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Wildlife tourism and conservation: an interdisciplinary evaluation of gorilla ecotourism in Dzanga-Sangha, Central African Republic

Kathryn Shutt

Abstract

Wildlife tourism is proliferating worldwide and has the potential to raise revenue for conservation as well as public awareness of conservation issues. However, concerns are growing about the potentially negative influence of such tourism on the wildlife involved. An absence of scientific information means that the potential costs of tourism are unidentified, tourism management strategies are not informed by scientific studies, and the ethics of habituating animals to humans remain relatively unexplored, though much discussed. This combination of ecological and anthropological research questions necessitates a bio-social approach. In this thesis I adopt an interdisciplinary approach to explore the factors that influence human-animal interactions and incorporate them into conservation biology. I use the Dzangha-Sangha Gorilla Habituation and Ecotourism Project in the Central African Republic as a case study. First, I explore the context of wildlife tourism and why people watch gorillas in the wild, their reactions to and behaviours during their gorilla encounters and the effect these encounters have on the visitors. People are drawn to gorillas because gorillas are human-like and tourists seek close encounters which are rare and authentic. Photography is a key motivation for tourists to visit gorillas but also a major cause of disturbance. Next, I detail a series of experiments I conducted to validate methods for measuring physiological stress in the western lowland gorilla. Using these methods, I then address the question of whether gorillas incur stress as a result of habituation and ecotourism activities, comparing faecal glucocorticoid metabolite levels (FGCMs) in four gorilla groups at different stages of habituation. Two (and possibly all three) of the human-contacted groups had significantly higher levels of FGCMs than unhabituated gorillas, and the group undergoing habituation had the highest FGCMs, suggesting that the process of habituation is perceived as a threat by gorillas, and that habituation reduces this response over time. FGCMs in habituated groups were significantly associated with increasing frequency of violation of the 7 m distance rule by observers and with a medical intervention but

not with other measures of human pressure, suggesting that some elements of human-gorilla contact still elicit a GC response in habituated gorillas. I then demonstrate a positive association between FGCMs and parasite infection that may reflect hormonal suppression of the immune system in gorillas with higher FGCM levels, or, stimulation of the HPA axis as a result of increased parasite infection. Finally, I explore socio-cultural, epidemiological and management aspects of human interactions with gorillas in order to identify how and why visitors break regulations and the subsequent risk of human-gorilla disease transmission. Socio-cultural and emotive factors motivate people to get close to gorillas. Epidemiological factors interact with socio-cultural and emotive drivers to create a variable profile of disease risk presented by each person during their interactions with gorillas. The outcomes of this interdisciplinary risk assessment will inform policy makers as to how they may better protect gorillas, and other animals, from the potential negative effects of human disturbance resulting from habituation, tourism and research activities. The implications of this study will help to maximize the potential for such projects to be beneficial, low-impact and sustainable conservation solutions.

Wildlife tourism and conservation: an interdisciplinary evaluation of gorilla ecotourism in Dzanga-Sangha, Central African Republic

Kathryn Shutt

Thesis submitted for the degree of Doctor of Philosophy

Durham University

Department of Anthropology

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List of Abbreviations

CAR:	Central African Republic
DSP:	Dzanga-Sangha Project
DSPA:	Dzanga-Sangha Protected Areas
EPG:	Eggs Per Gram
EIA:	Enzyme Imunno Assay
FGCM(s):	Faecal Glucocorticoid Metabolite(s)
GLMM:	General Linear Mixed Model
GTZ:	German Technical Corporation
GC(s):	Glucocorticoid(s)
HPLC	High Performance Liquid Chromatography
ICDP:	Integrated Conservation and Development Programme
IUCN:	International Union for Conservation of Nature
MD:	Mean Difference
MGVP:	Mountain Gorilla Veterinary Project
NGO:	Non-Governmental Organisation
PPT:	Poly-Propylene Tube
PHP:	Primate Habituation Programme
Spp.:	Species - Plural
Sp.:	Species – Singular
SD:	Standard Deviation
SE:	Standard Error
US-AID:	United States Aid
USFWS:	United States Fish and Wildlife Services
WWF:	World Wildlife Fund

Statement of copyright

The copyright of this thesis rests with the author. No quotation from it should be published without the prior written consent of the author, and information derived from it should be acknowledged.

Acknowledgements

I am writing my acknowledgments! I have been looking forward to this day for over four years; it feels like a dream. The whole idea of conducting this PhD was once a complete dream: that of the privilege of studying gorillas and working with some of the most amazing people I could ever hope to meet. This dream would, most definitely, not have been achievable without the support of an incredible network of people, from start to finish, and I would like to thank them profusely.

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Before starting my PhD, I skimmed through a few books about 'how to get a PhD', 'what to expect from your PhD', etc. I noticed how much each one emphasised the importance of a strong supervisory team, and maintaining good relationships within it. They also emphasised, however, that I should not expect to get through my PhD without having at least a few major battles or fallings-out with my supervisors. Well, happily, I have a different story to tell, and for that, I am extremely grateful. I can't say there haven't been tears, but only because through the course of a PhD, if you're lucky, someone that can write really, really well tries to teach you how to write really, really well. It's quite a painful process: you write something that you think is amazing, send it off, get it back, realise its utter rubbish, do some crying and start again. You send something you think is quite good, get it back, and concede it's still quite rubbish ... and so on and so on until something gives, and you start writing something that is maybe less rubbish, and cry less. Needless to say, I have a whole world of thanks to give to my supervisors, Jo and Sandra, for enduring this process with me. Jo, somehow you believed in me from the start despite my 12,000 word proposal, at which point you should have run for the hills! You have never been anything other than supportive and encouraging with your calm advice and pursuit of perfection on every level. If I can ever guide anyone half as well as you, I will still be awesome at it, thank you. Sandra, thank you for seeing a small flicker of an anthropologist-flame

somewhere in me, and for fanning it! There are so many tenants of this research that I would never have begun to consider without your ideas and guidance. Here, I must also thank the post-graduate administrative support of the anthropology department, Kate surely deserves medals of all kinds and I thank you Judith and John for letting me fill up your office with poop-collection tubes, chemicals and giving me the benefit of the doubt on my RSTG on many occasions. Also, for somehow getting me through a risk assessment for the Central African Republic!

I thank my research assistants sincerely, without whom my fieldwork would simply have failed. Primarily, Bara, Ilona, Dicky and Paulo, but thank you also to everyone who ever collected a gorilla poop for me. Bara came to me barely speaking English, no French and certainly no Sango, having never been away from the Czech Republic for longer than a few months. I thought I was slightly crazy taking her to central Africa with me for nine months, but something told me it would be OK. I can only say that Bara excelled on every level, and I watched her grow into an outstanding field worker, colleague, and most appreciably, a wonderful friend. Thank you also to Ilona, for keeping me sane in the final months of my field-work and feeding me beautiful forest versions of Czech dumplings and sardine patties that I now realise not everyone appreciates outside of the forest. Thank you Terrence, for being a lovely little brother from another mother, I am immensely proud of you and grateful to have spent my time in Bai Hokou with you. The same applies to you, Bruce, your work ethic is an inspiration and your gentle advice was critical to my health and wellbeing at times in Bai Hokou. Thank you also Klara, for agreeing to be a critical collaborator and colleague on my project, but also for your *kirikiri-ness* in our work and friendship. I know you are inspiring a generation.

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always, and now in spite of the horrendous civil war now threatening everything. You and the enduring DSP staff are real heroes. It's difficult to illustrate quite how many thanks I owe to the PHP leader, Angelique Todd, for her enduring support, collaboration and friendship during my time in Bai Hokou, and after. Thanks for so many things, but sharing your Sprints, Grants and precious butter with me meant more than you know. Actually, you know exactly.

I owe a huge amount of thanks to my expert project collaborators and their extended teams. To Klara Petrzelkova (again) and David Modry in the Czech Republic and the many members of your teams who provided valuable opinions. Equally, my sincere thanks go to Michael Heistermann for invaluable advice and collaborative support. Enormous thanks also to Petra Kiesel and Andrea Heistermann for their expert help with hormone analyses. Thanks to Adetayo Kasim, for somehow teaching me R and linear regression, it must have been awful for you. I must also thank Amy-Leigh Powell and Victoria Anderson for taking time out during their undergraduate studies to volunteer assistance in the lab, to help with the very mundane task of drying and weighing gorilla poo!

In the world of write up, I owe huge thanks to a few awesome friends who helped me keep perspective, or otherwise avoid thinking all together, with tea and wine, at mostly appropriate times ... thanks Tash, Fi and Emily! Fi, let's hope we will both recover from the curse of Durham time-keeping and the dreaded house-lurgy! Thank you also to my non-PhD friends; especially you Lucy, for always believing in me, listening to my rants and silly tears, and for transforming me back into something like a woman when I came out of the jungle looking like the elephant man, again.

There is one person to whom I owe thanks for so many things. That's my Al. Firstly, without you, I would likely still be at the data entry stage and my thesis would look like a rushed key-stage 3 submission. Beyond the excel and formatting wizardry, thanks for your loving support, being my rock, training buddy, best friend, and the most delightful post-work distraction any girl could hope for.

Finally, I owe thanks beyond all others to Ma and Pa Shutt. I don't suppose any mother or father stops worrying about their children on a daily basis, but I feel I have thoroughly tested the boundaries of acceptable activities for daughters over the years. Sometimes, in my pursuit of a career involving large animals in tropical African forests, I have brought little ones home with me, in my blood for example, or buried in my skin. Thanks Dad, for starting me breathing again when the little blighters took residence in my lungs, and for supporting Mum through years of sleepless nights because of me. Thank you Mum, for your hours of proof-reading

(nothing funny about lurking naturalists!), helping me pack, your secret letters and little gifts that smelt of home. More than anything, thank you both, so much, for your endless support and encouragement. It means the world to me that you were able to visit and share a bit of it all with me. Simply, I could not have done any of this without you.

What is it about wild animals? What is the power they wield over our imaginations, our dreams? What is it about a wild mustang, with its flowing mane, that ennobles him above the domestic carthorse? The wolf - despite its reputation of evil and cunning - assumes an exalted position in our souls that the yapping poodle can never hope to achieve. The romantic notion of friendship with a beast untamed and perhaps untameable: why do we feel so humbled and at the same time so honoured when this creature - he of the feral temper and the wild look in his eye - turns trusting and submissive in our presence? Any scientist will tell us that love from animals is an anthropomorphic notion that should be banned from our vocabulary. An animal cannot love us. A dog may get used to its regular meals and will regard his owner as the pack's alpha male. It submits to him and it might respect him, but it does not love him. The imprinted goose, the horse that recognises his rider as he walks across the stable yard, the cow that anticipates the milk maid, or the circus lion that correctly reads his trainer's mood - they don't love us. Yet something touches our souls when a wild animal, free and unrestrained and with no reason to seek out our company does just that. Could it be the ancient memory of a time when we ourselves were part of that wilderness, when we communicated in the same way, without language, when we too, were wild and free?

(Vic Guhrs. The Trouble with Africa. P89)

Chapter 1 - Introduction

1.1. Wildlife tourism

Nature tourism is one of the fastest-growing industries in the world (Mehmetoglu 2005), with wildlife tourism at its core. Wildlife tourism has major overlaps with the domains of ecotourism and rural tourism, links with consumptive uses of wildlife (such as fishing and hunting) and rural tourism, and sits within a rich background of human relationships with animals which covers aspects of ecology, psychology, animal ethics and tourism (Figure 1.1). Integrated Conservation and Developments Programmes (ICDPs) arose during the 1980s, out of a shifting conservation emphasis towards local livelihoods and sustainable resource use, and in parallel with new goals to increase the involvement of local people in conservation (Western, et al. 1994). ICDPs seek ways to produce material benefits for local peoples' livelihoods from the conservation of resources, or to compensate communities for the associated costs of conservation in other ways (Naughton-Treves and Treves 2005; Sandbrook 2006). While various resource management tools have been implemented to meet these costs, ICDPs often depend on external sources of revenue (Sandbrook 2006). Where such sources are not available, wildlife tourism has been increasingly adopted as a tool to generate revenue for conservation (Budowski 1976).

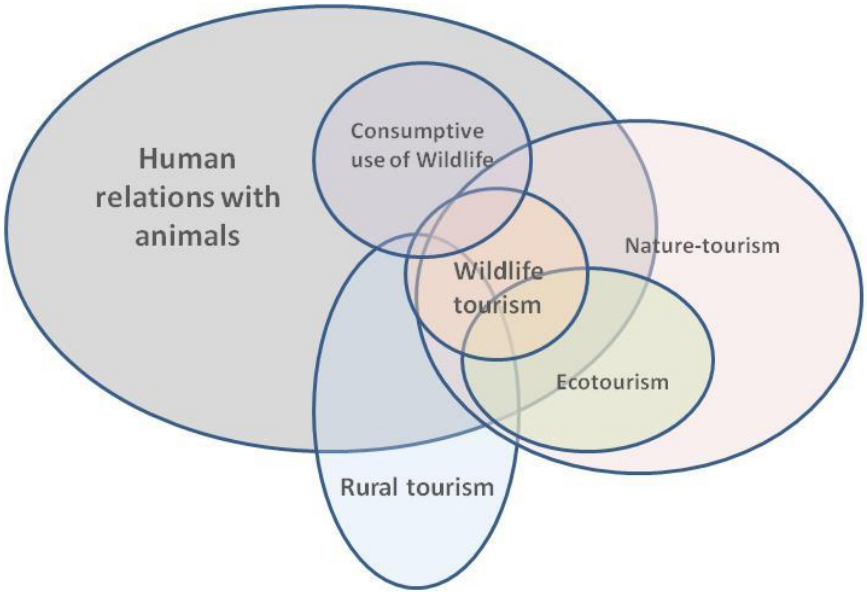

Figure 1.1. A conceptual framework for wildlife tourism, adapted from Reynolds and Braithwaite, (2001).

The success of revenue generation via tourism is heavily dependent on the quality of the tourism product. Protected areas offering tourists encounters with species such as mountain gorillas (*Gorilla berengei*) in Rwanda, or rhinos (*Ceratotherium simum*) in Ngorongoro Crater, Tanzania, are often highly successful, even in the face of political instability and poverty (Wilkie, et al. 2001). Such 'flagship' species are often the focus of wildlife tourism and conservation programmes, as they are considered to connect to a wider public, and they represent a greater backdrop of biodiversity in protected areas as ambassador species (Dawson 2001; Mehlman 2009). Conservationists have, therefore, capitalised on wildlife tourism where a large number of mega-fauna species remain and where there is enormous potential for the creation of protected areas, such as in central Africa (Dawson 2001).

A growing number of studies illustrate the varying successes and failures that wildlife tourism offers within the ICDP concept (Adams and Hulme 2001; Brockington 2002; Oates 1999; Ross and Wall 1999; Wells and McShane 2004). Benefits include increased government and public support for conservation, increased foreign exchange earnings, positive changes in local people's attitudes towards local wildlife, employment generation, and attraction of financial investment for threatened species and areas (Butynski and Kalina 2009). Wildlife-viewing is held to promise economic survival and sustenance for future generations for many developing countries (Todd 2008). However, a major criticism of the ICDP use of nature and wildlife tourism as a source of revenue is that the focus on delivery of economic benefits to local people eschews the real issues of resource distribution and social inequality that are commonly the root cause of conservation issues (Fletcher 2012). Critiques of the ICDP conservation approach refer to it as a neoliberal incentive for preservation which ultimately reduces nature, or parts of nature such as wildlife, cultures or wilderness scenes, into nothing more than a product for consumption and an extension of capitalist reign over natural resources (Fletcher 2009; 2012).

A further major concern relating to the rapid emergence of ecotourism is the lack of mechanisms to evaluate the environmental consequences of tourism on the target species and their habitats. Although the focus of safari tourism has changed from exploration to shooting film, it appears that people in the developed world still have a strong emotional need to experience wild places and animals (Adams and McShane 1992), and a persistent desire to connect with the ancient rhythms of wildlife and nature which are thought to be prevalent in Africa (Buchanan, et al. 2005). Human behaviour towards wildlife can arise from various motivations, perceptions and attitudes which lead to conflicting meanings of expectations and aspirations in tourists, as well as differing perceptions of risks to the animals. Viewing

regulations designed to protect wildlife can fail because of a lack of understanding of the different ways in which people experience their interactions with wildlife. For example, photography and visual media are likely to be some of the most important tools people use to mediate their interactions with wildlife, to create their meanings about themselves around those interactions in society. At the same time, the drive to pursue photographic images may be one of the strongest reasons why people disturb wildlife (Lott 1992; Montag, et al. 2005; Russell 1996), endangering both themselves and the animals they may be hoping to help. There is a currently a lack of information regarding the motivations and expectations of different stakeholders of wildlife tourism, although this information is vital for effective management of the human-wildlife interactions. A great deal of available information regarding tourist's motivations is concentrated on what people do while they are away, without addressing why they go in the first place, the relationship between motivation and behaviour, and the dynamic characteristics of motivation (Curtin 2005). Additionally, a key criticism of much research into human-wildlife relations in the contexts of ecotourism is that it pays little or no attention to the ways in which people, including tourists, construct non-human nature (Russell and Ankenman 1995).

Habituation must often be achieved before wildlife tourism or research activities can commence, so that humans can observe the wildlife closely, providing a pleasing wildlife experience for observers (Knight 2009). The habituation process involves exposing the animal(s) to the presence of humans repeatedly without reinforcement until the behavioural fear response wanes and the animal(s) appear to accept humans in their environment (Williamson and Feistner 2001). Behavioural observations of wildlife suggest that habituation is a highly stressful process for the animals concerned (Butynski and Kalina 1998; Rose and Rankin 2001), but over time, successful habituation reduces the stress response to human contact. For example, unhabituated wild adult Magellanic penguins (*Spheniscus magellanicus*) showed severely elevated plasma corticosterone levels in response to tourist visitation, which diminished quickly during the course of habituation (Walker, et al. 2006). Once animals are habituated, repeated, intermittent visitation by humans during tourism or research activities may also cause long-term physiological alterations to the hypothalamic-pituitary-adreno (HPA) axis, which mediates the effects of stress via activation of various behavioural and metabolic processes (Cyr and Romero 2008; McEwen and Stellar 1993; Sapolsky 1992). For example, European pine martins (*Martes martes*) and little penguins (*Eudyptula minor*) visited by tourists have significantly higher measures of physiological stress than conspecifics that are not exposed to tourism (Barja, et al. 2007; Behie, et al. 2010; Turner 2001). Habituation has also been found

to lead to alterations in animal stress responses needed to mount normal 'flight or fight' reactions as a result of permanently altered adrenocortical tissue function. For example, marine iguanas in the Gala´pagos that were visited by tourists showed a lower stress response to capture and restraint than non-tourist exposed animals (Romero and Wikelski 2002).

Chronic stress reduces an animal's ability to respond to environmental stressors and suppresses the immune and reproductive systems (Cyr and Romero 2008; Sapolsky 1992). This means that animals involved in habituation and tourism activities may be more vulnerable to anthropozoonotic transmission of disease and infection than those that are not (Butynski and Kalina 1998; Homsy 1999; Muehlenbein and Ancrenaz 2009; Travis, et al. 2008b; Woodford, et al. 2002). All animals carry many species of parasites in the stomach and small intestine which are not dangerous under normal conditions but can multiply and cause illness when a persistent stress occurs (Meder 1994), affecting host survival and reproduction. Severe parasitosis can lead to blood loss, tissue damage, spontaneous abortion, congenital malformations, and death (Chapman, et al. 2007). The potential for stress to increase the risk of disease transmission and pathogenesis is a vitally important, but so far unmeasured, potential influence of habituation and tourism on wildlife species.

Managing the balance between conservation and recreation in natural areas is complex, and addressing the multiple competing, and often conflicting, interests of stakeholders that exist in most natural areas requires a comprehensive understanding of their dynamics (Catlin, et al. 2011). An integrated view of the relationship between the experiential needs of the consumer (e.g., tourists and tour operators) and product management (e.g., conservationists and researchers) is essential for wildlife tourism organisations in order to protect the sustainability of the resource. For example, damage from tourism can occur as a result of inappropriate management, such as allowing visitors or staff to overcrowd wildlife, to get too close, damage the habitat or visit for too long (Curtin 2005). Conservationists now warn that where tourism is not based on conservation from the start, there is the risk that economic objectives will take precedence and lead to uncontrolled, poorly managed tourism growth, risking the continued preservation of the species and its habitat (Williamson and Macfie 2010). A substantial number of cases now link nature tourism to the loss of species and degradation of natural habitats (Boo 1991; Butynski and Kalina 1998; Higginbottom, et al. 2003; Roe, et al. 1997). In particular, a growing number of accounts detail behavioural and physiological alterations in the wildlife species encountered (Semeniuk, et al. 2009; Tadesse and Kotler 2012; Thiel, et al. 2011; Treves 2005; Velando and Munilla 2011), causing experts concern that costs of

tourism and research activities for wildlife may outweigh the conservation benefits (Butynski and Kalina 1998; Ferber 2000; Higginbottom, et al. 2003).

1.2. Gorilla tourism

Gorillas are perhaps one of the best charismatic mega fauna to provide a pathway into people's relationship with nature and animals and to sensitise them about preservation of biodiversity (Mehlman 2009, P45).

Gorilla tourism is perhaps the most well-known and widespread form of human-wildlife interaction on the wildlife tourism market. Tourism and research based on habituated gorillas are promoted as one of the best means of conserving gorillas and their habitats (Butynski and Kalina 1998; Todd 2008; Weber and Vedder 2002; Williamson and Macfie 2010). Millions of pounds are poured into gorilla conservation in Africa each year (Adams and McShane 1992), which demonstrates the strong human desire to conserve the species (Montgomery 2009). Gorillas have captivated the imagination of the public and scientific community since the mid-nineteenth century, drawing us into mounting tensions between curiosity about our ancestry and a reluctance to accept commonality between ourselves and other primates (Montgomery 2009). The gorilla lies close to the chimpanzee at the taxonomic boundary dividing human and non-human primates (Corbey 2005), and has perhaps been discussed as much by the media and in popular literary sources as it has in science. The most prominent example is the story of Dian Fossey and the mountain gorillas of east Africa, which was first brought to mainstream attention via images in National Geographic magazine (1970), and subsequently as a blockbuster film, *Gorillas in the Mist* (1988). Fossey's life, as portrayed by the actor Sigourney Weaver, is a tale of struggle and emotion in which she slowly befriends animals that were popularly ferocious beasts. Wildlife documentaries increased recognition of the species, perhaps the most famous moment being David Attenborough's (1979) encounter with a group of habituated gorillas during which he is seen engaging in playful antics with a juvenile. This interaction between species has since been used repeatedly by media, Non-Governmental Organisations (NGOs), governments and conservationists around the globe to capitalise on peoples' intense fascination with gorillas, and has contributed to the gorilla becoming a symbol of wider conservation efforts in Africa (Adams and McShane 1992; Dawson 2001). In some ways these events have been fruitful not only for gorillas, but also for other species, because the 400 km^2 of habitat required for a viable gorilla population is sufficient to support populations of other sympatric forest flora and fauna (Tutin 2001). Nowhere is the apparent fascination with

gorillas better demonstrated than in the multi-million pound wildlife tourism industry, within which gorillas have become a highly successful attraction (Litchfield 2009).

Recent estimates suggest there are 101,518 gorillas remaining in the wild (Table 1.1). Gorilla habitat ranges from patchy blocks in the east in the Democratic Republic of Congo, the Republic of Congo and Uganda, over to Central and West Africa where populations exist in the Central African Republic, Gabon, Cameroon, Nigeria and Angola (Figure 1.2). Recent taxonomy describes four subspecies of gorilla (Mehlman 2009), with a geographical division of approximately 900 km between eastern (mountain and eastern lowland) and western (Cross River and western lowland) gorillas.

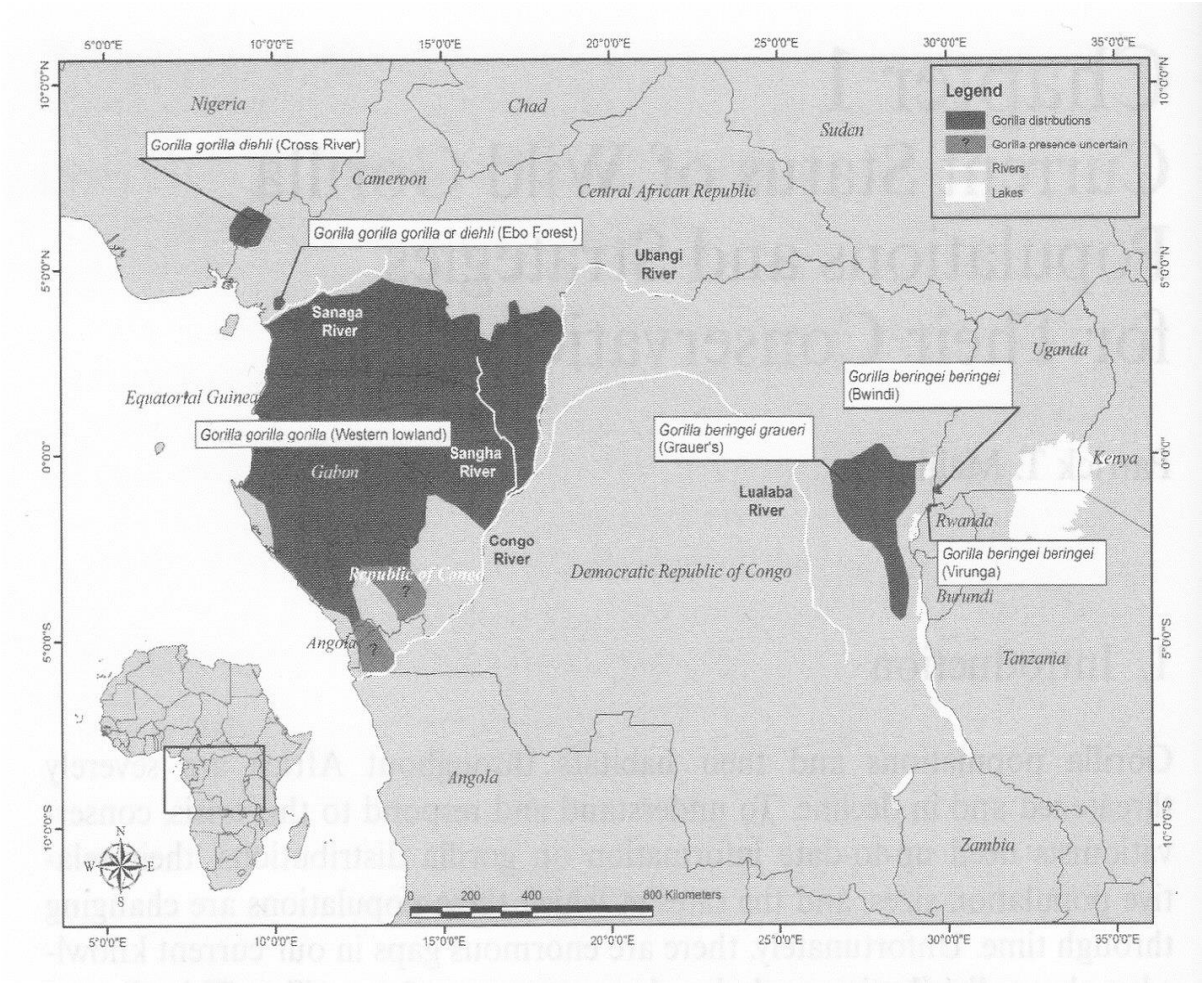

Figure 1.2. Distribution of the genus *Gorilla* in equatorial Africa, reproduced from Stoinski, et al. (2009).

Table 1.1. Extant gorilla subspecies and their conservation status (Mehlman 2009).

	Geographical Range km^2	Estimated Remaining Wild Population	Population Inc/Decreasing (IUCN Redlist)	References
Western Gorillas				
Western lowland gorillas (*Gorilla gorilla gorilla*)	709,000	95,000	Decreasing	Harcourt, (1996)
Cross river gorillas (*Gorilla gorilla diehli*)	2,000	250-300 (inc' Ebo F. Pop)		Oates, (2003)
Ebo forest gorillas (*Gorilla gorilla gorilla/diehli*)	n/a	n/a	Decreasing	
Eastern Gorillas				
Eastern lowland gorilla (*Gorilla gorilla graueri*)	52,000	5,588	Decreasing	Mehlman, (2009)
Bwindi mountain gorillas (*Gorilla gorilla berengei*)	330	300	Increasing	McNeilage *et al.*, (2006)
Virunga mountain gorillas (*Gorilla gorilla berengei*)	447	380	Increasing	Grey *et al.*, (2006)

Gorilla populations are particularly slow to recover from disturbance because gorillas are long-lived and slow to reproduce (Taylor and Goldsmith 2003). Direct threats to populations are habitat loss, modification and fragmentation, the bush-meat trade, Ebola haemorrhagic virus, disease transmission from humans and war (Köndgen, et al. 2008; Mehlman 2009; Woodford, et al. 2002). It is perhaps surprising, given the size of current populations, that the western lowland gorilla is classified as critically endangered, when the eastern mountain gorillas are only endangered (International Union for the Conservation of Nature [IUCN], 2008). However, this is due to the 80 % population decline predicted over the next three generations for western lowland gorillas (Walsh 2008), compared to the – albeit slowly – increasing population of mountain gorillas. Threats specific to central and western Africa exacerbate the decline of western gorilla populations, for example, whilst it is seen as culturally taboo to eat primates in Uganda and other parts of east Africa, hunting gorillas for meat is common in west and central Africa (Weber, et al. 2002). Further, the commercial logging industry is destroying the forests of western Africa at a rate higher than anywhere else on the continent (Barnes 1990; Mehlman 2009). The creation of national parks has been seen as one option for habitat conservation, but estimates propose that only 4-7 % of gorilla ranges are protected by parks, and that efforts to protect these areas are inadequate (Butynski and Kalina 1998).

Tourists have visited wild gorilla groups since 1955, and growing numbers of gorilla groups have been habituated specifically for the purpose of tourism and research activities since the 1970s (Butynski and Kalina 1998). Gorilla tourism has become a key success in terms of revenue for Rwanda and Uganda (Harcourt, et al. 1989). This revenue has contributed to alternative livelihoods to hunting for local people living around the national parks, income and improved attitudes towards gorillas and park protection amongst local people, as well as an increasing gorilla population size (Weber 1993). For example, in 1988, Parc National des Volcans (Rwanda) was overrun by a mass of poor people and their cattle, heavily infected with disease,

and gorillas were hunted. The situation improved dramatically after the initiation of well-managed gorilla tourism in 1989 by the Mountain Gorilla Project, which later became the International Gorilla Conservation Programme. The money paid for tourists' gorilla tracking permits brought improved funding for protecting gorilla habitat through the training of guards and the development of a conservation education programme for populations adjacent to the park (Harcourt 2001; Weber and Vedder 2002). Today, mountain gorillas are protected by the highest density of national park guards in the world (1 guard/2 km^2), who monitor more than one third of the mountain gorilla groups (Harcourt 2001). Snare densities, which reflect human hunting activity, are lower in areas where mountain gorillas groups are visited by tourists or followed by researchers than in areas of forest with no habituated gorilla groups (McNeilage 1996). Similarly, Litchfield (2009) speculates that Mgahinga Gorilla National Park in Uganda would not exist today without mountain gorilla tourism. Habituated gorillas are also monitored for illness or injury, allowing rapid intervention if required. For example, the Mountain Gorilla Veterinary Project (MGVP) conducted more than 60 gorilla treatments *in situ* (treatment via darting) and 22 full immobilizations between 2001 and 2005 (MGVP 2009). The contribution of this work to the mountain gorilla population increase and scientific knowledge of the causes of mountain gorilla deaths is substantial and only possible because the gorillas are habituated.

1.2.1. The need to evaluate tourism as a tool for gorilla conservation

> *Tourism has been recognised as an important conservation management tool to protect gorillas, yet itself may pose a significant threat to their survival!* (Homsy 1999, P6).

In light of the success achieved by the mountain gorilla tourism programmes, millions of dollars have been provided by donors to develop and support gorilla tourism elsewhere in Africa. It is now possible to visit three out of the four gorilla subspecies as a tourist (Table 1.2), and plans for tourism with the fourth, the Cross River gorillas, are underway (Blom 2000; Dunn 2005; Williamson and Macfie 2010). However, the success of a few sites is unlikely to be replicated in all (Williamson and Macfie 2010), and the value of conservation offered by gorilla ecotourism projects depends on the balance of risks to gorillas against conservation benefits (Jones-Engel and Engel 2006). Little information is available to assess this trade-off in research and tourism practice as it relates to human-induced physiological repercussions for wildlife (Jones-Engel and Engel 2006; Travis, et al. 2008a).

Table 1.2 Gorilla habituation and tourism sites in equatorial Africa

Site	Country	Gorilla Sub-Species	Year Commenced	Status
Park National des Volcans	Rwanda	*Gorilla gorilla berengei*	1979	Highly successful gorilla habituation, run by the Mountain Gorilla Project incorporating anti-hunting and conservation education
Park National des Virungas	Democratic Republic of Congo	*Gorilla gorilla berengei*	1989	Shut down in 1996 due to political instability, recent attempts made to re-open it.
Mgahinga National Park	Uganda	*Gorilla gorilla berengei*	1994	2000 residents were evicted from the park in 1991 to protect it.
Bwindi Impenetrable Forest	Uganda	*Gorilla gorilla berengei*	1993	Highly successful gorilla habituation, tourism numbers are recovering after 8 tourists were murdered by the Rwandan and Congolese Rebels (Interahamwe) in 1999.
Kahuzi-Biega National Park	Democratic Republic of Congo	*Gorilla gorilla graueri*	1973	4 of 5 gorilla groups were killed during civil war in 1992, and little tourism has returned since.
Mikongo Gorilla Conservation Centre	Gabon	*Gorilla gorilla gorilla*	1995	Unsuccessful gorilla habituation - now offering a 'rain-forest experience' with the chance to see wild gorillas
Moukalaba Doudou Gorilla Ecotourism Site	Gabon	*Gorilla gorilla gorilla*	2003	Habituation of at least two gorilla groups proving successful, tourism not yet commenced.
Lope Wildlife Reserve, Lope National Park	Gabon	*Gorilla gorilla gorilla*	1982	Habituation was not successful, now focuses on sympatric gorilla and chimpanzee research and other forest fauna.
Lossi (Near Odzala National Park)	Republic of Congo	*Gorilla gorilla gorilla*	1993	Highly successful habituation, however 8 groups were lost to Ebola in 2002.
Maya North Saline, Odzala National Park	Republic of Congo	*Gorilla gorilla gorilla*	Not Known	Gorillas reported to have been habituated. See Mehlman 2009.
Bai Hokou, Dzanga-Ndoki National Park	Central African Republic	*Gorilla gorilla gorilla*	1989	Successful gorilla habituation, lost one group in 2004 but now have 2 habituated groups and two groups are under habituation.
Monte Alen National Park	Equatorial Guinea	*Gorilla gorilla gorilla*	Not Known	Gorillas reported to have been habituated. See Mehlman 2009.
Lomie, near Dja Wildlife Reserve	Cameroon	*Gorilla gorilla gorilla*	Not Known	Habituation trials have taken place. Personal communication.
Afi Mountain Reserve	Nigeria/Cameroon Boarder	*Gorilla gorilla deihli*	2009	Ecotourism feasibility studies have been carried out and plans for tourism are being discussed. See Macfie 2007.
Loango National Park	Gabon	*Gorilla gorilla gorilla*	~2005	One group of gorillas habituated to 50m currently solely for research purposes, tourism may commence in the next year. Plans for another group in a nearby area to be habituated for tourism are in place. Personal communication.

As with other species subject to tourism, there is a substantial need for investigation of the human dimensions of gorilla tourism and how human socio-cultural and behavioural factors affect people's constructions of gorillas, their attitudes and behaviour towards them, and therefore the risks to gorillas if tourism is to contribute to conservation of the species. Moreover, gorillas are thought to be particularly vulnerable to the effects of exposure to tourism (McNeilage 1996; Nizeyi, et al. 2001). Gorilla habituation is a difficult, expensive and time-consuming activity, with no guarantee of success (Williamson and Macfie 2010). Compared to mountain gorillas, western lowland gorillas are particularly difficult to habituate due to their dense forest habitats and the large distances they travel daily. This means western lowland

gorilla habituation often takes more than 5 years to achieve (personal observation). Studies describing the behavioural response of gorillas to habituation suggest that they suffer severe stress throughout this period but that this may be reduced as gorillas become more habituated (Ando 2008; Blom 2004a; Cipolletta 2003). Additionally, gorilla tourism activities have been associated with increases in self-directed behavioural indicators of stress in gorillas (e.g., self-grooming and scratching) (Muyambi 2005) and altered behavioural patterns when in the presence of tourists and researchers (Klailova, et al. 2010; Steklis 2009). Despite growing evidence of stress effects resulting from habituation in various animal species, the only measurement of potential influence of stress on gorillas has been comparisons of birth-rates in habituated vs. unhabituated groups (McNeilage 1996). No study has yet used endocrinological indicators of stress in habituation and tourism (Muehlenbein 2009). Therefore, the extent to which stress is incurred, reduced as habituation progresses or heightened as tourism commences is unknown (Köndgen, et al. 2008; Travis, et al. 2008a; Woodford, et al. 2002). Furthermore, no study has yet combined hormone and gastrointestinal parasite infections in the context of habituation or ecotourism (Muehlenbein 2009). Monitoring of such endocrine-immune interactions is essential in order to inform conservationists of any detrimental physiological effects that may be associated with habituation and ecotourism activities.

An overriding risk unique to great ape tourism is their susceptibility to human diseases, which results from their phylogenetic closeness to humans (Köndgen, et al. 2008; Litchfield 2009). However, the risk of disease transmission and the extent to which human diseases affect gorilla populations are little studied and poorly understood (Butynski and Kalina 1998; Köndgen, et al. 2008; Nizeyi, et al. 2001). To protect gorillas against the risks associated with close human observation such as physiological stress and disease transmission, most gorilla ecotourism and research sites require all people entering the forest in search of gorillas to abide by a set of rules, which have recently been revised in an official IUCN document detailing best practice guidelines for great ape tourism (Williamson and Macfie 2010). These include: declaring illness and not entering the forest whilst ill; maintaining a minimum distance of 7 m from the gorillas (increased from 5 m as a result of evidence that sneeze particles travel up to 7 m in still conditions, Homsey, 1999); tourists who defecate must bury their faeces; no eating or drinking in proximity of gorillas; visits are limited to one hour; and each group must not exceed 8 tourists (increased from 6, Sandbrook and Semple 2006). Each year, however, thousands of tourists exit crowded, poorly ventilated aeroplanes and airports and get within 6 m of, and sometimes touch, or even hug, gorillas within 1 or 2 days, creating a potentially huge risk of human-gorilla disease transmission (Butynski and Kalina 1998). The fact that adequate control over gorilla

tourists is often lacking is clearly demonstrated by many photographs and videos captured by tourists and guides, showing humans in close proximity to, and deliberately touching, gorillas (Butynski and Kalina 1998; personal observation). Despite the long-term problem of satisfactory control of gorilla tourists, little research has investigated this problem and its origin (Butynski and Kalina 1998; Garber 2008; McNeilage 1996; Travis, et al. 2006). Only one study, of mountain gorillas, has examined encounters between gorillas and humans in detail, showing that the mean proximity between them was only 2.76 m, and that juvenile gorillas had the highest number of close contacts with humans (Sandbrook and Semple 2006). Like young children, juvenile gorillas are vulnerable to disease, especially novel strains brought into their environment by international tourists, against which gorillas have no immunity (Cranfield 2008). The authors concluded that gorilla viewing regulations are failing, and that the risk of disease transmission is greater than previously believed (Sandbrook and Semple 2006).

Very few studies have investigated the contexts in which human visitors become a risk to the gorillas and their environment, and only one study has included conservation personnel, whose activity should theoretically be managed most easily (MGVP 2009). Moreover, conservation personnel are under great pressure to achieve extensive contact with gorillas, which may foster the strongest motivations to break the rules (C. Cipolletta, personal communication). Reward schemes for making contacts with gorillas are common in habituation programmes, and pressures driving researchers and project staff to work despite illness or to move closer on consecutive contacts with gorillas can often go unrecognised and unmonitored (C. Cipolletta, personal communication; personal observation). Guides can also be put under pressure to allow people to get closer to gorillas during tourist visits in the hope of receiving a larger tip, or as a result of tourists pressuring them for more memorable experiences and photographic footage (McNeilage 1996).

1.3. Thesis structure

The ultimate success or failure of a gorilla tourism site can lie in factors that are not easily visible to policy makers who may otherwise base decisions on the revenue-earning potential of conservation programmes (Williamson and Macfie 2010). The absence of such information means that the potential costs of gorilla tourism are unidentified, tourism management strategies are not informed by scientific studies, and the ethics of habituating gorillas to humans remain relatively unexplored, though much discussed. This combination of ecological and anthropological research questions necessitates a bio-social approach. In this

thesis I adopt this interdisciplinary approach and provide an integrated understanding of the factors that influence human-gorilla interactions and incorporate them into conservation biology. The outcomes of the interdisciplinary risk assessment aim to inform policy makers as to how they may better protect gorillas from the potential negative effects of human disturbance resulting from revenue-raising tourism and research activities, and to maximize the potential for such projects to be beneficial, low-impact and sustainable primate conservation solutions.

This thesis is made up of ten chapters, some of which are published papers or submitted to peer-reviewed journals. In Chapter 2 I provide an introduction to the study site and the gorilla habituation and tourism programme. In Chapter 3 I provide an overview of my interdisciplinary research methods and the collaborative network involved in the study. In Chapter 4 I review what is currently known about human-wildlife interactions, what drives them and the repercussions they have for the people involved. In Chapter 5 I use tourists' experiences of tracking western lowland gorillas to describe and explore their perceptions and constructions of gorillas. I investigate why people want to watch gorillas in the wild, their reactions to, and behaviours during, their gorilla encounters and the effect these encounters have on them and place my findings in the context of the theoretical background presented in Chapter 4. Chapter 6 is a paper published in General and Comparative Endocrinology which details a series of experiments conducted to validate an enzyme-immuno assay and field methods for measuring physiological stress in the western lowland gorilla. Chapter 7 is a manuscript accepted for publication in Biological Conservation. It details the problem of physiological stress hormone alterations in gorilla habituation and tourism programmes, reports the results of a year-long study of western lowland gorilla physiological stress response to measures of human contact in the habituation and ecotourism context and discusses the conservation implications of the findings. Chapter 8 is a manuscript prepared for submission to the American Journal of Physical Anthropology. In this manuscript I combine the hormone data presented in Chapter 7 with gastrointestinal parasite infection data to address the question of whether increased stress hormone concentrations are associated with increased infections of pathogenic parasite species and discuss the conservation implications of the findings. In the final empirical chapter (Chapter 9) I investigate the epidemiological risk factors affecting the health and illness of different groups of people engaged in gorilla tourism activities. I explore how human-gorilla interactions are affected by the individual motivations, attitudes and risk perceptions discussed in Chapter 5 and how these factors integrate with data presented in Chapters 7 and 8 to affect the risk of disease transmission to gorillas. In the final chapter (Chapter 10) I provide a summary and synthesis of the findings. I integrate the biological and socio-cultural aspects of human

interactions with gorillas and discuss the conservation management implications. I provide a set of management recommendations for my study site before discussing how the findings are more widely applicable in wildlife tourism management and make suggestions for future research. I conclude with a discussion of the value of the interdisciplinary research and my experience in conducting it.

Chapter 2 - The Study Site

2.1. The Central African Republic

The Central African Republic (CAR) is situated approximately 500 km north of the equator. It is 622,984 km^2 in area, and is landlocked by neighbouring countries Sudan, Chad, Cameroon, the Republic of Congo and the Democratic Republic of Congo. With a population of 4.4 million, concentrated in four central areas around the capital city Bangui (Nana Mambere and Mambere Kadei to the west, Ouham in the centre-north, and Ouaka in the centre-east), the rest of the country is largely devoid of human habitation. The CAR is ranked as one of the least developed countries in the world with a gross national income of $454 per capita and an average life expectancy of 47-50 years (WHO, 2013). Just over half of the population (57.3 %) are literate (World Bank, 2010). The economic situation has been badly affected in recent years, mostly by political disturbance and violence.

The territory, previously known as Ubangi-Shari in the late 1800s under French rule, became known as the Central African Republic shortly before claiming independence on the 13th August 1960 under the presidency of David Dacko. Political stability has since been rare with four presidential coups and questionable multi-party elections, and power has historically been taken by force. At the time of writing, General François Bozize was president for the second time, and was re-elected during the time of my study. The organization of the voting system was questioned, however, having been plagued by racial discrimination and bullying (personal observation), but no political violence was reported around that time, which is a promising development for the country.

The CAR is predominantly flat. Almost all the terrain is below 1000 m and the relief is related to two main river drainage systems: two thirds going to the Congo basin system, and the remaining third to the Tchadian system (Blom 2004a; Boulvert 1986). The terrain changes dramatically however, from desert landscape in the north, down to the midst of the Congo Basin in the south where wooded grasslands adjoin dense rainforests. The CAR has been described as having four main ecosystems or vegetation zones, which relate strongly to climatic zones (Blom 2004a; Boulvert 1986). From north to south these are: the Sahelian Savanna (mostly savanna), Sudanian Savanna (savanna and small groups of trees), Congolian Savanna forest mosaics (wooded savanna and dry deciduous forest) and the Congolian dense forest in the south (deciduous and evergreen forest) (Carroll 1986a).

2.1.1. Protected areas of the CAR

The CAR's small and centralised population, somewhat lost amongst the thousands of square kilometres of forest, makes for a promising situation for biodiversity conservation. Under the definitions of the International Union for the Conservation of Nature (IUCN) the CAR's protected areas cover close to 25.5 million hectares. This area is divided into 16 designated protected areas of varying status. These are: one integral reserve, five national parks, one biosphere reserve, seven fauna reserves, one presidential park, one special reserve, 47 leased safari-hunting sectors and ten community hunting zones. Together these add up to nearly 41 % of the national territory. However, as highlighted by Blom (2004), many of these areas exist only on paper and have little or no management on the ground (e.g., only two of 16 protected areas have even near-adequate management to be able to function as an area of protected territory). This results in a much lower figure of approximately 4.2 % of the CAR which is actually under management and offering mid- to long-term biodiversity conservation (Blom, 2004). The main threats to the survival of remaining protected areas networks are large-scale hunting and uncontrolled cattle grazing and logging. It is the responsibility of the government to find solutions to these problems (Blom, 2004). A few key protected area examples offer hope, however, where technical and financial assistance interventions led by Non-Governmental Organisations (NGOs) have had some success with cooperation from the government.

2.2. The Dzanga-Sangha Protected Areas

2.2.1. History

The Dzanga-Ndoki National Park, together with Lobeke National Park (Cameroon), and Nouabale-Ndoki National Park (Republic of Congo), now form the Sangha Tri-National complex covering an area of over 25,000 km^2, within which the CAR protected areas are referred to as the Dzanga-Sangha Protected Areas (DSPAs). The Dzanga-Ndoki National Park, in the Dzanga-Sangha Dense Forest Special Reserve, is in the prefecture of Sangha-Mbaere in the extreme south-west of the country (33 N 654357, 322606 UTM, Figure 2.1). Bayanga, the largest settlement in the reserve, was established in the late 1800s as a trading post during a time when the French brutally exploited the area's local people for the slave trade. Later, and into the early 1900s, Bayanga was a central market for ivory and rubber (Blom 2000; Giles-Vernick 1996). Coffee and diamond industries followed in the 1930s, and timber became the main source of economic interest in the 1970s (Giles-Vernick 2002). The most recent logging company in the area went bankrupt in 2004, but, the continuous presence of economic

opportunities has seen the population grow from less than 50 inhabitants to nearly 4000 in less than 50 years, and it is still growing (Hodgkinson 2008; Kretzinger 1997).

As a result of continued 'boom and bust' industries and logging cycles with extensive negative environmental effects, the CAR Government requested technical assistance from the World Wildlife Fund (WWF) to investigate alternative financial opportunities to logging (Blom 2000). A consulting firm called TELESIS was recruited in 1991 to examine sustainable economic options for the DSPA reserve and to evaluate the economics of logging. Their report showed that the economic advantages of continued logging would be minimal with high ecological costs, and concluded that the development of ecotourism, combined with associated small enterprise development and non-timber forest product exploitation, would be the best alternatives to logging in the area (Blom 2000; TELESIS 1991; 1993). In 1988, a management plan for the creation of the park and reserve system was created following a series of surveys requested by the government (Carroll 1986a), leading to a signed agreement between the CAR government and WWF for the creation and management of a protected area system in the Dzanga-Sangha region, which became the DSPA.

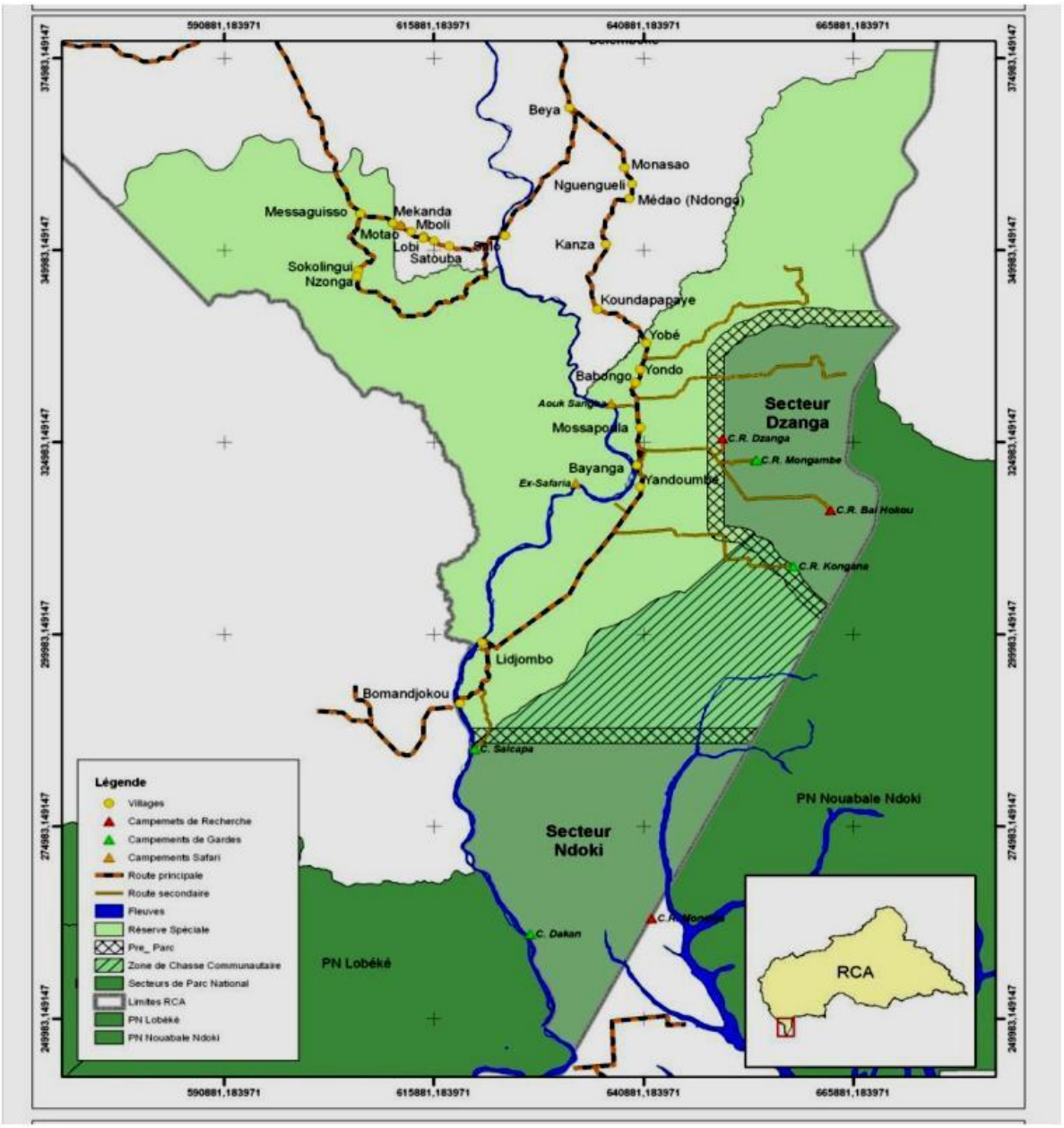

Figure 2.1. Map showing the location of the DSPA in the CAR, tri-national parks and designated sections of protected areas within the DSPA (source: DSPA, 2011).

2.2.2. Physical characteristics

The Dzanga-Sangha region is characterised by an equatorial climate, although it actually falls between two climatic zones: the sub-equatorial and Congolese equatorial zones (Carroll, 1992), with a typical three month dry season (December to February) and a nine month wet season (March to November), interrupted by a short dry season in June-July. The mean annual rainfall is 40-60 mm, and the mean annual temperature is 26 °C (Figure 2.2).

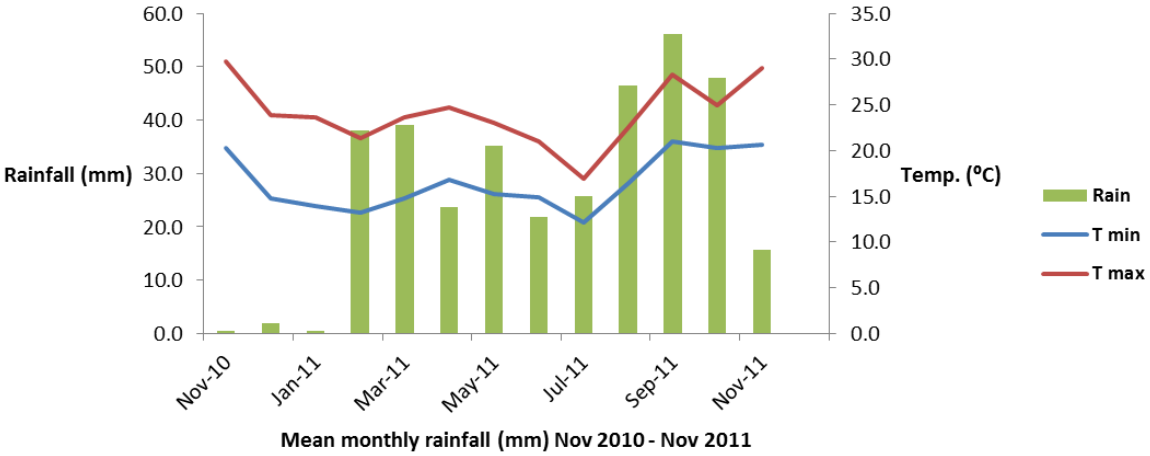

Figure 2.2. Mean monthly rainfall (mm) and minimum (Tmin) and maximum (Tmax) temperature (^{o}C) at the Bai Hokou study site for Nov 2010 – Nov 2011.

Sitting on the northern fringe of the Congo basin plateau, the DSPA is relatively flat, varying between 350 m above sea-level towards the south where many open areas of clay soil rich in mineral salts ('grand salines'), forest clearings and river tributaries are found further north where the terrain plateaus to the east and west (Blom 2000; Boulvert 1983, Figure 2.3). The geology of the area has been described as 'recent alluvial' (Blom 2004; Boulvert, 1983), and fertility is very good but quickly exhausted as the soil is on a sandstone plateau (Hodgkinson, 2009). The Dzanga area is famed for its forest clearings, salines or '*bais*', that forest elephants (*Loxodonta Africana cyclotis*) frequent in large numbers to dig in the volcanic clay-like soil (Klaus 1998 cited in Blom, 2004).

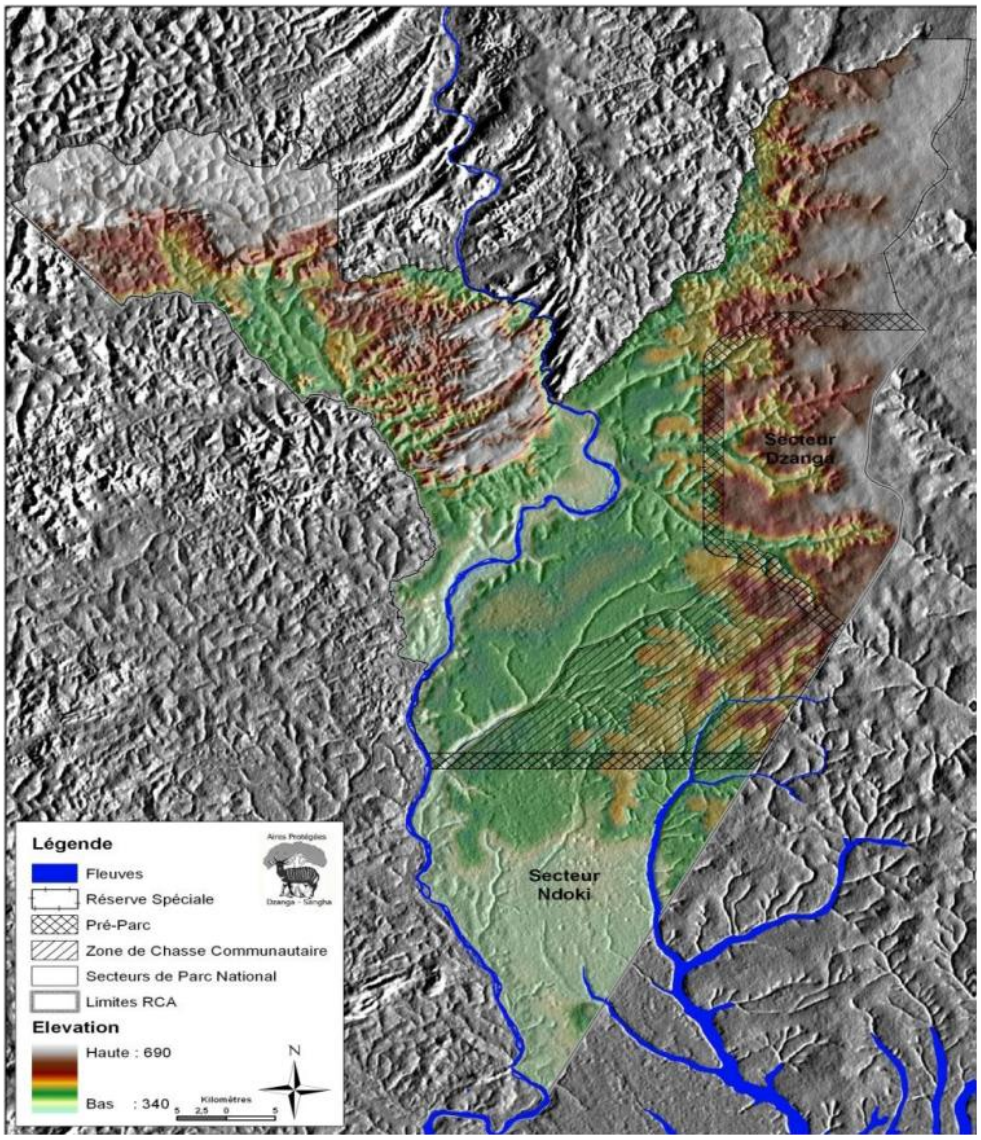

Figure 2.3. Map showing the relief and elevation of the DSPA (source: DSPA, 2011).

2.2.3. Biological characteristics

The main types of forest found across the DSPA are characterised by dominant species such as Limba (*Terminalia superb)*, Malapa (*Gilbertiodendron dewevrei*), Marais (*Raphia hookeri),* and *Uapaca* species (Figure 2.4). Selective logging has taken place in the reserve section of the DSPA since 1986, and has focused on a few species of high value, mainly *Meliaceae* of the *Entandrophragma utile* (Sipo) and *cyclindricum* (Sapelli) species (Noss, 1995; Hodgkinson, 2009; DSPA, 2011).

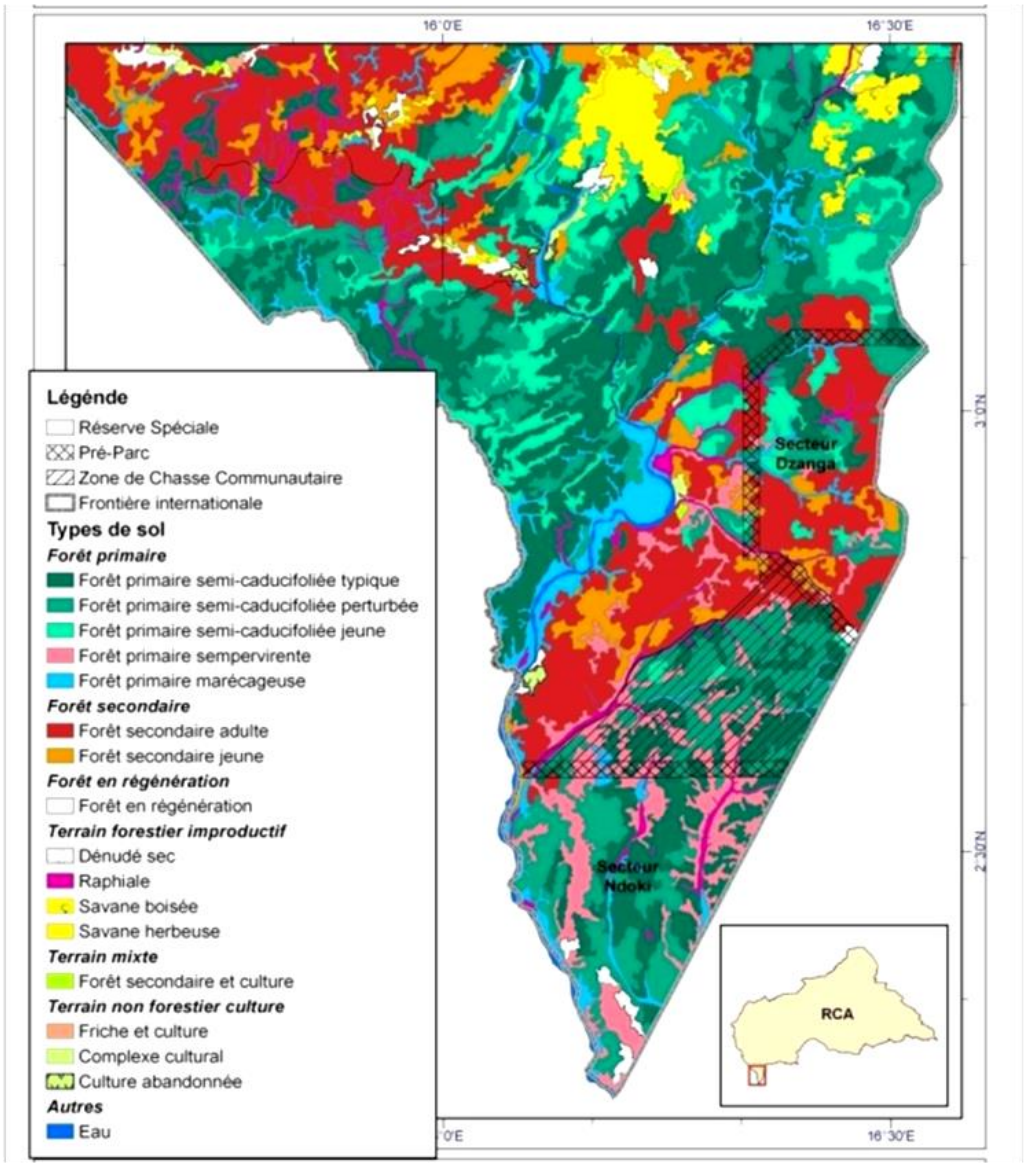

Figure 2.4. Map showing the different types of forest across the DSPA (source: DSPA, 2011).

The Dzanga-Sangha area is known as a stronghold of biodiversity (Carroll 1992). The large mammals include several 'flagship' conservation species, such as the forest elephant; 20 primate species including the chimpanzee (*Pan troglodytes)*, western lowland gorilla (*Gorilla gorilla gorilla)*, black colobus monkey (*Colobus satanus)*, sun-tailed monkey (*Cercopithecis solatus);* 14 species of ungulates including the rare forest bongo (*Tragelaphus euryceros);* and 14 species of carnivores including the leopard (*Panthera Pardus*), civit (*Viverra civetta*) and golden cat (*Catopuma temminckii*) (Blom 2000; DSPA 2011; Noss 1995). Since 1990, 379 bird species have been observed from approximately 66 families, including the rare and highly sought-after rock picathartes (*Picathartes Oreas*), (Beresford 1999; Blom 2004a; Green 1991).

2.2.4. People of the DSPA: The 'BaAka' and the 'Bilo'

Little was documented about the Bayanga region before the arrival of Europeans, however it is thought likely that Bantu peoples from the lower regions of Nigeria, along with Ubanguian peoples of the CAR, were settled alongside the pygmys[1] of the Sangha River area as early as 500 BC (Hodgkinson 2008; Vansina 1990). Well over half the population of the reserve now live in Bayanga. The latest census (2005) suggested that close to 85 % of household heads were not born in the reserve, and that they represent 36 different ethnicities that are not indigenous to the area (Noss 1995 cited in Hodgkinson 2009). Continuous tribal wars during the 19th century are thought to have resulted in the present distribution of ethnic groups (Blom 2001). There are now four major ethnic groups within the reserve: BaAka, Gbaya, Mpiemu and Sangha-Sangha (Carroll 1992). However, these groups are commonly separated into two main ethnicities: the BaAka, who speak their language, referred to as BaAka, and occasionally the national language, Sango; and the non-Aka, Bilo or Bantu (referred to hereafter as Bilo), population who speak Sango and, generally, French. The division of residents into BaAka and Bilo is based on radical differences between the subsistence and residency approaches of the two groups, but the name BaAka generally refers to the pygmy peoples living in and around the forest of southern CAR and Northern Congo. Although the two cultures are now heavily integrated geographically in this region, in my experience the BaAka often refer to the Bilo population as 'les gens du village' (the village people), and the Bilo often use the term 'pygmy' rather than BaAka to signify 'les gens du forest' (the forest people). Despite variability within Bilo ethnicities, the most striking and visible ethnic tensions rest between the Bilo, who make up approximately 77 % of people in the reserve, and the BaAka, who form the remaining 23 %.

The historical relationship between the forest BaAka and the Bilo agriculturalists is largely unknown. There are some references to the BaAka having been slaves to the Bilo (Gide 1927) in the past, although the BaAka in the Dzanga-Sangha region are thought to have had a close relationship with the Bilo 'Sangha-Sangha' people, often exchanging their meat and forest goods for cassava, manioc, salt and money, before the mass influx of immigrants in the 1970s (Bahuchet 1991; Blom 2004b; Hodgkinson 2008). However, traditionally, the BaAka people are nomadic hunter-gatherers who spend a large proportion of their time moving around the forests hunting and gathering insects, plants, mushrooms and honey (Kretsinger 1993; Noss

1 In recognition that the word 'pygmy' can often have derogatory connotations I choose not to use this in writing about my research, instead I refer to the ethnic group as BaAka. However, where I am citing another author's work, where the term is directly relevant to the subject, or its use is otherwise unavoidable, I use the word 'pygmy' when referring to the indigenous BaAka ethnic group.

2001). Generally, the BaAka are subsistence net hunters, although they sometimes use spears or traps. Family groups of approximately 10 to 30 people go to known hunting areas in the forest, where they set up temporary camps from which to go hunting. Nets are traditionally made from *kosa*, a long liana vine of *Manniophyton fulvum*, which is cut down, stripped and dried before being woven into sections of net. Both men and women make the nets which can be as long as 20 m. Sarno (1993) describes the practice of catching small duiker prey with the BaAKa perfectly:

> *One of them would pop a leaf over his clenched fist, a sharp rapport that carried far, and the men would fan out left and right, stringing their nets in a large circle. Each hunter had a designated place in the circle, according to family groups, and set his net up between the same two men throughout the day. The hunter moved swiftly and without a word, first hooking one end of the net to a sapling or liana, then dropping the net along the ground. Wives and daughters followed, securing the net above and below to saplings, roots, branches and vines. For some reason the circle was never closed. One end would curve in, the other out, leaving an open corridor that seemed to have some mystical significance. The women stationed themselves strategically out of sight in the vicinity of the nets. The men disappeared into the cordoned-off jungle. For a moment there was a tense silence. A leaf popped, and the hunting cries began* (Sarno 1993, P66).

Net hunting is a particularly inefficient means of hunting, although it is still likely to be ecologically unsustainable (Noss 1998). It usually results in a small amount of meat being divided between a number of people according to their role in the hunt and killing of the animal. If surplus meat is caught it may be sold to other families or in the market. It is often the Bilo population, who hunt with guns, who harvest the greatest number of animals from the forest (Kretzinger and Zana 1997; Blom 2004; L. Sarno, personal communication). As other sources of employment have diminished with the closing of the logging companies, the Bilo population has increasingly turned to the forest as a source of food and revenue. Bilo hunters often employ skilled BaAka men, or tempt them into hunting or tracking by offering them money or a share in the off-take. It is generally the Bilo population that organises illegal activities such as snare and gun hunting at night, which is indiscriminate of age, sex and type of animal (Hodgkinson 2009). Night hunts are appealing, as the Bilo believe the forest is less monitored by ecoguards (section 2.3 below) during the night. The BaAka now face a high level of competition from Bilo gun-hunters who hunt for the local bush-meat trade. Many BaAka report that although they understand and agree in principle with the long-term conservation

goals of the DSPA, they have lost a huge amount of hunting ground to the national park, and that the Bilo have emptied the forests with their guns, meaning that the BaAka have to go further and further into the forest to catch animals, and that they are often unfairly targeted or hassled by the Bilo ecoguards for their kills.

> *… they [ecoguards] do it deliberately – they know we [BaAka] have to cross the park section to get to the hunting zone otherwise we walk for hours to go around, and if they catch you there with the meat you caught hunting far, far away from the park, they just take you and the meat and say that you caught it in the park. Then they eat or sell the meat themselves. What can we do?* (BaAka man)

The CAR government granted BaAka people citizen status only as recently as 1998. In the last 10-15 years, many of the BaAka population have come out of the forest, preferring to create and work their own plantations instead of working those of the Bilo villagers for meagre wages. They are also drawn by the employment opportunities offered by various industries and organisations. The closest villages either side of Bayanga are Yandoumbe and Mossopoula. Although still the closest village to Bayanga, Yandoumbe was relocated away from Bayanga by an American musicologist called Louis Sarno, who went to live with the BaAka in the early 1980s, and is now considered BaAka after over 25 years living among them. This move was an effort to reduce the growing conflict between the BaAka and Bilo populations during a massive influx of Bilo immigrants (L. Sarno 2011, personal communication). Today the BaAka live a much more sedentary life and affiliate more closely with the Bilo agriculturalist population than in the past (Bahuchet 1991). However, as the Bilo population of Bayanga has increased, the interdependency and traditional exclusive relationships between the BaAka and Bilo have deteriorated (Hodgkinson 2009; L. Sarno 2011 personal communication). Kretzinger's (1993) observation that present-day BaAka people are stigmatised as primitive by the Bilo population still appears to be true today, and BaAka people are often exploited by the Bilo population for work, money or loans (Sarno 1993, personal observation).

2.3. The Dzanga-Sangha project: purpose, people and processes

The CAR government created the Dzanga-Sangha Project (DSP) as a management body for the DSPA, with assistance and funding from the WWF-US, US aid agency (USAID) and the World Bank. Until 2009, management was shared by nationals appointed by the government (generally from the Ministry of Water and Forests) with technical advice from representatives of a collaboration between WWF and the German Development Agency (GTZ). The DSP is now

managed under a similar partnership between the CAR government, WWF, a programme funded by the European Union and the International Union for Nature Conservation (IUCN), who have recently taken over from the GTZ.

DSPA's `special reserve' classification signifies a major shift in policy by the CAR Government, from classic protected area management towards more participatory and integrated management policies, which allow for multiple uses of resources within the conservation area (Blom 2001). The DSP's status as an Integrated Conservation and Development Project represents the first regulatory system in CAR where the financial benefits of conservation are distributed locally in return for support and involvement in the area's conservation (Caroll 1986; Blom 2001). Over time, the purpose or mission statement for the Dzanga-Sangha area has changed, although not drastically. It started out as:

> *[for the] development, protection, and management of the forest of south-western Central African Republic for the conservation of its important floristic, faunal and human components* (Blom 1999, cited in Blom 2004, P29-30).

After a series of wildlife and socio-economic surveys, stakeholder and expert consultations, this became:

> *[to] protect the biodiversity of the forest of the south-western Central African Republic by the management and the development of a protected area system with a multiple use conservation buffer zone (Special Reserve), within its core a strictly protected area (National Park)* (Blom, 2004).

Currently, the DSPA objectives are defined as:

> *[to] ensure the protection of biodiversity and ecosystems under the tri-national park using sustainable management for the DS protected areas and the enhancement of its natural resources* (DSPA 2011 – translated from French).

Within the DSPA, the 3359 km^2 Dzanga-Sangha Forest Reserve acts as a buffer to the core sectors of the park, the Dzanga (meaning *bai* or *clearing stream*) sector (495 km^2) and Ndoki (meaning *witchcraft*) sector (752 km^2) which are separated by a community hunting zone. A small pre-park buffer margin stretches around the limits of the national parks in the south and north of the reserve. *Sangha* is the name of the river passing through the national parks and reserve, and is a tributary of the Congo River, as is the *Ndoki* River in Congo. Previously, three safari hunting companies had rights to hunting concessions in the forest reserve. At the time of

writing (late 2013), however, these concessions were non-operational, and only one company had recently been granted a safari-hunting licence for a limited number of animals. A long-term biodiversity monitoring team monitors the population dynamics of the park fauna intermittently, most recently conducting a four month survey of the national parks, focusing on gorilla and elephant abundance but incorporating numerous other biodiversity markers. Since the creation of the parks the DSP has run an anti-hunting enforcement team, which has increased from 10 to 50 permanent nationals, referred to as *ecoguards*, who form the *conservation team.* The ecoguards patrol the parks and reserve by road and river, and a minimum of two ecoguards patrol the road in and out of the reserve in the north, 24 hours a day.

Hunting or gathering of forest products is strictly forbidden in the two national park sections of the DSPA. The local population in the eight surrounding villages is, however, permitted to carry out subsistence hunting using traditional methods (using weapons and tools such as nets, bows and arrows, and cross-bows made from natural materials) in the reserve and in designated hunting zones. If illegal wire snares are found, the authorities bury them; unregistered or artisanal guns are confiscated. Registered guns are allowed for hunting purposes but the owner must obey protected animal restrictions and kill quotas or risk having the meat confiscated and destroyed if it is from a protected species, or sold by officials if it is from an unprotected species. People found killing protected species are arrested and tried in front of an open hearing in which local residents can witness the process and outcome.

2.4. The Dzanga-Sangha ecotourism project

One of the main goals of tourism in the DSPA is to reduce human pressures on natural resources and wildlife by providing stakeholder communities with alternative livelihoods in place of hunting and logging (Todd 2009). With the creation of the DSPA, a need for a more formal structure to encourage tourism in the area was recognised, and by 1995 a visitor centre and tourist lodge had been created (Hodgkinson 2009). Now, tourists can participate in numerous activities both inside and outside the park, organised by the DSP in conjunction with local residents, such as non-Aka-run pirogue rides, fishing and palm-wine collecting or gathering traditional medicine with the BaAka women, net hunting or watching traditional BaAka dancing (Figure. 2.5).

Figure 2.5. DSPA tourism promotional posters. Top left promoting traditional net hunting with the BaAka; top right promoting Dzanga Bai where hundreds of forest elephants and bongo can be observed from a viewing platform; bottom left promoting gorilla trekking; bottom right promoting fishing excursions on the Sangha River. Source: DSPA promotional literature, 2011.

The CAR government allows a portion of national park entry-fees to be distributed locally, with 50 % going back into the DSPA to contribute to functioning costs and management of activities and 40 % shared with local communities for long-term development and education with the aim of reduce wildlife hunting in the long-term (Todd 2009). The remaining 10 % is paid into the government's forest fund. This ICDP governance framework for the DSP is based on the concept that:

> *The provision of these incentives allows local communities and government to better understand the economic benefits of species protection, allowing them to view gorillas (and other threatened species) and their habitat, not just as a food resource, but also as an economic resource. The latter is fundamental to encouraging national, regional and international political will towards law enforcement, land-use and park/wildlife protection and essential for the survival of the western lowland gorilla* (DSP 2009, P6).

Tourism in the region has been discouraged by difficulties including political instability, including several coups d'états and elections, and the worldwide financial crisis, which had a notable effect on international travel to the area. However, since 1992 a mean of 800 tourists

per year have visited the DSPA, slowly increasing with the commencement of a western lowland gorilla tourism programme in 2001 (Figure 2.6).

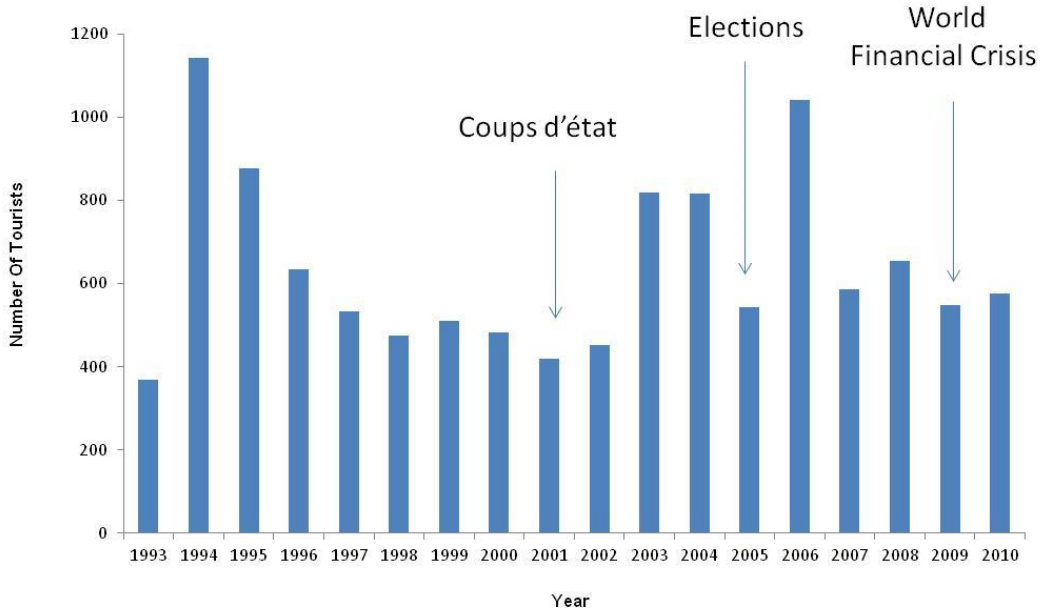

Figure 2.6. Number of tourists visiting the DSPA 1993 – 2010 in relation to key national and international financial and political events. Data from the DSPA Management Plan, 2011.

2.5. Gorilla tourism and the primate habituation project

The Tri-National Reserve area supports one of the most pristine blocks of protected forest in Central Africa and one of the world's last strongholds of western lowland gorillas, with approximately 1.6 individuals/km^2 in the Dzanga sector (Todd 2008; DSPA 2011). The Ndoki sector is thought to have an even higher density of gorillas, but has not been surveyed recently (A.Todd personal communication). With the creation of the DSPA in 1990, the DSP started an ecotourism programme to protect and better understand the western lowland gorilla, and the Primate Habituation Project (PHP) was created in 1997 with the aim of habituating western lowland gorillas, and later, a group of agile mangabeys, *Cercocebus agilis* (Todd 2008). The key objective of the PHP is to:

> *… contribute meaningfully to the long-term conservation and sustainable management of natural resources within the DSPA by reducing human pressures through providing resident communities with alternative livelihoods, income, and revenue-sharing, and by*

raising DSPA funding through tourism revenue and international donor support. (DSP 2010, P6).

The PHP is now of international importance, as hunting, logging and the potential spread of diseases including Ebola haemorrhagic fever, continue to present major threats to gorilla survival in the region (Blom 2001; Todd 2008). The aim of sustaining a viable population of gorillas in CAR by increasing ecotourism activities has generated national awareness and interest for the plight of the western lowland gorilla, and has attracted substantial donor support for gorilla conservation for the DSPA and throughout the Congo Basin (Todd 2008). To date, the PHP is one of only two projects that have been successful in habituating western lowland gorillas and generating a sustained international tourism presence, despite enormous effort elsewhere. The DSPA is now the largest provider of employment in Bayanga with 174 staff members, of which over one third are from local BaAka communities (Todd 2008).

Two forest camps in the Dzanga sector of the national parks, Bai Hokou (meaning clearing with a hole (33 N 663109, 316187UTM)) and Mongambe (named after the river running through it, 33 N 654357, 322606 UTM) are supervised by the PHP Gorilla Habituation and Tourism Advisor, Angelique Todd. Together, the two camps cost approximately £100,000 per year to run (basic operating costs only, excluding the salary of the technical advisor and investments such as 4 x 4 vehicles which need to be replaced every 3-5 years). These basic operating costs include salaries for the key camp staff such as the team of 35 BaAka trackers (on permanent contracts), eight local guides, one national research assistant, one technical assistant to the PHP technical advisor and the camp guards. Currently, these costs are covered by gorilla tourism revenue (53 %), United States Fish and Wildlife Service (42 %) and WWF-Germany (7 %). Projected figures based on an established 9 % yearly increase in revenue from gorilla tourists and 3 % in costs suggest that the PHP can become self-sustaining in basic running costs (excluding costs of expatriate management salaries and investments) by 2018.

2.5.1. History of gorilla habituation at the PHP

Deliberate gorilla habituation for tourism started in 1997 at *Bai Hokou* camp. The first gorilla group was the *Munye* group (meaning ‘well’ or ‘good’), and was first visited by paying tourists in 2001. However, the group decreased rapidly in size, and then disbanded, as a result of female gorillas leaving the group and the death of the silverback male due to an attack by a leopard and another male gorilla.. Fortunately, because the PHP recognised that the project was vulnerable to the loss of the gorilla group as a result of unforeseen events, they had already started to habituate a second group, the *Makumba* (meaning ‘they run’) group, in 2000. The

Makumba group was almost ready to receive tourism at the time of the Munye silverback's death. Habituation of a third group began in 2005. This group, the *Mayele* (meaning 'trickster') group, was originally followed by trackers from the *Bai Hokou* camp, but due to the distant location of the group's range, and a desire not to increase the size of the Bai Hokou camp and its effect on the forest, a satellite camp was established at an existing site called *Mongambe* (named after the river running through the camp entrance) to access this group. Mongambe camp was originally used for preliminary gorilla density studies (Carroll 1986) and as a base for various biodiversity survey expeditions (Blom 2004).

At both Bai Hokou and Mongambe camps, *fini* (meaning 'new') gorilla groups are being habituated as successors and additions to the current habituated groups (Figure 2.7). During the time I conducted my field-work, the habituation of the fini group at Bai Hokou had progressed to the point where the group was thought ready to have its own name, and it therefore became the *Mata* group (meaning 'successor'). The fini group at Mongambe, despite being at very early stages of habituation, became the *Wonga* group (named after a river in the group's home-range).

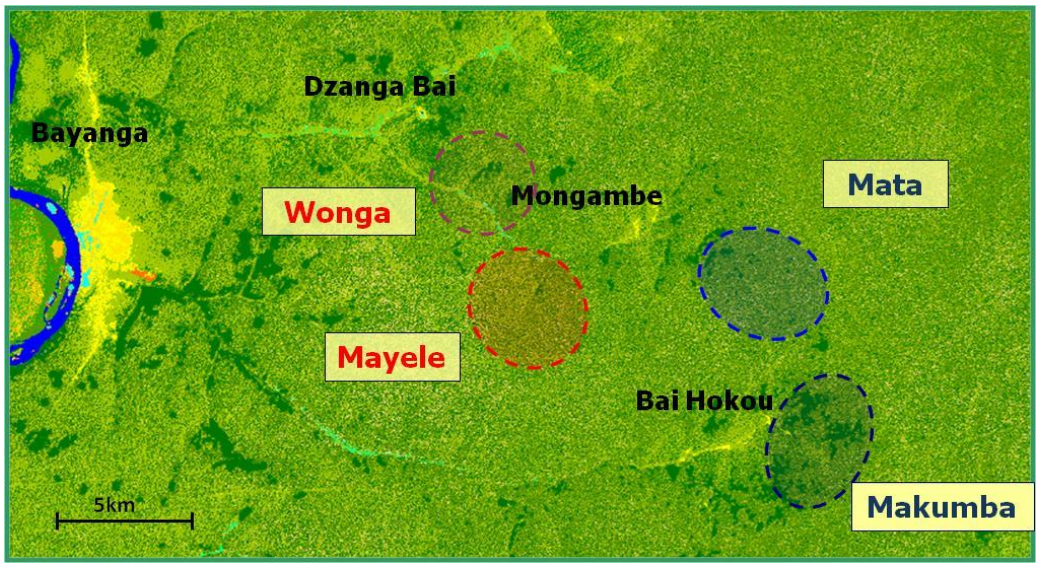

Figure 2.7. Location of the four gorilla groups (*Makumba* and *Mata* at *Bai Hokou*, *Mayele* and *Wonga* at *Mongambe*) in Dzanga National Park in relation to Bayanga village and a famous elephant clearing called Dzanga Bai (adapted from PHP guide-training presentations, 2011).

2.5.2. The Makumba group

The Makumba group was first visited by tourists in September 2004. When first contacted the group consisted of 12 individuals. One adult female (Mopatapata) emigrated

after the death of her infant in 2005, leaving behind her adolescent son Kunga. Subsequently, three sub-adult females (Etefi, Silo and Mio) reached sexual maturity and left the group. At the beginning of my study the group again consisted of 12 individuals due to the birth of new infants (Table 2.1, Figure 2.8), but two sub-adult females (Mai and Essekerende), and one adult female (Bombe) left the group during the study period.

Table 2.1. The Makumba group composition, birth dates or approximate ages and maternal lines at the start of the study, November 2010.

Individual	Sex	Age-class & known or approximated birth dates	Mother's Name or Kin
Makumba	♂	Adult Silverback ~1979	Unknown
Mopambe	♀	Adult female	Mai, Bokata
Malui	♀	Adult female	Mossoko Abuli, Tembo
Bombe	♀	Adult female	Essekerende, Mobangui
Kunga	♂	Adolescent ~1998	Mopatapata
Mai	♀	Adolescent Jan 2003	Mopambe
Essekerende	♀	Adolescent ~2002	Bombe
Mossoko Abuli	♀	Adolescent ~Feb 2004	Malui
Bokata	♀	Juvenile Jan 2006	Mopambi
Mobangui	♂	Infant Jul 2006	Bombe
Tembo	♂	Infant Dec 2007	Malui
Sopo	?	Infant Jul 2010	Mopambi

* Bombe emigrated from the group very early on in the full data collection period, leaving her very young son Mobangui.
* Mai emigrated from the group in 07/2010, it is likely she went to join a solitary male having reached sexual maturity.
* Essekerende emigrated from the group on 03/04/2011, the author later observed her with a new silverback male.

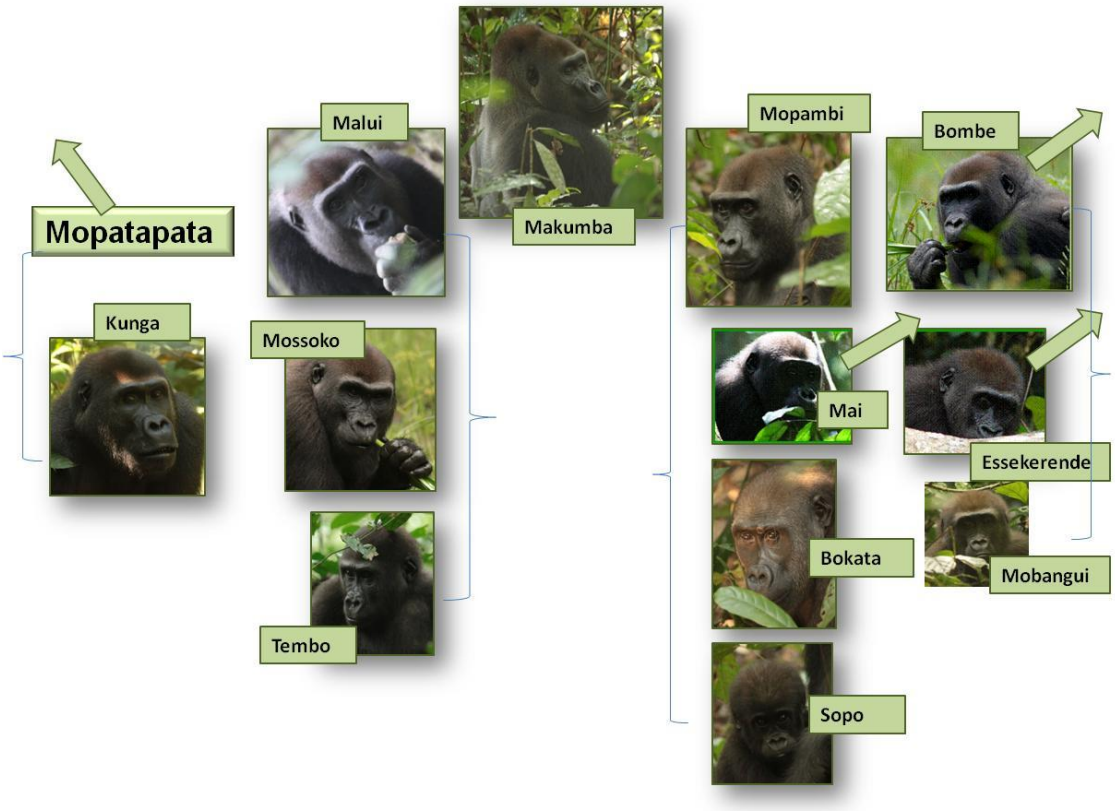

Figure 2.8. Photographs of the Makumba group and family relations from the mother. No photo of Mopatapata is available.

2.5.3. The Mayele group

The Mayele group (Table 2.2, Figure 2.9) was located in late 2005. It is a large group of 15 individuals and the silverback (Mayele) has four adult females, which may suggest that he is slightly younger than Makumba and in his prime group-leading years (A. Todd, personal communication). The exact structure and kinship of the group are less well known than for the Makumba group, however it seems likely that a fifth adult female may have previously emigrated from the group leaving behind offspring (Mopangu and Kusu) who have no obvious mother. It is rare to see the whole group together, and during my data collection period there remained some debate as to the existence of one individual (Kusu) who may have been another gorilla (Yoko), mistakenly identified by different observers. Habituation of the Mayele group progressed well after the Mongambe satellite camp was established in 2006, and pilot tourism commenced in late 2009. In mid-2010 and early 2011 tourist groups were typically sent to see the Makumba group at Bai Hokou due to this group's more advanced level of habituation and their open forest range, with overflow bookings being sent to the Mayele group. However, towards the end of 2011 the Mayele group's habituation was progressing well, so PHP

management started to equalise tourism pressure across the two groups regardless of booking schedules.

Table 2.2. The Mayele group composition, birth dates or approximate ages and maternal lines at the start of the study, November, 2010.

Individual	Sex	Age-class & known or approximated birth dates	Mother's Name or Kin
Mayele	♂	Adult Silverback~1983	Unknown
Penge	♀	Adult female	Sousa, Moangale
Mapoki	♀	Adult female	Liamba, Lungu
Ellili	♀	Adult female	Ngobo, Kaya
Duma	♀	Adult female	Mabeka, Yoko, New(!)
Mambeka	♀	Adolescent ~2002	Duma
Mopangu	♂	Adolescent ~2002	? Unknown female
Sousa	♂	Juvenile ~ 2004	Penge
Yoko	♂	Juvenile ~2006	Duma
Kusu	♂	Juvenile ?	? Questionable identity
Liamba	♂	Juvenile ~2006	Mapoki
Ngobo	♂	Juvenile ~2006	Ellili
Moangale	♂	Infant Aug 2008	Penge
Lungu	♀	Infant Jul 2010	Mapoki
Kaya	♂	Infant Feb 2010	Ellili

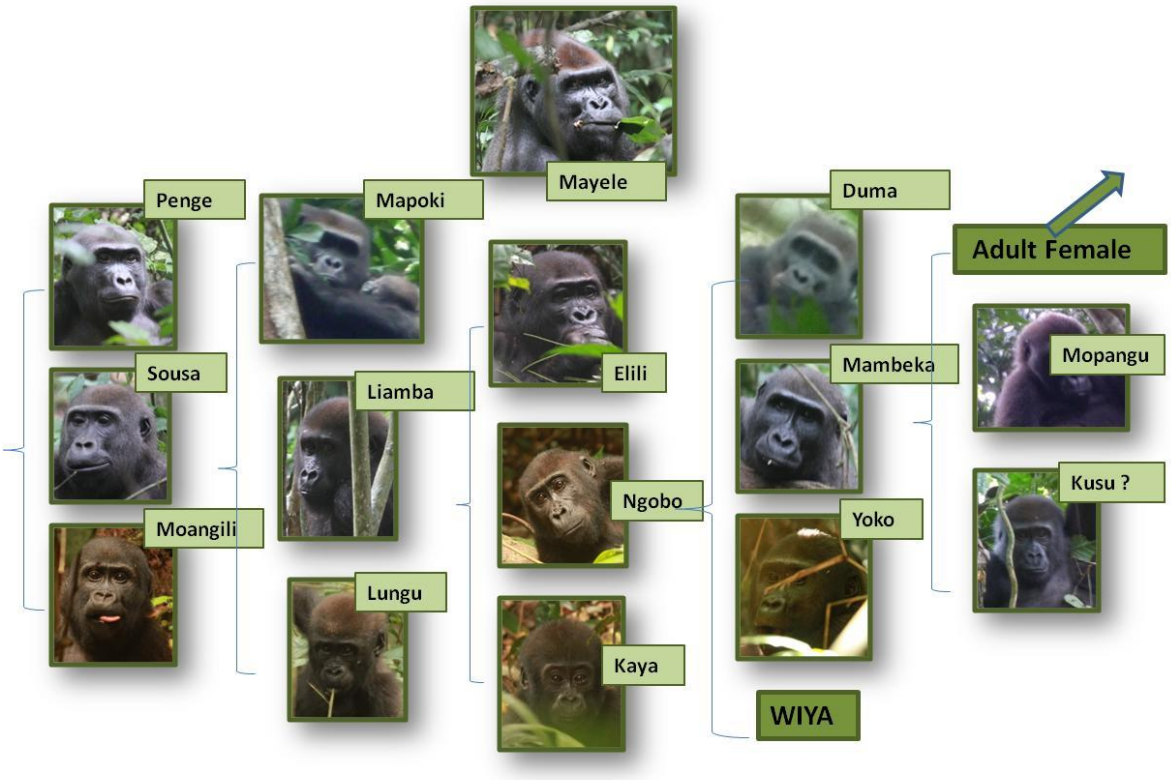

Figure 2.9. Photographs of the Mayele group and family relations from the mother. No photo of Wiya is available.

2.5.4. Camp people and processes

Bai Hokou camp has a minimum of 13 trackers, two guides, a camp monitor, and the camp manager as permanent staff. Mongambe has eight trackers and one camp manager who also operates as a guide. The BaAka trackers start working for the PHP on a temporary contract, and their salaries are calculated by the number of days spent working in the forest plus *primes*, which are supplementary wages earned from various work tasks or achievements such as finding gorilla nests, making contact with gorillas, or helping carry water in camp. Once the trackers have gained experience and are deemed reliable – and if they wish to become a permanent member of staff – they are given a contract. The contract system is designed to accommodate the traditional, nomadic, forest-based lifestyle of the BaAka, who are required to work a minimum of 6 months in any one year. The contract affords each tracker a base salary, which is split and paid to them each month when they are at the gorilla camps. *Primes* are added to this monthly wage as for temporary workers. This means that each tracker can choose whether he wants to stay in the forest camp and work for consecutive months, or work for a minimum of one month then return to the village and his family. Contracted trackers also

benefit from health *primes* and retirement packages, and their wives continue to receive a percentage of their wages for several years in the case of their husband's death.

Project guides, local research assistants and the camp sentinels (local Bilo inhabitants of Bayanga) rotate in and out of the forest on monthly schedules, staying 21 days in the forest camp, and nine days in the village. International volunteers are often recruited to help with the habituation of new gorilla groups and data collection from habituated groups, and to give these people an opportunity to gain field experience. The presence of an international volunteer or researcher can also help in the camps if tensions occur between the BaAka and the Bilo, although generally relations between the very different ethnic groups remain very good, even in the space-limited forest camps. International researchers come and go from both sites depending on the requirements of their research, but typically there is one 'key researcher' working towards their doctoral thesis (as I was during 2010 and 2011). Other student researchers/research assistants stay if their research fits in with the staff schedule and camp capacity. Film crews, journalists and photographers plus occasional representatives of donor-agencies are the only other personnel allowed to stay in the camp, although volunteers/researchers' families are occasionally accommodated for brief visits due to the isolated nature of the work and the limited time that relatives are often able to visit.

Teams go out to track and follow the gorilla groups every day of the year. Usually, two BaAka trackers accompany one guide/assistant/researcher/volunteer (hereafter assistant), but sometimes two assistants are needed because of training or supervisory purposes or film crews/photographers etc need to join the team. In this case, up to six people are allowed, but for no more than a maximum of two hours per day. To follow the habituated groups, the teams set out at 6.30 am and go to the place they left the gorillas before dark the previous day. If they encounter fresh tracks on the way the trackers follow these, otherwise they continue following the previous day's gorilla trail until they find the night nests, and carry on from there on fresh tracks until they find the group. This process can take from a matter of minutes to several hours, and on occasion the gorillas cannot be located within the day, or even for a number of days, depending on their movements, the forest conditions and the trackers' experience.

When the team approaches the gorilla group, and often while they are following the gorillas, they make 'clacking' noises, snapping their tongue off the top of their mouths. This noise was chosen as a noise that is not in the gorilla vocal repertoire, and is used so as not to surprise the gorilla group. Once the group is located the trackers follow it until approximately 10.30 am, when one tracker goes to a previously agreed meeting point in the forest or back to

camp depending on the location of the gorillas, making a trail of broken twigs and leaf-piles called *panji*. This system is very well-known to the trackers, who often rely on these signs to locate each other while out hunting. It means that the teams do not rely on expensive battery-operated equipment, but also, unfortunately, that young saplings and branches are broken every day as part of the effort to habituate gorillas. At 11.00 am, a second team leaves camp and heads for the agreed meeting point. This team meets the returning tracker, discusses the direction of the trail and any events from the morning, and follows the *panji* trail to the gorilla group to take over from the morning team. The second team then follows the gorilla group until approximately 4.30-5.30 pm, depending on the distance to camp. Teams always attempt to stay at least seven meters away from the gorilla group (but see Chapter 9) according to the 2010 IUCN best-practice guidelines for great ape tourism (Williamson and Macfie 2010, based on Homsey 1999). The guides/assistants collect basic project data which is added to the long-term data files. If there is only a researcher present then the researcher collects both their own data and project data.

Teams going out to contact the groups that are under habituation operate in much the same way, although as the position of the group is less easy to locate the meeting point is often simply back at camp. Teams out looking for the groups under habituation often spend days following tracks before making a contact, and contact depends on the stage of habituation, the season, the expertise of the tracking team and luck. Once fresh tracks are found in the group's known ranging area, the trackers attempt to follow the group until they get close enough to observe it without being detected by the gorillas. This can be very difficult, and the gorillas frequently smell or hear the approach and react by screaming, charging or fleeing, and often leave a trail of diarrhoea behind. If they do not flee, the team initiates contact and tries to get into a good position, where the gorillas will be able to see them from a safe distance, to observe and start to identify the group. The length of time the observers stay with the gorillas from this point depends on the reactions of the gorillas to the observers and the relative level of habituation. There is no pre-determined protocol to follow for habituation as so much depends on the context of the contacts, the temperaments of the gorillas, and the collective experience of the habituation team.

2.5.5. Gorilla tourists

At the time of the study, all gorilla trekking activities are organised via the head-office in Bayanga. Enquiries and bookings can be made by contacting the DSP directly, in which case they are dealt with by the PHP gorilla habituation and tourism advisor. Tourists most commonly book

through one of several independent tourist agencies however, who organise all their travel logistics. These bookings also go through the Bayanga booking system. Expatriates in CAR often make bookings through the WWF headquarters in Bangui, which are then passed to the Bayanga office. From June 2011, international tourists paid 230 Euros for a gorilla trekking permit, which reflects a notable price increase from the previous 152 Euros, although concessions are available for national citizens and international expatriates. This price increased again in 2012 to 300 Euros, as the DSP planned to bring western lowland gorilla tourism prices more in line with those of the mountain gorilla trekking permit fees (currently US$500) (Figure 2.10).

Figure 2.10. Number of gorilla tourists, revenue (in Central African Francs) from gorilla tourism, 2001 – 2010 and gorilla trekking permit prices (source: PHP long-term data).

Tourists arriving in Bayanga have the choice of two main lodges to stay in: Doli (meaning 'elephant') lodge, and Sangha Lodge (after the Sangha River). Rarely, tourists stay at a Roman Catholic mission a little way out of Bayanga. Ideally, all tourists should check-in at the tourist reception centre (*centre d'acceuil*) at the Bayanga headquarters, either in advance of their planned gorilla trek or on the day of arrival. Tourists who check-in should receive their gorilla trekking permit and a briefing from the DSP tourism coordinator at the reception centre. They are checked for signs of illness and given a first briefing on the rules of gorilla tourism. However, travel logistics and current management processes often mean that one or all of these steps are omitted (see Chapter 9). No more than three people are allowed per tourist group, who visit the

gorillas for one hour, but up to two tourist groups may visit the gorillas on one day, ideally one in the morning and one in the afternoon.

Four-wheel drive vehicles are arranged for tourists by the DSP or their tourist agency, or independent tourists bring their own cars from Bangui. They make a 1hr 45 min drive on the forest road into the park to Bai Hokou camp, or 1 hour to Mongambe camp, over extremely rough and muddy terrain. In the rainy season the road can become completely impassable. When groups arrive at either camp they are met by a member of the PHP team, resident in the camp. This can be a local project guide (trained in basic data collection and tourist guiding), a local project research assistant (usually qualified to local A-level equivalent), the PHP technical assistant, any of the international researchers/volunteers, or a combination of the above. The team member greets the tourist group and delivers the gorilla viewing rules again, talking about the gorilla group and trekking experience in detail and paying attention to forest safety issues, and answering any questions visitors may have. Currently, tourist groups arrange for a BaAka tracker that is not employed by, but is known to, the PHP, to accompany them into the forest. This tracker then joins the group of tourists, the designated guide and one of the resident PHP specialist gorilla trackers in camp to head into the forest and find the gorillas. They locate the gorillas using the same system of *Panji* as described for the habituation and research teams. Once the tourist group arrives within approximately 100 m of the gorilla group the trackers exchange 'clacks' to indicate to the habituation or research group that they should move back and allow the tourist group to begin their hour with the gorillas. The tourists return to the camp accompanied by their guide and trackers, where they often have refreshments and talk with the camp staff, before driving back to Bayanga and their accommodation.

2.5.6. The PHP gorilla trekking rules

In recognition of the potential effects that humans may have on habituated gorillas during their visits, the PHP has developed a set of 11 key gorilla trekking rules which are explained to all visitors, regardless of their status. The rules are sent or given to each visitor when they book (Table 2.3, Appendix 1), and reiterated by a PHP assistant during their welcome and gorilla trekking briefing in camp using the most appropriate language possible, before going to find the gorillas. The rules are also printed and illustrated on a large plaque in the tourist briefing hut, which the PHP assistant usually stands next to whilst providing the briefing.

Table 2.3. The gorilla trekking and forest rules, as printed in the current PHP 'gorilla guidelines' which are sent or given to tourists on booking.

1. Stay close to team members at all times.
2. Avoid making unnecessary noise or sudden movements. Keep your voice low and speak only in a whisper
3. Do not point at the gorillas.
4. Never run or scream or make loud noises particularly when in the vicinity of the gorillas.
5. If a gorilla shows aggression (barks, screams or charges), it is imperative that you do not move. The gorilla may perceive a fast or abrupt movement as threatening, eliciting further aggression.
6. Do not try to touch the gorillas.
7. Never step in front of your tracker or guide.
8. To minimise stress on the animals and reduce the risks of disease transmission, we ask you to respect a distance of 7m from the animals.
9. Do not use flash or other artificial lighting while filming or photographing the gorillas.
10. On rare occasions, your guides may ask you not to take photographs, if the gorillas are nervous, very close, or if your equipment makes too much noise.
11. Do not litter in the forest (including toilet paper and handkerchiefs).
12. Do not eat or leave any human waste in the forest
13. To avoid the risk of disease transmission, we ask that visitors avoid defecating, vomiting and spitting in the forest. However, if unavoidable you can ask your guide for assistance to dig a hole (25 cm deep), which must then be well covered. If you need to sneeze or cough in the presence of the gorillas please turn from the animals and cover your nose and mouth using a handkerchief (or by pulling up your shirt), to avoid the dispersal of bacteria and viruses.
14. No smoking is permitted in the forest except at the camp.
15. Please screen your state of health and physical capacity before deciding to participate in the gorilla tracking programme.

IN CASE OF NON-COMPLIANCE, THE VISIT WILL BE TERMINATED IMMEDIATELY WITHOUT REFUND

Chapter 3 - General Methods

Data collection methods used to address the aims and objectives set out in Chapter 1 have two key components – biological and social-anthropological – and focus on a range of areas. As well as generating several original data sets, I draw on data from the PHP long-term records, to which I contributed during my data collection period, and data to which I contributed as part of two key research collaborations. As different data are drawn on in multiple chapters throughout the thesis, I outline the general methods here. Specific detailed methods are provided in the relevant chapters.

Table 3.1. Summary of data collection methods for original, PHP long-term and collaborative data sets and where the data is used in the thesis.

Discipline	General Data Collection Method	General Subjects & Informants	Area Investigated	Contributing to data sets: OD	PHP	CD	Chapter
Biological	Gorilla Faecal Sample Collection	All gorilla groups	Non-invasive hormone analyses	X			6,7,8
			Gastrointestinal parasite analyses	X		X	8
	Gorilla Behavioural Observations	All gorilla groups	Behaviour & proximity scan sampling	X	X		7,9
Socio-Anthropological	Interviews	Tourists, PHP staff, DSPA Direction, Journalists, Film Crews, Photographers & Journalists	Gorilla tourism & conservation: perceptions, attitudes, motivations, health	X			5,9
	Questionnaires	Mostly gorilla tourists but some journalists/film crews/donors etc	Gorilla tourism & conservation: demographics, perceptions, attitudes, motivations, health	X	X		5,9
	Participant Observation & Ethnography	In this study all people can be an informant, but specifically tourists and PHP-related staff/personnel.	Gorilla tourism & conservation: behaviour, perceptions, attitudes, motivations, health	X			5,9

OD - Original data set created by the author
PHP Bai Hokou - Primate habituation programme long-term data sets
CD - Collaborative data set created by the author as part of the defined research collaborations

3.1. Pilot study and research assistants

Between March and May 2010 I conducted a pilot field study to test and refine data collection methods and to develop research collaborations. I make references to experiences or lessons learnt during this time where relevant. The pilot study confirmed that I would need assistance with various aspects of my research (Table 3.2), most evidently for faecal sample collection. I recruited Barbora Kalosouva (Bara), a trained parasitologist, from the Czech Republic as a long-term field assistant, as part of my collaboration with the Czech Institute of Parasitology (see section 3.3.3). At the end of Bara's fieldwork in July 2011, another student from the Czech Institute came out to help me for a further four months: Ilona Profousova. With Bara's help, Ilona's training took very little time, and Ilona also provided excellent assistance.

Finally, as part of my research collaboration with WWF, and in-line with the DSP protocols for projects lasting more than six months, I recruited a local research assistant, Jean-Francais Dicky (Dicky). Dicky had just started working for the PHP as a guide at the beginning of my fieldwork in 2010. He did not have the formal higher education to work as an official PHP research assistant, but he had previously been employed as a research assistant for two different socio-anthropological studies in the Bayanga region run by American researchers. This had provided him with valuable experience in finding and approaching potential informants, interviewing and transcribing. He also had a very polite manner and was a well-respected member of the local Bayanga community, having formerly been a teacher. Dicky helped me greatly in learning Sango. In early January 2011 we agreed that Dicky would assist me part-time, and carry out his PHP project work responsibilities concurrently. This was feasible due to a large overlap in work tasks. Additionally, the Mongambe camp-manager Jean-Bruno Bopolanzagnako (Paulo) helped to collect baseline data and faecal samples from the Mayele group in exchange for developing his data collection, GPS and computer skills.

Table 3.2. Summary of work allocated to each research assistant and timeframes during the fieldwork

Bara (Nov 2010 - July 2011)	Faecal sample collection from Makumba/Mata, sample extraction, management of dried samples and sample records, gorilla scan data, PHP project data, occasional tourist guiding, and occasional tourist interviews
Ilona (July - Nov 2011)	Faecal sample collection from Makumba/Mata, sample extraction, management of dried samples and sample data-bases, gorilla scan data, PHP project data
Dicky (Jan - Dec 2011)	Faecal sample collection from Makumba/Mata, gorilla scan data, PHP project data, guiding tourists, identifying and locating informants, assisting interviews, translation, transcribing interviews
Paulo (Jan - Nov 2011)	Faecal sample collection from Mayele, gorilla scan data, PHP project data, guiding tourists - managing Mongambe camp.

3.2. Biological methods

3.2.1. Gorilla faecal sample collection

There were four gorilla groups from which I could potentially collect faecal samples for hormone and parasite analyses, in addition to samples from unknown, non-habituated gorillas. Given the size of my team, and the logistical challenge of following gorilla groups from two camps, I focused on the two groups reached from the Bai Hokou camp, Makumba (the most habituated) and Mata (early stages of habituation), to ensure an adequate sample size from a minimum of these two groups at distinctly different stages of habituation. I also trained Paulo to

collect samples and behavioural data from the Mayele group, spending two weeks with him in the beginning, and then making monthly three day visits to the camp to review data collection methods. Bara also made these visits on occasion, once her Sango and experience with the gorillas had progressed. Unfortunately the Wonga group (the new group followed from Mongambe camp) went missing for much of the study period, and so I dropped it as a study group.

As the Makumba group was completely habituated and afforded collection of behavioural observations alongside identified faecal samples, this group became the focal group with whom we tried to maintain at least one member of the research team (i.e., Dicky/Bara/Ilona/me) every day in either the morning or the afternoon. We devised a rota of three days with the Makumba group, a rest/data-day in camp, then three days trying to find either the nests of or make contact with the Mata group. As this group were at an early stage of habituation it often happened that we could go days or weeks without finding even traces of them. During this time, or whenever other project assistants trained in faecal sample collection were available to help, one of the team would go out with a BaAKa tracker, scouring the forest for fresh faeces from unknown gorillas.

I set up a field-lab at Bai Hokou to treat fresh faecal samples on return from the forest (Figure 3.1). To collect samples for hormone analyses, we prepared several 15 ml centrifuge tubes in advance of a gorilla follow, with 4 ml of 90 % ethanol using a surgical syringe. We weighed the tubes plus ethanol to two decimal places using a portable battery-operated scale and wrote the weight on the tube. We also prepared two sets of tubes in which to collect faeces for gastrointestinal parasite analysis (parasite samples hereafter). We put 10 ml of formalin solution (4 % formaldehyde in water) into small plastic 25 ml tubes for coproscopic methods of gastrointestinal parasite analyses and approximately 4 ml of 95 % molecular ethanol in 10 ml plastic tubes for molecular parasite analyses. Carrying these tubes with us during gorilla follows in the forest allowed us to collect approximately 0.05 g (the size of a little-fingernail) of faeces for hormone samples into alcohol immediately (which halts alteration of hormone metabolite levels – see Chapter 6) and approximately 2.0 g, (a thumb-tip sized amount) of faeces for parasite samples immediately into formalin/ethanol solutions, to fix a ‘snap-shot’ of parasite species, eggs and/or larvae present in the faeces.

Generally, we collected hormone samples at every opportunity. For parasite samples, we aimed to sample each individual at least three times per month for Makumba group. For the Mata group we took samples for both hormones and parasites at every opportunity, taking a

cross-section of identifiable age-categories from the nest sites (Blom 2004a) or fresh faeces from the trail around contacts.

Figure 3.1. The field Lab at Bai Hokou. K.Shutt, 2010.

3.2.2. Sample collection and treatment

We labelled sample tubes with the identity of the individual, or the estimated age-sex class for nest samples, the time of defecation and time of collection, date, and the numbers of other samples taken from the same faecal bolus. We took the tubes back to camp at the end of the follow session and subjected hormone samples to a validated extraction and drying process within 24 hours (Shutt, et al. 2012; Chapter 6). We stored samples collected at Mongambe camp in their respective fixatives and transferred them to Bai Hokou camp during the weekly supply run. We extracted these samples exactly three weeks after collection to standardise delayed extraction error. The extraction and drying process resulted in a duplicate set of 2 ml polypropylene tubes containing dried faecal glucocorticoid metabolites (FGCMs) which we sealed with parafilm. We logged one copy of each sample and kept it in a dark, safe place in camp, and took the other to Bayanga at the next available opportunity for storage in a WWF colleague's freezer in case of damage or loss to the original set which were sent to the German Primate Centre (Deutsches Primatenzentrum, DPZ) in Göttingen every three-four months. The samples were then analysed using a validated enzyme-immuno assay (Shutt, et al. 2012; Chapter 6) to establish FGCM values. This was according to a collaboration established with Dr.

Michael Heistermann (a world expert in non-invasive animal hormone research). We also shipped parasite samples to the UK intermittently, where they were stored until Bara/Ilona left the camp in July/November and could take them to the Institute of Parasitology in the Czech Republic for gastrointestinal parasite analysis. This was part of a research collaboration with Dr. Klara Petrzelkova of the Czech Academy of Sciences, a long-term researcher of great-ape gastrointestinal parasites at the Bai Hokou field site.

We carried out several experiments to validate our faecal hormone enzyme-immuno assay, extraction methods, storage medium and effects of sampling routines in collaboration with Dr. Heistermann. Experiments conducted in the UK were carried out with samples from captive western lowland gorillas that were provided by several zoos in the UK and Ireland. Full details of the methods used for this work are described in Chapter 6.

3.2.3. Scan sampling and project data collection

For habituated groups Makumba and Mayele, we worked with local BaAka trackers and followed established PHP gorilla research and habituation procedures (Cipolletta 2003; Klailova, et al. 2010), to collect data during daily follows and tourist visits (Table 3.3) when the total number of people did not exceed the maximum permitted group size of six. Daily contact duration varied depending on group location but was 6-9 hours per day. We took instantaneous scans (Altmann 1974) every 10 minutes on behaviour, habitat variables and distance from the nearest human for all visible gorillas (Table 3.2). It can be hard to judge distances in thick vegetation, and obscured gorillas can be surprisingly close, making it easy to break the 7 m distance rule accidently. Additional pressure from tourists, photographers, film-crews and researchers may add to the frequency at which this occurs. We collected *ad libitum* all occurrence data on the frequency of humans breaking this rule (Table 3.2), and used our discretion to judge whether it was caused by an unavoidable accident as opposed to ignorance or deliberate intent. We disregarded occurrences where gorillas approached humans. During gorilla follows (including tourism visits) we recorded all coughs and sneezes (a few months into the study, we also added whether or not the person covered their mouth after realising that this often did not happen). We also recorded the identity of the team members, the closest member of the team to gorillas on the scan and how many people in total were with the gorillas throughout the day. We also concurrently collected data for the long-term Bai Hokou records, which is drawn on later in the thesis.

As it was not possible to collect detailed behavioural information from the unhabituated Mata group, we recorded only basic categories of behaviour based on contact durations and

reactions in-line with Bai Hokou long-term data collection protocols. These are based on behavioural categories described in Blom, et al. (2004) and Cipolletta (2003), and include: first gorilla to react to observers; their position; distance in meters from observers and the reaction and distance of the silverback; any food items being eaten at the time of contact, and any vocalizations. We also recorded the number of days on which contacts were made (130 contacts on 90 days over the study period, Table 3.3) and the number of contacts per day (range 0 – 5). Project assistants recorded daily rainfall from a camp rain-gauge and temperature data from the min-max thermometer at the end of the day.

I trained all research assistants by accompanying them in the forest for up to a month, or until our simultaneous data collection consistently matched. We measured distance in meters, and trained ourselves first in camp using a tape-measure, then in the forest in varying vegetative zones, repeating this exercise monthly to retain inter-observer reliability. I have not included all behavioural data collected and described in this section in this thesis. Instead, the papers are presented as they were accepted or submitted after peer review: and plan to include the behavioural data in future publications.

Table 3.3. Observational data collected for habituated gorilla groups during instantaneous scans every 10 minutes, and *ad libitum*.

	Scan Observation	**Description**
Behaviour	Eating - ground	Food is being consumed whilst the individual is terrestrial - behaviour is prioritised over resting and travelling
	In a tree - activity unknown	Presence confirmed, activity unidentifiable
	Resting - ground	The individual ceases other actions and assumed sitting/lying/leaning position, eyes may be open or closed
	Vigilance	The individual appears to be watching/listening intently
	Observer vigilance	The individual directs vigilance towards the observer(s) - behaviour is prioritised over eating
	Playing - ground	Either on own or interactively - behaviour is prioritised over eating and social
	Travelling -ground	The individual is moving terrestrially - no other behaviour exhibited
	Mating/Sexual Behaviour	Includes attempts at mating/presenting and mating calls
	Social	Other than play such as nursing/grooming/embracing
	Infant on mother's back	Differentiated from play-bouts/scrambling
		Categories are repeated adding 'T' to the annotation if taking place in a tree
Diet		Fruit, Leaves, Stems/Shoots, Bark, Mushrooms, Water/Mud (exact food item noted)
Habitat	Mixed Open	Predominately primary forest of mixed species, open understory. Visibility is good.
	Mixed Closed	Predominately secondary forest of mixed species, closed understory of often Maranatace spp. Visibility is impaired by thicker vegetation.
	Ebuka	Thick secondary forest, concentrations of liana and Marantacae spp. impairing movement and vision often to less than a few meters.
	Bai	Open forest clearings often visited by numerous animals species for the rich mineral contents. Visibility is excellent.
	Malapa	Primary forest characterised by *Gilbertiodendron dewevrei* species. Understory is very open, visibility is very good.
Gorilla - Gorilla Interactions		All members of the Bai Hokou PHP team reported any known occurrences or evidence of the group's interactions with other gorillas on a daily basis. Signs included increased vigilance and displaying (particularly the silverback), tracks/sign of aggressive interactions on trails and vocalisations as well as direct visual observations.
Human-Gorilla Proximity	Scan Proximity	Distance is gauged to the meter for each visible gorilla up to 25m, then recorded as 25+. (Distances greater than 25m were often obscured by vegetation and deemed too difficult to judge accurately in a pilot study). If in a tree - distance to the trunk of the nearest tree.
	Ad-libitum Proximity	A record was made each time one or more observer approached the gorillas to less than 7m. A further record was made if the gorilla moved away, and the observer again approached to <7m, but no further record was made when observers remained less than 7m for a period of time. Researchers used discretion to judge when this was unavoidable or in error (surprise encounters with hidden gorillas/stuck in tight vegetation).

Table 3.4. Total days, hours and scans collected during the study period, November 2010 – December 2011, for Makumba and Mayele groups.

Group	No. Days Scanning	No. Hours Scanning	Total No. Scans
Daily Follows			
Makumba	250	1050	6371
Mayele	116	427	2553
Tourism Follows			
Makumba	57	83	641
Mayele	16	20	120
Total	**439**	**1580**	**9685**

3.3. Socio-cultural methods

I aimed to develop a greater understanding of the human dimensions of gorilla tourism using a mixed-methods approach to socio-cultural data collection. Here, I describe my methods of data collection via interviews, questionnaires and participant observation, collected during the 16 months I spent at the Bai Hokou field site.

3.3.1. Interviews

I used 'opportunistic purposive' sampling to select interview subjects. That is, my geographical position meant I would be exposed to the people I wished to gain information from with a specific purpose in mind. I did not set out to conduct a specific number of interviews, but simply took all available opportunities to interview tourists for the purposes of this research.

Semi-structured interviews can elicit information from people regarding the meaning and significance they attribute to their actions, and is an effective way of gaining greater understanding of why people act in the ways they do (Burns 2008; Jones 2004). They are also an effective tool where an interviewer has only one chance to contact informants and for a limited time (Bernard and Bernard 2006). This situation describes my available contact with tourist informants well and semi-structured interviews proved to be appropriate when tested in the pilot study. Generally, if the camp received advance notice that tourists were on their way, I arranged to be present on their arrival to observe the greeting they received from camp personnel, or to deliver it myself. I accompanied tourists on their gorilla visits whenever tourist

numbers were less than three per hour of time with the gorillas (in accordance with the gorilla group regulations). This permitted me to collect gorilla behavioural data when I was not guiding the tourists myself. On return to camp, I asked tourists if they were willing to answer questions for my research, explaining the nature of my enquiries and the ethical considerations around them. I made it clear to all interviewees that their responses were voluntary, and that they could withdraw from the study at any time, in which case I would erase all record of their participation. This also applied to questionnaire data elicited from the same informants. The amount of time and willingness to talk with me varied remarkably and I was careful not to intrude into people's holiday-time if they appeared to be otherwise occupied. This meant that I often conducted group interviews with several tourists, to elicit responses from the maximum number of people in the limited time available. In such situations I tried to allow each person to provide an answer to each question and recorded the answers by individual. However, I treated these responses as group responses in recognition of the possibility that participants may have influenced each other's discourse. Although I continued taking every opportunity to interview tourists, towards the end of my study period I felt that some 'theoretical saturation' occurred (Bryman, 2008), where responses had become predictable and further questioning elicited little new material.

I based semi-structured interviews around my key questions (see Appendix 2), but allowed the conversation to drift into related topics as the interview progressed. Where relevant I added further questions, being guided by the tone of the interview. During semi-structured interviews with tourists I took written notes, and transcribed them into QSR NVivo 8 (QSR international NVivo 8) the same day. Interview durations with tourists varied extensively, ranging from a few minutes to a number of hours. I conducted a total of 65 separate interview sessions with tourists; these represent the voices of 160 people. I conducted 80 other semi-structured interviews with other stakeholder groups, from basic socio-cultural health interviews with PHP personnel, to donors, other researchers, vets, journalists, DSPA direction, ecoguards, hunters, local market women and the people of Bayanga. I also used semi-structured interviews for these, and conducted them in English, French or Sango, on my own, or accompanied by my research assistant Dicky (who helped me if I experienced linguistic difficulties). Dictaphone recordings in Sango were transcribed into French, and I transcribed all interviews fully or in part and entered them into NVivo 8 following initial theme and content analysis.

3.3.2. Questionnaires

I, or another member, of the PHP asked all people who visited gorillas under the auspices of the PHP to fill in a questionnaire at the conclusion of their visit to the gorillas. The questionnaire aimed to elicit qualitative and quantitative data concerning their motivations, risk perceptions and attitudes towards gorillas and their conservation, as well as basic demographic and health information. As such the questionnaire was divided into 6 major sections: (1) demographics; (2) trip characteristics; (3) travel interests; (4) travel health; (5) gorilla tourism part A, and (6) gorilla tourism part B. I designed the questionnaire to include a mixture of closed and open-ended questions, which would complement and contrast information from participant observation and interviews. I aimed to elicit questionnaire responses from all tourists with whom I conducted interviews, although this was not always possible due to camp logistics and time constraints. The questionnaires were also aimed at providing an opportunity to crosscheck information against interview responses and observed behaviour, and to broaden the amount of information I could elicit from tourists in a short period of time (Bernard, 2006).

I developed and trialled the questionnaire in collaboration with WWF during my pilot study and finalised it before the full data collection period (see Appendix 2). I had the questionnaire translated into French, and made it available in the tourist 'paillotes' (huts) in both camps, accompanied by a short, written introduction to my research. Some visitors filled in the questionnaire unbidden, others agreed at my request, while others took them away to complete in the evening and which I later collected from the lodges. Some people simply did not have time, or were not interested in filling in a questionnaire. In these cases I did not persist after a first request.

All questionnaires were completed anonymously and data kept confidential. In total, 218 questionnaires were fully or partially completed. If section 1 was not completed I disregarded the questionnaire. If another section had been partially completed, but some responses were left blank, I used the remaining data where relevant and recorded 'no-response' for missing information. I present numerical results as percentage values based on the number of respondents specific to each question, rather than the total number of questionnaires drawn on.

3.3.3. Participant observation and ethnography

Participant observation was a key tool in my ethnographic research. Being a participant of what one observes facilitates a deep understanding and interpretation of the meanings of

people's actions and experiences (Cole 2005). It allows the researcher to see what people actually do, not just how they talk about it or what they say they do, and can illuminate a situation or context not always apparent simply from an interview or questionnaire response (Burns 2008). I agreed a functional collaboration with the non-governmental organisation (NGO) WWF to conduct my research at the site. That is, the Primate Habituation Programme project itself was interested in the hormone and health monitoring aspects of my work, as well as the tourism and wider gorilla tourism risk-assessment evaluation that I proposed. This allowed us to reach an agreement regarding my role as a collaborating researcher. In this sense, I became a researcher working with/for WWF, rather than maintaining my stance as an independent researcher based at the site. I felt that I became an intrinsic part of the functioning of the camp(s) and a part of the WWF PHP team in Bayanga during the 16 months I spent conducting fieldwork. Simply making observations in this context was not an option. For example, the very management actions or decisions I aimed to observe often fell into my hands as part of daily camp life, and I was required to support the team on several occasions guiding tourists/donors/film crews with the gorillas. I also played a key role in defining work strategies, such as finding missing gorilla groups and monitoring forest behaviour for acceptability, as defined by the WWF. I was often consulted about camp staff issues, such as illness/family issues and dwindling food supplies. Being part of what I set out to observe afforded me a privileged, rich position from which to record, and later interpret, events and their meanings.

I recorded information from my observations in an ethnographic diary. I wrote an entry each day or as soon as I could, with specific attention to discourse that I deemed relevant to my research. At times, whilst observing the gorillas, I made notes in my gorilla behavioural data book, to remind myself of actions or conversations, and during tourists' sessions with the gorillas I would openly record notes in a notebook specific to this purpose. If asked, I showed the entry to the interested party in its entirety. I recorded or transferred all information into NVivo 8, and coded it for theme and content.

I present the opinions and voices of the people interviewed and observed throughout Chapters 4,5 and 9, often using raw data quotes as illustrations. These are indented in the text and italicised, and followed by a pseudonym denoting the gender of the informant and the location in which the information was gathered if not during a standard interview, in which case the subject is simply an 'interviewee'. For example

Quote about gorillas. (Richard, interviewee).

3.3.4. Data analysis

The type of mixed data collection approach I employed to elicit information from tourists can be described as a sequential mixed-method technique (Tashakkori and Teddlie 1998; 2003). This is where the researcher collects data during several distinct phases, in my case, before, during and after tourists' gorilla watching. Each phase of data collection is guided by key questions which are used to integrate results during one final interpretative phase, forcing the focus of the research study onto the theoretical perspective rather than the intricacies of data collection methodologies (Creswell 2003; Tashakkori and Teddlie 1998; 2003). I present a mixture of data from each methodology, to address my research questions. I used a grounded theory approach (Glaser and Strauss 2009) to identify reoccurring themes and patterns within the discourse analysis. That is, I allowed ideas to emerge from the data rather than imposing or fitting theory to them. I distinguished major themes based on the frequency of their occurrence in the discourse and allowed sub-themes to unfold in the analysis, using a 'bubble-flow diagram' initially to observe my interpretations of how the concepts overlapped and linked together. As such, many of the concepts are not mutually exclusive and the structure I use to present them is not intended to suggest a common pathway, but is simply the most logical way the concepts evolved for me. I adopted a social-constructivist view of the discourse to consider and unpack what is being said and done within the social and cultural settings in which they occur – and how this in turn influences the construction of what is said and done (Burns 2008).

3.3.5. Social construction theory

Wildlife management is based on a range of assumptions about wildlife and expectations about nature (Hytten and Burns 2007) and several social constructions of nature have been demonstrated (e.g., Davenport, et al. 2002; Hytten and Burns 2007; Vaske, et al. 2003). However, a key criticism of much research into human-wildlife relations in these contexts is that "researchers pay no or only cursory attention to the ways in which people, including tourists, construct non-human nature" (Russell and Ankenman 1995, P1), and by doing so lose reference to the discourses that give meaning to social realities upon which they are based. The central tenet of social constructionism is that the way we conceptualise components of reality depends on discourses that construct them in conflicting, often contradictory ways (Hytten and Burns 2007). Phillips and Hardy (2002) describe a discourse as an interrelated set of texts, and the practices of their production, dissemination and reception that bring ideas, concepts and beliefs into being. These then turn into knowledge and may be used as a framework for

understanding and the basis of our actions in social life (Hytten and Burns 2007). Our constructed frameworks become the common understanding with which we interpret the world, but are fluid, dynamic cognitive processes, which can be influenced by social whims or media activities (Lemelin 2006) that change our perceptions of people, places and things. It would seem sensible therefore to suspect, then, that perceptions of animals encountered through ecotourism are culturally and historically specific (Russell 1995). As perceptions of wildlife change, management of interactions must also change (Burns 2006).

With the growing recognition of the importance of the social dimensions of wildlife management, social construction theory is a useful tool with which to address the need for research in this area and I use it as a major conceptual framework to address my socio-cultural data analyses. Applying social constructionism requires that a critical stance is assumed towards the commonplace ways of understanding and thinking (Hytten and Burns 2007). By examining, or deconstructing, discourses and texts of a particular setting it is possible to reveal the contradictions, biases or inaccuracies beneath them, which will allow a critical analysis of various topics of concern with the view to improve it; for example human-wildlife interactions.

3.4. Ethics and research permission

The Research Ethics and Data Protection Committee of the Department of Anthropology, Durham University approved this project. The Durham Life Sciences Ethical Review Process Committee, Durham University, approved work with animals and the collection of non-invasive faecal samples. Zoo research was conducted with permission and in accordance with the relevant Zoos' research protocols and adhered to the legal requirements of the UK. We adhered to the research protocols defined by the Dzanga-Sangha Protected Areas Direction, and the Ministre de l'Education Nationale, de l'Alphabetisation, de l'Enseignement Superieur, et de la Recherche granted research and sample transport permits for the full period of study (Appendices 3 and 4).

Chapter 4 - Human dimensions of wildlife tourism: a theoretical background

In this chapter I provide a detailed background to gorilla tourism in the wider context of wildlife tourism research. I review what is currently known about human-wildlife interactions, what drives them and the repercussions they have for the people involved, focusing on what is currently known about *who* is watching wildlife, and *why.*

4.1. Introduction

People have always been interested in animals. This is well illustrated by our keeping of domestic animals as pets for millennia (Orams 1996). Attention has only recently started to pull away from interest in wildlife primarily as a source of food, trophy, fabric and other resources however, towards less-consumptive interactions, including the institutionalisation of watching animals as a source of pleasure and recreation (Reynolds and Braithwaite 2001). In response to these developments, human-animal interactions have recently started to take shape as a topic of study in tourism (Cohen 2009). Research into the use of animals in tourism has foremost yielded the realisation that little is known both in theory and in practice (Fennell 2011). Given the foundations on which tourism exists, of novelty and curiosity about the 'other' and the world in general, tourism offers an ideal domain for the study of human-animal interactions (Cohen 2009).

Tourism is about consuming goods and services that are inessential, but generate pleasurable experiences different from those typically encountered in everyday life. Part of the experience of 'going away' is to 'gaze' on a set of scenes, landscapes, objects, animals, that are out of the ordinary, in hope and anticipation of them speaking to us in ways we can appreciate. In other words, "we gaze at what we encounter" (Fennell 2011; Urry 1990, P1), and what we encounter is socially organised and systematized and varies by society, social group and historical period (Urry 1990). One of the oldest ways humans have recreationally 'gazed' at wildlife is via zoos, which display nonhuman animals to the public (Knight 2006). A major criticism of the zoo is of the "denaturing effect that zoo life has on animals, arising from the displacement from their natural habitats" (Knight 2006, P254). Knight suggests that an essential feature bringing popularity to the 'watching' aspect of wildlife tourism is that it requires humans to go to where the animals are, as opposed to them coming to (or classically being brought to)

us (2009). The growth and development of a recreational relationship with wildlife may have to do with several emergent issues including a societal re-evaluation of wildlife and of nature in general and its place in society (Fennel 2011); an increase in the proportion of the population that is urbanised and remote from the natural world and who now seek constructs of nature that are more emotionally and spiritually fulfilling (Curtin 2005; 2009); and society's changing attitudes towards particular species as wildlife education becomes more accessible and entertaining (Reynolds and Braithwaite 2001). This combination of changing socio-cultural values, product development and marketing, alongside a growing interest in the natural environment and media representations of wildlife, drives the supply and demand for wildlife tourism experiences (Curtin and Wilkes 2005).

There are several available frameworks in the literature which describe and organise the ways that wildlife has been used for recreational tourism purposes. For example, Orams (1996) was one of the first to define a range of the opportunities for exposure of tourists to live animals, which he called a "spectrum of tourist-wildlife interaction opportunities" with captive animals at one end, and fully wild unhabituated animals at the other. Bulbeck (1999; 2005) categorises three types of animal encounters, but bases her distinctions on the differing levels of *authenticity* provided between sites. Where fully authentic sites allow people to visit or be visited by completely wild animals, semi-authentic sites encompass safari-park experiences and sanctuaries and staged encounter sites are those where animals are viewed in captivity or under another means of constraint. This recreational pursuit of people visiting wild animals, has, however raised serious wildlife management concerns as a result of "necessitating that the demands of conservation be juggled with the provision of an authentic wildlife viewing experience" (Schänzel and McIntosh 2000, P36). Managing the balance between conservation and recreation in natural areas is a complex and frequently difficult endeavour and to adequately address the many competing and conflicting interests that exist in almost any natural area requires a comprehensive understanding of their dynamics (Catlin, et al. 2011). Understanding the relationship between the experiential needs of the consumer and product management is particularly important for wildlife tourism organisations as the sustainability of the resource can be compromised by inappropriate management, such as allowing visitors to get too close to the wildlife, damage to the habitat, overcrowding and poor interpretation (Curtin 2005). As Fennell argues, "this enjoyment of nature on nature's terms or for nature's sake corresponds to a different type of relationship, a different type of consumption between humans and animals" (2011, P189). This new interaction adds complexity to the consumptive/non-consumptive dichotomy often associated with definitions of wildlife tourism

(Lemelin 2006; Tremblay 2001), which can incorrectly lead to the suggestion that tourist activities which do not harvest or remove specimens from their environments, have no impacts (Tremblay 2001).

Whilst there is a relative abundance of biological impact and trade-off analyses of wildlife tourism, important information is lacking on the needs, desires and opinions of the public, an understanding of the public's relationship with wildlife, and how vital it is to human welfare (Reynolds and Braithwaite 2001). Authors on the subject of wildlife tourism to date suggest that a traditional lack of focus on the *attraction* or *experiential nature* of the exchange has left a gap in knowledge as to what is actually being gained by the individual visitor at a specific wildlife tourism site (Schanzel and McIntosh 2000; Curtin 2005) and that research seeking to understand wildlife viewing in a natural setting would be well served by attending to the actual nature of the experience (Montag, et al. 2005). A focus on the human dimensions of sustainable wildlife viewing-management is needed to "ensure that the beneficial experiences gained by visitors ultimately help preservation efforts in the long term" (Schanzel and McIntosh 2000, P37).

4.2. Who watches wildlife?

Given the wide range of types of wildlife tourism available it is evident that there will be a wide range of participants, in age, socio-economic status and motivation. Motivations and attitudes emerging from a variety of backgrounds affect the way participants approach wildlife interactions and should be taken into account in any examination of the components of human-animal interactions in these contexts (Reynolds and Braithwaite 2001). One approach taken to examining the heterogeneous market is to categorise it according to tourists' demographic information (Curtin 2010b; Newsome and Moore 2012). For example, a tourism report compiled in the United States in the 1990s found *consumptive* wildlife users to be mostly male (>90 %) with few having graduated from higher education (HLA Consultants 1990), but in general, (Fletcher 2009) observes that non-consumptive ecotourism "is both practised and promoted predominantly (although not exclusively) by female, white, professional middle-class members of the post-industrial western societies" (p269). Following this, several studies have used different criteria to assess and provide greater insights into specialisations within groups of wildlife tourists (Chipman 1988; Duffus and Dearden 1990; Martin 1997; McIntyre and Pigram 1992) and their levels of involvement. Cole and Scott (1999) divide wildlife enthusiasts into serious or casual categories, according to various criteria regarding past experiences with

wildlife tourism. For example, Bulbeck, (2004) reporting on results of a survey of visitors to animal encounter sites in Australia, suggests that special interest tourists belong to the better educated and higher income segments of society, are likely to plan a trip focused on self-actualising needs, as opposed to generalised, or less serious, tourists who focus on physiological needs such as the sanitary facilities available onsite. Some researchers differentiate the general naturalists market, or ecotourist group, from a non-naturalist tourist group by a tendency to be well educated and well-travelled, with a high level of disposable income (Mintel 2008) and an inclination to "shun the contrived spaces of mass tourism and instead seek an authentic, successful and somewhat educative tourism experience" (Curtin 2010, P220). Furthermore, wildlife tourism novices have a greater interest in the non-wildlife aspects of their tourism experiences than do specialist users, and place more emphasis on the wider range of services and amenities provided. In contrast, specialist users concentrate on the focal species, require detailed interpretations and are, in general, more conservation-minded (Reynolds and Braithwaite 1999). For example, a study of tourists viewing sting-rays found that two tourist groups emerged (Semenuik, et al. 2009). The first, which they called a pro-management group, were in support of conservation fees and measures to protect stingrays from injury, while the second, which they called a pro-current group, were likely to approve of a small access fee and management decisions that allow the handling of stingrays despite the risk that this might contribute to injury or stress for the animals. In general, studies of this kind are useful from a management point of view, as specialisation among tourists is often related to increased environmental awareness and to a more realistic expectation of the wildlife experience sought. Therefore, if increased conservation values are to be imparted to participants, management objectives should be primarily focussed towards novice users or the destinations they tend to favour (Fennell 2011; Malcom 2008).

4.3. Why do people watch wildlife?

The 'experience-based management' (EBM) paradigm is based on the idea that people engage in activities such as wildlife viewing in specific settings to attain certain desired psychological outcomes. It is an approach which "seeks to understand and ultimately manage recreation experiences via the characterisation of attributes of the experiences, settings and activities that define a particular recreational opportunity" (Montag, et al. 2005, P274) and has been used increasingly in studies of the experience of wildlife tourism (Schanzel and McIntosh 2000; Lemelin 2006; Montag, et al. 2005). The EBM framework fosters a conceptualisation, which is growing in popularity in tourism management, of the wildlife recreationist as a

consumer of an experience and tourism as the *facilitator* (Manfredo and Larson 1993; Schänzel and McIntosh 2000). The approach promotes an understanding of the experiences gained from a benefits and attraction perspective, and provides a useful framework from which to organise and review prior research regarding the outcomes, benefits, and motivations of humans engaging in recreational wildlife watching (Montag, et al. 2006).

4.3.1. Educational Benefits

> *We have little hope of reaching a sustainable society unless education helps people understand the fundamental interaction between humans and their environment, including fish, and wildlife resources* (Brown 1982, P198)

Some researchers conceive of wildlife as acting as a symbolic proxy for the concept of the natural environment (Schoenfeld 1977), and as a vehicle that transports youth and adults alike into the broader arena of the environment (Hair and Pomerantz 1987). Miller (1975) proposes that the foundations of pre-adult attitudes towards the environment are formed during early childhood and govern behaviour throughout later life. It has also been suggested that better understanding of the underlying reasons for people's attitudes and behaviours towards wildlife could contribute to a reduction in conflicts and misunderstanding among the various users of natural resources (Hair and Pomerantz 1987). Tanner (1980) showed that of 45 respondents selected for being environmental leaders, 35 could recall early environmental experiences as a major influencing factor in their choice of professions. Such examples highlight the importance of experiential learning at an early age for individuals, and potentially for society as a whole, to benefit from people with positive, sustainable approaches to the environment.

4.3.2. Recreational Benefits

Defining categories of benefits, and particularly recreational benefits, is a complex issue, within which it is almost impossible to separate out aspects such as ecological knowledge and cognitive processes driving human behaviour (Steinhoff 1980). Often, benefits gained from wildlife do not result from direct use or observation, but engage our symbolic imaginations and stimulate awareness of other environmental concerns within different societies (Shaw, et al. 1984). For example, benefits can accrue in the form of improved peace of mind, a sense of moral responsibility for protecting the integrity of the biosphere and for providing future generations with options. Furthermore, researchers assert that a sense of cultural identity can be derived from recognition of common evolutionary kinships among all people and animals (Shaw, et al. 1984). Holbrook and Hirschman (1982) and Hull (1990) describe benefits in the

form of psychological outcomes as a "steady flow of multiple fantasies, feeling and fun which may be encompassed by what is called the experiential view" (Schanzel and McIntosh 2000, P37) that may include 'mood benefits' like stress reduction (Curtin 2005; 2010). Montag, et al (2005) explain that experience attributes can be defined in terms of 'bundles' of psychological outcomes (or satisfactions/goals) that recreationists seek. They provide an example from Duda, et al (1998), who report that amongst recreationists in their study observing beauty in nature, relaxation and seeing any wildlife or seeing a variety of wildlife predominated over the goal of seeing a specific type of wildlife. Such theoretical findings are useful for resource managers who may be concerned with providing recreational benefits. In other words, it is necessary to move away from simply controlling or manipulating the resource base exposed to the recreationists' gaze and look beyond the overt behaviour of people to understand the capacity for certain experiences to deliver such 'bundles' of psychological benefits effectively (Shaw, et al. 1984). As such, a thorough understanding of the elements of human-wildlife interactions which give rise to these benefits is critical.

4.3.3. Aesthetic and experiential appeal of wildlife interaction

"Animals can move!" (Rolston 1981, P187)

Many wildlife species are striking in form, unfamiliar, novel in size, colour, and smell and therefore fascinating to encounter. Rolston (1981) suggests, however, that our gaze is held by more than this: "by the laments of anticipation, surprise and uncertainty, not just in the opportunity to see the wildlife at all, but in what it will do", which adds "adventurous openness to the scene" (P188). The importance of spontaneous form in motion in the human gaze was demonstrated in a zoo setting by Bitgood, et al (1988), who found a strong correlation between observation time and animal activity (twice as long for active animals), the size of animals (larger species were watched for longer) and the presence of animal young (more young resulted in more interest). Importantly, these factors may enlighten us as to why the immediacy of watching [or waiting to watch] wildlife means that television wildlife programmes, art, photography, and even zoos, will never be an adequate substitute for the 'real thing', as "their motion has been captured ... tamed ... no dog is equal of a coyote, a cow is never as exciting as a deer ... the pariah species, which prosper as parasites and outcasts of civilisation, lose their glory" (Rolston 1981, P187). But why are wild animals so important to us? What makes an unrestricted gaze on a jaguar inside an enclosure fundamentally less satisfying than glimpsing the same species in the wild?

Not only do wildlife move, they have eyes! (Rolston 1981, P189)

Symbolic interactionists have long argued that all meaning is a product of social interaction rather than a quality inherent in the objects themselves. Although animals have a physical being, once in contact with humans, they are given a cultural identity as people try to make sense of them, understand them, use them, or communicate with them. They are brought into civilisation and transformed accordingly as their meaning is socially constructed. To say that animals are social constructions means that we have to look beyond what is regarded as innate in animals - beyond their physical appearance, observable behaviour, and cognitive abilities - in order to understand how humans will think about and interact with them. 'Being' and animals in modern societies may be less a matter of biology than it is an issue of human culture and consciousness (Arluke 1996, P3).

With reference to the use of totemic animals in human societies, Claude-Levis-Strauss (1966) is famous for saying that animals are 'good to think with'. Bulbeck (2004) describes animals as being dense with the symbolic meanings attributed to otherness, which patrol the borderlands constructed between the human and the natural world. This case is well-illustrated by the frequency with which animals are used as symbolic icons for the marketing of wildlife tourism, although, evidently, some animals, such as whales or gorillas, attract more interest than others. Tremblay (2002) suggests that we know little about the traits which make certain species more preferable to us, but suggests a set of attributes or characteristics that relate to their size, aesthetic appeal, visibility in the media, or the difficulty with which they are found in the wild (Fennell 2011). Furthermore, the extent to which animals are 'like humans' or reflect human characteristics, is important, and goes beyond animals being seen simply as 'cute' to include 'approachability' and 'playfulness' (Fennel 2011), a discourse the author also suggests has been rarely alluded to in the study of tourism or ethics, except perhaps those pertaining to dolphins. Curtin (2005) suggests that such human-like characteristics usually refer to the extent to which tourists can empathise with animal behaviour of attributes, a sentiment famously reflected by Berger in his 1980 essay *about looking*, who writes that "when we gaze upon animals we hold a mirror up to ourselves" (P67). Given that animals cannot share their thoughts and feelings with us, we impose our own interpretations of their world, based on our own human experience, language and emotions (Curtin, 2005).

4.3.4. Close encounters

Bulbeck (2004) notes how much promotional wildlife tourism literature centres on the sale of 'close encounters' with wildlife. This feature of the visitor experience has often been

identified in the literature, yet little explored, especially the emotional, cognitive and physical satisfaction people report after these close interactions (Curtin 2005). For example, Schanzel and McIntosh (2000) note that tourists felt greater satisfaction when able to get close to penguins, reporting 'the closer the better'! Pearce and Wilson (1995) report that Orca whale-watchers rated close observation as the second most important aspect of their trip (after seeing whales at all), and Davis, et al. (1997) report that numerous tourists actually touched whale sharks whilst diving with them, despite a potential $10,000 fine for so doing. There appears to be an innate desire in humans to want to touch animals, especially those which are untouched by humans (Bulbeck 2004). One of Bulbeck's (2004) respondents commented on the supposed origins of this innate desire, suggesting that the desire to touch was a natural human urge, enabling learning as well as a more complete experience of the animal. Another respondent stated, "think of a baby, the first thing is touch and taste; we've never grown out of it" (P32). Aslin (1996, P321) appears to support these notions, that our understanding of engagement with nature may arise much more strongly out of tactile embodied experiences with actual animals than intellectual engagement with ideas (P321), suggesting that a physical interaction with animals may be more positively persuasive than thoughts of an 'abstract wild' (Bulbeck 2004). Franklin (1999) suggests that modernity is based on curiosity and the spectacle of the other, a move to the post-modern is characterised by a heightened emotional bond with animals that is couched in a broader moral context; the search for a more intimate or embodied experience. It seems, at least in terms of a meaningful wildlife experience, closeness can be everything (Bulbeck 2004).

4.3.5. Photography

During the late 1800s photography emerged as an alternative sport to hunting that brought humans in close contact with animals (Fennel, 2011). Crawshaw and Urry (1997) state that the popularity of wildlife tourism has desensitised viewers to natural rhythms in some instances, and accustomed tourists to temporary exposure to exotic landscapes and wildlife. Hermer (2002) refers to this process as 'emparkment', where manufacturing of 'ordered natural experiences' occurs within protected areas, which creates an environment where experiences are consumed and visitation evidence is gathered through the help of photographs. Lemelin, referring to the proposed notion of 'ocular-consumption' (2006) also marks:

> *... these photographic collectables can become addictive and fuel in some tourists, a need to pursue bigger and better trophies providing further evidence of one's accomplishment, and in these settings, greater 'hits' are needed to fulfil this craving and*

are pursued in more unusual places as more and greater 'exotics' are sought. (Lemelin 2006, P517)

As far back as 1970, Leopold raised concerns regarding the act of photography and the potential for the occurrence of ocular-consumption, stating that the new recreationist wishes to return from their activity with a trophy or something attesting to their accomplishments. He suggested that the sought-after trophy can matter most to the tourist, over and above experiential factors. Russell and Ankenmann (1996) report similar findings in their studies of orang-utan tourists for whom the key theme is that of 'orang-utans as photographic collectables'. Emerging from this research were motivations to seek proof of the animal encounter by possessing a trophy of nature, control over nature, a pneumonic tool to remember the encounter, and a source of de-contextualisation from it. Such photographic quests can, however, be particularly aggravating for species that inhabit remote and sensitive environments (Lemelin 2006).

4.3.6. The 'Attenborough effect'

Bulbeck (2004) suggests that the need to get closer to wildlife and capture it photographically has been catalysed by what she calls the 'Attenborough effect' – named after the famous naturalist and documentary maker Sir David Attenborough. Wildlife documentary viewers are exposed to a barrage of close images of wildlife all delivered within a few minutes, obscuring the fact that filming the images broadcast may have taken months or even years. As tourists, people thus expect to re-create these images in their own eyes or photographs in a single visit. When they fail to do so their satisfaction is eroded and guides and tour operators are often blamed (Fennel 2011). The demand for close, personal wildlife encounters has necessitated the implementation of regulations to control the physical touching and collection of photographic images of animals in wildlife tourism (Fennel 2011). Subsequently, however, a tension is created, as the conservationists who aim to attract paying visitors and enrol them in the conservationist ideology may find that barriers such as trails, fences, binoculars, regulations, which act to conserve animals in the physical sense, reinforce a disconnecting sense of 'otherness' between humans and animals (Fennell 2011; Markwell 2001), and restrict the full satisfaction of tourists on their quests for meaningful interactions with wildlife.

4.3.7. Seeking 'Authenticity'

MacCannell (1976) first introduced the concept of 'authenticity' to sociological studies of tourist motivations and experiences over 30 years ago and it has since become a popular

agenda for tourism study (Wang 1999). A plethora of definitions of authenticity now exist, for example, “authenticity connotes traditional culture and origin, a sense of the genuine, the real or the unique” (Sharpley 2008, P130). Spooner (1986) describes authenticity as a “conceptualisation of elusive, inadequately defined, other cultural, social ordered genuineness” (P225), whilst Cohen (1988, P374) suggests that “authenticity is an eminently modern value whose emergence is closely related to the impact of modernity upon the unity of social existence”. Theobald (1998, P411 as cited in Reisinger and Steiner 2006, P68) states that “authenticity means genuine, unadultured, or the real thing”. As Wang (1999) asserts, the extended use of the now-ambiguous term in tourism was thought to originate from museum usage, quoting Trilling (1972, P93), “where persons expert in such matters test whether objects of art are what they appear to be or are claimed to be, and therefore worth the price that is asked for them or, if this has already been paid, worth the admiration they are being given”.

This type of conventional authenticity described in tourism studies is classified as *objective authenticity*. This concept has however been criticised for its lack of usefulness to explain many tourists’ motivations and experiences, as, “the search for authenticity is too simple a foundation for explaining all contemporary tourism” (Urry 1999, P51). However, authors in the late 1990s, such as Wang (1999), suggested that authenticity is highly relevant to some kinds of tourism, such as ethnic, history or culture tourism, which involve the representation of the *other* or of the past (Wang 1999). Wang, agreeing with the limited applicability of the contemporary objective form of authenticity, suggested that the term can be approached in three ways, as the conventional *objective authenticity*, *constructivist*, and the *experiential* or *postmodern authenticity*. He suggests that the latter is more useful to explain people’s behaviour than the first two.

Wang describes objective authenticity as relating back to museum usage of toured objects which can be measurably defined as authentic or inauthentic, the inauthentic being what MacCannell (1973) would refer to as ‘staged authenticity’. Recognition of the objective authenticity of objects may lead to the perception of an authentic experience, however. Constructionist or symbolic authenticity refers to tourists’ perceptions of authenticity as a result of social construction processes. This perception cannot be measured, and as Wang (citing Cohen, 1988) argues, it can be relative and negotiable or simply a product of one’s ideological dreams, stereotyped images and expectations of toured objects (citing Salamone 1997; Silver 1993). In this case, constructivist authenticity can result in various versions of authenticities concerning the same objects and is likely to be highly influenced by a person’s historical,

cultural and social status. For example, in his ethnographic descriptions of tourists on safari in Kenya, Little (1991) proposes that wildlife (safari) tourism is based on an "embedded set of visual practices basic to the tourist industry and to western discourse of which the tourist industry is a product and a producer, the focal practice of which is looking and enframing 'the other' as spectacle or picture" (P154). He suggests that this is what makes Kenya a "tourists' dreamland; a set of highly selected images reinforcing the tourists' experience as they gaze upon mythologized wild nature" (P154). He explains that there is a mediation involved in the tourists' gaze and use of mechanical devices, to experience and capture a 'wild', and supposedly 'authentic nature'.

Wang believes, however, that existential, post-modern authenticity may be a more useful, alternative way to perceive tourism, rather than classifying the actual places or objects that are toured. In contrast, existential authenticity refers to a potential existential state of *being* that can be activated by tourist activities (Wang 1999), and by which people feel they are a much more authentic or free version of themselves. Existential authenticity denotes a special state of being in which one is true to oneself, and acts as a counter-dose to the loss of 'true self' in public roles and public spheres in modern Western society (Berger 1973; Wang 1999). Wang further classified the concept of existential authenticity into subcategories of interpersonal (concerned with the bodily feelings resulting from tourism experiences) and intrapersonal (concerned with the 'self-making' or 'self-constructing' aspects of tourism motivations), which he believes help to explain more tourism experiences than conventional authenticity based on the perception of toured objects. Such objects then simply become, according to Wang, aids in the personal quest for realisation of the 'real, authentic self'.

The underlying challenge for wildlife-watching sites is to make wildlife viewable in order to deliver an authentic encounter (Knight 2009). Bulbeck (2004) suggests that a further tension within the proclaimed authenticity of the encounter is the desire of visitors for interaction with the animals, perhaps because they are the 'real', 'wild' or 'genuine' artefact, giving the example of swim-with-dolphins tourists who reported mystical reactions, and feelings of wonderment, awe and privilege as a result of physical or close encounters with dolphins. For many, capturing authenticity photographically is central to the completeness of the experience, as previously discussed. As a tourist in Russell and Ankenmann's (1996, P73) orang-utan study stated after successfully photographing a captive infant in the trees as though it were wild, "now I can go home happy".

Curtin (2005) states that the information available about tourist's motivations, whilst widespread, is unconvincing, as too much of the work is concentrated on what people do while they are away, without addressing why they go in the first place, the relationship between motivation and behaviour, and the dynamic characteristics of motivation. Further studies are needed to deepen an understanding of how management of the human dimensions of wildlife viewing can assist with ensuring the preservation of endangered animal species (Schanzel and McIntosh 2000). The aim of the work reported in the following chapter is to contribute to this gap in our knowledge. To do this, I draw on the literature and theory outlined here to present and discuss the findings of my socio-anthropological and ethnographic research with tourists. I describe and explore tourists' perceptions and constructions of gorillas, why people want to watch gorilla them in the wild, their reactions to and behaviours during their gorilla encounters and the effect these encounters have on tourists.

Chapter 5 - Human dimensions of gorilla tourism

In this chapter I present my socio-anthropological research findings, drawing on the theoretical concepts introduced in chapter four in the analysis and discussion. As is customary within qualitative research where theory emerges from the data, I present the results and discussion simultaneously (Curtin 2010), divided into sections. First, I use data from questionnaires to report *who* the ecotourists are, via a range of demographics and characteristics. Here I also take a first, high level, look at the reasons the tourists report as to *why* they have come to the country and to the Dzanga-Sangha Protected Areas (DSPA) and discuss how they may be categorised and described appropriately according to the literature. Next, I discuss the three major emergent themes arising from questionnaires, interviews and ethnography. I use these themes, which give rise to a number of sub-themes, to describe and explore tourists' constructions of gorillas, why people want to watch them in the wild, their reactions to, and behaviours during, their gorilla encounters and the effect these encounters have on them. I conclude the chapter with a discussion of the findings in terms of wildlife tourism management and conservation implications.

5.1. A view of wildlife tourists derived from tourism questionnaires

5.1.1. Who are the wildlife tourists?

Of the questionnaire respondents, 67 % are male and 33 % female. The age range is 16 – 80 years old, with a mean of 46.8 years. The majority are either French (24.8 %) or German (24 %), followed by American (10.4 %), British (9.3 %) and Swiss and South African (both 4.4 %). The remainder are represented by 15 other countries each constituting less than 4 % of the total. Almost half of the respondents are educated to university level (42.9 %), and a high proportion educated to post-graduate level (35.7 %). There is a relatively equal spread of respondents across the income brackets, suggesting that the greatest representation is in the middle-income brackets of £ 15,000 to 45,000 per annum, 58.9 % of tourists categorised themselves as independent travellers, who arranged the trip or constituent parts of it largely for themselves, the remainder booked through an agency, thereby having the larger part of the excursion arranged for them and often accompanied by a guide. Many respondents had travelled extensively in Africa, visiting a mean of 8.6 other African countries visited (range 1-46). With the exception of voluntary development and other humanitarian aid workers, the 76 % of respondents were employed in a professional occupation, the most common being for example:

physicists, chemists, engineers, dentists, accountants, bankers, teachers, doctors, architects, missionaries and administrators.

5.1.2. Why are they in the CAR?

More than half of the respondents (52.7 %) reported being in the Central African Republic (CAR) for wildlife tourism purposes. I refer to this group as the 'wildlife specific group'. 20 % were in the country for work, 16.6 % were expatriates living in CAR and 9.6 % were visiting family or friends living in CAR. I have combined the latter three categories and refer to this 46.9 % as the 'opportunistic visitors group', being people who did not book their flight to CAR specifically to partake in wildlife tourism. The remaining 0.9 % consists of two tourists who stated they primarily came to CAR to climb a mountain. Among the responses of the wildlife specific group, gorillas are mentioned most frequently as a particular reason for booking the trip (27.9 %), elephants (11.29 %), and to see BaAka 'pygmys'[2] (8 %) (I did not include the generic response of *to see Dzanga-Sangha* as this encompasses all these elements).

Both wildlife specific and opportunistic visitor groups give similar responses overall to the question *why did you want to visit the DSPA?*, to which gorillas again emerge as the predominant attraction (wildlife specific - 47.9 %, opportunistic visitors - 33.8 %). Interestingly, only 3 opportunistic visitors identify photography as a reason to visit, 13 people state the main reason for being there as simply to have a holiday, 3 are 'curious', and 8 self-proclaimed opportunistic visitors who did not identify other specific interests or reasons as to why they chose to visit. A few visitors informed me that it is the 'only safe place worth visiting in CAR', however. I noted a general reluctance to respond to the section of the questionnaire requesting indication of income, mostly by those I would put at the higher end of the income brackets, perhaps due to modesty or cultural sensitivity, or the personal nature of the research interaction. The majority of respondents were trained as professionals in the public or private sector but many were working in voluntary positions or may have been paid a lower salary than equivalent positions would warrant in their countries of residence, if they exist (e.g., many humanitarian workers were doctors working with *Medicines Sans Frontiers*). I would therefore suggest that the income statistics are not useful in categorising visitor participants at this site. More useful towards understanding the different types of tourists at the site is the differentiation based on the high level reason given for being in the country at all, which in my results, evolved into the previously defined wildlife specific and opportunistic visitor groups. In

[2] I use the word 'pygmy' as my subjects did, to reflect the tone of discourse accurately. See Chapter 2, P21 where I explain use of this word in the thesis.

this sense, the opportunistic visitor group tends to fit with the more generalised wildlife tourist category that Cole and Scott (1999) describe (with the notable exception of two opportunistic visitors who disclosed to me that they had specifically asked for their placement with an NGO to be in CAR because of the wildlife tourism opportunities). Interestingly, of the opportunistic visitor group, only 6.5 % report having seen habituated gorillas before in the wild, whereas 31.3 % of the wildlife specific group previously have, ratifying their more specialist interests and motivations.

5.2. Major emergent themes arising from questionnaires, interviews and ethnography

Three major themes emerge from questionnaires, interviews and ethnography (Figure 5.1): the human-likeness of gorillas; perceptions of authenticity; and photography. I use these themes, which give rise to a number of sub-themes, to describe and explore tourists' constructions of gorillas, why people want to watch them in the wild, their reactions to, and behaviours during, their gorilla encounters and the effect these encounters have on them. Photographic concepts underscore many tenets of the first two major themes and are thus illustrated adjacently in figure 5.1.

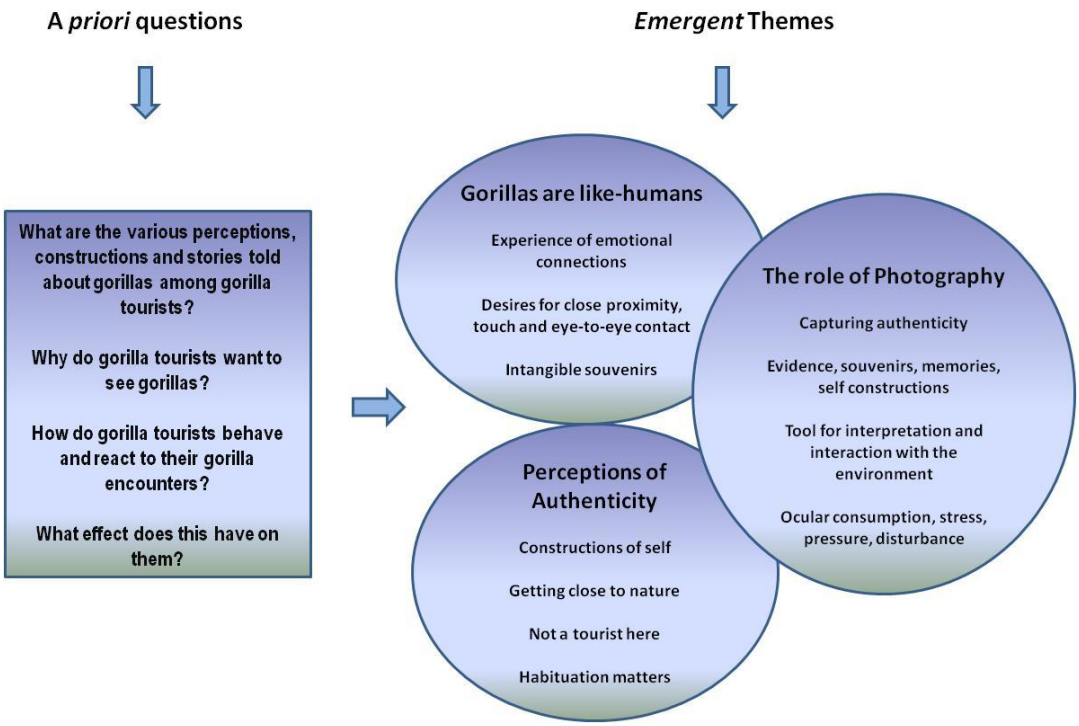

Figure 5.1. Thematic framework of major emergent themes of the gorilla tourism experience arising from questionnaires, interviews and ethnography. The main headings of each bubble are provided in the text. Sub-themes are a guide to the subject-flow of the analysis.

5.2.1. Gorillas are "like us"

Among the various constructions of gorillas given by gorilla tourists, a key perception of wild gorillas is their 'human-likeness'.

> *.... for me, I wanted to see them because they mimic humans so much, their behaviour, compared to humans, their faces, how they live in the forest, and I was surprised to see them so much in trees - such big animals on small branches! I wanted to see this how they live in nature.* (Kate, discussion in the forest).

Respondents' constructions of wild gorillas also commonly differentiate them from other animals with reference to their human–likeness, innocence and mystery.

> *.... yeah when you see them you [see] that they are not wild animals in the way that a lion is wild, they are not smelly, dirty animals, they are really like humans.* (Jane, interviewee)

> *They are so much like us and no other species like them ... you can see all their personalities and yet they are still quite mysterious*. (Paula, conversation in the forest).

One tourist struggles with his thoughts as to why he wanted to see gorillas, but then sums up the comments expressed by many:

> *.... Oh this is hard for me! I'm a bit of a primate person in general, and I'm into the natural world. I see them [gorillas] as something special, there's the similarity to humans of course, something about them is mysterious you know like a myth from fairytales, a creature you would find in a mysterious forest from the past. They are a contradiction, so strong and yet innocent - there's an innocence about all animals that people like; they are introverted which makes them more mysterious.* (Steve, interviewee).

The construction of the gorillas as 'like us, but not us' sits neatly within a large body of literature detailing the history of human-animal relations (Davis and Balfour 1992; Franklin 1999; Mullin 1999; Serpell 1996), throughout which we have held the non-human-animal as 'the other'. To quote Fudge (2002, P2), "humans need animals in order to be human". What is interesting is the common assertion among respondents that although the gorilla may not quite

be human, it is also not like any other animal. Perceptions such as the gorilla not being a 'smelly, dirty animal' are apparently important in this differentiation and reflect the 'western', modern, secular ideology of human-dominion and superiority over animals which is linked historically to teachings found in Judaism, Christianity and Islam (Franklin 1999). Separating the gorilla (or other apes) from other animals may allow people to feel more comfortable with acknowledging what they recognise as the gorilla's human-traits (Riley 2006).

Steve describes gorillas as a contradiction, which resonates with what Corbey (2005) describes as an ambiguity. He suggests that our human nature is both intrigued and disturbed by this ambiguity, which can often result in the kind of fascination observed between humans and gorillas, which is well demonstrated in the discourse of the study subjects. As Douglas asserts, "it is part of our human condition to long for hard lines and clear boundaries" (1966, P162), but apes contest these boundaries, in a similar way that Bulbeck (2004, P8) describes animals in general as "patrolling the borderlands between the human and natural world". Corbey further suggests that apes and monkeys may pose an ever deeper "sense of cultural disorder that invites curiosity", as they "are among the most prominent inhabitants of the blurred borderland between beast and human in western cultural imagination" (Corbey 2005, P5). Humans have struggled to agree on what to make of apes' connections to, or differences from, humans throughout history (Sponsel 1996). A leading French natural historian of the 1700s described the developing Linnaean taxonomy which had started to recognise morphological similarities between man and ape, as a "humiliating truth for humans; to confuse man with a beast, you must be as poorly enlightened" (Buffon 1808, P437 as cited in Corbey 2005). The German scientist professor Blumenbach later split the Linnaeus definitions of the primate order in two, "riding the system of the uncomfortable closeness of human and ape" (Corbey 2005, P50), and over time, the debate as to the status of apes' encroachment upon the purity of humans focused on distinctions as to what humans can do that apes cannot (i.e., use tools and speak). This status endured up to only a few decades ago when more positive views of the natural state of humanity emerged as the result of the work of primatologists such as the famous 'trimates', Jane Goodall, Dian Fossey and Birute Galdikas, among others (Jahme 2002).

The taxonomic system bringing humans and apes together has of course, since been reinstated, and fascination with the natural history of humans continues. For example, apes are commonly used as a symbolic tool to explore the human-animal boundaries, and used to feed our curiosity and what appears to be an emotional connection with our human nature, origins and next of kin (Corbey 2005). As is illustrated by a respondent:

... it's a gift to have them, we are so fortunate to be able to almost go back in time and coexist with them, seeing them this way, it's more accessible now, you don't have to be a David Livingstone to come and experience this, it's like if someone offers you the key to a magic window and a lost tribe - why wouldn't you want to have a look in there? (Patrice, interviewee).

Douglas (1996) explains how the transgression of, or ambiguity regarding, boundaries and difficulties understanding and pigeonholing things around them makes them symbolically central, powerful carriers of meaning and emotion. In line with this, for respondents who describe themselves as being generally 'into nature', the gorilla is described as being 'the pinnacle' of available experiences. This supports their symbolic importance in the natural world and reveals the species-ist tendencies humans have in considering animals that we perceive as less 'like us', to be the 'other', and, therefore value less. In other words, a 'primato-centrism' exists which favours the human-like animals at the expense of others (Corbey 2005; McGrew 1992).

Well, if you're into nature like I am, gorillas are really the best, you know. (Peter, interviewee).

A further key factor that gorilla tourists highlight is how the gorillas' human-like form and characteristics make them easy to 'relate' to.

... to watch apes, they have so many common traits with human beings that they are easier to understand, people can identify with them more easily. (Trish, interviewee).

A wildlife film-maker defends her anthropomorphic stance regarding her comments on the aspects of gorillas' morphological form, which make them easy for her to relate to:

... it might be anthropomorphic, but I think people can relate to them more - for example today when we saw the mother with her baby, I could imagine for example if the baby cried she would comfort it like a human mother, perhaps less so with elephants ... because of the human form. (Andrea, interviewee).

Notwithstanding the female-dominated trend observed in ecotourism, it is interesting that almost all of the comments I received about 'relating' to gorillas, as opposed to simply observing human-like form and characteristics, were from females. In her book *Beauty and the Beast* Jahme (2000) discusses the connections between female primatologists and apes, noting that Louis Leakey first suggested that field primatology would be best suited to women before

recruiting the aforementioned 'trimates'. Jahme discusses how females may be predisposed with the necessary emotional and intellectual apparatus to 'read' the behaviour of infants, and may therefore be more sensitive to the non-verbal communicative behaviours of primates. Certainly it is my experience that fellow female field-workers can foster exceptionally strong feelings and bonds with their study subjects, as compared with the few males I have encountered in the field, although it is possible males are simply less openly emotional about their feelings. Whilst collecting data for the current study, a female research assistant developed a protective, territorial stance towards the gorilla group we observed most often, expressing horror at a group of tourists' photographic frenzy and subsequent bad behaviour, which she believed upset the gorillas.

> *I just couldn't stand to watch it, I almost had to leave, they were just everywhere and not respecting X (guide), it was like they just all wanted to take parts of my gorillas and I just wanted to tell them all to leave us alone, and leave us with them in peace.* (Research assistant, on return from observing a tourist group's gorilla viewing).

In her fury, my assistant viewed herself as being separate from the tourists, but as one with the gorillas. From my observations and conversations with people since embarking on this study, I have gathered that this is a strong driver for many who either visit or spend extended periods of time with apes or other primates. People speak as though being accepted by a wild animal differentiates you from others, makes you special, and somehow directly connected with nature in a way that no longer exists for the majority of people in modern, urbanised societies. This feeling is highly coveted. Variants of this sentiment may be what motivates the female primatologists Jahme (2000) describes, who abandon comfort, lovers and family for a lifetime with their acquired primate troops, and, importantly, may be a central motivation for ecotourists in search of meaning in their wild-animal encounters.

Peace, et al (2005) also observes a tendency amongst whale-watchers to attribute human qualities to the animals, and critiques this, suggesting that a focus on superficial comparisons with humans separates animals from the broader ecological system of which they are part, and fails to acknowledge the global environmental issues that surround the animals, and us all. Many observations I made of tourists support this notion. For example, the woman in the following quote sees the gorillas as so human, she struggles to understand how they survive in the forest at all.

Every time I see them I am amazed how such an animal can survive in the forest at all. (Sarah, discussion in the forest).

However, Fennel (2011) suggests that the discourse based on animals sharing human characteristics is, as yet, not understood in relation to tourism. He asserts that, although the 'like humans' discourse 'smacks of anthropomorphism', it is not necessarily a position that should be attacked for misrepresenting animals. In some western societies, post-modern relations with animals are characterised by a strong, emotional and moral content and a greater zoological range of involvement, whereas modern relationships were defined merely as gaze, spectacle and curiosity of the 'exotic other' as exemplified by pre-modernised zoos (Curtin 2010). Curtin (2010, citing Franklin 1999) suggests that the concepts of modernity and post-modernity are useful in understanding our "collective imaginings, representations and understandings of wildlife and the wildlife-human relationship" (P151), and, as such, anthropomorphic tendencies may simply represent how people are becoming more aware of sharing their worlds with other species and are actively exploring possibilities for empathy, mutuality and coexistence by seeing wild animals in their natural (authentic) settings (Franklin 1999; Curtin 2010). Similarly, Bulbeck (2004) suggests that a respectful stewardship of nature via a more enlightened anthropomorphism can be fostered, which may in fact help to break down the walls of species-ism (Cater and Cater 2007; Fennell 2011) and add to educational options available for the management of wildlife tourism.

The desire to want to be close, touch, or be touched by gorillas and to have a moment of eye contact is also highly evident amongst respondents.

It's great, but I just wanted to reach out and touch them, scratch his back! (Tanya, observed in the forest).

... I saw these gorillas six years ago, they were so far away, today was even better they were much closer and I just kept thinking what if one came over and touched me like that guy talked about in a documentary about mountain gorillas, did you see that? (Chris, discussion on the way back from viewing the gorillas).

...oh yes, closer is better, always better. (Janet, observed in the forest).

I had a moment when I was in Mondika when an individual just sat looking at me - he was looking right into my eyes, it was really magical, and that kind of moment you can't miss. (Patricia, observed in the forest).

The desire for close proximity to wildlife has been identified as a key characteristic of the wildlife tourists' zoological gaze, despite the serious wildlife tourist often being equipped with a range of optical equipment which improves viewing-from-afar (Curtin 2010). Biologically, there is a wealth of information which equates positive social interaction, petting and physical contact (both between and within species) to a release of oxytocin, the social-bonding hormone, which may play a role in driving this behaviour (Di Simplicio, et al. 2009; Heinrichs, et al. 2003). Curtin (2010) describes two possible cognitive drivers which are reflected among the gorilla tourists' discourse: first, as a result of the proliferation of wildlife media and documentaries which depict close-up views, and thus create a 'benchmark', or 'norm' for tourists; and second, because the appreciation of close encounters comes from an innate human fascination for the animal 'other' which renders close proximity a desirable and highly memorable occurrence.

> *I know it's silly, but, like, me, I've wanted to see gorillas since I was little and I watched the film with Sigourney Weaver, Gorillas in the Mist. This was really fascinating for me and I especially wanted to come and see them.* (Carl, interviewee).

> *Just to be in the presence of gorillas, it's amazing - they just seem so relaxed and not at all bothered by our presence - they don't seem stressed by us! It's just amazing to be so close to a wild animal - a gorilla! I feel so privileged to have this chance - what a privilege!* (Fiona, observed in forest)

Also reflected among the responses of the gorilla tourists are the ideas of Aslin (1996), Bulbeck (2004) and Franklin (1999) regarding the importance of tactile embodied experiences within our desires for an emotional bond, education from, and connection to nature.

> *I am really a person who has to feel everything, and yesterday I joked that I would like them to come in and touch me, they all laughed at me [signalling other members of her travel group] ... but I don't want to do it if it's bad for the animals, but I think we learn more from them when we are closer ... but we should always keep our distance these are wild animals, and we want to experience wild animals.* (Grace, interviewee).

I suggest that in the case of the majority of gorilla tourists, the pleasure gained from these encounters resulted from a feeling of privilege, or being 'chosen' by a wild gorilla, as were the feelings expressed by many of Bulbeck's 'swim-with-dolphin' tourists when approached by wild dolphins. The exhilaration of such a moment may also be heightened by the knowledge that human-initiated physical interaction in these contexts is prohibited and because these

species are easily anthropomorphised, attributed with sentience, high intelligence, human-like form and cognitive abilities. This reflects Curtin's (2005) view, that the human desire for closeness and physical contact with wildlife is embodied within a "romantic, typically anthropomorphic view of the animal kingdom" (P4).

On further analysis, I identified that the desire or expectation for close, or eye-to-eye contact moments are in fact most common among people who had previously visited mountain gorillas (and therefore predominately the wildlife-specific group), who frequently recounted such key moments, and which seem important as intangible souvenirs. These souvenirs seem almost expected, as though representing a return on the investment in travel expense, distance and risk.

> *... at one point a youngster came in close to me, so close, to have a look at the reflection of my lens. It was a classic moment; it made it all worth it.* (Paul, interviewee).

> *... it was great, we saw the [mountain] gorillas as everyone else - out in the open, a big pile of gorillas rolling all over and playing with each other, like they said we should keep five metres but it wasn't controlled by anyone, and there was this one moment I absolutely cherish where some youngsters came in and touched us 'n' stuff - it was so cool.* (Stanley, interviewee).

> *When you come to such a remote area that's so hard to get to it's important to have such a high value species like this.* (John, observed in forest).

These findings reflect what Curtin (2010) discovered, that the most profound emotions and lasting memories are evoked from wildlife tourists' encounters with animals when there is eye-to-eye, or physical contact. Curtin suggests the attraction of these moments is caused by a feeling of participatory interaction, as opposed to the normal passive observation. MacCannel's explanation (1999, original 1979, P4) suggests that the attraction of these feelings might have to do with the search for an "authentic experience of a place, and is, perhaps, a search for ownership, a kind of personal colonisation, a search for both the unfamiliar and the things-in-common, a moment of belonging in an alien place, where, in that moment, that place belongs to you, and you to it". Such feelings also reflect Wang's (1999) descriptions of tourists searching for their authentic selves in their existential experiences of places and objects, and is discussed in greater detail in section 5.2.2.

Notably however, those with tales of intimate moments with mountain gorillas emerge as the most likely to express disappointment after their viewing of western lowland gorillas, commonly attributed to feelings of 'being ignored'.

> *The gorillas there [east Africa] seem to be much more interested in you. They were all coming in and really staring in our faces - really interested in who we were and what we were wearing 'n' stuff, whereas here, they just don't seem to pay that kind of attention to you, they don't seem bothered at all.* (Till, interviewee).

> *... Yes here it seems they just ignore you, they are not interested in you. In Rwanda they take you to the gorillas, and they say 'don't go too close', but you sit down and the gorillas just come to you - the babies even want to touch you.*

> Her husband added:

> *... yes we were there and a youngster came very close and wanted to touch me, then out of the bush his mum came and swept him away from me, it was really incredible.* (Maureen and Dom, interviewees)

A conversation with a tourist operator in east Africa goes some way towards explaining this difference.

> *It's really different [here], you don't get that kind of instant gratification you get with the mountain gorillas because they're so much closer, and you can see them better, you're amongst them. Some of the gorillas are third generation habituated, and you know the guides are often hacking down the bush to allow people to get closer - there's a huge pressure on guides not to stay at the seven metres.* (Craig, tour operator, discussion in the forest).

The tour operator's point about the greater degree of habituation of the mountain gorillas compared to the western lowland gorillas is true, but there are other contributing factors. Humans must closely follow western lowland gorillas from dawn till dusk because they move fast over a greater distance each day. The scarcity of western lowland gorilla groups also means they are often closely followed by researchers, film crews, and tourists within one day. In contrast, the abundance and ease of tracking large groups of slow moving mountain gorillas through relatively clear vegetation means that separate groups can be allocated for researchers and tourist groups. Mountain gorilla research groups are followed closely for a maximum of four hours a day, and tourism groups only one hour, after which trackers follow in their direction at

distance. The situation for western lowland gorillas may therefore be disadvantageous both for them and for the tourists, as this comparatively large exposure of the gorillas to humans renders the western lowland gorillas at risk from stress and subsequent health risks. The prolonged exposure may also desensitise the gorillas to the novelty, or enrichment value of visits from humans. I was once told by a friend conducting research on mountain gorillas that many of the gorilla groups assigned to tourists appeared to 'know and monitor' the duration of their daily visits, seemingly settling for rest and play whilst tourists were visiting, moving away or signalling with vocalisations and low aggressive gestures if much more than an hour transpired. It may be that western lowland gorilla groups do not have the option, or inclination to perceive human visits as a source of enrichment or interest.

Preferences expressed by tourists for the interactions experienced with mountain gorillas were however often contrasted by the apparent problem of east African mass tourism. This leads me into the discussion of the next major emergent theme: the motivation and gratification that tourists expressed as a result of rare experiences.

5.2.2. Seeking 'Authenticity'

> *I heard that less than 3000 people can say they've seen lowland gorillas in the wild.* (Vanessa, interviewee)

> *It's really such an amazing chance to see them [gorillas], you know I feel very lucky to have this chance that not many other people might get.* (Richard, interviewee).

Montag, et al. (2005) observed amongst wolf-viewing tourists that the anticipation, authenticity and significance of 'achieving' these encounters are also enhanced by the chance that the wildlife might not be seen. As with Montag's respondents, this appeared to stem from two sources: that the behaviour observed was natural, genuine and unadultered as a result of observing animals in the wild (i.e., not a human-controlled zoo environment, which anyone can see); and because they had to travel a long way to witness this first-hand, as opposed to watching it on the television or seeing it in a magazine (which anyone can do). In this sense, it appears that exclusivity of an experience may offer a similar value to that of authenticity, or in fact be a part of it.

> *I liked the fact that it was a genuine/authentic experience – i.e., not too commercial/contrived.* (Male, questionnaire respondent).

It felt like a very authentic experience though natural and beautiful. Thank you. (Male, questionnaire respondent).

In this sense, for some, wildlife tourism facilitates satisfaction and psychological wellbeing via the fulfilment of achievements and accomplishments, rather than particular moments of the encounters themselves. Related to this is a sub-theme of the value placed specifically on seeing a rare, endangered species. I feel, however, that these later sentiments were divided in their meanings: a small proportion of the respondents who mention the rarity of the species do so in the context of their apparent concern for gorilla conservation, expressing guilt about subjecting the animals to their potentially aggravating presence for their own gratification, but also hope that the money they pay to do so will go towards their conservation:

*I feel like I want to see them to contribute to their conservation, that I sometimes feel bad that maybe it has a negative impact on the gorillas, but I think that it's their only chance for survival, that without people showing interest in them and protecting them, and them bringing money and jobs etc that they might be extinct in a few years maybe! (*Mila, interviewee)

In contrast, the majority of tourists expressed interest in the rarity of the species from what might be referred to as a more egocentric position, underscored less by their concern for the survival of the species than for a personal opportunity. For example, I ask a respondent if having seen the gorillas would make him more interested in conserving them.

...naa, you know, it's one of the last big animals I haven't seen, I just wanted to do it, get it done, you know like one of those top 10 things you have to do

[I added the question, '*before you die'*?]

... yeah.

[I asked, 'so for you it was really about coming and ticking it off?']

... definitely! (Bob, interviewee)

The attraction of rare species in wildlife recreation is well documented (Curtin 2005; Kellert 1985; Schänzel and McIntosh 2000; Shackley 1996). A clear message from gorilla tourists' discourse supports the impression that witnessing events (or species) which are rarely seen renders the experience exceptionally memorable and special (Curtin, 2010), in the same way that the rarest objects gain greater commercial value. Lemelin's (2006) suggestion that tourists'

behaviour is demonstrative of 'ocular consumption' is therefore accurate even though wildlife tourism is about purchasing and consuming experiences, rather than 'things'. Related to this is the recognition (e.g., Curtin 2005 and Bulbeck 2004) of the growing tourism fashion trend for wildlife list-ticking and the bucket list, which details all the things we must apparently do before we die.

> *It's a once in a lifetime trip, something I wanted to experience before I died.* (Male, questionnaire respondent).

A different kind of self-imposed goal is evident in the curious trend I observed amongst tourists to illustrate what Bulbeck (2004) describes as the post-modern irony, of not 'being a tourist here', or not wanting to be construed as an average or normal tourist.

> *Maybe you should ask the more normal tourists, we're not so representative I guess, coming from biological backgrounds*. (Tina and Geoff, observed in the forest).

Particularly interesting is the man who felt that wearing insect repellent was a mark of being a 'tourist'. He refuses to apply it on the grounds that he is an expatriate and is thus immune to insect bites.

Upon being offered repellent by his friend he declares dismissively:

I don't need that stuff, I live here! I'm not a tourist! (Clive, observed in camp).

And equally many respondents reported how important it was for there to be few people around, so that they were not part of a mass crowd.

> *I like the peace and quiet you see, I wouldn't want it changed and become like massively touristy - I wouldn't come if it changed. I don't think I would like to go to east Africa and see the mountain gorillas, there's too many tourists there hovering like flies. It's like a zoo. I just enjoy the travel and don't want to be bothered by all those other people – seriously it just would remind me of a zoo. Here it's not like that, it's about as far different as it can be from a zoo, it's like it should be - untouched remote area without loads of people. And you know, if you got loads of people here it would change the area too.* (Robert, interviewee)
>
> *...like, if it became like going to Spain or something it wouldn't be good.*
>
> [I asked, 'why'?] ...

Because if you were just walking in and another group leaving passes you and another one behind you it would really lose its charm here. It's like in east Africa - yes you can really see amazing animals etc but it's too many people I think ... here it's like the real Africa - this is the reality. (Tiana, interviewee)

We're always interested in places that are untouched, and original. (Tessa, interviewee)

Even the owner of one of the local lodges proclaimed that his clientele are 'not that sort of tourist', having been to east Africa and done safaris and now want the 'real' Africa!

...yeah we don't get those people [inexperienced, mass tourists] here, you don't find first time Africa-goers coming here its normally older people who've travelled a lot, well, who I market to, people that have done east Africa and now want something more. (Lodge owner, over dinner).

The emergent 'me and them' dichotomy is particularly interesting, as it suggests that part of the attraction and thus benefits gained by tourists at this particular wildlife viewing site is the opportunity for visitors to distinguish themselves from other, perhaps less enlightened tourists, the mass tourists, for whom, perhaps, a more 'staged authenticity' will suffice. Certainly the questionnaire results support my impression that the study subjects are generally well travelled in Africa prior to their arrival at the site. Therefore, perhaps related to this claim of superiority is the value and achievement of having travelled a long way to have a rare experience, observe or conserve a rare species, or experience something deemed more authentic than is available to the less adventurous mass tourist who sticks to the beaten track. The opportunity to distinguish oneself appears to be embedded in the tourists' beliefs that the lesser human-frequented sites represent more of the 'real deal', the 'real' Africa, and carries with it the implication that the heavily visited places are less authentic, spoiled by too many tourist gazes, and thus a less satisfactory medium to fulfil people's desires for communion with the 'wild, untouched Africa'.

Urbanisation and industrialisation are commonly blamed for distancing people from nature, fuelling a resurgent interest in biophillia and profoundly romanticising our psychological and physical relationship with nature by appropriating animals into our consumer culture (Curtin 2005; Urry 1990; Wolch, et al. 1995). The 'authentic experience' has been equated to one in which individuals feel themselves to be in touch with the 'real world', and in doing so also find their 'actual' selves (Wang 1999; Curtin 2005). Furthermore, McCabe (2005) suggests that the term 'tourist' has become imbued in contemporary understandings with culturally

derogative and negative connotations of being lazy, dumb and unfamiliar with the toured environment. The man refusing to wear mosquito repellent on the grounds that he lives in the country can be seen as a clear example of somebody exerting their familiarity with the setting, again setting himself apart from the other 'tourists'. This 'better than a tourist' phenomenon typified in the subject's discourse may relate to what Wang (1999) refers to as the search for intra-personal aspects of existential authenticity, the self-making of identity, and what Cohen (1988) discusses as being typical of the *experiential tourist*. He describes such a tourist as being alienated from their centre. These kinds of tourists are aware of their own precarious alienation and actively seek meaning and authenticity in the lives of others. Simultaneously, they remain aware of their otherness as visitors; thus retaining ownership of the positions within whichever communities they have travelled from.

Similarly, Curtin (2005) explains, much work based on the experience of wildness suggests that being close to nature has a powerful and moving effect on people, stimulating a sense of freedom and release, which, importantly, is heightened by the realisation that not many other people experience the natural world in their everyday lives. Ironically, however, in their search for enlightenment through the real, authentic lives of other species, people and places (Jarvis 2000), such explorers may eventually deprive themselves of achieving their goal by the very nature of their presence (Bulbeck, 2004). As Curtin (2005, P11) states "in reality, wildlife tourist experiences are rarely authentic or natural. There is usually an element of mediation in the form of tourist infrastructure, viewing platforms, boardwalks, guides, which render them a contrived experience". This point provides an opportunity for me to raise discussion of an important element of the 'authentic experience' with regards to the habituated status of the gorillas.

The pleasure of experiencing animals in their natural habitat is an experience that is enabled via the habituation of gorilla groups. It is a strong motivation for the gorilla tourists in the study and is commonly reported in the wildlife tourism literature regarding tourists' travel motivations (Curtin 2005; Knight 2006; Muloin 1998; Orams 2000).

> *...it gives a wonderful feeling, inspiration and motivation seeing primates in their natural habitat.* (Female, questionnaire respondent).

> *Being able to follow behind them and see what they actually do in their worlds, it's really special.* (Carla, observed in the forest).

The importance of the element of *wildness* is reflected among the expressions of many tourists, who, it emerges, often contrast the opportunity to see wild gorillas with zoo gorillas, which are ascribed with very different constructions and attributes, despite being the same species.

> *... Well you can see gorillas anytime in a zoo, but for many people to see them in the wild is way better.* (Phillip, interviewee).

> *... But the gorillas in zoos are just stupid, doing the same thing all the time.* (Tim, interviewee)

> *It's the same with all animals really, you get a better feeling from seeing these amazing animals in nature, working as they should be working in nature. In zoos it's all artificial - here you have to look for them they're not just put in front of you like that.* (Sylvie, interviewee)

> *... yes to see them in their natural environment, what they do, and to have the experience of tracking them, looking for them, it's really special.* (Beatrice, interviewee)

The tourist's discourse reflects what Mullin and Marvin (1999) discuss regarding the representation of wild animals in zoos. They suggests that the words 'represent' and 'present' are important with regards to understanding people's relationships with animals, stating:

> *… presentation might be taken as indicating a first level of embodied, immediate, unmediated being in the world – animals present for their own purposes, whereas the addition of the prefix "re" indicates or suggests the necessary presence of a directing, active other – an agent with its own concerns about the nature of what is present. Representations are one remove from a presentation; they are present in another register and, necessarily suffused with cultural meaning.* (Mullin and Marvin, 2001 P275-276).

The authors go on to suggest that zoo animals are incapable of conveying a sense of their wild counterparts as a result of their containment spaces; they do not portray an accurate image of the wild species. As Hancocks (2001) states, "the problem is that zoos cannot present the 'reality' of the wild – they can merely offer a representation of it. The zoo can be viewed as a theatre of in-authenticity (here) attempting to tell a story of authenticity (there)". This may result in the type of disappointment expressed by many of the tourists regarding zoo gorillas, as a result of not providing a sense of having seen the 'authentic' or 'real thing'. Moreover, for

Marvin, another element of fundamental importance in terms of how the zoo animal is constructed out of the wild animal is *visibility*, the kind of perpetual presence, which respondent 'Sylvie' reports as unsatisfactory above. "Zoo animals are very different from most other wild animals in that they are permanently visible; an important demand of the zoo... one of the powers of wild animals in their natural surroundings is that they can elude the human gaze, that they are free to deny a relationship with the humans who seek to engage with them" (Mullin and Marvin 2001, P9). This aspect may add to the importance of the rare and coveted eye-to-eye or physical contact interactions discussed previously, and is also illustrative of the 'denaturing effect of zoo life on animals' that Knight (2006, P1) describes.

Mulin and Marvin (1999) also contrast the safari park with the zoo. At the safari park visitors feel as though they are alongside the animals 'in a natural habitat', which renders the experience qualitatively different from the zoo (P81), even though, as Knight reflects in his (2006) study of a wild monkey park in Japan, the "natural or wild" status of the monkeys is in fact highly questionable because of the effects of provisioning. For Knight the monkey park resembles what he calls, a 'megazoo'.

I do not suggest that the effects of the process of habituation should be considered denaturing or questionable in the sense that the tourists might feel themselves to be at a zoo or safari park. However, I was continually surprised by the ubiquitous lack of tourists' acknowledgement of the process of habituation with regards to their perceptions and constructions of gorillas. Nowhere among the various constructions of gorillas I recorded, either before or after tourists' visits, did I encounter references to the habituated state of the gorillas, or any reference to the fact that gorillas could be 'scary' or 'dangerous'. On the contrary, most remarks regarding tourists' lasting impressions of gorillas referred to their 'gentleness', 'peacefulness' and 'tranquillity'.

> *They're such gentle creatures actually, it's important for people to know that.* (Jim, interviewee).
>
> *Ah the tranquillity of them! It's amazing, so calm and composed, wow.* (Margret, observed in the forest).

These perceptions may be of great importance in maintaining the momentum of support for the gorilla as an ambassador for conservation and reinforce existing understandings of people's preferred animals as discussed in the previous chapter (Dietz, et al. 1994; Kellert 1980; 1985; Ryan and Saward 2004). In reality however, according to Ryan's (1998) continuum

of preferred animals based on perceived safety and danger and the degree of human similarity, the gorilla should sit between the axes of 'human oriented', and 'dangerous' (Figure 5.2).

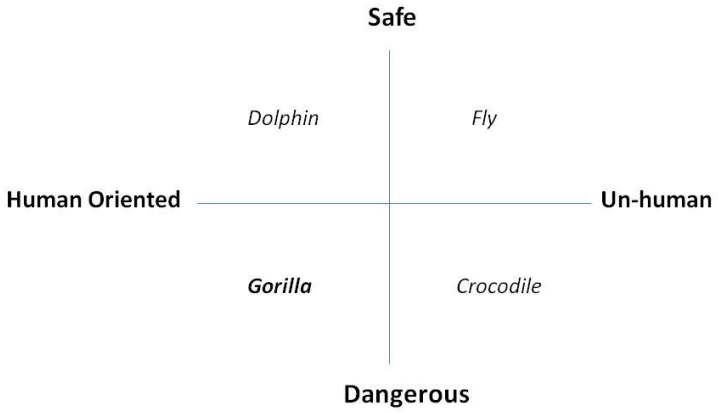

Figure 5.2. Ryan's (1998) continuum of preferred animals based on perceived safety and danger and the degree of human orientation. The gorilla lies between 'dangerous' and 'human oriented'.

The element of perceived danger was not reflected in the discourse or behaviour of the gorilla tourists in this study. I propose that this constitutes a problem. As Mullin and Marvin (2001) state, "representations have consequences for living animals because of the ways they frame the encounters that humans have with them" (P3). Whilst some gorilla tourists were respectful of guiding rules and advice whilst visiting gorillas, a great number were not and approached the gorillas as though they posed no threat. Apparently, therefore, somewhere along the process of constructing 'habituated gorillas', a tension has emerged in the tourism experience, where tourists' desire to see 'original', 'authentic', wild gorillas in their natural environments, but in reality, do not know how to behave in the gorillas' environment and continue to 'consume' and observe them as they would in a human-controlled environment such as the zoo. It would be easy to attribute this behaviour to human arrogance; the assertion that we can dominate any interaction with animals. However, my observations of tourists suggest that it is more to do with a lack of education about the process of habituation combined with unrealistic expectations from the media and perpetuated stories and images from the tourists themselves.

The lack of exposure of the general public to the role of habituation in human-animal encounters was highlighted to me vividly after leaving the field, at a conference about gorilla tourism. A renowned gorilla expert, Ian Redmond, gave a keynote speech describing how he held the microphone and positioned the film crew around David Attenborough whilst filming his famous 'gorilla-moment'. A participating academic anthropologist interrupted the speech to

state that "*Ian, you've ruined that entirely for me. I had this image of David stumbling across the gorillas and setting up a tripod to film himself, I hadn't acknowledged that it was set up by a whole crew of people!"* He had apparently assumed that the 'wild' gorilla would have been naturally gentle and accepting of humans, an interesting construction which may be influenced by such documentaries and films.

This misperception may demonstrate how tourists' construct the images they wish to see, built on interpretations and experiences that Wang (1999) argues are part of the human constructivist perspective of authenticity. With regards to the various definitions of 'authentic' however, whilst the gorillas are real, wild animals, habituated gorillas are neither unadulterated nor free from the influence of human activities. Years of habituation has tempered their natural reactions to humans and their interactions with other unhabituated (or unadulterated) gorillas and other wildlife. Does habituation mean the gorillas are less 'authentic'? Apparently for gorilla tourists, habituated gorillas are a close enough representation to the 'wild' they seek, perhaps mostly because they retain their freedom and are therefore critically different to zoo gorillas. Perhaps it is the fault of the attraction providers, for inadvertently misleading tourists into a convenient ignorance, thereby perpetuating their quests to embody romantic ideals of convening with the 'wild'. As Cohen (1998) states, in this sense, if tourists empathically experience the toured objects (gorillas) as authentic, then, their viewpoints are real in their own right.

My research reveals therefore, that gorilla tourists acknowledge, or understand little or nothing about habituation. This finding leads me to suggest that although gorilla tourists perceive the experience of encountering habituated gorillas as fully authentic, based on the premise of seeing wild animals unrestrained in their environment, actually, this type of encounter with habituated animals lies between fully authentic and semi-authentic, as the aspect of habituation adds an element of staged authenticity to the interaction.

5.2.3. Photographic dimensions of gorilla tourism

The final major theme that emerged from analysis of my socio-cultural data was the significance of photography as a theme that underscores and links with many of the concepts of behaviour and discourse I have so far identified from my encounters with gorilla tourists. Whilst coding data recorded after tourists' viewings, I found more than 150 references to photographic incidences in the discourse which illustrate important concepts within this theme. I have chosen one particular diary entry below, which, although extreme, I felt most accurately represents a

number of these key, emergent concepts which frequently arose in relation to gorilla tourists' photographic habits.

In the following entry I describe my observations of a couple 'Fred and Peggy' who were grouped with, another man, 'Francis', during their gorilla trekking visit.

> *The minute I indicated that we had arrived near the gorillas Fred became apparently anxious to get all his equipment out, started sweating and heavy breathing and got snappy with his wife Peggy. They both started arguing about who would hold what equipment. The gorillas were completely spread out today - it was incredibly hard to find them but for a period of time we were quite close to Bokata [juvenile female gorilla] so they had a great view of her eating termites: however the rest of the group was moving quickly, so we had to keep moving to keep up. Fred had a huge video camera with him, it looked like professional equipment and Peggy had a huge SLR with at least a 400mm lens, and was constantly complaining that she couldn't get the settings right. I asked her at one point if it was a new camera, which seemed to aggravate her greatly, snapping at me: "No, no, not so new, not so old either. I just can't get the settings right for this flippin' dark forest". Had I been inclined, I couldn't offer advice as I needed to keep my eyes on the gorillas and Fred, who was wandering off towards a gorilla behind a bush as we spoke. She proceeded to spend a huge amount of time fiddling with the camera and actually missed seeing most of the opportunities I was attempting to point out, which the trackers seemed amused by too, saying "alla baa aebobo ape!"... [literal translation from Sango, 'they don't see gorillas']. She was constantly asking Fred how to work the camera, and then even started asking Francis another member of the group about her settings, obliging him to become engrossed in helping her fix her camera too.*
>
> *I found it hard to keep them all together today, especially with Fred's tripod and camera as he had to set it up each time we stopped and then looked tired and angry, 'humphing', each time we had to move to keep up with the group. I was finding myself getting rather annoyed as they were making such negative comments about the gorillas moving all the time, Peggy complaining that "I haven't made a single shot yet", and Fred turning to me to inform me that "this is not good for photography, not good at all", shaking his head and looking angry, as if it were my fault. I agreed that it is very hard, and tried to remind them of my warning during the briefing, after seeing their mountain of photographic equipment, that "nothing is guaranteed, its dark and they must be patient", but as ever, that just immediately went out of the window upon arrival with*

the gorillas. I tried providing information about the gorillas and their behaviour, - as much as I could as we were following the group - however they were all so engrossed in taking pictures I really felt like I was just talking to myself. I counted nine times that I had to verbally remind Fred and Peggy to keep back from the gorillas, and once, having been clipped around the ankles by Fred's tripod as he darted past me towards Makumba [the silverback], I had to physically pull him back using his backpack. He was shocked by this, I didn't care, and the trackers found this hilarious. Peggy rudely indicated to me once to get out of her shot, expressing that "I just want one photo without your back in it", and thoroughly upset Francis, who was being pushed out of the way at each opportunity, to the point where he snapped to Peggy "I'm entitled to one shot too OK!" I continued to bite my tongue and hold my ground in front of them as best I could but was being constantly pushed, as were the trackers so I tried to support them and remind them not to be pushed too, bearing in mind they long ago equated these strange westerners' generosity in tipping to their photographic satisfaction.

The final straw came when Makumba started to climb down a tree he'd been feeding in, and they rushed to the bottom of it to set up their tripods. I firmly asked them to move back as they were crowding the spot where he would need to land, but as is typical of tourists with a camera attached to their eye, all sense of hearing and comprehension go out the window. By the time they decided to acknowledge me and make actions to move back with their cumbersome tripods Makumba had descended and side-charged us, throwing a broken vine in our direction. I absolutely didn't blame him, just wished he had a more accurate shot. Peggy shouted at him to 'turn around' so she could capture his rage and no-doubt proximity, at which point I called time and told them we would be heading back to camp.

Back in the tourist paillotte I allowed my anger to subside and approached the couple for an interview. Given our recent forest experience, I firstly asked if they would have come if they couldn't take photos, to which Fred promptly responded: "Not a chance, I've come all the way from America, I wouldn't do that if I couldn't take pictures". Peggy shook her head, and said: "For us, the whole reason we do this is to show it to others, we make a film or slide-show and get our friends over to show them when we're back. We've been doing this for 25 years now, we wouldn't do any of it if we couldn't film it to share with people afterwards - it's a long way to come just to see them

if we can't film, and I think you'll find most people would say the same". I didn't have the energy to disagree and couldn't help feeling a bit sorry for their neighbours.

Peggy and Fred's assertion that they would not come or would certainly not have travelled so far if they could not take photos was echoed by 55 % of interviewees. Russell and Ankenmann (1996) note that this is a common phenomenon in today's visual society, where many people would find it unacceptable to travel just for pleasure without taking some sort of visual aid with which to observe and capture images.

...all my friends have good photos of gorillas from their visits you know. It's what we do in the modern age, of Facebook, it's the modern culture to document your adventures, blogs etc, and so for years after you can bring back the memories. (Jim, interviewee).

I've been all over Africa and got photos of everything. It would be like having a book with a chapter missing if you said to people you've been to see gorillas but not got the photos. (Mat, interviewee).

With this philosophy photography becomes less an illustration of one's level of artistic tendency and more an act of mimicking other photographers, ticking-off lists and providing evidence to support constructions of adventurous personalities. However, some respondents use their lack of photographic dependency to again separate themselves from 'the norm', exhibiting somewhat of a 'been there, done that' attitude which affords them a superior stance over novice tourists, the mass-herd, who are apparently more dependent on props as a means to experience and/or capture their experiences:

Normal, regular tourists might not [come if they couldn't take photos], it's probably more necessary for them, but we've travelled a lot, we just need the memory. (Shirely and Pete, observed in the forest).

Tourists were also evidently gathering evidence of their 'emparked gazes', frequently manoeuvring themselves into positions to have a photograph with themselves and a gorilla in the background.

...well that photo [women with gorilla] is proof! It's something not many people do so we want to show we have! (Debs, interviewee)

I would want them to show people I was there, it was me who took the photos, I did it. (Barbara, interviewee)

Lemelin (2006) suggests that wildlife tourists select tourism destinations based on the potential of meeting their needs and expectations which, at the micro-scale of personal preference, are influenced by anticipation of landscapes, different from those customarily encountered. These wished-for places are constructed socially, for example via romantic notions of wilderness and pristine Africa and are reinforced by people's specific motivations and values. They are also predisposed by what Lemelin calls the 'meso-scale' of people's everyday experience, which can include the influence of friends and family. Such relations may share similar interests and desires, and expect to be provided with evidence with which they can share their friend or relative's trip.

On occasion tourists asked the BaAka to take-off their 'western' apparel for a photograph. Authors such as Butler and Hinch (2012) and Richards and Hall (2000) discuss at length the various interactions between indigenous peoples and tourists in search of authentic images, matching romanticised constructions of how indigenous people should live, which for the BaAka is apparently without influence from the west and close to nature.

> *I think we came really especially to see the gorillas - but I am also very interested in the pygmies, I really like pygmies they live so simply and without all our crap.* (Steve, interviewee).

> *I think mostly we are looking for a place that is really untouched, somewhere that is healthy, untouched by people or western impact, few people, or just people who are at least living alongside or trying to fit in alongside nature.* (Fran, interviewee).

The desire to see 'Pygmy people' is often quoted among tourists as a key 'attraction' for tourists coming to the area, and is highly representative of the basic tourist perspective that Little (1991) described of how people categorically lump together wildlife, landscape and primitive people within the discourse framing tourists' spectacle and gaze.

The role of the Pygmy people, or BaAka, in the habituation and maintenance of contact with gorilla groups for tourism is absolutely fundamental. The project would not exist without them. I often noted the irony, however, of how the role of the BaAka and other local peoples has unfolded to enable tourists to view gorillas, and in this sense, how it is highly reminiscent of colonial structures which reinforce problematic cultural hierarchies. That is, previously, 'westerners' colonised Africa and either enslaved or employed Africans to help them find and kill wildlife for fun and for trophies. Pygmies were sought-after for their skill at hunting and were often sourced and controlled by Bantu Africans who could communicate better with the

white hunters. Now, westerners arrive at their chosen gorilla tourism sites, are greeted and guided by Bantu Africans who are guided by pygmy trackers, (who I often considered as the 'gateway to the gorillas') and who have little or no interaction with the tourists.

During my research, tourists would seek clearer views for photography by frantically, even verbally, willing the gorillas to travel into forest openings called *bais* as illustrated by the following diary excerpt:

> *They [the Germans] kept asking me ... 'do you think he [the silverback] will take them into the bai? Are we close to a bai?' Thankfully, the group did go. They [the tourists] were so happy the man kissed me on the cheek, gave me big thumbs up, turned to his wife and giggled with excitement. Personally, I find their [gorilla] behaviour in the bais comparatively unvaried and boring, the light is harsh and half their bodies are obscured by keyeye (a reed plant), but I guess the image looks like the brochure, or the standard images of mountain gorillas in the open amongst green vegetation. A good lens would give the impression that you may have been sat next to them too.*

The promotional leaflet for the DSPA and gorilla trekking shows the silverback Makumba sitting in a *bai*, a habitat which looks similar to that of the mountain gorillas, in full bright light, rather than in the darker forest. Whilst it is important for the business operation of the site to appeal to tourists' notions of romanticism, the behaviour based on unrealistic constructed expectations such as those perpetuated by the project's promotional literature may also create a tension between conservation ideology and the demands on the attraction. Referring again to Knight (2006), one of the greatest challenges of tourism sites is to balance the provision of an authentic wildlife experience with the demands of practicing conservation. A more accurate image might go some way to reduce inappropriate behaviour or disappointment resulting from false expectations.

For many respondents, photographs were clearly trophies, collected in the way that hunters collect heads or horns:

> *I was fascinated with Africa and knew I had to go there. Eventually in 1978 I went on my first trip to east Africa, and did safaris, and it happened all over again, I was hooked ... and you know now, I do something like a sublime way of hunting....taking photos for my collection, it's the same but I don't hurt the animals!* (Paul, interviewee).

Some respondents seemed less bothered about the quality of their photos, and said they would be happy with just 'anything' and to see the rest with their eyes, as seeing it through the lens detracts from this experience, or can result in missing key moments completely.

One woman explained her position describing her first sighting of a whale:

> *I had two seconds to decide if I wanted to reach down and get my camera, or just see it ...or miss it, I'm so glad I saw it I have it in my head forever - my first whale!* (Jenny, interviewee)

Other tourists found greater pleasure in viewing the gorillas through their lens, arguing that it improved the details of their gaze:

> *I don't feel at all stressed out by taking photos, and actually I use my lens as a bit of a binocular, if I didn't have this I would be using binos' to see them better, so just to take photos while I'm looking isn't a problem for me, I enjoy it.* (Toby, interviewee).

A man whom I had previously observed in the forest and who had been quite pushy with his photographic demands explained to me that his camera provides him with a way to interact with people and places in a way that wouldn't otherwise be acceptable:

> *It's my way of interacting with the animals and people I see, I also like looking at the details, and having the camera there gives me a reason to do so ...*
>
> [He then got up and came round to me, leaning in to my face as if holding a camera, and said ...]
>
> *... if you were some little old Chinese lady with all your teeth falling out and I was interested to look at you, I couldn't just come up and stare at you, but if I had my camera it's something people understand and respond to ... it's my way of seeing these things and getting all the expressions and details.* (Mark, interviewee).

In this way photography can act as a tool, a medium used to get closer to a subject. In the context of wildlife tourism, however, this is a problem which is currently little explored, as, for example, over 80 % of incidences I recorded of tourists approaching gorillas inappropriately were while they were taking or attempting to take photos. It was my impression that for many, the camera in front of the face represented a justification for ignoring instructions, and became a magic barrier that would protect them against potential aggressive gorilla responses.

It was interesting, however, that for a few, getting closer to take photographs provoked the impression that they were taking something away from the gorillas, as a kind of theft or intrusion:

> *I felt like I didn't want to get so close to them, if you intrude like that to take photos I would feel like it's taking away something from them, it's wrong.* (Tatiana, interviewee).

For one respondent, however, photography provides him with analgesic properties:

> *You know, photography for me, it's like, when I take pictures, all my pain goes away.* (Ken, interviewee).

A few visitors suggested that they would have been happier if told they could not take pictures, implying that they would welcome the excuse to put the camera down and escape the pressure from others to capture their experiences photographically:

> *I would happily leave my camera behind; I would feel relieved and not feel that I should get a photo of everything that happens and just enjoy being there!* (Sue, interviewee).

> *... yes I would [still come if I couldn't take photos], I just try to take photos, just to have one or two nice ones, but within one hour it's so short, that sometimes I have the feeling that I'm just wasting time trying to take photos rather than just enjoying it and seeing everything. It's nice to have them to show other people and to remember it by, but other people know that you've gone to see gorillas and will ask you about it, and you must have something to show people, - almost like a competition*. (Tina, interviewee).

The majority of this type of response came from the opportunistic visitor group which I would suggest may relate to the opportunistic nature of their being at the site. That is to say, it appeared to me that international tourists, mostly the wildlife specific group, generally placed a higher value, or pressure on their need for photos, which may relate to the earlier concept of an investment-reward type of exchange, or perhaps because many of the specialist tourists were aiming to complete gorilla or other wildlife-photo collections.

For others, photos were simply a bonus, a way to spark a memory because the permitted hour with gorillas was considered too short:

> *...One hour with the gorillas is so short, too short to remember properly.* (Janis, interviewee)

However, a number of tourists, even international visitors, said that they would be happy to have a post-card to achieve the same effect:

> *... well I think some people would probably be a little bit upset if they came all this way and couldn't take a souvenir away with them. Yes it's a long way to come not to take photos when you get here, but then it would be nice though even if we could buy a postcard as a souvenir instead though.* (Anne, interviewee)

Only a small number of respondents said they would be happy with nothing at all, happy just to have been in the presence of gorillas, and to recall the original image as seen through their own eyes, as one woman said:

> *....the most important thing is to have the experience in my heart*! (Mary, interviewee).

5.3. Conclusions and conservation implications

This research has revealed some pertinent findings with regards to gorillas and the general field of wildlife tourism. The findings have important implications which point to a widespread need for greater tourist education, perception and expectation management. Bulbeck's (2004) proposition of a 'respectful stewardship of nature' is a useful way to explore the emotive and intellectual elements of wildlife understanding and management and is drawn upon in the following discussion.

Anthropomorphic perceptions of the wild gorilla as human-like, mysterious and rare add to the attraction of encountering and getting close to wild gorillas, but many respondents report feeling ignored and dissatisfied by the lack of expected reciprocal eye-contact with the subjects of their gaze, especially those who have previously visited mountain gorillas. The fact that few others have had, or will have, such an experience is an important motivation, and is apparently used by tourists to distinguish themselves from other novice tourists who may not be as connected to nature. For many, the lack of mass-tourism at the site also adds to their notions of the site as the 'real, pristine, Africa', which bolsters constructions of themselves as more 'enlightened', tourists. A strong contrast between the negative constructions of zoo gorillas and the more positive, romanticised notions of wild gorillas is important in tourists' perceptions of an authentic wildlife experience. Ignorance of the process of habituation seemingly perpetuates a perception of the habituated gorilla as 'gentle' and 'tranquil' and may influence tourist behaviour towards them.

Finally, photography emerges as a major theme which significantly intertwines among the many tenets of the gorilla trekking experience. Photographs are gathered as evidence to prove achievement of making the trip, or of particular moments within it to others, particularly getting close to gorillas. The wish to add to, or complete, photographic collections as trophies is frequently expressed, and photographs are also proof of a person's photographic prowess, or important as a tool for recording memories to share with peers. Frequently, photographs are regarded as souvenirs, expected in exchange for the price of the experience. Overwhelmingly, however, photography is important as a way to interact with the environment in ways that combine with an anthropomorphised perception of the gorillas. These perceptions lead to a lack of understanding of the gorillas as a potential threat to tourists' personal safety and may evoke inappropriate behaviour. The identified motivations for practicing photography amongst tourists evidently cause pressure, stress and distraction both directly and indirectly on tourists and gorillas. Efforts to capture shots are frequently the cause of intrusive behaviour and negative social dynamics amongst staff and visitors. Most importantly, photography emerged as the single greatest cause for disturbance of, and subsequent aggressive reactions from, gorillas.

For many in predictable urban environments, nature is no longer dangerous or powerful (Asquith and Kalland 1997). Animals have been reduced to characters of amusement and ridicule like the children's TV characters 'Skippy' the kangaroo and 'Flipper' the dolphin, which no longer demand our respect (Turner 1996). Anthropomorphic attributes of wildlife can be valuable in drawing our attention to matters of environmental concern, but as Bulbeck (2004, P182) states, "if we have learned to treat other humans as instruments of our satisfaction, it is little wonder that many of us treat animals the same way". In these ways, the danger exists for "wildlife tourism to degrade from the gaze into a 'gawk', a form of entertainment or a quest for collectables, which encourages the more consumptive aspects of tourism" (Lemelin 2006, P531). However, rejecting anthropomorphism, or encouraging 'anthropodenial' in the context of wildlife tourism may prevent the interested parties from making important connections with animals that could enhance their understanding of, and empathy for them in mutually beneficial ways (Burns 2004). Many links have been made between anthropomorphism and conservation (e.g., Mitman 2005). Further, the evidence so far does not suggest that anthropomorphic interpretations of animal discourse detract from informative messages conveyed by wildlife tourism management (Burns 2004). Within the context of human-gorilla interactions, the notion that they are human–like may encourage people to get closer than advised as they do not smack so much of dangerous otherness. However, if tourists remain unaware of the pivotal role of habituation in facilitating their gorilla interactions, they will remain ignorant and unaffected

by the complexities of the conservation initiative in which many appear interested. Further research into such perceptions is needed.

"There are no wilderness areas left in the world; all is touched in some way by human intervention, and given that this situation is irreversible, there are no options other than to manage the natural world" (Bulbeck 2004, P11). The ideal of sustainable tourism is to lead to positive action for the natural environment by fostering awareness of conservation and appreciation for the resource (Dowling 1993). Avoidance of wildlife disturbance is a critical aspect of wildlife tourism management (Curtin 2010; Curtin, et al. 2009). Many studies have demonstrated that close proximity and eye-to-eye contact are central to a positive tourist experience (Schanzel and McIntosh 2000; Pearce and Wilson 1995; Curtin 2010), and the present study identifies that photography has a key role in perpetuating motivations that drive these desires, but equally results in undesirable wildlife disturbance. Photography appears more important for the foreign travellers, but a small group of 'more experienced or specialist tourists, however, seem to be pioneering a move towards a more 'enlightened' wildlife tourism ethic, illustrated by those who claim no photographic or other dependencies on the wildlife they watch, and who appear to wrestle with their conscience about visiting wildlife in these contexts. As one of Curtin's (2010) respondents suggests, "when an animal looks at you, it is a change to its normal everyday behaviour, as you are not normally there, and therefore, it is being disturbed". The challenge, therefore, is to 'respectfully steward' this type of eco-message in the minds of all tourists, that actually, "it's far better if the wildlife does not look at you" (Curtin 2010, P164).

Demand for rare wildlife encounters suggests that it is not necessary to tolerate the type of behaviour tourists exhibit as a result of their photographic needs; thus regulations should be devised to control the negative physical and psychological impacts of these on the wildlife. My findings indicate that in this case, the focus of the regulations should be on the wildlife specific international travellers. I refer to this distinction between specialist and opportunistic tourists again in Chapter 9, but for the purposes of the current discussion these distinctions do not add further insight. It might, however, be a useful way to explore the after-effect of tourists' gorilla interactions on their conservation ethics and behaviours. I discuss this topic briefly in Chapter 10 but it warrants greater attention in future research. Part of the problem of wildlife disturbance by tourists is that tourists are simply not aware, and if respect for the wild and wilderness is no longer inherent among the people that seek to experience wild

animals in wild places, it must become the duty of wildlife tourism managers who offer such interactions to ensure and regulate disturbance in other ways.

> *It's important that the money keeps going to the conservation of the species as long as it is strictly controlled. It's not the gorillas that need to be controlled but the people!* (Male, questionnaire respondent).

Chapter 6 - Non-invasive monitoring of physiological stress in the western lowland gorilla (*Gorilla gorilla gorilla*): Validation of a faecal glucocorticoid assay and methods for practical application in the field

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This paper is predominately the work of the first author (KS). KS conceived the experimental design in conjunction with M. Heistermann (MH) and J. Setchell (JS). KS carried out all field work and wrote the manuscript. MH conducted all hormonal analyses and provided expert review of the endcrinological data analyses and interpretation. JS provided supervisory review of the manuscript.

Abstract

Enzyme-immuno-assays (EIAs) allow researchers to monitor stress hormone output via measurement of faecal-glucocorticoid metabolites (FGCMs) in many vertebrates. They can be powerful tools which allow acquisition of otherwise-unobtainable physiological information from both captive animals and endangered wild animals in remote forest habitats, such as great apes. However, methods for hormone measurement, extraction and preservation need to be adapted and validated for remote field settings. In preparation for a field-study of western lowland gorillas (*Gorilla gorilla gorilla*) in the Central African Republic we used samples from captive gorillas collected around opportunistic stressful situations to test whether four different glucocorticoid EIAs reflected adrenocortical activity reliably and to establish the lag-time from the stressor to peak excretion. We also validated a field extraction technique and established a simple, non-freezer-reliant method to preserve FGCMs in extracts long-term. We determined the rate of FGCM change over 28 days when samples cannot be extracted immediately and over 12 hours when faeces cannot be preserved immediately in alcohol. Finally, we used repeat samples from identified individuals to test for diurnal variation in FGCM output. Two group-specific assays measuring major cortisol metabolites reliably detected the predicted FGCM response to the stressor, whereas more specific cortisol and corticosterone assays were distinctly less responsive and thus less useful. Our field extraction method performed as well as an established laboratory extraction method and FGCMs in dried extracts stored at ambient temperatures were more stable than those at -20C over one year. Hormones in non-extracted faeces in alcohol were stable up to 28 days at ambient temperatures. FGCMs in un-fixed gorilla faeces deteriorated to almost 50 % of the original values within 6 hours under field conditions. We detected no diurnal variation of FGCMs in samples from wild gorillas. Our study highlights the importance of thorough biological and immunological validation of FGCM assays, and presents validated, practical methods for the application of non-invasive adrenocortical monitoring techniques to field conservation contexts where it is crucially needed.

Key Words: Degradation, Diurnal, Extraction, Primate, Storage, Stress

6.1. Introduction

The vertebrate stress response involves the release of glucocorticoids (GCs, cortisol and corticosterone into the bloodstream which, in conjunction with accompanying physiological and (Breazile 1987; Di Simplicio, et al. 2009) behavioral responses, enables vertebrates to cope with threatening or demanding situations. Chronic stress, associated with prolonged periods of elevated GC concentrations, however, interferes with numerous physiological processes critical to individual health and survival, including immune and reproductive function and disease resistance (Muehlenbein 2009; Rivier and Rivest 1991; Selye 1955; von Holst 1998; Wingfield and Sapolsky 2003). It is, therefore, important to monitor and reduce possible sources of chronic stress in the management of captive breeding and the conservation of wild animal populations. Enzyme-immuno assays (EIAs) for faecal glucocorticoid metabolite (FGCMs) measurements have proven highly valuable in this context, as they provide reliable information about FGCM output and thus help monitor physiological stress non-invasively. EIAs are used to investigate the potential links between stress and animal behaviour (Whitten, et al. 1998a), reproductive biology (Lasley 1985; Lasley and Kirkpatrick 1991; Peter, et al. 1996), and animal welfare (Pirovino, et al. 2011; Romano, et al. 2010). They also have important applications for addressing conservation issues (Cockrem 2005; Foley, et al. 2001; Millspaugh and Washburn 2004; Wasser and Hunt 2005).

There are, however, several potential problems associated with the application of EIAs to new species and field settings. FGCM assays must be validated for each species (Bahr, et al. 2000; Heistermann, et al. 2006; Touma and Palme 2005) as must methods to preserve the faecal samples (or the steroid hormones therein) in the field (Ziegler and Wittwer 2005). Additionally, the effects of sampling limitations on the FGCM levels found in faeces [e.g., post-defecation degradation due to aged samples or environmental effects (Mostl, et al. 1999; Washburn and Millspaugh 2002) and diurnal variation in individual FGCM output (Beehner and Whitten 2004; Raminelli, et al. 2001; Sousa and Ziegler 1998) need to be assessed and considered in the final analyses. Thus, the most suitable field sampling protocols for a given study population need to be developed before these techniques can be used to their full potential in wild animal populations (Washburn and Millspaugh 2002).

Most steroid hormones, including GCs, are heavily metabolized in the liver and are secreted through the bile into the gastrointestinal tract before they are eliminated from the body via excretion into the urine and/or faeces (Brownie 1992; Mostl, et al. 2005). Species

metabolise GCs (and other steroids) differently resulting in a wide range of metabolites being present in the faeces (Bahr, et al. 2000; Palme, et al. 1996; Wasser, et al. 2000). Consequently, assays for FGCMs must be thoroughly validated physiologically, biologically and immunologically for each species to ensure biologically meaningful results (Buchanan and Goldsmith 2004; Heistermann, et al. 2006; Touma and Palme 2005). Further, there are substantial differences in the rate of FGCM excretion in faeces between species (Palme 2005). For example, larger bodied primates such as chimpanzees (*Pan troglodytes*) show peak excretion rates after approximately 24 hours (Bahr, et al. 2000) whereas the lag-time to peak excretion in spotted owls (*Strix occidentalis)* is approximately 12 hours (Wasser and Hunt 2005, but for a review see Palme 2005). Knowledge of the delay to faecal excretion is crucial in determination of the experimental setup and biologically meaningful interpretation of assay results (Palme 2005).

In addition to analytical and physiological validation of the assay procedure itself, it is equally important that faecal samples are processed and stored in a way that ensures the stability of hormone levels long-term if it is not possible to extract and analyse them immediately in the laboratory. The gold standard storage method for faecal samples is simple freezing, as this stabilizes levels of FGCMs (and other steroid metabolites) over long periods of time (Herring and Gawlik 2009; Hunt and Wasser 2003; Palme 2005). However, many field sites are in remote locations in developing countries where it is not possible to keep faecal samples at sub-zero temperatures. Researchers have tried to overcome this problem using a variety of faecal storage methods, including preservation in ethanol and/or drying the faeces (Brockman and Whitten 1996; Foley, et al. 2001; Galama, et al. 2004; Hunt and Wasser 2003; Khan, et al. 2002; Pettitt, et al. 2007; Terio, et al. 2002). While some of these methods have proven useful in stabilizing faecal steroids in the short- and long-term in some species, they have proven ineffective in others. One solution to overcome a potential "faecal storage effect" is to extract hormones from the faeces immediately *in-situ*, and to preserve the extracts so that microbial activity - the most likely reason for alterations in steroid levels when faeces are stored in alcohol or dried - is minimized. Various extraction/storage techniques have been developed, but the efficiency of these techniques in extracting the hormones to be measured, and the reliability of the storage methods used to stabilize the FGCMs long-term varies with the species and context (Beehner and Whitten 2004; Freeman, et al. 2010; Pappano, et al. 2010; Santymire and Armstrong 2010; Wielebnowski and Watters 2007). For example, while storing faecal extracts in solid-phase-extraction cartridges is highly efficient for preserving gelada (*Theropithecus gelada*) FGCM levels in for up to three weeks (Pappano, et al. 2010), it results in a decline of FGCM levels of about 80 % within 30 days of storage in faeces from African wild dogs (*Lycaon pictus*)

(Santymire and Armstrong 2010). Field-friendly extraction and storage methods should therefore also be validated for each species and context.

Apart from analytical considerations, field sampling also involves other constraints and challenges which may affect the results of endocrine analysis. For example, it is rare to be able to sample each focal individual equally, or at the same time of day. Moreover, focal subjects may 'guard' their sample for long periods of time before the researcher can collect it without causing disturbance to them or their neighbours, or they may drop their contributions on the side of a high rocky outcrop or into a nest, allowing recovery of the sample only after a delay (K.S. personal observation). Immunoreactive FGCM concentrations may begin to deteriorate or change immediately after defecation if they are not preserved in a suitable fixative (Mostl, et al. 1999; Muehlenbein 2012; Palme, et al. 2004). It is, as yet, largely unclear to what extent this rate of change/deterioration is species-, temperature-, or time-specific. As a result, field sample sets can be limited to fresh samples, or may be affected by an unknown amount of exogenous FGCM variation when the samples cannot be immediately fixed, frozen, lyophilized or dried.

Finally, GC production is linked to adreno-corticotrophin releasing hormone (ACTH) circadian rhythms, where levels peak in the mornings and decline towards the evening (Chung, et al. 2011; Rusak 1989). Steroid hormone levels found in blood serum, saliva, and excreted in urine often demonstrate circadian variation (Coe and Levine 1995; Goodman, et al. 1974; Heintz, et al. 2011; Kalsbeek, et al. 2012; Piro, et al. 1973; Schlatt, et al. 2008), but the effect on FGCM output appears to be species-specific (Beehner and Whitten 2004). For example, (Sousa and Ziegler 1998) cortisol peaks in the afternoon in faeces of the common marmoset (*Callithrix jacchus*), whilst (Beehner and Whitten 2004) there is no detectable effect of diurnal variation in FGCM output in baboons (*Papio* spp.) . Thus, it is necessary to evaluate the extent of distortion that sampling constraints introduce to both ensure the validity of a method, and to account for any rates of FGCM change/deterioration in the final hormone results.

Approximately 95,000 western lowland gorillas (*Gorilla gorilla gorilla*) remain in the wild (Walsh 2008). The species is classified as critically endangered, as a result of the bush-meat trade, habitat destruction and disease (Mehlman 2009). All zoo-housed gorillas are lowland gorillas, and zoo efforts are based on maintaining healthy and genetically-robust breeding populations (Peel, et al. 2005). In recent years, conservation efforts in habitat countries have turned to the habituation of gorilla groups for research and to draw in tourism revenue for conservation. Gorillas are, however, particularly sensitive to stress (McNeilage 1996), meaning that the impacts of methods used to manage, conserve or research populations should be

monitored carefully to ensure that the costs of such efforts to the individuals concerned do not outweigh the conservation benefits. To our knowledge, published information on faecal GC output in western lowland gorillas is limited to only one study (Peel, et al. 2005), using an un-validated cortisol assay and with largely inconclusive results. In preparation for a remote field study of free-living western lowland gorillas at an ecotourism project in the Central African Republic we set out to validate a suitable assay system for monitoring adrenocortical activity in gorillas based on faecal samples, validate a suitable extraction and storage method and to assess the effects of sampling constraints on FGCM measurements.

We tested four different FGCM enzyme-immuno-assays using samples from captive gorillas collected around opportunistic stressful situations (both physiological, and biological). All four assays had been used previously to monitor FGCM output in other primate and non-primate species (Ganswindt, et al. 2003; Heistermann, et al. 2004; Heistermann, et al. 2006; Wasser, et al. 2000). We also developed a 'field-friendly' extraction technique and validated its efficiency by comparing the results of the field method with those of currently accepted laboratory methods. We then conducted storage experiments on faecal extracts to assess the effects of different storage conditions and durations on FGCM levels, to establish a reliable method for long-term preservation of faecal extracts in the field where no freezer is available. Finally, our study required us to compare FGCM measures in completely wild, under-habituation, recently-habituated, and fully-habituated gorillas. This presented us with numerous sampling challenges, as the goal of collecting and extracting adequate fresh samples from identified individuals could only be achieved with the fully-habituated gorilla group, whereas samples from the recently-habituated groups could only be extracted three weeks later. Additionally, and because sampling wild gorillas in thick vegetation is very challenging, we maximized our potential sample size by collecting samples opportunistically at different times of the day.

Finally, samples from groups under-habituation, and non-contacted, 'wild' gorillas were only available from their nests (usually defecated at around 05.30 am), which could take several hours to locate each day, or from opportunistic contacts. In order to have directly-comparable data-sets, we conducted experiments in the field to: determine the rate of FGCM change over 12 hours after defecation when faeces are not preserved immediately in alcohol; test whether FGCM concentrations alter as a function of storing faeces for one month in alcohol under tropical conditions (e.g.,Hunt and Wasser 2003; Khan, et al. 2002; Lynch, et al. 2003) and

whether FGCM measurements in repeat samples from individuals varied between morning and afternoon samples.

6.2. Material and methods

6.2.1. Animals and sample collection

We asked ape keepers from three UK zoos to collect faecal samples from captive gorillas prior to six opportunistic routine veterinary and breeding management interventions that we predicted would be stressful for the gorillas. We obtained samples from two males around three medical examinations (n=2) and relocations between zoos (n=2) and from a female around her social integration with two unfamiliar, but already bonded, females (n=1) and later as a new silverback male joined all three females (n=1). For medical examinations and relocations a veterinarian anaesthetized the gorillas with mass-dependent doses of a combination of Zoletil (Virbac, France; a fixed-ratio combination of Zolazepam and Tiletamine) and Zalopine (Orion, Finland; Medetomidine). The procedures associated with anesthesia (isolation, darting) are considered to be a physiological stressor for the animals. Anaesthesia was not required for the social integrations, which involved social stress, and all animals were housed in their usual social groups, except when the various 'treatments' required short periods of isolation. The animals continued to receive a normal diet consisting of fruits, vegetables and leaves and water was available *ad libitum*.

Keepers collected faecal samples (range 1-15) for 1-6 days from each gorilla prior to exposure to the potential stressor to establish a pre-stress baseline FGCM level, and continued to collect samples for 3-9 days after the stressor to establish the FGCM response. During post-stress periods, the keepers collected all available samples including samples defecated overnight, noting any evidence of urine contamination. Faecal samples were stored at -20°C within 1 hour of collection.

Samples for our site-specific short-term storage, hormone degradation and diurnal variation controls were collected under completely natural field conditions. Sample collection took place between November 2010 to December 2011, at Bai Hokou study site Bai Hokou (33 N 663109, 316187UTM) in the Dzanga-Sangha Protected Areas in the Central African Republic. For a more detailed description of the study site see Carroll (1986b). We worked with local BaAka trackers employed by the World Wildlife Fund (WWF) to collect opportunistic faecal samples from different groups of gorillas. We collected samples as soon as possible after defecation, noting any evidence of urine contamination.

6.2.2. Validation of FGCM measurements

We tested the ability of four different glucocorticoid assays to detect an increase in the gorillas' FGCM output in response to potential stressors: cortisol (CORT), corticosterone (CCST) and two group-specific enzyme-immunoassays against 5-reduced cortisol metabolites with a 3α,11ß-hydroxy (3α,11ß-dihydroxy-CM and 3α,11oxo structure (3α,11oxo-CM). (1995; Ganswindt, et al. 2003; Heistermann, et al. 2006; Mostl and Palme 2002; Palme and Mostl 1997)

Faecal samples were shipped frozen to the endocrine laboratory of the German Primate Centre where we processed and extracted them as described in Heistermann, et al. (2004). Briefly, we lyophilized and pulverized the faeces and extracted an aliquot representing 0.05-0.08 g of faecal powder with 3 ml 80 % methanol in water by vortexing for 10 minutes. Following centrifugation of the faecal suspension, we recovered the supernatant and stored it at –20°C until analysis. We analyzed faecal extracts for FGCM immune-reactivity using the four different EIA systems described in (Heistermann, et al. 2004; Heistermann, et al. 2006). Intra- and inter-assay coefficients of variation (CVs) of high- and low-value quality controls were <10 % and <13 %, respectively, for all four assays.

We performed reverse-phase high performance liquid chromatography (HPLC) to assess the pattern of metabolites measured and to characterize the specificity of the four GC assays tested. We chose a faecal extract from a male with a peak in FGCM output in response to stress of relocation and carried out HPLC using the procedure described in Heistermann, et al. (2006). HPLC also allowed us to evaluate whether the FGCM antibodies co-measured faecal androgens which can also be detected by antibodies raised against cortisol metabolites (see Ganswindt, et al. 2003; Heistermann, et al. 2006; Mostl and Palme 2002). We measured each HPLC fraction in all four FGCM assays to generate profiles of immunoreactivity.

6.2.3. Experiment 1: Testing a field-friendly method for hormone extraction, and long-term preservation of faecal extracts

We compared two extraction methods using samples (n=29) collected for the FGCM assay validation tests from the two males who underwent anaesthesia for medical examinations. We asked keepers to homogenize each sample well and to split it into two before freezing at -20°C. One set of samples was shipped frozen to the endocrine laboratory for processing using the laboratory extraction procedure described above ("laboratory extraction"). We incubated the other set in an oven at 40°C for 30 minutes until thawed, then mixed it again thoroughly using a spatula. We then weighed 0.5 g of wet faeces into a 15 ml polypropylene

tube (PPT) containing 5 ml 90 % ethanol and carried out a field-friendly extraction method ("field extraction") based on the procedure described in (Ziegler and Wittwer 2005). We shook the faecal-ethanolic suspension horizontally by hand for 5 minutes and allowed the faecal sedimentation to settle for 30-40 minutes standing on a bench. Following the separation process, we pipetted 1 ml of each extract into a 2 ml PPT and stored it at -20°C until shipment to the endocrine laboratory for GC analysis. We established FGCM content for extracts generated by both methods using the two group-specific GC assays, as they were deemed the most suitable for monitoring FGCM output during validation testing (see section 4.1).

To test preservation of GCs in faecal extracts under different conditions for periods of between one month and one year we extracted 0.5 g of wet faeces (n=12 samples, 6 for each sex) using the "field extraction method" (but using a centrifuge to separate the liquid from the faeces). We then divided the faecal extracts into 5 aliquots. We stored three 0.65 ml aliquots as liquids and dried two 0.2 ml aliquots overnight at 50°C. We subjected the aliquots to the following 5 conditions: i) storage as liquid in PPTs (Sarstedt 2.0ml safe-seal micro tube neutral flip cap Poly Propylene) at room temperature (RT, 21-23°C); ii) storage as liquid in a glass tube (75x12 mm) at RT; iii) storage dried in PPT at RT; iv) storage dried in a glass tube at RT and v) storage as liquid in a PPT at -20°C. We closed the glass tubes with fitted caps and wrapped all tubes (glass and PPT) with parafilm to minimize risk of evaporation. We determined FGCM levels for each sample immediately after extraction ("Time-0") and repeatedly after 1, 3, 6, 9 and 12 months of storage for each condition to assess any potential storage type- and time-dependent effect on FGCM stability. We determined FGCM content using the two group-specific assays. For this experiment, inter-assay CVs of high- and low-value quality controls determined over the 12 months of analysis were 7.4 % (high) and 14.2 % (low) for the 3a,11ß-dihydroxy-CM assay and 12.7 % (high) and 11.5 % (low) for the 3a,11oxo-CM assay.

6.2.4. Experiment 2 - Testing short-term storage of faeces in alcohol under field conditions

We collected large faecal samples (n=10; 8 animals) directly after defecation and homogenized them well. We split the faeces into 15 portions of ~0.5 g and placed them in 4 ml 90 % ethanol within 5 hours of collection. We extracted one portion immediately as described above ("day 0") and extracted the remaining 14 aliquots every other day until day 28. Following each extraction, we pipetted 0.5 ml of supernatant into 2 ml PPTs and evaporated the liquid by putting the tube(s) into a transparent fish-steamer placed in a light-reflective basin in the sun (an additional drying-down step based on the ideas of Terrio, et al (2002) and Galama, et al

(2004). Sample extracts dried within a range of 1-3 days depending on the amount of direct sunlight. We kept dried samples at ambient temperatures in the dark until shipment to the endocrine laboratory where they were kept at -20°C until analysis.

For analysis, we reconstituted samples in 0.5 ml 80 % ethanol in water by sonication in a water bath for 5 minutes, followed by 30 seconds vortexing. We analyzed reconstituted extracts for FGCM levels using the 3a,11ß-dihydroxy assay. Inter-assay CVs for these measurements were 6.8 % (high value quality control) and 13.2 % (low value quality control).

6.2.5. Experiment 3 - Testing post-defecation FGCM change in un-preserved faeces under field conditions

To test whether FGCM levels in faeces change as a function of the time between defecation and sample preservation in alcohol, we collected 10 large fresh faecal samples (from 7 animals) immediately after defecation and homogenized them well. We placed ~0.5 g of each sample in a tube with 4 ml 90 % ethanol whilst still in the forest to act as the time-0 sample. We left remaining faeces at ambient temperature (on the ground exposed to air but no samples were subjected to rain) and removed and preserved an aliquot (~0.5g) in alcohol every two hours until 12 hours after defecation. Thereafter, we extracted each sample and dried down 0.5 ml from each sample in 2ml PPTs as described above. We kept dried extracts at ambient temperatures in the dark until shipment to the endocrine laboratory for FGCM analysis using the 3a,11ß-dihydroxy assay. Inter-assay CVs for these measurements were 6.8 % (high value quality control) and 13.2 % (low value quality control).

6.2.6. Experiment 4 - Testing for diurnal effects on FGCM levels in faeces

To test for a potential diurnal effect in excretion of FGCMs, we collected 15 pairs of morning (07:00 - 09:35) and afternoon (13:45 – 16:05) samples from eight gorillas. We put ~0.5g wet faeces of each sample into 4 ml 90 % ethanol, and subjected each sample to the field extraction procedure described above within 24 hours of collection. We kept dried extracts at ambient temperatures in the dark until shipment to the endocrine laboratory for FGCM analysis using the 3a,11ß-dihydroxy assay. Assay CVs for these measurements were <5 % for both high and low value quality controls.

6.3. Data analysis

All hormone data are given as mass hormone per mass faecal wet weight, except for the validation tests, where we used lyophilized samples for extraction. FGCM levels in samples

where urine contamination may have occurred did not differ obviously from adjacent uncontaminated samples so we used all samples in the analysis. To evaluate the correspondence between FGCM levels in extracts generated by the laboratory and field extraction method, we calculated the Spearman rank correlation coefficients for the set of samples tested.

For Experiment 1, we calculated the percentage change in FGCM levels for each of the five storage conditions and each storage duration (1, 3, 6, 9, and 12 months) as $(a_n\text{-}x_n)/x_n*100$, where a_n is the nth sample value in each condition/duration and x_n is the value at time point 0 of the nth sample. To analyze the overall main effects and possible interaction of time and condition on FGCM changes we first fit a General Linear Mixed Model for Repeated Measures (GLMM-RM), with the best fit based on AIC Selection Criteria (ASC). The final model used unstructured variance and log-transformed FGCM values, as variance in the original values was high and not-normally distributed. We treated the repeated measure variable of "Time" as categorical, assuming variance from day 0. Following this we ran pair-wise comparisons on each condition separately using the fitted GLMM-RM model with post-hoc comparisons using Bonferroni tests. We again treated the variable "Time" as categorical assuming variance from 0 to locate where FGCM levels significantly differed from day 0 values. We also carried out Spearman rank correlation tests to investigate whether FGCM concentrations in extracts stored for 12 months (the maximum period of storage) in the various conditions correlated with the control values measured directly after extraction. Finally, we calculated the coefficient of variation (CVs) for each of the 12 samples across the six measurements conducted over the whole experimental period for each condition and took the mean to assess how variation in sample values varied as a function of storage duration (which includes inter-assay variation) compared with inter-assay variation for our quality controls.

For Experiments 2 and 3, we calculated the percentage change in FGCM levels relative to time 0 values or each of the extraction time points within each sample set as described above. We analyzed changes in FGCM levels as a function of short-term storage in alcohol (Experiment 2) or lag time between defecation and preservation of the sample (Experiment 3) using Friedman Repeated Measure ANOVA on ranks with post-hoc analysis using the Wilcoxon signed rank test where applicable. We also calculated Spearman rank correlation coefficients to determine whether FGCM values in faeces stored in alcohol for 28 days (the maximum storage duration tested; Experiment 2) and samples left for 12 hours at ambient temperature before preserved in alcohol (the maximum delay to preservation tested, experiment 3) correlated with

the control values irrespective of possible change in absolute hormone levels. In Experiment 3, we eliminated two outlier values (≥3.5 standard deviations above the mean of all other samples) from the dataset before analysis. Finally, for Experiment 4, we tested for a potential time-of-day effect on FGCM levels by comparing levels in the paired morning and afternoon samples using a paired t-test.

All statistical tests were conducted using SPSS v17, were two-tailed and we considered results significant when $p \leq 0.05$.

6.4. Results

6.4.1. Validation of FGCM measurements

The highest levels of faecal FGCMs were measured by the two group-specific cortisol metabolite assays (peak value range: 0.90-3.95 µg/g; Table 6.1) with those measured via the CORT and CCST assays being generally much lower (peak value range: 0.02-0.25 µg/g; Table 6.1). In all six cases, animals responded to the potential stressful event (medical examination/transport/social stressor) with an increase in FGCM levels (Table 6.1). However, the magnitude of response differed clearly across the four assays. Whilst the CORT assay showed no clear response in most cases and the CCST assay showed only a moderate response overall (Figure. 6.1), both group-specific assays showed a marked FGCM elevation in five of the six cases. In all six cases, the 3α,11ß-dihydroxy-CM assay showed a stronger response to the stressor than the 3α,11oxo-CM assay. The timing of FGCM peak elevation varied between cases and assays, but was more consistent for the two group-specific assays than for the more specific ones (Table 6.1). Peak response was usually detected between 43 and 68 hours after the stressor and FGCM levels had usually returned to pre-stress baseline levels by day 5 (Figure. 6.1).

Table 6.1. Faecal glucocorticoid concentrations (as detected by four different assays) in response to various types of stressors in individual lowland gorillas.

Table 1: Fecal glucocorticoid concentrations (as detected by four different assays) in response to various types of stressor in individual lowland gorillas

Animal	Stressor[c]	3α, 11ß-dihydroxy-CM				3α, 11oxo-CM				Cortisol				CCST			
		Pre[d]	Peak[e]	Delta[f]	Lag[g]	Pre	Peak	Delta	Lag	Pre	Peak	Delta	Lag	Pre	Peak	Delta	Lag
Matadi[a]	Relo	0.19	3.26	17.2	96	0.33	3.95	12.0	96	0.02	0.08	4.0	124	0.02	0.15	7.5	24
Matadi	Health	0.21	0.95	4.5	47	0.32	0.90	2.8	47	0.04	0.06	1.5	55	0.04	0.07	1.8	47
Boulas[a]	Relo	0.58	3.14	5.4	68	0.95	3.32	3.5	110	0.02	0.08	4.0	195	0.05	0.25	5.0	110
Oumbi[a]	Health	0.98	1.77	1.8	43	1.03	1.78	1.7	44	0.02	0.03	1.5	44	0.07	0.10	1.4	43
Assante[b]	Social 1	0.50	1.78	3.6	60[h]	0.71	1.60	2.3	60[h]	0.01	0.02	2.0	60[h]	0.06	0.13	2.2	60[h]
Assante	Social 2	0.39	1.99	5.1	47	0.52	1.82	3.5	47	0.02	0.02	0	----	0.11	0.14	1.3	71
Median		**0.45**	**1.89**	**4.8**	**54**	**0.62**	**1.80**	**3.2**	**54**	**0.02**	**0.04**	**1.8**	**44**	**0.06**	**0.14**	**2.0**	**54**

[a] male; [b] female

[c] Relo = Relocation to another zoo; Health = health check; Social 1 = introduction to other females; Social 2 = introduction to a silverback male

[d] pre-treatment levels in µg/g feces (see Methods)

[e] peak levels in response to stressor in µg/g

[f] x-fold increase of peak levels above pre-treatment concentrations

[g] lag time in hours between occurrence of the stressor and peak GC response.

[h] no samples available after 60 hours

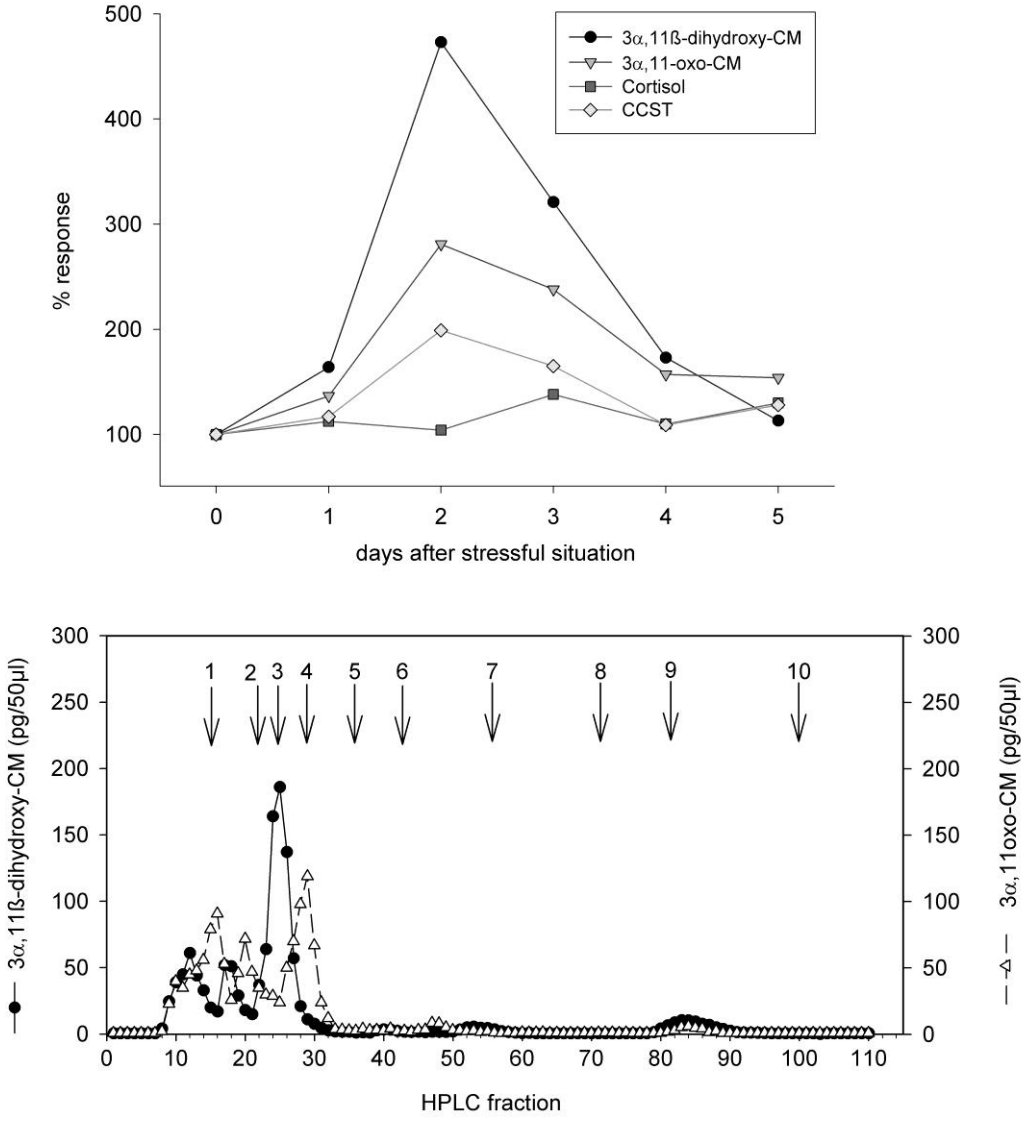

Figure 6.1. Top: Percentage response in immunoreactive faecal FGCM levels over baseline values in response to a stressful situation in lowland gorillas. Points represent median values calculated for 24 h intervals across 6 cases. Time 0 = onset of potentially stressful situation. Bottom: High Performance Liquid Chromatography immunoreactivity profiles detected using the 3a,11ß-dihydroxy-CM and 3a,11oxo-CM EIA in a peak sample of adrenocortical response to sedation in a male lowland gorilla. Arrows indicate elution positions of reference standards: 1) cortisol (fraction 14/15), 2) corticosterone (22), 3) 11ß-hydroxyetiocholanolone (24/25), 4) 11-oxoetiocholanolone (29/30), 5) 5ß-androstane-3,11,17-trione (36), 6) testosterone (42/43), 7) androstendione, dehydoepiandrosterone (55), 8) epiandrosterone, 5ß-DHT, 5ß-androstane-3ß-ol-17-one (72), 9) 5ß-androstane, 3α-ol-17-one (82/83), and 10) androsterone (100)

High Performance Liquid Chromatography (HPLC) analysis for the two group-specific assays indicated that approximately 90 % of immunoreactivity was detected as several distinct peaks between fractions 9 and 31 - positions where cortisol metabolites elute in our HPLC

system. The low immunoreactivity after fraction 31, (positions where certain possible cross-reacting androgen metabolites elute; Ganswindt, et al. 2003; Heistermann, et al. 2006) suggests a low degree of co-measurement of these androgens in the two assays (Figure. 6.1). Moreover, the presence of the highest peaks of immunoreactivity at the elution positions for 11ß-hydroxyetiocholanolone (fractions 24/25) and 11oxo-etiocholanolone (fractions 29/30) in the respective assays indicated that these two cortisol metabolites were abundant in lowland gorilla faeces. By contrast, and as expected based on the validation results, HPLC indicated only low levels of immunoreactivity measured by the CORT and CCST assays (data not shown).

6.4.2. Experiment 1 - Testing a field-friendly method for hormone extraction, and long-term preservation of faecal extracts

Across all samples FGCM measurements from extracts generated using the "field extraction" method correlated strongly with those generated from extractions derived from our established laboratory procedure (3α,11ß-dihydroxy-CM: $r=0.79$, $p<0.001$; 3α,11oxo-CM: $r=0.80$ $p<0.01$; $n=29$).

Our storage experiment revealed that for each storage condition, FGCM levels measured in the two group-specific assays stayed relatively stable over the 12 months of storage as indicated by the findings that i) mean changes in FGCM concentrations at each condition and storage duration did not exceed ±20 % of the controls and ii) the relative rank orders of samples during the experimental period remained very stable (Figure. 6.2).

Storage condition did not have an overall significant effect on FGCM values as measured by both assays (3α,11ß-dihydroxy-CM: $F(3, 44.0) = 0.012$, $p = 0.998$; 3α,11oxo-CM: $F(3, 44.0) = 0.027$, $p = 0.994$), but time did have a significant effect (3α,11ß-dihydroxy-CM: $F(5, 44.0) = 37.290$, $p<0.001$; 3α,11oxo-CM: $F(5, 44.0) = 11.462$, $p<0.001$). This resulted in an overall significant interaction effect of time and storage condition on FGCM values for both assay measures (3α,11ß-dihydroxy-CM: $F(15, 44.0) = 17.619$, $p<0.001$; 3α,11oxo-CM: $F(15, 44.0) = 13.244$, $p<0.001$). Time also had an overall significant effect in each condition (3α,11ß-dihydroxy-CM: liquid -20C: $F=15.05$; liquid PPT RT: $F=59.43$; dried PPT RT: $F=100.70$; dried glass RT: $F = 31.06$; all at 5,11.0, $p<0.001$; 3α,11oxo-CM: liquid -20C: $F=6.45$; liquid PPT RT: $F=29.63$; dried PPT RT: $F=62.66$; dried glass RT: $F = 20.58$; all at df 5,11.0, $p<0.005$). However, post-hoc analysis showed that there was no consistent pattern of significant FGCM level changes across conditions or in relation to the duration of storage (Figure 6.2), i.e., within condition 4 'PPT Dried RT' as measured by the 3a, 11ß-dihydroxy-CM assay, values for month of storage 3 is higher than for month 6 which is lower than month 9. There was one exception here: the

"Liquid Glass RT" condition showed a more linear increase and higher variation from controls in both assay measures in months 9 and 12 (Figure. 6.4). Visual inspection of these samples suggested that this change was most likely due to increased evaporation in at least two samples. Although the correlations between extracts stored in this condition for 12 months were still highly correlated with control values (3α,11ß-dihydroxy-CM: r_s=0.84, p<0.0005; 3α,11oxo-CM: r_s=0.76, p<0.004), we removed this condition from the analysis as it no longer reliably reflected true changes in FGCM levels. We report all results accordingly. Correlations for all other storage conditions between 12 months and 0 control values were much stronger (r_s ≥0.94, p<0.0001 for both assays).

Mean CV values across the 6 measurements of each sample over the 12 months of analysis ranged 9.6-25.2 % for 3α,11ß-dihydroxy-CM and 9.5-16.4 % for 3α,11oxo-CM. For both FGCM measures the highest CV values were for the removed condition "Glass liquid RT". All others were <14 % and thus well within the range of our inter-assay variation.

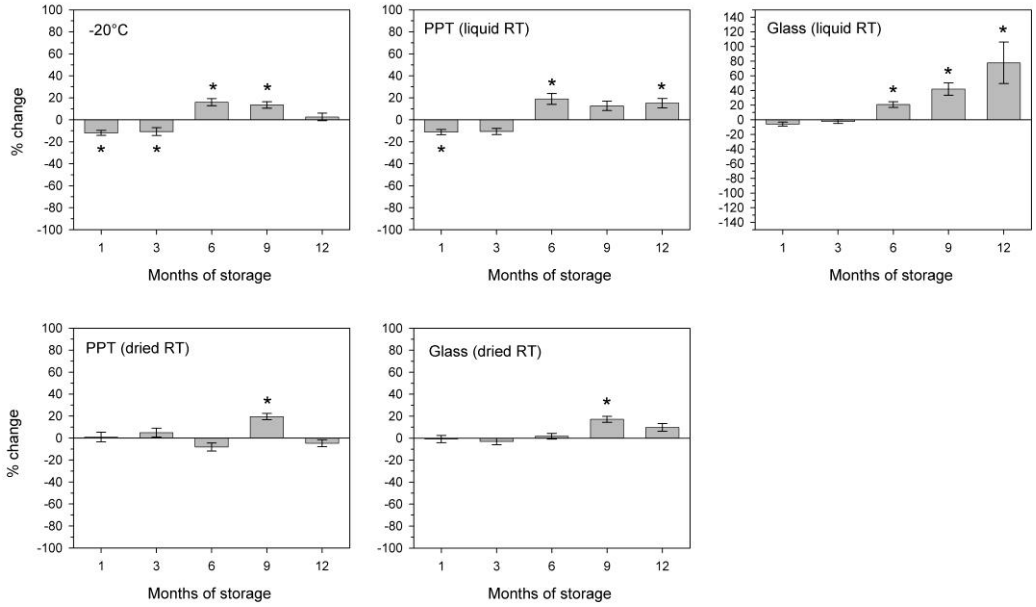

Figure 6.2. Percentage change in 3α,11ß-dihydroxy-CM levels in relation to samples analyzed immediately (time 0) for faecal extracts stored under various conditions for 1-12 months (* = indicates where p<0.05 compared to time 0 in the GLMM-RM model for each condition).

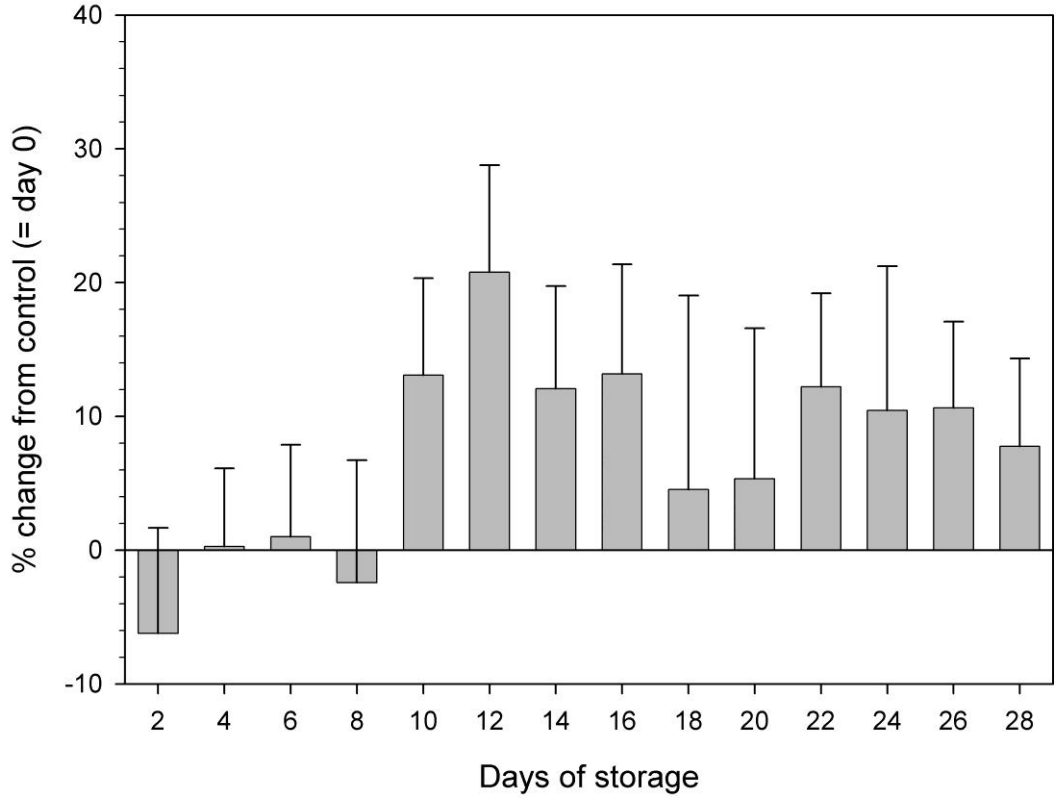

Figure 6.3. Percent change relative to Day 0 values in 3α,11ß-dihydroxy-CM concentrations of faecal samples stored for up to 28 days in 90 % ethanol. Values represent mean +SEM (n=9).

6.4.3. Experiment 2 - Testing short term storage of faeces in alcohol under field conditions

Mean FGCM levels in faeces stored for 2-28 days in ethanol before extraction were usually slightly (but non-significantly) higher than control values extracted at time 0, with a mean increase of 8.2 % (range: -6.2-20.8 %) over the 4 week experimental period (χ^2=22.407, p=0.071). FGCM levels measured after 28 days of storage, however, showed a strong and significant correlation with the values immediately after extraction (r_s=0.83, p<0.001, Figure. 6.3).

6.4.4. Experiment 3 - Testing post-defecation FGCM change in un-preserved faeces under field conditions

FGCM levels in faeces stored at ambient temperature for up to 12 hours before preservation in alcohol showed a significant and strong decline over time (χ^2=24.376, p=0.001; Figure. 7). On average, concentrations decreased by about 17 % within the first two hours and declined progressively further to reach a plateau at approximately 50-55 % of their original

concentration by 8 hours (Figure. 6.4) after which levels remained stable. Post-hoc analysis revealed that FGCM concentrations in samples stored for 6 hours or more before preservation were significantly lower than those measured in samples preserved directly after defecation (all $p<0.05$).

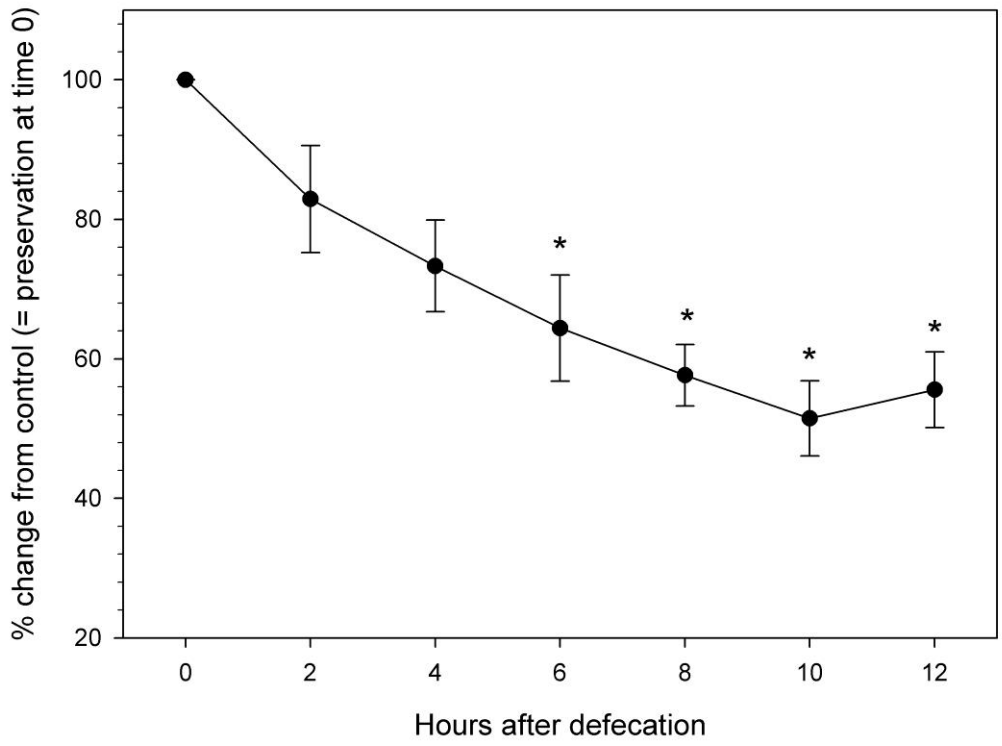

Figure 6.4. Percentage change of 3α,11ß-dihydroxy-CM concentrations of faecal samples from values preserved and extracted immediately, in those stored for up to 12 hr at ambient temperature before being preserved in 90 % ethanol. Values represent mean +SEM (n=10) relative to time 0. (* = indicates where measurements were significantly different ($p<0.05$) compared to time 0 values, ANOVA model for each 2 hr test condition.

6.4.5. Experiment 4 - Testing for diurnal effects on FGCM levels in faeces

Comparison of FGCM concentrations in samples collected in the morning hours versus afternoon hours indicated no statistical difference (morning samples: mean ± SD: 114.1±52.0 ng/g; afternoon samples: 121.5±67.9 ng/g; N=15, t=-0.625; P=0.542).

6.5. Discussion

We demonstrated the validity of a group-specific EIA for 5-reduced cortisol metabolites with a 3α,11ß-dihydroxy- and 3α-11oxo structure for monitoring the physiological stress

response from faeces in the western lowland gorilla, and established methods to extract and preserve FGCM concentrations long-term under tropical field conditions where freezing is not possible. We also showed that samples stored in 90 % ethanol can be stored up to 28 days prior to extraction in tropical conditions without altering FGCM concentrations. In addition, we demonstrated that FGCM concentrations decrease almost linearly over the course of 12 hours when faeces are not preserved immediately, and that FGCM concentrations do not show diurnal variation in wild western lowland gorillas. Our study therefore provides important new information for field researchers interested in using faecal hormone analysis techniques to monitor endocrine status in their study species.

6.5.1. EIA Validation of FGCM measurements

The two group-specific assays measuring major cortisol metabolites detected the predicted FGCM response to stressors reliably, whereas the two more specific cortisol and corticosterone assays were distinctly less responsive. The characteristics in terms of magnitude of response and time course detected by the two group-specific measurements were within the range of those reported in other studies on primates (Heistermann, et al. 2006; Whitten, et al. 1998b) and non-primate species (Wasser, et al. 2000; Young, et al. 2004) and indicate that peak FGCM output responses in the lowland gorilla can generally be predicted 2-3 days after exposure to a stressor. Our finding that the group-specific cortisol metabolite assays were superior to the two more specific assays is in line with findings from many other studies comparing the suitability of diverse faecal FGCM assays in reflecting the stress response (Fichtel, et al. 2007; Ganswindt, et al. 2003; Heistermann, et al. 2006; Palme 2005; Palme and Mostl 1997; Pirovino, et al. 2011; Weingrill, et al. 2011). Of the two cortisol metabolite assays, the 3α,11ß-dihydroxy-CM assay appears to have a higher biological sensitivity compared to the 3α,11oxo-CM assay, showing a stronger response to the stressor in all animals. As such we recommend using the 3α,11ß-dihydroxy-CM assay to assess FGCM output in the gorilla.

6.5.2. Experiment 1 - Testing a field-friendly method for hormone extraction, and long-term preservation of faecal extracts

Our simple extraction technique using hand-shaking samples in 90 % ethanol recovered FGCMs from faeces reliably, providing information on relative FGCM level changes similar to that generated with established laboratory methods. Having a validated option to extract faeces in the field is important as it removes the risk of unknown alterations in hormone concentrations when faeces are stored in alcohol for prolonged periods of time (Daspre, et al. 2009; Hunt and Wasser 2003; Khan, et al. 2002), and also allows the researcher to collect faecal

samples quickly whilst following wild animals without the need for lengthy or complicated treatments. The best solvent for extracting hormones from faeces may be species- and hormone-specific (Palme and Mostl 1997; Pappano, et al. 2010), but several studies have reported high extraction efficiency for steroids using ethanol at 80-100 % (Freeman, et al. 2010; Mateo and Cavigelli 2005; Palme and Mostl 1997; Santymire and Armstrong 2010). The strong correlation between field- and laboratory-extracted FGCM values in our study supports this contention indirectly, and we recommend ethanol for extraction of faeces in the field as it is often readily available in primate habitat countries. Our data also suggest that simple hand-shaking of samples for a constant amount of time, as suggested by Ziegler and Wittwer (2005) is sufficient to obtain reliable results, although use of a battery-powered homogenizer might increase hormone extraction efficiency slightly (Santymire and Armstrong 2010) especially if faeces are hard in texture.

As it is uncommon to have the necessary laboratory facilities available to analyse sample-extracts in the field, researchers need simple but appropriate methods to preserve them long-term under field conditions. Our storage experiments showed that FGCMs (measured by either of the two group-specific assays) are generally stable over 12 months (the longest period tested) when stored in liquid or dried forms at ambient temperatures, and that storage at -20°C did not appear to be better than storage at higher temperatures. Although post-hoc pair-wise comparisons revealed a number of significant differences in hormone concentrations at different months when compared to time-0 values within conditions, there were no linear or otherwise predictable patterns over time within any of the conditions. Furthermore, the percentage change in hormone values between time periods were always ≤ 20 %, the relative rank orders of samples remained stable over time and FGCM values after 12 months of storage strongly correlated with those at time 0. As the variation in repeated sample measurements across the 12 months was within the range of inter-assay variability, we believe that any significant differences within conditions are likely to be an artefact of assay variation and do not reflect true changes in FGCM concentrations. Such changes to FGCM levels in faeces can occur, due to, for instance, activity of extracted bacterial enzymes or chemically-induced changes in metabolite structure (e.g., due to oxidation processes). However, such effects would normally result in a more directional change of hormone levels similar to that found when faecal material is stored long-term in alcohol (Daspre, et al. 2009; Hunt and Wasser 2003; Khan, et al. 2002) and may also be temperature-dependent, being more pronounced in samples stored at higher temperatures when compared to frozen samples (Hunt and Wasser 2003; Khan, et al. 2002). Our results did not support either prediction, however.

Our finding that keeping extracts frozen is not better than storing them at ambient temperatures is remarkable and contrasts to current thinking that freezing is the 'golden standard' for steroid preservation (Hodges 2011; Touma and Palme 2005; Ziegler and Wittwer 2005). This may be extremely useful for field researchers working in remote conditions without a freezer.

Additionally, we show that FGCM levels in dried extracts stored in simple polypropylene (PPT) tubes were no different from those stored in glass tubes, a material generally considered more inert and therefore better suited for keeping steroids long-term. This finding is also very valuable for field researchers as plastic is lighter than glass and less prone to breakage, providing a better option for shipment of samples from field sites to laboratories. Use of dried extracts in PPT was also shown to stabilize FGCMs from African wild dog faeces for up to six months (Santymire and Armstrong 2010). To our knowledge however, our study is the first to validate the use of dried faecal extracts for one year; again highly valuable for researchers in remote places wishing to include yearly seasonality effects in studies of FGCMs from animal species as it overcomes the need to analyse samples during fieldwork. Furthermore, we are confident that dried sample extracts can be stored beyond 12 months without causing significant changes to FGCM content as FGCM levels in liquid extracts re-analysed after 18 months of storage at ambient temperatures remained equally stable (data not shown).

Whilst our storage experiments show that hormones are stable in both liquid and dried forms even at ambient temperatures, drying the ethanol extract in the field may be preferable for several reasons. First, drying likely inactivates any bacterial enzyme activity (for which the presence of water is essential), thus preventing the risk of biologically induced alterations (e.g. deconjugation) that may change hormonal structures. Second, drying removes the possibility of evaporation and subsequently falsely inflated hormone values over time, which, as our results suggest, is a real risk when alcohol is stored in liquid form long-term. Third, using dried samples removes potential problems associated with transportation/exportation of alcoholic solutions from field sites. Drying alcoholic extracts should be easily possible under most field conditions, particularly as only a small volume of extract (e.g. 0.5 ml or less) is needed for hormone analysis. However, when researchers prefer storing extracts in liquid form, we would recommend to bring samples to a fridge or freezer periodically (if this is possible) in order to reduce the risk of solvent evaporation and a resultant change in hormone levels.

Using field extraction by hand-shaking in combination with drying small volumes of extract in plastic tubes which can be stored long-term at ambient temperatures therefore offers

a simple and reliable method for preserving hormones under remote or tropical conditions. We envisage that this method applies not only to faecal FGCM levels in the gorillas tested here, but also to studies of other hormones and animal species (see for instance Santymire and Armstrong 2010).

6.5.3. Experiment 2 - Testing short term storage of faeces in alcohol under field conditions

We found that hormone values in samples stored for up to 28 days in alcohol did not differ from values of immediately extracted samples. This finding is similar to that reported for yellow baboons (*Papio cynocephalus*) (Hunt and Wasser 2003; Khan, et al. 2002; Lynch, et al. 2003) and grizzly bears (*Ursus arctos*) but different from the results of a storage experiment conducted with elephant faeces in which FGCM levels rose after two weeks of storage (Hunt and Wasser 2003). Although we did observe some variation in mean FGCM levels between days within the month, there was no predictable trend for increasing/decreasing FGCM content over time. The small changes observed may again be due to assay variation, or to the uneven spread of metabolites in faeces (Wasser, et al. 1996), as although we homogenized the sample well, gorilla faeces are very large and can be hard, making them difficult to mix. Our findings mean that immediate faecal extraction after collection is not necessary for obtaining reliable results for gorilla FGCM levels. This is a particularly valuable implication as field conditions often prevent immediate or regular processing of samples after defecation.

6.5.4. Experiment 3 - Testing post-defecation FGCM change in un-preserved faeces under field conditions

The results of our hormone change experiment show an almost linear pattern of hormone degradation over 12 hours, with the most pronounced decay between zero and four hours, and levels stabilizing at around 50 % of the original concentration from 6 hours onwards. To date, few studies have investigated hormone change in faeces between defecation and fixation, but studies of cattle, horses and pigs (Mostl, et al. 1999; Muehlenbein 2012) and bornean orang-utans (*Pongo pygmaeus morio*) also found a significant change in FGCM levels within a few hours when samples were stored unpreserved at ambient temperature. In these studies however, FGCM concentrations increased rather than decreased as we report here for gorilla faeces. However a decrease in concentrations was also observed in faeces of brown hyena (*Hyena brunnea)* (Hulsman, et al. 2011). Differences in experimental treatments (e.g. samples stored in plastic tubes vs. samples left exposed to real environmental conditions) may partly account for the different effects seen, although chemical alteration (e.g. oxidation or

deconjugation) of the metabolites due to species-specific gut flora activity, which would be more immunoreactive in farm animals and orang-utans and less in the gorilla or hyena, is a more likely explanation for the differences in findings (Mostl, et al. 1999; Washburn and Millspaugh 2002). These results highlight the importance of controlling for possible sources of exogenous FGCM change and show that faecal samples should be preserved as soon as possible after defecation to minimize the risk of sample degradation. For gorilla studies, our data specifically imply that FGCM concentrations in samples collected from nests, where exact defecation time is usually unknown, are likely to be underestimated. If, however, information on the time between defecation and collection can be obtained, our finding of an almost linear degradation pattern would allow a corrective factor to be applied to estimate more realistic final hormone values.

6.5.5. Experiment 4 - Testing for diurnal effects on FGCM levels in faeces

We found no differences in mean FGCM levels between morning and afternoon samples. This finding is to be expected for the gorilla which has relatively consistent feeding patterns (and therefore likely FGCM excretion rate) throughout the day interrupted by regular periods of rest in the wild (personal observation). Our data are consistent with those from other studies of larger-bodied mammals (Ostner, et al. 2008; Schwarzenberger, et al. 1996; Wasser, et al. 1993) where gut passage-time is comparatively long as for the gorilla. In contrast, diurnal differences in FGCM levels are often seen in smaller-bodied species (Beehner and Whitten 2004; Kalliokoski, et al. 2012; Sheriff, et al. 2009; Sousa and Ziegler 1998) and, more generally, in animal urine (e.g., Muller and Lipson 2003; Robbins and Czekala 1997) due to faster and more frequent excretion rates. Given that the time of day did not affect faecal FGCM levels in our study of lowland gorillas, we suggest that faecal samples for FGCM analysis do not need to be collected during a specific time-window, but can be collected throughout the day. This is of high practical value as it potentially allows researchers to follow more animals and gather larger sample sets within restricted periods of time.

6.6. Conclusions

Overall, our results further support the use of FGCMs for long-term studies of the correlates of FGCMs in animals as they reflect an integration of the hormone over a longer period rather than the shorter-term fluctuations found in serum and urine. Here, we validated a system to monitor FGCMs in the critically endangered western lowland gorilla species. The ability to non-invasively monitor adrenocortical activity in gorillas is of major value in captive

animal breeding and welfare-management strategies. Researchers studying wild populations can also use this tool to monitor natural and human-derived effects on FGCMs which may affect health and reproduction. Methods for non-invasive faecal hormonal monitoring are generally not field-friendly and ways to adapt and validate them to the field need testing for each animal species. Here we provide general methods by which faecal-hormonal monitoring can be applied to a variety of field conservation contexts and wild animal species where arguably, it may be most crucially needed.

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This research was conducted with permission and in accordance with the Zoos' research protocols and adhered to the legal requirements of the UK. We adhered to the research protocols defined by the Dzanga-Sangha Protected Areas Direction and all research was approved by the Durham University Life Sciences Ethical Review Process Committe.

Chapter 7 - Effects of habituation, research and ecotourism on faecal glucocorticoid metabolites in wild western lowland gorillas: Implications for conservation management

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This paper is predominately the work of the first author K.Shutt (KS). KS conceived the study in conjunction with M. Heistermann (MH) and J.Setchell (JS). KS carried out all field work with data collection assistance from B.Kalousova (BK), I.Profousova (LP), T.Fuh (TF), J.F.Dicky (JFD) and J.Bopolanzognako (JB). A.Todd (AT) provided technical and logistical support in the field. KS wrote the manuscript and made all revisions received from reviewers. MH conducted all hormonal analyses and provided expert review of the endcrinological data analyses and interpretation. A.Kasim provided expert statistical advice and review. JS provided supervisory review of the manuscript.

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Abstract

Wildlife tourism is proliferating worldwide and has the potential to raise revenue for conservation as well as public awareness of conservation issues. However, concerns are growing about the potentially negative influence of such tourism on the wildlife involved. We investigate the effects of habituation, ecotourism and research activities on levels of faecal glucocorticoid metabolites (FGCMs), a proxy for physiological stress, in wild western lowland gorillas (*Gorilla gorilla gorilla*) in the Central African Republic. We compare FGCMs in three human-contacted groups with those in unhabituated gorillas. We also explore how human-gorilla contact influences FGCMs of a gorilla group undergoing habituation and investigate how measures of general human-gorilla contact, tourism and human proximity influence FGCMs in recently and long-term habituated groups. Two of the three human-contacted groups had higher levels of FGCMs than unhabituated gorillas. The group undergoing habituation had the highest FGCMs, which increased up to 25 days following contacts, suggesting a cumulative FGCM response, in line with descriptions of a hormonal adaptation response to a chronic intermittent stressor. FGCMs in habituated groups were significantly associated with increasing frequency of violation of the 7m distance rule by observers and with a medical intervention but not with other measures of human pressure. Our findings provide critical information for the management of this, and other, species whose conservation depends on habituation for ecotourism.

Key Words: Conservation, Ecotourism, Faecal-glucocorticoids, Habituation, Primate, Stress, Wildlife.

7.1. Introduction

Wildlife tourism is one of the fastest growing sectors of the international tourism market (Fennell 2011). It has been advocated as a tool to conserve species and habitats and can accrue educational and socio-developmental benefits as infrastructure builds around tourism activities (Williamson and Macfie 2010). Today's tourists desire close, personal, wildlife encounters and are particularly attracted to endangered species in remote, fragile habitats (Williamson and Macfie 2010). However, a growing number of accounts document behavioural and physiological alterations in the species encountered (Tadesse and Kotler, 2012; Thiel, et al. 2011; Treves and Brandon, 2005; Semeniuk, et al. 2009; Velando and Munilla, 2011), causing concerns that the costs of tourism to the focal organisms may outweigh the wildlife conservation benefits (Butynski and Kalina, 2009; Ferber, 2000; Higginbottom, et al. 2003; Litchfield, 2009; Woodford, et al. 2002).

A stressor is any environmental stimulus that either threatens an organism's survival and homeostasis directly or is perceived to do so (Boonstra 2012). All animals must cope with unpredictable occurrences, or stressors, in their environments (Cyr and Romero 2008). A normal vertebrate stress response involves a release of glucocorticoids (GCs) from the adrenal cortex (Selye 1955), which protects an organism against the effects of acute stress via activation of various behavioural and metabolic processes, and is adaptive in the short-term (Cyr and Romero 2008; McEwen and Stellar 1993; Wingfield and Romero 2010). Long-term elevation of circulating GC levels is, however, maladaptive, as it is linked to hyperglycaemia, neuronal cell death, and suppression of the immune and reproductive systems (Cyr and Romero 2008; Sapolsky 1992). Moreover, unpredictable, chronic, intermittent stressors, as typified in wildlife tourism contexts, are thought most likely to cause pathology (Boonstra 2012; Burchfield 1979; Sapolsky 1992). As extensive research has linked increased GC output to ill-health (Cyr and Romero 2008), GCs in blood or faeces have often been used to monitor individuals and populations in conservation research (Cyr and Romero 2008; Tarlow and Blumstein 2007; Thiel, et al. 2011; Van Meter, et al. 2009; Walker, et al. 2005; Wikelski and Cooke 2006), and are used increasingly to assess the physiological effects of human disturbance and wildlife tourism on the animals concerned (Behie, et al. 2010; Creel, et al. 2002; Ellenberg, et al. 2007; French, et al. 2010; Maréchal, et al. 2011; Pineiro, et al. 2012; Zwijacz-Kozica, et al. 2013). Like other charismatic mega-fauna, great apes figure highly on wildlife tourism wish-lists (Williamson and Macfie 2010). Great ape tourism relies on the intentional 'taming', or habituation, of wild animals, which involves exposing the apes to a habituation team, until they become accustomed

to daily visits ('contacts'), appearing to pay little attention and showing minimal aggression to humans (MGVP 2009). In the early stages of habituation apes typically show behavioural indications of an acute stress response (Blom, et al. 2004; Tutin and Fernandez 1991). However, once the apes are behaviourally habituated it is postulated that they no longer perceive the arrival of humans as a threat (Butynski and Kalina 1998), and thus cease to mount an adrenocortical response. To the best of our knowledge, however, no study has examined the effect of the process of habituation on HPA axis activity in any mammal species.

It is important to test the effects of habituation on the GC response in great apes, and the assumption that habituated apes no longer experience an elevated GC response when visited by humans, as chronically elevated GCs can lead to a reduction in resistance to disease (McEwan and Stellar 1993). Additionally, the close genetic relationship between humans and other apes renders habituated apes vulnerable to human diseases (Woodford, et al. 2002). This is of particular concern, as gorillas appear to be physiologically less resilient to stressful situations compared to other great apes (Butynski and Kalina 2009; McNeilage 1996), as demonstrated by the low survival rate of gorillas in zoos and sanctuaries (King 2009). Gorilla tourism sites have adopted regulations in an attempt to reduce the negative effects of human contact on habituated gorillas (Williamson and Macfie 2010), including maintenance of a 7 m distance between humans and gorillas, limiting tourist visits to one hour each per day with a maximum number of people per group, and prohibiting visits to gorillas by people who have visible symptoms of contagious illness. However, these rules are difficult to enforce and often fail; leading experts to suggest that the risks of close-contact tourism may be greater than previously believed (Butynski and Kalina 2009; McNeilage 1996; Sandbrook and Semple 2006). Here, we investigate the impacts of habituation, research and tourism on the physiological GC response of the critically endangered western lowland gorilla (*Gorilla gorilla gorilla*).

Western lowland gorillas range across many of the least developed countries in central and West Africa. The remaining wild population size is estimated to be 95,000 animals and is predicted to decline by 80 % over the next 66 years (Walsh 2008). Attempts to conserve western lowland gorillas and their habitat via tourism started in the early 1990s. However, despite long-term efforts to habituate groups at several sites, only four groups can currently be visited by tourists. It can take 4 – 8 years to habituate western lowland gorillas, unlike mountain gorilla groups which can typically be habituated within a year. This is probably because western lowland gorillas live in smaller, less cohesive groups in dense forests, vocalise less and travel further in a day (Cipolletta 2003; Doran-Sheehy, et al. 2007; Robbins, et al. 2004; Williamson

and Macfie 2010). These tracking difficulties also mean that habituated western lowland gorillas must be followed closely from dawn to dusk to sustain daily contact with the group to facilitate research and tourism activities. In addition, the paucity of habituated western lowland gorilla groups means that they often serve the interests of multiple stakeholders, including researchers, funding donors, film crews and photographers, as well as tourists. These pressures increase the risks of physiological stress in western lowland gorillas compared to other apes involved in tourism.

We studied a gorilla group undergoing habituation, a recently habituated group, a long-term habituated group, and non-human-contacted, unhabituated gorillas, to test the following hypotheses and predictions.

Hypothesis 1: Contact with humans elicits a GC response in gorillas, but habituation reduces this response over time. This predicts that:

- Gorillas undergoing habituation and habituated gorillas exposed to ecotourism and research activities will have higher FGCMs that those that are not exposed to human contact at all.
- Gorillas undergoing the process of habituation will have higher FGCMs than habituated gorillas.
- Long-term habituated gorillas will have lower FGCMs than more recently habituated gorillas.

Hypothesis 2: The process of habituation is perceived as a threat by gorillas. Based on patterns of FGCM excretion in captive gorillas (Shutt, et al. 2012), this predicts that:

- FGCM levels in gorillas undergoing habituation will be higher 48 hr after a contact with humans than before the contact.
- FGCM levels in gorillas undergoing habituation will decrease to pre-contact levels 48-62 hr after contact with humans assuming the gorillas are not subjected to other environmental stressors.

Hypothesis 3: Elements of daily contact with humans still elicit a GC response in habituated gorillas. This predicts that:

- FGCM levels will increase with increasing levels of human-gorilla contact, measured as: amount of daily human-gorilla interaction; amount of close-follow research activities; the total daily number of people in contact with the gorilla group; occurrence of tourism; duration of tourist visits; total number of tourist groups;

total daily number of tourists; frequency of humans following gorillas at < 25 m; and frequency of humans approaching to less than 7 m (violating the distance regulation).

7.2. Material and Methods

7.2.1. Study Site

We conducted our study at Bai Hokou (33 N 663109, 316187UTM) and Mongambe (33 N 654357, 322606 UTM) study sites, in the Dzanga-Sangha Protected Areas (DSPA) in the Central African Republic (CAR). The DSPA are co-managed by the CAR government, the World Wildlife Fund and the Primate Habituation Programme (PHP). For a more detailed description of the study sites see Carroll (1986). Gorilla habituation aimed at developing ecotourism and research activities at Bai Hokou commenced in 1997. Today, tourists (426 in 2011) can visit a long-term habituated group of gorillas (Makumba) at Bai Hokou and another more recently habituated group (Mayele) at Mongambe. A further gorilla group (Mata) is undergoing the process of habituation at the Bai Hokou site. With the development of tourism the PHP has taken measures to reduce the health risks that close human contact poses to gorillas, such as maintenance of a 7 m distance from gorillas and maximum number of six visitors over two, 1 hour visits per day, with a maximum of three tourists per group.

7.2.2. Study Subjects

We collected observational data and faecal samples from the three known gorilla groups and also from non-human-contacted, unhabituated gorillas in the same area between November 2010 and December 2011 (Table 1).

Table 7.1. Details of study groups: group identification, site location, habituation status, group composition, faecal sample identification level and number of faecal samples.

	Study Gorilla Groups			
Habituation Status	Long-term Habituated	Recently Habituated	Under Habituation	Unhabituated
Site Location	Bai Hokou	Mongambe	Bai Hokou	Both (predominately BH)
Year Habituation Commenced	2000	2005	2008	N/A
Date Tourism Commenced	2004	2009	N/A	N/A
Group Size*	9	14	~8/9	N/A
Group Composition	*Silverback, 2 adult females, 2 sub adults, 3 juveniles, 1 infant*	*Silverback, 4 adult females, 3 sub adults, 3 juveniles, 3 infants*	*Silverback, presumed ~4 adult females, evidence of sub-adults/juveniles &*	*Mixture of all age-groups, both group & lone-male silverbacks*
Faecal Sample Identification	Individual	Individual & Age Category	Age Category	Age Category
Total Faecal Samples Used in Analyses	554	250	301	70

*Group size decreased from 10 to 9 during the study period in MK group due to female off-spring immigration and increased from 13 to 14 with the birth of a new infant at the end of the study period in MY group. Data are adjusted accordingly.

7.2.3. Observational sampling

For habituated groups, we collected contact data during daily follows (long-term habituated group n= 250, recently habituated group n= 116 follow days) and tourist visits (long-term habituated group n= 57, recently habituated group n= 16 tourism days) when the total number of people did not exceed the maximum permitted group size of six (including two trackers and a guide). Daily contact duration was 6-9 hours per day. We took instantaneous scans (Altmann 1974) on human-gorilla proximity every 10 mins, noting the distance of each visible gorilla in meters up to 25 m, then as >25 m, as pilot data suggested that distances >25 m were often obscured by vegetation. We collected all occurrence data on the frequency of humans breaking the 7 m distance rule by approaching a gorilla. We made a further record if the gorilla moved away and the human approached again to < 7 m, but did not make a further record if the human remained at less than 7 m. We disregarded occurrences where gorillas approached humans.

For the group undergoing habituation, we recorded the number of days on which contacts were made (130 contacts on 90 days over the study period) and the number of contacts per day (range 0 – 3).

7.2.4. Faecal sampling

We collected a small portion (~0.5g) of fresh faeces (up to 30 minutes after defecation) when following habituated gorillas. For the gorillas undergoing habituation and unhabituated gorillas we collected samples from the trails if estimated to be less than 30 minutes old and

from fresh (defecated the same day) samples from nest sites. We were only able to observe defection, and thus identify all samples to the level of the individual for the long-term habituated group. We attempted to equalise sampling effort across groups; however, sampling from unhabituated gorillas was very difficult as teams had to locate wild groups or individuals or their fresh dung. Experienced trackers assisted with age/sex class identification of faeces from the trails and nests according to faecal bolus size, nest size and position (Remis 1997; Tutin, et al. 1995). We followed validated methods to avoid variation in our FGCM measurements resulting from sampling, extraction and storage (Shutt, et al. 2012). We have previously detected no effects of urine contamination on FGCMs (Shutt, et al. 2012). Nevertheless, we took all sample portions from the centre of the faecal bolus where it should not have been affected by urine.

We shipped the samples to the German Primate Centre Endocrinology Laboratory. We conducted FGCM measurements using a 11ß-hydroxyetiocholanolone (3a,11ß-dihydroxy-CM) enzyme immunoassay which we have previously shown to be physiologically, biologically and immunologically valid for measuring faecal glucocorticoid output in the western lowland gorilla (Shutt, et al. 2012). Inter-assay coefficients of variations for these measurements were 9.2 % (high value quality control) and 15.1 % (low value quality control). We removed any samples with known complications (e.g., seeds discovered in the faecal matrix or alcohol evaporation), leaving 1175 samples for analyses.

7.2.5. Independent variables: human-gorilla contact measures

For habituated groups, we used daily PHP records to establish contact days, and calculated contact duration (humans following the gorillas with or without direct observation), duration of direct visual contact (mutual line of visibility) and the total number of people with the group each day. For each day, we recorded whether researchers followed individual gorillas closely, the presence of medical researchers and film crews or professional photographers, whether tourists visited the gorillas, how many tourist groups visited the gorillas, and the total number of tourists (Table 7.2). We calculated the mean daily distance to the gorillas, splitting distances <25 m from those >25 m, and calculated the hourly frequency at which humans broke the 7 m distance regulation, correcting for the number of gorillas in the group. We also used PHP project data on daily rainfall (range 0-75.5 ml) and temperature (range 14.0 – 29.7º Celsius) where available (long-term habituated group only).

Table 7.2. Details of observational data collected to establish measures of human-gorilla contact for both the long-term habituated group and the recently habituated group.

Observation	Long-term habituated group	Recently habituated group
Overal contact duration range (mins)	45-607	202-632
Direct visual contact range (mins)	45-598	202-615
Total daily number of peple with the group range	1-19	N/A
Close-follow research days	48	N/A
Medical intervention days	9	35
Film/camera crew days	41	N/A
Tourism days	57	16
Tourism groups range	1-4	1-3
Total daily number of tourists range	1-11	1-11

For the group undergoing habituation, we used the number of human contacts with the group each day as a measure of habituation pressure.

7.2.6. Dependent Variable: FGCM measures

FGCMs decrease over time in unpreserved gorilla faeces (Shutt, et al. 2012). The temporal degradation pattern is best described by a polynomial fit, $Y = 0.0039x^2 - 0.0844x + 0.9976$, ($R^2 = 0.9929$, $n = 10$) where x = time between defecation and preservation. We calculated the age of faecal samples collected from nests using the precise collection time and the average time gorillas leave their nests (5:30 am: K. Shutt pers. obs; A. Todd pers. comm) and used this information to compensate for hormone degradation in samples that were not collected immediately. We obtained a corrected value (A) from the original wet hormone content value (B) using $A = B*100 / Y$.

We found no diurnal variation in FGMCs (Shutt, et al. 2012), so used all samples in analysis. We express all hormone data as hormone per faecal wet mass. We applied a 48 hr time lag when fitting observational data to the hormone data as western lowland gorilla FGCMs peak 48 hrs after a stressor (Shutt, et al. 2012). We used the natural logarithm of our hormone data (lnFGCM) in all analyses to achieve a normal distribution.

7.2.7. Statistical Analysis

Before testing our predictions, we ran a series of analyses using generalised linear mixed effect models (GLMM) with a Gaussian distribution and identity link to investigate variation in FGCMs between age-class categories, the two sexes, and wet (April-October) and dry months (November to March). We also explored the relationship between FGCMs and daily rainfall and mean temperature.

7.2.8. Hypothesis 1.

To test the predictions of hypothesis 1, we used a GLMM to compare FGCMs of the three human-exposed groups (the long-term habituated group, the recently habituated group and the group undergoing habituation) with those of unhabituated gorillas, and to one another. We used age category as a random effect as the data were not always uniquely identified to individual gorillas in the recently habituated gorilla group, the group undergoing habituation, and the unhabituated gorillas. We then applied adjustments for multiplicity corrections based on a false discovery rate (Benjamini and Hochberg 1995).

7.2.9. Hypothesis 2.

To test the predictions of hypothesis 2, we used FGCM data from the group undergoing habituation. We used GLMMs with age category as a random effect as the data for this group were not uniquely identified to individual gorillas. To test prediction 2(a) we compared FGCMs 48 hr after contacts were made with the group (range 1-3 contacts on one day) with those before contacts were made as FGCMs peak 48 hr after exposure to a stressor (Shutt, et al. 2012). To test prediction 2(b), we tested for an association between FGCMs and the number of days since the last contact(s) was made.

7.2.10. Hypothesis 3.

We used GLMM to test the predictions of hypothesis 3, setting gorilla identification as a random effect for data from the long-term habituated group. We used multiple linear regression models (assuming all observations were independent) for analyses of the data from the recently habituated group. After testing all the variables we excluded those with non-significant bivariate associations with FGCMs at $p>0.25$. We then performed separate analyses for three categories of the remaining variables: general human-gorilla contact; tourism-specific contact; and human-gorilla proximity. We treated the three categories separately as there were substantial differences in the amount of data available for each category. For the long-term habituated group there were 510 observations for the general human-gorilla contact, 141 for

tourism-specific contact, and 334 for human-gorilla proximity. For the recently habituated group, there were 205 observations for the general human-gorilla contact, 31 for tourism-specific contact, and 96 for human-gorilla proximity. We applied adjustments for multiplicity correction for the final models based on false discovery rates (Benjamini and Horchberg 1995).

In building our models, we first tested for associations between FGCMs and the occurrence of tourism (yes/no), the duration of daily human-gorilla contacts (mins), duration of daily direct visual observation (mins) and the total daily number of people with the group. We also tested for relationships between FGCMs and close-follow research, a medical intervention, and film crew/photographer presence (all yes/no) in the same model. Second, we used tourism-specific data and tested for associations between FGCMs and the duration of tourism visits (mins), the total daily number of tourist groups and the total daily number of tourists. Finally, we tested relationships between FGCMs and human-gorilla proximity when gorillas were at < 25 m and > 25 m, and the frequency of violation of the 7 m distance regulation by humans (long-term habituated group range 0.19-10.5/ hr, mean = 1.83/ hr; recently habituated group 0.29-3/ hr, mean = 1.29/ hr). We could not run all tests for the recently habituated group, as sampling difficulties greatly reduced the data set.

We conducted all statistical analyses in R2.14.2. We report the mean difference (MD), the standard error (SE) and the p-value for each association tested and the slope (S), its standard error (SE) and p-value for quantitative predictors. We show the variance (Var) and standard deviation (SD) for the random effects component of the GLMM models in the results tables.

7.3. Results

We found no significant relationships between mean FGCMs and age-class, sex, season, and mean daily temperature or rainfall in any of the gorilla groups where data were available to test (GLMM: all $p>0.25$, data not shown). We, therefore, excluded these variables from further analyses.

7.3.1. Hypothesis 1:

In line with prediction 1a, both the group undergoing habituation and the recently habituated group had significantly higher FGCMs than unhabituated gorillas. However, we found no significant difference between the FGCMs of the long-term habituated group and unhabituated gorillas. In line with prediction 1b, FGCMs in the group undergoing habituation

were also significantly higher than those in the long-term habituated group. However, contrary to prediction 1c, FGCMs in the recently habituated group were not significantly different to those in the long-term habituated group (Figure 7.1, Table 7.3).

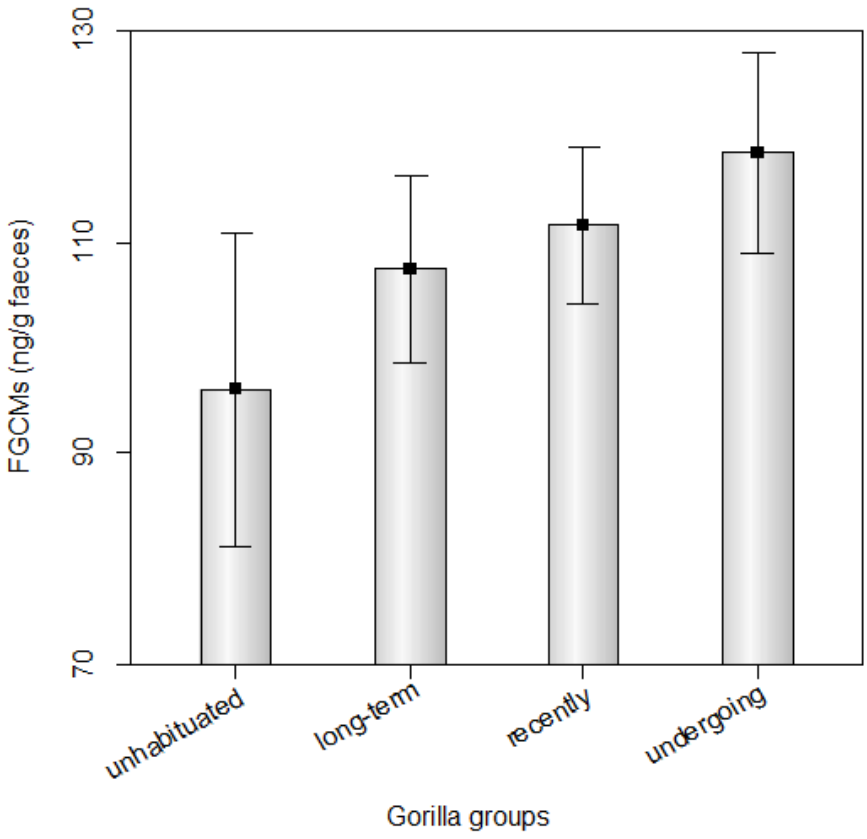

Figure 7.1. Mean +/-SD FGCM values for gorillas that are unhabituated, long-term habituated, recently habituated and undergoing habituation with 95 % confidence intervals.

Table 7.3. Results of a GLMM comparing FGCMs in the long-term habituated group, the recently habituated group, the group undergoing habituation and unhabituated gorillas, with pairwise comparisons between groups.

	Gorilla Group	MD	SE	P-value
Main Model	Model Intercept	4.15	0.067	0.01
	Under habituation-unhabituated	0.23	0.07	**0.01**
	Long-term habituated - unhabituated	0.13	0.07	0.05
	Recently habituated - unhabituated	0.18	0.07	**0.01**
		Random Effects		
			Var	SD
		Age Group	0.00	0.07
		Residual	0.26	0.51
Pairwise Comparisons	Under habituation - recently habituated	0.05	0.05	0.23
	Recently habituated - long-term habituated	-0.05	0.04	0.27
	Under-habituation - long term habituated	0.01	0.04	**0.01**

Results highlighted in bold indicate significance at 0.05.

7.3.2. Hypothesis 2.

We found some support for prediction 2a, that FGCM levels in gorillas undergoing habituation will be higher 48 hr after a contact with humans than before the contact. FGCMs were significantly higher than pre-contact levels 48 hr after 3 contacts with humans in the group undergoing habituation (MD=0.350, SE=0.135, P=0.010), although they were not significantly different from pre-contact levels within the predicted 48 hr period after only 1 or 2 contacts with humans (1 contact: MD=0.048, SE=0.085, p=0.572; 2 contacts: MD=0.234, SE=0.209, p=0.265). Contrary to prediction 2b, that FGCMs would decrease to pre-contact levels 48-62 hr after contact, they continued to rise, and rose significantly for up to 21 days after contact(s) (S=0.020, SE=0.008, p=0.011, Figure 7.2, Table 7.4).

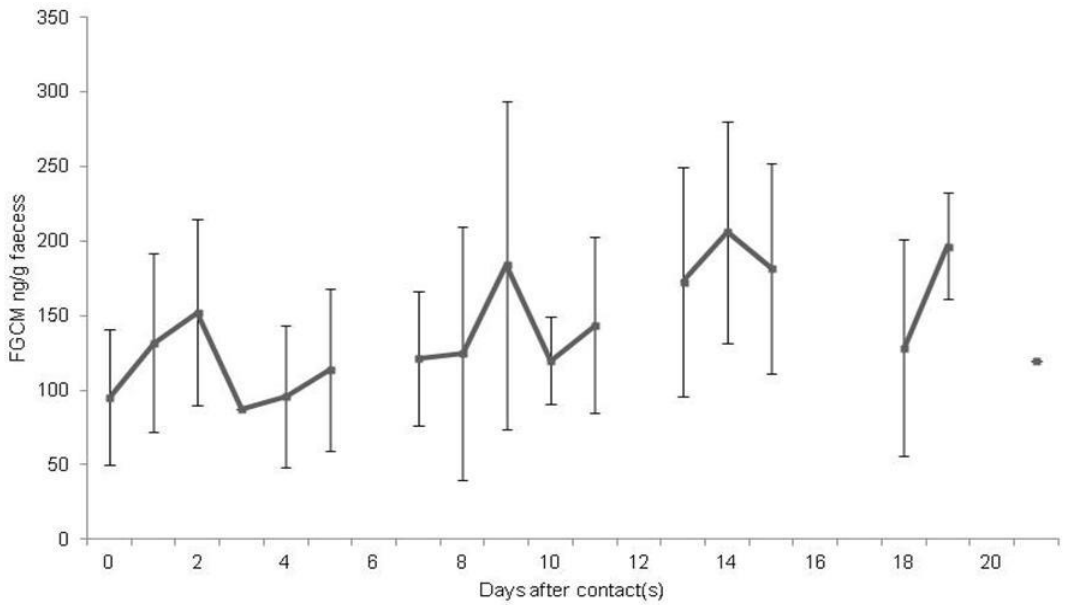

Figure 7.2. Relationship between mean +/-SD FGCM values and the number of days after humans made contact(s) with the group undergoing habituation. 'Day 0' represents day of contact (therefore the FGCM response to contact would be expected 48 hr later).

Table 7.4. Results of GLMM comparing pre-contact and 48 hr post-contact (1-3 contacts on any one day) FGCM levels in a gorilla group undergoing habituation and the relationship between FGCMs and the number of days after contacts made (range 1-21).

	FGCMs 48 hr after contacts	**MD**	**SE**	**P-value**
Main Model	Model Intercept	4.67	0.04	0.01
	1 contact Vs. 0	0.05	0.09	0.57
	2 contacts Vs. 0	0.23	0.21	0.27
	3 contacts Vs. 0	**0.35**	**0.14**	**0.01**
	FGCM increase in days after contacts	**0.02**	**0.01**	**0.01**
		Random Effects		
			Var	SD
		Age Group	0.00	0.04
		Residual	0.22	0.50

Results highlighted in bold indicate significance at 0.05.
Contact data is adjusted for a 48 hr time lag.

7.3.3. Hypothesis 3.

The medical intervention period was significantly associated with increased FGCMs for both the long-term habituated group and the recently habituated group (Table 5). An increasing frequency of humans breaking the 7 m distance regulation was also significantly associated with higher FGCMs in both habituated groups, but this relationship only remained significant in the recently habituated group after multiplicity correction. We found no significant difference in FGCM levels relating to the effects of tourism days or other types of contacts, nor in our detailed analysis of tourism variables (Table 7.5).

Table 7.5. Results of GLMM analyses testing relationships between measures of human-gorilla contact and FGCMs in the long-term and recently habituated gorilla groups.

		Long-term habituated			Recently habituated		
	Variable	MD	SE	P-value	MD	SE	P-value
a). General human-gorilla contact	Model Intercept	4.58	0.10	0.01	4.54	0.13	0.01
	i. Tourism occurance yes/no	0.01	0.05	0.86	-0.16	0.10	0.12
	iv. Contact duration	0.00	0.00	0.48	0.00	0.00	0.55
	iv. Total visual observation	0.00	0.00	0.34	0.00	0.00	0.53
	iii. Number of people	-0.01	0.01	0.52	-	-	-
	iv. Focal-follow research	0.07	0.08	0.38	-	-	-
	iv. Medical intervention	**0.36**	**0.11**	**0.01**	**0.21**	**0.08**	**0.01**
	iv.Film/photographer pressence	0.10	0.10	0.36	-	-	-
			Random Effects				
			Var	SD			
	Identification		0.02	0.13	-	-	-
	Residuals		0.24	0.49	-	-	-
b). Tourism-specific	Model Intercept	4.48	0.12	0.01	4.60	0.22	0.01
	i. Tourism duration	0.00	0.00	0.06	0.00	0.01	0.95
	ii. Number of tourist groups	0.06	0.12	0.63	-0.12	0.59	0.84
	iii. Number of tourists	-0.09	0.05	0.06	-0.01	0.05	0.85
			Random Effects				
			Var	SD	-	-	-
	Identification		0.02	0.13	-	-	-
	Residuals		0.21	0.46	-	-	-
c). Human-Gorilla Proximity	Model Intercept	4.54	0.16	0.01	4.79	0.31	0.01
	i. Humans at lessthan 25m from gorillas	0.00	0.01	0.78	-0.02	0.02	0.28
	ii. Humans at greater than 25m from gorillas	-0.16	0.24	0.51	0.01	0.01	0.58
	iii. Humans breaking the 7m distance regulation	0.01	0.01	0.07	**0.15**	**0.05**	**0.01**
			Random Effects				
			Var	SD	-	-	-
	Identification		0.03	0.16			
	Residuals		0.23	0.48			

Results highlighted in bold indicate significance at 0.05.

7.4. Discussion

7.4.1. Hypothesis 1: Contact with humans elicits a GC response in gorillas, but habituation reduces this response over time.

We found some evidence to support this hypothesis, as gorillas undergoing habituation and recently habituated gorillas had significantly higher FGCMs than un-habituated gorillas. These findings are similar to those for other species: tourism-exposed black howler monkey groups (*Alouatta pigra*), European pine martins (*Martes martes*) and little penguins (*Eudyptula minor*) all had significantly higher faecal cortisol than non-tourism-exposed groups of the same species (Barja, et al. 2007; Behie, et al. 2010; Turner 2001). However, long-term habituated gorillas did not differ significantly from un-habituated gorillas, which may indicate that long-term habituation reduces the GC response to human contact to a similar level to that when there is no contact at all.

The FGCM levels of the group undergoing habituation were significantly higher than those of the long-term habituated group and unhabituated gorillas, which supports prediction 1b, although they were not higher than the recently habituated group. These results are similar to a study that showed that FGCMs in unhabituated orangutans that had been followed by humans for several days were higher than those of habituated animals after human contacts (Muehlenbein, et al. 2012). Together, these two studies provide evidence that unhabituated animals mount a stronger GC response than habituated animals when contacted by humans.

The most parsimonious explanation of the differences in FGCMs we observed between the gorillas groups may relate to their habituation status. That is, for gorillas, not being contacted by humans at all may be the least stressful situation compared to being under habituation or recently habituated. However, with time, habituation may result in gorillas perceiving human contact as less of a threat, and therefore less stressful, so that long-term habituated animals have lower FGCM levels than those undergoing habituation. However, these between-group comparisons should be interpreted with caution, and do not necessarily allow us to conclude that the variation in FGCM levels are a direct result of human-exposure, as differences in FGCMs are not necessarily indicative of a stress response (Breuner, et al. 2013). For example, elevated FGCMs may simply reflect a normal response to stimuli, which does not necessarily equate to fitness costs (Treves 2005) and individuals may have different basal levels of stress hormones (Ostner, et al. 2008; Shutt, et al. 2012). Environmental stressors are not equal across individuals or groups, and FGCM differences may be related to seasonal, diet, and

life history differences (Romero 2002) as well as behavioural differences (Muehlenbein, et al. 2012). We found no significant individual or seasonal effects on FGCMs, and controlled for age-sex class in our analyses, making these unlikely explanations for the between-group variation in FGCMs. However, we were unable to control for nutritional differences between groups, or the effects of any demographic changes in gorillas undergoing habituation and unhabituated gorillas. Furthermore, GC responses to human exposure may be influenced by animal temperament and context (Martin and Réale 2008). Therefore, we adopted a stronger, more informative approach and explored a gorilla groups' FGCM response to habituation (hypothesis 2), and the response of habituated groups to measures of daily human contact (hypothesis 3).

7.4.2. Hypothesis 2: the process of habituation is perceived as a threat by gorillas

Although our specific predictions that FGCMs would rise significantly and decrease after 48-68 hrs after contacts were not supported, our findings still provide support for this hypothesis. We observed a significant increase in FGCMs 48 hr after three contacts (but not one or two contacts) had been made with the group on one day. This result is similar to results of an experimental study which found that sparrows exposed to three stressors per day had significantly increased endogenous corticosterone levels compared to those that received only one (Busch 2008). This may suggest that the disturbance caused by one or two contacts per day is not perceived a great enough stressor by the gorillas at this stage in their habituation to cause significant alterations to the FGCM response, but that three contacts in the space of one day are. However, we also detected a significant increase in FGCMs following the initial peak response within the 48 hr period, which continued to rise during time between contacts for up to 21 days, instead of decreasing around 62 hrs as we predicted. This finding suggests that human contact (irrespective of the number of contacts per day) is perceived as a stressor, which results in an increased GC release by the gorillas during the process of habituation. This finding contrasts with the FGCM response to human-visitation in habituated and unhabituated orang-utans, which returned to baseline levels within 48 hr (Muehlenbein, et al. 2012). As it is not possible to carry out physiological validation using sedation or ACTH challenge with the wild gorillas, we cannot conclude whether the elevated FGCM levels rose sufficiently above their basal levels to become bound to the hormone receptor that activates the stress response (Breuner, et al. 2013) and thus represent a true stress reaction. However, if allostatic overload persists and GCs are above basal levels for days or weeks, this may result in what is often termed ''chronic stress", which can alter baseline GCs, stress-level GCs and/or the duration of the GC response to stressors (Busch, et al. 2008; Busch and Haywood 2009).

The rising GC response we observed in the days following contacts may be due to a state of anticipatory vigilance (Arthur 1987; Busch 2009). A single predator attack, or a severe attack by a dominant conspecific, may cause an animal to anticipate more of the same and thus to become chronically stressed (Boonstra 2012; Clinchy, et al. 2010). This response is well-illustrated in humans and other animals responding to chronic unpredictable stressors (Arthur 1987; Burchfield 1979; Clinchy, et al. 2010; Davis and Levine 1982), and may have similar cognitive underpinnings to those preceding post-traumatic-stress-disease in humans (Boonstra 2012; Muehlenbein, et al. 2012; Yehuda 2002). If the rising FGCM response of the group undergoing habituation is due to a physiological reaction to anticipation of a chronic intermittent stressor such as habituation, this would offer an explanation as to why the FGCMs of unhabituated human-contacted orangutans returned to baseline 48 hr later (Muehlenbein, et al. 2012), as the orangutans were not undergoing the process of habituation.

We observed a large amount of variation in the day 0 FGCM levels (Figure 7.2), which may indicate other influential environmental or social stressors in the lives of this gorilla group which we were unable to control for in the study. If this is the case, then it may suggest that the effect of the habituation process in an FGCM context is no different to other energetically challenging events that occur in the lives of these gorillas. However, if the group undergoing habituation do react physiologically to contacts with humans with a long-term (<21 days) elevation in FGCMs, as figure 2 suggests, then this in itself may explain the large variation in FGCM levels observed in the day 0 samples before contacts were made. For example, if contacts were made with the group during the 21 days (or potentially longer) prior to the collection of day 0 samples, variation on day 0 may result from the animals' physiological response to this earlier contact, whilst other animals may have returned to a non-anticipative baseline FGCM level. Thirdly, like brown bears during the hunting season (Ordiz, et al. 2012), gorillas under habituation detect humans before contact is made and adjust their movements accordingly (Blom, et al. 2004; Cipolletta 2003; Doran-Sheehy, et al. 2007). If the gorillas under habituation perceive a threat of human contact continually, this may combine with the effect that increased physical activity as a result of human avoidance may have on GC release (Filaire, et al. 1996; Li, et al. 2012) and contribute to the sustained increase in FGCM levels observed in the days after contacts made with the group undergoing habituation.

7.4.3. Hypothesis 3: Elements of human-gorilla contact may still elicit a GC response in habituated gorillas

We found no associations between FGCMs in the habituated groups and the time humans spent in visual or non-visual contact, the total numbers of people visiting the group each day, or the occurrence of tourism. These results suggest that current human-gorilla contact regulations are effective at preventing significant FGCM increases. However, variation in the tourism variables was generally small and our methods may not be sufficiently sensitive to detect adrenocortical responses to relatively subtle variation.

Our findings do not, however, necessarily suggest that the long-term and recently habituated gorillas are not chronically stressed, as physiological alterations can occur in response to repeat stressors in the absence of detectable FGCM alterations (Busch and Haywood, 2009). For example, desensitisation can occur without habituation, where an organism remains chronically stressed by a repetitive threatening situation but there is no, or a blunted, physiological response as the axes mediating the response have been down-regulated (Busch 2009; Cyr and Romero 2009; Rich and Romero 2005). This seems to be the case in Magellanic penguins (*Spheniscus magellanicus*) exposed to tourism (Walker, et al. 2005; 2006) and is well documented in research investigating the stress impacts of wildlife tourism on other animal species (Fowler 1999; Millspaugh and Washburn 2004; Müllner, et al. 2004; Sakellaris and Vernikos-Danellis 1975).

Our finding of significantly increased FGCMs in both habituated gorilla groups in response to the medical intervention is not surprising as the intervention required close and persistent follows of individual gorillas. We expected this process to elicit a temporary GC response, compensated by a long-term health benefit (details in Walsh, et al. in prep). Our most important finding, however, was that transgressions of the 7 m distance rule were associated with an increase in FGCMs in both habituated gorilla groups in initial analyses, and remained significant in the recently habituated group overall, which provides support for prediction 3. Similar findings are reported in tourism-exposed Barbary macaques (*Macaca sylvanus*), where a rise in FGCMs was detected in response to aggressive (possibly closer) interactions with tourists (Marechal, et al. 2011).

7.5. Management Implications

Although there is debate as to whether naturally occurring chronic stress results in pathology (Boonstra 2012), immunosuppression and illness are commonly linked to chronic

intermittent stress (Busch and Haywood 2009; Cohen, et al. 2007; McEwan 2008). Given that the group undergoing habituation and the recently habituated group had higher FGCMs than unhabituated gorillas, it would seem prudent to take all measures possible to reduce potential causes of FGCM elevation in habituated groups and those undergoing habituation in order to reduce potential physiological impacts of their imposed contact with humans.

7.5.1. Habituation

Our findings are important in understanding hormonal habituation and provide a useful tool with which to assess GC variation during the vulnerable phase of habituation. A key implication of our study is that contacts made with gorillas undergoing habituation elicit a significant FGCM response, which accumulates in the days following contacts, and may be indicative of a chronic stress response. This enforces the need to conduct routine, direct, visual monitoring of gorillas undergoing habituation for indications of ill health that would advise termination or modification of a habituation programme, such as weight loss, ectoparasitic infection (Cyr and Romero 2009) and behavioural alterations. Samples should also be collected non-invasively to monitor health or establish other measures of 'downstream' physiology (Breuner, et al. 2013) that would clarify the status and physiological impacts of potential chronic stress in the group. Furthermore, if the FGCM response to human visitation reduces with increasing habituation, as our between-groups comparison suggests, then it would be prudent to carry out habituation as consistently as possible. This means that the decision to start habituation should not be made without ensuring the availability of funds and mechanisms to locate and monitor gorillas and priority should be placed on completing habituation over research and tourism demands, once started.

7.5.2. Research and Tourism with Habituated Groups

We observed that humans often broke the 7 m regulation and that this was linked to increasing FGCM levels in recently habituated gorillas. This suggests that managers should consider increasing the minimum viewing distance beyond 7 m. Research on habituated western lowland gorillas found that behavioural alterations, such as increased visual monitoring of humans and low-level aggression directed at humans, decreased when visitors remained at 10 m from gorillas (Klailova, et al. 2010), suggesting that FGCM levels may also decrease, but further research is be necessary to test this possibility. A greater distance regulation would also reduce the risks of direct human-gorilla disease transmission and bring the site in line with the most recent IUCN recommendations (Williamson and Macfie 2010).

Finally, our results may be representative of the effects of human-visitation on other species in similar contexts where habituation for close-contact research and tourism is used for conservation. The implications of our study are likely to be more widely applicable to other such ecotourism and conservation management contexts. The development and application of similar studies to monitor and advise ecotourism management strategies is vital if it is to offer a sustainable wildlife conservation solution.

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Chapter 8 - Faecal glucocorticoids and gastrointestinal parasite infections in wild western lowland gorillas involved in ecotourism

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This paper is predominately the work of the first author K.Shutt (KS). KS conceived the study in conjunction with J.Setchell (JS) and K. Petrzelkova (KP). KS carried out all field work with data collection assistance from B.Kalousova (BK), I.Profousova (LP), T.Fuh (TF), J.F.Dicky (JFD) and J.Bopolanzognako (JB). A.Todd (AT) provided technical and logistical support in the field. KS wrote the manuscript. MH conducted all hormonal analyses and provided expert review of the endcrinological data analyses and interpretation. BK performed all parasitological analyses supported by KP and IP, D. Modry (DM) provided expert review of the parasitological data analyses and interpretation in conjunction with KP. A.Kasim (AK) provided expert statistical review. JS provided supervisory review of the manuscript.

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Abstract

Wildlife ecotourism can offer a source of revenue which can simultaneously benefit local development and conservation. However, habituation can cause long-term elevation of glucocorticoid hormones which may suppress immune function and increase an animal's vulnerability to disease. We aimed to test the relationship between endocrine and immune function in the context of wildlife habituation and ecotourism. We predicted that that faecal glucocorticoid levels (FGCM) would be positively associated with the intensity of infection of stronglylid nematodes in two groups of wild western lowland gorillas that are habituated for tourism, and that the group undergoing habituation with the highest FGCM levels, would have a higher intensity of infection of stronglylid nematodes than the long-term habituated group. We collected 949 faecal samples over 12 months for FGCMs and established the intensity of infection *Necator*/*Oesophagostomum* spp. and *Mammomonogamus* sp. in a subset of 314 samples (as an index of immune function). Controlling for seasonal variation in parasite infections, we found a positive relationship between FGCMs and the intensity of infection of *Necator*/*Oesophagostomum* spp. across all individuals and in the long-term habituated group. However, there was no relationship between FGCMs and intensity of infection of *Mammomonogamus* sp. and no significant difference in monitored parasitic infections between groups. Our findings support the hypothesis that elevated glucocorticoids reduce a host's ability to control the extent of parasitic infections. Monitoring endocrine-immune interactions may inform conservationists of any detrimental physiological effects that may be associated with habituation and ecotourism activities.

Key Words: Primate, conservation, endocrine, immunity, non-invasive

8.1. Introduction

Ecotourism has been advocated as a tool to conserve endangered species and habitats as it can bring educational and socio-developmental benefits to local people as infrastructure builds around tourism and conservation activities (Williamson and Macfie 2010). Before ecotourism activities can commence wildlife must often be habituated to human presence. Habituation refers to an animals' waning response following repeated stimulation (such as the arrival of humans in their environment) without reinforcement (Thorpe 1963 in Williamson and Feistner 2001). The few available studies of animals' physiological response to habituation have reported that animals undergoing the process typically have elevated glucocorticoid levels during this time (e.g., Walker, et al. 2006; Barja, et al. 2007; Turner, et al. 2008; Behie, et al. 2010). While an acute rise of glucocorticoids in response to a stressor is an adaptive physiological response in the short term, chronically elevated glucocorticoid output is linked to pathology, reduced fitness and increased mortality (Selye 1955; Sapolsky and Spencer 1997; Sapolsky 1992, 2000; Tilbrook, et al. 2000; Wingfield and Romero 2001; Pride 2005; Cyr and Romero 2008; Boonstra 2012, 2013). In particular, increased cortisol suppresses the immune system (McEwan 1998). Animals subject to habituation and tourism stressors may therefore have increased susceptibility to diseases (Hofer and East 1998; Hudson, et al. 1992; Meder 1994; Woodford, et al. 2002).

No study has yet combined hormone and gastrointestinal parasite infections in the context of habituation or ecotourism (Muehlenbein 2009), but several studies have tested the hypothesis that increased glucocorticoid output is positively associated with parasite infections in primates. Five studies support this hypothesis: a study of red colubus (*Piliocolobus tephrosceles*) in Kibale National Park, Uganda, found a positive association between faecal cortisol and intensity of nematode infection (Chapman, et al. 2007); faecal cortisol and testosterone were positively associated with gastrointestinal parasite richness in male chimpanzees (*Pan troglodytes*) in the same National Park (Muehlenbein 2006); faecal cortisol was positively related to parasite diversity in mandrills (*Mandrillus sphinx*) (Setchell, et al. 2010); and variation in hormone levels was associated with parasite species richness and parasite infection intensity in red-fronted lemurs (*Eulemur fulvus rufus*) However, two other studies found no support for the hypothesis: glucocorticoids and parasite richness were not significantly associated in gibbons (*Hylobates lar*) in Thailand (Gillespie, et al. 2013), and faecal cortisol and parasite infection (*Trichuris* sp., and *Strongyloides* sp.) were not related in a second study of red

colobus (*Procolobus rufomitratus*), or in black colobus (*Colobus guereza*) in humanized versus non-humanized sections of forest in Kibale National Park, Uganda (Hodder and Chapman 2012).

The rapid decline of great apes over recent years highlights the urgent need for data to inform conservation strategies; health monitoring of remaining ape populations, particularly those at risk from known anthropogenic disturbances, is central to this process (Howells, et al. 2011). As part of a larger study of the influence of habituation, research and ecotourism on the physiology of an endangered great ape, the western lowland gorilla (*Gorilla gorilla gorilla*), we compared non-invasively-established levels of faecal glucocorticoid metabolites (FGCMs) with the intensities of infection of strongylid nematodes in two groups of gorillas. We have previously shown that one group, which was undergoing the process of habituation for ecotourism at the time of the study, had significantly higher FGCM levels than the other group, which was well-habituated, and had been visited by tourists and researchers for several years (Shutt, et al. in press). Previous coproscopic analyses revealed 11 parasite taxa across the gorilla groups including five protists (*Blastocystis* sp., *Entamoeba* spp., *Prototapirella gorillae*, *Troglodytella/Gorillophillus* spp., unidentified entodiniomorphid ciliates) and four nematodes (*Strongyloides* spp*., Mammomonogamus* sp*.,* unidentified strongylids, unidentified spirurids) and one cestode (*Bertiella* sp.). Filariform larvae developed by coprocultures showed that the unidentified strongylids belonged to two genera, *Necator* and *Oesophagostomum* (Hasegawa, unpublished data). They are considered pathogenic (Brooker 2004; Collet, et al. 1986; Terio 2011) and their prevalence is widely reported in previous studies of gorillas (Freeman, et al. 2004; Masi 2008; Masi, et al. 2012). We therefore chose these parasite species (*Necator/Oesophagostomum* spp. and *Mammomonogamus* sp.) to be monitored in relationship to FGCM levels.

We predicted that, if increased glucocorticoid levels affect strongylid infections, then FGCM levels would be positively associated with the intensity of strongylid infection and that the group undergoing habituation would have higher intensities of infection than the long-term habituated group, as the former has higher FGCM levels.

8.2. Materials and methods

8.2.1. Study site and subjects

We conducted our study at Bai Hokou site (33 N 663109, 316187UTM) in the Dzanga-Sangha Protected Areas (DSPA) in the Central African Republic (CAR). The DSPA are co-managed by the CAR government, the World Wildlife Fund and the Primate Habituation Programme

(PHP). For a more detailed description of the study sites see Carroll (1986b). Gorilla habituation aimed at developing ecotourism and research activities at Bai Hokou commenced in 1997. Today, tourists (426 in 2011) can visit a long-term habituated group (Makumba) at Bai Hokou and a further gorilla group (Mata) is undergoing the process of habituation for future research and ecotourism activities at the same site. At the time of conducting the study the Makumba group consisted of 9 individuals and was well habituated to human observers at 7 m. The individuals in the Mata group were not yet identifiable, as their stage of habituation meant that contacts with the habituation teams were fleeting and irregular. We estimated that the group consisted of approximately 8 individuals, however, based on nest site-count data.

8.2.2. Faecal sample collection

We collected faecal samples from November 2010 to November 2011. We worked with local BaAka trackers to collect samples non-invasively from both groups. The habituated status of the Makumba group meant that we could collect samples from identified individuals within 30 minutes after we observed defecation although we could usually do so immediately. We collected freshly defecated (<12 hr) samples from the nests of the Mata group and were assisted with the identification of age/sex classes of the faeces by experienced trackers, according to the faecal bolus size, nest size and position (Remis 1997; Tutin, et al. 1995).

We collected a small portion (~0.5 g) of faeces from each sample and homogenized it well before placing it into 4 ml of 90 % ethanol in water. We detected no effects of urine contamination on FGCMs (Shutt, et al. 2012). Nevertheless, we took all sample portions from the centre of the faecal bolus where it should not have been affected by urine. We followed validated methods to avoid variation in our FGCM measurements resulting from sampling, extraction and storage (Shutt, et al. 2012). This meant we extracted all samples within 24 hr and stored 0.5 ml of dried faecal extracts in the field before shipping them to the German Primate Centre endocrine laboratory for hormone analysis.

We collected samples for parasitological analyses from the same faecal bolus, aiming to sample each individual in Makumba group three times each month, although in some months we only achieved two samples per individual. For Mata group we could identify samples from the silverback's nest and took two samples per month for each age-group of adult females, sub-adults, juveniles/infants. We took approximately 2 g of faeces and fixed it with 4 % formaldehyde in 10 ml vials. We stored samples at ambient temperature before shipping them to the Department of Pathology and Parasitology, University of Veterinary and Pharmaceutical Sciences, Brno, Czech Republic, for parasitological analyses.

8.2.3. Hormone analyses

We carried out FGCM measurements using a 11ß-hydroxyetiocholanolone (3a,11ß-dihydroxy-CM) enzyme immunoassay which we have previously shown to be physiologically, biologically and immunologically valid for measuring FGCM output in our study species (Shutt, et al. 2012). Inter-assay coefficients of variations for these measurements were 9.2 % (high value quality control) and 15.1 % (low value quality control). We removed any samples with known complications (e.g., seeds discovered in the faecal matrix or alcohol evaporation).

8.2.4. FGCM Data

FGCMs decrease over time in un-preserved gorilla faeces (Shutt, et al. 2012). The temporal degradation pattern is best described by a polynomial fit, $Y = 0.0039x^2 - 0.0844x + 0.9976$, where x = time between defecation and preservation. We calculated the age of faecal samples collected from nests using the precise collection time and the average time gorillas leave their nests (5:30 am: K. Shutt pers. obs.; A. Todd pers. comm.) and used this information to compensate for hormone degradation in samples not collected immediately. We obtained a corrected value (A) from the original wet hormone content value (B) using A = B*100 / Y. We found no diurnal variation on FGCMs (Shutt, et al. 2012) so used all samples for analysis. We express all hormone data as hormone content per faecal wet mass.

8.2.5. Parasite analyses

To prepare samples for parasitological analyses, we homogenized each sample and strained it through a sieve into Falcon conical tubes (50 ml). We diluted samples with Phosphate Buffer Solution up to 50 ml volume and centrifuged them for 5 min at 2000 rpm. We then weighed the sediment and re-suspended it in 10 ml of 4 % formaldehyde. For coprological examinations we used Sheather's flotation with modified sugar solution (specific gravity 1.33) (Sheather 1923). We mixed 2 ml of the re-suspended faecal sediment with distilled water in a flotation tube and centrifuged it for 3 min at 2000 rpm. We then removed the supernatant and mixed the sediment with sugar solution and centrifuged it for 3 min at 2000 rpm. We transferred the surface film onto a microscopic slide with a horizontal loop, added a cover-glass and examined each sample using a light microscope at 200× magnification.

We then used a simple sedimentation method (Kassai 1999; Zajac and Conboy 2012) for thorough examination, as recommended by Gillespie (2006), but modified it to count strongylid eggs. For this, we put 2 ml of the faecal suspension into Eppendorf tubes and centrifuged it for 2 min at 1500 rpm. We poured the supernatant off and transferred the remaining sediment onto

a microscopic slide using a micropipette, put a cover-glass on it and examined it using a light microscope under 400× and 1000× magnification. We counted all the strongylid eggs on the slide. We repeated this procedure until we had examined all of the sediment, examining 2 g of sample in 10 ml solution at a time, then calculated the number of eggs per gram of sediment (EPG) using the following equation: eggs/g of sediment=N/(m/5) where N=number of eggs and m=mass. Here, we reported prevalence and intensity of infection (EPG) of found strongylid nematodes (*Necator/Oesophagostomum* spp., *Mammomonogamus* sp.) The exact determination of strongylids to the genus or species level is unreliable when based only on egg morphology. *Mammomonogamus* sp. is the only strongylid, which can be distinguished on the basis of egg morphology so we were able to count the eggs of *Mammomonogamus* sp. individually. Based on the results of coprocultures (Hasegawa, unpublished data), we knew that the remaining eggs belonged to either the genus *Oesophagostomum* or *Necator sp*., and so we grouped eggs of these two genus' together.

8.3. Statistical analyses

8.3.1. Control variables

Before testing our predictions we ran a series of analyses using generalised linear mixed effect models (GLMMs) with a Gaussian distribution and identity link for continuous variables to investigate variation in our dependent variables (EPG of *Necator/Oesophagostomum* spp. and *Mammomonogamus* sp.) between age-class categories, the two sexes (Makumba group only as we did not know the sex of all samples identified from nests), and wet (April-October) and dry months (November to March). We used individual identification as a random effect for analyses for Makumba group as we could identify the individual for each sample, and age-class category as a random effect for Mata group as we did not always know which individual produced the sample. We retained control variables significant at p=0.05 and later included these in the relevant hypothesis testing models.

8.3.2. Hypothesis testing

First, we used GLMMs to test our prediction that increasing FGCMs are associated with increasing intensity of infection of strongylid nematodes. We tested the association between our independent variable, FGCM levels, and our two outcome variables, intensity of infection of *Necator*/*Oesophagostumum* spp. and *Mammomonogamus* sp. across all individuals (i.e., both gorilla groups). We used *group* and *age-class* as random effects as we could not identify all

samples to the individual level in Mata group. We then ran the models again including any influential control variables from our initial analyses as fixed affects.

As we had data at the individual level for the Makumba group, but not for the Mata group, we also tested the same associations between FGCMs, *Necator*/*Oesophagostumum* spp. and *Mammomonogamus* sp. infection in the two groups separately. For Makumba group, we used *individual identification* as a random factor and included significant control variables from our initial analyses as fixed effects. For Mata group we used *age-class* as a random effect as we could not identify the samples to the individual level in this group. We again repeated the models including any significant control variables as fixed effects. Finally, to test our prediction that the Mata group would have higher intensity of parasite infection than the Makumba group, we again used GLMM to compare the mean intensities of infections of both strongylid (*Necator*/*Oesophagostumum* spp. and *Mammomonogamus* sp.) between the two groups, including *age-class* as a random effect in the model given the lack of individual identification in the Mata group.

We conducted all statistical analyses in R2.14.2 using function lme of the R package nlme. We report the mean difference (MD), standard error (SE) and p-value for each association tested. We show the variance (Var) and standard deviation (SD) for the random effects component of the GLMM models in the results tables. We used the natural logarithm of our hormone (lnFGCM) and parasite data (ln *Necator/Oesophagostumum* spp. infection eggs/gram and ln*Mammomonogamus* Sp. eggs/gram) in all analyses to achieve a normal distribution. We report significant associations at p=0.05.

8.4. Results

8.4.1. FGCM Measurements.

The group mean FGCM level was 104.85 ng/g wet weight faeces for Makumba group (n=553, range 15.96 - 327.69 ng/g, SD=53.8 ng/g), and 120.2ng/g for Mata group (n=398, range=19.1 - 423.1 ng/g, SD=60.0 ng/g).

8.4.2. Parasitological Infection.

For Makumba group the prevalence of *Necator/Oesophagostumum* spp. was 98 %, with a mean intensity of infection 26.25 EPG (n=257, range 1-178.5 EPG, SD=28.67 EPG). For Mata group the prevalence of *Necator/Oesophagostumum* spp. was 100 %, and the mean intensity of infection was 39.43 EPG (n=57, range 1-231.88 EPG, SD=51.87 EPG). The prevalence of infection

with *Mammomonogamus* sp. in Makumba group was 54 %, with a mean infection of 2.90 EPG (n=257, range 1-24.39 EPG, SD=4.19 EPG). The prevalence of *Mammomonogamus* sp. in Mata group was 70 %, mean intensity of infection 2.44 EPG (n=57, range=1 - 23.19 EPG, SD=3.58 EPG). We describe the diversity and prevalence of all other parasites identified elsewhere (Kalousova & Shutt, et al. in prep).

8.4.3. Control Variables: Effect of sex, age-group and season on strongylid infections

We found no effect of *sex* or *age-class* on the intensity of infection of *Necator/Oesophagostumum* spp. in Makumba group (Table 8.1), but the intensity was significantly lower in the *wet season* than in the *dry season* (Table 8.1). In Mata group we detected effects of *age-class* and *season*. Infants and juveniles had a significantly higher intensities than the silverback (Table 8.2), and intensity of *Necator/Oesophagostumum* spp. infection was again significantly lower in the *wet season* than in the *dry season* (Table 8.2). We found no effect of *sex*, *age-class* or *season* on the intensities of infection of *Mammomonogamus* sp. in Makumba (Table 8.1) or Mata group (Table 8.2).

8.4.4. Hypothesis testing: FGCMs and intensity of infections of strongylids

FGCM levels were significantly positively associated with intensities of infection of *Necator/Oesophagostumum* spp. across the two groups, and this relationship remained significant when we included season in the model (Figure 8.1, Table 8.3). We also found a significant positive association between FGCMs and *Necator/Oesophagostumum* spp. intensity of infection in Makumba group alone, which also remained when we included season in the model (Figure 8.2, Table 8.1). We found the same significant positive association between FGCMs and *Necator/Oesophagostumum* spp. intensity of infection in Mata group (Table 8.2) but it was no longer significant when we included the effect of season in the model (Table 8.2). We found no significant differences in mean intensities of infection of *Necator/Oesophagostumum* spp. between the two groups (GLMM: MD=0.090, SE=0.153, p=0.56).

We found no association between FGCMs and the intensity of infection with *Mammomonogamus* sp. across the two groups (Table 8.3), nor within the Makumba or Mata group alone (Tables 8.1, 8.2). We found no significant differences in mean intensity of infection of *Mammomonogamus* sp. between the two groups (GLMM: MD=-0.081, SE=0.105, p=0.443).

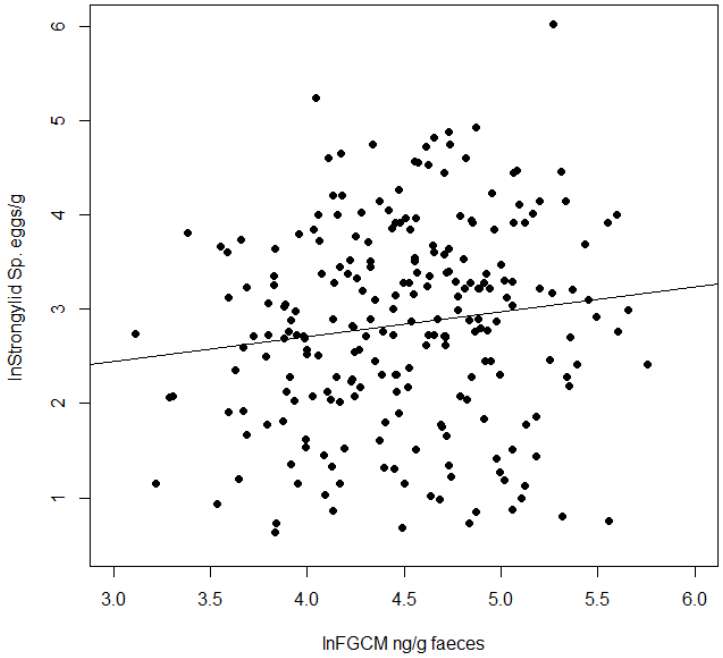

Figure 8.1. Association between ln FGCM levels and ln Necator/Oesophagostumum spp. infection levels across all individuals in two gorilla groups.

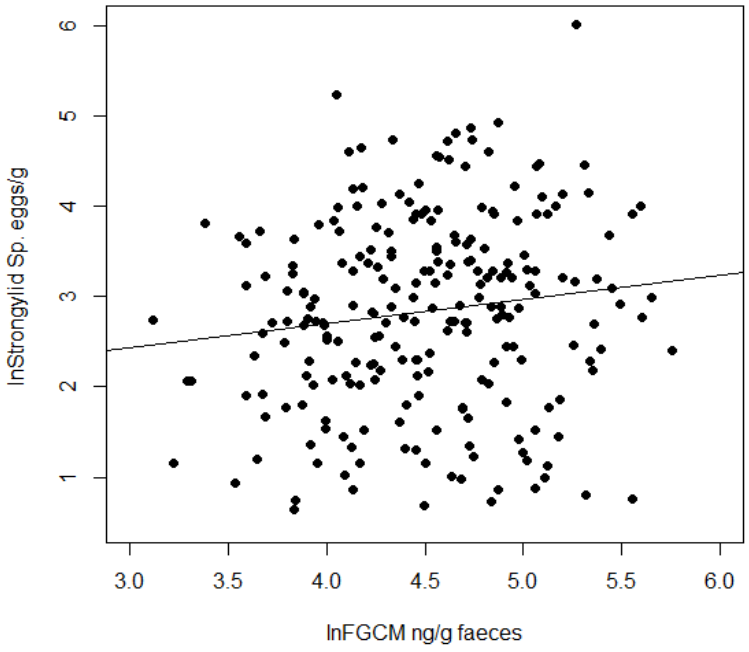

Figure 8.2. Association between lnFGCM levels and ln Necator/Oesophagostumum spp. infection levels in the Makumba group.

Table 8.1. Results of GLMM analyses testing the association between control and hypothesis variables and *Necator/Oesophagostumum* spp. and *Mammomonogamus* sp. in the Makumba group.

Control Variables		**Necator/Oesophagostumum Spp.**			**Mammomonogamus sp.**		
		MD	SE	P-Value	MD	SE	P-value
Sex	Model Intercept	2.852	0.160	0.001	1.448	0.078	0.001
	Male/Female	-0.036	0.219	0.870	0.021	0.103	0.837
			Random Effects			Random Effects	
			Var	*StDev*		Var	*StDev*
		Identification	0.066	*0.257*		0.000	0.000
		Residual	1.061	*1.030*		0.344	0.587
Age Category Differences Compared to the Silverback	Model Intercept	2.721	0.261	0.001	1.448	0.115	0.001
	Age Group - 2	-0.226	0.382	0.554	-0.116	0.209	0.580
	Age Group - 3	-0.121	0.327	0.711	0.144	0.146	0.326
	Age Group - 4	0.288	0.314	0.360	-0.083	0.141	0.559
	Age Group - 6	0.326	0.313	0.299	0.047	0.150	0.753
			Random Effects			Random Effects	
			Var	*StDev*		Var	StDev
		Identification	0.035	*0.187*		0.001	0.001
		Residual	1.069	*1.034*		0.344	0.086
Season	Model Intercept	3.067	0.117	0.001		0.103	0.001
	Wet/Dry	-0.441	0.133	***0.001***		0.103	0.236
			Random Effects			Random Effects	
			Var	*StDev*		Var	*StDev*
		Identification	0.043	*0.208*		0.001	0.001
		Residual	1.027	*1.014*		0.341	0.584
Hypothesis Variables		MD	SE	P-Value	MD	SE	P-Value
Association with FGCM levels	Model Intercept	1.285	2.109	0.036	1.609	0.455	0.001
	FGCMs	0.347	0.133	**0.010**	-0.033	0.100	0.744
			Random Effects			Random Effects	
			Var	*StDev*		Var	*StDev*
		Identification	0.069	0.262		0.001	0.001
		Residual	1.037	1.018		0.344	0.586
Including the effect of season with FGCM levels in the model					N/A	N/A	N/A
	Model Intercept	1.784	0.620	0.004			
	FGCMs	0.280	0.133	**0.036**			
	Season	-0.394	0.133	**0.003**			
			Random Effects				
			Var	*StDev*			
			0.0581123	0.2410649			
			1.0065292	1.0032593			

Table 8.2. Results of GLMM analyses testing the association between control and hypothesis variables and *Necator/Oesophagostumum* spp. and *Mammomonogamus* sp. in the Mata Group.

Control Variables		**Necator/Oesophagostumum Spp.**			**Mammomonogamus sp.**		
		MD	SE	P-Value	MD	SE	P-Value
Sex		N/A	N/A	N/A	N/A	N/A	N/A
Age Category Differences							
Compared to the Silverback	Model Intercept	2.327	0.212	0.001	1.227	0.140	0.001
	Age Group - 3	0.566	0.293	0.058	0.534	0.197	0.075
	Age Group - 4	0.566	0.540	0.299	-0.291	0.327	0.379
	Age Group - 5	1.166	0.367	***0.002***	-0.054	0.264	0.837
	Age Group - 6	1.046	0.410	***0.013***	0.097	0.608	0.873
			Random Effects			Random Effects	
			Var	*StDev*		Var	*StDev*
		Age Category	*0.509*	0.713		0.075	0.273
		Residual	0.988	0.994		0.347	0.589
Season	Model Intercept	3.532	0.174	0.001	1.469	0.139	0.001
	Wet/Dry	-1.105	0.230	**0.001**	-0.135	0.184	0.467
Hypothesis Variables		MD	SE	P-Value	MD	SE	P-Value
Association with FGCM levels	Model Intercept	0.435	1.218	0.722	1.406	1.125	0.221
	FGCMs	0.545	0.257	**0.039**	-0.035	0.236	0.882
			Random Effects			Random Effects	
			Var	*StDev*		Var	*StDev*
		Age Category	0.146	0.381		0.079	0.281
		Residual	0.939	0.969		0.351	0.592
Including the effect of season							
with FGCM levels in the model	Model Intercept	1.672	1.096	0.132	N/A	N/A	N/A
	FGCMs	0.401	0.227	**0.082**			
	Season	-0.970	0.209	**0.001**			
			Random Effects				
			Var	*StDev*			
			0.141	0.375			
			0.712	0.844			

Table 8.3. Results of GLMM analyses testing the association between control and hypothesis variables and *Necator/Oesophagostumum* spp. and *Mammomonogamus* sp. across both gorilla groups (Makumba and Mata).

Accross groups Hypothesis Testing		**Necator/Oesophagostumum Spp.**			**Mammomonogamus sp.**		
		MD	SE	P-Value	MD	SE	P-Value
Associaition with FGCMs and							
including the effect of season in	Model Intercept	2.046	0.586	0.001	1.853	0.483	0.001
the model	FGCMs	0.350	0.114	**0.002**	-0.045	0.095	0.636
(N/A for Mammomonogamus Sp.)	Season	-0.512	0.114	**0.001**	N/A	N/A	N/A
			Random Effects			Random Effects	
			Var	*StDev*		Var	*StDev*
		Age Category	0.087	0.295	Age Category	0.015	0.121
		Group	0.001	0.001	Group	0.001	0.001
		Residual	0.961	0.980	Residual	0.349	0.586

8.5. Discussion

We report the findings of the first study combining measures of glucocorticoids and strongylid nematodes (O*esophagostumum/Necator* spp. and *Mammomonogamus* sp.) in the context of habituation and ecotourism. We detected an influence of season and age-class on the intensity of infection of *Oesophagostumum/Necator* spp., but not on the intensity of infection of *Mammomonogamus* sp. We found support for our hypothesis that FGCMs are positively associated with the intensity of infection of particular gastrointestinal parasites in the western lowland gorilla: FGCMs were positively associated with the intensity of infection of *Oesophagostumum/Necator* spp. across the two gorilla groups and within individuals of the habituated group, although not in the Mata group undergoing habituation. No associations were found between intensity of infection of *Mammomonogamus* sp. and FGCMs however, and we did not find support for our prediction that the mean intensity of strongylid infections would be higher in the Mata group than the Makumba group as a result of their higher mean FGCMs.

Egg output has been used in many studies of primates as a measure of parasite intensity (Chapman, et al. 2006a; Kyvsgaard, et al. 2011; Muller-Graf, et al. 1996; Stoner 1996). However, there is debate as to whether the number of parasite eggs shed in the faeces is linearly correlated with the intensity of infection (Anderson and Schad 1985; Bush 2001; Cabaret, et al. 1998; Warnick 1992). High variability of individual and temporal egg output can mean that using egg output as an estimate of parasite intensity is unreliable. Several ecological factors affect this variability. For example, rates of egg shedding can depend on the density of adult female worms within the host, as some parasite species release eggs or larvae intermittently, whereas prepatent adults, larvae or adult males do not excrete eggs at all (Anderson and Schad 1985; Warnick 1992; Cabaret, et al. 1998). The fixation and examination technique employed can also affect the quantification of egg output (Foreyt 2013; Mes 2003; Warnick 1992). For example, gorillas often swallow whole seeds during fruiting seasons (Knogge and Heymann 2003) and other feeding residuals such as plant fibres or undigested food matter excreted in faeces can affect the original faecal mass. In the present study we minimized the effects of feeding residuals variation on our egg quantification by referring the faecal sediment mass to the total number of eggs only after the removal of feeding residuals, rather than simply using the original faecal mass.

Our finding that FGCMs are associated with intensity of infection with *Oesophagostomum/ Necator* spp. is consistent with other studies of primates that found associations between elevated faecal glucocorticoids and parasite infections (Chapman, et al.

2006; 2007; Muhelenbein 2009; Setchell, et al. 2010; Clough, et al. 2010). Chronic overproduction of mediator hormones controlled by the hypothalamic-pituitary-adrenal axis such as glucocorticoids and catecholamines can disrupt the production of immune factors such as cytokines and lymphocytes (Cyr and Romero 2009; McEwan 1998; McEwan and Wingfield 2003). Studies have shown that elevated glucocorticoids contribute to immune suppression in humans and animals (Råberg, et al. 1998; Sapolsky 1998; Sapolsky, et al. 2000), and some studies demonstrate a specific immunosuppressive effect of steroid hormones resulting in increased parasite infections (Klein 2004; Zuk and McKean 1996). It is therefore possible that our results also demonstrate an inhibitive effect of elevated FGCMs on the hosts' immune function and therefore their ability to control parasitic infections and resulting higher parasite fecundity demonstrated by higher egg output (Else 2005; Moreau and Chauvin 2010; Periago and Bethony 2012; Quinnell, et al. 2004). However, as our findings are correlative, we cannot infer the causal direction of the relationship between FCGMs and *Oesophagostumum/Necator*. It is possible that the relationship is in fact the reverse, as increased intensities of parasite infections may result from stimulation of the stress response by parasitic infection as part of the immune response (Chapman, et al. 2007; Lochmiller and Deerenberg 2000). For example, increases in male androgen and glucocorticoid levels in red fronted lemurs (*Eulemur fulvus rufus*) during the mating season were followed by a time-lagged increase in nematode infection intensity (Clough, et al. 2010). However, the authors also found a long-term change in male steroid hormone levels across years, indicative of a negative association of nematode infection intensity, which may demonstrate a potential immune-enhancing, rather than inhibiting function of the androgens and glucocorticoids on parasite infection. The time-lagged response of parasite infections to endocrine changes can be explained by a prepatence period which is the parasite-specific time needed from infection of a host by a parasite to excretion via the faeces. Information regarding the prepatence period is not available for the monitored parasites in gorillas, however, the prepatent period for *Necator americanus* in chimpanzees was 42-54 days (Orihel 1971). The reported prepatent period for *Oesophagostomum* spp. in animals varies with different authors (see Talvik, et al. 1997) but is reported as less than 60 days in humans (Ziem 2006). Subsequently, it was not possible to observe the time-lag response for monitored parasite infections in the current study, therefore, interpretation of the direction of our results must be done with care.

Other factors may also influence the relationship between FGCMs and parasite infections. The nutritional status of an animal can also interact with its immune response and affect an animal's susceptibility to parasitic infection (Chapman, et al., 2006; 2007). Both

Oesophagostomum and *Necator* have the potential to cause intestinal pathology (Brack 1987 cited in Huffman, et al. 1997; Chapman, et al. 2006b). Strong infections with these nematodes may influence the host's nutritional status, reducing the energy available to control the intensity of parasitic infections (Chapman, et al. 2006b; Koski and Scott 2001; Kyriazakis, et al. 1998).

Nutritional status can be strongly connected with seasonal variation in food availability, and may go some way to explaining the strong influence of season in our models. The intensity of infection of *Oesophagostumum/Necator* spp. was significantly lower in the wet season (May to October) compared to the dry (November to April) season. This difference remained a significant influence when combined with our predictor variable FGCMs in the across groups model and in the Makumba group model, and was more influential than the effect of FGCMs in the Mata group model. The latter finding may also be due to the smaller sample size and weaker level of sample identification (age-class only) for Mata group; but the strong influence of season on parasite ecology in general is not surprising as seasonal effects are widely reported among primates (e.g., Mexican howler monkey (*Alouatta palliata),* black howler monkeys (*Alouatta pigra*), Trejo-Macias and Estrada 2012; Japanese macaques (*Macaca fuscata*), MacIntosh, et al. 2010; Mandrils (*Mandrillus sphinx*), Setchell, et al. 2010). Our finding is consistent with another study from the same site (Masi, et al. 2012). Transmission of *Oesophagostomum/ Necator* spp. may be higher in the dry season at Bai Hokou, as the gorillas visit forest clearings (bais) more frequently (PHP, unpublished data), and the flowing water may provide a favourable environment for the development of infective filariform lavae as in other river and swamp habitats (Levine 1968). Additionally, in humans, studies in West Africa showed that populations of filariform larvae in the environment are highest during the rainy season (Udonsi, et al. 1980), but faecal egg counts in host faeces are highest 2–7 months after the rainy season (Knight and Merrett 1981; Nwosu 1981), which supports our findings.

FGCM levels were not associated with the intensity of infection of *Mammomonogamus* sp. *Mammomonogamus* sp. are found in many host species (e.g., buffalo, Graber, et al. 1972; elephants, okapi and humans, Mornex, et al. 1980), as well as gorillas (Freeman, et al. 2004). *Mammomonogamus* infections can pose a serious health risk to great apes and is reported to have caused deaths in orang-utans (Collet, et al. 1986). The parasite exists and reproduces as a single breeding pair in the trachea of the host where it may cause pathology to the bronchial airways (Acha PN 2003; Castelli 2004; Nosanchuk, et al. 1995). It is therefore possible that infections by this parasite may not be dependent of the host's immune status, however, the life

cycle of this parasite is partially unknown and thus interpretation of the lack of a relationship between glucocorticoids and intensity of infection is difficult.

Although we found a relationship between FGCMs and the intensity of infection with *Oesophagostomum/Necator* spp. across the two groups and in Makumba group, our results did not support our predication that Mata group, which was undergoing habituation and had significantly higher FGCM levels than Makumba group, would also have a higher intensity of infection of strongylids. It is possible however that the differences between the two groups may have been affected by the smaller sample size in the Mata group as a result of non-identifiable data, and much data sets for both hormone and parasitic measurements.

Habituation and ecotourism present novel, anthropogenic sources of potentially chronic elevated glucocorticoids in animals. Studies demonstrating the suppressive effects of elevated glucocorticoids on human and non-human animal physiology are abundant (reviews in Sapolsky 1992, 2000). Glucocorticoid-parasite interactions are therefore of great interest to evolutionary biologists, as they represent life-history trade-offs between hormone and immune function processes (Muehlenbein 2004, 2006), and to conservationists, in terms of monitoring the health of endangered species. This type of information would be most usefully applied to conservation if connected to direct fitness outcomes in animals with variable parasitic infections (Chapman, et al 2006). Given that experimental manipulation is not appropriate with endangered animal species, however, non-invasive monitoring of variation in available indices such as parasite infections provide an important source of information regarding any potential physiological effects of habituation and ecotourism on targeted animal species.

8.6. Acknowledgements

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Chapter 9 - Human-gorilla interactions: risks and regulations

"Arguably one of the most significant impacts that people may have on the wildlife they watch is through the transmission of infectious diseases"

(Muehlenbein, et al. 2010).

In this chapter I integrate biological and anthropological data collected at the Bai Hokou study site to explore how, and why, humans in this specific context pose health risks to the gorillas they encounter. I review the questionnaire, interview and ethnographic data in light of the current regulations upheld at the specific site, the suggested IUCN best practice regulations and summarise the findings. I discuss the subsequent management implications and recommendations in the following chapter (Chapter 10).

9.1. Introduction

An estimated 50 million people from the industrialised world now cross international borders to tropical or subtropical destinations with the aim of encountering different cultures, societies and economies and at the same time encounter different microbiological environments (Castelli 2004). In addition to their luggage, travellers carry their genetic makeup, immunological history of past infections, cultural preferences, customs and behavioural patterns and are accompanied by microbes, animals and other biological life (Wilson 1995).

75 % of the 1415 known human pathogens causing emerging infectious diseases are zoonotic (Taylor, et al. 2001). New zoonoses are suggested to have emerged many times from wildlife, but may have failed to spread from their source historically as infected people died or recovered before contacting larger human populations. In modern times, however, the exponential rise in volume and speed of trade and travel has transformed the epidemiology of emerging infectious diseases, resulting in global, rather than local, effects of the outcomes of disease outbreak events (Karesh and Noble 2009). For example, the West Nile virus in North America, and HIV and SARS globally, emerged as a result of human encroachment deeper into

wildlife habitats, and spread as a result of extensive globalisation of people and products (Daszak, et al. 2001). Over the last 30 years more than 30 new diseases have emerged (World Health Organisation 2002), many of which appear to have originated from the African continent (Wilson 1995).

Ecotourism accounts for a significant proportion of all international tourism and is increasingly seen as a means to promote and raise revenue for wildlife conservation, increase public awareness and support local developing economies (Muehlenbein and Ancrenaz 2009). However, a growing concern relating to increasingly adventurous expansion of ecotourism development in wildlife habitats is the risk of anthropozoonotic pathogen transmission (Travis, et al. 2008). This is a particular worry for primate species that are phylogenetically closely related to humans, and has been highlighted in relation to the development of ape-based ecotourism (McNeilage 1996; Butynski & Kalina 1998; Homsey 1999; Woodford, et al. 2002; Kondgen, et al. 2008; Travis, et al. 2008). However, despite the issue slowly moving up the research agenda since the 1990s (Daszak, et al. 2003), there is still very little information regarding the sources of infection and routes of transmission which would allow more effective preventative measures to be taken in such contexts (Travis, et al. 2008).

Wild apes die from multiple causes, often from unknown diseases (Meder 1994). In West Africa, Ebola haemorrhagic fever is the biggest killer of western lowland gorillas and chimpanzees (Walsh 2008), both wild and human-habituated (Bermejo, et al. 2006; Boesch 2008). The scant information available regarding causes of death in mountain gorillas indicates that respiratory infections are the second highest cause after various forms of trauma and that deaths occur predominantly during the rainy season when local human populations also experience multiple outbreaks (Cranfield 2008). Besides this, there is little documented on the causes of deaths in gorillas which would add to an understanding of the disease threats that occur naturally in their habitats (Wolfe, et al. 1998). However, several suspected cases of disease transmission and associated sources of infection between humans and habituated primates have been documented (Muehenbein 2008). Cases of suspected transmission of human poliomyelitis and pneumonia to chimpanzees emerged in the 1990s (Hosaka 1995; Kortlandt 1996; Wallis and Lee 1999), during which mortality rates reached as high as 30 % of the population at Gombe and 20 % at Mahale (Lukasik-Braum and Spelman 2008). Byers & Hastings (1991) reported the first case of a habituated gorilla dying from a suspected human viral pneumonia infection, which spread to 81 % of the group, and killed a further five animals despite vaccination intervention. In 1990, bronchopneumonia reached 26 of 35 tourist-visited

mountain gorillas, resulting in two deaths (Macfie 1996). It is also well documented that gorillas in zoos in North America and Europe contract bacterial infections consistently following infection with a human respiratory virus (Janssen 1993). Suspected, but not proven, transmission of gastrointestinal pathogens and bacterial infections from humans to great apes have also been reported (Graczyk, et al. 2002; Nizeyi, et al. 2001) and human-origins confirmed in other outbreaks (Goldberg, et al. 2007; Graczyk, et al. 2001). In 2008, Kondgen, et al presented the first direct evidence of fatal human paramyxovirus transmission to habituated chimpanzees in the Thai forest, Cote d'Ivoire. This finding makes the human-viral-origin of the Mahale chimpanzee fatalities even more likely, as the human-related metapneumovirus was later found in faecal samples from surviving chimpanzees (Kaur, et al. 2008).

9.1.1. How apes contract diseases from humans

Disease can be transmitted to apes from humans entering their environment via two main routes: aerosol/inhalation and faecal/oral transmission (Homsey 1999). Aerosol/inhalation facilitates the transmission of infectious agents via coughing, sneezing, spitting or nose-blowing. The risk of infection is directly proportional to the closeness of contact, and this route transmits common human diseases such as colds and influenza efficiently, as well as poliomyelitis, mumps, measles, chicken pox, and tuberculosis, to which apes are extremely susceptible (Homsey 1999; Wolfe, et al. 1998, Woodford, et al. 2002). Other varieties of pathogens can be transmitted from humans by faecal/oral routes, such as spitting, defecating or vomiting, and can cause potentially fatal illnesses such as chronic diarrhoea and other severe intestinal infections, including hepatitis A and B and poliomyelitis (Yu, et al. 2004). Footwear has also been known to spread infectious disease (Woodford, et al. 2002), which can present a considerable risk if people visit multiple groups of apes in close succession and fail to disinfect their footwear. Human metapneumovirouses can also survive 20 minutes in fresh secretions, such as sweat, on hands or plain surfaces (Kondgen, et al. 2008) such as food wrappings. Thus viruses can be transported indirectly into ape habitats on human clothing, food items or by simply touching the environment (Kaur & Singh 2008). Apes can also be at risk from disease long after tourists have departed the forest and even in the absence of close contact events (Homsey 1999). Agents such as polio are capable of surviving several months in soil, and others, such as measles, can be transported over great distances in the open (Homsy 1999). Cultures of *Mycobacterium tuberculosis* maintained at 37 ^{o} C have been found to be viable and infective after 12 years when protected from sunlight (Baker 1995; Chadwick 1982; Woodford, et al. 2002). The dark and humid tropical environment that apes inhabit therefore makes perfect

conditions for the cultivation of highly infectious pathogens which would otherwise be eliminated (Woodford, et al. 2002).

9.1.2. Human sources of disease exposure

The current trend in tourism based on novel adventures translates into more tourists increasingly entering remote, isolated and sometimes poorly accessible regions of the world in search of rare and meaningful encounters (Homsey 1999). This has meant that increasingly, wild, endangered species such as great apes have to be habituated to human presence before such tourism activities can commence. Once apes are habituated and no longer flee the approach of humans, they may receive multiple and/or extended daily visits from humans. For example, Homsey (1999) calculated that the habituated mountain gorilla groups of East Africa were exposed to an average of more than 2,000 visitor hours per year, which meant over 900 hours of additional visits by guides, rangers and trackers accompanying the tourist parties. This equated to gorilla groups' exposure to more individuals per year than the average person meets in their lifetime, and represents, "from an epidemiological point of view, a very effective means of transport for an increased number of exotic germs due to the speed and diversity of modern transport systems" (Homsey 1999, P5). Three main categories of humans can be described in terms of the different roles they have in relation to habituated gorillas, and the disease transmission risks they may present to them. These are: a) tourists b) researchers, conservation management staff and media crew c) local trackers, guides and guards, as well as local inhabitants (although local inhabitants are not discussed in detail).

a). Tourists

International tourists of Western origin typically plan their great ape encounters many months in advance as the journeys can require significant financial and logistical planning. The long international journeys commonly required to reach ape habitats present unique opportunities for close contact with large numbers of other individuals (e.g., transportation, terminals, accommodation and tour groups), many of whom may harbour influenza and other respiratory pathogens (Freedman and Leder 2005). For example, when an aeroplane holding 54 passengers, one of whom had influenza, was grounded for 3 hours with a faulty air conditioning system, clinical influenza developed in 72 % of the other passengers (Moser, et al. 1979). Additionally, not long after arrival at their destinations tourists often suffer from locally acquired intestinal infections as a result of unfamiliar food and the disrupted sleep patterns and difficult travel may stress tourists and reduce normal immunity making them more vulnerable to infection (Woodford, et al. 2002). Given the distance and expense of reaching the remote

habitats of great apes many tourists plan a full itinerary of activities during their stay of typically 5-14 days in the ape habitat countries (Williamson and Macfie 2010). This means tourists can exit international planes and find themselves in close proximity of wildlife within one or two days, moving quickly from site to site. The problem here is that the diseases of greatest concern can be transmitted without direct or prolonged contact (Leendertz, et al. 2011), and are often novel respiratory strains against which wildlife, particularly highly susceptible great apes, have had no previous exposure and thus have no resistance (Ferber 2000; Garber 2008). For example, Adams, et al (2001) conducted a self-reported medical history survey of visitors to habituated chimpanzees in Kibale National Park, Uganda. The results indicated a high prevalence of clinical signs of disease, particularly diarrhoea and several current infections. Although great ape tourism sites generally stipulate that tourists must declare illness as a standard regulation, tourists have often paid large sums of money and can be unwilling to reveal they are ill (Woodford, et al. 2002), or may not think to do so simply because they do not perceive that there is a real risk of disease transmission (Homsey 1999). Additionally, even for those that may be willing to declare, viral shedding can occur long before symptoms appear (Kaur and Singh 2008).

b). Researchers, management staff and media crew

Researchers, management staff and media crew (film crews/photographers/journalists) present a particular concern in the context of human contacts with habituated great apes, given their close, relatively prolonged contact, and moral responsibility (Macfie & Williamson 2010). As such, it has been suggested that those engaged in research, management or media-based occupations with habituated great apes, should obey even stricter hygiene protocols than tourists (Woodford, et al. 2002). However, researchers and media-personnel at several gorilla habituation sites are permitted to work at closer distances to the habituated animals they study or capture than tourism regulations permit. For example, at Mondika in Northern Congo, researchers are permitted to work at 5 m from the gorillas, where as tourists must remain at 7 m (T. Breuer, personal communication). The behaviour of researchers and media personnel can also be affected by their work agendas. For example, those on tight research or filming schedules have a great responsibility to achieve extensive contact with gorillas, which may subsequently foster strong motivations to break the rules (C. Cipolletta, personal communication). Equally, long term researchers may find themselves relaxing adherence to the rules over time as fatigue and familiarity set in (personal observation). Although, like tourists, western-based researchers and other expatriate staff generally have access to good health care

before leaving their countries, they tend to stay *in situ* for longer periods of time than tourists, and become vulnerable to local diseases and infections, often more so than the local people, who may have developed resistance over time. This can make researchers and management staff an even greater risk to ape health than tourists. In fact, international or local researchers were the likeliest source of infection causing the fatal outbreaks documented by Kondgen, et al (2008).

c). Local trackers, guides and guards

It is possible that disease may be introduced into the habitats of great apes by local communities, military, local hunters and so on, however, at many project sites ape habituation relies heavily on the expertise of such local people. It is also often a key aim of many conservation and development oriented projects to provide employment in the area and thus revenue to assist in developing livelihoods and conservation awareness. However, guides, guards, and particularly trackers, have daily, frequently close, extended contact with apes, more so than tourists, researchers and management staff. They are, however, least likely to have access to health care or vaccination schemes and often understand little about the routes and risks of disease epidemiology due to poor education standards. Ironically, safety protocols at many viewing sites stipulate that the trackers and guides should be closer to animals than tourists and researchers, and if researchers work at 5 m from the apes, so too must the trackers and local staff. Reward-based schemes for making contacts with gorillas are also common in habituation programmes, and financial pressures driving project staff to work in spite of illness or to push closer on consecutive contacts often go unrecognised and unmonitored (C. Cipolletta, personal communication; personal observation). Guides may be put under pressure to allow tourists to get closer to gorillas during tourist visits in the hope of receiving a greater tip, or as a result of tourists demanding a more memorable experience and video footage (McNeilage 1996; Chapter 3). Surprisingly however, only one study of the health risks to great apes from humans has included conservation personnel, despite the fact that their exposure-related activity should, in theory, be most easily managed (MGVP 2002).

9.1.3. Ape viewing regulations

Visitation rules for mountain gorillas were first initiated in 1985 in Rwanda and were initially designed to avoid behavioural alterations and over-habituation (Lukasik-Braum & Spellman 2008). Disease transmission was not a consideration at the time (Lukasik-Braum & Spellman 2008 citing B. Weber personal communication). These regulations were revised in 1999 by a team of veterinarians, doctors and researchers who were concerned about the

possibility of human-ape disease transmission (Homsey 1999). These have been revised as research on the topic progresses and adopted by most ape habituation and tourism sites in Africa. The most recent review of great ape tourism practice was published by the Primate Specialist Group of the IUCN in 2010 (Williamson and Macfie, 2010). Sites now strive to adhere to these revised regulations and to achieve 'best practice' status.

The current best practice regulations include ways to reduce the risk of direct and indirect disease transmission, and also aim to reduce the potential for stress in the gorillas, which would increase vulnerability to current and novel diseases. IUCN regulations aimed at preventing direct transmission of diseases include: a minimum age of 15 due to highly contagious childhood diseases; declaring illness and not entering the forest when ill; maintaining a minimum distance from the gorillas (this increased from 5 m to 7 m as a result of evidence that sneeze particles travel up to 7 m in still conditions, Homsey 1999 and again to 10 m in the IUCN guidelines after evidence of pathogen transmission was reported by Kondgen, et al. 2008; Kaur and Singh 2008); no eating or drinking near gorillas and prohibition of waste disposal in the forest; washing of hands before entering the forest and if people need to defecate in the forest the faeces must be buried at least 30 cm deep at a minimum of 500 m from the apes or water sources. Indirect measures to reduce disease transmission risks by reducing stress in the gorillas suggest that only one tourist visit should be made to each gorilla group per day, and that a maximum number of four people (for lowland gorilla species), instructed to stay together, should be maintained in dense forest conditions to avoid loss of control of visitors and over-crowding of the apes.

In light of the growing direct evidence of the human origins of fatal disease outbreaks in habituated apes, the recent compilation of the IUCN best practice guidelines was an appropriate platform for discussion regarding the necessity of further measures to reduce disease transmission (Macfie and Williamson 2010). Since one of the biggest risks of human-ape contact comes in the form of air-borne pathogens (Cranfield 2006), discussions followed concerning whether humans in close proximity to apes should wear N95 surgical respirator masks. The use of such masks was originally discussed when the minimum viewing distance was revised from 5 – 7 m in 1999, but the decision to implement their use was postponed due to concerns about mask management and compliance (Macfie and Williamson 2010). The use of facemasks presents advantages and disadvantages. The primary advantage is that under normal conditions the masks effectively create a barrier to exhaled pathogens and should thus reduce risk of air-borne pathogen transmission. The disadvantages are that under tropical, humid conditions, the

efficacy of the masks reduces over time and they can cause discomfort and steaming-up of spectacles that can impede vision and photography. There were also concerns that the apes visited would need to be habituated to the sight of observers wearing facemasks despite the common array of clothing, hats and equipment and so on that tourists and researchers wear regularly. There is, however, increasing advocacy for the use of facemasks by researchers, tourists and staff alike (Macfie and Williamson 2010). The current IUCN guidelines now recommend that all persons approaching to less than 10 m (but a minimum of 7 m) should wear the N95 facemasks. Several sites have implemented this regulation during tourism visits only, while others have adopted the practice in full (facemasks are worn by all humans near to apes at all times), especially those sites that have experienced fatal disease outbreaks in their study populations (Macfie and Williamson 2010).

Another option that ape tourism sites have to reduce disease transmission risk is to request evidence of vaccinations from all visitors before they are allowed to visit the apes. Recent research has shown that this regulation may be particularly prudent, as a large proportion of tourists visiting wildlife sanctuaries underestimate their own risk of infection as well as their potential to contribute to the spread of diseases (Muehlenbein 2008; 2009; 2010). Muehlenbein, et al (2008) describes several studies which demonstrate travellers' poor knowledge, attitudes and practices concerning health and disease risk perceptions in general (Annelies Wilder-Smith 2004). Specifically, few travellers use pre-travel health advice or preventative medicine (Koen Herck 2004), whilst many have poor vaccination histories relative to the risks presented by the countries they travel to (Lopez-Velez and Bayas 2007; Muehlenbein, et al. 2008; Prazuck 1998). Tourists also recall their vaccination histories poorly (Wilder-Smith, et al. 2004) and appear to lack basic understanding of common sources and causes of infection and health risks (Herck, et al. 2004; Wilder-Smith, et al. 2004; Zuckerman and Steffen 2000). Tourists on specific primate tourism trips were also found to present risks to the species they visit as a result of being ill and potentially infectious, and as result of having had recent contact with children or domestic animals en route (Muehlenbein, et al. 2010). Therefore, whilst it can be assumed that ecotourists are concerned with species conservation in general, evidence suggests that they are largely uninformed or misunderstand the extent of the risks their health can pose to the wildlife they visit (Muehlenbein, et al. 2010). Vaccination regulations introduced at some ape-viewing sites now ask for evidence of current polio, tetanus, measles, mumps, rubella, hepatitis A and B, yellow fever, meningococcal meningitis, typhoid and tuberculosis (or negative skin test results in the last 6 months). There are no available immunisations for the common cold and those for influenza strains need updating every year so

vaccination records are not a solution for all diseases of concern. However, it is suggested that, at a minimum, this forced awareness of the requirements should reinforce visitors' perceptions that their personal health is a real threat to the apes they visit and stimulate willingness to adhere to regulations during their visit (Macfie and Williamson 2010).

Despite growing concerns about disease transmission risks, the pattern of inter-species transmission and the extent to which it influences wildlife populations is still little studied and poorly understood (Butynski 1998; Nizeyi, et al. 2001; Kondgen, et al. 2008) and little empirical data exists to support adoption or enforcement of these measures. In particular, little has been done to assess the impacts of human activities on targeted wildlife species in ecotourism contexts. There is, therefore, a lack of accurate data connecting human social and epidemiological factors with direct influences on wildlife, such as disease transmission to wildlife, incurred during imposed human-wildlife interactions. The data presented in this chapter aims to address this problem.

9.2. Research aims

I set out to investigate the following questions:

- What are tourist perceptions of the risk of disease transmission to gorillas?
- What health risks do the different categories of human visitors present to habituated gorillas via their:
    - health and vaccination status?
    - disease risk exposure?
    - disease risk behaviours?
- How and why do the current gorilla-viewing capacity regulations fail?

9.3. Methods

A full description of the daily research and tourism practices at the study site is detailed in Chapter 2, section 5.3, and the gorilla tracking regulations are outlined in Chapter 2, section 2.5.6. Table 9.1 details the data drawn on in this chapter. In summary, I gathered information about people's perceptions using the same combination of questionnaires, interviews and participant observation methods used in Chapters 3 and 4. The questionnaires (section 4) also enabled me to gather specific data from respondents about their current health status and vaccination histories. I use data from behavioural observations of humans with gorillas on

coughing frequencies and 7 m rule violations, presented in part in Chapter 5. I supplemented my personal data regarding the number of people with gorillas each day with the Bai Hokou long-term project data.

	Data Section	Interviews	Questionnaires	Participant observation and ethnography	Instantaneous Behavioural Observations	Bai Hokou Project Records
		Thesis section 3.4.1, P45	Thesis section 3.4.2, P46	Thesis section 3.4.3, P47	Thesis section 3.3.4, P42	Thesis section 3.3.4,
1	Tourist's perceptions regarding the risk of disease transmission to gorillas	X	X	X		
2	Health risks that people present to gorillas via their:					
	a. health and vaccination status	X	X	X		
	b. disease risk exposure	X	X	X		
	c. disease risk behaviours	X		X	X	
3	How and why do the current capacity regulations fail			X		X

Table 9.1. Methods used to address each key question in this chapter and the location of detailed descriptions of each in the thesis.

9.4. Results and Discussion 1: risk perceptions

9.4.1. Tourist perceptions of the risk of disease transmission to gorillas

195 people responded to the question *"Why do you think it is important to stay more than 7 m from gorillas during your visit?"* (section 5.1 of the questionnaire, Appendix 2). Of these responses, 64 % mention the word *disease* directly or implied reasons relating to gorilla health in their responses. Other reasons fall into the categories of *safety for humans* (18 %), *not disturbing the gorillas* (10 %), and a small group of miscellaneous *other* (7 %) some of which are discussed in following sections. Dividing these responses according to the 'wildlife specific' and 'opportunistic visitor' groups described in Chapter 3, it emerges that a greater percentage of the wildlife specific group give responses indicating that they are aware of disease transmission risks (69 %) than the opportunistic visitor group (52 %), and a greater percentage of the opportunistic visitor group think that the rules are there for their own safety (22 %) compared with the wildlife specific group (4 %).

The finding that wildlife specific tourists are better informed about disease transmission risks also emerged during interviews, conversations and observations of tourists' discourse. I identified two key reasons for this difference. First, international tourists plan their trips based on motivations that often related to an interest in gorilla conservation, as discussed in Chapter 3, thus they are more likely to be aware or exposed to information pertaining to disease

transmission risks from various sources of literature. For example, in response to my interview question:

> *If you had woken up with a cold this morning would you have known that you should not go ahead with the gorilla trek?*
>
> One woman in the wildlife specific group replies:
>
> *... well we were sent some information about the gorilla trek and the rules 'n' stuff when we booked the trip so when I read that it reminded me that I'd heard somewhere else, maybe in a magazine where I'd read about gorilla trekking, that tourists can give gorillas diseases, I was quite surprised when I read that though, I remember.* (Sheila, interviewee)
>
> And another couple add:
>
> *Oh yes, we were well aware for a while now since booking the trip that we would not be able to go near the gorillas if we were sick! It would just be completely ridiculous if we came here wanting to help gorilla conservation somehow and ended up making them sick!* (Jan and Bob, interviewees)

Secondly, as also discussed in Chapter 3, many of the wildlife specific group had previously visited mountain gorillas or lowland gorillas where they would have been exposed to safety briefings and health protocols. Many of the tourists reiterate this point, some even suggesting that they did not need to hear the briefing at Bai Hokou as they had heard it all before when visiting mountain gorillas:

> *You can just say the briefing quickly as we've been to see mountain gorillas so we know it.* (Phill and Sue, observed during briefing)
>
> *Argh, we've really heard this so many times now.* (Kate, observed during briefing)

Similarly, those who have recently visited the neighbouring western lowland gorilla tourism site in Mondika – Congo, as part of their travels, appear highly informed regarding the risks of disease transmission.

> *Oh yes we read a lot about it in Mondika, they are very keen about the idea of good health and provide you with a lot of information, which was super, as then we could really appreciate how important it is, you don't realise it otherwise as everything gets organised by the agency.* (Vanessa, interviewee)

In contrast, an opportunistic visitor informed me that:

The only reason I knew about the disease thing, you know, that I shouldn't be ill was because a friend of mine has been here and had mentioned to me something about it, otherwise I really wouldn't have had a clue.(Delia, interviewee)

Another opportunistic visitor from the capital, Bangui, is less well informed:

Nope, not a sausage, that's the first I've ever heard on the topic. And to be honest, I'd be a bit pissed off if I got here not knowing and was turned away for having a cold. Like, if I knew it was bad for the gorillas, sure, not a problem, but it's a bloody long way to come to be told at the last minute you can't do what you came for isn't it? (Adrian, interviewee).

It is notable that even expatriate visitors from Bangui feel that the distance they have travelled would factor in their response to being prohibited from visiting the gorillas if ill. This emphasises the need for clear provision of information to all tourists at the time of booking, especially those booking and travelling internally from the capital, as the information currently provided (Appendix 1) is apparently often missed or not sufficiently emphasised by Bangui booking routes. Moreover, the responses indicated to me that, for the large part, gorilla tourists would more readily declare illness if suitably warned in advance. For example, there seems to be a widespread vague understanding that sick people are a bad thing for gorillas, however very few people fully understood why, which illnesses are problems, or how they are transmitted to gorillas:

So, have gorillas really been died from human diseases then? (Sarah, discussion in forest)

Really? So, they can get a cold just like us? And they would sneeze and cough like us too? (*G*eoffrey, conversation during the briefing)

Tourists also appear to desire information as to why their being ill is a problem for gorillas.

It would be better to indicate some literature as to why disease is a problem for gorillas, I don't know of any such cases. (Questionnaire respondent)

Interestingly, several tourists, receiving instructions during their briefings that they should cover their mouths with clothing if coughing and turn away from the gorillas, question as to whether this is because the noise of the cough would upset the gorillas, rather than being for prevention of disease transmission:

> *Ah yes, so we don't make noise around them (gesturing covering the mouth with their jumper).* (Claude, observed during briefing)

> *Is that because the noise will cause them to charge? What about camera clicking? (*Jennifer, observed during briefing)

In contrast, several tourists indicate their awareness of the fact that colds and flu-like symptoms might prevent them from visiting gorillas and make the specific point of informing me or the guide giving the briefing that they suffer from allergies:

> *I was so worried there would be a problem for me today, I have terrible allergies and of course it looks just like I have a cold! I almost went to see my doctor to get a note but I thought it would be ok here but it's terrible.* (Simone, interviewee)

In general, the impression I received from tourists who had visited other gorilla tourism sites and been made aware of disease transmission risks, was that the precautionary measures were perceived as a good thing, and encouraged visitors to adhere to regulations as part of a caring and conservation-oriented activity:

> *Oh no it was really not a problem for us, we were aware that if we were sick we would not go and that's just bad luck but when you see how much the staff care for the gorillas it just fills you with pride and you feel better about intruding on the lives of the gorillas when so much care is taken.* (Josh, interviewee)

> *Actually I don't mind at all, when you see a proper set-up with some structure it makes you feel like you're part of some valid conservation and like it might be useful – I prefer when there's better organisation even if it's a bit of a palaver.* (Timothy, interviewee)

These quotes suggest that the visible adoption of disease prevention regulations help respondents to resolve any cognitive dissonance they may have as a result of feeling that they are intruding on the lives of gorillas, but at the same time, wanting to contribute to gorilla conservation. The rules surrounding disease prevention made these tourists feel that they were part of valid conservation efforts. Chapter 3 described how many tourists expressed this sentiment, hoping that their financial contributions would also recompense for any disturbance

they caused. Curtin (2010) describes how serious wildlife tourists she studied also expressed a similar quandary regarding the disturbance of birds they wanted to watch ("I always worry that my being there is going to change what they are doing" Curtin, 2010, P229 citing a respondent), and notes how this situation, being close to wildlife, creates a difficult contradiction for people. This finding is important for management implications, as if the imposition of regulations enables the conscientious tourist to feel better about their experience, this goes some way towards addressing the problem of simultaneously wrestling with the demands for an *authentic experience* and the wellbeing of the wildlife, which Knight (2000) describes as one of the biggest challenges for managers.

During interviews with tourists I often asked if they thought they were having any negative influences on the gorillas by visiting them. This elicited two predominant responses. The first was based on tourists' impressions that the gorillas ignored them, thus they assumed no negative influence (43 % of respondents).

> *I don't think we disturbed them they just carried on doing what they wanted really, I was surprised.* (Stan, interviewee).

The second was a more philosophical response, where, again, people exhibited dissonance with their decision to visit, due to potential negative influences such as disturbance to gorilla behaviour, habitat and to the local human population, but balanced these considerations against the potential financial and physical protection for gorilla conservation (37 % of respondents).

> *Yeah I imagine we do have an impact on them, like their behaviour maybe, but then if we didn't come would they be protected from hunters? I think it's probably worth it [some negative influence].* (Peter, interviewee)

> *They are flag ship species aren't they? So the money should protect the whole area so even if it's maybe a bit bad for them in the short-term. It's better in general.* (Tim, interviewee)

Curtin (2010) reports a similar issue expressed among various wildlife tourists, who suggest that if *"I don't come, someone else will and nothing will be gained"* (Curtin, 2010, P231, citing a respondent), or that if tourism didn't exist the wildlife would not be valued and would be destroyed. 15.7 % of the respondents gave a reply to my question regarding their potential negative influence on the gorillas which included reference to the risk of disease transmission to gorillas. The remaining 4.6 % gave mixed answers including one suggestion from an

opportunistic visitor from Bangui, that it would be better for the gorillas to be provisioned each day with bananas and make a hide for humans to sit in and watch them.

Finally, in total, 76 % of the 111 people I had the opportunity to ask said that they would not have been aware that if they had developed a cold that they should declare it and cancel their visit to the gorillas. This figure fits well with the impression of generally poor awareness of disease transmission risks I gathered from my discussions, observations and interviews with tourists, and is consistent with other studies demonstrating tourists' poor awareness of the health risks they pose to wildlife (Wallis and Lee 1999; Wallis 2004; Jones-Engle and Engle 2006; Muehlenbein and Ancrenaz 2009; Muehlenbein, et al. 2010). The questionnaire results that show a poor understanding of the 7 m rule are particularly surprising, given that tourists filled in the questionnaire at the end of their visits to gorillas after having received the briefing informing about the health and safety regulations. These findings indicate both a general prior lack of awareness among tourists, especially opportunistic visitors, regarding disease transmission risks, and that the information they receive prior to their gorilla visits is doing little to rectify this.

9.5. Results and Discussion 2: health risks that humans pose to gorillas

9.5.1. Tourist health status

The most common self-reported symptoms of illness experienced by 216 tourists during the 3 weeks prior to or during their trips were diarrhoea (12.0 %), runny nose (9.7 %), sneezing (8.3 %), hay fever (4.6 %), vomiting (4.2 %) and coughing (3.7 %). Throat infections occurred in 1.9 % of respondents, and nasal, skin and respiratory infections were reported by less than 1 % of respondents. Muehlenbein, et al. (2010) found that tourists visiting semi-captive orang-utans who had medical backgrounds were more likely (or perhaps more able) to report sickness symptoms. Rates of reported illness symptoms may therefore be underestimated in the current study. It is also possible that tourists may have been reluctant to report illness after their visits in case of repercussions if, for example, a gorilla became sick, or their anonymity was not respected by researchers. In their study of chimpanzee tourists in Kibale, Uganda, Adams, et al. (2001) report much higher incidence rates for symptoms of fever (82 %), coughing (64 %) respiratory distress (26 %), diarrhoea (24 %) and vomiting (24 %) than found in the current study. However, the chimpanzee tourists were asked to report their health symptoms from the six months prior to their visit, which is much longer than the three week period required in the current study and potentially explains the higher rate of reported illness symptoms. The finding

that diarrhoea and vomiting were frequently experienced symptoms in the current study's three week period is, however, consistent with Woodfood, et al's. (2002) suggestion that tourists often experience diarrhoea on arrival in new countries, which is likely to be related to the consumption of contaminated food by the non-immune western travellers that can lead to gastrointestinal problems or systematic diseases such as hepatitis A and typhoid fever (Castelli 2004). In general, the reported rates of illness symptoms in the current study, particularly for fever, respiratory and throat infections, are low. However, the fact that runny noses, sneezing and coughing were also among the most frequently experienced symptoms (and at a greater rate than hay fever conditions are reported) could be indicative of the onset of colds/influenza-related infections which have not yet developed or been recognised as a particular medical condition. This provides some cause for concern that infectious stages and viral shedding during incubation periods are often before the onset of recognisable symptoms, as highlighted by Kaur and Singh (2008).

Of 189 respondents, 69.6 % reported that they were currently taking malaria prophylaxis and the most common preventative taken was *Malarone*. Almost a third of visitors (30.4 %) reported not taking preventative measures against malaria. These results are very close to those reported by Castelli (2004) for a survey carried out across four continents, which showed that 25 % of European travellers surveyed going to highly malaria-endemic countries did not perceive malaria as a risk. While the direct risk of malarial disease transmission from gorillas to humans in this context is low, these results add to the greater picture of tourists' low adherence to readily available travel-sickness preventative information and inaccurate disease risk perceptions.

9.5.2. Local, management and research/support staff health status

In comparison to tourist's sickness symptoms, the rates reported by the local BaAka and Bilo (Bantu) project staff who are employed as trackers and research/camp assistants, were high. For the 32 staff members interviewed, reported symptoms experienced during the previous three weeks were: colds/flu symptoms (including runny noses and coughing) (82 %), diarrhoea/blood in stools (68 %), headaches (59 %), fever (45 %), stomach cramps/digestion problems (48 %), tooth problems (5 %), malaria or suspected malaria (45 %), abscesses (32 %), vomiting (15 %), muscular/bone problems (33 %). It is worth acknowledging that the BaAka may have been more willing to disclose health ailments to me than tourists, given their employment status and our working relationship, however, these levels of sickness symptoms are representative of the low standard of health experienced in the area, and the general

population of the CAR. Remote areas such as Bayanga offer poor health facilities, which many of the staff do not attempt to use due to their social marginalisation or because they are unable to afford it, turning instead to traditional healers or forest medicine as the primary source of medical intervention. For example, when asked why he does not go straight to the local clinic, a BaAka tracker replies:

> *We wait all day, maybe sleep there, and sometimes are not seen. Once I was beaten up and thrown outside by some Bilo because I just went inside. It's better to go to the Nganga [traditional doctor].*

The Bilo population are sedentary and thus likely to have completed a higher level of education than the nomadic BaAka. Perhaps as a result, they are relatively aware of the names and symptoms of common transmissible diseases such as polio, tuberculosis, HIV and viruses such as the common flu/colds, and ways to prevent them. For example, 100 % of Bilo staff questioned about their understanding about how diarrhoea and influenza can be spread provided answers relating to poor hand/toilet sanitation and aerosol/inhalation routes of infection. In comparison, only 43 % of BaAka staff interviewed gave correct, relevant responses, the rest gave alternative explanations such as via bad smells, sitting next to each other or even via butterflies. Many of the BaAka staff did not know the names of common illnesses in French or when translated into Sango, however this does not exclude the loss of information as a result of translation as the BaAka have their own names for diseases or collections of symptoms. Five of the older BaAka respondents reported that they were aware of or had observed the ill-health effects of tuberculosis, leprosy and polio in their villages, however, and therefore demonstrate some awareness of major transmissible diseases.

In 2002, the Mountain Gorilla Veterinary Project Employee Health Group (MGVP) conducted a study of 127 local staff members and reported that >70 % tested positive for one or more pathogenic organisms, >80 % tested positive for viral antibodies against various communicable diseases including measles, chickenpox and hepatitis, and the main risk factor predicting positive results for any pathogenic organism was identified as use of a pit latrine-style toilet. Standards of hygiene among the BaAka are particularly low, (even pit latrines are often not used in the camp and BaAka villages) and rates of reported gastrointestinal and viral infection symptoms are high. In combination with the poor understanding of disease epidemiology and prevention, the health of the local staff, particularly the BaAka, is of great concern when considering risks of disease transmission to gorillas.

Researchers and management staff represented too small a sample to report health statistics meaningfully. I discuss the health risks that they potentially pose to gorillas in section 9.8.5.

9.5.3. Tourist vaccination status

A high percentage of the tourists surveyed were not currently vaccinated against various vaccine-preventable infections (Table 9.2).

Disease	% of Tourists Vaccinated
Measles	53.40
Mumps	46.60
Rubella	49.21
Polio	86.91
Typhoid	69.11
Yellow Fever	98.43
Common Flu	25.65
Swine Flu	15.18
Rabies	32.98
Tuberculosis	58.62
Meningitis	47.64
Hepatitis A	75.92
Hepatitis B	73.30
Diphtheria	55.50
Japanese Encephalitis	9.42

Table 9.2. Vaccination status of 191 tourists at Bai Hokou and Mongambe study sites between November 2010 and November 2011.

The reported perceived current immune status is likely to be significantly higher than actual current immune status (Muehlenbein, et al. 2008), as demonstrated by several studies verifying perceived status with reference to vaccination certificates (Herck, et al. 2004; Stephen Toovey 2004) or via serological testing (Hilton, et al. 1991). These vaccination rates are, however, consistent with the results of several other studies surveying international travellers (for a review see Muehlenbein, et al. 2008). They are almost identical to the rates described in Muehlenbein, et al. (2008) for traveller vaccination against tuberculosis (60.5 %), influenza (27.4 %) and measles (53.6 %), and very close to those for hepatitis A (69.8 %), hepatitis B (63.2 %), rabies (22.1 %) and polio (72.2 %). Although vaccines for measles, mumps and rubella have only recently become standard inoculations of adolescence, the low vaccine rates reported for measles, mumps and rubella are surprising. They are also somewhat concerning given that

almost half of respondents had been in contact with children prior to their visits and cases of measles infections in wild and captive primates are well documented (Choi, et al. 1999; Jones-Engel, et al. 2006; Oliveira, et al. 2003; Potkay, et al. 1966; Willy, et al. 1999). Travellers' likelihood to seek and use travel advice is affected by several factors such as age, gender, trip purpose and length and personal risk assessments and perceptions (Crockett and Keystone 2005; Muehlenbein, et al. 2008). It is possible that the similarities between the results found in the current study and those reported in the study of orang-utan tourists (Muehlenbein, et al. 2008), relate to general characteristics of tourists visiting great ape encounter sites.

Whilst these results do not imply directly that tourists in the current study were infected with transmissible diseases, they do highlight the frequency at which tourists are exposed to disease infection interfaces before arriving at the site to visit gorillas. Moreover, as Muehlenbein, et al. (2010) report, a proportion of visitors continued their visit to endangered great apes when they have known sickness symptoms or are potentially ill. The authors suggest that, as in the current study, a significant proportion of tourists are either uninformed of the risks they may pose to non-human animal health, or chose to ignore them.

9.5.4. Tourists' perceptions of vaccination regulation rules

I included a question in the survey which aimed to assess tourists' reactions to the future implementation of vaccination regulations at the site: "If you were asked to present your vaccination history before confirming your gorilla trek in Bayanga would this cause you concern or inconvenience?"

Of 188 responses, 66.6 % of gorilla visitors said "No" this would not be a problem. A further 11.1 % said, "No", but qualified their response with comments such as "as long as we are warned in advance to bring them", and even made suggestions as to how this could be done, and that it should be done:

> *No problem, if given plenty of warning.* (Female questionnaire respondent)

> *No problem, vaccination card can be sent per email in advance.* (Male questionnaire respondent)

> *No – this should be done! We had to in Congo.* (Female questionnaire respondent)

The remaining 22.2 % of respondents suggested they would be concerned or inconvenienced by the regulation, giving reasons relating to lack of warning and a lack of existent historical records, or asking why the regulation is important or necessary as with general perceptions of disease transmission risk.

Only because I don't have it with me. (Male questionnaire respondent)

It would be difficult to prove - I've lost my records. (Male questionnaire respondent)

Inconvenience. Other than recent vaccinations have no record. (Male questionnaire respondent)

Yes, unless the relevance was communicated well in advance. (Female questionnaire respondent)

We were at more than 10 meters from gorillas so I think it's not possible to contaminate them so I don't understand why we should show vaccination history. (Female questionnaire respondent)

This small portion of visitors who expressed concern about the provision of prior warning or lack of historical records highlights the need to provide adequate prior warning so that problems such as those identified above (loss of records, documents expired) can be dealt with before travelling.

9.5.5. Local, management, research / support staff vaccination status

At the time this research was conducted only approximately one quarter (exact numbers not known due to lack of complete records) of the local project staff had previously been vaccinated for any communicable disease. Records that did exist indicated that any vaccinations were likely to have been more than 10 years old, and therefore potentially expired (e.g., the tuberculosis vaccination given in childhood lasts approximately 15 years but is less effective when given in adulthood, and yellow fever vaccinations offer protection for up to 10 years). Whilst is possible that some of the staff had previously received a yellow fever and/or polio vaccination as part of government health campaigns, many of the local BaAka trackers were unsure whether they had received these vaccinations. They may have been absent during the campaign visits as they spend much of their time outside of work in the forests. This proportion of staff with questionable vaccination histories represents a major potential health

risk to the gorillas, and a discord with the management plans to implement tourist regulations for the presentation of vaccination records prior to visits. Some tourists also picked up on this problem, when the topic of conservations occasionally drifted towards the health of the local staff. Several tourists highlighted the hypocrisy of potentially asking 'healthy Europeans' to present vaccination records when the project's own staff were unvaccinated and much more likely to be suffering from ill-health:

> *But what about the staff? Are they vaccinated? Not being funny but they are much more likely to be ill than us I think – can they get health care? How can we be asked to go to the trouble of showing all our vaccinations when they are always with the gorillas and not vaccinated?* (Hans, interviewee)

During initial conversations with senior management on this topic I gathered the impression that the health of the staff working with the gorillas was considered to be quite a low priority and the plans for staff vaccinations were delayed on the basis of lack of funds and difficulties arranging for the correct vaccinations to be available, which is very difficult in the CAR. Management also thought that local staff, and potentially the gorillas, would have some resistance to local strains of diseases and may therefore not be as vulnerable to them as foreigners to the region. However, project staff deal with tourists and visitors from outside the locality daily and may also be susceptible to infection by novel strains of diseases, to which they and the gorillas do not have immunity. For example, cold and influenza virus constantly mutate into new strains to which one must be exposed before immunity is acquired (Marti, et al. 2008; WHO 2013). Members of management working closely with the staff and gorillas were, however, keen to rectify the situation, perhaps fuelled by the focus of this health research and that of a collaborator. In March 2012 the project found funds to vaccinate approximately two thirds of the staff using a childhood 5 vaccines-in-one: diphtheria, tetanus, whooping cough, polio, and haemophilus influenza type b. As tuberculosis immunisations are largely ineffective in adults, especially those already exposed (Ottenhoff and Kaufmann 2012) the staff were not vaccinated against tuberculosis.

All researchers/volunteers are asked to have up to date vaccination records but none are, to my knowledge, systematically checked or required in advance of arrival or work with the gorillas. Additionally, local friends and colleagues from the project headquarters who may, or may not, be vaccinated, often make weekend visits to the site accompanied by management/research staff.

9.5.6. Tourists' risk of exposure to disease

44 % of 119 respondents reported having been in contact with children under the age of 16 in the week prior to their gorilla visits, 84 % of these contacts were with local village children, whose health is generally poor, while taking part in village activities or stopping for supplies. 16 % of respondents had also been in contact with the child of a member of the PHP management staff. 13 % of respondents reported having knowingly been in the presence of a sick person before their arrival at the site, having shared cars or planes with visibly sick passengers. 108 of 119 respondents had passed through a mean of 2 other African countries prior to their arrival in CAR, which increases the likelihood of contracting illnesses from multiple foreign environments. Of 205 respondents, the mean number of days for their full holiday was 18, of which they spent a mean of 5 days in the DSPA. This relatively short period of time spent in the DSPA is likely to be related to the limited availability of other activities in the area, high cost of accommodation and time spent travelling to such a remote area. The problem here is that the short time frame also does not offer tourists an opportunity to rearrange their trek if they would otherwise have self-declared illness at short notice.

Another way tourists can pose disease-transmission risks to gorillas is via their footwear. 71 % of 214 respondents report having only one pair of boots/footwear with them for their wildlife trekking activities and 67 % of respondents report having been to another national park prior to their gorilla trek or that they would be going to another park afterwards. Whittier, et al. (2010) investigated parameters of disease infection spread in mountain gorilla groups. Based on simulated models the authors show that even small groups of humans regularly contacting gorillas can potentially double or triple the spread of outbreak levels between groups and in an entire gorilla population. They suggest that activities as simple as rotating tourist guides, researchers and tourists between gorilla groups may facilitate the spread of the outbreak by wearing the same field clothes or unclean boots to different groups on consecutive days, and poses obvious risks to gorillas that would never be permitted in laboratories, zoos, or even most well-managed farms. As there were no regulations at the study site at the time of writing about the disinfection of boots and shoes, before or after gorilla trekking, the results reveal an overlooked area of risk of disease infection and spread within the DSPA.

9.5.7. Local, management and research / support staffs' risk of exposure to disease

The forest camp staff population is particularly fluid. Every week, at least two new members of staff rotate out of work in the forest with the gorillas, and other staff member rotate in after being with their families and children in the villages. Researchers and

management staff also make trips in and out of the project site. For example, every three weeks or so researchers and volunteers go to the village and spend time emailing or working in the villages, then return to the site and their work with the gorillas. Management staff, friends, colleagues and influential people like project donors and patrons often come to the site for the day to visit gorillas and may have been in contact with their own or local children previously. My observations suggest that these people are also the least likely to be refused visits on the grounds of visible symptoms of sickness, probably due to their positions as potential funders/promoters of the project. During one memorable instance, I felt obliged to ask a woman with a party of highly influential project donors to wear a facemask during the visit as the senior management had either overlooked her self-reported (and obvious) laryngitis infection or perhaps did not perceive it as a real health threat to the gorillas.

9.5.8. Disease risk behaviours

7 m rule violations

We made 1,545 hr of observations of the habituated Makumba group. During this time, we recorded humans breaking the 7 m human-gorilla distance rule 1,606 times, a frequency of 1.04 violations / hr. When tourists were not present, the frequency of 7 m rule violations was 0.8 / hr, but it increased to 3.9 violations / hr when tourists were present. During both observations of teams when tourists were and when they were not present, 7 m rule violations were made by BaAka trackers or assistants on 39.3 % of occasions, the whole team on 39.09 % of occasions, researchers on 3.3 % of occasions, tourists on 1.15 % of occasions and volunteers on 0.05 % occasions. It was not possible to sample all groups equally (i.e., there was not always a volunteer present but BaAka trackers were always present) and the project's working protocols stipulate that there must always be a BaAka tracker in front and behind of the researcher/assistant/volunteer/tourist group. Consequently, the BaAka are much more likely to be responsible for 7 m rule violations as they must constantly judge the distance of the gorillas in dense forest. The whole team violated the 7 m rule at a very similar rate to the BaAka trackers, which, from my observations was likely due to the remaining team following very closely in dense forest. In this case, the tracker is usually still the closest person to the gorillas.

Only one other published study has documented disease-risk behaviours of people in close-contact with great apes during research and tourism activities (Nakamura and Nishida 2009). In the study, the authors recorded 15 cases of tourists violating the distance regulation, which at Mahale, is 10 m. They do not report the number of observation hours, however, so it is difficult to compare the frequency of rule-breaking between the sites. The authors suggest that

the rate is low compared to the almost daily violation of distance rules, self-reported by mountain gorilla tourists in Bwindi National Park, Uganda (Sandbrook and Semple 2006), which are supported by my ethnographic data reported in Chapter 5. The authors go on to suggest that the low rates may have been due to the park and tourist guides' awareness of researcher presence, which caused them to adhere more closely to the rules.

The high rate of 7 m rule violations at the Bai Hokou site suggested to me that there was a problem with the understanding or enforcement of this distance among the staff. Therefore, when conducting health interviews I also asked the staff if they knew how far the distance regulation requires humans to stay from gorillas. 100 % of the project assistants/guides (not BaAka trackers) provided the correct answer to this, which was unsurprising as they had received training and regularly provide visitors with the safety briefings themselves during which they are expected to inform tourists about the 7 m regulation. They are also expected to enforce the rule. However, the BaAka are employed as trackers due to their exceptional forest skills, and are not expected to provide briefings. Many trackers only speak their native BaAka or Sango languages, meaning that even if they were present during a briefing, they would understand little. They also do not receive guide training. This was reflected in the low 5 % of BaAka staff who were aware of the 'rule' and referenced the number 7 in their responses to my question. Due to the possibility of information loss due to translation or lack of understanding of the concept of 7 m (many BaAka staff are not numerically literate), I asked them to show me how far from the gorillas they thought they should stay, either as "show me how far 7 m is from here" for those who could count, or as "show me how far from here it is 'good' to stay from gorillas" for those that could not count. I encouraged them to walk away from me until they reached their estimated distance, and then measured the distance with a tape measure. The overall mean distance was 4.45 m (range 2 – 4.8 m), for those who estimated above 7 m, the average was 10.7 m (range 8 -14 m).. Distance estimation can be difficult, particularly in dense forest, but these results clearly indicate that the trackers who lead teams with gorillas have very little understanding of the concept of the distance rule, or what this equates to in terms of visual distances. A notion of 'closer is better' amongst trackers also emerged from my recordings of discourse whilst working with tracking teams during the study. For example, I documented several comments where trackers alluded to their perceptions that being closer to the gorillas is better:

> *Getting really close to them is really good, it shows the habituation is good and we do good work.* (BaAka tracker, translated from Sango)

Yeah, it's good, we used to follow at 2 m over there, in those days it was really good, here people are afraid and say no, come back, come back, always always. (BaAka tracker, translated from Sango).

In the later quote, the "over there" the tracker refers to is the western lowland gorilla habituation and tourism site, Mondika, in Congo. Given the close proximity of the site to the BaAka villages, many of the trackers worked at the Mondika site when it was first developed as a gorilla habituation and research site. A great deal of talk alluded to how the staff and researchers initially habituated the original groups of gorillas to 5 m and regularly followed them much closer and even occasionally physically interacted with them. There is no published information on the topic, but conversations with previous BaAka employees at the site and field colleagues suggested that many of the gorillas may have died due to illness. My observations suggest that many of the trackers now working at the Bai Hokou study site retain the mentality that 'closer is better', with regards to their gorilla tracking work, and require training otherwise.

Coughing

During the observation hours, humans were recorded coughing near to gorillas a total of 1,680 times. 90.4 % of these observations involved project staff or researchers/volunteers during non-tourism visits. 9.6 % of coughs were recorded during tourism visits, of which 11.3 % were by tourists or photographers/film crews, the rest were by local staff, researchers or assistants and volunteers. 67 % of coughs were scored as 'covered coughs' or 'non-covered coughs' (this addition to data collection commenced later into the study), where the coughing party did, or did not use a hand or clothing to cover their mouths. Of the monitored coughs, 34.7 % were uncovered and the majority (89.3 %) were by BaAka trackers, 9.7 % by local assistants, and 2 % by researchers and volunteers.

Uncovered coughing near gorillas is a major source of potential disease transmission, and increasing frequency of people breaking the distance regulation adds to this risk. It is not my impression that the staff (BaAka or local assistants) are breaking these rules covertly when researchers, managers or tourists are not present, as was suggested by Nakamura and Nishida (2009) as a reason for rule violations in Mahale. In fact, my own observations suggest that pressure from researchers carrying out focal follows of individual gorillas or collecting faeces can, in itself, be a cause for staff to get closer than they should. I suggest, however, that the staff continue to break the rules on a daily basis when following gorillas simply because they

have either forgotten the importance or reasons for maintaining the distance, never knew them, or are unable to judge the distance accurately.

Facemasks

Questionnaire respondents were asked "if you were given the option to either A) stay at 10 m from the gorillas at all times, or to B) wear a facemask and approach to 7 m, which option would you choose?" 32 % of 108 respondents chose option A, and 68 % chose option B. These results support the findings presented in Chapter 3 which illustrate the high prevalence of a desire to get close to gorillas. However, the majority of the additional comments left by tourists who selected option B in response to this question suggest that it is not just the idea of getting close to gorillas which influenced their choice, but that they felt strongly that facemasks should be worn at all times regardless of the proximity of humans to the gorillas. For example:

Does not matter, would want what is best. (Male questionnaire respondent)

Ah! You should always wear a mask! (Female questionnaire respondent)

Face masks should be required no matter what. If tourists really cared about gorillas, they wouldn't mind. (Female questionnaire respondent)

The above sentiments were also echoed in tourists' discourse during interviews. When discussing facemasks, I observed that the conservation generally led to questions regarding the relevance of, and theory behind, wearing them, as previously discussed. In a relatively small proportion of cases people expressed their surprise at not being asked to wear them already (again usually those who had recently visited Mondika, mountain gorillas or other great ape sites) and in one case during an interview a lady pulled out the facemask that she had saved from Mondika as she was so impressed by having to wear it. Thus, again, it emerges that tourists are largely unaware of the health risks they pose to gorillas, yet when informed, seem keen to learn about them, and those that are aware, appear satisfied and impressed by the imposition of regulations protecting gorillas during their visits.

9.6. Results and Discussion 3: how and why current gorilla viewing capacity regulations fail

In this section, I use my ethnographic observations to describe and explore the daily procedures and social interactions that caused the gorilla visitation regulations to be broken. I identified four key problems which contributed to rule violations, and have therefore divided my reflections on these into four sections below. These relate to: problems with the tourism

booking system, lack of an imposed central tourism check-in point, the current daily maximum capacities and additional non-tourist stakeholder pressure.

9.6.1. Booking systems

Macfie and Williamson (2010) include the need for clearly communicated and enforced booking systems in the IUCN recommendations, and suggest that a seasonal marketing rate (i.e., lower low season rates) might reduce pressure during high seasons, which can lead to violation of rules. As detailed in section 2.5.5, the current capacity regulations at the Bai Hokou and Mongambe study sites allow three tourists in each trekking group, and two groups can visit the same gorilla group in one day. Therefore, on any given day, a maximum of six tourists should contact the gorillas. These regulations are aimed at controlling the number of people in contact with the gorillas each day to reduce the risk of stressing the gorillas and of disease transmission. Generally, this rule is respected, but, on occasion, difficult circumstances result in the visitation rules being broken. For example, over one weekend during the study period, 11 tourists saw the gorillas in one day and 9 saw them the next day. My observations suggested that there were several reasons why these exceptions occurred; the most obvious being the lack of an appropriate, reliable booking system, causing multiple double-bookings. This became a particular problem around the seasonal peaks and national holidays in CAR, when many expatriate tourists visited from Bangui either without making a prior booking or having booked at the same time as the permits already allocated to international tourists. Additionally, on occasion, tourists had made bookings but cars broke down and tourists were delayed. This meant that scheduled visits had to be rearranged at short notice, putting pressure on staff to allow more than the permitted number of tourists per group.

9.6.2. Central tourism check-in point

The problem of a lack of a robust booking system was also exacerbated by the lack of a central tourism check-in-point at the project headquarters. For example, tourists could arrive during the day or night due to unpredictable travel conditions and were often driven straight to the tourist lodges by their guides. They might then make an itinerary of activities with the lodge owners or guides without checking the gorilla trekking programme with a designated project member. This resulted in many instances where tourists would arrive at the forest camps, unforewarned or with little warning, causing chaos with the work rota and allocation of staff to activities in the forest. It also meant that when double-bookings occurred they were not discovered until tourists had already paid to hire expensive 4 wheel-drive vehicles and drive the 1.5 hours to the site. When this happens tourists are very unhappy to return to the

headquarters without seeing gorillas. Moreover, the flexible system of tourist arrivals means that tourists' first exposure to the gorilla trekking regulations or any project staff member, is also on arrival at the site. Of the 123 people I asked if they had been given any briefing about the gorilla trekking rules or asked about their health before leaving Bayanga, 92 % answered no. This means that staff are forced to deal with the difficulties of filtering out visibly sick people and refusing double-booked parties when they have already driven to the site. For local guides, dealing with sometimes pushy, European tourists speaking a foreign language, this can be very difficult, and unnecessary exceptions to visitation rules can result.

9.6.3. Daily maximum capacities

Similar problems arose with the rule that restricted the number of tourists to three per group, and the limit of two tourism groups per day. As reported in Chapter 4 the general tourism demographic at the site is of middle-older aged, middle-class tourists, which includes many retirees. Although occasionally mixed singles groups were evident, generally I observed that most tourists travelled in couples or small groups of couples. This often caused visible upset or disappointment when couples had to be split into groups of three. When two groups of tourists make the trek to the gorillas at the same time, the division of parties is often decided in the camp before heading out. I observed a number of occasions, however, when these decisions fell through on arrival near the gorillas, resulting in mass discussions, noise and disruption to the gorilla groups while guides tried to help parties to decide who would take the first hour with the gorillas and who would wait behind for their turn in a second hour. Although I did not collect behavioural data to support these observations, it was my impression that this caused visible changes in the gorillas' behaviour, particularly in the silverback, who became more vigilant and travelled further during this time. Moreover, the fact that two tourist parties per day are allowed to visit gorillas, accompanied by different guides, researchers and trackers, meant that the daily numbers of people the gorillas are exposed to are much higher than if one single tourist party were permitted, as per the IUCN recommendations. This leads me to a final discussion regarding non-tourism groups of people with gorillas.

9.6.4. Non-tourist stakeholder pressure

There are a variable number of researchers, volunteers, photographers and film-makers based at Bai Hokou camp, all needing to spend time with the habituated gorilla groups. These parties stay from a number of days to a number of months or even years. Typically, the schedules of film crews and photographers are prioritised as they pay high permit and accommodation fees and have limited time. Usually, depending on their work objectives, they

are limited to the same regulations as tourists: no more than 3 people in their party for a maximum 2 hours a day, which means no tourism on those days. If paying researchers are present during this time, they slot into the schedule with priority over volunteers and project assistants and, when sufficiently experienced, may take the place of a local assistant with the trackers throughout the day or guide tourists with the gorillas themselves. For example, if a researcher accompanies the morning tracking team instead of a project assistant or volunteer, s/he may stay (or guide) during the two hours allocated to a film crew/photographer as long as the total number of people with the gorillas does not exceed 6. A conflict arises however, when tourism and research needs overlap, given that both are paying observers. Researchers who are not acting as guides must step back during tourist visits to allow the maximum number of tourists to visit at once. It was my experience that researchers who did not have an interest in aspects of tourism (in contrast to myself), found this aggravating and disruptive to their work. When there were many researchers at the site at the same time, this also caused the daily number of people with the gorillas to reach up to 17 on occasion, although there were not more than six people at any one time. For example, the maximum three researchers (in this case a principle investigator and two trainees) accompanied morning tracking teams (two trackers), after which the gorillas were visited by two full groups of tourists (another tracker or two plus three tourists and a guide in each group), followed by the afternoon team with more researchers, assistants or photographers. Although such extreme cases were rare, and no individual capacity rules were broken on these days, it became evident to me that the overlapping expectations and motivations of so many stakeholders, could, and often did, put additional pressure on the gorillas. When I discussed this situation in an interview with the PHP management it was clear that this was a surprising and unwelcome occurrence which would not have occurred had they have been on site. It seems this conflict can be a source of potential disturbance to the gorillas and a further source of increased risk of disease transmission. There are no recommendations in the IUCN guidelines about the regulation of media, research and tourism priorities in these contexts. This lacking information is a problem as it may leave site regulations open to interpretation by various – albeit, well-meaning parties, and result in such cases of avoidable daily overcrowding or over-exposure of people to the gorillas.

9.7. Concluding remarks

Ecotourism is the heartbeat of many national economies in the countries that harbour wildlife. The animal species at the focus of ecotourism deserve to be beneficiaries of the research and tourism programmes that they support (Kaur and Singh 2008). However, despite

the numerous regulations at wildlife tourism locations, tourists and other visitors typically violate rules and animals are left vulnerable to additional stressors and risks of disease transmission from their spectators. These risks cannot be justified, regardless of financial investment, and it is the combined responsibility of the visitors and the hosts to adhere to and enforce pro-conservation behaviours in these contexts (Muelhenbein, et al. 2010). In the following Chapter 10 (Discussion) I draw together the findings presented throughout the thesis and summarise the specific implications and recommendations arising from the full research project.

Chapter 10 - Discussion

In this thesis I adopted an interdisciplinary approach to conduct a bio-social risk assessment of gorilla tourism, with the aim to provide an integrated understanding of the factors that influence human-gorilla interactions and incorporate them into conservation biology. I presented the results of socio-anthropological and ecological methods both separately (e.g., Chapters 4, 5 and 6) and combined (e.g., Chapters 7 and 9) in the chapters of the thesis. Here, I synthesise the findings, then discuss the management implications and propose a series of recommendations for improving the management of gorilla tourism at the study site. I then provide conclusions and future research directions, and conclude with my reflections on the utility and experience of conducting interdisciplinary research.

10.1. An integrated view of human-gorilla interactions and the biological outcomes for gorillas

In Chapter 4 I introduced some of the key concepts underlying human-wildlife interactions and the theories that have been used to interpret the meaning of human-wildlife encounters. In reviewing the literature it emerges that there is a lack of focus on the *attraction* or *experiential nature* of the exchange between humans and wildlife, which results in a gap in our understanding as to what is actually being gained by individual visitors at wildlife tourism sites (Schanzel and McIntosh 2000; Curtin 2005). I highlighted how such information, gained from a focus on the human dimensions of sustainable wildlife viewing-management, is increasingly important to ensure that the experiences gained by visitors are ultimately beneficial towards wildlife conservation efforts in the long term (Schanzel and McIntosh 2000). I introduced the experienced-based-management paradigm as a way to understand, and ultimately manage, recreation experiences by characterising attributes of the experiences, settings and activities that define a particular recreational opportunity (Manfredo and Larson 1993). I used this framework to provide a background to the literature describing the outcomes, benefits, and motivations of people engaging in recreational wildlife watching. Employing a combination of social research methods I used this background to explore the data presented in Chapter 5, which sought to explore the types of tourists engaging in gorilla tourism, their constructions of gorillas, why they had chosen to watch them, their reactions to their gorilla encounters and the effect these encounters had on them.

Demographic analysis revealed that gorilla tourists are predominately French and German males aged around 46 (range 16 – 76), with tertiary education and a tendency to have travelled extensively in Africa prior to their arrival at the site. These results are similar to those describing tourists visiting other ecotourism sites with the exception that a greater proportion of tourists elsewhere were female (Beh and Bruyere 2007; Fletcher 2009; Muloin 1998; Stronza 2001). This difference might be a reflection of the particularly remote location of the site and perceptions of CAR that I detected among visitors as more dangerous and hostile than other African tourism destinations. Demographic information offered little useful information to categorise tourists at the site, but a divide emerged between international tourists that chose to visit the site as a specific wildlife tourism experience and those who visited opportunistically while in the country for other reasons. Based on their specialist or more generalist interests in wildlife tourism, the tourists falling into these two groups that I describe as the opportunistic visitor group and the wildlife specific group are similar to specialist and non-specialist categories of tourists described in the wildlife tourism literature (Beh and Bruyere 2007; Cole and Scott 1999; Curtin 2010b).

Three major themes emerge relating to tourists' constructions of gorillas, their motivations, behaviour during their gorilla encounters and the meanings interpreted from them (Figure 10.1, top theme box). Firstly, gorillas appear to fit the criteria for preferred animal species (Kellert 1985) due to their similarity to humans, both physically and in their behaviour. In line with several other studies reporting wildlife tourists' motivations (Curtin 2010b; Montag, et al. 2005; Muloin 1998; Orams 2000), close proximity and eye contact with gorillas is a highly valued part of the interaction which stimulates feelings of validation and emotional connection to the gorillas. Predominately for the wildlife specific group, these moments are valued as souvenirs which justify the expense, effort and risk involved in their journeys to visit gorillas. A lack of eye-contact during tourist-gorilla encounters is a source of upset or dissatisfaction, however, especially for tourists who have previous experiences of visiting mountain gorillas. A second major theme suggests that tourists have individual quests to experience various perceptions of authenticity in their wildlife experiences. Perceptions of authenticity and value in this setting fit with previously described benefits of wildlife tourism experiences (Curtin 2008; 2010a,b; Montag, et al. 2005; Russel and Ankenmann 1996), being strongly linked to the rarity of experiencing wild gorillas in nature, where the value of an experience decreases when shared with increasing numbers of 'others' (Urry 1990). These criteria appear to help tourists construct a view of themselves as different from regular or mass tourists, and to feel that they are more connected to nature than other tourists, because they are willing to stray from the beaten track.

However, tourists in this setting know very little about the process of habituation which allows them to visit wild gorillas in their natural environment. This opens the question of how habituated wild animals are perceived by tourists in terms of their authentic, wild value. Finally, for some tourists, photography offers both mental and physical benefits as a way to interact with the gorillas and the environment. Pleasure is linked to success in capturing versions, or souvenirs, of authenticity in a manner which is highly consistent with other authors' descriptions of ocular consumption (Lemelin 2006). Images are consumed by tourists in their self-constructions which they share with other people. For others, photography is a burden, a source of anxiety and a mental distraction from the experience. As reported by other studies of wildlife-tourism experiences, photography, regardless of motivation, is an obvious cause of both human-human and human-wildlife disturbance (Boyle 1985; Knight and Cole 1995; Lott 1992; Roe, et al. 1997; Russell 1996).

Chapters 6, 7 and 8 are concerned with measuring biological outcomes for gorillas that are at the focus of wildlife tourism activities (Figure 10.1, right theme box). Chapter 6 reports a series of experiments conducted to validate the methods needed for non-invasive biological hormone monitoring. The results offer researchers a validated tool for measuring faecal hormones in western lowland gorillas, and a set of field methods for extracting and storing faecal glucocorticoid metabolites that can be adapted for non-invasive monitoring of other hormones and for other species.

Chapter 7 presents the results of the faecal hormonal analyses in relation to habituation and tourism activities. Unhabituated gorillas who are not involved in wildlife tourism activities have lower mean FGCMs than gorilla groups involved in tourism and a group undergoing habituation. These results are consistent with studies of other species that report higher faecal hormonal glucocoticoid levels in tourism exposed animals compared with those that are not (Barja, et al. 2007; Behie, et al. 2010; Turner 2001). I predicted that the process of habituation would be stressful for gorillas based on the behavioural reaction of gorillas to the arrival of habituation teams (Blom, et al. 2004; Cippolletta 2003; Doran-Sheehy, et al. 2007; Tutin 1991; K.Shutt personal observation). However, there may be a longer-lasting effect of the intermittent nature of contacts made with gorillas during habituation on their physiological FGCM response, as demonstrated by the significant rise in mean FGCM levels over days between contacts. Similar patterns of increasing stress hormones are found in humans and animals in anticipation of stressful events (Abbott, et al. 1984; Davis and Levine 1982; Fulton and Gottesman 1980; Grillon, et al. 2004) and the response has been referred to as a state of anticipatory vigilance

(Arthur 1987; Burchfield 1979). A key element which may trigger this specific stress response is the lack of predictability of the occurrence of the stressful event over the long-term (Abbot, et al. 1984), and is suggested to be linked to the mechanisms causing post-traumatic stress disorder in humans (Boonstra 2013; Yehuda 2002). However, hormonal studies of unhabituated animals are difficult to interpret with certainty as alternative sources of stress may cause the hormonal response (Chapter 7). Assuming, however, that the gorilla groups are subject to similar levels of environmental stress, the single major element varying between the groups is their level of habituation to human-visitors.

A medical intervention was associated with elevated FGCMS in both habituated gorilla groups. This result was not surprising as the intervention required more people in the forest around the gorillas than otherwise permitted and the teams following the gorillas needed to break the 7 m distance regulation to administer a vaccine injection using a blow-dart. The humans involved in administering the vaccine were also particularly concerned about the effects on the gorillas and their potential reaction to blow-darting, displaying visible tension, which the gorillas may have detected. The intervention was conducted with the justification that the vaccination would offer a long-term benefit that would outweigh any short-term stress.

Elevated FGCMs were also associated with increasing frequency of humans breaking the 7 m distance regulation, although only in the more recently habituated group. This adds weight to the suggestion that the effect of the medical intervention on FGCMs partly related to violation of the 7 m rule. Moreover, as the long-term habituated group's FGCMs were not significantly affected by the same pressure of 7 m rule violations, this supports the hypothesis that successful habituation to human presence reduces the gorillas' stress response over time. Measures of tourism pressure were not associated with changes in FGCMs. The management implications relating to the process of habitation and human visitation for tourism activities are discussed in Chapter 7 and integrated in to the final recommendations in section 10.3 below.

Chapter 8 investigated the influence of FGCMs on the intensity of infection of pathogenic gastrointestinal parasites in the long-term habituated group and the group undergoing habituation. Across the individuals of both groups there was an association between increasing FGCMs and parasite infection, but the higher mean FGCMs of the group undergoing habituation did not translate into significantly higher mean group infection. These findings are in line with studies of other primate species, showing that increased FGCMs are associated with increased measures of parasite infection. I discuss the hypothesis that this association is due to reduced immunocompetence as a result of the effects of stress, but also the possibility that the

association is in reverse where FGCMs may be elevated as a response to increased parasitic infection.

The final data chapter, Chapter 9 explored socio-cultural, epidemiological and management aspects of humans' interactions with gorillas in order to identify when and why gorilla trekking regulations are broken and how human-gorilla disease transmission risks occur (Figure 10.1, left theme box). In general, tourists are not well informed about the potential for human-gorilla disease transmission. The wildlife specific tourist group demonstrate better knowledge than the opportunistic visitors, maybe, as a result of their more extensive travel to similar locations, travel research and planning prior to embarking on the journey. Tourists express a keen interest to learn about the risks of disease transmission, and suggest that the provision of more information and adoption of strict regulations would be well received. They also suggest that illness would be declared more readily if people better understood what specific illnesses are a risk for gorillas, how they may be transmitted and what the repercussions can be for the gorillas.

Tourists' self-reported health status reveals that diarrhoea is the most common ailment experienced prior to visiting the gorillas, which is in line with other studies of tourists visiting wildlife in other national parks (Adams, et al. 2001; Al-Abri, et al. 2005). Approximately a quarter of tourists are not well informed regarding the risk of malaria in the region and are not taking prophylaxis, adding to the overall picture of tourists' low adherence to readily available travel-sickness preventative information and inaccurate disease risk perceptions (Lopez-Velez and Bayas 2007; Muehlenbein and Ancrenaz 2009; Piyaphanee, et al. 2009). Local staff, specifically the BaAka trackers, however, emerge as a much greater health risk to gorillas than tourists, as a result of their generally poorer access to health care, health education and the comparatively large amount of time they spend in close contact with gorillas. The vaccination of local staff appeared to be a low priority among the higher levels of the DSPA management; the BaAka and other local staff had only recently been vaccinated against several communicable diseases despite having already worked for the PHP for up to eight years. Many tourists' vaccinations are inadequate for the region of Africa visited and for gorilla trekking, but tourists demonstrate a general willingness to update and provide evidence of their vaccinations for gorilla trekking if given enough prior warning, as they wish to support efforts to protect gorillas.

Other sources of disease transmission are presented by tourists, local and expatriate staff who visit local villages and are exposed to young children and domestic livestock shortly before visiting or working with gorillas and by not changing their clothing and footwear before

visiting gorillas (Whittier 2010). There is a worryingly high rate of 7 m rule violations by humans following gorillas which is highest during tourist visits and carried out most frequently by the BaAKa trackers who lead the teams. The BaAKa have a poor awareness of the imposed 7 m rule and demonstrate difficulty translating it into a relevant distance in the forest.

Almost unanimously, tourists support imposition of a rule to wear facemasks, but again request information as to why they should do so. Finally, an ineffective and overly flexible booking system and the lack of a mandatory central tourism check-in point mean that tourists' health status cannot be effectively monitored before arrival at the tracking camps and that capacity regulations are ultimately compromised when double-bookings occur.

In synthesis, once gorillas have been deemed habituated to human presence, ecotourism and research activities bring various groups of people, such as tourists, local staff and researchers, in contact with gorillas on a daily basis. Socio-cultural and emotive factors motivate people to get close to gorillas. The physiological response of habituated gorillas to close interactions with humans can be measured as a rise in FGCM output, which can reduce immune function over time and render gorillas more vulnerable to infection and disease. Management regulations which protect gorillas from close interactions with humans may not be adequate and often fail, increasing the gorillas' vulnerability to disease and increasing the likelihood of human-gorilla disease transmission as a result of the close human-gorilla proximity. Epidemiological factors interact with socio-cultural and emotive drivers to create a variable profile of disease risk presented by each person during their interactions with gorillas (Figure 10.1).

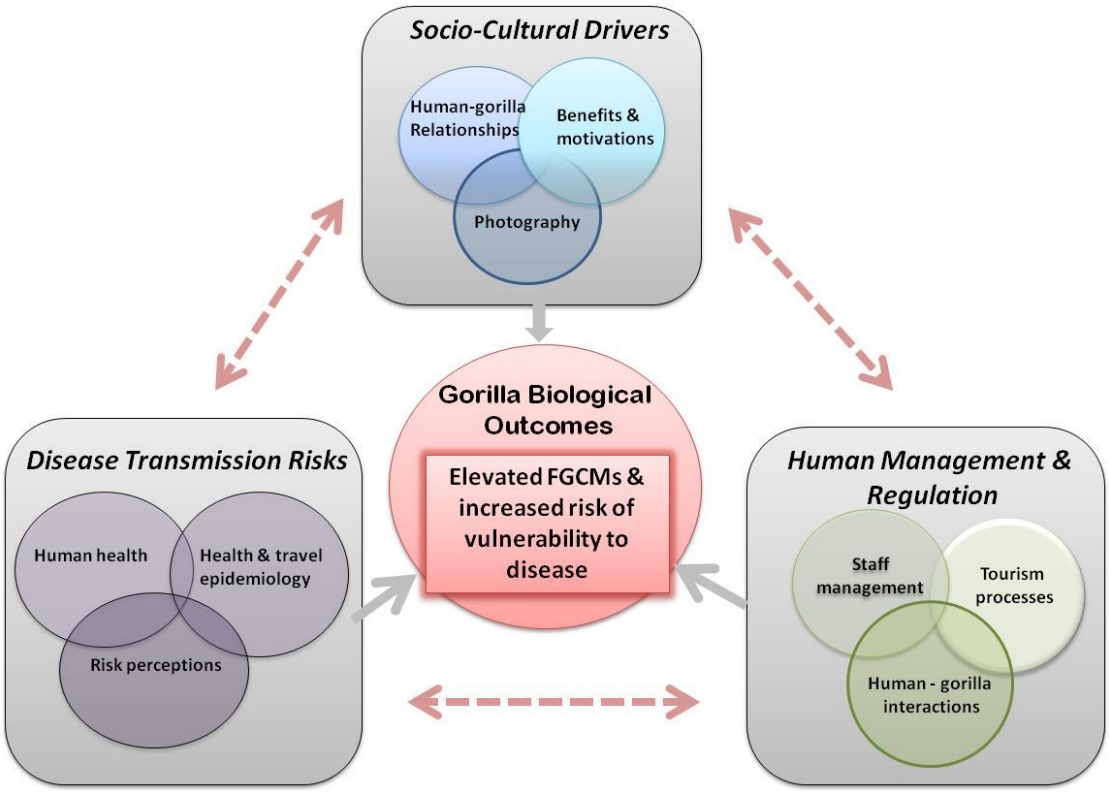

Figure 10.1. Relationships between factors influencing human-gorilla interactions and subsequent biological outcomes for gorillas involved in ecotourism activities. (Dashed arrows demonstrate the indirect influence of each human-data theme on each other and solid arrows represent their influence on gorillas).

10.2. Management implications

10.2.1. PHP tourism processes

Chapter 8 highlighted how double-bookings can occur as a result of miscommunication between offices in Bangui, international agencies and the Primate Habituation Programme (PHP) headquarters. Tourists from Bangui or those travelling in CAR can also arrive at the Dzanga-Sangha Project (DSP) headquarters without bookings and hope to visit gorillas. As there is currently no requirement to show evidence of a booking on arrival at the two forest camps, lodges hosting tourists can simply send tourist groups to the gorilla trekking camps without notice and expect them to be accommodated, often causing prior bookings to be discarded and pressure for capacity regulations to break. Therefore, there is a need for a more sophisticated central booking system which can integrate both national and international bookings, although this can be challenging in an under-developed country such as CAR. A more structured approach to monitoring and respecting original tourist bookings would also provide clarity as to whether last minute bookings can be accommodated without causing infringements to gorilla regulations or major upset for tourists with long-term bookings.

Tourists may pose a risk to gorillas simply because they are not aware of the risks (Homsy 1999). Chapter 9 highlighted that there is a need to improve tourists' understanding of the disease risks they may pose to gorillas, which, in turn, should improve adherence to regulations. Tourists also express a desire to be educated about the risks they pose, for their own understanding and because, in general, they wish to contribute to gorilla conservation (Chapter 9). An improved booking system and more formal requirements around tourists' arrival to visit gorillas would offer tourists the opportunity to provide detailed health information when booking, and a check-in requirement would offer staff the opportunity to provide a first briefing of the gorilla trekking regulations, which is important given that people have been shown to forget rules and regulations even within five minutes of receiving them (Armstrong and Weiler 2002; Bauer 2003). The current tourism assistant suggested that playing a short briefing video of the experience and regulations at a check-in centre would be a good idea to reduce pressure on staff. The provision of an initial central check-in would also allow staff to screen tourists for visible signs of ill-health. Ideally, a member of staff could be trained in basic medical observations and use a check list to observe and question tourists before they depart for the forest camps to visit gorillas. If deemed in suitable health, tourists could be given their permit which should be shown to the forest staff upon arrival at the camps. Staff should be empowered to refuse trekking to anyone not in possession of an official permit. A medical

screening would demonstrate a message and increase awareness regarding the risks of disease transmission to all involved (e.g., tourists/agencies/guides etc) and screening prior to arrival at the forest camps would avoid difficult situations where local camp staff have to turn tourists away once they have already made the arduous and expensive journey to the forest camps. It is, however, extremely difficult to base a comprehensive screening process on visible health indications. The best method to test for transmissible asymptomatic viruses would be a saliva-swab PCR machine which detects the presence of viral pathogens (Muehlenbein, et al. 2010; P.Walsh personal communication.). However, these machines are very expensive and the use of such technology to protect gorillas in a place where the local hospital has no running water would be controversial.

Finally, if tourists are staying in the DSPA for a several days to undertake several tourist activities the PHP should work with and encourage tourist lodge managers to book tourists' gorilla trekking visits at the start of their stay as this would allow greater flexibility for re-booking should there be any health complications and reduce the chances of tourists being exposed to local sources of infection whilst visiting the villages prior to their gorilla visits.

10.2.2. Gorilla trekking capacity regulations

At the time of writing (September 2013), the PHP gorilla trekking regulations allowed two groups of tourists to visit gorillas each day, with a maximum of three tourists per group. As discussed in Chapter 9, this caused problems for tourists as it meant splitting travelling couples across groups, and for staff providing multiple tourist briefings and guiding groups. In addition, two overlapping parties of people in the forest appeared to disturb the gorillas. Chapter 7 showed that there was no influence of increased tourism group size, or number of people with the gorillas in general, on the gorillas' FGCM output. A major recommendation resulting from these findings, therefore, is to increase the number of tourists permitted in each group to four, but decrease the number of permitted tourist groups each day to one. This offers the following benefits: travelling couples can remain together, which is important to tourists' satisfaction with regards to the sharing and laying down of memories (Chapter 5); reduce booking complexities and associated problems which ultimately reduces tourist satisfaction; reduce the daily logistical requirements for vehicles and staff to provide briefings; limit daily disruption to researchers' programmes to one hour per day when they must step back for tourist groups. One group of four will also avoiding potential disturbance to gorillas caused by the exchange of tourist parties close to them in the forest; reduce the overall number of people with the gorillas each day by removing a second group of guides and trackers, thereby reducing daily disease transmission

risks. Finally, adopting a one-group per day capacity would bring the site in line with the IUCN great ape tourism best practice recommendations. This final point is important, as tourists often visit sites in close succession.

This recommendation reduces the number of tourist permits from six to four per day, which may reduce the total number of tourists that can visit per year. However, current demand for tourism permits is nowhere near the current capacity levels based on six visits per day. Thus, overall tourism numbers should not be affected. Managers may wish to consider implementing seasonal pricing strategies which would encourage more tourism outside of peak periods (Sandbrook 2006; Williamson and Macfie 2010). This would help to avoid booking difficulties during peak times and better spread revenue throughout the year. If the once a day, four person per tourist group capacity recommendation is taken up guides should also be given additional training in the management of larger groups of people around gorillas, as larger groups of mountain gorilla tourists were found to get closer to gorillas than smaller groups (Sandbrook 2006).

Chapters 5 and 9 identified a number of risks that tourists present to gorillas during interactions with them as a result of tourist behaviour and health profiles. Based on these findings, in the following sections I outline several recommendations for changes to the current gorilla trekking processes affecting tourists in the forest camps before, during and after their trek to see gorillas.

10.2.3. Facemasks and vaccination requirements

Tourists feel that formal regulations and protocols increase their perception of the project as well-run and professional, and reduce their guilt with regards to potential negative impacts on gorillas as a result of their visits (Chapter 9). These findings have important wildlife management implications for the current study and wildlife-tourism sites elsewhere, as they demonstrate how the imposition of rules and regulations to improve the management of humans around wildlife may simultaneously provide benefits for the humans and animals involved. A major regulation recommendation with regards to the reduction of disease transmission is to require tourists to wear facemasks. This is also an IUCN best practice recommendation (Williamson and Macfie 2010). Facemasks are not 100 % effective at preventing aerosol disease transmission (Williamson and Macfie 2010) and can cause discomfort and steaming of lenses for those wearing glasses and using photographic equipment. However, tourists supported the idea of wearing them almost unanimously, and many were surprised and worried that they had not been required to do so during their gorilla treks.

Moreover, if tourists are required to wear facemasks this will, at a minimum, reinforce a message about the reality of disease transmission risks. Other gorilla trekking sites now require tourists to wear masks and other great ape tourism sites are following suit. If the PHP aims to be a leading and best practice site it will need to be consistent with the health messages and regulations enforced elsewhere.

Tourists also supported the proposed requirement to present their vaccination records prior to their gorilla treks. Those who had visited other sites where this requirement was in place were surprised not to be asked for them by the PHP, and were notably much more aware of the disease transmission risks they may pose to gorillas than tourists who had never visited gorillas before. For much the same reasons as enforcing facemasks, a major recommendation arising from this research is therefore to also adopt the requirement that tourists have up-to-date and relevant vaccinations. However, this recommendation has certain difficulties. From conversations with tourists and managers of other gorilla tourism sites imposing vaccination regulations, it became clear that tuberculosis (TB) vaccinations records, in particular, are not useful for predicting actual immunity in adults (Chapter 9) and tests to establish current TB immune status are expensive and time consuming to obtain. While international tourists may have enough advance warning to organise the necessary tests for TB status (which involve a chest X-ray and/or a skin test), expatriates and local people in the CAR will find this more difficult, and this is likely to deter them from visiting gorillas. Given the low prevalence of tuberculosis in European and the North American states where the majority of tourists come from, this may not be a necessary requirement. Certainly, it would not be good practice to request TB records from international tourists, because they can provide them, if people living in and native to the CAR (a country with a high prevalence of TB infection), do not have to do so, simply because they can't.

Human respiratory viruses such as influenza are the most commonly transmitted virus and cause of mortality in great apes (Meder 1994). It would seem prudent to take all measures to prevent potential transmission where possible. Influenza vaccines are developed on a yearly basis to combat new mutations of the virus and are readily available and inexpensive compared to other vaccinations. The PHP does not currently require an up-to-date influenza vaccination but may wish to consider making this part of vaccination record requirements. Implementation of the vaccination record regulation should be well advertised and clearly communicated to all tourists at the time of booking and information as to why this requirement is in place should be provided. This reiterates the need for an effective booking system.

10.2.4. Tourist briefings

Wildlife guides and tour leaders act as an interface between the product and the tourist and are critical to both the success of the tourism experience and the responsible behaviour of the group (Curtin 2010). Gorilla trekking briefings provided by the project guides and assistants for tourists in the forest camps also require improvement. The PHP made a large effort to address this issue during the study period, when staff underwent an intensive re-training and assessment week. The re-training course incorporated recommendations developed from my observations of tourist briefings, and data collected for a master's study that assessed and improved gorilla guide training. However, several further recommendations may improve tourists' adherence to existing regulations and reduce human-gorilla disease transmission risks.

Tourists often remain outside the briefing huts while the briefings are delivered, either because there is no space to sit down, they do not believe they need to hear the information, or because the guide feels they cannot insist on their attention. A more structured approach to the briefings is needed, as is the physical space to provide them. As researchers have shown, education goes a long way in terms of communicating the reasons behind management actions to visitors, especially those that restrict their behaviour (Chin 2000; Curtin 2009), and will make them more likely to support such management interventions (Curtin 2010a). An educational approach appears particularly appropriate where destructive behaviour is a product of ignorance or carelessness (Marion and Rogers 1994). Managers and tour leaders/guides have the opportunity to reduce impacts by simply informing visitors of management concerns by educating visitors about low-impact behaviours through visitor interpretation (Curtin 2012 citing Armstrong and Weiler 2002). Guides therefore need to be empowered to inform tourists that they cannot visit the gorillas unless the guides are satisfied that they have listened to and understood the briefing. Working from a check-list to deliver the briefings would prevent guides from omitting regulations because they are nervous or have forgotten them. The check-list should include a brief justification for each rule, because people respond better to regulations when they understand the reasons behind them (Marion and Rogers 1994), and because tourists are generally keen to learn about gorillas and their conservation (Chapter 9). Additionally, being asked to agree to the regulations in writing may focus the attention of the tourists, and thereby increase their adherence to the regulations. For example, tourists could be informed that they will be asked to sign an agreement and personal waiver form after the briefings before commencing their visit to the gorillas. This should request their written consent to adhere to the rules and regulations and remind visitors that non-adherence will result in the

termination of their visit. Guides must therefore be willing, and encouraged, to enforce this regulation on the basis of two warnings then termination of the visit.

With the current regulations that permit two groups of tourists to visit a gorilla group each day, the second tourist group is often neglected or rushed through the briefing because drivers and agency guides become nervous about the time available to drive back to Bayanga. Allowing only one group of tourists per day, as recommended above, would allow each briefing to be delivered more thoroughly. As such, the briefings could be expanded to include presentation of information about the gorilla groups, the gorilla conservation project and the forest camps, the process of habituation and gorilla conservation issues, which will provide a more enriching and educational experience for tourists, improving their understanding of the context, and therefore adherence to, the trekking regulations. This would provide an opportunity to educate tourists on the subject of wildlife tourism and wildlife disturbance.

Chapter 9 highlighted an important contradiction in tourists' motivations regarding gorilla interactions: it is important for tourists to feel that they are observing wild animals in their natural environment, yet, at the same time, tourists desire a physical or emotional interaction with the gorillas. This motivation drives behaviours that disturb wildlife or results in the tourists' disappointment about their gorilla interactions when the interactions do not occur. Tourists should be informed that habituated animals perceive observers as a neutral element in their environment, and, therefore, if interaction such as eye-contact and certainly physical contact occurs, it means the wildlife is being disturbed (Curtin 2010). As many tourists use prior experiences of having seen or personally interacted with mountain gorillas as a point of comparison, it would be useful to refer to these cases as an example of what should be avoided and presented as bad tourism practice. This will present the gorilla tourism programme in a positive and progressive light to the outwardly eco-conscious tourist, and allow them to feel good about their observations of, rather than interactions with, the gorillas.

10.2.5. Pre-trek sanitation regulations

Tourists have often passed through several other African countries, wildlife tourism destinations and local villages where domestic livestock roam freely before arriving at the study site to visit gorillas. They may also have visited other gorilla groups on previous days and typically only travel with one pair of suitable shoes or boots for gorilla trekking (Chapter 9). This presents a substantial risk in terms of potential disease spread (Willamson and Macfie 2010; Whittier 2010). A basin containing water mixed with bleach or chlorahexadine disinfectant should be provided next to the tourist briefing huts and tourists should be required to disinfect

the bottoms of their shoes before leaving to visit the gorillas, and again before returning to their vehicles after their trek. Antibacterial hand wash and water or sanitation gel to rub onto hands should also be provided as matter of basic sanitation provision for tourists, and because disease can be spread to wildlife by people touching vegetation in the forest.

10.2.6. Photographic regulations

Chapter 5 identified gorilla tourists' photography-based motivations to visit gorillas can be a driver of regulation violations and disruptive behaviour. Photography is an important part of people's experiences with gorillas. A large proportion of tourists said they would not come if they could not take photographs, and conservation messages and interest can be stimulated by tourists sharing photos with others after their visits (Chapter 5). Thus, banning tourist photography would not be advisable. However, several other options to control photographic behaviour should be considered:

1. Camera number restriction: the number of SLR-type cameras could be restricted to only one per couple, or per group at a time, although tourists may share use of the camera. This will avoid the situation of three tourists jostling for the best photo opportunities and ignoring the guide and safety regulations.

2. Prohibit tripods: long lenses (approximately 300mm +) require a tripod in dark forest conditions. Novice photographers can be particularly clumsy with tripods. I have been hit by tripods and observed tourists almost hitting, certainly accidently threatening, gorillas with them. Tourists with tripods often also assume priority for the best position to see gorillas over tourists with smaller cameras and use them as a physical barrier to hold their ground. This type of behaviour is disruptive to other group members, difficult for guides to control and can be a risk around gorillas. Prohibiting tripods would also reduce the size of lenses people can bring and their associated disruptive behaviour. Professional photographers who pay commercial fees to spend an appropriate period of time with the gorillas under supervision could be permitted tripods.

Written agreement of non-commercial use: I met and guided several tourists who later revealed that they were semi-professional photographers, there to take photos of the gorillas for sale. These tourists were by far the most pushy, panicky and disruptive around the gorillas as they were under pressure to provide saleable images to their agencies. This practice not only increases disruptive behaviour around gorillas but under-cuts and compromises the work of professional photographers who have paid large fees to gain their images responsibly. The

agreement that images are for non-commercial use should be included in the waiver form signed before the trek and included in information provided at the time of booking.

3. Sell souvenirs: tourists place great importance on their photos as souvenirs and as tools to remember and share experiences with others (Chapter 9). Many tourists I spoke to about photography said that they would be happy not to take photos at all but would instead like to be able to buy a souvenir post-card of the gorillas they visited. Thus, there is an opportunity to sell professionally made postcards to tourists after their visits at the forest camps. It is very likely that professionally made postcards could be donated to the project by a suitable photographer, for example, in exchange for access to photograph the gorillas for an agreed period of time. Souvenirs could also be expanded over time to include traditional jewellery made by the BaAka association which could be sourced via an organised rotation system that represents the crafts of all local villages fairly. This money could be put directly back into the health fund for the BaAka population. These souvenir options may not only reduce photographic dependencies on tourists' hour-long visits to gorillas but would help improve the livelihoods and health of the surrounding BaAka population.

4. Encourage tourists to go without: while banning photography altogether is not a viable option, some tourists may be responsive to encouragement to leave their cameras behind or put them away during their visits. Signs could be posted in the tourist briefing huts encouraging tourists to think about their photographic behaviours and the impact these may have on the gorillas. These messages may encourage tourists to experience their visits visually, without the distraction of their cameras.

10.2.7. Tourist interactions with gorillas

A final major recommendation with regards to tourist-gorilla interactions is to increase the minimum viewing distance from 7 m to 10 m as discussed in Chapter 7. This is also an IUCN best practice recommendation (Williamson and Macfie 2010) and is supported by Klailova, et al. (2011) in light of the behavioural response of western lowland gorillas to different observers. When the 7 m regulation is broken (albeit accidently), the result is that observers are actually at 5 -7 m from gorillas. If tourists are required to remain at 10 m this should reduce the frequency of < 7m violations and the associated physiological hormone alterations in gorillas.

Maintenance of the distance between tourists and gorillas is ultimately the responsibility of the guide, and tourists should always be level with, or behind, a guide or tracker while with the gorillas. However, moving around can be difficult in the dense forest

vegetation and tourists may be required to, or choose to, move away from the guide at times. Tourists may not be able to judge 7 m (or 10 m) accurately and may break this regulation accidently. Additionally, tourists may put pressure on guides and trackers to get closer to gorillas simply because they haven't judged the minimum distance correctly. To address this, guides should demonstrate the required distance during the tourist briefing and/or in the forest to demonstrate forest conditions. Visual aids for the guides to use such as those adopted in mountain gorilla trekking camps would be useful for this purpose (Figure 10.2).

Figure 10.2. A guide uses the 7 m model to demonstrate the required distance between human and gorillas in a mountain gorilla trekking camp, Uganda.

Laser distance measures are a further option which could be investigated to assist maintenance of distances in the forest. These devices are relatively inexpensive and may be useful for forest-based training or for every-day use in tracking gorillas. If the devices were effective this would help guides to enforce tourist distances as it would provide a visible, objective measurement that tourists would be less able to dispute than the guide's own judgment.

10.2.8. Facemasks

Chapter 9 presented information regarding the health risks that the local BaAka trackers and project staff pose to gorillas as a result of their health, behaviour and disease risk exposure. The BaAka trackers present the greatest disease-transmission risks to gorillas as a result of their poor health, because they get closer than 7 m to gorillas the most frequently and because they are poorly educated about disease-transmission risks. In Chapter 9 I highlighted several causes as to why the BaAka most frequently break the 7 m distance rule: the BaAka trackers lead the teams in the forest and are therefore the most likely to get too close unintentionally; they are not aware of the 7m regulation or estimate 7 m incorrectly; they have a poor understanding of disease transmission risks and therefore the reasoning behind the regulation. Several recommendations may address these problems.

1. Facemasks: sneeze particles have been shown to travel further than 7 m in still conditions (Fernstrom 2013). All project staff should be required to wear facemasks when at 10 m or less from the gorillas, at all times. Resistance to implementing the use of facemasks among staff revolves around concerns such as masks being uncomfortable for the long periods of time spent with gorillas and that masks won't be used or disposed of correctly and will thus increase disease-transmission risks. Comfort should not, however, be a reason to put gorillas at risk from human-diseases, and facemask design is developing rapidly to be more effective and comfortable. Staff should be trained in correct use and disposal of masks, and monitored or penalised if they do not adhere to regulations. Staff could be permitted to remove their masks when further than 10 m away from gorillas, which may also encourage teams to increase the distance between themselves and the gorillas when it is not necessary to be in closer proximity. For example, if the gorillas are resting the teams may choose to move away and remove their masks until the gorillas move again and require closer monitoring. Mask efficacy reduces with time and in humid conditions (Willamson and Macfie 2010), therefore, if the masks are in constant use for a number of hours they should be changed for a fresh spare carried by each team member. Although the health of foreign researchers and film crews/journalists may be generally better than local staff, they may have strong motivations to get close to gorillas and continue to work in spite of locally acquired illness. Therefore, they should be subject to the same regulations as the local project staff and wear facemasks when at 10 m or less from the gorillas.

2. Re-training: the BaAka trackers should be re-trained regularly to improve their estimation of the 7 m or 10 m distance. They could be trained in the camp by management, on

at least a monthly basis, and be tested informally and rewarded according to their accuracy. The visual aid described above would also be useful for this training. If laser measuring equipment proved effective this could also be incorporated into training. Additionally, as the BaAka trackers lead the tracking teams they have to look carefully for tracks and signs on the ground, which may contribute to their frequent breaking of the 7 m rule. More emphasis should therefore be placed on the role of the assistant/guide or researcher accompanying the trackers to observe the distance between the lead tracker and the gorillas.

3. Health education: The PHP could collaborate with a local or international doctor or health volunteer to provide basic health education to the project staff. This would improve their understanding about disease transmission risks for their own health and safety and for the gorillas they work with.

4. Vaccination programmes: The PHP must ensure consistency in the vaccination requirements for all staff and visitors and maintain local staff vaccination records as a matter of priority.

5. Camp sanitation regulations: The same hand and foot sanitation regulations that apply to tourists should be enforced for all project staff. All staff entering the forest should be required to go through a pre-forest routine of checking their facemask, disinfecting their hands and footwear. They should do the same when they return to the camp, disposing of their facemasks, washing their hands and disinfecting their footwear. Additionally, the PHP should strive to improve toilet and hand washing facilities in the camp, particularly for the BaAka, who often urinate and defecate around their sleeping areas when their toilet is occupied/full, during the night or during bad weather. This would reduce the risks of BaAka walking on soiled ground and potentially spreading disease among themselves and to wildlife.

6. Staff rotations and quarantines: Project staff rotating into the forest to work may have been around young children, sick people and domestic livestock and, therefore, present disease transmission risks to other staff and gorillas. Other sites where incoming staff work in close contact with great apes enforce quarantine periods for up to a week (K. Shutt personal observation). The PHP could consider this, although it would prove difficult logistically with staffing rotas and researcher's work schedules. However, it may be possible to reconsider the work schedule so that incoming staff work on the habituation of new groups for their first 1-2 weeks as these groups are rarely contacted closely, or act as tourist trackers, who stay behind

during the visit and therefore have less close contact with gorillas. Enforcing facemasks regulations will also reduce the risk of disease transmission from incoming staff.

Maximum daily staff numbers: Finally, there are currently restrictions as to how many people may be with the gorillas at any one time, but not in total over the course of one day. When non-tourist stakeholder pressure is high (e.g., five researchers and a film crew wanting time with the gorillas) the gorillas can be exposed to a high total number of people during the course of a day, which increases the risks of disease transmission and may increase behavioural disturbance (Klailova, et al. 2011). Therefore, the PHP should consider capping the total number of people that work with the gorillas each day and ensure that stakeholder presence is managed appropriately to reduce periods of high research/film crew pressure.

10.3. Summary of the findings and future work

The recommendations outlined above are specific to the PHP gorilla habituation and ecotourism programme. However, many can be applied directly to other wildlife tourism settings, while other aspects of the research could be developed and built on in future work. In the following subsection

This study is the first to investigate the physiological repercussions of wildlife habituation for ecotourism. The findings suggest that there is a potentially deleterious consequence of the habituation process on the stress physiology of the gorillas involved. The implications of these findings suggest that sites planning to undertake habituation of new gorilla groups (and other great apes) should carefully consider the availability of committed funds and habituation staff required to carry out the process as efficiently as possible and plan habituation and health monitoring activities as a priority (Chapter 7). Additional insight could be gained from a longer-term study of hormonal habituation commencing from the outset of the process however. The findings of this research reinforce the need for wider application of non-invasive physiological monitoring of wildlife involved in ecotourism and the validated methods provide a solution to common problems faced by such studies in difficult field settings. This study also provides a novel investigation of the relationship between endocrine and immune measures in the context of wildlife ecotourism. The results of this work reveal an important relationship between gorilla stress physiology and gastrointestinal parasite infection which itself requires further research. Other more informative measures of immune-function, such as viral or bacterial infection, could be monitored non-invasively in order to improve our understanding of hormone-immune relationships and what they mean in relation to conservation biology.

Findings from investigations of gorilla tourists will be relevant to the management of wildlife tourists across diverse contexts where people experience wildlife in nature. These findings echo what has been suggested to be the most common tension between the wildlife tourism provider and the user: that the user seeks greater and closer access to the wildlife and the providers seek to restrict access and increase the distance between them (Reynolds and Braithwaite 2001). The study of people visiting gorillas is perhaps one of the most extreme examples of the need for effective management of this tension. Gorilla tourism puts non-specialist visitors in close proximity to large wild animals that are capable of causing significant bodily harm. There is no wall of glass, no fence and no arms are carried by staff or guards. The only source of protection the visitor has is an apparent trust in a poorly understood process called habituation. While this juxtaposition of concepts is clearly a source of appeal for visitors, the physical management of the situation relies purely on non-physical regulatory adherence. Information gained from this study concerning what visitors seek and are prepared to accept in a wildlife-based tourism experience is relevant to wider wildlife tourism. In particular, tourists suggest that their support for and adherence to conservation-oriented regulation would be improved with the provision of relevant justification and scientific evidence. A study designed to evaluate the reality of such claims would be highly informative. Further study is also needed to explore the different perceptions wildlife-watchers hold of habituated animals to understand how the interaction is experienced and therefore how to appropriately tailor management interventions in such contexts. Finally, as positive wildlife tourism experiences are suggested to increase support for conservation activities, a study addressing whether this effect occurs and exploring the role of photography in mediating the potential influence would be valuable for understanding tourism's contribution to wider gorilla conservation and many other species at the focus of tourism activities.

10.4. Reflections on the value and experience of conducting interdisciplinary research

A multidisciplinary approach to a problem draws on skills and experience from different disciplines, with each discipline approaching the problem from its own perspective. In this sense a multidisciplinary approach to a problem can provide more knowledge and experience than disciplines operating in isolation (Jessup 2007). An interdisciplinary approach integrates those of the separate disciplines to solve problems and answer questions that cannot be satisfactorily addressed using single methods and approaches of individual disciplines (Klein 1996). I outline the definitions of these two terms as, although my thesis retains elements of both, it also

represents my growing understanding of and transition from the former into the later quite accurately.

Anthropological studies of tourism and the environment are increasingly abundant, but anthropology has focused less on ecotourism and even less on wildlife tourism. Burns (2006) speculates that this is because anthropology is about people, and therefore anthropologists have feared to tread on the scholarly toes of disciplines that traditionally focus on animals. A few authors have made a move to bring a qualitative approach to wildlife tourism research (e.g., Curtin 2005, 2010, Bulbeck 2004; Fennell 2011, Ritchie 2005; Deruiter 2002), and there is a widely applicable body of work describing human-animal relationships on which to build (e.g., Arluke 1996; Davis and Balfour 1992; Mullin 1999; Franklin and White 2001). However, anthropologists are rare in the field of human-wildlife interactions (Burns 2006). A major source of conflict in wildlife tourism operations arise between those who are concerned with operating wildlife tourism and those concerned with conservation and protection of the resource base, as there is a lack of understanding by each party of the constraints and pressures on the other (Reynolds and Braithwaite, 2001). The solution may, therefore, lie in a combination of relevant, reliable, independently derived evidence on the influence of human visitation on the wildlife as well as what visitors gain from, and contribute to, their wildlife interactions (Reynolds and Braithwaite 2001). Such situations call for transformations in research practice and for researchers to undertake interdisciplinary research to address the complexity of current environmental problems (Moore, et al. 2009).

I approached the development of my PhD question with a naive but optimistic understanding that the study would require me to draw together a plethora of different theories and methods from multiple disciplines. I was excited about this challenge and saw the opportunity for international and cross-boundary collaboration, perhaps initially mistaking multidisciplinarity for interdisciplinarity. It was not until I started to execute the study that I truly began to understand what it meant to be an interdisciplinary researcher, both in the physical demands of the data collection in the field, but also analytically, thinking across the disciplinary boundaries I had learnt.

Operating as a single researcher with aspirations to collect data that will address questions rooted in conservation biology, but actually spanning epidemiology, psychology, sociology and anthropology, is not an easy task. I wondered at first if throwing more finance at the situation would solve some my problems of seemingly being 'one man with *many* governors'. Expanding my team was helpful, but it was eventually a result of having backed

myself into a corner of data collection requirements that I was forced to find my inner 'interdisciplinarian'. Integration was key, and once I realised that it was acceptable to explore using typically ecological methods of animal behavioural observations to collect data on humans too, this helped more. Then I realised I could conduct anthropological observations at the same time as, for example, collecting gorilla faeces, and in fact, my doing so elicited different and deeper conservations with my informants than might have occurred had I simply been a primatologist observing in the background. There were days, however, when I would look jealously at the researchers sitting calmly taking their gorilla observations and wish I could just do the same. In contrast to the other researchers I would rush back to camp from the Congo border, ahead of the tourists I had been observing, deliver tubes of gorilla faeces for my assistant to extract while I rushed over to the tourist hut to conduct hours of interviews with tourists, squeeze some questionnaires out of them, and then finally log and prepare sample tubes for the next day.

Then came the data analysis. As a trained biologist, learning a new discipline was time consuming and challenging. Switching between the different styles of analysis and writing, and finally being able to see ways to bring parts of the analysis and theory together, proved quite a journey. Many other authors have acknowledged how challenging such work is (e.g., Fairet 2012; Nikitina 2005; Østreng 2010). Others suggest that interdisciplinary research will result in the disintegration of the core of each discipline involved (e.g., Milton 2013), which might be true, if, interdisciplinary work meant that the separate disciplines should cease to exist themselves as separate entities. There are, of course, questions and problems that are best addressed from within a single discipline. However, many problems require, or, at a minimum, benefit from, an integrated disciplinary approach, and would be inadequately addressed without it. Undoubtedly a pure anthropologist would do parts of my socio-anthropological research differently, or better, as similarly a committed biologist would the biological aspects of the research. For example, it took time for me to understand the best form of note taking when interviewing tourists, and subsequently, what I should write up from my notes afterwards. I also had limited time to write up these notes in the evening as I had to prepare faecal sample collection tubes for the next day. I therefore, no doubt, lost some information from my ethnographic accounts and interviews in the beginning stages of my study. Equally, it is possible that I might have been able to collect a more extensive faecal sample set if I was purely dedicated to spending hours in the forest following gorillas, rather than cutting this time short in order to interview tourists back in camp. However, a purely biological study obtaining more faecal samples might offer greater detail on the physiological stress response of gorillas to

humans, but I would not be able to identify the details of human-behaviour around gorillas that elicits the response, and subsequently how to prevent it. Thus, it is the integration of these 'ologies' into a more three-dimensional view, which I now see has ultimately been essential in addressing my particular research questions.

10.5. General conclusion

A key challenge in sustainable nature tourism is to develop economically viable ventures that provide livelihood and community benefits while protecting indigenous cultures and environments. Many conservationists do not believe that wildlife should have to be the focus of tourism in order to pay for its own conservation (Butynski and Kalina 1998). However wildlife tourism is a potentially valuable tool to assist conservationists in preserving increasing numbers of endangered animal populations, and alternative funding mechanisms independent of tourism are, as yet, unavailable (Litchfield, 2009). It is therefore essential to produce definitive guidelines based on scientific research which will ensure the long-term wellbeing of wildlife at the heart of tourism and research activities. This crucially begins with monitoring the effects of human interactions during habituation and tourism on wildlife physiology (Muehlenbein 2009). It is, therefore, vitally important that conservationists are able to recognize and meet the needs of both people and animals, and are trained in the development and application of integrated conservation methodology in these contexts. Many studies have documented various biological and behavioural repercussions for great apes involved in tourism activities, and tourism guidelines based on growing experience from human-ape encounter sites are developing. However, few studies have considered the integrated effect of socio-cultural and biological factors that contribute to the conservation impact of these particular tourism contexts. The main achievement of this work has, therefore, been to contribute information to this critical gap in knowledge. By gaining an integrated understanding of the impacts of harnessing tourism to nature conservation and incorporating them into conservation biology, these problems can subsequently be better controlled, and directly increase the positive impact of gorilla conservation via tourism. The conclusions of this study will also contribute more widely to a sustainable future for developing projects and wildlife-tourism-based conservation solutions elsewhere.

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Appendix 1: Primate Habituation Program gorilla trekking regulations

PRIMATE HABITUATION PROGRAMME

Dzanga-Sangha Protected Areas

WWF

GUIDELINES FOR GORILLA/ MANGABEY TRACKING

Seeing wild animals in thick tropical forest is not guaranteed, but to date over 90 % of the tourists taking part in tracking activities have seen the animals up close. Visitors to the gorillas must be 16 years and older. Group size is limited to three visitors, twice per day, with visits to the gorillas limited to 1 hour.

All visitors should be aware that gorillas can be dangerous and may charge, push vegetation, grab, or bite; the Gorilla Tracking team cannot control their behaviour but instead strives to reduce these risks to visitors and themselves.

The role of the dominant male gorilla, the silverback, is to defend his family, keep the group together, and prevent other males from taking the resident females. This protective role partially explains the charges given to humans, who without knowing the full repertoire of gorilla 'social manners', can occasionally make mistakes. If a gorilla charges, do not move, remain quiet, and look away. A gorilla may charge to within a few metres, a charge can quickly become serious, if one makes a wrong move. The Gorilla Tracking team has many years of experience with the gorillas. Following their instructions will substantially reduce the risk and severity of charges and other aggressive behaviour.

But please note that visitors participating in forest activities do so entirely at their own risk.

Close encounters with elephants and, less frequently, buffalos can also occur. Often the best strategy is to leave quietly and divert around them. However in the case of a charge, you may need to run away – so please follow the instructions of your guide.

To minimise risk we ask each potential visitor to assess his or her physical capacity, based on the conditions described above. All visitors to the gorillas must present a vaccination card (with up-to-date polio, measles, and yellow fever vaccinations) at the Tourist Welcome Centre before visiting the gorillas. (Measure added in 2013, post-research review).

Visitors with a history of allergic reactions to bees or other insect bites/stings should carry the necessary emergency medicines (adrenaline and/or anti-histamines) and inform the guides of the potential problem before starting the visit.

IMPORTANT: IN THE FOREST, ALWAYS FOLLOW THE INSTRUCTIONS OF YOUR GUIDE TO REDUCE THE RISK OF ACCIDENTS DURING ENCOUNTERS WITH WILD ANIMALS.

PLEASE RESPECT THE FOLLOWING RULES WHICH WILL BE REITERATED BY YOUR GUIDE BEFORE YOUR DEPARTURE

1. Wash your hands and dip your boots in the footbath at the hand-washing stations located at the camp forest exits before and after your gorilla trek.
2. (Measure added in 2013 post-research review).
3. Stay close to team members at all times.
4. Avoid making unnecessary noise or sudden movements. Keep your voice low and speak only in a whisper throughout your time in the forest.
5. Do not point at the gorillas.

6. Never run or scream or make loud noises, particularly when near the gorillas. If a gorilla shows aggression (barks, screams or charges), do not move. The gorilla may perceive a fast or abrupt movement as threatening, which increases the risk of further aggression.
7. Do not try to interact with or touch the gorillas.
8. Never step in front of your tracker or guide. To minimise stress on the animals and reduce the risks of disease transmission, we ask you to remain at least 7 m from the animals.
9. Do not use flash or other artificial lighting while filming or photographing the gorillas. On rare occasions, your guides may ask you not to take photographs, if the gorillas are nervous, very close, or if your equipment makes too much noise.
10. Do not drop any litter in the forest (including toilet paper and handkerchiefs). All items brought into the forest must return with the visitor.
11. Do not eat or leave any human waste in the forest. To avoid the risk of disease transmission, we ask that visitors avoid defecating, vomiting and spitting in the forest. However, if unavoidable you can ask your guide for assistance to dig a hole (25 cm deep), which must then be well covered. If you need to sneeze or cough in the presence of the gorillas please turn from the animals and cover your nose and mouth using a handkerchief (or by pulling up your shirt), to avoid spreading bacteria and viruses.
12. Smoking is not permitted in the forest except at the camp.
13. Please screen your state of health and physical capacity before deciding to participate in the gorilla tracking programme. Visitors who are knowingly ill or show signs of infectious illness will not be allowed to participate in gorilla tracking.

IN CASE OF NON-COMPLIANCY, THE VISIT WILL BE TERMINATED IMMEDIATELY WITHOUT REFUND

Appendix 2: Tourism questionnaire

BM 27/02

Dicky.

70

Cher visiteur, Chère visiteuse,

Nous vous remercions vivement de prendre de votre temps pour remplir ce questionnaire. Vos réponses nous sont extrêmement utiles et nous aideront à assurer un futur pour le tourisme de vision des gorilles, ainsi que pour la survie même des gorilles !

Ce questionnaire ne devrait pas vous prendre plus de 10 minutes.

Merci de répondre seul, et de répondre à toutes les questions. Ceci va nous garantir la qualité des réponses et des données qui vont en découler !

Nous vous assurons que vos informations seront traitées de manière anonyme et confidentielle.

Kathryn Shutt, Doctorante, Université de Durham, Royaume Uni.

Section 1 ***Information Personnelle***

a) Date de naissance: 12/11/74 b) Sexe: M / (F) c) Nationalité: Française

d) Pays de résidence: RCA

e) Profession: Entrepreneuse

f) Niveau de formation

- Niveau BPC (collège) ou inférieur ☐
- Niveau BAC ☐
- BAC+2 ☐
- BAC+3/4 ☒
- BAC+5 et plus ☐

g) Merci d'indiquer votre revenu annuel moyen si cette information cela ne vous gêne pas (Euros)

- €0 – 18,000 ☐
- €19,000 – 36,000 ☐
- €37,000 – 54,000 ☐
- €55,000 – 71,000 ☒
- €72,000 – 89,000 ☐
- €90,000+ ☐

Section 2 ***Information sur vos Voyages***

a) Combien de pays africains avez-vous déjà visités jusqu'à aujourd'hui ? 9

b) Combien de pays africains visitez-vous durant votre voyage actuel? 1
Merci d'indiquer le nom de ces pays :

RCA

c) Environ combien de fois avez vous utilisé, durant votre voyage actuel, chacun des types de transport mentionné ci-dessous ?

	Nombre de fois
Vol international	
Vol national	
Transport routier public	
Véhicule privé	
Véhicule de location	X
Bateau	
Autres	

d) De quelle manière voyagez-vous actuellement ?

- Agence de voyage/ Tour opérateur Si oui, laquelle ? ☐
- Indépendant sans agence ☒
- "Backpacker" (autonomie totale) ☐
- « overlander » (expédition autonome en 4x4) ☐

e) Combien de jours avez-vous prévu pour votre voyage actuel ? 4

f) Combien de jours avez-vous prévu rester à Dzanga Sangha 2

Section 3 ***Intérêts Personnels***

a) Quel est le votre premier intérêt/raison à venir en Centrafrique? Travail.

b) Quel est le votre premier intérêt/raison à venir dans la Réserve de Dzanga Sangha? Presque la seule activité en RCA - Voir les gorilles.

c) Quel est le niveau d'importance que vous accordez au fait que votre argent soit redistribué aux populations locales ?

Pas du tout / (Un peu) / Assez important / Très important

Est-ce que cet aspect a contribué pour vous à choisir spécialement la destination de la réserve de Dzanga Sangha ? Oui / (Non)

d) SVP, listez, quel sont vos autres intérêts à venir en RCA cette fois-ci, (par exemple, des autres activités/parc national)? Chutes de Boali, de Mbéré, de Kembé, l'Oubangui

i). Déjà faites avant votre visites des gorilles ↓ ↓ ↓ ↓

ii). Prévues après votre visite des gorilles Refaire les mêmes.

e) Quel est le niveau d'importance que vous accordez au fait ~~qu'il existe~~ d'autres activités dans la réserve ?

Pas du tout / Un peu / Assez important / (Très important)

f) Est-ce votre première fois de visiter les gorilles habitué dans la nature ? (Oui/non) Non.

Si non, combien de fois l'avez-vous fait, où, et quelle(s) années(s)? 1 autres fois en 2009 ici

f) SVP, compléter la phrase qui suit, avec autant de raisons que vous le souhaitez (continuer sur l'autre côté si nécessaire):

"Je voulais visiter les gorilles car c'est un animal rare, en voie de disparition - Très proche de l'Homme.

Section 4 ***Aspect Medical sur votre Voyage***

a) SVP, cochez les vaccinations que vous avez à jour :

Rougeole ☐ Oreillons ☐ Rubéolle ☐ Polio ☒ Typhoïde ☒ Fièvre jaune ☒ Grippe "commune" ☐ Grippe porcine ☐

Rage ☐ Méningite ☐ Hépatite A ☐ Hépatite B ☒ Diphthérie ☒ Encéphalite japonaise ☐

b) Prenez vous un traitement prophylactique contre le paludisme (ou/non) ? Si oui, lequel ? Non.

c) SVP, cochez toutes les cases qui correspondent à une maladie ou un symptôme que vous avez eu (constaté ou soupçonné) ces derniers 3 semaines (y compris celles-la qui a commencé avant les trois semaines) :

Fièvre ☐ Problème digestif (Diarrhée) ☐ Problème digestif (Vomissement) ☐ Nez encombré ☐ Toux ☐ Eternuement ☒ Rhume des foins ☐

Infection de la gorge ☐ Pneumonie ☐ Rhinite/Sinusite ☐ Infections de la peau ☐ Infection pulmonaire (tous types) ☐ Autre _____

d) Avez-vous été en contact avec des enfants (p.e., moins de 16 ans) durant la dernière semaine (**O/ N**) ? Oui

Si oui, votre plus récent contact a duré combien du temps? un quart d'heure

e) Avez-vous été en contact avec une personne malade (certain ou soupçonné) durant les 3 dernières semaines ? Par exemple dans un avion / une voiture/ ou lors d'une vite en groupe (entourez)? **O / N** ... SVP, décrire brièvement. Non.

f) Combien de fois (environ), avez-vous eu accès durant votre voyage à des toilettes « traditionnelles » (trou creusé dans la terre, avec ou sans plancher) ? 4 fois chez vous -

g) Combien de paires de "chaussures de marche" pour votre expérience/trek dans la forêt avez-vous avec vous ? 2

Section 5 ***Tourisme des Gorilles (1)***

a) Pourquoi pensez-vous que c'est important de rester à une distance d'au moins 7 mètres des gorilles lors des visites ?
pour respecter leur santé – Ne pas trop les déranger.

b) Pensez-vous que vous avez été à un moment donné à moins de 7 mètres d'un ou de plusieurs gorilles lors de votre visite ? Oui (c'est lui qui est venu)

c) Pourquoi pensez-vous que c'est important de rester groupé lorsque vous êtes près des gorilles ?
Moins les déranger –
Eviter les contagions des guides –

d) Si l'on vous demandait de présenter la situation de vos vaccins à Bayanga avant d'aller visiter les gorilles, est-ce que cela vous dérangerait ? Non si m'a prévenu avant le départ –

e) Si l'on vous demandait de porter un masque chirurgical pendant la visite des gorilles, pensez-vous que cela :
i). Affecterait le plaisir de votre visite/expérience (entourez la réponse) **oui / (non) / peut être**
ii). Vous déciderait à ne pas visiter les gorilles (entourez la réponse) **oui / (non) / peut être**

f) Si des mesures devaient être prises, quelle option choisisseriez-vous ? A ou B (entourez la réponse)

Option A). Rester systématiquement à au moins 10 mètres des gorilles, ou **(Option B).** Porter un masque chirurgical et approche jusqu'à 7 mètres.

Section 5 ***Tourisme des Gorilles (2)***

a) Etes-vous heureux que votre guide ou votre structure d'acceuil vous donnent :
i). Les règles à suivre lors de la visite des gorilles? Oui

ii). Les risques et règles à suivre lors de la rencontre avec d'autres animaux (potentiellement dangereux) dans la forêt? Oui

iii). Des informations sur le comportement social et le régime alimentaire des gorilles en général, ou encore des caractéristiques des individus du groupe ? oui, j'aimerais en avoir encore plus –

b) Avez-vous le sentiment que le prix que vous payez pour la visite des gorilles est justifié? Oui mais il ne faudrait pas plus –

c) SVP, entourez le terme qui correspond le mieux à votre niveau de satisfaction pour la visite des gorilles :

Très Décevant / Décevant / Sans Commentaire / Satisfaisant / (Très Satisfaisant)

d) Recommanderiez-vous ce voyage à d'autres personnes?

Pas du tout / Possible / (Certainement)

e). Le fait d'avoir vu les gorilles en pleine nature vous amènera-t-il à contribuer à l'avenir à la cause de la conservation des gorilles?
Pas du tout / (Possible) / Certainement

f) Avez-vous des commentaires ou suggestions concernant la visite des gorilles? Non tout était bien.

Appendix 3: DEFRA Licence for field work study period.

Authorisation No: **TARP**/2011/369

DEPARTMENT FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS

AUHORISATION FOR THE IMPORTATION FROM THIRD COUNTRIES OF RESEARCH SAMPLES

European Communities Act 1972

TRADE IN ANIMALS AND RELATED PRODUCTS REGULATIONS 2011
ANIMAL BY-PRODUCTS (ENFORCEMENT) (ENGLAND) REGULATIONS 2011

The Secretary of State for Environment, Food and Rural Affairs, by this authorisation issued under the terms of Paragraph 4 of Schedule 3 of the Trade in Animal and Related Products Regulations 2011 authorises:

Durham University Anthropology Department, Dawson Building, South Road Durham DH1 3LE	Name and full postal address

Subject to and in accordance with the conditions set out below, the landing in England of:

Gorilla Faeces, intended for particular studies or analyses	Product

From

Central African Republic	Countries of origin

At

Gatwick/Heathrow Airport	Ports of entry

Until

17 April 2012	Expiry Date

DEPARTMENT FOR ENVIRONMENT FOOD AND RURAL AFFAIRS animalhealth

17 October 2011

Officer of the Department for Environment, Food and Rural Affairs

Appendix 4: Research permit provided by the Central African Research Ministries.

MINISTERE D'ETAT A L'ENSEIGNEMENT
SUPERIEUR ET A LA RECHERCHE
SCIENTIFIQUE
--*-*-*
DIRECTION DE CABINET
--*-*
DIRECTION GENERALE DE L'ENSEIGNEMENT
SUPERIEUR ET DE LA RECHERCHE
--*-*-*
DIRECTION DE LA RECHERCHE SCIENTIFIQUE
--*-*-*
SERVICE DE COORDINATION ET GESTION DES
PROJETS DE RECHERCHE SCIENTIFIQUE
--*-*
N° 056 /MEESRS/DIRCAB/DGESR/DRS/SCGPRS.11

REPUBLIQUE CENTRAFRICAINE
Unité – Dignité – Travail
--*-*

Bangui le 09 MAI 2011

AUTORISATION DE RECHERCHE

****

Le Ministre d'Etat à l'Enseignement Supérieur et à la Recherche Scientifique autorise :

Nom et prénom : **SHUTT KATHRIN ANN**
Date et lieu de naissance : **12 /06/1982 à DHEKELIA en Angleterre.**
Thème de recherche :***Effet de l'homme et du tourisme en milieu sauvage, écotourisme sur les gorille***
Adresse professionnelle complète : **Direction WWF de Bangui (RCA)**
à effectuer des travaux de recherche sur le territoire centrafricain plus particulièrement dans la zone de Dzanga-Sangha, à l'exception des zones d'intérêt stratégique et militaire pendant la période allant du 06 juin 2011 au 05 juin 2012.

Les autorités civiles et militaires de la République Centrafricaine sont priées d'apporter protection et assistance à l'intéressé(e) en cas de besoin.

Pour le Ministre d'Etat,
et par délégation, le Directeur Général de
L'Enseignement Supérieur et de la Recherche

Guy-Florent ANKOGUI-M'POKO

N.B *: Ce document est personnel et doit être visé par les autorités administratives de la localité où réside le chercheur. Le détenteur doit se conformer aux indications prescrites ci-dessus et déposer à l'issue de sa recherche une copie de son rapport de mission, ainsi qu'un exemplaire de sa ou ses publications au Ministère de l'Education Nationale, de l'Enseignement Supérieur et de la Recherche.*