paniscus*) the common chimpanzee (*Pan troglodytes*) frequently shares its home range with other great apes, namely gorillas (*Gorilla* spp.) (Head *et al.*, 2011). Sympatry between African apes is a phenomenon with a long precedent dating back to the time of *Homo erectus* and *Paranthropus boisei* 1.34 million years ago, and perhaps even further (Dominguez-Rodrigo *et al.*, 2014). Those details preface this discussion by demonstrating that apes do co-exist despite physiological and ecological similarities. In the case of gorillas and chimpanzees there is very little niche separation. However, not all apes are entirely plant-based eaters. The chimpanzee for example is known to eat many other primates, tends to prefer the western red colobus monkey (*Piliocolobus badius)* and will sometimes cannibalise its own species (Kawanaka, 1981; Boesch, 1994). Modern humans (*Homo sapiens*) are the descendants of *Homo erectus* and do eat other apes and the IUCN considers poaching to be the greatest threat to the survival of both the gorilla and the chimpanzee (Humle *et al.*, 2016; Maisals *et al.*, 2018). This leads to the assertion that it is feasible for *Homo erectus* to have shared its range with another ape species. It is thought that increased aridity in Africa led to the development of bipedalism in hominins as they had to travel farther for resources (Cachel *et al.*, 1998). This habitat change also makes herd animals a more viable resource which may lead to a dietary shift towards meat eating (Ungar *et al.*, 2006). However, western chimpanzees (*P. t. verus*) live in savannah type environments and there is also fossil evidence to show chimpanzees having ranged as far east as Kenya, so quadrupedal apes can clearly tolerate drier habitats when they need to (Pruetz & Bertolani, 2007). As predation of apes is not uncommon for modern humans and sometimes occurs in chimpanzees, then if *H. erectus* shared its range with other apes then there is a strong possibility that this did occur.

Like most primates *H. erectus* had a generalist diet. Based on analysed samples of teeth African *H. erectus* tended to avoid hard and brittle foods. Also, the microwear is quite like that in chimpanzees and baboons (*Papio* spp.) (Ungar *et al.*, 2006). Like chimpanzees, baboons will prey upon other animals and they also do so in an organized systematic

fashion like groups of *H. erectus* did (Strum, 1975). There is also less abstract evidence of the meat-eating habits of *H. erectus.* In Tanzania lies an archaeological site named BK4B that provides a wealth of fossil specimens. Particularly significant is the evidence of the use of tools to cut meat away from the bones mostly of *Sivatherium* and *Pelorovis* specimens. While the fact that *H. erectus* did eat meat is not contested the BK4B site suggests they ate more than earlier estimates suggest (Dominiguez-rodrigo *et al.*, 2014). Regarding apes, there has been one sample of *Paranthropus boisei* at the site (Dominiguez-rodrigo *et al.*, 2013). *Paranthropus boisei* is an extinct hominin, slightly larger than a chimpanzee and renowned for their incredibly robust cheek teeth which suggests they would eat mechanically challenging foods (Ungar *et al.*, 2008). The *P. bosei* specimen at BK4B showed markings on the bones suggesting that it had been preyed upon. However, the authors state that the shape of the markings is more likely from the teeth of a larger predator rather than the tools used by *H. erectus* (Dominiguez-rodrigo *et al.*, 2013). Nevertheless, markings from large teeth and stone tools are quite similar so there is still a chance that they were caused by *H. erectus.*

As there was only one sample, the likelihood of sympatry between *H. erectus* and *P. boisei* should be considered with caution. However, gorillas and chimpanzees can form stable sympatric populations even though both are frugivorous and rely on foliage as a fall-back food (Remis, 1997). The difference between these niches is much smaller than would be the difference between *H. erectus* and *P. boisei*. In fact, the wide cheek teeth and strong jaw musculature of *P. boisei* give access to hard brittle foods which is the one resource *H. erectus* does not exploit (Ungar *et al.*, 2006; Ungar *et al.*, 2008). Ungar and colleagues (2008) suggest that the harder brittle foods consumed by the *P. boisei* are fall-back foods. As evolutionary history does dictate *H. erectus* was the more successful species, this would place an intense selection pressure on *P. boisei* to access the foods *H. erectus* was not interested in. The teeth of *P. boisei* do not show the microwear of frequently eating hard brittle foods, leading to the conclusion that they had a more generalist diet which would put them in competition with *H. erectus.*

Unlike extant primates it is much more difficult to find exact answers to these dietary questions. However, based on the success of modern primates it follows that sympatry between *H. erectus* and another ape is very viable. Additionally, since *H. erectus* did hunt other animals that puts a target on the back of any other species that shares their range (Dominiguez-rodrigo *et al.*, 2014). The conditions are right for *H. erectus* to prey upon other apes but to answer the question conclusively there would need to be

archaeological evidence to show the use of tools to prepare meat from ape carcasses.

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An investigation into primate diversity and livelihoods of the Maraguá people in Central Amazonia, Amazonas, Brazil

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The Amazon basin is one of the most important ecosystems for sustaining biodiversity on the planet. This biodiversity is threatened by large-scale deforestation and hunting. Effective planning, monitoring, and management of protected areas are needed to preserve species long-term (Nepstad *et al*., 2001). Therefore, it requires a detailed understanding of local biodiversity and how it is influenced by humans (Brook & McLachlan, 2008). In the Amazon, indigenous lands exceed the area of all environmental conservation units (CNUC/MMA, 2018; FUNAI, 2018), highlighting their enormous conservation potential.

The aims of this study were to 1) gain insights into primate diversity in the study area (Fig. 1); 2) assess local indigenous people's use of and attitudes towards primates; 3) explore local hunting, including a definition of main target species, factors influencing hunting behaviour and the importance of hunting for subsistence and culture; 4) learn about the influence of religion on target species; 5) identify local threats to biodiversity; 6) discuss the potential of indigenous reserves for wildlife conservation and evaluate consequential implications for the present case study.

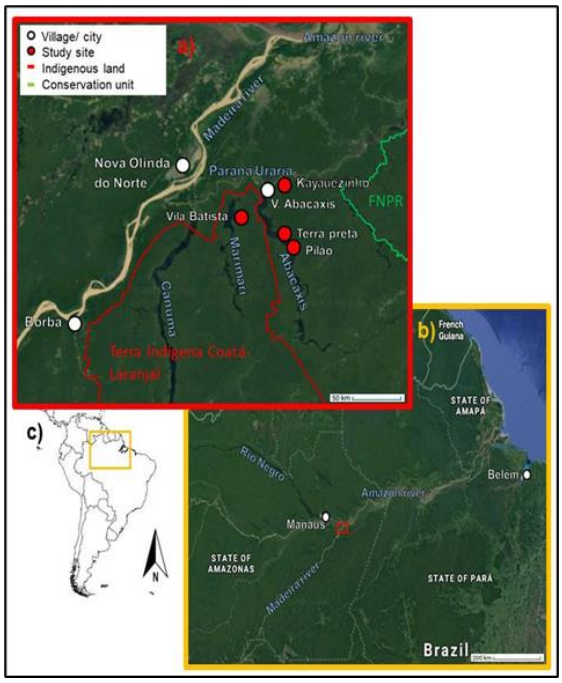

Figure 1. Study area (a) and location within the Amazon (b) and within South America(c). V.Abacaxis= Vila Abacaxis. FNPR= Floresta Nacional Pau-Rosa.

Field work was conducted in June and July 2018 in four indigenous communities along the lower Abacaxis, Urariá, and Marimari Rivers in the Brazilian state of Amazonas, Central Amazon. Three communities were of the Maraguá people and were situated within the area proposed as indigenous Maraguá land, although the legal demarcation process is pending. One community was populated by the Sateré-Mawé tribe and iwa situated within an indigenous reserve (Fig. 1). The latter site was used to compare the

commercial impact between non-demarcated and demarcated land. The area is characterized by *igapó* (seasonally inundated forest) and *terra firme* forest. I used semi-structured interviews and displayed primate pictures to access local ecological knowledge about the abovementioned topics. I conducted research with 31 participants**.** Ethical clearance was obtained from Oxford Brookes University.

Primate diversity: Thirteen species of primates could be confirmed in the study area (Fig. 2). Two species are categorized as Data Deficient and three as Endangered by the IUCN Red List (IUCN, 2018).

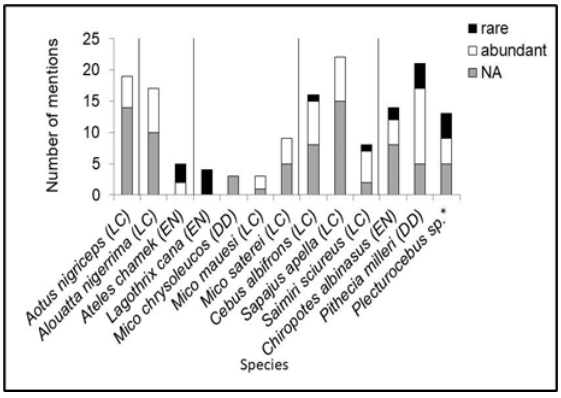

Figure 2. Primate species confirmed to be present in the study area, divided by families. Bars represent the total number of participants defining species' abundance. * The exact species of the genus could not be defined.

Primates and people: The primary purpose of primate hunting in the study area was for food. However, none of the primate species was amongst the preferred game species as defined by the interviewees. All in all, seven participants (22% of all interviewees) were presently hunting primates. All present primate species had been used as pets within the communities. Two species (the tufted capuchin, *Sapajus apella,* and the black howler monkey*, Alouatta guaribai*) were used for medicinal purposes. The main reasons against primate hunting were religion (n=5), compassion (n=3), age (n=2), and rareness (n=1).

Livelihoods: Maraguá livelihoods were found to depend mainly on fishing, agriculture, and hunting. Males in the visited communities went fishing at least twelve times per month and hunted an average of ten times per month. Fishing frequency was more balanced between participants than the frequency of hunting. Only one-fifth of participants preferred wild meat to fish. Besides their meat, wild animals provide indigenous people with medicine. Their body parts constitute the foundation of traditional artwork, used to reinforce cultural identity and unity, and reflect hierarchies within the community.

Religion and hunting: Thirteen of the 31 interviewees were Adventists. Adventist religion is characterized by food taboos, forbidding the consumption of animals other than birds and ruminants (Queen *et al.,* 2009). My study shows that wildlife consumption is influenced by Adventism, an issue that has been poorly studied in the Amazon (Luzar *et al.,* 2012). Adventists consumed different species than Catholics (Fig. 3) and did not consume primates.

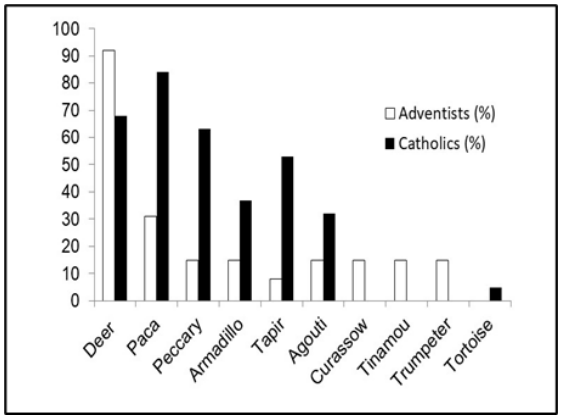

Figure 3. Consumption of game species by religious group. Proportion of participants (Adventists and Catholics) for the animals identified as most hunted species.

Threats to biodiversity: Participants of all villages had witnessed population decreases of different species, most markedly of jaguars (*Panthera onca*), tapirs (*Tapirus terrestris*), peccaries (*Tayassu* spp.), and chelonians. For primates, Atelinae species (the black-faced spider monkey, *Ateles chamek* and the Peruvian woolly monkey, *Lagothrix cana*) were identified as the species with the most marked population declines. Results indicate that commercial hunting by non-residents is the most critical threat to local biodiversity. However, the current situation of wildlife diversity and abundance along the lower Abacaxis and Urariá Rivers, as well as in most other regions in the Amazon, must be interpreted as a result of an interaction between former and current commercial and subsistence hunting (Antunes *et al.,* 2016). Although other factors potentially influencing the abundance of wildlife are present, these are the essential drivers impacting biodiversity in the study area. This finding accords with results from other studies from the Amazon, where deforestation rates, compared with other regions with high biodiversity, are relatively low (Antunes *et al.,* 2016). The overall results agree with the finding that larger species are more susceptible to depletion than smaller species. This assumption applies to mammals in general (Jerozolimski & Peres, 2003) as within the order of the primates, as found by Peres and Dolman (2000) and confirmed by my case study. Populations of both species of Atelinae present have declined during the last few decades in my study area. Additionally to their larger body size, which makes them a preferred target by selective hunters (Peres & Dolman, 2000), Atelinae primates have the lowest fecundity rate of Neotropical primates and have been driven to local extinction in many areas of the Amazon (Peres & Dolman, 2000).

Indigenous reserves and biodiversity conservation: The presence of forest-dwelling people in low governance regions, such as Amazonia, has the potential to inhibit large-scale forest clearings and commercial resource extraction as well as to serve as a political force against environmentally detrimental legislation and infrastructure projects (Zimmerman *et al.* 2001; Shepard Jr. *et al.* 2012). In the case of my study, this potential was exemplified by the differing situations of the Sateré-Mawé village (located

in an indigenous reserve) and the Maraguá villages (outside of any protected area). Around the non-demarcated Maraguá communities, different types of encroachments for commercial purposes by non-residents were present, whereas none of these activities are present around the demarcated site.

Conclusion

My study provides the first insights into the overall primate diversity of the lower Abacaxis, Marimari, and Urariá rivers and thereby contributes to the knowledge gained about Central Amazonian primate species' distribution. Furthermore, the study identifies the study region as an important area for the conservation of Endangered species and further research on Data Deficient species. The study highlights the conservation research potential of studying the relationship between the recently emerged Adventist religion and related food taboos in the Amazon, where traditional beliefs constantly deteriorate (Luzar & Fragoso, 2013). Another key insight resulting from my study is that indigenous reserves can impede commercial hunting. The results indicate that the demarcation of the Maraguá indigenous land can potentially alleviate hunting pressure in that area. This conclusion is reinforced by the current engagement of the villagers against commercial hunting. However, the current impact of indigenous people in the study area remains to be investigated to identify the potential biodiversity conservation value of the area more accurately as an indigenous reserve and eventual regulations to be implemented to meet biodiversity conservation goals. The results show that wild meat is not the primary source of protein.

However, the local depletion of Ateline species indicates unsustainable subsistence hunting practices in the past. To guarantee the long-term sustainability of hunting in protected areas, source-sinks dynamics must be intact, i.e., wildlife refuges where hunting is absent must be present for the recuperation of animal populations (Novaro *et al.* 2000; Antunes *et al.* 2016). The Maraguá indigenous land could act as a buffer zone for the nearest conservation units, FNPR (Fig. 1), and Acarí National Park (about 200 km south of the study area).

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Human and monkey interactions at Cape Vidal, South Africa

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Cape Vidal is a popular tourist beach destination within the Eastern Shores section of the iSimangaliso Wetland Park (Previously the Greater St. Lucia Wetland Park), a natural World Heritage site in Kwa-Zulu Natal, South Africa. As well as being an area of outstanding natural beauty, iSimangaliso contains eight interlinking ecosystems, such as coastal dune forests, wetlands, and bush veldt. As such is an important area for conservation (Findlay, 2006).

The park includes a wide variety of wildlife, including five primate species: two species of bushbabies (*Galago moholi* and *Otolemur crassicaudatus*), baboons (*Papio ursinus ursinus*), vervet monkeys (*Chlorocebus pygerythrus*) and samango monkeys (*Cercopithecus mitis*) (Lawes, 1992). While the baboons are unhabituated to the presence of humans and do not enter Cape Vidal, many vervet and samango monkey troops live within the site and have become problematic (Chapman *et al.,* 1998).

There are two sub-species of samango monkeys within South Africa, *C. m. erythrarchus* and *C. m. labiatus*. Apart from slightly different colouring, they inhabit different habitats; *C. m. labiatus* is found in the Afromontane forests of the Eastern Cape and Limpopo Provinces, while *C. m. erythrarchus* prefers the coastal dune forest of KwaZulu-Natal (Lawes, 1990). Unfortunately, heavy logging in the past has meant that most *C. m. labiatus* populations live in small, isolated forest patches and are unlikely to be long-term sustainable (Chapman *et al*., 2006). However, creating the iSimangaliso Park has resulted in a long stretch of uninterrupted and protected dune forest, allowing for a healthy and increasing population of *C. m.erythrarchus*. Therefore, the area is vital for preserving the species in South Africa (Lawes, 1992).

Unlike vervets and baboons, samangos are shy forest monkeys, and few South Africans know them (Lawes, 1992). iSimangaliso is one of the only places where visitors can view them; however, this increased and close contact has meant that they have also become a primate considered a pest, which could potentially put them at risk (Lee & Priston, 2005).

I conducted a combination of observations and interviews at the site to determine the severity of the situation and its effect on conservation at Cape Vidal and assess how it could be improved (Newing, 2010).

Both samango and vervet monkeys at Cape Vidal were observed entering tents, log cabins, and cars to find food and frequently raided picnic tables. They have learned to open zips and coolers as well as 'monkey proof' bins, and as a result, visitors are forced to remain constantly vigilant, to the extreme that some visitors would choose to leave someone behind to guard the tents while others went to the beach. Monkeys also threatened and physically harmed visitors on occasion, destroyed the canvas and netting on tents and caravans, and scattered rubbish around an otherwise clean environment, all behaviours which have been going on for decades (Chapman *et al*., 1998). The campers claimed that they visited the site to relax; but the constant vigilance affected how much they enjoyed their holiday and, in some cases, was severe enough to affect their decision to return.

Visitors were often forced to wield sticks at the picnic and camping sites and resorted to throwing sand or stones at the monkeys. Slingshots were generally considered an acceptable way to deter the monkeys, and they were used openly by visitors who always kept them close at hand. Young boys frequently were observed searching for monkeys to 'shoot,' often with adult encouragement, with some even bringing BB guns. Few visitors seemed to have a problem with this, and those who did were more concerned with the danger to other visitors or

their belongings. While iSimangaliso staff were always present at the camping and picnic sites, they were never observed reprimanding visitors and were reluctant to confront visitors over their behaviour. The reason may be partly due to past racial tensions and inequality in South Africa since all the ground staff is black, while the visitors are primarily white (Pickard, 2003).

Like many protected parks, iSimangaliso is under much pressure to 'pay its way' and provide financial security to the local people. Many were forcibly removed during apartheid and have been unable to return since the park became a heritage site (ibid). While some removal of natural resources is allowed through a permit system, tourism is the primary source of revenue for many community members, and Cape Vidal is a massive draw to the area (Dahlberg, 2005).

In order to reduce this conflict in the past, the iSimangaliso Authorities have chosen to cull primate troops present at the site, as well as particularly troublesome individuals resulting in a problematic solution (Chapman *et al*., 1998). Firstly there is the ethics behind culling species that are not causing any disruption to the ecosystem, within a natural park, because of problems caused by humans. The authorities in the park prefer not to interfere, and in particular, do not want visitors to see them 'managing' or interfering with any of the animals to ensure that they continue to be viewed as wild, despite the close contact they have with humans at the site (ibid). Secondly, while samango monkeys in general are considered Least Concern by the IUCN (Butynski & de Jong, 2019), within South Africa, they are considered rare and endangered (Lawes, 1992; Friedman & Daly, 2004).

The managers at the park are against culling, while the staff at the site are for it because they spent more time observing the problem and bearing the brunt of visitors' complaints. They also come from the areas surrounding the park, which are extremely poor, and are reliant on the visitors for their jobs (Pickard, 2003; Dahlberg, 2005).

Most visitors have been visiting Cape Vidal for years, in some cases decades, and while they often found the monkeys irritating, they also felt that the situation had always been the same and would continue to be so. When asked what the authorities could do to improve the situation, most of the people interviewed replied that nothing could be done and that the monkeys had to be endured. While culling was generally considered acceptable, even by those who were fond of the monkeys, many questioned how successful this method would be in the long term, as it was presumed that new monkeys would move into the area. The same argument was raised with regard to moving the troops.

Education was considered to be of crucial importance. The primary education method is

through site signs warning visitors about the monkeys. Most signs were largely negative (*Beware! Monkeys!*), which, while necessary, could reiterate the idea of them as pests. A more positive sign (*Please help protect the rare and endangered samango monkey*) was often mentioned by visitors, who generally knew little about them. It affected how they felt about topics such as culling. In the future, placing more positively worded signs could help to improve visitors' feelings towards these primates. This could also be applied to how the staff warns visitors about monkeys.

The rules of acceptable behaviour towards the monkeys must be clear and understood by both staff and visitors. It is equally important that staff are equipped with the confidence and authority to approach and rebuke visitors who cross the line. Almost all the visitors interviewed stated that Cape Vidal is a natural habitat and that as intruders into that habitat, they needed to respect the monkeys; however, that sentiment was not mirrored in their actions. While the conservation of the monkeys at Cape Vidal may not be under direct threat, the negative attitudes picked up by visitors to the park may be more detrimental to primate conservation in the long run.

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