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Bushbaby illustration by Annette Gunn
Front Cover Macaques at Chiang Mai Zoo, Thailand. Photo by Padcha Chatpongcharoen.

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Table of contents

Letter from the Editors

Dear primate conservation professionals, enthusiasts and friends,

Welcome to *Canopy*! In this second issue of the nineteenth cohort, the editorial team chose to highlight articles demonstrating applied, on-the-ground conservation research. We broadly adopted the theme *Breaking through the Ivory Tower*, emphasising that, while academic pursuits are crucial to the conservation of primates, the field would be woefully incomplete without the efforts occurring outside the halls of academia.

Conservation is hard work. For some, it means being knee-deep in the mud, tracking elusive animals that want nothing to do with you. For others, it's talking to folks at a zoo or sanctuary to help them understand why it's important to conserve a given species. There is (or should be!) a lot of self-questioning involved. Primate conservationists spend long hours in front of dimly-lit monitors. They boast callouses on their hands, blisters on their feet and sometimes even broken hearts. Nevertheless, the important thing to remember is that *every* job within the field is valuable, whether you're the one on the podium or out doing the dirty work. And this is the point we aim to emphasise — we *must* work, whatever we do.

In this issue we also share a few words with the renowned Dr David Chivers, whose illustrious career spans five decades and has yielded valuable insights into gibbon behaviour, ecology and conservation. You will find his advice to future generations in the pages you are about to read.

We invite you to explore the research of previous cohorts, who assumed initiatives as varied as completing population censuses, examining the parameters of ecotourism, investigating the ecology of rare species and implementing education initiatives. We hope you enjoy them as much as we did.

Happy conserving,

The editors

From left to right: Monica, Joy, Gaspard, Nicki, Amy, Padcha, Brittany

Letter from the Module Leader

Careers in Conservation Biology: Getting Started and Making it Work

My desire to work with saving and conserving wildlife started properly when I was 10 years old. I knew I did not want to be a vet, I wanted to be outside! And I decided I was going to save the world. This was a bit ambitious and I narrowed my focus to one group of species, gibbons in South-East Asia. My conservation work now encompasses several species across SE Asia (focus on Indonesian Borneo). I am co-director for the Borneo Nature Foundation and Borneo River Initiative for Nature Conservation and Communities as well as Vice-chair for the IUCN Section on Small Apes. But how did I get here? Unlike becoming a lawyer or medical doctor, there is no single path into conservation. Indeed, you could talk to 100 different conservationists and get 100 different answers.

I have had various roles over the last 20 year and these do not include are the times I had no income, the times our young NGO was struggling for funds, when things went wrong with permits and permissions, when staff were unhappy, when I felt out of my depth starting a new project, illness (mine and others) etc. It does not also include the amazing people I have worked with and who continue to play a big role in my work, the excitement of expeditions and new discoveries and the sense of achievement when your work is received at local or national government level to really make a difference at policy level. And no one is ever working alone in conservation.

Academic qualifications are a necessity for most conservation careers, but practical work is just as important. There has been much debate recently that conservation is for the rich: you need disposable income to gain experience by volunteering, by paying for higher education, for managing when you are in the inevitable periods of unemployment. There is some truth to this, and it may take time to get a paid job in your ideal field of conservation, but there are positions available out there if you have the time and patience to look. Conservation Careers is a good starting point (https://www.conservation-careers.com/), but also follow organisations on social media to learn about positions, e.g. Society for Conservation Biology (https://conbio.org/). Take inspiration from others: the Oxford Brookes MSc in Primate Conservation posts jobs on their Facebook page, but also #AlumniFriday is where you can learn what past students are now working on https://www.facebook.com/PrimConsOBU/.

Network at every chance you get and be clear about what you are looking for in your career progression but be flexible. There are many transferable skills you can learn from conservation jobs which might not match your ideal. Many roles are needed in conservation: researchers, managers, educators, policy managers, communicators, financial experts, grant writers, film-makers, zoo-keepers, consultants, graphic designers, geographical information systems experts etc. You can establish your own NGO/expedition – seeking out like-minded people is a huge help in this, and you can help make a difference. It is imperative to include local people in these efforts.

So there is no one clear path, also there is no one definition of a conservation biologist. Perseverance, knowing where you want to be and what you want to work on are the first steps. And do not be afraid to reach out to organisations/people etc to ask for help. Most people who are established are very aware of how hard it was for them to get started, so they are more than willing to help.

Dr Susan M. Cheyne
Module leader, Primate Conservation

The importance of cultural factors in people-*Macaca fascicularis* interactions at tourist sites in South-East Asia

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The frequency of people-primate interactions at tourist sites is increasing in many locations around the world. Some well-documented examples of opportunities to view or interact with primates are *Macaca* spp. in Asia, Gibraltar and North Africa (Mallapur, 2013), *Cebus capucinus* and *Alouatta palliata* in Costa Rica (McKinney, 2014), and *Gorilla beringei beringei* in Rwanda (Goldsmith, 2014).

Wild primate viewing can be classified into two main types of ecotourism depending on tourist motivation. First, there is ecotourism where the primary motivation is to see the primate in question, an example of which is mountain gorilla tourism. In the second type of ecotourism, the main motivation is to see something other than the primate. For example, viewing and interacting with primates may be secondary to visiting temples or archaeological sites. This often occurs at Angkor Wat in Cambodia, where there are frequent interactions between tourists and long-tailed macaques (*Macaca fascicularis*). This type of ecotourism has been labelled *incidental eco-tourism* by Grossberg *et al*. (2003). Whether or not primates or other wildlife are the primary reason for ecotourism, the demand for wildlife viewing is increasing. According to Orams (2002), this increase may be due to two reasons: diminishing opportunities for urban-dwelling humans to interact with nature and the rise of nature documentaries. Food provisioning is usually required to make wildlife viewable (Knight, 2009), which can be detrimental for a number of reasons (Orams, 2002). In the case of wild primates, zoonotic and anthroponotic pathogen transmission is a significant risk (Engel *et al*., 2002). Other effects are changes in the natural behaviour and activity budgets of the species and increased aggression towards humans (Fuentes & Gamerl, 2005; Fa, 1992).

Macaca fascicularis lives alongside humans in towns, cities, religious sites and recreational areas throughout much of South-East Asia (Gumert, 2011). The species shares a long and complex history of commensalism and mutualism with sympatric human communities. *Macaca fascicularis* is revered in Hinduism and animist cultures, particularly at religious sites, but considered a pest in urban areas and agricultural landscapes (Schilaci *et al*., 2010). Due to the considerable overlap of macaque habitat and human landscapes, people-*M. fascicularis* interactions are common and sometimes

problematic. Negative interactions occur frequently, particularly where there are shared food sources. For example, macaques may be intentionally provisioned at tourist or religious sites, and they often forage on crops or snatch human food. They may also forage from human food waste (Gumert, 2011). A large body of research indicates that cultural factors play an important role in the perceptions of *M. fascicularis* in many South-East Asian countries and that the attitudes and behaviours of tourists can have a significant impact on macaque behaviour. Fuentes (2006) found that, when compared with their Balinese counterparts, Western tourists were more likely to shout or scream during interactions with *M. fascicularis*. Conversely, local people interacted less and reacted less extremely.

I investigated human perceptions of long-tailed macaques *(Macaca fascicularis)* at Angkor Archaeological Park in north-western Cambodia through semi-structured interviews with people who came into contact with these animals. Forty-one interviews were conducted. Respondents were from a wide range of countries and age groups (Fig. 1), and represented a number of cultures and religious beliefs. They were asked about their perceptions of the macaques, how they felt about provisioning and other human-macaque interactions, and whether they thought restrictions should be put into place to limit interactions.

Cultural factors appeared to play an important role in views and perceptions. Tourists from primate range countries had a less positive opinion of the macaques than those from non-primate range countries. Moreover, opinions towards provisioning

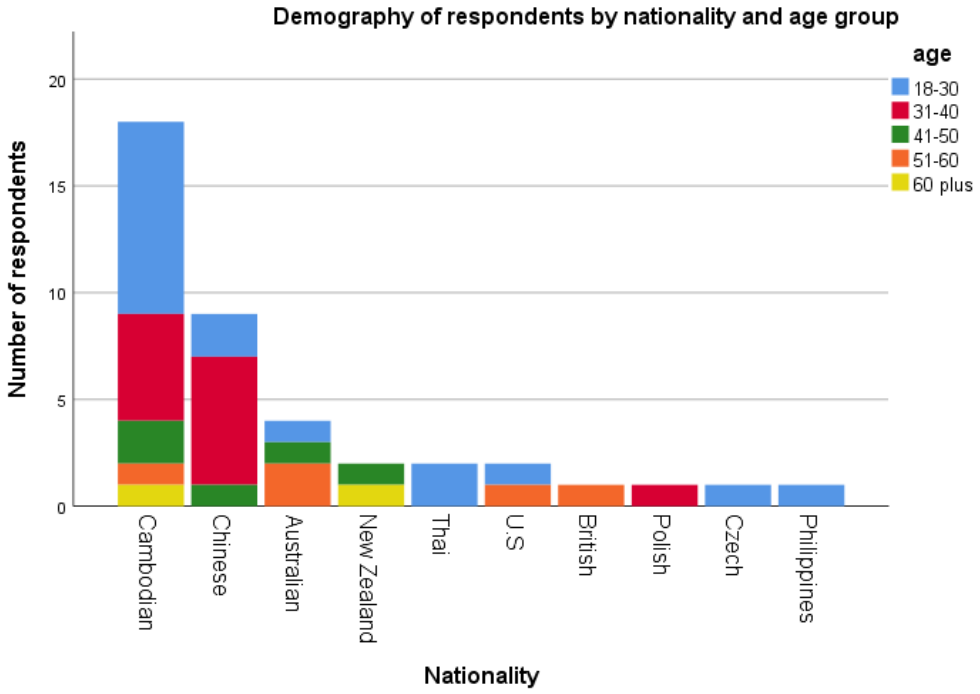

Figure 1. Graph showing the number of respondents according to nationality (n = 41)

differed substantially according to provenance of respondent. Of particular interest was a contrast in the views of Cambodian respondents (either domestic tourists or locals) and international tourists on provisioning the macaques. Cambodian nationals were largely in favour of provisioning, while international tourists generally opposed feeding the animals. Reasons given by Cambodian respondents were often based in the Buddhist beliefs that food sharing was a way to gain positive karmic merit and that it showed love for the animals. Another reason given was that they pitied the macaques because they did not have sufficient natural food. In contrast, most international tourists expressed concern regarding provisioning. Many international respondents believed that the macaques should forage for natural food and that provisioning would cause them to (1) lose their natural foraging behaviour and (2) possibly become aggressive towards humans. Furthermore, when asked whether restrictions should be placed on human-macaque interactions and food provisioning, Cambodian respondents were against it, while international respondents felt that some measures should be put into place.

Implications and recommendations

These results suggest that careful consideration should be given to cultural and religious factors when implementing public education programmes and management strategies. In some cases, it may be unlikely that banning food provisioning would work where the belief exists that feeding and interacting with macaques is a good deed that accumulates merit. Instead, raising awareness of the macaques' ecology and ability to forage could be implemented through information panels. In addition, Buddhist visitors and locals could be provided with an alternative method of gaining karmic merit.

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Using freelisting to evaluate education in South-East Asia

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Few primate conservation organisations publish evidence of systematic evaluation of their programmes, despite research showing that it can improve their efficacy by enabling informed adaptation and modification of content and delivery methods (Norris & Jacobsen, 1998; Kling & Hopkins, 2015). Organisations tend to rely on qualitative assessments using questionnaires (Kuhar *et al*., 2010; Rakotomamonjy *et al*., 2015) or interviews (Engels & Jacobson, 2007; Nijman & Nekaris, 2014). However, several drawbacks to using traditional data collection tools have been identified. People are often pre-disposed to answering questions they believe will please their interlocutor (Waterman *et al*., 2001). Furthermore, cultural differences have been detected in responses to Likert-style questionnaires (Chen *et al*., 1995). To elicit accurate responses from participants, it is important that data collection methods are both accessible and interesting (Breuer & Mavinga, 2010; Johnson *et al*., 2014).

My research comprised the creation, delivery and evaluation of a three-month education programme specifically designed for teenagers in Viet Nam and Java, Indonesia. Its objectives were to increase participants' knowledge about the behavioural ecology of six native animal species and enhance their feelings of affinity – or connectedness – for the animals they studied. My data collection

method was culturally and age appropriate, engaging and capable of producing accurate data for evaluation. It also needed to elicit data about both knowledge and feelings, capable of analysis of how these aspects had changed after students' participation in the education programme. Traditional data collection tools can be unsuitable for children, who may perceive questionnaires or interviews as daunting or uninteresting (Fien *et al*., 2010). In psychology research, children involved in forensic questioning found that open questions are more likely to elicit accurate answers than suggestive questions or those with options (Lamb & Fauchier, 2001). Therefore, I chose to collect data using a freelisting approach.

Freelisting has been described as 'a deceptively simple, yet powerful technique' (Bernard, 2011) and has rarely been used as a form of data collection in conservation. Research participants are asked to list words on a specified subject. A rank of the list of words is made and the degree of importance decided. By analysing the lists of a group of people, the rank and frequency of use of each word signifies its importance to the group (Puri, 2011).

My research was conducted in collaboration with the Little Fireface Project in Java and Endangered Asian Species Trust in Viet Nam. I created a three-month education course and teaching resources that focussed on six animals. My curriculum uses:

- Investigative learning to develop students' knowledge of the animals' behavioural ecology, and

- Puppetry to inspire their feelings of affinity for the animals.

My course was implemented between May and August 2016 by experienced educators in three schools in Cát Tiên National Park, Viet Nam and Cipaganti, West Java, Indonesia, both countries with a rich tradition of puppetry. 71 students, aged 12-17, participated over three months. The study animals were selected to be common to both regions and to highlight a range of conservation issues.

Freelist data were collected at the beginning and end of the course to evaluate efficiency. My evaluation focussed on change in participants' knowledge and affinity for the slow loris and gibbon species: in Java, the Javan slow loris (*Nycticebus javanicus*) and silvery Javan gibbon (*Hylobates moloch*), and in Viet Nam, the golden cheeked gibbon (*Nomascus gabriellae*) and pygmy slow loris (*Nycticebus pygmaeus*) (Fig. 1). Participants were shown photographs of each animal and asked to list 10 words about them; they were prompted only that words could be what they thought or felt about the animal in the picture.

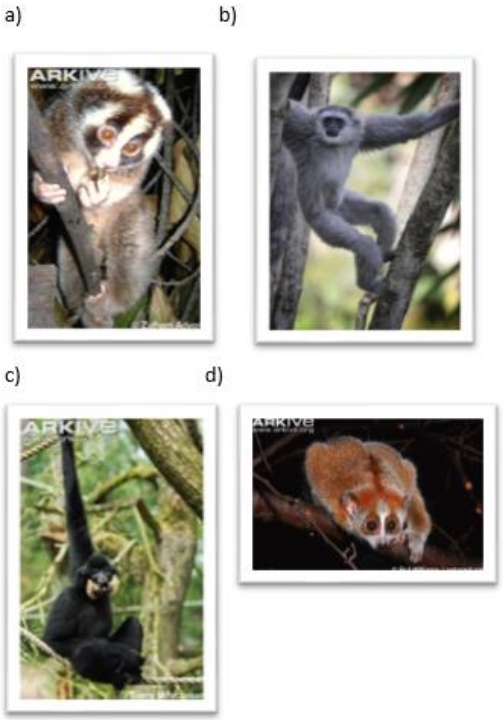

Figure 1. Photograph cards used as cues for participants in the freelisting exercise, showing a) Javan slow loris, b) silvery Javan gibbon, c) golden cheeked gibbon and d) pygmy slow loris

Freelists are most commonly used in cultural domain analysis, which analyses how people categorise, prioritise and mentally organise items (Puri, 2011). Cultural domain analysis is normally used to explore a subject area and to identify key concepts and values to inform further studies (Bernard, 2011; Puri, 2011). I took my analysis of the freelist data further by applying a series of quantitative and qualitative measures. I conducted quantitative analyses to compare participants' knowledge of the behavioural ecology of gibbons and slow lorises before and after the education. I also carried out content analyses of the actual words used to explore how individual participants and the group described the animals before and after the education course. Changes in both knowledge and feelings expressed about the animals was assessed.

In their evaluation of gorilla conservation education programme, Kuhar *et al*. (2010) demonstrated that a straightforward and reproducible approach was key to long-term follow-up. I found freelisting met these requirements for educators to implement and was accessible to participants. It generates a wealth of data that are flexible to analyse and allows both qualitative and quantitative approaches (Ruiz-Mallen *et al*., 2009). By carefully specifying the wording of instructions, it can readily be used to explore a range of factors, including people's knowledge, attitudes, values and feelings. While questionnaires continue to be widely used in conservation education, my research supports findings that a methodology using open questioning can generate accurate and useful data (Lamb & Fauchier, 2001). My research has highlighted the usefulness and versatility of freelists in providing rich data for consideration of the impact of education programmes. The technique is quick and easy to collect, making it an attractive evaluation tool.

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Movement and socio-ecology of the Tonkin snub-nosed monkey and recommendations for future conservation

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With anthropogenic disturbances to the environment on the rise, the resulting exponential rate of extinctions has been termed 'the sixth extinction event' (Kolbert, 2014). One of the worst hit taxa is mammals, with 35-69 species becoming extinct in the last century and 25% of all extant terrestrial species thought to be at high risk (Brum *et al*., 2017). Ecologically, mammals are valuable protein sources and provide key ecosystem functions such as seed dispersal, pollination and pest control (Howe & Smallwood, 1982;

Goldingay *et al*., 1991; Carthew & Goldingay, 1997; Eldredge, 2000; Ellison et al., 2005; Marques *et al*., 2013). With the breakdown of these services, entire ecosystems will struggle to maintain the processes necessary for life.

The IUCN Red List identifies species 'considered to be facing an extremely high risk of extinction in the wild' as Critically Endangered (CR) (IUCN, 2019). Innately, the CR classification encompasses most mammal species with extremely low total population counts due to the increased vulnerability caused by small population size (IUCN, 2019). The recovery rate of threatened mammal populations is poor; for example, Hoffmann *et al.* (2011) found that only 24 of 195 cases exhibited recovery, all of which were the result of conservation intervention. Conversely, inadequate conservation management are implicated where populations continued to deteriorate (Hoffmann *et al.*, 2011). With high-volume biodiversity loss in Southeast Asia (Sodhi *et al*., 2004; Sodhi *et al*., 2010), conservation work in the region is a priority, especially with rare and unique species such as the Tonkin snub-nosed monkey (*Rhinopithecus avunculus*). This Critically Endangered primate (C2ai), a classification based on a total population estimate of less than 200 individuals, continues to decline in number. To address the issues of a shrinking *R. avunculus* population, I studied the extant ecological strategies of the species. I reviewed past and current conservation interventions to inform future actions and to protect surviving populations from extinction. Due to limited reports containing detailed information on the ecology of *R. avunculus*, I conducted surveys at sites containing the two largest-known populations (Fig 1). These data were complemented by analyses of a two-year data set. Understanding the ecology of the species, especially factors pertaining to habitat requirements and movement, is essential to planning and developing conservation strategies for *R. avunctulus*.

I conducted field observations of the two largest-known populations of *R. avunculus* from June 2016 to June 2016 in the Tung Vai watershed forest (TVWF) and from December 2016 to January 2017 in the Khau Ca Species and Habitat Conservation Area (SHCA). These data were then complemented by analyses of a two-year dataset collected by the community conservation patrol team (CCT) from October 2015 to November 2016 for sound statistical analyses (Table 1). All data were collected using the 'Recce method' (White & Edwards, 2000) due to extremely difficult terrain.

The two populations were found to contrast with each other considerably. The TVWF population was estimated to be low and in decline as a result of high-level anthropogenic disturbance, primarily from sub-canopy

Table 1: Results from survey and patrol data combined for *Rhinopithecus avunculus* at two research sites in northern Vietnam study site.

	Survey effort (km)	Number of group observations	Encounter rate (individuals/km)	Home range (km^2)
Tung Vai	1786	5	0.014	3.74
Khau Ca	1110	73	1.47	3.15

cardamom farming and potentially illegal hunting. Meanwhile, SHCA was still a species stronghold with few disturbances and a population potentially greater than 100. To aid future conservation planning, including the conversion of the TVWF to a species and habitat conservation area and the creation of a green corridor project from Khau Ca to other regions of the Du Gia National Park, I created a land use classification map for the TVWF and a suitable habitat distribution model for both research sites (Fig 2). As the populations only occupy 3.1% and 2.5% of the administrative regions within the TVWF and Du Gia National Park, respectively, these analyses improve the potential for successful population expansion and zoning for restricted areas.

This study poses a range of poignant ecological information, including first-time data on day range, population density and group composition of *R. avunculus* from a long-term study. The land use analysis of the TVWF shows the extent of usable habitat for *R. avunculus* as well as the extent of cardamom farming. Given a shrinking population, a strict protection protocol is highly recommended for this population to survive. However, finding a sustainable solution will require the express consent and inclusion of local farmers. From the conservation effort review, a strict protection protocol was identified as the most effective measure in conserving *R. avunculus*..

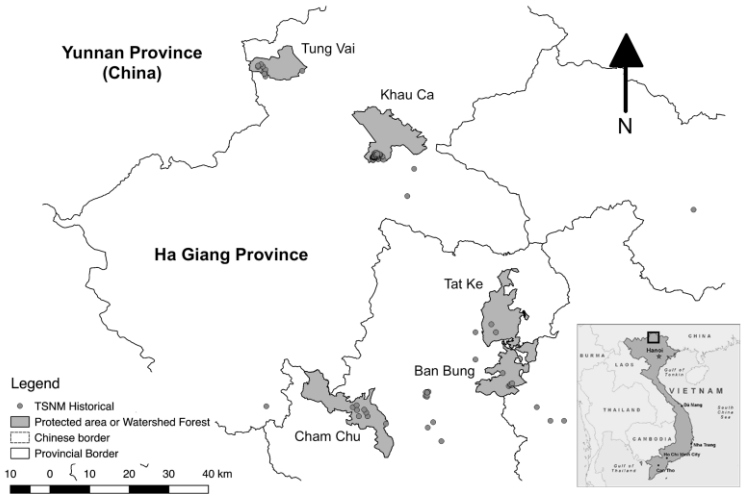

Figure 1. Distribution of all known historical records of *Rhinopithecus avunculus* with boundaries of the protected areas or watershed areas where the remaining four populations exist. Research locations during this study were in the Tung Vai watershed forest and the Khau Ca Species and Habitat Conservation Area.

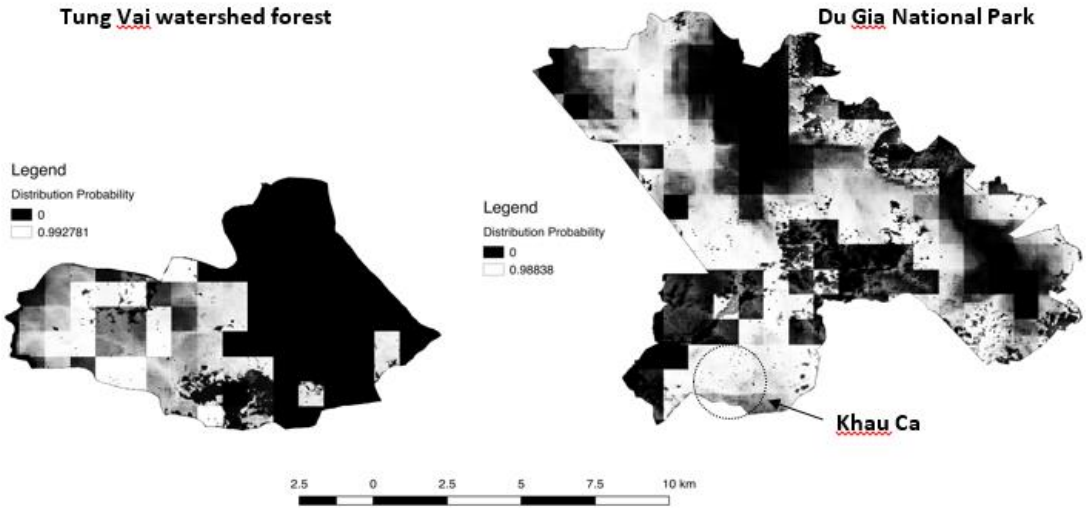

Figure 2. Suitable habitat distribution within administrative areas of the Tung Vai watershed forest (left) and the Khau Ca Species and Habitat Conservation Area (right). Distribution is based on climate, forest cover and elevation variables using a generalised linear model algorithm.

It was also identified that past failed conservation attempts, particularly within Vietnam (Brook *et al*., 2014), were often due to the ineffective responses of legislation and management bodies

I also recommend further behavioural ecology studies of *R. avunculus* as available data is still very rare. In particular, studies on group size and composition, home range, day range and population density with supporting phenology surveys could boost conservation efforts by determining habitat quality. I recommend that the costly process of data collection be streamlined with the use of a camera trap grid to reduce restrictions from bad weather and steep terrain and improve habitat monitoring via the study of sympatric species. Many of the findings of this study are relevant on a larger scale for conservation efforts, in particular with regard to CR mammals. I intend for these contributions to have a positive impact on future outcomes, especially for species with increased vulnerability due to low population size.

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Microcebus murinus population and habitat assessment in the remaining transitional littoral forest of south-east Madagascar, Petriky

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Madagascar is the world's fourth largest island, with 81% of plant species and 100% of lemurs being endemic (Tattersall, 1982; Ganzhorn *et al*., 1999). Due to the exceptional high number of threatened species the island is classified as one of the top biodiversity hotspots in the world (Myers *et al*., 2000). One of the biggest threats to Madagascar is the degradation and destruction of its forests. With a total area of 590,000km^2, it is estimated that only 30,000km^2 remain forested while 200km^2 disappear per year (Tattersall, 1982). 67% of the island's recognised faunal taxa are predicted to be at risk of extinction over the next few decades (Mittermeier *et al*., 2003).

In the south-east region of Madagascar, the transitional littoral forests reside on notably mineralised sandy substrates and contain 42 plant and 14 invertebrate species endemic to the area (Temple *et al*., 2012). QIT Madagascar Minerals (QMM) is a Malagasy company that mines the sandy littoral forests for titanium dioxide-producing ilmenite minerals, a practice that has contributed to the creation of an action plan classifying the littoral forests as a high conservation priority

(Dumetz, 1999). With the action plan came avoidance areas, also known as conservation zones, that make it illegal to log or consume wildlife within their boundaries. At 920 hectares, Petriky Forest is a remarkably understudied transitional littoral forest between the wet and dry zones of south-eastern Madagascar. Its conservation zone is 120 hectares, leaving 800 hectares unprotected. Petriky also lacks systematic lemur studies compared to companion littoral forests.

Lemurs are flagship species for conservation in Madagascar and require ongoing research due to their quickly disappearing habitats (Ganzhorn *et al*., 1999; Mittermeier *et al*., 1992). Accordingly, I conducted a baseline population assessment on one of the smallest living primates, *Microcebus murinus* (Figure 1). Grey mouse lemurs are classified as Least Concern with a decreasing trend in population (IUCN, 2012). They reside in a variety of habitats, including littoral forest, spiny forest and degraded forests (Ganzhorn *et al*., 1999). This species is not considered a *fady* (taboo) by locals, and the two main threats for the study population in Petriky are logging-associated habitat loss and opportunistic hunting.

The main aim of this study was to determine the vegetation structure and diversity of tree species alongside the density and population size of *M. murinus* in a transition zone between the wet and dry forests of Petriky.

Figure 1. *Microcebus murinus* in Petriky Forest.

Additionally, I sought to explain whether the conservation zone still harbours a diverse plant community and if the zone's boundaries should be extended. Understanding what contributes to lemur abundance is necessary for their conservation; accordingly, I also assessed their population density between Petriky's conservation and unprotected zones. The study results provide a population baseline and aim to improve future conservation strategies and restoration projects associated with Petriky and QMM.

For the vegetation structure, 20 plots were chosen at random and measured at 20m x 50m. Within each plot, trees ≥ 5cm diameter at breast height (DBH) were measured, provided with a local vernacular name and estimated for height (Ganzhorn *et al*., 2001; Ingram *et al*., 2005). A line-intercept technique was used to document the species and height at which vegetation made contact with a canopy measuring stick at 1m intervals for 20m. For the density estimations, ten line transects, 0.5km-1km in length, were

measured, with five in the conservation zone and five in the unprotected zone. Transects were walked at a speed of approximately 1km/hour with a repetition of four times over 31 days during the time period of 18:30-22:00 (Plumptre, 2000; Ross & Reeve, 2011). Headlamps were used to detect lemur eye shines, and at each observation, the species, time, height in tree, species and DBH of tree, and perpendicular distance from transect were recorded (Buckland *et al*., 1993; Ganzhorn *et al*., 2007). All data were analysed with DISTANCE 6.0, Excel and SPSS Statistics 19.

The vegetation survey resulted in 2,040 individual trees and 72 species, with four out of the five most abundant species found in both the conservation and unprotected zones. The mean canopy height was 4.16m (SD=0.73) for the conservation zone and 2.76m (SD=0.48) for the unprotected zone. The conservation zone also had more trees in both the understory (below 3m) and canopy area (above 3m). The diversity results were a Shannon Index of 1.29 in the conservation zone and 1.45 in the unprotected zone, a non-significance difference [U=49.5; *P*= 0.97]. Results indicated that the conservation zone was denser with taller trees, and while the unprotected zone was a bit more diverse, trees in both zones had a relatively similar DBH. For *Microcebus murinus*, there was a mean encounter rate of 5.8 individuals/km (ranges: 2.7-9.3) in the 31.24 km surveyed, with t 5.4 individuals/km in the unprotected zone and 6.2 individuals/km in the conservation zone. Encounter rates were not significantly different between zones. The mean density of *M. murinus* in the conservation zone was 6.5/ha (ranges: 4.6-9.3; standard error: 1.1). The total population size in Petriky was 4,586 individuals.

The results showed a clear difference between the conservation zone and unprotected zone in both the floristic and faunal structures. The results of this study were compared to the results of a 2005 study indicating that larger trees were likely disappearing due to logging. For both studies, the average canopy height was relatively consistent (Rabenantoandro *et al*., 2007). Six of the 72 tree species measured were considered endemic to the south-eastern region of Madagascar, and four of those six were also classified as utilitarian (Ingram *et al*., 2005; Lowry, 2001). Despite an increase in anthropogenic impact and degradation of the forest, Petriky still contained a floristic composition that was comparable with previous accounts. A long-term habitat monitoring study following the trends of natural disasters, impacts of mining and the effects of human presence is needed in Petriky.

In the context of fauna, the higher *Microcebus* population size in Petriky may owe to the ecosystem's many similarities to dry forests, which tend to have higher populations, little

nocturnal competition and an abundance of food available (Dumetz, 1999). Regarding future mining in Petriky, there is a viable population of *M. murinus* residing in the conservation zone; nevertheless, other lemur species do not have viable populations. If possible, a future study determining the home range of other lemur populations should be conducted to better assess the boundaries of the conservation zone. Employing local forest police to patrol the conservation zone has shown to be successful and should continue, along with more training and education. There is still time for conservation efforts to protect the future of Petriky.

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Preliminary survey of the primates of the coastal dry forest in West Ecuador: population density and conservation status of the mantled howler monkey (*Alouatta palliata aequatorialis*) and the white-fronted capuchin monkey (*Cebus albifrons aequatorialis*)

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Primate population surveys are vital tools for enhancing our knowledge on remaining population numbers and, when complemented with vegetation studies, allow for assessments of different habitats important for primate conservation (Brockelman & Ali, 1987; Plumptre & Cox, 2006). The dry forest of the Ecuadorian coast is part of the Tumbes-Choco-Magdalena hotspot, one of the 25 most biologically rich and endangered terrestrial ecoregions in the world (Conservation International, 2007). This biodiversity hotspot is especially abundant in endemic species, many of which are severely threatened by human activities such as resource exploitation, agriculture land conversion, hunting and deforestation (Mast *et al.,* 1999; Myers *et al.,* 2000; Hurtado *et al.,* 2010). Only 2% of the original forest coverage along Ecuador's coast is left, a decrease due mainly to an explosive growth in population, a doubling of agricultural activities, major increases in timber extraction and the establishment of large-scale plantations of palm oil and eucalyptus (Conservation International, 2007).

Although howler and capuchin monkeys are among the most studied Neotropical primates, there is a lack of information on their populations in Ecuador and obtaining data on their conservation status is crucial (de la Torre, 2010). Together with a small region in the north of Peru, Ecuador represents the southern limit of the mantled howler monkey (*Alouatta palliata aequatorialis*) range in South America (Cuarón *et al.,* 2008). The geographic range of the white-fronted capuchin monkey (*Cebus albifrons aequatorialis*) is restricted to western Ecuador and extreme north-eastern Peru (Cornejo & de la Torre *,* 2008). The two species are currently listed by the IUCN Red List as Vulnerable (A4cd) and Critically Endangered (A2cd), respectively, with decreasing population trends exhibited by both taxa (IUCN, 2012).

The aim of this study was to conduct a preliminary survey of the primate populations inhabiting the Refuge of Marine and Coastal Wildlife of Pacoche, West Ecuador. Two primate species had been previously reported in the area: the mantled howler monkey (Fig. 1) and the white-

Figure 1. Mantled howler monkey in the forest of Pacoche.

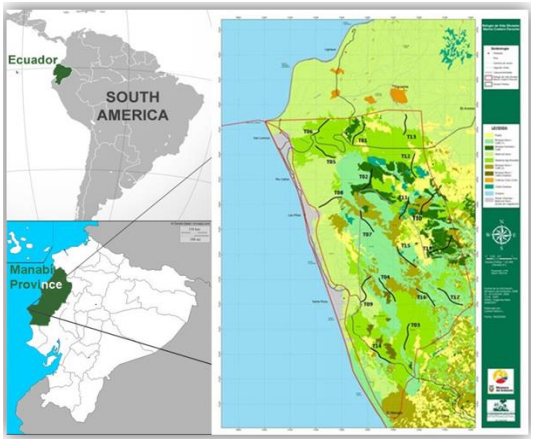

Figure 2. Location of the Refuge of Marine and Coastal Wildlife of Pacoche in the province of Manabi. Modified from MAE, 2009

fronted capuchin monkey (Ecociencia, 1998; MAE, 2009).

Surveys were carried out in the Refuge of Marine and Coastal Wildlife (RMCW) of Pacoche (1°02'S, 80°50'W), located in the coastal region of West Ecuador in the province of Manabí. RMCW is a natural area protected by the Ecuadorian government (MAE, 2009) (Fig. 2). The park has a total area of 13,714ha, with 8,618ha comprising the marine area and 5,096ha of terrestrial land (MAE, 2009). The line transect method (Burnham *et al*., 1980) was used along 18 transects of 1km in length each. Each transect was walked 5 times by two researchers at an average speed of 1m/s, from 6.30-12.30 and from 15.00-17.00h.

Contrary to local reports, no white-fronted capuchin monkeys were found in the area and only mantled howler monkeys were identified. Howler monkeys were sighted 44 times during 90km of censusing (mean=2.04km per sighting). The density of the howler monkey population for the whole protected area including lowland scrub (5,000ha) was estimated to be 20.44ind/km^2 (95% CI 14.42-28.96 ind/km^2), and the average group size was 9.17±4.01, with two in the smallest group and 23 in the largest.

The mean age and sex composition was 1.7±0.54 adult males, 7±3.67 adult females, and 2±1.22 infants (<1 year) (Table 1).

Table 1. Demography of the howler monkey population inhabiting the dry forest of Pacoche

	Demography	
	$\bar{X}$	**SD**
Group size	9.17	4.01
Sex ratio	3.95	1.15
F:imm	0.35	0.19
Adult females	7	3.67
Adult males	1.75	0.54
Infants (<1y)	2	1.22

The results of this study indicate that the area represents a suitable location for the co-existence of human and non-human primates if conservation management plans are established. Further research is necessary to determine the conservation status of the white-fronted capuchin monkey in the area as a low number of individuals may be left in the coastal Pacific region of Ecuador.

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Studying faecal glucocorticoid metabolite (FGCM) concentrations in East African chimpanzees (*Pan troglodytes schweinfurthii*) in Budongo Forest Reserve, Uganda

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The study of stress is a large, diverse scientific field where much can be learnt about animal responses to social and physical environments. It is important to monitor and reduce possible sources of chronic stress in the conservation management of wild populations as stress has detrimental effects on long-term population viability (Marechal *et al*., 2011). By understanding how animals respond to their environments, we can predict how changes may affect their well-being and survival. Diet quality, climate, social competition, dominance rank and reproductive access can all affect the well-being of wild animals and, as a result, increase cortisol levels (Sapolsky, 2005).

Endocrine activity provides an unparalleled insight into the biology of a species as hormones affect all tissues in the body. Primates and other mammals exhibit a glucocorticoid (GC) stress response to somatic and psychological stressors (Anestis *et al*., 2006). Acute activation is adaptive, yet persistent activation is detrimental to an individual's health as high levels of GCs are associated with chronic stress that leads to pathology and poor population health (Sapolsky *et al.*, 1988; Sapolsky *et al*., 2000). Faecal glucocorticoid metabolites (FGCMs) reflect the free (unbound) GC fraction of total GCs, and enzyme-immunoassays (EIAs) allow researchers to monitor stress hormone output via the measurement of FGCMs. When combined with other data, measuring FGCMs provides an insight into the stress response of an animal to particular environmental or social conditions. These methods are frequently used to investigate potential links between stress and animal behaviour, and reproductive biology and animal welfare (Shutt *et al*., 2012).

Cortisol levels in chimpanzees (*Pan troglodytes*) are affected by dominance rank and diet quality (Muller & Wrangham, 2004a), female oestrus state (Muller *et al*., 2007), age (Thompson *et al*., 2010) and levels of aggression (Muller & Wrangham, 2004b). This study aimed to investigate how the presence of oestrus females, female oestrus state, dietary quality, individual age, male dominance rank and sex influence FGCM concentrations in wild eastern chimpanzees (*P. t. schweinfurthii*) of the Waibira community in the Budongo Forest, Uganda.

Table 1. The total number of samples collected (from the total number of individuals) for adult males (AM), adult females (AF), sub-adult males (SAM) and sub-adult females (SAF) in each rank and oestrus category.

Sex Class	Number of samples collected (Total number of individuals sampled)								
	Total	**High Rank**	**Mid Rank**	**Low Rank**	**Oestrus 0**	**Oestrus 1**	**Oestrus 2**	**Oestrus 3**	**Oestrus 4**
AM	39(15)	16(8)	22(7)	0	-	-	-	-	-
AF	36(12)	-	-	-	27(9)	0	2(1)	2(2)	5(3)
SAM	11(5)	0	2(1)	9(4)	-	-	-	-	-
SAF	4(2)	-	-	-	3(2)	0	1(1)	0	0
Total	90(34)	16(8)	24(8)	9(4)	30(11)	0	3(2)	2(2)	5(3)

The Waibira chimpanzee community at Budongo Conservation Field Station (BCFS), Masindi, Uganda were followed between 01/06/16 and 31/07/16. During this time, a total of 137 chimpanzee faecal samples were collected from 35 different individuals (Table 1). Samples were collected and processed following the faecal sample collection protocol of the German Primate Centre, with each sample consisting of ~0.5g faeces in 5ml 80% ethanol. Animal ID, time, male dominance rank, female oestrus state and a GPS waypoint were recorded at the time of collection. Oestrus (cycling) females at BCFS were graded on a scale of swelling from '1' (minimal swelling) to '4' (maximal swelling). Anoestrous (non-cycling) females were graded as '0'. Samples were shipped to the Endocrinology Lab of the German Primate Centre for analyses of metabolite '3a,11ß-dihydroxy-CM', using an enzyme-immunoassay previously validated for assessing stress hormone output in chimpanzees (Heistermann *et al*., 2006). A total of 90 samples (Fig. 1) were used in a main analysis to assess the effects of social and environmental factors on FGCM concentrations in Waibira chimpanzees.

To gather social data, I recorded sub-group size and composition via scan-based party size (Reynolds, 2005) every 15 minutes. Sub-group size was defined as the number of individuals in sight of the observer, and composition was recorded via the number of adults and sub-adults of each sex present, as well as the number of oestrus females (Fig. 2). Male dominance ranks were obtained from BCFS field assistants. To measure dietary quality, I conducted a scan-sample every 15 minutes to record chimpanzee feeding behaviour in the sub-group. Fruit availability was then estimated indirectly by calculating the total percentage of the feeding observations where chimpanzees were eating fruit (Muller & Wrangham, 2004a). Increased time feeding on fruit reflected an increased availability of fruit in the environment for chimpanzees and

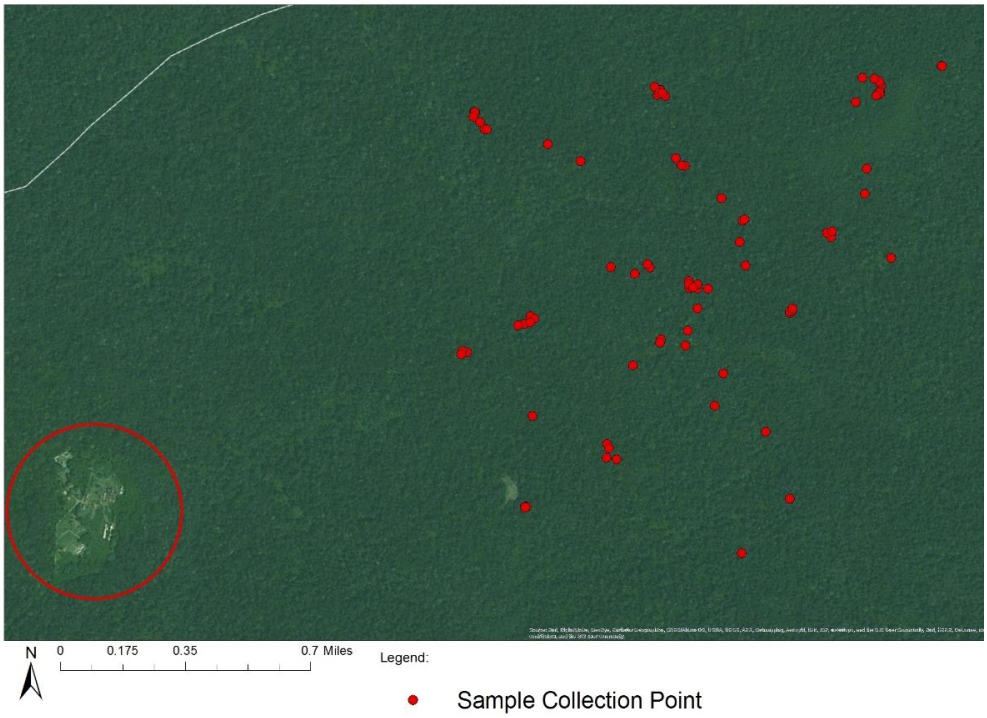

Figure 1. Map showing the GPS waypoints taken at the location of collection for samples collected in the home range of the Waibira community in the Budongo Forest (note: not all samples were marked due to GPS availability). The BCFS camp is encircled in red, and a disused National Forestry Authority road is marked via a white line.

therefore an increase in dietary quality (Wrangham *et al*., 1998).

A General Linear Mixed Model was used to determine if male dominance rank, female oestrus state, the presence of oestrus females, percentage of fruit eaten, age and sex were predictors of FGCM concentrations in the Waibira community. The results did not match those of many other studies on chimpanzees, and further investigation is required to determine factors that may explain this. Subsequently, it is worth noting that whilst stressors may come from the social or physical environment in which the animal lives, or from a combination of both, the response is generalised as similar demands will be placed upon the organism by different stressors. Therefore, responses to different stressors are similar and need careful interpretation (Goymann, 2012).

This study highlighted the complexities of using field endocrinology to measure social and environmental stressors in wild animals, especially chimpanzees, by providing contrasting results to many previous studies. However, field endocrinology studies have the potential to show how knowledge acquisition can directly impact threatened populations,

Figure 2. Sub-group of resting Waibira chimpanzees containing an oestrus female (far right).

and chimpanzees are a notable success in the field of endocrine studies (Kersey & Dehnhard, 2014). The information gained via this study has furthered our understanding of the biology of this species with regard to its general behavioural biology and adrenocortical activity. It is hoped that with such knowledge acquisition, conservation management practices can further be improved for wild chimpanzees.

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Population density of reintroduced Bornean orangutans (*Pongo pygmaeus*) in Sungai Wain Protection Forest, East Kalimantan, Indonesia

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The Bornean orangutan (*Pongo pygmaeus*) and the Sumatran orangutans (*P. abelii, P. tapanuliensis*) are the only extant great apes occurring in Asia. Currently, the Bornean orangutan inhabits the wilds of Bornean Malaysia within the states of Sarawak and Sabah, and Bornean Indonesia within the provinces of East Kalimantan, West Kalimantan, North Kalimantan and Central Kalimantan (Ancrenaz *et al*., 2016). There are currently three recognised subspecies of Bornean orangutans: *P. p. morio* (which occurs in Sabah and northeastern Kalimantan), *P. p. wurmbii* (which occurs in southwest and central Kalimantan) and *P. p. pygmaeus* (which occurs in Sarawak and northwestern Kalimantan) (Groves, 2001).

The wild population of Bornean orangutans is rapidly declining due to habitat loss and hunting by humans (Ancrenaz *et al*., 2016).

Figure 1: The location within Borneo of Sungai Wain Protection Forest (Fredriksson & Nijman, 2004).

The population is estimated to have declined by over 60% from 1950-2010 and predicted to decline by over 82% by the year 2025 (Ancrenaz *et al*., 2016). The forests of Borneo have been cleared expeditiously, with an estimated 39% destroyed between 1973-2010 (Gaveau *et al*., 2014). It is predicted that an additional 37% of Borneo's adequate orangutan habitat will be lost between 2010-2025 (Wich *et al*., 2012). Although there are many reasons for the ongoing deforestation, the high global demand for palm oil is one of its primary drivers (Gaveau *et al*., 2014).

Due to rapid loss of habitat, orphaned and injured orangutans are often brought to rehabilitation centres. These facilities aim to release orangutans back into the wild once they have become healthy and have attained the necessary skills for survival. One such rehabilitation centre is the Borneo Orangutan Survival Foundation's (BOS) Orangutan Reintroduction Project at Wanariset (BOSW). BOSW released 82 ex-captive orangutans in Sungai Wain Protection Forest (SWPF) from 1992-1997 (Russon & Susilo, 1999). SWPF (Fig. 1) is among the remaining primary lowland coastal forests in the province of East Kalimantan. It is located approximately 15km from the city of Balikpapan and is mostly made up of lowland dipterocarp forest (Fredriksson & Nijman, 2004). Severe forest fires burned approximately 60% of the forest in 1998 (Russon & Susilo, 1999).

Currently, SWPF comprises approximately 40km² of primary forest, 40km² of regenerating forest that was burned in the 1998 fires, and 20km² of encroached forest (Fredriksson & Nijman, 2004). The forest fires of 1998 likely had a severe negative impact on SWPF's reintroduced orangutan population, as a nest survey conducted 2.5 months after the cessation of the fires produced an estimate of only 13-17 individuals (Russon & Susilo, 1999). No other orangutan nest surveys had been conducted in SWPF prior to my study.

The aim of this study was to conduct an orangutan nest survey in SWPF in order to produce a current estimate of the population size and population density of orangutans in the reserve. Orangutan nests were counted along a series of previously constructed line transects from July-August 2017.

The standard equation for estimating population density from nest surveys (van Schaik *et al*., 1995) revealed that the population size and population density of orangutans had declined considerably since the previous nest survey. Only two individuals were seen during the study: a flanged male and an adolescent female. The male was heard long-calling before he was seen travelling in the direction of a transect in the southern area of the forest (Fig. 2). The adolescent female was seen on the main trail in the southern area of the forest. Both of the orangutans appeared to be in good health.

Given its low density and size, as well as the long 7-9 year interbirth interval of Bornean orangutans (Wich *et al*., 2004; Knott, 2001), it does not appear that the population in SWPF will become viable without additional intervention from humans. The most recent orangutan Population and Habitat Viability Assessment (PHVA) gave a mean estimated population of 20 orangutans in SWPF (Utami-Atmoko *et al*., 2017). The PHVA also estimated that the smallest orangutan population that could meet Minimum Viable Population standards, defined as having a less than 1% chance of becoming extinct in 100 years and a less than 10% chance of becoming extinct in 500 years, was 50 orangutans (Utami-Atmoko *et al*., 2017). However, this is only if the population has adequate room for growth and is not threatened by habitat loss (Utami-Atmoko *et al*., 2017).

Figure 2: The flanged male orangutan which was observed during the study.

Considering the inherent limitations of orangutan nest surveys, such as overlooked nests and variability in nest decay and production rates between locations and populations (van Schaik *et al*., 1995; Buij *et al*., 2003), I recommend that a thorough camera trap and spatial capture-recapture modelling study is conducted in SWPF, similar to Spehar *et al*.'s (2015) study, in order to determine the precise number of orangutans still residing there. Following the study, a potential conservation action might see the introduction of a rehabilitated young female to the area. In addition to increasing the orangutan population in SWPF, the introduced female could also increase the population's genetic diversity. Given that orangutan populations as large as 100-150 individuals suffer from a decrease in genetic diversity (Utami-Atmoko *et al*., 2017), it is almost certain that SWPF's orangutans experience similar consequences, including the possibility of inbreeding depression. The introduced female should be closely monitored in order to study her health and reproductive success. Any further conservation action in SWPF would depend upon the results of the female orangutan's introduction to the forest.

It is also important to continue regular patrols of SWPF in order to prevent poaching and the conversion of forest to agricultural land. Research should also be conducted on the regenerating forest area that was burned in

1998 to assess its species composition, fruit abundance and utility for orangutans. Since fruit abundance has a major impact on orangutan population densities (van Schaik *et al*., 1995; Knop *et al*., 2004), it is possible to increase the orangutan carrying capacity of SWPF if the regenerating area can regain levels of fruit abundance that are analogous to those in the primary forest area.

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Six questions for Dr David Chivers

The Canopy editors caught up with Dr David Chivers at Oxford Brookes University before his Monkey Monday talk last February. After fifty years both in the classroom and in the field, Dr Chivers is the perfect candidate to share his thoughts on primate behaviour, the future of field work and the role that academia should play in conservation.

What is your most memorable experience from the field?

Clarence Ray Carpenter, wonderful man, conducted the first study of howler monkeys and then he went to South-east Asia and did the first study of gibbons. So I sort of followed in his footsteps. But he didn't follow a group for more than 1 month. So he created this picture of the groups scattered out defending territories with their loud calls. But I managed to show, just in 3 months, that they weren't defending territories or clearly-defined parcels of land, they were just defending where they were. Thus, they have overlapping home ranges. So that was exiting and I wrote my 1969 paper in *Folia Primatologica*.

I could have completed a PhD study there, but I was wedded to gibbons and went to Malaysia to study the siamang, the largest of the gibbons - black with an inflatable throat sac, hence the devastating songs. What was really memorable was when the family group accepted me and allowed me to follow them from dawn to dusk, and not just for one day but for all ten, in the fifth month of my field study, in April 1969.

Equally memorable were seeing the very rare lion-tailed macaque in the Western Ghats of South India, the Kloss gibbon in the remote Mentawai Islands, the hoolock gibbon Bangaladesh (and later in Assam), and the yellow-cheeked crested gibbon in the south of Vietnam. Especially memorable was 5 weeks in 1983 cruising around the Solimoes (Amazon) and Japura rivers out of Tefe with the late Marcio Ayres studying the rare white uakari.

The unsuccessful search for the new ape species (known in the west for 100 years) -orang pendek - in the Kerinci-Seblat National Park of west-central Sumatra was really memorable. It is surely a large gibbon species, because of its erect bipedal habit, that has come to the ground, rather than a new species of orang-utan.

This is the tip of the iceberg! In truth, most experiences as a primate field worker are memorable, especially after clearing trails and hours of fruitless searches for primate sightings.

Do you have any advice for future primatologists?

There are some signs of optimism, even though the forest loss has escalated in recent years with the increasing demand for palm oil. You cannot ban palm oil, but efforts to make the production sustainable need to be successful rapidly. The problem is defining and enforcing sustainable production. This is a

problem originating in South-east Asia, but now spreading to tropical Africa and America. I am not sure how palm-oil is sustainable, but you would have to manage and certify - clear the first crop out and then plant the next one there, then you fertilise the soil. You must not cut down any more forest.

The key problem is to save orang-utan genes; there are about 1000 young animals in centres in Borneo alone, victims of deforestation and the pet trade - an increasingly significant proportion of the species gene pool. They need to be rehabilitated and reintroduced back into the wild – a project that is well underway. You need to be optimistic, but it is not easy for the optimism to survive. Remember that conservation is not just about studying primates but helping to manage them, involving yourselves in socio-political activities.

What role should academia play in shaping future primate conservationists?

You have to engage in objective and quantitative science to achieve real results. A sound scientific framework is essential for effective conservation.

There has been criticisms that some current conservation strategies resemble neo-colonial practices. Do you have any insights that you would like to share about this issue?

Such behaviour, which does occur, is unforgivable. I have always worked with the local people - universities and villages. They get upset, the Malaysians, Indonesians, Bangladeshis, Indians and Brazilians, and so forth, when primatologists come in, carry out studies, and then disappear back home to publish their research. That is unforgiveable, but fortunately not common, especially nowadays. We have always worked very closely with our hosts, shared with our host, helped our host, and benefitted from their great local experience. We have neither dictated nor dominated - just learned and applied.

In your opinion what are the key areas in need of attention in the field of conservation?

Protection of forest habitats with local NGOs, management of buffer zones with the local people for their economic benefit, and the rescue, rehabilitation and reintroduction primates, involving local people and protected forest.

I used to think that protecting wild populations was the only effective approach to conservation, but soon realised, with the abject failure to protect habitat, that homeless primates should be restored to the gene pool.

If you could be any primate, which on would you be and why?

Siamang or orangutan. They have a lovely life (if left alone!). They know their area of forest. They wander around, checking for food trees; they know roughly where the food will be at any time of year. When not feeding, they rest in the sun (sometimes in the rain) and occasionally sing or interact with neighbours.

University Events

Seminar Series

The seminar series is a weekly event which events guest speakers to present their research. We are always looking to recruit speakers for our seminar semester. If you are interested in attending or presenting, please do not hesitate to get in contact with us. Contact details are provided within the contents pages.

28 Jan	**Philipe Bujold** (University of Cambridge) *Adaptive economics: exploring choice biases in macaque decision-making*
4 Feb	**Penny Wallace** (TRAFFIC) *Combatting the illegal wildlife trade using a trade chain approach: rhino horn, ivory and beyond*
11 Feb	**Andrew Walmsley** (Freelance wildlife photographer) *On Assignment - From conception to publication of a wildlife photo story*
18 Feb	**Natalie Horner** (Cotswold Wildlife Park) *Lemur conservation in and ex situ - a wildlife park perspective*
4 March	**Dr Andrea Donaldson** (Durham University) *Rehabilitation release of vervet monkeys in south coast Kenya: a scientific approach*
11 March	**Dr David Chivers** (University of Cambridge) Socio-ecology and conservation of Asian apes
18 March	**Grace Ellison** (Manchester Metropolitan University) *Behaviour and ecology of the northern lesser galago*
1 April	**Prof Anna Nekaris & Prof Vincent Nijman** (Oxford Brookes University) *Conservation of Javan primates: an update from the Little Fireface*
8 April	**Dr Christoph Schwitzer** (Bristol Zoological Society) *The IUCN Red List and lemur conservation*

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