A BIBLIOGRAPHY OF GREAT APES, AND THE LINKS BETWEEN GREAT APES CONSERVATION AND POVERTY IN UGANDA

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Uganda Poverty and Conservation Learning Group (U-PCLG) (http://povertyandconservation.info/en/pages/uganda-pclg) is a learning network that brings together Uganda based conservationists and development practitioners to share their experiences and to work together to better inform development and conservation policy and practice. U-PCLG is coordinated by the Jane Goodall Institute (JGI) Uganda.

U-PCLG is part of a wider group called Poverty and Conservation Learning Group (PCLG), an international network of organisations and individuals that promotes learning on the linkages between biodiversity conservation and poverty reduction, in order to improve policy and practice.
The PCLG is coordinated by the International Institute for Environment and Development (IIED), one of the world's most influential policy research organisations working at the interface between development and environment.

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Acronyms

A.P.E.S.	Ape Populations, Environments, and Surveys
BCFS	Budongo Conservation Field Station
BINP	Bwindi Impenetrable National Park
CTPH	Conservation Through Public Health
GRASP	Great Apes Survival Partnership
ITFC	Institute of Tropical Forest Conservation
JGI	Jane Goodall Institute
MBCT	Mgahinga-Bwindi Conservation Trust
MGNP	Mgahinga Gorilla National Parks
MUBFS	Makerere University Biological Field Station
NBDB	National Biodiversity Data Bank
NFA	National Forestry Authority
PCLG	Poverty and Conservation Learning Group
PSG	Primate Specialist Group
UWA	Uganda Wildlife Authority
UWEC	Uganda Wildlife Education Centre
WCS	Wildlife Conservation Society
CSWCT	Chimpanzee Sanctuary and Wildlife Conservation Trust

INTRODUCTION

This report contains a collection of the literature on great apes (specifically, chimpanzees and gorillas), and on the linkages between great apes conservation and poverty alleviation in Uganda. The documents reviewed include books, journal articles, academic theses and grey literature produced by different organisations and individuals working on great apes conservation.

We expect this report will be of interest to undergraduate and postgraduate students of conservation, zoology and environment science; researchers at different levels; practitioners working in the field of great apes conservation and poverty alleviation.

Methodology

As mentioned above, while researching documents to be included in this report emphasis has been placed on Uganda, although resources from other countries, especially in the Albertine Rift Region, have been included. The references were collected in Uganda using the following places and resources.

1. **Libraries and resource centres, including:**

- The National Biodiversity Data Bank (NBDB);
- Uganda Wildlife Authority (UWA) central library;
- Makerere University Library.

2. **Organisations involved in great apes research and conservation in Uganda:**

The Jane Goodall Institute-Uganda (JGI)

Founded by renowned primatologist Jane Goodall, the Jane Goodall Institute is a global non-profit organization that empowers people to make a difference for all living things. In Uganda, JGI has been active for over two decades and has worked to increase the capacity of local government and forest adjacent communities to manage protected areas, engage in natural resource management planning, promote sustainable livelihoods, and educate community members about chimpanzees, wildlife, and sustainable environmental conservation.

http://janegoodallug.org

Conservation Through Public Health (CTPH)

CTPH pursues gorilla conservation by enabling humans, wildlife and livestock to coexist through improving primary healthcare in and around Africa's protected areas. The public's health status has been recognised as one of the most important indicators of poverty in Africa. The goals of CTPH are centred around an innovative integrated conservation and development approach that focuses on improving the health of local communities to support wildlife conservation through preventing and controlling disease transmission between closely genetically related species such as humans and gorillas, and cattle and buffalo. Conservation Through Public Health envisions ecosystems where wildlife and people prosper in shared, dynamic, resilient, and healthy environments.

http://www.ctph.org

Makerere University Biological Field Station (MUBFS), Kibale

Makerere University Biological Field Station is a research institute committed to undertaking and providing opportunities for high quality, multi-disciplinary research and education in tropical ecosystems, with the underlying objective of contributing to the conservation and development needs of Kibale National Park and its surrounding ecological and human communities. Originally, most of the research at MUBFS was primatology but over the years, the research agenda has broadened to include ecological and behavioural research on taxes, and socio economic studies.

http://caes.mak.ac.ug/research/research-institutes/100-makerere-university-biological-field-stations-mubfs.html

Kibale Chimpanzee Project

The Kibale Chimpanzee Project is dedicated to the conservation and welfare of chimpanzees and their habitats. They are committed to promoting long-term research on chimpanzees and their ecosystems, to further their understanding of primate diversity, conservation biology, and the evolution of the human condition. This is a long-term field study of the behaviour, ecology, and physiology of wild chimpanzees established by Dr. Richard Wrangham in 1987. The project is also involved in conservation of Kibale National Park and conservation education of communities surrounding the park.

https://kibalechimpanzees.wordpress.com

Budongo Conservation Field Station (BCFS)

Since its inception in 1990, BCFS has blended research and conservation to ensure sustainable management and utilisation of the Budongo Forest Reserve as a model for tropical rain forest management. The aim is to continue generating world-class scientific research on primates and tropical forest ecology as well as diversifying the research programme to encompass other biological taxa, and to use this information to support policy development, conservation action and sustainable resource management. Budongo forest is habitat to thousands of tropical plants and animals including chimpanzees. To the local and distant communities, the forest is a source of timber and non-timber forest products.

http://www.budongo.org

Uganda Wildlife Education Centre (UWEC)

Formerly known as Entebbe zoo, the Uganda Wildlife Education Centre was founded in the 1950s by the government of Uganda with the help of the Wildlife Conservation Society. It was initially managed by a Wildlife Trust to accommodate confiscated and injured wildlife. In recent years UWEC has grown considerably and is set to become one of the most important display for wildlife on the African continent.

http://uwec.ug

Mgahinga-Bwindi Conservation Trust (MBCT)

Mgahinga-Bwindi Conservation Trust was established in 1994 to conserve Mgahinga Gorilla and Bwindi Impenetrable National Parks (MGNP and BINP), two critical forest habitats that provide a home to half of the world's remaining population of mountain gorillas in South Western Uganda.

http://www.bwinditrust.ug

Chimpanzee Sanctuary and Wildlife Conservation Trust (CSWCT) at Ngamba Island

Chimpanzee Trust's vision is that chimpanzee populations are secure in their habitats. It is among the leaders in chimpanzee conservation, providing excellent care of rescued chimpanzees (some of which are confiscated from traffickers), contributing to raising public awareness and understanding of conservation issues and engaging with communities living alongside chimpanzee populations.

http://ngambaisland.org

Wildlife Conservation Society (WCS) - Uganda

WCS has been supporting conservation in Uganda since 1957 making WCS the oldest conservation organisation working in Uganda. Currently, focus is on three key landscapes which are critical for conservation: Greater Virunga Landscape, Murchison-Semliki Landscape and the Kidepo Landscape.

http://www.wcs.org

Great Apes Survival Partnership (GRASP)

GRASP is an innovative and ambitious partnership comprised of great ape range states faced with an immediate challenge: to fight the threat of extinction faced by gorillas (Gorilla beringei, G. gorilla), chimpanzees (Pan troglodytes), bonobos (Pan paniscus) and orangutans (Pongoabelii, P. pygmaeus) across their ranges in Equatorial Africa and Southeast Asia.

http://www.un-grasp.org

The Institute of Tropical Forest Conservation (ITFC)

ITFC is a post-graduate research institute of Mbarara University of Science and Technology (MUST). Its mission is to support and undertake research, monitoring and capacity development, and to bolster conservation understanding and practice in the region. It is located on the edge of Bwindi Impenetrable National Park (BINP), a UNESCO World Heritage site in South West Uganda. This area has numerous endemic species and is home to half of the world's mountain gorillas (*Gorilla gorilla berengei*).

http://itfc.must.ac.ug

3. Law enforcement bodies

These included customs offices at Entebbe, UWA and NFA.

4. The Internet

In particular, the websites that provided information for this report include:

- *The Ape Populations, Environments, and Surveys (A.P.E.S.) database:*

  This database provides a comprehensive bibliography of peer reviewed articles, reports, books, and academic theses relating to ape surveys. It includes references on all apes and it is fully searchable.

  http://apes.eva.mpg.de/eng/index.php

- *Poverty and Conservation Learning Group (PCLG):*

  This website includes a bibliographic database that provides details of the literature on conservation-poverty linkages. It can be searched for publications by key word or by theme. Links are provided to abstracts and full articles when available.

  http://povertyandconservation.info/en/bibliographies

- *Primate Specialist Group (PSG)*

The Primate Specialist Group is a network of scientists and conservationists who stand against the tide of extinction which threatens humanity's closest kin. Active throughout the tropical world, and working in dozens of nations in Africa, Asia and Latin America, the PSG promotes research on the ecology and conservation of hundreds of primate species — monkeys, apes, lemurs and their many nocturnal relatives.

http://primates.squarespace.com/great_apes

- Websites of all organizations mentioned above.

Structure of the report

The relevant references identified in the course of this work have been organised under two main headings, Chimpanzees and Gorillas. The references have been further organised in each category according to different aspects: taxonomy, population and distribution, ecology, habitat, zoonoses and other diseases, conservation, poverty and development, human-wildlife interaction. Under each sub-category, the references are listed according to their publication's date, from the most recent to the oldest. When available, abstracts or short summaries have been included, as well as information on how to access the publication.

1. CHIMPANZEES

Together with the bonobo, the common chimpanzee (*Pan troglodytes*) makes up the genus *Pan*. Chimpanzees are our closest living relatives. In fact, humans and chimpanzees share 98 percent of their DNA. The chimpanzee has four recognised subspecies: the eastern chimpanzee *P. t. schweinfurthii*; the central chimpanzee *P. t. troglodytes*; the western chimpanzee *P. t. verus*; and the Nigeria-Cameroon chimpanzee *P. t. ellioti*. Chimpanzees have black hair and pinkish to black skin on their faces, ears, palms of their hands, and soles of their feet. Infant chimpanzees have very pale brownish skin on their faces, ears, palms of their hands, and soles of their feet. They also have a white tail tuft that disappears by early adulthood. Males are slightly larger and heavier than females. Chimpanzees have opposable thumbs and big toes, which enables them to have a precision grip and to make and use tools. In fact, they use more tools for more varied purposes than any other creature except human beings. They live in unstable social groups of 10 – 80 members called communities, whose members associate in temporary parties of varying size and composition. Chimpanzees can currently be found in 21 African countries. The greatest concentration of chimpanzees is in the rain forests of what used to be the equatorial forest "belt."[1]

1.1 Taxonomy

Reinartz, G.E, Ingmanson, E.J. and Vervaecke, H. 2013. **Pan troglodytes: robust chimpanzee (Common chimpanzee)** pp 55-63 in Butysnski, T., Kingdon, J. and Kalina, J. (eds) 2013. Mammals of Africa. Volume II: Primates. Bloomsbury publishing. London.

Available at: Zoology museum, Makerere University Kampala.

1.2 Population and distribution

Watts, D.P., Aronsen, G.P. and Teelen, S. 2009. **Developing Research at Mainaro, Uganda: Chimpanzee density, primate abundance, and vegetation features**. UWA and UNCST Final Report (UWA/TDO/33/02; UNCST NS-150). Yale University, Connecticut.

Available at: UWA central library.

Plumptre, A.J., Nampindo, S., Mutungire, N., Gonya, M. and Akugizibwe, T. 2008. **Survey of chimpanzees and other large mammals in Uganda's Forest Reserves in the Greater Virunga Landscape.** Wildlife Conservation Society.

Available at: UWA central library and WCS.

Marshall, A.J., Jones, J.H. and Wrangham, R.W. 2000. **The Plight of the Apes: A Global Survey of Great Ape Populations**.

The aim of this survey is to gather specific, qualitative data on the nature and magnitude of threats to ape populations in different areas, in order to enable a more accurate assessment of the various threats to global ape populations. As we all know, great ape populations worldwide are under pressure from a variety of factors: habitat loss, human disturbance, hunting, and epidemic disease. While the fact that most ape populations are threatened is well known, we still have surprisingly little data on the specific threats to ape populations in different locations. This lack of information is alarming, given the fact that

[1]Key references:
http://www.janegoodall.org/chimpanzees
http://a-z-animals.com/animals/chimpanzee

the combination of apes' low population density and slow reproductive rates means that ape populations have low resilience to population shocks.

Available at: UWA central library and http://www.fas.harvard.edu/~gas

1.3 Ecology

McLennan, M.R. and Hockings, K.J. 2014. **Wild chimpanzees show group differences in selection of agricultural crops**. Scientific Reports. 4, 5956.

The ability of wild animals to respond flexibly to anthropogenic environmental changes, including agriculture, is critical to survival in human-impacted habitats. Understanding use of human foods by wildlife can shed light on the acquisition of novel feeding habits and how animals respond to human-driven land-use changes. Little attention has focused on within-species variation in use of human foods or its causes. We examined crop-feeding in two groups of wild chimpanzees – a specialist frugivore – with differing histories of exposure to agriculture. Both groups exploited a variety of crops, with more accessible crops consumed most frequently. However, crop selection by chimpanzees with long-term exposure to agriculture was more omnivorous (i.e., less fruit-biased) compared to those with more recent exposure, which ignored most non-fruit crops. Our results suggest chimpanzees show increased foraging adaptations to cultivated landscapes over time; however, local feeding traditions may also contribute to group differences in crop-feeding in this species. Understanding the dynamic responses of wildlife to agriculture can help predict current and future adaptability of species to fast-changing anthropogenic landscapes.

Available at: DOI: 10.1038/srep05956 and http://www.nature.com/articles/srep05956

McLennan, M.R. 2013. **Diet and Feeding Ecology of Chimpanzees (Pan troglodytes) in Bulindi, Uganda: Foraging Strategies at the Forest–Farm Interface**. *International Journal of Primatology*, Vol. 34, pp. 585–614. Springer Science and Business Media, New York.

Wild animals increasingly inhabit human-influenced environments such as forest fragments amid agricultural systems. Dietary studies provide a means of assessing wildlife responses to anthropogenic habitat changes. Chimpanzees are specialist frugivores that consume other plant parts, e.g., fibrous pith and leaves, in greater amounts during fruit shortages. I examined the plant diet and seasonal foraging strategies of chimpanzees inhabiting small forest fragments within a cultivated landscape in Uganda. I determined diet over 13 months via systematic fecal analysis, supplemented by direct observation and feeding trace evidence. I identified important foods and examined their role as seasonal fallbacks. Diet composition and breadth were overall species typical. Chimpanzees were highly frugivorous and the fruit component of fecal samples exceeded that of non-fruit fiber in all months. Forest fruit availability fluctuated seasonally, including a 3-months low fruiting season, when overall fruit intake declined. During this time chimpanzees pursued a mixed strategy of increasing fiber consumption and feeding more heavily on energy-rich cultivars, including those obtained through crop raiding. The data suggest that exploiting agricultural fruits helped chimpanzees maintain a fruit-dominated diet when forest fruit was scarce. No evidence suggested this disturbed forest–farm mosaic is a food impoverished habitat for chimpanzees overall. Nevertheless, cultivar feeding creates conflict with people and the high nutritional quality of crops is likely offset by the inherent risk associated with obtaining them. This study adds to growing evidence of ecological and behavioural adaptability of Pan troglodytes in response to anthropogenic habitat alteration. Targeted conservation of key natural foods for wildlife —particularly fullbacks— would help reduce conflicts and improve the survival prospects of threatened species sharing environments with people.

Available at: http://link.springer.com/article/10.1007%2Fs10764-013-9683-y

Reynolds, V., Lloyd, A.W., English, C.J. 2012. **Adaptation by Budongo Forest chimpanzees (Pan troglodytes schweinfurthii) to loss of a primary source of dietary sodium**. *African Primates*. 7(2): 156-162.

Chimpanzees of the Sonso community, Budongo Forest, Uganda were observed eating clay and drinking clay-water from waterholes. We show that clay, clay-rich water, and clay obtained with leaf sponges, provide a range of minerals in different concentrations. The presence of aluminium in the clay consumed indicates that it takes the form of kaolinite. We discuss the contribution of clay geophagy to the mineral intake of the Sonso chimpanzees and show that clay eaten using leaf sponges is particularly rich in minerals. We show that termite mound soil, also regularly consumed, is rich in minerals. We discuss the frequency of clay and termite soil geophagy in the context of the disappearance from Budongo Forest of a formerly rich source of minerals, the decaying pith of Raphiafarinifera palms.

Available at: http://eprints.brighton.ac.uk/11034

Crockford, C., Wittig, R.M., Mundry, R. and Zuberbühler, K. 2012. **Wild chimpanzees inform ignorant group members of danger**. *Current Biology*. 22(2): 142-146.

The ability to recognize other individuals' mental states—their knowledge and beliefs, for example—is a fundamental part of human cognition and may be unique to our species. Tests of a “theory of mind” in animals have yielded conflicting results. Some nonhuman primates can read others' intentions and know what others see, but they may not understand that, in others, perception can lead to knowledge. Using an alarm-call-based field experiment, we show that chimpanzees were more likely to alarm call in response to a snake in the presence of unaware group members than in the presence of aware group members, suggesting that they recognize knowledge and ignorance in others. We monitored the behaviour of 33 individuals to a model viper placed on their projected travel path. Alarm calls were significantly more common if the caller was with group members who had either not seen the snake or had not been present when alarm calls were emitted. Other factors, such as own arousal, perceived risk, or risk to receivers, did not significantly explain the likelihood of calling, although they did affect the call rates. Our results suggest that chimpanzees monitor the information available to other chimpanzees and control vocal production to selectively inform them.

Available at: http://dx.doi.org/10.1016/j.cub.2011.11.053

Wilson, M.L., Boesch, C., Furuichi, T., Gilby, I.C., Hashimoto, C., Hohmann, G., Itoh, N., Matsuzawa, T., Mitani, J., Mjungu, D.C., Morgan, D., Nakamura, M., Pruetz, J., Pusey, A.E., Sanz, C., Simmons, N., White, F., Watts, D.P., Zuberbühler, K. and Wrangham, R.W. 2012**. Rates of lethal aggression in chimpanzees depend on the number of adult males rather than measures of human disturbance**. *American Journal of Physical Anthropology*. 147: 305-305.

Wild chimpanzees sometimes kill other chimpanzees. Why they do so has been controversial. Here we use a species-wide dataset to ask to what extent such killings (a) occur in the species as a whole, (b) result from human disturbances, such as deforestation, hunting, or food-provisioning, and (c) occur frequently enough to affect behavior. Including only cases in which the attack was observed, the body was found, or observers found other compelling circumstantial evidence, data from 17 habituated communities at 10 sites revealed 77 cases of killings by chimpanzees. Most killings (78%) were conducted by groups of males, and most victims (82%) were also male. More victims were infants (57%) than adults (35%); juveniles and adolescents were rarely targeted. Most killings (68%) involved intergroup attacks. The number of killings recorded per site was related to the number of males in a community, but not to measures of human disturbance. Expressed in terms used for homicide rates, males killed other grown males at a median rate of 4,658 per annum per million individuals. In contrast to chimpanzees, no lethal conspecific aggression has been documented among wild bonobos (N = 4 communities at 3 sites). We conclude that lethal aggression is a species typical behavior of chimpanzees that occurs sufficiently often to affect the evolution of chimpanzee behavior.

Melis, A.P., Warneken, F., Jensen, K., Schneider, A.C., Call, J., and Tomasello M. 2010. **Chimpanzees help conspecifics obtain food and non-food items**. Biological Sciences.

Chimpanzees (*Pan troglodytes*) sometimes help both humans and conspecifics in experimental situations in which immediate selfish benefits can be ruled out. However, in several experiments, chimpanzees have not provided food to a conspecific even when it would cost them nothing, leading to the hypothesis that prosociality in the food-provisioning context is a derived trait in humans. Here, we show that chimpanzees help conspecifics obtain both food and non-food items—given that the donor cannot get the food herself. Furthermore, we show that the key factor eliciting chimpanzees' targeted helping is the recipients' attempts to either get the food or get the attention of the potential donor. The current findings add to the accumulating body of evidence that humans and chimpanzees share the motivation and skills necessary to help others in situations in which they cannot selfishly benefit. Humans, however, show prosocial motives more readily and in a wider range of contexts.

Available at: Doi: 10.1098/rspbb.2010.1735; UWA central library and http://rspb.royalsocietypublishing.org/content/278/1710/1405

Melis, A.P., Hare, B. and Tomasello, M. 2009. **Chimpanzees coordinate in a negotiation game.** *Evolution and Human Behaviour*. 30: 381-392.

A crucially important aspect of human cooperation is the ability to negotiate to cooperative outcomes when interests over resources conflict. Although chimpanzees and other social species may negotiate conflicting interests regarding travel direction or activity timing, very little is known about their ability to negotiate conflicting preferences over food. In the current study, we presented pairs of chimpanzees with a choice between two cooperative tasks—one with equal payoffs (e.g., 5-5) and one with unequal payoffs (higher and lower than in the equal option, e.g., 10-1). This created a conflict of interests between partners with failure to work together on the same cooperative task resulting in no payoff for either partner. The chimpanzee pairs cooperated successfully in as many as 78–94% of the trials across experiments. Even though dominant chimpanzees preferred the unequal option (as they would obtain the largest payoff), subordinate chimpanzees were able to get their way (the equal option) in 22–56% of trials across conditions. Various analyses showed that subjects were both strategic and also cognizant of the strategies used by their partners. These results demonstrate that one of our two closest primate relatives, the chimpanzee, can settle conflicts of interest over resources in mutually satisfying ways—even without the social norms of equity, planned strategies of reciprocity, and the complex communication characteristic of human negotiation.

Available at: UWA central library.

Herrmann, E., Wobber, V. and Call, J. 2008. **Great apes' (Pan troglodytes, Pan paniscus, Gorilla gorilla, Pongopygmaeus) understanding of tool functional properties after limited experience**. *Journal of Comparative Psychology*. 122(2): 220-230.

Primates' understanding of tool functionality has been investigated extensively using a paradigm in which subjects are presented with a tool that they must use to obtain an out-of-reach reward. After being given experience on an initial problem, monkeys can transfer their skill to tools of different shapes while ignoring irrelevant tool changes (e.g. color). In contrast, monkeys without initial training perform poorly on the same tasks. Compared to most monkeys, great apes show a clear propensity for tool using and may not require as much experience to succeed on tool functionality tasks. We investigated this question by presenting 171 apes (Pan troglodytes, Pan paniscus, Gorilla gorilla, and Pongo pygmaeus) with several tool-use problems without giving them initial training or familiarizing them with the test materials. Apes succeeded without experience, but only on problems based on basic properties such as the reward being supported by an object. However, only minimal experience was sufficient to allow them to quickly improve their performance on more complex problems in which the reward was not in contact with the tool.

Available at: UWA central library; doi: https://doi.org/10.1037/0735-7036.122.2.220

Sherrow, H.M. 2008. **Variation in and Ontogeny of Social Behaviour in Young Male Chimpanzees (Pan troglodytes schweinfurthii) at Ngogo, Kibale National Park, Uganda**. PhD thesis, Yale University. Hogan Michael Sherrow.

In this thesis, the author uses behavioural data to investigate the ontogeny of social behaviour in wild male chimpanzees from an unusually large community at Ngogo, Kibale National Park, Uganda. The author focused particularly on behavioural development during adolescence and early adulthood, and collected data on 20 adolescent, 3 juvenile, and 6 young adult males. The author subdivided adolescent males into three categories: early, middle and late adolescence. By sampling the complete breadth of male age ranges from juvenility to early adulthood, he obtained a more complete picture of the development of male behaviour in chimpanzees than previously available.

Available at: UWA central library and online in ProQuest dissertations and Theses.

Melis, A.P., Hare, B. and Tomasello, M. 2008. **Do Chimpanzees reciprocate received favours?** *Animal Behaviour*. Vol. 76, pp 951-962. Elsevier Ltd.

Reciprocal interactions observed in animals may persist because individuals keep careful account of services exchanged with each group member. To test whether chimpanzees, Pan troglodytes, possess the cognitive skills required for this type of contingency-based reciprocity, we gave chimpanzees the choice of cooperating with a conspecific who had helped them previously or one who had not helped them in two different experimental tasks. In the first experiment, one of the partners preferentially recruited the subjects to cooperate in a mutualistic task, while the other potential partner never chose to cooperate with the subject, but rather chose a different partner. In the second experiment, one of the partners altruistically helped the subjects to reach food, while the other partner never helped the subject, but rather took the food himself. In both experiments there was some evidence that the chimpanzees increased the amount they cooperated with or helped the partner who had been more helpful towards them compared to their baseline behaviour towards the same individual (or in a control condition). However, in both experiments this effect was relatively weak and subjects did not preferentially favour the individual who had favoured them over the one who had not in either experiment. Although taken together, these experiments provide some support for the hypothesis that chimpanzees are capable of contingent reciprocity, they also suggest that models of immediate reciprocation and detailed accounts of recent exchanges (e.g. Tit for Tat) may not play a large role in guiding the social decisions of chimpanzees.

Available at: UWA central library and
http://www.eva.mpg.de/psycho/pdf/Publications_2008_PDF/Melis_Hare_Tomasello_2008.pdf [PDF]

Warneken, F., Hare, B., Melis, A.P., Hanuz, D. and Tomasello, M. 2007. **Spontaneous Altruism by Chimpanzees and Young Children**. *PLoS Biology*. 5(7): 184.

People often act on behalf of others. They do so without immediate personal gain, at cost to themselves, and even toward unfamiliar individuals. Many researchers have claimed that such altruism emanates from a species-unique psychology not found in humans' closest living evolutionary relatives, such as the chimpanzee. In favor of this view, the few experimental studies on altruism in chimpanzees have produced mostly negative results. In contrast, we report experimental evidence that chimpanzees perform basic forms of helping in the absence of rewards spontaneously and repeatedly toward humans and conspecifics. In two comparative studies, semi–free ranging chimpanzees helped an unfamiliar human to the same degree as did human infants, irrespective of being rewarded (experiment 1) or whether the helping was costly (experiment 2). In a third study, chimpanzees helped an unrelated conspecific gain access to food in a novel situation that required subjects to use a newly acquired skill on behalf of another individual. These results indicate that chimpanzees share crucial aspects of altruism with humans, suggesting that the roots of human altruism may go deeper than previous experimental evidence suggested.

Available at: UWA central library and

https://software.rc.fas.harvard.edu/lds/wp-content/uploads/2010/07/2007_Warneken_etal_PLoSBiology_MS.pdf [PDF]

Hare, B., Melis, A.P., Woods, V., Hastings, S. and Wrangham, R. 2007. **Tolerance allows Bonobos to Outperform Chimpanzees on a Cooperate Task**. *Current Biology*. 17: 619-623.

To understand constraints on the evolution of cooperation, we compared the ability of bonobos and chimpanzees to cooperatively solve a food-retrieval problem. We addressed two hypotheses. The "emotional-reactivity hypothesis" predicts that bonobos will cooperate more successfully because tolerance levels are higher in bonobos. This prediction is inspired by studies of domesticated animals; such studies suggest that selection on emotional reactivity can influence the ability to solve social problems 1 and 2. In contrast, the "hunting hypothesis" predicts that chimpanzees will cooperate more successfully because only chimpanzees have been reported to cooperatively hunt in the wild 3, 4 and 5. We indexed emotional reactivity by measuring social tolerance while the animals were cofeeding and found that bonobos were more tolerant of cofeeding than chimpanzees. In addition, during cofeeding tests only bonobos exhibited socio-sexual behavior, and they played more. When presented with a task of retrieving food that was difficult to monopolize, bonobos and chimpanzees were equally cooperative. However, when the food reward was highly monopolizable, bonobos were more successful than chimpanzees at cooperating to retrieve it. These results support the emotional-reactivity hypothesis. Selection on temperament may in part explain the variance in cooperative ability across species, including hominoids.

Available at: UWA central library; http://www.sciencedirect.com/science/article/pii/S0960982207010172

Slocombe, K. 2005. **Referential Vocal Communication in Chimpanzees**. Final Progress Report.

Available at: UWA central library.

Reynolds, V. 2005. **The chimpanzees of the Budongo forest - Ecology, behaviour, and conservation**. Oxford: Oxford University Press. 297pp.

Chimpanzees have never been more threatened with extinction than they are today. This book focuses on one chimpanzee group, the Sonso community, living in a tropical rain forest, the Budongo Forest in western Uganda. The book builds up a detailed picture of the forest environment of these apes, their social and behavioural adaptations, and the range of threats they face at the present time. The facts presented in the book summarize the author's own work and that of the many students and colleagues who have worked with the Budongo Forest Project, which the author founded, over the years from 1990 to the present day. Comparisons are made with other chimpanzee field studies. A picture is built up to show the Sonso community living in a complex environment to which it has adapted well. The diet, culture, social behaviour, and social organization of the chimpanzees are described in detail. Focus then shifts to the various dangers they face in the modern context of increasing pressure from local hunters who put snares in the forest, and from a local agribusiness which threatens to engulf the forest. A careful appraisal of the future for these animals is made, ending with a note of hope for their survival if the national organizations that exist to protect them can become more effective.

Available at:
http://www.oxfordscholarship.com/view/10.1093/acprof:oso/9780198515463.001.0001/acprof-9780198515463

Tweheyo, M., Lye, K.A. and Weladji, R.B. 2004. **Chimpanzee diet and habitat selection in the Budongo Forest Reserve, Uganda.** *Forest Ecology and Management*. 188: 267-278.

Between June 2000 and August 2001 observations were made on food types, plant species and parts consumed by chimpanzee in relation to various habitats in the Budongo Forest Reserve (BFR), Uganda. Factors influencing their occurrence as well as their activity patterns were also assessed. The chimpanzees of the BFR spent 80% of their daytime feeding and their diet comprised 56 plants species of which 94% were trees. Chimpanzees spent most of their feeding time on *B. papyrifera*, *Ficus sur*, *Ficus mucuso*, *Ficus exasperata* and *Ficus variifolia*. Chimpanzees fed mostly on fruits (71%), favouring ripe ones, and young leaves (16%). Factors positively influencing occurrence of chimpanzees included habitat types (logged area and forest edge), plant types (trees), food types (fruits), fruit maturity (ripe fruits), and fruit quantity. Logged area and forest edge provided 76% of the chimpanzee food but are also the habitats with the highest human interference, e.g. logging and agriculture encroachment. Past forest management plans did not consider chimpanzee food trees; most were considered weeds and killed with aboricides. We conclude that the long-term survival of chimpanzees of the BFR requires implementation of management plans based on conservation of food tree species.

Available at: http://dx.doi.org/10.1016/j.foreco.2003.07.028 and

http://caes.mak.ac.ug/Publications/2003/Mnason-Tweheyo-et-al-Chimpanzee-diet-and-habitat-selection-in-the-Budongo-Forest-Reserve-Uganda.pdf [PDF]

Tweheyo, M. and Lye, K.A. 2003. **Phenology of figs in Budongo Forest Uganda and its importance for the chimpanzee diet.** *African Journal of Ecology*. 41: 306-316.

This paper reports on the phenological patterns of figs in Budongo Forest, Uganda, and how it relates to chimpanzee food availability in different seasons. In addition, we analysed the dung of chimpanzees to understand the composition of fruits in their diet. The aim of our study was to assess *Ficus* phenology and how it affects chimpanzee diet. Fifteen species of figs were monitored for fruit (syconium) and leaf phenology between June 2000 and 2001. *Ficus* fruit production varied significantly between and within species, and also with tree trunk and crown diameters. Fig fruit production was asynchronous and individual fig trees produced crops from one to five times in a year. In addition to fruits, chimpanzees fed on young leaves of some *Ficus* species. Shedding of old *Ficus* leaves coincided with the dry season, followed by appearance of young leaves. The dry season in Budongo is a period of general fruit scarcity. The combination of fig fruits and young leaves make up the most important food in the diet of chimpanzees. From the chimpanzee dung, more than 78% of seeds comprised fig 'seeds' (nutlets) and the rest of the diaspores were from other tree species. Our findings suggest that chimpanzees disperse large number of diaspores in their dung, thereby serving as important agents of natural forest regeneration.

Available at: http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2028.2003.00475.x/full and

http://caes.mak.ac.ug/Publications/2003/Mnason-Tweheyo-and-Kare-A-Phenology-in-figs-in-Budongo-Forest-uganda-and-its-importance-for-the-Chimpanzee-Diet.pdf [PDF]

Wrangham, R. 2002. **The cost of sexual attraction: is there a trade off in female Pan between sex appeal and received coercion?** In: Boesch, C., Hohmann, G. and Marchant, L. eds. 2002. Behavioural Diversity in Chimpanzees and Bonobos. Cambridge University Press, Cambridge.

Available at: UWA Central library and
http://ebooks.cambridge.org/chapter.jsf?bid=CBO9780511606397&cid=CBO9780511606397A030

Linden, E. 2002. **The wife beaters of Kibale**. Time. 160, 56-57.

Available at: UWA Central library.

Newton-Fisher, N.E., Notman, H. and Reynolds, V. 2002. **Hunting of mammalian prey by Budongo Forest chimpanzees.** *Folia Primatologica*. 73: 281-283.

Chimpanzee (Pan troglodytes) predation has been found in communities across Africa [Uehara, 1997; Stanford, 1998; Boesch and Boesch and Achermann, 2000; Mitani and Watts, 2001]. Little evidence of such behaviour has previously been reported from the Budongo Forest, western Uganda. Here we present preliminary observations of predatory behaviour for the Sonso community, collected between August 1994 and February 2002. These chimpanzees have been studied continuously since 1990, with habituation sufficient by late 1994 for detailed behavioural and ecological studies [Newton and Fisher, 1999, in press]. All observations of hunting and prey consumption were recorded ad libitum by field assistants and researchers, and logged centrally at the Budongo Forest Project field station.

Available at: https://www.karger.com/Article/Abstract/67454

Newton-Fisher, N.E. 2002. **Ranging patterns of male chimpanzees in the Budongo Forest Uganda: range structure and individual differences**. In: New Perspectives in Primate Evolution and Behaviour. eds C.S. Harcourt and B. R. Sherwood, p 287-308. Westbury Academic & Scientific Publishing.

Whiten, A., Goodall, J., McGrew, W.C., Nishida, T., Reynolds, V., Sugiyama, Y., Tutin, C.E.G., Wrangham, R.W. and Boesch, C. 2001. **Charting Cultural Variation in Chimpanzees**. Behaviour. Vol. 138, pp 1481-1516. Koninklijke Brill NV, Leiden.

Cultural variation among chimpanzee communities or unit-groups at nine long-term study sites was charted through a systematic, collaborative procedure in which the directors of the sites first agreed a candidate list of 65 behaviour patterns (here fully defined), then classified each pattern in relation to its local frequency of occurrence. Thirty-nine of the candidate behaviour patterns were discriminated as cultural variants, sufficiently frequent at one or more sites to be consistent with social transmission, yet absent at one or more others where environmental explanations were rejected. Each community exhibited a unique and substantial profile of such variants, far exceeding cultural variations reported before for any other non-human species. Evaluation of these pan-African distributions against three models for the diffusion of traditions identified multiple cases consistent with cultural evolution involving differentiation in form, function and targets of behaviour patterns.

Available at: UWA Central library.

Wilson, M.L., Hauser, M.D. and Wrangham, R.W. 2001. **Does participation in intergroup conflict depend on numerical assessment, range location, or rank for wild chimpanzees?** *Animal Behaviou*r. 61: 1203–1216.

Male chimpanzees, Pan troglodytes, engage in cooperative territorial defence and sometimes kill members of neighbouring communities. Observations of intergroup interactions suggest that escalation of aggression depends on numerical assessment, with lethal attacks occurring when numerical advantage reduces the costs of attacking. To gain a better understanding of the factors guiding participation in intergroup conflict, we conducted a series of playback experiments with the Kanyawara chimpanzee community of the Kibale National Park, Uganda. We tested whether the response to the playback of the ‘pant-hoot’ call of a single extra group male depended on the number of adult males in the listening party, the location of the speaker relative to the territory edge, and each male’s agonistic rank. These playbacks elicited cooperative responses, with the nature of the response depending on the number of adult males in the party. Parties with three or more males consistently joined in a chorus of loud vocalizations and approached the speaker together. Parties with fewer adult males usually stayed silent, approached the speaker less often, and travelled more slowly if they did approach. In contrast to many territorial species, the location of the simulated intruder did not affect the response. Although high-ranking males might be expected to benefit more from repelling outside males, both high- and low-ranking males showed a similar pattern of response. Each male responded as if he benefited

from repelling intruders, but only if he had strength in numbers. This pattern of response is consistent with cooperation based on mutualism.

Available at: UWA central library and http://www.engdes.com/sigwin/company/biblio/papers/Participation%20in%20intergroup%20conflict%20(Wilson-Hauser-Wrangham%202001).pdf [PDF]

Conklin-Brittain, N.L., Knott, C.D. and Wrangham, R.W. 2001. **The Feeding Ecology of Apes**. In: The Apes: Challenges for the 21st Century, conference proceedings, May 10-13, 2000. Chicago Zoological Society, Brookfield, Illinois.

Available at: UWA central library.

Muller, M.N. and Wrangham, R. W. 2001. **The Reproductive Ecology of Male Hominoids**. In: Reproductive Ecology and Human Evolution. ed. Ellison, P. T. pp 397-427. Aldine de Gruyter, New York.

Available at: UWA central library.

Muyambi, F.B. 1999. **Feeding Ecology of Chimpanzee of Kanyanchu Community – Kibale Forest National Park.** Bachelors Dissertation, Makerere University Kampala.

Available at: UWA central library and Department of Forestry, Makerere University Kampala.

Arcadi, A.C. and Wrangham, R.W. 1999. **Infanticide in Chimpanzees: Review of Cases and a New Within-group Observation from the Kanyawara Study Group in Kibale National Park.** *Primates*. 40(2): 337-351.

A prolonged attack on a mother and 2-year-old infant that resulted in the death of the infant was observed in the Kanyawara study group in Kibale National Park. The mother was a border-area resident who was first observed associating with unit-group males six years previously. The attackers were an adult male and an adult female with a 6-week-old infant clinging ventrally to her. The attack was unusual in several respects: it is the first time a male and a female chimpanzee have been observed cooperating closely in an infanticidal attack; the adult female initially attempted to intervene in the victim's behalf, but later joined in the attack after receiving aggression from the male; and the episode was longer in duration than other reported cases. In the year following the incident, the mother did not increase her association with community males, but was seen with the male who killed her infant. The relevance of these observations to sexual selection-based explanations for infanticide in chimpanzees is discussed.

Available at: UWA central library.

Conklin-Brittain, N.L., Wrangham, R.W. and Hunt. K.D.1998. **Dietary Response of Chimpanzees and Cercopithecines to Seasonal Variation in Fruit Abundance. II. Macronutrients**. *International Journal of Primatology*. 19: 6.

In a continuation of our study of dietary differentiation among frugivorous primates with simple stomachs, we present the first comparison of differences in dietary macronutrient content between chimpanzees and cercopithecine monkeys. Previously we have shown that chimpanzee and monkey diets differ markedly in plant pan and species content. We now examine whether this diet diversity is reflected in markedly different dietary macronutrient levels or the different feeding strategies yield the same macronutrient levels in their diets. For each primate group we calculated the total weighted mean dietary content of 4 macronutrients: crude lipid (lipid), crude protein (CP), water-soluble carbohydrates (WSC), and total non-structural carbohydrates (TNC). We also calculated 4 fiber fractions: neutral-

detergent fiber (NDF), which includes the sub-fractions hemicellulose (HC), cellulose (Cs), and sulfuric acid lignin (Ls).The HC and Cs are potentially fermentable fibers and would contribute to the energy provided by plant food, depending on the hind gut fermenting capacity of the individual primate species. The chimpanzee diet contained higher levels of WSC and TNC because during times of fruit abundance the chimpanzees took special advantage of ripe fruit, while the monkeys did not. The monkey diets contained higher levels of CP because the monkeys consumed a constant amount of leaf throughout the year. All four primate species consumed diets with similar NDF levels. However, the chimpanzees also took advantage of periods of ripe fruit abundance to decrease their Ls levels and to increase their HC levels. Conversely, the monkey diets maintained constant levels of the different fiber fractions throughout the year. Nevertheless, despite these differences, the diets of the 4 frugivores were surprisingly similar, considering the substantial differences in body size. We conclude that the chimpanzee diet is of higher quality, particularly of lower fiber content, than expected on the basis of their body size.

Available at: UWA central library and http://www.indiana.edu/~semliki/PDFs/ConklinHunt98.pdf [PDF]

Goldberg, T.L. and Wrangham, R.W. 1997. **Genetic correlates of social behaviour in wild chimpanzees: evidence from mitochondrial DNA.** *Animal Behaviour*. 54(3): 559-70.

This study explored some aspects of chimpanzee social behaviour using mitochondrial DNA sequence data as an index of matrilineal relatedness. The hypothesis tested was that matrilineal relatedness predicts social affiliative preference in wild chimpanzees. Several behavioural measures of individual social preference were examined for chimpanzees from Kanyawara community in Uganda's Kibale Forest. None of the four pairs of strongly affiliative males in this community could have been maternal brothers, since no pair shared the same mitochondrial DNA sequence. Fourteen chimpanzee communities outside Kibale, for which no direct behavioural data were available, were also studied by using communal nesting as a rough index of affiliative preference. Again, chimpanzees that nested together did not tend to be matrilineally related. The results suggest that kin selection is weaker than previously thought as a force promoting intra-community affiliation in chimpanzees.

Available at: UWA central library and
http://www.fas.harvard.edu/~kibale/pdfs/Goldberg1997_AnimBeh.pdf [PDF]

Wrangham, R.W., Conklin-Brittain, N.L. and Hunt, K.D. 1997. **Dietary Response of Chimpanzees and Cercopithecines to Seasonal Variation in Fruit Abundance. I. Antifeedants**; *International Journal of Primatology*. 19: 6.

In order to understand dietary differentiation among frugivorous primates with simple stomachs, we present the first comparison of plant diets between chimpanzees and cercopithecine monkeys that controls for food abundance. Our aim was to test the hypothesis that monkeys have a more diverse diet as a result of their dietary tolerance for chemical antifeedants. Our study species are chimpanzees, blue monkeys, redtail monkeys, and gray-cheeked mangabeys living in overlapping ranges in Kibale National Park, Uganda. We indexed food abundance by the percentage of trees having ripe fruit within the range of each group; it varied widely during the year. Chimpanzees spent almost 3 times as much of their feeding time eating ripe fruits as the monkeys did and confined their diets almost exclusively to ripe fruits when they were abundant. Monkeys maintained a diverse diet at all times. When ripe fruit was scarce chimpanzee and monkey diets diverged. Chimpanzees relied on piths as their main fallback food, whereas monkeys turned to unripe fruits and seeds. For each primate group we calculated the total weighted mean intake of 5 antifeedants; condensed tannins (CT), total tannins assayed by radial diffusion (RD), monoterpenoids (MT), triterpenoids (TT), and neutral-detergent fiber (NDF).

Monkeys had absolutely higher intakes of CT, RD, MT, and TT than those of chimpanzees, and their intake of NDF did not differ from that of chimpanzees, appearing relatively high given their lower body weights. However contrary to expectation, dietary divergence during fruit scarcity was not associated with any change in absolute or relative intake of antifeedants. For example, fruit scarcity did not affect the relative intake of antifeedants by cercopithecines compared to chimpanzees. Our results establish

chimpanzees as ripe-fruit specialists, whereas cercopithecines are generalists with a higher intake of antifeedants. The low representation of ripe fruits in the diets of cercopithecines has not been explained. An important next step is to test the hypothesis that the difference between Kibale chimpanzees and cercopithecines represents a more general difference between apes and monkeys.

Available at: UWA central library and http://www.iu.edu/~semliki/PDFs/WranghamEtAlFruit.pdf [PDF]

Mahaney, W.C., Milner, M. W., Sanmugadas, K., Hancock, R. G. V., Aufreiter, S., Wrangham, R., and Pier, H. W.1997. **Analysis of geophagy soils in Kibale Forest, Uganda**. *Primates*. 38(2): 159-176.

Four soil samples from the Kibale Forest, Uganda, representative of material regularly ingested by chimpanzees, were studied for their mineral, chemical, and geochemical composition. These geophagy soils have a high content of metahalloysite, a partially hydrated clay mineral that may act much like the pharmaceutical Kaopectate™. Among the elements that may act as a stimulus or stimuli for geophagy behaviour, only iron is very high (total iron ranges from 6% to 17%); other possibilities such as calcium, chromium, cobalt, bromine, and iodine are either relatively low or are below their detection limits. Chlorine is below detection limits which eliminates sodium chloride as a possible stimulus. Depending on relative availability in the gut, iron offers the most likely chemical stimulus for geophagy and given the mineral composition of the samples, metahalloysite is the most likely mineral stimulus. Iron may play a role in replenishing hemoglobin which would be important in chimpanzee physiology at high elevations near the flanks of the Ruwenzori Mountains. Metahalloysite, which in this case exists in a relatively pure crystalline form, may well act to quell symptoms of diarrhoea and act similarly to Kaopectate™. Organic chemical analyses indicate only traces of organic matter and no humic acids in the K14-E14 sample.

Available at: UWA central library and
http://www.fas.harvard.edu/~kibale/pdfs/Mahaney1997_Primates.pdf [PDF]

Hunt, K.D. and Doran, D.M. 1996. **Comparative Locomotor Behaviour of Chimpanzees and Bonobos: Species and Habitat Differences.** In Wrangham, R. W. et al. (eds) Chimpanzee Cultures pp. 93–108. Harvard University Press: Cambridge, Massachusetts.

Wrangham, R.W., Chapman, C.A., Clark-Arcadi, P.A. and Isabirye-Basuta, G. 1996. **Social ecology of Kanyawara chimpanzees: Implications for understanding the costs of great ape groups.** In: Great Ape societies, eds. McGrew, W.C., Marchant, L.F. and Nishida, T., pp 45-57. Cambridge University Press, Cambridge.

Available at: UWA central library and http://chapmanresearch.mcgill.ca/Pdf/75_Kanchimp.pdf [PDF]

Wrangham, R.W., Chapman, C.A. and Chapman, L.J. 1994. **Seed Dispersal by Forest Chimpanzees in Uganda.** *Journal of Tropical Ecology*. 10: 355-358.

The role of chimpanzees (Pan troglodytes) as seed dispersers in the Kibale Forest Reserve of western Uganda was assessed by analysing 1849 dung samples from two chimpanzee communities and by conducting germination trials on dispersed and non-dispersed seeds. Of the chimpanzee dung samples, 98.5% contained seeds, and fig seeds were the most common. The number of large seeds (>2 mm) per dung sample was often high, even for species with a relatively large seed. For example, Mimusops bagshawei has a 15-mm diameter seed and had an average of 26.5 seeds per sample. In addition, many seed species were found in the dung repeatedly over several months. Germination trials demonstrated that the species of seed commonly collected from dung were viable. Comparisons of both the rate and success of germination of chimpanzee-dispersed seeds with seeds collected directly from the parent trees, showed that gut passage increased the speed and probability of germination. The number of large seeds dispersed by the chimpanzee population was estimated at 369 large seeds km-'

day-'. We suggest that in Kibale, chimpanzees may play a more significant role in primary seed dispersal than implied by their low numbers and biomass.

Available at: http://chapmanresearch.mcgill.ca/Pdf/63_ChimpSeedDispersal.pdf [PDF]

Ghiglieri, M.P. 1984. **The Chimpanzees of Kibale Forest: A field study of Ecology and Social structure**. Columbia University Press, New York. 226 pp.

Available at: http://link.springer.com/article/10.1007%2FBF02736390

1.4. Habitat

Kyongera, D. 2014. **Mapping of Private Sector Investments in the Albertine Rift Region and their Impact on Great Apes' Habitats**. U-PCLG, Kampala.

This study focused on the destruction (past, present and future) of great apes' habitats due to medium to large scale private sector investments in various commercial ventures that require extensive land in the Albertine Region of Western Uganda. A satellite image analysis for the period 1980s–2000s showed that about 800 sq. km of great apes' habitats were lost (Plumptre, 2002). However, Plumptre's study of 2002 did not attribute various land use types (small to large scale) to the measured loss of 800 sq. km. It is against this knowledge gap that this study sought to relate the loss of habitats (past, present and future) to medium and large scale private sector investments in the Albertine Rift Region of Western Uganda. Therefore, the purpose of this study is to identify the probable factors likely to impact on the future status (loss and modification) of great apes' habitats due to medium to large scale private sector investments in order to provide the required information for enhancing the conservation of the great apes in the Albertine Rift Region of Western Uganda.

Available at: http://pubs.iied.org/G03910.html?k=denis

Olupot, W. and Plumptre, A.J. 2010. **Conservation research in Uganda's forests: A review of site history; research and use of research in Uganda's forest parks and Budongo forest reserve**. pp 81-113. Nova Science publishers, Inc. New York.

In recent decades, there has been increased interest in understanding ecosystems in order to be able to manage and conserve them. Yet examples of how research directly supports conservation are rare. Protected area managers and policy makers need scientific information from protected areas for policy development and to effectively devise, revise, and implement management strategies. Researchers seek a clear understanding of what types of research can directly support conservation efforts to guide them in the design of such projects. A variety of perspectives of what constitutes 'conservation' or 'applied' wildlife research may exist, and indeed conservation priorities do differ between sites so that ultimately, what we describe here is from one perspective and designing projects that directly support site conservation depends on a prior understanding of issues at the site. This book is intended to encourage thinking about what constitutes conservation research to be able to better develop projects that directly support conservation. The aim of this book is to support research that directly benefits conservation by reviewing applied research and providing examples in which it has been used for conservation purposes.

Available at: National Biodiversity Data Bank.

Potts, K.B. 2008. **Habitat heterogeneity on multiple spatial scales in Kibale National Park, Uganda: Implications for chimpanzee population ecology and grouping patterns**. PhD Thesis, Yale University, 195 pp.

Kibale National Park (KNP) in south western Uganda supports the largest population of chimpanzees in the country. Chimpanzees are unevenly distributed among social groups throughout the park, such that different groups inhabiting areas separated by as little as 10–12 kilometres vary in size by a magnitude of three or more. Such dramatic intra-population variability is unusual, and suggests that ecological heterogeneity over relatively small scales may profoundly impact chimpanzee population ecology. Moreover, chimpanzees inhabiting a common home range utilize their habitat in a non-uniform fashion, perhaps in response to even finer-scale ecological heterogeneity. In this study, two primary questions were addressed: (1) what is the extent of ecological heterogeneity among and within sites in KNP, and (2) how might this heterogeneity be influencing the noted differences in chimpanzee density among sites and in habitat use patterns by chimpanzees within sites? I conducted behavioural observations at two sites (Ngogo and Kanyawara) inhabited by 150 and 50 chimpanzees, respectively, to assess differences in foraging efficiency among the two communities. Additionally, I quantified within-forest heterogeneity that may be relevant to chimpanzee ecology at multiple spatial scales using extensive botanical sampling at both sites, combined with long-term phenology records. Ngogo, the site of high chimpanzee density, supported a relatively high abundance of plant species showing high inter-individual fruiting synchrony and tending to produce fruits eaten by chimpanzees during times of low overall fruit abundance, which may provide an important component of temporal reliability to the resource base at this site. Perhaps correspondingly, individuals at Ngogo had higher foraging efficiency, on average, than their Kanyawara counterparts, and net caloric intake values fluctuated less intensely over time at Ngogo. Finally, chimpanzees inhabiting a common home range (Ngogo) differentially utilized, on a time scale of >1 year, areas with high abundances of food plants producing fruit during times of high overall food abundance, whereas on a monthly time scale range use focused most intensively on areas with abundant fig (Ficus spp.) stems. These results provide important information regarding the influence of small-scale resource heterogeneity in influencing chimpanzee behavioural ecology and population dynamics.

Available at: ProQuest Dissertations and Theses (PQDT) database.

Manyindo, J. 2003. Wildlife series #3. **Conflicting interests: Land use change in protected areas for private commercial benefit**. Uganda Wildlife Society, Kampala.

Available at: http://www.uws.or.ug/wp-content/uploads/PUWR%20Brief.pdf [PDF]

Weber, W., White, L.J.T., Vedder, A. and Naughton-Treves, L. 2001. **African Rain Forest Ecology and Conservation: An Interdisciplinary Perspective.** Yale University Press.

Extending from West Africa to Madagascar, from the vast lowland Congo Basin to the archipelago of forest islands on its eastern rim, the African rain forest is surpassed in size only by the Amazon. This book sheds light on the current efforts to understand and conserve the African rain forest, an area in need of urgent action to save its biological wealth, cultural heritage, and economic potential. Written by conservation scientists and practitioners based in the African rain forest, the book offers a multidisciplinary perspective that integrates many biological and social sciences. Early chapters trace the forces - from paleoecological factors to recent human actions - that have shaped the African forest environment. The next chapters discuss the dominant biological patterns of species ranging from the distinctive elephants, gorillas, and okapi to the less well known birds, butterflies, and amphibians. Other chapters focus on how such different groups as hunter-gatherers, forest farmers, bush meat hunters, recent immigrants, and commercial foresters have used the forests. Several authors stress the need for tighter links between research and conservation action. The final section draws lessons from the collective experience of those working in an Africa wracked by political strife and economic hardship.

Available at:
http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=130187&fileId=S0376892902220287

Makumbi, I. 2001. Forestry series #1: **Forest degazettement in Uganda.** Uganda Wildlife Society, Kampala.

This brief considers the legal regime and practice of politically motivated illegal activities in forest reserves in Uganda. It is argued that the degazettement thrives under a closed decision making system and inadequate legislation. The Forests Act Cap.247 of 1964, for example, is outdated and does not provide for the modern methods of natural resource management. The Act is also inadequate to the extent that it does not specifically provide for degazettement procedures, therefore reliance has to be made on other legislation. The Act further vests the authority to gazette in one individual; the Minister thus has the opportunity for abuse of such exclusive powers. Therefore there is a need to establish procedures that are transparent and redistribute the authority and responsibility for degazettement.

Available at: http://www.uws.or.ug/wp-content/uploads/Forestry%20brief.PDF [PDF]

1.5. Zoonoses and other diseases

Budongo Conservation Field Station. 2015. **Chimpanzee Health: Monitoring the health of our chimpanzee.**

Great ape populations in the wild are steadily declining. Timber exploitation, agricultural expansion and the bush-meat trade are well-known factors that contribute to the risk of extinction of all wild apes, unless urgent measures are taken. Recent research has suggested that eco-tourism and the presence of researchers may be equally dangerous. In some study sites, chimpanzee study groups have declined rapidly due to pathogens, most likely introduced by human researchers. Human respiratory diseases caused by human Paramoxyviruses are particularly dangerous for wild chimpanzees

Available in: BCFS documents http://www.budongo.org

Carne, C., Semple, S., Morrogh-Bernard, H., Zuberbu¨ hler, K., Lehmann, J. 2014. **The Risk of Disease to Great Apes: Simulating Disease Spread in Orang-Utan (*Pongo pygmaeuswurmbii*) and Chimpanzee (*Pan troglodytes schweinfurthii*) Association Networks**. *PLoS ONE.* 9(4): e95039.

All great ape species are endangered, and infectious diseases are thought to pose a particular threat to their survival. As great ape species vary substantially in social organisation and gregariousness, there are likely to be differences in susceptibility to disease types and spread. Understanding the relation between social variables and disease is therefore crucial for implementing effective conservation measures. Here, we simulate the transmission of a range of diseases in a population of orang-utans in Sabangau Forest (Central Kalimantan) and a community of chimpanzees in Budongo Forest (Uganda), by systematically varying transmission likelihood and probability of subsequent recovery. Both species have fission-fusion social systems, but differ considerably in their level of gregariousness. We used long-term behavioural data to create networks of association patterns on which the spread of different diseases was simulated. We found that chimpanzees were generally far more susceptible to the spread of diseases than orang-utans. When simulating different diseases that varied widely in their probability of transmission and recovery, it was found that the chimpanzee community was widely and strongly affected, while in orang-utans even highly infectious diseases had limited spread. Furthermore, when comparing the observed association network with a mean-field network (equal contact probability between group members), we found no major difference in simulated disease spread, suggesting that patterns of social bonding in orang-utans are not an important determinant of susceptibility to disease. In chimpanzees, the predicted size of the epidemic was smaller on the actual association network than on the mean-field network, indicating that patterns of social bonding have important effects on susceptibility to disease. We conclude that social networks are a potentially powerful tool to model the risk of disease transmission in great apes, and that chimpanzees are particularly threatened by infectious disease outbreaks as a result of their social structure.

Available at: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0095039

Rushmore, J., Allison, A.B., Edwards, E.E., Altizer, S., Bagal, U., Cranfield, M.R., Glenn, T., Liu, H., Mugisha, L., Muller, M., Stumpf, R.M., Thompson, M.E., Wrangham, R. and Yabsley, M.J. 2013. **Screening Great Apes for Putative Sexually Transmitted Diseases: Evidence of trichomonididae Infections in Wild Chimpanzees.** In: Rushmore, J.L. 2013. Social and Ecological Drivers of Pathogen Transmission Dynamics in East African Great Apes. PhD thesis, University of Georgia. Julie Lynn Rushmore, Georgia.

Sexually transmitted diseases (STDs) can persist endemically, are known to cause sterility and infant mortality in humans, and could have similar impacts in wildlife populations. African apes (i.e., chimpanzees, bonobos, and to a lesser extent gorillas) show multi-male mating behavior that could offer opportunities for STD transmission, yet little is known about the prevalence and impact of STDs in this endangered primate group. We used serology and PCR-based detection methods to screen biological samples from wild and orphaned eastern chimpanzees and gorillas (N = 172 individuals, including adults, and juveniles) for four classes of pathogens that either commonly cause human STDs or were previously detected in captive apes: trichomonads, Chlamydia spp., Treponema pallidum (syphilis and yaws), and papillomaviruses. Based on results from prior modeling and comparative research, we expected STD prevalence to be highest in females versus males and in sexually mature versus immature individuals. All samples were negative for Chlamydia, Treponema pallidum, and papillomaviruses; however, a high percentage of wild chimpanzee urine and fecal samples showed evidence of trichomonads (protozoa). Analysis revealed that females were more likely than males to have positive urine-but not fecal-samples; however, there was no evidence of age (sexual maturity) differences in infection status. Sequence analysis of chimpanzee trichomonad samples revealed a close relationship to previously described trichomonads within the genus Tetratrichomonas. Phylogenetic comparisons to archived sequences from multiple vertebrate hosts suggests that many of the chimpanzee parasites from our study are likely transmitted via fecal-oral contact, but the transmission of some Tetratrichomonas sequence-types remains unknown and could include sexual contact. Our work emphasizes that only a fraction of infectious agents affecting wild apes are presently known to science, and that further work on great ape STDs could offer insights for the management of endangered great apes and for understanding human STD origins.

Available at: UWA central library and https://doi.org/10.1002/ajp.22442

Sharp, P.M., Rayner, J.C. and Hahn, B.H. 2013. **Great Apes and Zoonoses.** *Science.* 340: 284.

Comparing the origins of AIDS and malaria may provide insight for gauging the prospect of future pathogen transmissions from apes to humans.

Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3752651/

Rushmore, J.L. 2013. **Social and Ecological Drivers of Pathogen Transmission Dynamics in East African Great Apes.** PhD Thesis, University of Georgia. Julie Lynn Rushmore, Georgia

Infectious diseases have threatened the health of Africa's endangered great apes. Work on pathogen dynamics in humans demonstrates that pathogen transmission can increase with social and mating contacts, yet few studies have examined the role of host behavior in wildlife pathogen spread. Further, despite promiscuous mating behavior among African apes (i.e., chimpanzees, bonobos and to a lesser extent gorillas), little is known about the prevalence or impact of sexually transmitted diseases (STDs) on this primate group. To better understand the social and ecological drivers of pathogen transmission dynamics in wild apes, I used a combination of field, molecular, and mathematical modeling techniques to 1) assess how temporal contact heterogeneity affects pathogen dynamics and control, and 2) examine the diversity and prevalence of potential STDs. To address goal 1, I collected nine months of behavioral association data from a wild chimpanzee community in Kibale Forest, Uganda, and I used these data to build monthly chimpanzee contact networks. I then used a combination of network analysis and epidemiological modeling to simulate pathogen spread on networks for a range of pathogen types. To explore optimal pathogen control strategies, I identified risk groups of individuals

most likely to initiate large outbreaks and compared model simulations of network-based vaccination strategies that targeted these risk groups. To address goal 2, I collected and screened samples from wild and sanctuary chimpanzees and gorillas for putative STDs, compared infection status against ecological factors, and used sequence analysis to better characterize positive samples. Overall, this work represents a multi-disciplinary approach to understand social and ecological factors affecting pathogen transmission in East African apes and provides crucial information for developing management strategies to protect endangered apes from current and future disease threats.

Available at: UWA central library, https://getd.libs.uga.edu/pdfs/rushmore_julie_l_201305_phd.pdf [PDF]

Rushmore, J., Caillaud, D., Hall, R., Stumpf, R.M., Meyers, L.A. and Altizer, S. 2013. **Network-based Vaccination Improves Prospects for Disease Control in Wild Chimpanzees.** In Rushmore, J.L. 2013. Social and Ecological Drivers of Pathogen Transmission Dynamics in East African Great Apes. PhD thesis, University of Georgia. Julie Lynn Rushmore, Georgia.

Many endangered wildlife populations are vulnerable to infectious diseases for which vaccines exist; yet, pragmatic considerations often preclude large-scale vaccination efforts. These barriers could be reduced by focusing on individuals with the highest contact rates. However, the question then becomes whether targeted vaccination is sufficient to prevent large outbreaks. To evaluate the efficacy of targeted wildlife vaccinations, we simulate pathogen transmission and control on monthly association networks informed by behavioural data from a wild chimpanzee community (Kanyawara N = 37, Kibale National Park, Uganda). Despite considerable variation across monthly networks, our simulations indicate that targeting the most connected individuals can prevent large outbreaks with up to 35% fewer vaccines than random vaccination. Transmission heterogeneities might be attributed to biological differences among individuals (e.g. sex, age, dominance and family size). Thus, we also evaluate the effectiveness of a trait-based vaccination strategy, as trait data are often easier to collect than interaction data. Our simulations indicate that a trait-based strategy can prevent large outbreaks with up to 18% fewer vaccines than random vaccination, demonstrating that individual traits can serve as effective estimates of connectivity. Overall, these results suggest that fine-scale behavioural data can help optimize pathogen control efforts for endangered wildlife.

Available at: UWA central library and doi: https://doi.org/10.1098/rsif.2014.0349

Rushmore, J., Caillaud, D., Matamba, L., Stumpf, R.M., Borgatti, S.P. and Altizer, S. 2013. **Social Network analysis of Wild Chimpanzees provides insights for Predicting Infectious disease Risk.** In: Rushmore, J.L. 2013. Social and Ecological Drivers of Pathogen Transmission Dynamics in East African Great Apes. PhD thesis, University of Georgia. Julie Lynn Rushmore, Georgia.

Heterogeneity in host association patterns can alter pathogen transmission and strategies for control. Great apes are highly social and endangered animals that have experienced substantial population declines from directly transmitted pathogens; as such, network approaches to quantify contact heterogeneity could be crucially important for predicting infection probability and outbreak size following pathogen introduction, especially owing to challenges in collecting real-time infection data for endangered wildlife. We present here the first study using network analysis to quantify contact heterogeneity in wild apes, with applications for predicting community-wide infectious disease risk. Specifically, within a wild chimpanzee community, we ask how associations between individuals vary over time, and we identify traits of highly connected individuals that might contribute disproportionately to pathogen spread. We used field observations of behavioural encounters in a habituated wild chimpanzee community in Kibale National Park, Uganda to construct monthly party level (i.e. subgroup) and close-contact (i.e. ≤5 m) association networks over a 9-month period. Network analysis revealed that networks were highly dynamic over time. In particular, oestrous events significantly increased pairwise party associations, suggesting that community-wide disease outbreaks should be more likely to occur when many females are in oestrus. Bayesian models and permutation tests identified traits of chimpanzees that were highly connected within the network. Individuals with large families (i.e. mothers and their juveniles) that range in the core of the community territory and to a lesser extent high-ranking males were central to association networks, and thus represent the most important individuals to target for disease intervention strategies. Overall, we show striking temporal variation in network structure and

traits that predict association patterns in a wild chimpanzee community. These empirically-derived networks can inform dynamic models of pathogen transmission and have practical applications for infectious disease management of endangered wildlife species.

Available at: UWA central library and Journal of Animal Ecology; http://onlinelibrary.wiley.com/doi/10.1111/1365-2656.12088/epdf [PDF]

Li, Y., Ndjango, J-B., Learn, G.H., Ramirez, M.A., Keele, B.F., Bibollet-Ruche, F., Liu, W., Easlick, J.L., Decker, J.M., Rudicell, R.S., Inogwabini, B-I., Ahuka-Mundeke, S., Leendertz, F.H., Reynolds, V., Muller, M.N., Chancellor, R.L., Rundus, A.S., Simmons, N., Worobey, M., Shaw, G.M., Peeters, M., Sharp, P.M. and Hahn, B. H. 2012. **Eastern Chimpanzees, but Not Bonobos, Represent a Simian Immunodeficiency Virus Reservoir**. *Journal of Virology*. 86(19): 10776-10791.

Chimpanzees in west central Africa (Pan troglodytes troglodytes) are endemically infected with simian immunodeficiency viruses (SIVcpzPtt) that have crossed the species barrier to humans and gorillas on at least five occasions, generating pandemic and nonpandemic forms of human immunodeficiency virus type 1 (HIV-1) as well as gorilla SIV (SIVgor). Chimpanzees in east Africa (Pan troglodytes schweinfurthii) are also infected with SIVcpz; however, their viruses (SIVcpzPts) have never been found in humans. To examine whether this is due to a paucity of natural infections, we used non-invasive methods to screen wild-living eastern chimpanzees in the Democratic Republic of the Congo (DRC), Uganda, and Rwanda. We also screened bonobos (Pan paniscus) in the DRC, a species not previously tested for SIV in the wild. Fecal samples (n = 3,108) were collected at 50 field sites, tested for species and subspecies origin, and screened for SIVcpz antibodies and nucleic acids. Of 2,565 samples from eastern chimpanzees, 323 were antibody positive and 92 contained viral RNA. The antibody-positive samples represented 76 individuals from 19 field sites, all sampled north of the Congo River in an area spanning 250,000 km2. In this region, SIVcpzPts was common and widespread, with seven field sites exhibiting infection rates of 30% or greater. The overall prevalence of SIVcpzPts infection was 13.4% (95% confidence interval, 10.7% to 16.5%). In contrast, none of the 543 bonobo samples from six sites was antibody positive. All newly identified SIVcpzPts strains clustered in strict accordance to their subspecies origin; however, they exhibited considerable genetic diversity, especially in protein domains known to be under strong host selection pressure. Thus, the absence of SIVcpzPtszoonoses cannot be explained by an insufficient primate reservoir. Instead, greater adaptive hurdles may have prevented the successful colonization of humans by P. t. schweinfurthii viruses.

Available at: UWA central library and http://jvi.asm.org/content/86/19/10776.full.pdf+html

McLennan, M.R. and Huffman, M.A. 2012. **High Frequency of Leaf Swallowing and Its Relationship to Intestinal Parasite Expulsion in "Village" Chimpanzees at Bulindi, Uganda**. *American Journal of Primatology*. 74: 642–650.

Self-medication by great apes to control intestinal parasite infections has been documented at sites across Africa. Chimpanzees (Pan troglodytes) swallow the leaves of certain plant species whole, without chewing. Previous studies demonstrated a relationship between chimpanzee leaf swallowing and expulsion of nematode worms (Oesophagostomum sp.) and tapeworms (Bertiella sp.) in dung. We investigated the relationship between leaf swallowing and parasite expulsion in chimpanzees inhabiting a fragmented forest–farm mosaic at Bulindi, Uganda. During 13 months whole undigested leaves occurred in chimpanzee dung at a considerably higher frequency (10.4% of dungs) than at other sites (0.4–4.0%). Leaf swallowing occurred year-round and showed no pronounced seasonality. Chimpanzees egested adults of multiple species of Oesophagostomum (including O. stephanostomum) and proglottids of two tapeworms—Bertiella sp. and probably Raillietina sp. The latter may not be a true infection, but the by-product of predation on domestic fowl. Compared to previous studies, the co-occurrence of whole leaves and parasites in chimpanzee dung was low. Whereas the presence of leaves in dung increased the probability of adult nematode expulsion, no association between leaf swallowing and the shedding of tapeworm proglottids was apparent. Anthropogenic habitat changes have been linked to alterations in host–parasite interactions. At Bulindi, deforestation for agriculture has

increased contact between apes and people. Elevated levels of leaf swallowing could indicate these chimpanzees are especially vulnerable to parasite infections, possibly due to environmental changes and/or increased stress levels arising from a high frequency of contact with humans. Frequent self-medication by chimpanzees in a high-risk environment could be a generalized adaptation to multiple parasite infections that respond differently to the behaviour. Future parasitological surveys of apes and humans at Bulindi are needed for chimpanzee health monitoring and management, and to investigate the potential for disease transmission among apes, people, and domestic animals.

Available at: https://doi.org/10.1002/ajp.22017

Leendertz, F.H., Scuda, N., Cameron, K. N., Kidega, T., Zuberbühler, K., Leendertz, S.A.J., Couacy-Hymann, E., Boesch, C., Calvignac, S. and Ehlers, B. 2011. **African Great Apes Are Naturally Infected with Polyomaviruses Closely Related to Merkel Cell Polyomavirus.** *Journal of Virology*. 85(2): 916-924.

The oncogenic Merkel cell polyomavirus (MCPyV) infects humans worldwide, but little is known about the occurrence of viruses related to MCPyV in the closest phylogenetic relatives of humans, great apes. We analyzed samples from 30 wild chimpanzees and one captive gorilla and identified two new groups of polyomaviruses (PyVs). These new viruses are by far the closest relatives to MCPyV described to date, providing the first evidence of the natural occurrence of PyVs related to MCPyV in wild great apes. Similar to MCPyV, the prevalence of these viruses is relatively high (>30%). This, together with the fact that humans in West and Central Africa frequently hunt and butcher primates, may point toward further MCPyV-like strains spreading to, or already existing in, our species.

Available at: http://jvi.asm.org/content/85/2/916.abstract

Kaiser, M., Lowa, A., Ulrich, M., Ellerbrok, H., Goffe, A.S., Blasse, A., Zommers, Z., Couacy-Hymann, E., Babweteera, F., Zuberbühler, K., Metzger, S., Geidel, S., Boesch, C., Gillespie, T.R. and Leendertz, F.H. 2010. **Wild Chimpanzees Infected with 5 Plasmodium Species.** *Emerging Infectious Diseases*. 16(12):1956-1959.

Data are missing on the diversity of *Plasmodium* spp. infecting apes that live in their natural habitat, with limited possibility of human-mosquito-ape exchange. We surveyed *Plasmodium* spp. diversity in wild chimpanzees living in an undisturbed tropical rainforest habitat and found 5 species: *P. malariae*, *P. vivax, P. ovale*, *P. reichenowi*, and *P. gaboni.*

Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3294549/

Goldberg, T.L., Gillespie, T.R., Rwego, I.B., Estoff, E.L., and Chapman, C.A. 2008. **Forest Fragmentation as Cause of Bacterial Transmission among Nonhuman Primates, Humans, and Livestock, Uganda.** *Emerging Infectious Diseases*. 14(9): 1375–1382.

We conducted a prospective study of bacterial transmission among humans, nonhuman primates (primates hereafter), and livestock in western Uganda. Humans living near forest fragments harbored *Escherichia coli* bacteria that were ≈75% more similar to bacteria from primates in those fragments than to bacteria from primates in nearby undisturbed forests. Genetic similarity between human/livestock and primate bacteria increased ≈3-fold as anthropogenic disturbance within forest fragments increased from moderate to high. Bacteria harbored by humans and livestock were approximately twice as similar to those of red-tailed guenons, which habitually enter human settlements to raid crops, than to bacteria of other primate species. Tending livestock, experiencing gastrointestinal symptoms, and residing near a disturbed forest fragment increased genetic similarity between a participant's bacteria and those of nearby primates. Forest fragmentation, anthropogenic disturbance within fragments, primate ecology, and human behavior all influence bidirectional, interspecific bacterial transmission. Targeted interventions on any of these levels should reduce disease transmission and emergence.

Available at: doi: https://doi.org/10.3201/eid1409.071196

Goldberg, T.L., Gillespie, T.R., Rwego, I.B., Wheeler, E., Estoff, E.L. and Chapman, C.A. 2006. **Patterns of gastrointestinal Bacterial exchange between chimpanzees and humans involved in research and tourism in western Uganda**. *Biological Conservation*. 135(4): 511–517.

Ecological overlap may increase the risks of microbial exchange between humans and wild non-human primates. Escherichia coli bacteria were collected from chimpanzees and humans in Kibale National Park, western Uganda, in May and June 2004, in order to examine whether interaction between humans and apes in the wild might affect gastrointestinal bacterial communities in the two species. Chimpanzees harbored bacteria genetically more similar to those of humans employed in chimpanzee-directed research and tourism than to those of humans from a local village. Most humans (81.6%) and 4.4% of chimpanzees harbored at least one isolate resistant to locally available antibiotics. In isolates from both humans and chimpanzees, resistance was higher to five of these antibiotics than to Ceftiofur, an antibiotic not available in the region. These data indicate that humans and apes in the wild can share genetically and phenotypically similar gastrointestinal bacteria, presumably originating from common environmental sources. Strategies to limit transmission of pathogens between humans and primates, whether that transmission is direct or indirect, would benefit both human health and primate conservation.

Available at: UWA central library and https://doi.org/10.1016/j.biocon.2006.10.048

Mugisha, L. 2004. **A Survey of the Gastro-intestinal parasites of Habituated wild Chimpanzees (Pan troglodytes), Humans and rodents in Budongo Forest Reserve**. MSc. Thesis. Makerere University, Kampala.

Available at: UWA central library and Wildlife Health and Management (WAHM) library, Makerere University.

Vartanian, J.P., Pineau, P., Henry, M., Hamilton, W.D., Muller, M.N., Wrangham, R.W., Wain-Hobson, S. 2002. **Identification of a hepatitis B virus genome in wild chimpanzees (Pan troglodytes schweinfurthi) from East Africa indicates a wide geographical dispersion among equatorial African primates**. *Journal of Virology*. 76(21): 11155-8.

DNAs from four wild chimpanzees (Pan troglodytes schweinfurthi) from eastern Africa were screened for 14 DNA viruses and retroviruses. Between two and three viruses were found in each animal. An entire hepatitis B virus (HBV) genome was amplified and sequenced from samples taken from one animal. This indicates that HBV is distributed across the entire range of chimpanzee habitats.

Available at: UWA central library and http://jvi.asm.org/content/76/21/11155.full

Hill, K., Boesch, C., Goodall, J., Pusey, A., Williams, J. and Wrangham, R. 2001. **Mortality rates among wild Chimpanzees.** *Journal of Human Evolution*. 40: 437-450.

In order to compare evolved human and chimpanzees' life histories we present a synthetic life table for free-living chimpanzees, derived from data collected in five study populations (Gombe, Kibale, Mahale, Bossou). The combined data from all populations represent 3711 chimpanzee years at risk and 278 deaths. Males show higher mortality than females and data suggest some inter-site variation in mortality. Despite this variation, however, wild chimpanzees generally have a life expectancy at birth of less than 15 years and mean adult lifespan (after sexual maturity) is only about 15 years. This is considerably lower survival than that reported for chimpanzees in zoos or captive breeding colonies, or that measured among modern human hunter-gatherers. The low mortality rate of human foragers relative to chimpanzees in the early adult years may partially explain why humans have evolved to senesce later than chimpanzees, and have a longer juvenile period.

Available at: UWA central library and doi: https://doi.org/10.1006/jhev.2001.0469

Wrangham, R., Wilson, M., Hare, B. and Wolfe, N. D. 2000. **Chimpanzee predation and the ecology of microbial exchange**. *Microbial Ecology in Health and Disease*. 12(3):186-188.

Hunting provides one mechanism for the transmission of microbes across host species boundaries. It has generally been assumed that this mechanism leads to unidirectional transmission to humans. We report that wild chimpanzees occasionally prey on human children. This result and other evidence of chimpanzee hunting show the need for consideration of more complex predation-mediated host networks.

Available at: UWA central library and http://www.researchgate.net/publication/216460573_Chimpanzee_predation_and_the_ecology_of_microbial_exchange

Ashford, R.W., Reid, G.D.F. and Wrangham, R.W. 2000. **Intestinal parisites of the chimpanzee Pan troglodytes in Kibale Forest, Uganda.** *Annals of Tropical Medicine and Parasitology*. 94(2):173-179.

One-hundred-and-twenty-three stool samples were examined from 45 chimpanzees in a natural population in western Uganda. Comparison with previous studies is complicated by the diversity of techniques used and interpretations. The Ugandan population had relatively many intestinal protozoa, including the probably beneficial entodiniomorph ciliates. Strongyloid nematodes are universal among chimpanzees, but were surprisingly absent from those on Mount Assirik in Senegal. Railletina tapeworms are sporadic in their occurrence. The absence of spiruroid nematodes in the Ugandan population reflects the absence of insectivory in this population. There was little evidence of seasonal difference in prevalences.

Available at: https://doi.org/10.1007/s10764-014-9753-9

Messner, E.J. and Wrangham, R.W. 1996. **In vitro testing of the biological activity of *Rubia cordifolia* leaves on primate *Strongyloides* species.** *Primates*. 37(1):105-108.

Chimpanzees Pan troglodytes in Kibale National Park, Uganda occasionally swallow entire leaves of Rubiacordifolia (Rubiaceae) without chewing them. The leaves are subsequently egested with minimal damage and no sign of any significant digestion. Similar behaviour reported elsewhere has been proposed to have medicinal effects. Here we test the hypothesis that chemical components in swallowed leaves have negative effects on intestinal nematodes. We used an in vitro assay to detect the effects of methanol extracts of R. cordifolia leaves on nematodes, Strongyloides spp., cultured from feces. Control extracts were distilled water, methanol solution, and methanol extracts of food items that were chewed, rather than swallowed, by chimpanzees. Effects of experimental or control solutions were assayed by nematode motility. There was no difference in nematode motility among control and experimental extracts. This study therefore did not support the hypothesis of pharmacological self-medication via leaf swallowing.

Available at: UWA central library and http://link.springer.com/article/10.1007%2FBF02382927

Wrangham, R.W. 1995. **Relationship of Chimpanzee Leaf-swallowing to a Tapeworm Infection**. *Amercan Journal of Primatology*. 37:297-303.

Leaf-swallowing by chimpanzees Pan troglodytes has been hypothesized to control parasites, but it has not yet been shown to be associated with specific parasitic infections. This report takes advantage of a tapeworm infestation among wild chimpanzees to examine whether leaf-swallowing was associated with the presence of tapeworms. Leaf-swallowing was monitored over 6.5 years in two chimpanzee communities in Kibale National Park (Uganda). In one community, tape-worms Bertiellastuderi were found only during a seven-month period, when they occurred in every month. During this period, leaf-swallowing occurred at an unusually high rate, and dungs that contained tapeworm fragments tended to contain whole leaves. These data suggest that tape-worm infections increased the rate at which chimpanzees swallowed whole leaves. However, this does not mean that tapeworms were necessarily controlled as a result.

Available at: UWA central library and http://onlinelibrary.wiley.com/doi/10.1002/ajp.1350370404/abstract

1.6. Conservation

McCarthy, M.S., Lester, J.D., Howe, E.J., Arandjelovic, M., Stanford, C.B. and Vigilant, L. 2015. **Genetic censusing identifies an unexpectedly sizeable population of an endangered large mammal in a fragmented forest landscape**. *BMC Ecology*. 15:21.

As habitat degradation and fragmentation continue to impact wildlife populations around the world, it is critical to understand the behavioural flexibility of species in these environments. In Uganda, the mostly unprotected forest fragment landscape between the Budongo and Bugoma Forests is a potential corridor for chimpanzees, yet little is known about the status of chimpanzee populations in these fragments. From 2011 through 2013, we noninvasively collected 865 chimpanzee fecal samples across 633 km2 and successfully genotyped 662 (77%) at up to 14 microsatellite loci. These genotypes corresponded to 182 chimpanzees, with a mean of 3.5 captures per individual. We obtained population size estimates of 256 (95% confidence interval246–321) and 319 (288–357) chimpanzees using capture-with-replacement and spatially explicit capture–recapture models, respectively. The spatial clustering of associated genotypes suggests the presence of at least nine communities containing a minimum of 8–33 individuals each. Putative community distributions defined by the locations of associated genotypes correspond well with the distribution of 14 Y-chromosome haplotypes. These census figures are more than three times greater than a previous estimate based on an extrapolation from small-scale nest count surveys that tend to underestimate population size. The distribution of genotype clusters and Y-chromosome haplotypes together indicate the presence of numerous male philopatric chimpanzee communities throughout the corridor habitat. Our findings demonstrate that, despite extensive habitat loss and fragmentation, chimpanzees remain widely distributed and exhibit distinct community home ranges. Our results further imply that elusive and rare species may adapt to degraded habitats more successfully than previously believed. Their long-term persistence is unlikely, however, if protection is not afforded to them and habitat loss continues unabated.

Available at: http://www.biomedcentral.com/1472-6785/15/21doi:10.1186/s12898-015-0052-x

Asiimwe, C. 2014. **Action Plan for Conservation of Chimpanzees outside Protected Areas in Western Uganda.** Eds. Kasoma, P., Reynolds, V., Young, S., Muhanguzi, G., Kumanya, H., Asalu, E., McLennan, M. and Wallis J.

Reports of chimpanzee-human conflicts outside protected areas have increased in the recent past across the Albertine rift especially in Bunyoro region resulting in loss of human life and chimpanzees killed. Though it is quite difficult to estimate how many chimpanzees have suffered, it is evident that many have been killed by people trying to protect their lives and crops. Much as it may be thought that the chimpanzees are increasingly becoming a menace, the reality is that the chimpanzees no longer have a way of staying away from humans due to forest degradation and cannot express their sentiments like humans can. Unfortunately, rural communities also do not understand the linkages. Because of the complex nature of the problem, there is need to join efforts and expertise by concerned stakeholders (individuals and organization) to find solution that address more intensively this serious issue of Human-Chimpanzee Conflicts outside protected areas with strong emphasis on co-existence strategies between the closely related species before the scenario gets worse. After critically analyzing the context underlying the challenges relating to chimpanzee conservation outside protected areas, it is clear that there is no single concrete solution but rather a combination of approaches that would work in different areas. Therefore, all the solutions that are being suggested may not necessarily work for all places.

Available at: JGI-Uganda

Ellis, R. 2014. **Assessing the spatial distribution of snares to direct chimpanzee conservation efforts in Kibale National Park, Uganda**. Thesis. Bates College, Bates College.

Though it is illegal, people in many parts of Africa set snares to protect agricultural land from crop raiding and to hunt wildlife. As a non-selective hunting method, by-catches are common. Endangered chimpanzees (Pan troglodytes) are often caught in these snares, which may kill the chimpanzee or cause digits, hands, or feet to be maimed or lost. For these reasons, snare removal is a conservation priority for chimpanzees. To help alleviate this problem, the Kibale Snare Removal Project (KSRP) was established to collect snares around the Kanyawara chimpanzee community in Kibale National Park (KNP). Between February 2009 and December 2013 (June 2009 excluded), KSRP collected 1,741 snares over 1,427 patrols, signaling that snares are still a prevalent problem in this area. Over this period, roughly equal ratios of foot and neck snares were collected; however, almost all of these were made from wire. Using ArcGIS 10 to compare the GPS (global positioning system) locations for these snares, it appears that the highest densities are closer to the boundary of KNP, which makes sense because it is the most easily accessed from the surrounding villages and agricultural lands. Further, with a higher percentage of patrol outside of the chimpanzee homerange finding snares than those inside the homerange, it appears that the presence of researchers and/or a snare removal team within the homerange may be discouraging poachers from setting traps there. Patrol efforts should continue to emphasize collection along the park boundary where snare densities are highest as well as continue to expand further into KNP to deter snare setting throughout the park. Beyond snare removal and education, interventions should be created that address the problems of crop-raiding and poaching separately. The creation of “chimpanzee-friendly” snares, promotion of nylon/neck snares, or the replacement of snares with an alternate crop-protection/hunting method may provide an avenue through which chimpanzee snare injury rates can be further curbed.

Available at: UWA central library.

McLennan, M.R. and Hill, C.M. 2013. **Ethical Issues in the Study and Conservation of an African Great Ape in an Unprotected, Human- Dominated Landscape in Western Uganda**. In: J. MacClancy; A. Fuentes (eds) Ethics in the Field: Contemporary Challenges. Berghahn Books, New York.

McLennan, M.R. and Hill, C.M. 2012. **Troublesome neighbours: Changing attitudes towards chimpanzees (Pan troglodytes) in a human-dominated landscape in Uganda**. *Journal for Nature Conservation*. 20(4): 219-227.

Long-term human–wildlife sympatry depends on the willingness and capacity of local people to coexist with wild animals. With human population growth and deforestation for agriculture, farmers increasingly live in proximity to wildlife, including large mammals of conservation concern. Understanding local perspectives and concerns regarding wildlife is essential for informing appropriate management strategies that reduce conflicts and promote sustainable coexistence. Social science approaches therefore have a critical role in integrated conservation programmes. We undertook an attitude survey to understand residents’ perspectives about sharing a landscape with chimpanzees (Pan troglodytes) in an unprotected forest–agriculture mosaic in Uganda. Interviews (n = 134) in 12 villages demonstrate residents’ ambivalence towards living alongside these protected yet potentially troublesome mammals. Chimpanzee behaviour is reported to have undergone recent changes. Residents claim apes increasingly enter villages for food, threaten people, and pose a particular threat to children's safety. Chimpanzee numbers are believed to have increased locally. Most interviewees fear chimpanzees, considering them dangerous. Crop losses to chimpanzees were widely reported. Farmers tolerate raiding of domestic fruits, but not cash-crops. Results demonstrate that attitudes towards wildlife are not fixed. Reported changes to chimpanzee behaviour are challenging villagers’ traditionally benign attitude towards them. Even so, residents acknowledge benefits to chimpanzees because they reportedly displace other crop-raiding wildlife which, unlike chimpanzees, damage important staple food crops. Survey findings are contextualised with respect to recent, major land-use changes in Uganda (clearance of unprotected forest for timber and agriculture) that have precipitated a sharp rise in farmer–chimpanzee interactions. We discuss the study's broader implications for protected mammal management and conflict mitigation in human-dominated landscapes, and ask whether it is appropriate

to expect impoverished rural farmers to accommodate large-bodied mammals that pose a potential threat to their safety and livelihoods.

Available at: http://www.sciencedirect.com/science/article/pii/S1617138112000349

McLennan, M.R. and Plumptre, A.J. 2012. **Protected apes, unprotected forest: composition, structure and diversity of riverine forest fragments and their conservation value in Uganda**. *Tropical Conservation Science*. 5(1):79-103.

Small forest fragments are common in anthropogenic landscapes in the tropics. These have conservation value if they provide habitat for threatened wildlife and maintain connectivity between larger habitats. Riverine forests have particular 'corridor' potential due to their linear shape, but are under-studied in many regions. We surveyed trees in riverine fragments in Bulindi, an anthropogenic landscape 25 km south of the Budongo Forest in western Uganda, to determine their condition and assess their value for wildlife, particularly endangered chimpanzees Pan troglodytes. We assessed tree composition, structure and diversity and compared results with a previous survey made in Budongo, the nearest main forest block. Riverine fragments were considerably less species-dense and species-rich than Budongo. Community composition differed markedly between sites and there was virtually no overlap in common species. Common trees in fragments were characteristic of East African swamp and groundwater forests (e.g. the palm Phoenix reclinata) and the dominant tree family was the Moraceae, members of which produce fleshy fruits attractive to frugivores (e.g. figs). Important fruit foods for chimpanzees differed between habitats. While basal area of important fruit trees was comparable, overall density was greater in fragments. Our data suggest the riverine fragments offer a relatively food-dense habitat for chimpanzees and other frugivores. Small riverine forests have little or no protection regionally and are being extensively logged and cleared for agriculture. Species logged for timber in Bulindi included important chimpanzee fruit trees. Unless conservation projects successfully reverse current trends, the value of the riverine corridors for maintaining connectivity between main forest blocks is limited.

Available at: http://tropicalconservationscience.mongabay.com/content/v5/TCS-2012_mar_79-103_McLennan.pdf [PDF]

Plumptre A.J., Rose R., Nangendo G., Williamson E., Didier K., Hart J., Mulindahabi F., Hicks C., Griffin B., Ogawa H., Nixon S., Pintea L., Vosper A., McLennan M., Amsini F., McNeilage A., Makana J.R.,Kanamori M., Hernandez A., Piel A., Stewart F., Moore J., Zamma K., Nakamura M., Kamenya S., Idani G., Saka T., Yoshikawa M., Greer D., Tranquilli S., Beyers R. and Bennett E. 2010. **Eastern Chimpanzee (Pan troglodytes schweinfurthii): Status Survey and Conservation Action Plan**. IUCN, Gland.

The Eastern Chimpanzee (Pan troglodytes scxhweinfurthii) is classified as endangered and of global conservation concern. Numbers are declining because of hunting for bushmeat, killing of animals to capture infants for the pet trade, disease, loss of habitat to agriculture and mining, and fragmentation of habitat leading to the isolation of small populations which are likely to become genetically unviable in the long term. This species occurs at a low density wherever it occurs (less than 1 per km2 of forest on average across much of their range) and has a relatively slow reproductive rate with one infant born every 4-5 years. Consequently they need large areas of habitat to maintain viable populations and take a long time to recover from any reduction in population from disease or hunting.

This conservation action plan was developed with the collaboration of scientists involved in research or conservation of chimpanzees, protected area authorities from each of the range states for this subspecies and also some representatives of the conservation NGOs. As much of the available data on recent distributions of chimpanzees were compiled amounting to over 22,000 GPS locations for this subspecies. These data have been supplied to the APES database in Leipzig which is supported by the IUCN/SSC Primate Specialist Group's (PSG) Great Ape Section and WCMC (World Conservation Monitoring Centre). The data contributed to a Range-wide Priority Setting Analysis (RPS) which identified the historical distribution, areas of current knowledge of chimpanzee presence in the last 10

years, identification of contiguous chimpanzee populations and the agreement on 16 Chimpanzee Conservation Units (CCU) which if focused on would conserve about 96% of the known populations of chimpanzees (about 50,000 individuals) across most of the eco-regions where they occur. Their conservation would therefore capture the range of ecological and hopefully cultural variation that exists within this subspecies. The results of the RPS are given in section 3 of the plan.

Large areas occur where there is little or no published knowledge about the presence of chimpanzees. It was clear during the RPS that there is a need to make surveys of areas outside the current extent of knowledge and to identify other CCUs that may deserve conservation attention. A modelling analysis was made in order to predict areas where it is likely that chimpanzees occur in reasonable numbers outside the current area of knowledge but inside the historical range of the eastern chimpanzee. This can be used to guide where future surveys concentrate their activities. The model used land cover and GIS layers pertaining to human impact to estimate the most suitable locations for chimpanzees. The results of the modeling are given in section 4 of the plan.

A workshop was held in Kampala, Uganda, to develop the action plan Vision and Goal between August 17and 20th 2009. Using a problem tree analysis of threats to the long term survival of chimpanzees made separately for Eastern Africa and the Congo Basin objectives to address these threats were identified and projects developed for each objective that together would contribute to the achievement of the objective. These objectives and projects are summarized here in section 5 of this plan.

This ten year plan if fully implemented will go a long way to ensuring that the eastern chimpanzee can maintain viable populations across much of its existing range. The plan requires significant financial support to implement it fully and one of the objectives was specifically identified to address this need of funds. However, chimpanzees make excellent flagship and umbrella species for conservation, whose conservation can help conserve many other species for which it is harder to raise funding. The focus on different ecoregions and cultural differences in the RPS aims to ensure that a wide variety of ecological variation is conserved in the CCUs and hence this would increase the diversity of species that would be conserved by using this species as a flagship.

Available at: UWA central library

Ministry of Tourism, Trade and Industry. 2006. **The Uganda National Great Apes Conservation and Action Plan 2006- 2010.** Ministry of Tourism, Trade and Industry. Kampala.

Approximately 4950 Chimpanzees occur in Uganda, primarily in the large forest blocks in western Uganda. These forests are protected as national parks or forest reserves. However a small proportion of chimpanzees occur in fragments of forest outside these parks and reserves, particularly in Hoima, Kibale and Masindi districts. There is also a small population in Otzi Forest Reserve on the Sudan border estimated at about 25 individuals. Kibale National Park is the most important for chimpanzees with over 25% of all Uganda's chimpanzees present in this forest.

A threat analysis was carried out to identify the key threats to mountain gorillas and chimpanzees in Uganda. Problem trees were constructed for each species and a swot analysis carried out for the Mt. Gorilla as well. This helped to come up with the weaknesses within mountain gorilla and chimpanzee conservation efforts. Individual consultations were also carried out. The main issues that need to be addressed were given as sustainable habitat management, disease control and poaching.

Available at: UWA central library.

Plumptre, A.J., Cox, D. and Mugume, S. 2003. **The status of Chimpanzees in Uganda**. Abertine Rift Technical report Series No. 2. Wildlife Conservation Society.

Available at: UWA central library and
http://programs.wcs.org/portals/49/media/file/AR_Tech_Rpt_2_Uganda_Chimps.PDF [PDF]

Plumptre, A. J., Arnold, M. and Nkuutu, D. 2003. **Conservation Action Plan for Uganda's chimpanzees 2003 – 2008.** Wildlife Conservation Society and Jane Goodall Institute.

Available at: UWA central library, WCS-Uganda, JGI-Uganda and http://programs.wcs.org/uganda/Wildlife/Chimpanzee.aspx

Arnold, M. 2003. **An Assessment of Threats to Chimpanzees in Budongo, Bugoma, and Kibale Forests, Uganda**. Bachelors Dissertation, The Australian National University.

The tropical rainforests of Western Uganda have been consistently selected as among the world's most valuable and endangered ecosystems. As a flagship, keystone and umbrella species, chimpanzees have been identified as an ideal focal species for the conservation of these forests. This study investigates potential threats to the three largest chimpanzee populations in Uganda, which occur in Budongo, Bugoma and Kibale forests. A variety of social, cultural and biophysical data from numerous sources were integrated in a Geographic Information Systems framework. This allowed a comprehensive examination of a wide range of potential threats at local and regional scales. Demographic indicators reflecting potential threats - such as human population densities and poverty levels - were examined spatially and temporally, and then considered in conjunction with the results of an assessment of forest loss using MODIS satellite data. Estimates derived from the analysis of forest loss indicate that a total of 157.2 km² of fully stocked tropical high forest were degraded or lost in these critical habitats during the seven year period 1995-2002. Clear relationships and statistically relevant associations between the selected anthropogenic variables and forest loss were not forthcoming. The results of a subsequent examination of influences such as the absence or presence of forest resources outside protected areas; road networks; and deterrents to illegal activities such as the presence of rangers and researchers, suggests that these variables may be more useful in identifying threats to chimpanzees and chimpanzee habitat. The results reveal important differences between regional and local scale pressures, demonstrating that conservation efforts require a range of integrated and carefully chosen strategies that address site-specific threats. Recommendations to enhance and further define chimpanzee conservation strategies in the three forests are presented, and conclude that without urgent efforts focussed on specific threatening processes, opportunities to ensure the long term survival of wild chimpanzee populations in Uganda may be lost.

Available at: JGI-Uganda

UNEP. 2002. **The great Apes survival project partnership (GRASP): Strategy**. United Nations Environment Programme, Nairobi.

The overall goal of the strategy is, as an immediate challenge, to lift the threat of imminent extinction facing most populations of great apes, namely gorillas, chimpanzees, bonobos (pygmy chimpanzees) and orang-utans, and, beyond that, to conserve in their natural habitats wherever they exist, wild populations of all species and subspecies of great ape, and to make sure that, where they interact with people, those interactions are mutually positive and sustainable.

Available at: UWA central library and http://www.unesco.org/mab/doc/grasp/e_globalStrategy.pdf [PDF]

Hill, C.M. 2002. **Primate conservation and local communities - Ethical issues and debates**. *American Anthropologist*. 104: 1184-1194.

Hunting and habitat destruction and alteration threaten the existence of many primate species. However, the conservation of these primates has significant costs, as well as benefits, for people living alongside them. Conservation policy now recognizes that people should not suffer impoverishment from wildlife preservation and that, instead, conservation programs should make a significant contribution to alleviating rural poverty. Ethical consideration requires that local communities have greater control over natural resources, and that conservation programs contribute to these people's livelihood security. Nevertheless, this conservation on the basis of potential economic value may not protect primates adequately and may render them still vulnerable to extinction, given their sensitivity to human activities.

This presents an ethical dilemma: primates have intrinsic moral value so should be conserved for their own sake, yet conservation policies should not cause harm to local human populations. This article explores ethical issues that arise when primates and people live in close proximity.

Available at: DOI: 10.1525/aa.2002.104.4.1184, http://resourcelists.brookes.ac.uk/items/F7872A3F-E96E-07D8-37AA-7ABB70C196E6.html [PDF]

Nishida, T., Wrangham, R. W., Jones, J. H., Marshall, A. and Wakibara, J.2001**. Do Chimpanzees Survive the 21st Century?** The Apes: Challenges for the 21st Century: Keynote papers. Pp. 43-51

Available at: UWA central library and http://sites.lsa.umich.edu/ajmarsha/wp-content/uploads/sites/162/2014/09/Nishida-et-al.-2001-Chimpanzee-conservation.pdf [PDF]

Balcomb, S. R., Chapman, C. A. and Wrangham, R. W. 2000. **Relationship between Chimpanzee (Pan troglodytes) Density and Large, Fleshy-Fruit tree Density: Conservation Implications**. *American Journal of Primatology*. 51:197-203.

Conservation efforts to protect chimpanzees in their natural habitat are of the highest priority. Unfortunately, chimpanzee density is notoriously difficult to determine, making it difficult to assess potential chimpanzee conservation areas. The objective of this study was to determine whether chimpanzee density could be predicted from the density of trees that produce large, fleshy fruits. Using chimpanzee nest counts from six sites within Kibale National Park, Uganda, collected during a year-long study, a predictive trend was found between chimpanzee nest density and large, fleshy-fruit tree density. This relationship may offer a quick, reasonably reliable method of estimating potential chimpanzee densities in previously unsurveyed habitats and may be used to evaluate the suitability of possible re-introduction sites. Thus, in conjunction with other survey techniques, such as forest reconnaissance, it may provide an effective and efficient means of determining appropriate chimpanzee habitat in which to allocate conservation efforts.

Available at: UWA central library and http://www.ncbi.nlm.nih.gov/pubmed/10902668

1.7. Conservation and development

Mugyenyi, O., Amumpiire, A. and Namujuzi, F. 2015. **Sustainable conservation of Bwindi Impenetrable National Park and community welfare improvement: creating a win–win situation**. PCLG Briefing paper.

This PCLG policy brief argues that level of funding available for community projects under the revenue sharing schemes of Bwindi Impenetrable National Park is too low, that the system of disbursement of funds has been corrupted leading to some of the allocated funds failing to reach intended beneficiaries, and that the schemes have not adequately engaged the poorest households nearest the park boundary. In order to improve current conservation outcomes, it proposes that the Uganda Wildlife Authority increase the community share of the gorilla permit fee from US$5 to US$10 and improve governance of the schemes to ensure that funds reach the frontline communities who are the poorest of the local communities around the park.

Available at: http://pubs.iied.org/G03912.html

Chimpanzee Trust. 2014. **2014 Annual report**. Strategic objective 2: Conservation of chimpanzee populations in the wild and their habitats enhanced.

In 2014, we focused on completing our four-year Payment for Ecosystem Services (PES) project in Western Uganda. Our pilot PES project tested the effectiveness of offering financial incentives to Private Forest Owners (PFOs) to conserve biodiversity outside protected areas in Uganda.

Available at: UWA central library and http://ngambaisland.com/wp-content/uploads/2013/08/Chimpanzee-Trust-2014-report.pdf [PDF]

Amooti Tinka, J. 2014. **Community successes and frustrations: conservation and livelihood in Kibale National Park**. In Hughes, O., Roe, D., and Thomas, D.H.L. (eds.) with Kabihogo, B., Kuria, David K., Imbayi Ligare, J., Nyiratuza, M., and Tinka J.A. (2014) Getting it together: how some local organisations in East Africa have succeeded in linking conservation and development. Natural Resource Issues No. 27. IIED, London.

Available at: http://pubs.iied.org/17516IIED.html

Hill, C.M. and Wallace, G.E. 2012. **Crop protection and conflict mitigation: reducing the costs of living alongside non-human primates**. *Biodiversity and Conservation*. 21:2569–2587.

Conflict between farmers and primates increasingly impacts conservation efforts in Africa and Asia. Field crops provide a reliable and readily-accessible source of food for primates coping with habitat loss. However, crop-raiding undermines food security and tolerance of wildlife within neighbouring human communities. Many primates consume crops regularly yet there are few accounts of systematic evaluation of techniques to deter them. Working in partnership with farmers, this study was conducted over two growing seasons within four villages adjacent to the Budongo Forest Reserve, Uganda. Using systematic observational sampling, semi-structured interviews, and focus groups, we (i) monitored primate crop-raiding behaviour prior to and after installing locally-appropriate deterrents, developed with local farmers, and (ii) explored farmers' initial responses to the methods trialled. Deterrent efficacy was assessed by comparing the frequency and characteristics of raiding events across seasons. Primates were the predominant diurnal crop-raiders; six species were observed raiding. Deterrents implemented included barriers, alarms, repellents, and systematic guarding. Incidence of raiding and crop loss decreased in almost all cases, often by shifting raiding to unprotected fields or adjacent farms. Farmers identified benefits and shortcomings for each deterrent, and considered most to be effective and valuable. Insights from the research directly inform intervention strategies to address crop-raiding issues and extend options to mitigate human–wildlife conflict.

Available at: http://www.researchgate.net/profile/Catherine_Hill7/publication/257538248_Crop_protection_and_conflict_mitigation_Reducing_the_costs_of_living_alongside_non-human_primates/links/0c96052b0556918803000000.pdf?inViewer=0&pdfJsDownload=0&origin=publication_detail

Chimpanzee Sanctuary and Wildlife Conservation Trust. 2012. **2012 Annual report.** Payment for Ecosystem Services (Pes) Pilot Project.

One of the main achievements of 2012 was making the first round of payments to the Private Forest Owners (pfos) enrolled in the PES pilot project. We paid out USD 50,000 to conserve 1,096 hectares of forest that is the size of 2,740 football pitches. Since then, other forest owners have inquired about joining the scheme. Our dream of restoring the Albertine Rift corridor, a rich landscape that contains isolated Populations of chimpanzees in fragmented forest patches, is now taking shape.

Available at: UWA central library and http://ngambaisland.com/wp-content/uploads/2013/08/Annual-Report-2012.pdf [PDF]

Smith, H. 2012. **The Overlap between Conservation and Development Organisations in the Albertine Rift, Western Uganda**. PCLG Discussion Paper number 7.

This discussion paper uses Western Uganda as an example, this study attempts to explore the geographical relationship between conservation and poverty alleviation (development) organisations. 2012.

Available at: http://pubs.iied.org/G03724.html

Naughton-Trevesa, L., Alix-Garcia, J. and Chapmanc, C.A.2011. **Lessons about parks and poverty from a decade of forest loss and economic growth around Kibale National Park, Uganda**. *PNAS*. 108:34.

We use field data linked to satellite image analysis to examine the relationship between biodiversity loss, deforestation, and poverty around Kibale National Park (KNP) in western Uganda, 1996–2006. Over this decade, KNP generally maintained forest cover, tree species, and primate populations, whereas neighbouring communal forest patches were reduced by half and showed substantial declines in tree species and primate populations. However, a bad decade for forest outside the park proved a prosperous one for most local residents. Panel data for 252 households show substantial improvement in welfare indicators (e.g., safer water, more durable roof material), with the greatest increases found among those with highest initial assets. A combination of regression analysis and matching estimators shows that although the poor tend to be located on the park perimeter, proximity to the park has no measureable effect on growth of productive assets. The risk for land loss among the poor was inversely correlated with proximity to the park, initial farm size, and decline in adjacent communal forests. We conclude the current disproportionate presence of poor households at the edge of the park does not signal that the park is a poverty trap. Rather, Kibale appears to provide protection against desperation sales and farm loss among those most vulnerable.

Available at: PNAS http://www.pnas.org/content/108/34/13919.full

Tumusiime, D.M., Eilu, G., Tweheyo, M. and Babweteera, F. 2010. **Wildlife Snaring in Budongo Forest Reserve, Uganda**. *Human Dimensions of Wildlife*. 15:129–144.

Snaring is an indiscriminate vertebrate trapping method that has maimed more than 36% of an estimated 700 resident chimpanzees (Pan troglodytes) of Budongo Forest Reserve. This study was conducted in two phases to assess this problem. First, we administered questionnaires to 240 randomly selected households in villages around the reserve to look at socioeconomic and cultural contexts within which snares are set. Second, hunters identified in the first phase were purposefully selected for deeper discussions into snaring; 12% of the farmers set snares. Logistic regression showed a significant relationship between snaring and socioeconomic variables such as education. Hunters considered bushmeat an integral part of their livelihood and thus, snaring may continue or increase from current levels. Alternative sources of protein and cash for local people will be necessary to offset snaring problems. Conservationists need to address in-forest diversity and strategies that improve food security and income for forest edge communities.

Available at: http://www.tandfonline.com/doi/abs/10.1080/10871200903493899#.Vegm7sny3IU

Sandbrook, C. and Roe, D. 2010. **Linking conservation and poverty alleviation: The case of Great Apes. An overview of current policy and practice in Africa**. PCLG Discussion Paper number 3.

The purpose of this report is to document current efforts to link great ape conservation and poverty reduction in the African ape range states. It is intended to provide a quick inventory of which organisations are working in which countries and using which approaches in order to highlight potential areas of collaboration and/or potential sources of experience and lessons learned. It is also intended to highlight other initiatives that are intended to link environmental management with social concerns - poverty reduction, governance, economic development - with a view to encouraging greater linkages between these initiatives and those that are focused on conservation.

Available at: http://pubs.iied.org/G02770.html

Hockings, K. and Humle, T. 2009. **Best Practice Guidelines for the Prevention and Mitigation of Conflict between Humans and Great Apes.** Gland, Switzerland: IUCN/SSC Primate Specialist Group (PSG). 40 pp.

One of the challenges facing great ape conservation is the rising level of interaction between humans and great apes, and the resulting conflicts that emerge. As human populations continue to grow and human development makes deeper incursions into forest habitats, such conflicts will become more widespread and prevalent in the natural ranges of great apes, especially considering that the majority of great apes live outside protected areas. It is essential that we develop a comprehensive understanding of existing and potential conflict situations, and their current or future impacts on both great apes and humans. This will require the integration of quantitative and qualitative data on multiple aspects of human and great ape behaviour and ecology, along with a good understanding of local people's perceptions of the situation. Such knowledge can then be used to develop effective, locally-adapted, management strategies to prevent or mitigate human-great ape conflicts, whilst respecting both conservation objectives and socio-cultural-economic contexts. These guidelines outline a sequence of logical steps that should be considered prior to any form of human-great ape conflict intervention, and propose possible counter-measures to be used in the management of human-great ape conflicts

Available at: https://portals.iucn.org/library/efiles/documents/ssc-op-037.pdf [PDF]

Amati, S., Babweteera, F. and Wittig, R. 2008. **Snare removal by a chimpanzee of the Sonso community, Budongo Forest (Uganda).** *Pan Africa News*. 15(1):6-8.

Hunting is one of the biggest threats to the survival of our closest living relative, the chimpanzee. While chimpanzees in West and Central Africa commonly get directly shot by hunters and subsequently end up on the bushmeat market (see: www.wildchimps.org), the effects of hunting on chimpanzees in East Africa are more indirect. Hunters put up wire snares in the forests of East Africa in order to catch duikers and bush pigs. However, often snares catch other animals, such as chimpanzees. Their hands or feet get caught in the snares, causing subsequent loss of limbs or mutilation of hands and feet.

Available at: http://mahale.main.jp/PAN/15_1/15(1)_03.html

Chimpanzee Sanctuary and Wildlife Conservation Trust (CSWCT). 2003. **Annual report**.

Available at: UWA central library and Ngamba Island.

Reynolds, V, Wallis J. and Kyamanywa, R. 2003. **Fragments, sugar and chimpanzees in Masindi District, W. Uganda.** In: L. Marsh (ed.) Primates in Fragments: ecology and conservation. Kluwer, New York pp. 309-319.

Masindi District in western Uganda contains the Budongo Forest, with a population of approximately 600 chimpanzees (Pan troglodytes schweinfurthii). In 1999, a group of chimpanzees was discovered living in semi-isolation in the Kasokwa riverine forest fragment outside the main forest block. Although there is growing local support among village residents for saving the chimpanzees, immigrant sugar farmers pose a problem as they have been removing forest cover at an alarming rate.

Available at: UWA central library.

Quiatt, D., Reynolds, V. and Stokes, E. J. 2002. **Snare injuries to chimpanzees (Pan troglodytes) at 10 study sites in east and west Africa**. *African Journal of Ecology*. 40:303-305.

Available at: http://onlinelibrary.wiley.com/doi/10.1046/j.1365-2028.2002.00356.x/abstract

Moyoni, Y., Manyindo, J. and Makumbi, I. 2006. **Sharing Natural resources revenue: Towards derivation fund for Uganda**. Uganda Wildlife Society, Kampala.

The overall aim of this study was to assess the feasibility of establishing derivation funds for elected natural resources sub-sectors. The specific objectives of the study were to: define the concept of a derivation fund, its rationale and features; review existing institutional, policy and legal arrangements bearing on derivation funds; document relevant international experience; present the challenges of establishing derivation funds in Uganda; propose applicable derivation funds; and derive main conclusions and key recommendations. The study concludes that establishing natural resources based derivation funds is feasible and ought to be implemented. It recommends additional analysis be carried out in: determining the extra charge for renewable natural resources derivation funds; and providing assistance in the establishment of, and managing, community derivation funds, among others.

Available at: http://www.uws.or.ug/wp-content/uploads/Natural%20Resource%20Derivation%20Funds%20in%20Uganda.pdf [PDF]

1.8. Human-chimpanzee interaction

Hockings, K.J., McLennan, M.R., Carvalho, S., Ancrenaz, M., Bobe R., Byrne, R.W., Dunbar, R.I.M., Matsuzawa, T., McGrew, W.C., Williamson, E.A., Wilson, M.L., Wood, B., Wrangham, R.W. and Hill, C.M. 2015. **Apes in the Anthropocene: flexibility and survival.** *Trends in Ecology and Evolution*. 30(4): 215–222.

We are in a new epoch, the Anthropocene, and research into our closest living relatives, the great apes, must keep pace with the rate that our species is driving change. While a goal of many studies is to understand how great apes behave in natural contexts, the impact of human activities must increasingly be taken into account. This is both a challenge and an opportunity, which can importantly inform research in three diverse fields: cognition, human evolution, and conservation. No long-term great ape research site is wholly unaffected by human influence, but research at those that are especially affected by human activity is particularly important for ensuring that our great ape kin survive the Anthropocene.

Available at: http://dx.doi.org/10.1016/j.tree.2015.02.002

McLennan, M. R. 2013. **Effects of Human-Driven Habitat Change on Health and Ecology of Chimpanzees in Uganda**. Final report to UNCST and UWA.

Available at: UWA central library, ref: UWA/TDO/33/02 and UNCST, ref: NS 420

Vogel, S.M. 2013. **Adapting crop composition in order to mitigate chimpanzee (Pan troglodytes schweinfurthii) crop raiding in Western Uganda**. MSc. Dissertation. Wageningen University, the Netherlands.

Conflicts between humans and wildlife are widespread, and often involve wildlife raiding of cultivated crops. An example of this is primate crop raiding, which poses a threat to both the (often) endangered primates and the livelihoods of the local communities. Many attempts at mitigating these conflicts by reducing primate crop raiding exist. One type of counter-measure is land-use change, which is potentially highly effective, but which carries variable costs and is understudied. To investigate the potential of adaptations to crop composition in decreasing chimpanzee and baboon crop raiding, we elaborated the following main research question: '*What is the relationship between agricultural practices, the local livelihood of farmers and chimpanzee and baboon crop raiding in the Masindi district of Western Uganda?'*.

Available at: JGI-Uganda.

McLennan, M.R., Hyeroba, D., Asiimwe, C., Reynolds, V. and Wallis, J. 2012. **Chimpanzees in mantraps: lethal crop protection and conservation in Uganda**. *Oryx*. 46:598-603.

A main concern of farmers worldwide is how to reduce crop losses to wildlife. Some potentially lethal crop protection methods are non-selective. It is important to understand the impact of such methods on species of conservation concern. Uganda has important populations of endangered eastern chimpanzees Pan troglodytes schweinfurthii. Farmers sometimes use large metal mantraps to guard their fields against crop-raiding wildlife, particularly baboons Papioanubis and wild pigs Potamochoerus sp.. Chimpanzees that range onto farmland also step in these illegal devices and without rapid veterinary invention face severe injury or eventual death. Unlike inadvertent snaring of great apes in African forests, the problem of mantraps in forest–farm ecotones has received little attention. We report 10 cases of entrapped chimpanzees in the cultivated landscape surrounding Uganda's Budongo Forest during 2007–2011, undoubtedly only a portion of the actual number of cases. Mantraps currently present a substantial threat to ape populations in this important conservation landscape. Our data underscore the need for conservation programmes to consider the techniques used by rural farmers to protect their livelihoods from wild animals.

Available at:
http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=8705084&fileId=S0030605312000592

Hockings, K.J. and McLennan, M.R. 2012. **From Forest to Farm: Systematic Review of Cultivar Feeding by Chimpanzees – Management Implications for Wildlife in Anthropogenic Landscapes**. PLoS ONE 7(4): e33391.

Crop-raiding is a major source of conflict between people and wildlife globally, impacting local livelihoods and impeding conservation. Conflict mitigation strategies that target problematic wildlife behaviours such as crop-raiding are notoriously difficult to develop for large-bodied, cognitively complex species. Many crop-raiders are generalist feeders. In more ecologically specialised species crop-type selection is not random and evidence-based management requires a good understanding of species' ecology and crop feeding habits. Comprehensive species-wide studies of crop consumption by endangered wildlife are lacking but are important for managing human–wildlife conflict. We conducted a comprehensive literature search of crop feeding records by wild chimpanzees (Pan troglodytes), a ripe-fruit specialist. We assessed quantitatively patterns of crop selection in relation to species-specific feeding behaviour, agricultural exposure, and crop availability. Crop consumption by chimpanzees is widespread in tropical Africa. Chimpanzees were recorded to eat a considerable range of cultivars (51 plant parts from 36 species). Crop part selection reflected a species-typical preference for fruit. Crops widely distributed in chimpanzee range countries were eaten at more sites than sparsely distributed crops. We identified 'high' and 'low' conflict crops according to their attractiveness to chimpanzees, taking account of their importance as cash crops and/or staple foods to people. Most (86%) high conflict crops were fruits, compared to 13% of low conflict crops. Some widely farmed cash or staple crops were seldom or never eaten by chimpanzees. Information about which crops are most frequently consumed and which are ignored has enormous potential for aiding on-the-ground stakeholders (i.e. farmers, wildlife managers, and conservation and agricultural extension practitioners) develop sustainable wildlife management schemes for ecologically specialised and protected species in anthropogenic habitats. However, the economic and subsistence needs of local people, and the crop-raiding behaviour of sympatric wildlife, must be considered when assessing suitability of particular crops for conflict prevention and mitigation.

Available at: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0033391

Malone, N.M., Fuentes, A. and White, F. J. 2010. **Ethics Commentary: Subjects of Knowledge and Control in Field Primatology**. *American Journal of Primatology*. 72:779–784.

Our primate kin are routinely displaced from their habitats, hunted for meat, captured for trade, housed in zoos, made to perform for our entertainment, and used as subjects in biomedical testing. They are

also the subjects of research inquiries by field primatologists. In this article, we place primate field studies on a continuum of human and all primate relationships as a heuristic device to explore the unifying ethical implications of such inter-relationships, as well as address specific ethical challenges arising from common research protocols ''in the field'' (e.g. risks associated with habituation, disease transmission, invasive collection of biological samples, etc.). Additionally, we question the widespread deployment of conservation- and/or local economic development-based justifications for field-based primatological pursuits. Informed by decades of combined fieldwork experience in Indonesia and the Democratic Republic of Congo, we demonstrate the process by which the adherence to a particular ethical calculus can lead to unregulated and ethically problematic research agendas. In conclusion, we offer several suggestions to consider in the establishment of a formalized code of ethics for field primatology.

Available at: http://www.ncbi.nlm.nih.gov/pubmed/20653003

McLennan, M.R. 2008. **Beleaguered Chimpanzees in the Agricultural District of Hoima, Western Uganda.** *Primate Conservation.* (23):45-54.

With approximately 5,000 chimpanzees, Uganda is important for the conservation of the eastern subspecies Pan troglodytes schweinfurthii. The population distribution is highly fragmented, however, and the prospects for the long-term viability of many populations will be greatly improved if dispersal opportunities are maintained between major forests via migratory corridors. Chimpanzees in unprotected human-dominated habitat outside the main forest blocks are often ignored by research and conservation efforts. This study assessed the status and distribution of chimpanzees in northern Hoima District, western Uganda. The survey region covered 400 km² between 1°26'–1°37'N and 31°09'–31°32'E, and separates two major forest blocks, Bugoma and Budongo. Chimpanzees use small forest fragments along watercourses throughout this region, both on private or communal land and in small government reserves, and a number of distinct groups (‘communities’) are present. There has been no evidence to indicate that chimpanzee populations are isolated; on the contrary chimpanzees appear highly mobile in this forest–farm habitat, confirming the region’s corridor potential. At one site in the region, chimpanzees occur at an estimated density of 0.66 individuals/km² which, if extrapolated across the survey area, implies a larger population than previously thought. Recent and rapid habitat change resulting from unregulated timber extraction and clearance of fragments for agriculture — particularly for cash crops such as tobacco — has exposed the chimpanzees, causing increased negative interactions between apes and farming communities. The chimpanzees in northern Hoima are unlikely to survive without immediate intervention.

Available at: https://radar.brookes.ac.uk/radar/items/57e7986f-9460-18e6-ea59-3c7c12d47e7a/1/

Tweheyo, M., Hill, C.M. and Obua, J. 2005. **Patterns of crop raiding by primates around the Budongo Forest Reserve, Uganda.** *Wildlife Biology.* 11:237-247.

Crop raiding by primates in particular and wild animals in general is a significant source of people-forest conflict around the Budongo Forest Reserve, Uganda. Crop loss to wild animals undermines local support for conservation efforts in this area. Patterns of primate crop raiding were studied over a period of 14 months in six villages (five adjacent to the Budongo Forest Reserve and one that is approximately 3,500 m from the forest edge). Data were collected via a questionnaire survey. Additional information was obtained from the relevant local government offices. Chimpanzees *Pan troglodytes*, baboons *Papio anubis*, other monkeys, bush pigs *Potamochoeus procus* and porcupines *Hystrix cristata* were reported by farmers to be the major causes of crop losses by wildlife. Of farmers, 73% reported suffering crop damage caused by primates, and 79% considered baboons to be the most destructive of all crop raiding species. Drought, insect pests, poor sowing, plant diseases and accidental fires were other sources of crop losses to farmers, though the risk of crop damage particularly by primates is perceived as the most serious potential cause of losses. Using chimpanzees as a case study, patterns of crop damage across the year are compared with seasonal fluctuations in availability of wild foods.

Available at:
http://www.bioone.org/doi/pdf/10.2981/0909-6396(2005)11%5B237%3APOCRBP%5D2.0.CO%3B2

Lloyd, J. 2002. **Chimpanzees Ecotourism in Uganda: Workshop Planning Document**.

Available at: UWA central library.

Wrangham, R.W. 2001. **Moral Decisions about Chimpanzees**. In: Beck, B., et al. 2001. Great Apes and Humans: The Ethics of Coexistence. pp 230-244.Washington, D.C.: Smithsonian.

Available at: UWA central library.

Wrangham, R. and Mugume, S. 2000. **Snare Removal Program in Kibale National Park: a Preliminary Report.** *Pan African News*. 7(2):18-20.

Available at: UWA central library and http://repository.kulib.kyoto-u.ac.jp/dspace/bitstream/2433/143557/1/PAN7(2)_18.pdf [PDF]

Muller, M.N. and Wrangham, R.W. 2000. **The Knuckle-Walking Wounded**. *Natural History*. 109(8):44.

This article features information on the dangers and injuries posed to chimpanzees by snares of poachers at the Kibale Forest National Park in Uganda. Conditions of injured chimpanzees; Mechanism of snares; Efforts of the Kibale Chimpanzee Project to treat the injured chimpanzees.

Available at: UWA central library.

Munn J. and Kalema G. 2000. **Death of a chimpanzee in a trap in Kasokwa Forest Reserve Uganda.** *African Primates journal/newsletter* (1999-2000). 4(1&2):58-62.

Available at: Conservation through Public Health (CTPH).

Naughton-Treves, L., Treves, A., Chapman, C. and Wrangham, R. 1998. **Temporal patterns of crop-raiding by primates: linking food availability in croplands and adjacent forest.** *Journal of Applied Ecology*. 35:596-606.

Primates dominate lists of pests that damage crops around African parks and reserves. Beyond creating management problems, crop foraging is integral to the ecology of primates inhabiting forest—agriculture ecotones. Twenty-three months of data from four villages around Kibale National Park, Uganda, revealed that redtail monkeys Cercopithecus ascanius, olive baboons Papio cynocephalus and chimpanzees Pan troglodytes selected different crops or plant parts. Baboons took root and tuber crops ignored by other primates, and fed on the greatest variety of crops. All three species preferred maize and/or bananas. Redtails ate only banana fruit, baboons ate banana fruit more frequently than pith, and chimpanzees raided pith and fruit in equal proportions. Each primate showed a distinct monthly pattern of crop foraging, significantly non-random for baboons and redtail monkeys, weakly for chimpanzees. Large inter-monthly variation was observed for all three primates, but was least pronounced in redtails. Raiding frequency on maize peaked approximately 8 weeks after the onset of rains and was strongly correlated between the three primate species. Abundant forest fruit did not diminish primate appetite for maize. Raiding frequency on bananas varied considerably despite continuous availability of fruit and pith. Peaks in banana consumption were unrelated to rainfall or maize raiding, but were associated instead with forest fruit shortages, specifically Mimusops bagshawei. Chimpanzees consumed banana pith more frequently when forest fruits were scarce, whereas baboons targeted more banana fruits. The use of banana pith by chimpanzees supports the suggestion that energy-rich pith is crucial to chimpanzees during fruit scarcity. Conservation of Mimusops bagshawei and other key forest fruit trees may lessen primate raiding intensity on perennial crops, e.g. bananas. Maize raiding appears unaffected by forest fruit abundance. Such highly palatable crops are best planted > 500 m from the forest edge. Planting agroforestry buffers along park edges creates ideal habitat for crop-raiders. This

management strategy is appropriate where human population density is low and crop raiding species are legal game. When dangerous or destructive wildlife species forage amidst densely settled subsistence farmland, managers are challenged to separate forests from agriculture using non-palatable plant barriers or electric fences.

Available at: UWA central library and http://onlinelibrary.wiley.com/doi/10.1046/j.1365-2664.1998.3540596.x/abstract

2. GORILLAS

Gorillas, locally known as Engagi in Uganda, are the biggest of the world's primates and live in the forests in a few countries in Africa. The gorilla population is sadly much lower than it used to be and the gorillas are now classed as an endangered species. Gorillas are very sociable animals living in groups of around 5 to 30 members. Gorillas spend most of their time eating, sleeping and grooming each other. They move about by walking on their knuckles which helps to support their weight. In Sub-Saharan Africa there are two subspecies of western gorilla Gorilla gorilla (the western lowland gorilla G. g. gorilla and the Cross River gorilla, G. g. diehli), and two subspecies of eastern gorilla, Gorilla berengei (the mountain gorilla G. b. berengei and Grauer's gorilla G. b. graueri). The mountain gorilla is one of the largest primates in the world with the male, known as a silverback, often growing to twice the size of a female. The mountain gorilla is found in the highlands in eastern Africa: in the volcanic mountains of Virunga across 4 national parks throughout the eastern Democratic Republic of Congo, Rwanda and Uganda and Bwindi Impenetrable Forest. The mountain gorilla has longer fur covering its body as compared to other gorilla species, allowing it to withstand both hot and cold temperatures. It has also taken to living mainly on the ground but is capable of hauling its enormous weight to around 6m high above the ground, when looking to feed on fruits and berries that are inaccessible from the ground[2].

2.1. Taxonomy

Williamson, E.A. and Butynski, T.M. 2013. **Gorilla berengei: Eastern Gorilla**. pp 45-53 in Butysnski, T., Kingdon, J. and Kalina, J. (eds) 2013. Mammals of Africa. Volume II: Primates. Bloomsbury publishing. London.

Available at: Zoology museum, Makerere University Kampala.

2.2. Population and distribution

Roy, J., Vigilant, L., Gray, M., Wright, E., Kato, R., Kabano, P., Basabose, A., Tibenda, E., Kühl, H.S., and Robbins, M.M. (2014). **Challenges in the use of genetic mark-recapture to estimate the population size of Bwindi mountain gorillas (*Gorilla beringei beringei*).** *Biological Conservation*. 180: 249-261.

Monitoring the population dynamics of endangered species is a critical component of conservation management strategies, but attaining accurate and precise estimates of population sizes using cost and time effective methods can be challenging. Routine censuses of the two populations of critically endangered mountain gorillas (*Gorilla beringei beringei*) have been conducted over the last decades to monitor populations and evaluate the effectiveness of conservation strategies. A census in 2006 of the mountain gorillas in Bwindi Impenetrable National Park, Uganda, showed the value of genetic analysis of fecal samples collected at nest sites by revealing discrepancies between the numbers of nests and uniquely identified gorillas. In this study, we censused the Bwindi gorilla population using a 'mark-recapture' method which involved genetic analysis of fecal samples collected in 2011 during two 'sweep' surveys of the entire park. We found that a notable proportion of gorillas were missed in either of the two sweeps (minimum 35% and 31%, respectively). Based on the number of genotyped gorillas and correction factors, we estimated the population to contain a minimum of 400 individuals. Using the mark-recapture approach, we infer possibly as many as 430 gorillas (95% confidence interval: 398–487). As the 2010 census of the Virunga Massif population found 480 gorillas, the total number of mountain gorillas worldwide is at least 880 individuals. Simulations using different mark-recapture models suggest that a future census of Bwindi mountain gorillas would benefit by increasing the number of sweeps in order to achieve accurate and precise results. Finally, based on our results, we

[2] http://a-z-animals.com/animals/gorilla/

recommend a sequential approach incorporating a pilot study and simulations for optimizing time and resources in large mammal genetic census studies.

Available at: http://dx.doi.org/10.1016/j.biocon.2014.10.011

Olupot, W. and Plumptre, A. J. 2010. **Conservation research in Uganda's forests: A review of site history; research and use of research in Uganda's forest parks and Budongo forest reserve**. pp 65. Nova Science publishers, Inc. New York.

Available at: National Biodiversity Data Bank.

McNeilage, A., Robbins, M.M., Gray, M., Olupot, W., Babaasa, D., Bitariho, R., Kasangaki, A., Rainer, H., Asuma, S., Mugiri, G., & Baker, J. 2006. **Census of the mountain gorilla Gorilla beringei beringei population in Bwindi Impenetrable National Park, Uganda.** *Oryx*. 40(4):419-427.

Mountain gorillas *Gorilla beringei beringei* are critically endangered, with just two small populations: in Bwindi Impenetrable National Park in south-western Uganda and the nearby Virunga Volcanoes on the borders with Rwanda and Uganda. A survey of the Bwindi population was carried out in 2002 and results were compared with the previous census in 1997. Our estimate of total population size increased over that period by *c*. 7% to 320 individuals and the structure and distribution of the population were largely unchanged. Signs of human disturbance were more common in 2002 than 1997, and gorillas tended to be found in areas of relative low disturbance. This suggested that disturbance could be a constraint on population growth and distribution but demographic stochasticity may also be responsible for the observed level of population change over a short time period. Other potential limiting factors, including habitat availability and disease, are discussed. While conservation activities in Bwindi have probably contributed to the stability of the population, strengthening of law enforcement and continued vigilance are needed to ensure the population's long-term growth and survival.

Available at: http://dx.doi.org/10.1017/S0030605306001311

Marshall, A.J., Jones, J.H. and Wrangham, R.W. 2000. **The Plight of the Apes: A Global Survey of Great Ape Populations.**

The prime purpose of the Global Strategy is to coordinate efforts to halt the decline in great ape populations and to ensure their long-term survival in their natural habitat. Where possible, this should be done in tandem with the sustainable development objectives of the Great Ape Range States

Available at: UWA central library.

2.3. Ecology

Ganas, J., Nkurunungi, J.B., and Robbins, M.M. (2009). **A preliminary study of the temporal and spatial biomass patterns of herbaceous vegetation consumed by mountain gorillas in an afromontane rain forest.** *Biotropica*. 41(1):37-46.

Although many animal species consume herbaceous vegetation found in African tropical forests, little is known of the temporal and spatial availability of these plants. From September 2004 to August 2005 we conducted a study that quantified the temporal and spatial biomass availability of 20 species of herbs frequently consumed by endangered mountain gorillas at two locations (Buhoma and Ruhija) in Bwindi Impenetrable National Park, Uganda. In general, the biomass of herbs varied over the study period, but these changes were relatively small. For 12 of 18 and nine of 11 species in Buhoma and Ruhija, respectively, herb biomass differed significantly among habitat types. Of the nine species found in both locations, seven species had a higher biomass at Ruhija, one species had a higher biomass at Buhoma, and one species showed no difference. These results demonstrate that herb biomass varied

little temporally but spatial differences in herb biomass were more pronounced. Future studies should investigate the variables that may influence herb phenological patterns such as rainfall, light, soil quality, previous disturbance regimes, and animal foraging and trampling damage.

Available at: http://dx.doi.org/10.1111/j.1744-7429.2008.00455.x

Ganas, J., Ortmann, S., and Robbins, M.M. 2009. **Food choices of the mountain gorilla in Bwindi Impenetrable National Park, Uganda: The influence of nutrients, phenolics and availability**. *Journal of Tropical Ecology*. 25(2):123-134.

The factors that influence food choice have implications for animal survival, reproduction and population growth. We conducted a 1-year study of food choice by four mountain gorilla groups that consumed herbs and fruit at two locations differing spatially and temporally in food availability in Bwindi Impenetrable National Park, Uganda. We collected data on 45 important foods consumed by the gorillas, the availability of those foods in each gorilla group's home range and their corresponding nutrient and phenolic concentrations. Employing a linear multiple regression, we tested three hypotheses regarding the influence of food availability and the nutritional and phenolic concentrations of food on food choice. Regardless of changes in herb availability, the choice of herbs was positively influenced by their abundance and sugar concentrations and negatively influenced by their fibre, condensed tannin and protein concentrations. Furthermore, regardless of changes in fruit availability, the choice of fruit was positively influenced by its abundance and negatively influenced by its condensed tannin concentrations. During periods of low fruit availability, the gorillas did not increase the consumption of herbs high in fibre and sugar. The choice of herbs low in fibre had less of an influence on food choice at the location with lower fruit availability than the other location. Our results underscore the importance of incorporating both availability and nutrient concentrations into studies of food choice; by doing so we found Bwindi gorillas were able to choose abundant, relatively high-quality foods year round.

Available at: http://dx.doi.org/10.1017/S0266467408005701

Eckhart, G. and Lanjouw, A. 2008. **Mountain Gorillas: Biology, Conservation, and coexistence**. The John Hopkins University Press, Baltimore.

Available at: UWA central library.

Ganas, J. 2008. **Foraging strategies of Mountain Gorillas in BINP, Uganda**. PhD thesis

Available at: ITFC.

Mutebi, N.A. 2005. **Genetic analysis of the social structure in wild mountain gorillas (Gorilla berengei berengei) of Bwindi Impenetrable National Park, Uganda**. PhD thesis

Available at: ITFC.

Conklin-Brittain, N.L., Knott, C.D. and Wrangham, R.W. 2001. **The Feeding Ecology of Apes. In: The Apes: Challenges for the 21st Century, conference proceedings, May 10-13, 2000**. Chicago Zoological Society, Brookfield, Illinois.

Available at: UWA central library and
http://www.researchgate.net/publication/230823364_The_Feeding_Ecology_of_Apes

Muller, M.N. and Wrangham, R.W. 2001. **The Reproductive Ecology of Male Hominoids.** In: Reproductive Ecology and Human Evolution. ed. Ellison, P.T. pp 397-427. Aldine de Gruyter, New York.

Available at: UWA central library.

2.4. Habitat

Uganda Wildlife Authority. 2014. **Mgahinga Gorilla National Park. General management Plan 2014 – 2024.** Uganda Wildlife Authority, Kampala.

Mgahinga Gorilla National Park (MGNP) is a home to the Nyakagezi group of the rare Mountain Gorilla. The park is contiguous with Parc National des Virunga (240 km2) in the DRC, and Parc National des Volcans (160 km2) in Rwanda, all forming the proposed transboundary PA known as the Virunga Conservation Area covering an area of 434 km2. The park includes three of the Virunga volcanoes – Mt Muhabura (4127 m), Mt Gahinga (3473 m) from which the park derives its name, and Mt Sabyinyo (3645 m). It lies in Bufumbira county, Nyarusiza and Muramba sub-counties and adjacent to the three parishes of Gisozi, Rukongi and Gitenderi. The park area was previously heavily encroached and settled, and its creation led to eviction of over 2400 people in 1992. For the last 21 years, Uganda Wildlife Authority has implemented programs and activities which have seen the park recover to its original vegetation, though not yet fully recovered at the moment. For the next 10 years (2014 – 2024) MGNP shall be conserved for its unique biodiversity including the critically endangered Mountain Gorilla and, the rare Golden Monkey, physical and ecological attributes of the park as part of the greater Virunga transboundary ecosystem for the benefit of the local, national and international community.

Available at: UWA central library.

Uganda Wildlife Authority. 2008. **Bwindi/Mgahinga Conservation area. General Management Plan 2001-2011, revised edition.** Ministry of Tourism, trade and industry (MTTI), Kampala.

Available at: UWA central library.

Weber, W., White, L.J.T., Vedder, A. and Naughton-Treves, L. (eds). 2001. **African Rain Forest Ecology and Conservation: An Interdisciplinary Perspective**. 608 pp. Yale University Press.

Extending from west Africa to Madagascar, from the vast lowland Congo Basin to the archipelago of forest islands on its eastern rim, the African rain forest is surpassed in size only by the Amazon. This book sheds light on the current efforts to understand and conserve the African rain forest, an area in need of urgent action to save its biological wealth, cultural heritage, and economic potential. Written by conservation scientists and practitioners based in the African rain forest, the book offers a multidisciplinary perspective that integrates many biological and social sciences. Early chapters trace the forces--from paleoecological factors to recent human actions--that have shaped the African forest environment. The next chapters discuss the dominant biological patterns of species ranging from the distinctive elephants, gorillas, and okapi to the less well known birds, butterflies, and amphibians. Other chapters focus on how such different groups as hunter-gatherers, forest farmers, bushmeat hunters, recent immigrants, and commercial foresters have used the forests. Several authors stress the need for tighter links between research and conservation action. The final section draws lessons from the collective experience of those working in an Africa wracked by political strife and economic hardship.

2.5. Zoonoses and other diseases

Rubanga, S.V., Bact, D. and Kalema-Zikusoka, G. 2013. **The Establishment and Use of Field Laboratories: Lessons from the Conservation Through Public Health Gorilla Research Clinic, Uganda**. *Journal of Exotic Pet Medicine*. 22(1):34–38.

Conservation Through Public Health, a grassroots, Uganda-based Non-Governmental Organization, in partnership with Uganda Wildlife Authority, established a field clinic for mountain gorillas and other animal species in Bwindi Impenetrable National Park in 2005. This was an initial step in the effort to establish a long-term wildlife health-monitoring system in Uganda. This wildlife health-monitoring system is to act as an early warning system for disease outbreaks. The clinic primarily analyzes gorilla fecal samples for parasites and, since its establishment in 2005, has grown to include in its remit livestock, park staff, and symptomatic humans from the Bwindi community. The diagnostic testing capability of the field clinic has expanded to include Giardia spp and Cryptosporidium spp. One policy outcome of this project has been the adoption of regular gorilla fecal sample collection as a health-monitoring intervention in the Uganda Wildlife Authority's annual operational plan. Conservation Through Public Health is also planning to erect a “One Health” Gorilla Centre, to accommodate extra tests, including polymerase chain reaction, for more accurate detection of cross-species transmission of bacteria, parasites, and other pathogens. The main challenges for the clinic personnel are associated with the building's remote location at the national park. Consequently, the diagnostic facility is not connected to the national electricity grid, which necessitates the use of a more expensive option for power, solar with the aid of a backup generator.

Available at: DOI: https://doi.org/10.1053/j.jepm.2012.12.005

Rothman, J.M. Bowman, D.G., Kalema-Zikusoka, G. and Nkurunungi, J.B. 2006. **Parasites of the Gorillas in Bwindi Impenetrable National Park.** *Primates of Western Uganda*. 10:171-192.

Detecting disease threats to endangered species and their ecosystems plays a crucial role in the survival of a population (McCallum and Dobson, 1995). As human pressure increases around and within habitats that contain endangered species, so does the potential for disease transmission. Communities and wildlife managers must act proactively to discourage and prevent zoonotic disease transmission between humans and endangered wildlife.

Available at: http://pages.nycep.org/rothman/5ChapterParasites.pdf [PDF]

Kalema-Zikusoka, G., Rothman, J.M., Fox, M.T. 2005. **Intestinal parasites and bacteria of mountain gorillas (Gorilla beringei beringei) in Bwindi Impenetrable National Park, Uganda**. *Primates*. 46:59-63.

A survey in 1994 examined intestinal helminthes and bacterial flora of mountain gorillas (*Gorilla beringei beringei*) in Bwindi Impenetrable National Park, Uganda. Parasites and bacteria were identified to genus in the feces of two groups of tourist-habituated and one group of non-tourist-habituated mountain gorillas. Eggs were identified as those of an anoplocephalid cestode, and nematode eggs representative of the genera*: Trichuris, Ascaris, Oesophagostomum, Strongyloides, and Trichostrongylus.* This is the first report of *Ascaris lumbricoides*- like eggs in mountain gorillas. Fecal samples (n=76) from all groups contained helminth eggs, with strongyle eggs and anoplocephalid eggs being the most common. Salmonella and Campylobacter were found in both gorilla groups. Regular long-term non-invasive fecal monitoring of the populations of mountain gorillas is essential for the prevention and identification of potential health threats by intestinal parasites and bacteria in this highly endangered subspecies.

Available at: https://doi.org/10.1007/s10329-004-0103-y

Kalema-Zikusoka, G., Kock, R.A. and Macfie, E.J. 2002. **Scabies in free-ranging mountain gorillas (Gorilla beringei beringei) in Bwindi Impenetrable National Park, Uganda.** *Veterinary Record.* 150(1):12-5.

Between August and December 1996, there was an outbreak of a debilitating skin disease attributed to Sarcoptes scabiei infection in mountain gorillas (Gorilla beningei beringei) in Bwindi Impenetrable National Park in Uganda. All four members of a gorilla group which had been habituated to tourists were clinically affected; the infant male gorilla was most severely affected and died, the juvenile male showed serious manifestations of the disease and the two adult animals showed milder signs. The three older animals recovered after a single intramuscular dose of ivermectin. S scabiei mites were observed on skin scrapings and biopsies taken while the juvenile was immobilised and in postmortem samples taken from the infant. The clinical signs did not recur during the following year, and no other gorilla groups in the park were observed to be clinically affected.

Available at: https://doi.org/10.1136/vr.150.1.12

Kalema-Zikusoka, G. and Lowenstine, L. 2001. **Rectal prolapse in a free-ranging mountain gorilla (Gorilla beringeiberingei): clinical presentation and surgical management**. *Journal of Zoo and Wildlife Medicine.* 32(4):509-513.

A juvenile female mountain gorilla (Gorilla beringei beringei) of the Mubare tourist group in Bwindi Impenetrable National Park, Uganda, developed a severe, complete rectal prolapse that did not spontaneously resolve. Eight months prior, a juvenile female mountain gorilla of the Mubare group developed a mild, complete rectal prolapse that resolved spontaneously within 24 hr. Field guides reported that spontaneously resolving prolapses had been seen previously in two other juveniles, one of which was from the Mubare group. The tissue became increasingly necrotic and maggot infested over the course of 1 week. Surgical intervention involved amputation of the affected rectal tissues and suturing the viable portion to the anal sphincter muscle with simple interrupted absorbable sutures. The surgery was performed in the field in accordance with Uganda Wildlife Authority policies. Antibiotics and anthelmintics were administered systemically, and the gorilla returned to the group. The gorilla appeared to recover fully after 3 wk. Histology of the resected rectal tissue confirmed intense inflammation and necrosis with myiasis but did not reveal an underlying etiology.

Available at: http://dx.doi.org/10.1638/1042-7260(2001)032[0509:RPIAFR]2.0.CO;2

Graczyk, T.K., DaSilva, A.J., Cranfield, M.R., Nizeye, J.B., Kalema, G.R. and Pieniazek, N.J. 2001. **Cryptosporidium parvum genotype 2 infections in free-ranging mountain gorillas (Gorilla gorilla beringei) of the Bwindi Impenetrable National park, Uganda.** *Parasitology Research*. 87(5):368-70.

For behavioral research and due to growing ecotourism, some populations of free-ranging mountain gorillas (Gorilla gorilla beringei) have become habituated to humans. Molecular analysis of two Cryptosporidium sp. oocyst isolates originating from two human-habituated gorilla groups and two oocyst isolates from non-habituated gorillas yielded positive identification of C. parvum Genotype 2 (G2; i.e., "cattle", "animal-adapted", or "zoonotic"). As G2 is cross-transmissible between humans and animals, C. parvum infections can be propagated in the habitats of human-habituated, free-ranging gorillas through both zoonotic and anthroponotic transmission cycles.

Available at: https://doi.org/10.1007/s004360000337

Nizeye, J.B., Innocent, R.B., Erume, J., Kalema, G., Cranfield, M.R. and Graczyk, T.K. 2001. **Campylo bacteriosis, Salmonellosis, and Shigellosis in free-ranging human-habituated mountain gorillas in Uganda.** *Journal of Wildlife Diseases*. 37(2): 239-244.

Cryptosporidiosis, a zoonotic diarrheal disease, significantly contributes to the mortality of people with impaired immune systems worldwide. Infections with an animal-adapted genotype (Genotype 2) of Cryptosporidium parvum were found in a human population in Uganda that shares habitats with free-ranging gorillas, from which the same genotype of C. parvum had been recovered previously. A high prevalence of disease was found in park staff members (21%) who frequently contact gorillas versus 3% disease prevalence in the local community. This indicates a zoonotic transmission cycle of this pathogen against which no effective prophylaxis or therapy exists. The results of the study

questionnaire demonstrated a high percentage of people not undertaking appropriate precautions to prevent fecal-oral transmission of C. parvum in the Bwindi Impenetrable National Park, Uganda. This human population will benefit from stronger compliance with park regulations regarding disposal of their fecal waste within the park boundaries.

Available at: http://dx.doi.org/10.7589/0090-3558-37.2.239

Nizeyi, J.B., Mwebe R, Nanteza, A, Cranfield, M.R, Kalema, G.R.N.N., Graczyk, T. 1999. **Cryptosporidium sp. and Giardia sp. Infections in mountain gorillas (Gorilla gorillaberingei) of the Bwindi Impenetrable National Park, Uganda**. *Journal Parasitology*. 85(7).

For conservation purposes and because of growing ecotourism, some mountain gorilla (Gorilla gorilla beringei) populations have been habituated to humans. Fecal specimens (n = 100) of non habituated and human-habituated gorillas (5 populations; 6 age classes) were tested for Cryptosporidium sp. oocysts and Giardia sp. cysts by conventional staining and immunofluorescent antibody (IFA). Cryptosporidium sp. infections (prevalence 11%) were not restricted to very young gorillas but were observed in 3-yr-old to >12-yr-old gorillas; most of the infections (73%) occurred in human-habituated gorillas. The prevalence of Giardia sp. infections was 2%; 1 non habituated gorilla was concomitantly infected. Oocysts of Cryptosporidium sp. in the gorilla stools were morphologically, morphometrically, and immunologically undistinguishable from a bovine isolate of Cryptosporidium parvum oocysts. Mean concentration of Cryptosporidium sp. oocysts and Giardia sp. cysts in gorilla stools was 9.39x10(4)/g, and 2.49x10(4)/g, respectively. There was no apparent relationship between oocyst concentration and gorilla age, sex, or habituation status. Most Cryptosporidium sp. infections found in gorillas with closest proximity to people may be a result of the habituation process and ecotourism. This study constitutes the first report of Cryptosporidium sp. infections in the family Pongidae, in the free-ranging great apes, and in the species of gorilla.

Available at: http://www.jstor.org/stable/3285672?seq=1#page_scan_tab_contents

2.6. Conservation

Gray, M. and Rutagarama, E. eds. 2011. **20 years of ICGP: Lessons learnt in mountain Gorilla conservation.** International Gorilla conservation programme, 137 pp. Kigali.

This report describes and analyses various components of ICGP's long-term engagement to conserve the mountain Gorilla and its forest habitat. The components include; 1) community conservation 2) capacity building 3) Trans-boundary natural resource management 4) Buffer zone and human-wildlife conflict management 5) Regional meetings.

Available at: National Biodiversity Data Bank.

Kalema-Zikusoka, G. 2010. **Comprehensive Conservation – Gorillas on the List.** The Reporter, a publication of Population Connection, February 2010, Vol.42, Issue 1.

Available at: Conservation through Public Health (CTPH).

Gaffikin, L. and Kalema-Zikusoka, G. 2010. **Integrating Human and Animal Health for Conservation and Development: Findings from a Program Evaluation in Southwest Uganda**.

This report documents the process through which a Ugandan conservation organization, Conservation through Public Health (CTPH), successfully integrated interventions to reduce threats to mountain gorillas and their habitat and improve the well-being of local communities directly dependent upon the health of the former (for ecotourism and natural resource use). JSI was instrumental in helping CTPH integrate family planning (FP) as a key primary health care intervention into its program around Bwindi Impenetrable National Park.

Available at: http://www.jsi.com/JSIInternet/Inc/Common/_download_pub.cfm?id=11196&lid=3

Beudels-Jamar, R. C., Lafontaine, R-M., Devillers, P., Redmond, I., Devos, C. and Beudels, M-O. 2008. **Gorilla. Report on the conservation status of Gorillas. CMS Gorilla Concerted Action.** CMS Technical Series Publication No. 17, 2008. UNEP/CMS Secretariat, Bonn.

Available at: UWA central library and
http://www.cms.int/gorilla/sites/default/files/publication/ts17_Gorilla_E_3_0_0.pdf [PDF]

Ministry of Tourism, Trade and Industry. 2006. **The Uganda National Great Apes Conservation and Action Plan 2006 - 2010.** Ministry of Tourism, Trade and Industry. Kampala.

The population of Mt. Gorillas in the whole world currently stands at approximately 700, with 380 found in the Virungas and 320 in Bwindi Impenetrable National Park (BINP). The number of mountain Gorillas in the Virungas declined from the late 1950s to the early 1980s. It is assumed that the same happened in Bwindi. Both populations have shown gradual increase since the early 1980s, with the total population almost doubling over this period. The forests where the Mt. Gorillas occur in Uganda are protected as national parks but gorillas do come out of these areas from time to time to forage on community land. Approximately 4950 Chimpanzees occur in Uganda, primarily in the large forest blocks in western Uganda. These forests are protected as national parks or forest reserves. However a small proportion of chimpanzees occur in fragments of forest outside these parks and reserves, particularly in Hoima, Kibaale and Masindi districts. There is also a small population in Otzi Forest Reserve on the Sudan border estimated at about 25 individuals. Kibaale National Park is the most important for chimpanzees with over 25% of all Uganda's chimpanzees present in this forest. A threat analysis was carried out to identify the key threats to mountain gorillas and chimpanzees in Uganda. Problem trees were constructed for each species and a swot analysis carried out for the Mt. Gorilla as well. This helped to come up with the weaknesses within mountain gorilla and chimpanzee conservation efforts. Individual consultations were also carried out. The main issues that need to be addressed were given as sustainable habitat management, disease control and poaching, which it was felt were to affect conservation of the species.

Available at: UWA central library.

Osofsky, S.O., Kock, R.A., Kock, M.D., Kalema-Zikusoka, G., Grahn, R., Leyland, T. and Karesh W.B. 2005. **Building support for Protected Ares using a One Health perspective**. In: McNeily, J. ed. 2005 Friends for Life, New partners in support of protected areas. IUCN, Species Survival Commission.

Wabunoha, R. 2004. **Review of development policies, legislation, and regional processes and frameworks that affect the conservation of Great Apes in the Democratic Republic of Congo, Uganda and Rwanda**. A consultancy report. The International Gorilla Conservation Programme (IGCP).

Rwanda, Uganda and the democratic Republic of Congo (DRC) are all implementing poverty eradication programmes. Uganda is developing Poverty Reduction Strategy Paper (PRSP) IV, Rwanda PRSP II and DRC PRSP I. The poverty reduction programmes are a good entry point for regional integration of conservation principles and activities. Highlighting the need to enhance the profile of the great apes in these strategies as a means of poverty reduction should be encouraged. Overall, the three countries appear to have fairly sound economic and development policies for regional cooperation. This is notwithstanding the fact DRC is still undergoing a period of reconstruction following the wars. Rwanda and Uganda have undergone public sector reforms and should therefore be able to spearhead the regional cooperation for the conservation of the great apes. The main objective of the regional cooperation is for the three countries to share a common vision and mission for the conservation of great apes. In order to achieve a common policy regime for the conservation of great apes, there is a need to harmonize laws and policies across borders. There is also a need for specific

national protection of great apes in the three countries, although proposed legislation will attempt to do so in Uganda.

Available at: UWA central library.

Kalema-Zikusoka, G. 2004. **Protected Areas, Human Livelihoods and Healthy Animals. Ideas for Integrated Conservation and development Interventions**. In: IUCN World Parks Congress AHEAD workshop proceedings.

Available at: Conservation through Public Health (CTPH).

Infield, M. and Adams, W.M. 1999. **Institutional Sustainability and Community Conservation: A Case Study from Uganda.** *Journal of International Development*. 11(2): 305-315.

Mgahinga Gorilla National Park is established to conserve gorillas and their habitats. This is a difficult task given the pressures on natural resources in Uganda and the poverty of the people in its vicinity. Since 1991 a community conservation programme has operated in attempts to foster conservation while contributing to rural development. This paper examines this strategy and makes an assessment of its achievements. Despite its initial success in bolstering support for the Park from neighbouring communities, both the community conservation programme and the Park itself remain fragile institutions.

Available at: http://onlinelibrary.wiley.com/doi/10.1002/(SICI)1099-1328(199903/04)11:2%3C305::AID-JID585%3E3.0.CO;2-U/abstract

Wilkie, D.S. and Carpenter, J. 1999. **Can Nature Tourism Help Finance Protected Areas in the Congo Basin?** *Oryx*. 33(4):332-338.

In the debt-ridden, high-population-growth, resource-mining states of the Congo Basin, conservation of biodiversity is seldom the primary concern of national policy makers or of local resource users. Moreover, the recurring costs of managing protected areas and the opportunity costs of forgoing logging and farming to maintain protected areas are a substantial net drain on national and local economies. Consequently, it is becoming increasingly important that protected areas generate, from user fees or donor contributions, sufficient funds to offset the costs of maintaining them. Government and donor investment currently meet less than 30 per cent of the estimated recurring costs required to manage the protected-area network within Central African countries effectively, and cover none of the growing opportunity costs. Nature tourism, the fastest growing sector of the $US 3 trillion (3 million million) a year global tourism industry, may offer a source of revenue to help fill this gap in funds. Congo Basin national parks and reserves harbour many charismatic animals (okapi, lowland gorilla, mandrills, bongo, and forest elephant) that are likely to attract tourists, and as a result many protected-area managers are sinking capital into the development of tourist infrastructure. This paper reviews the evidence for ecotourism's capacity to generate revenue for protected-area management and appraises the financial viability of nature tourism in the Congo Basin.

Available at: http://www3.interscience.wiley.com/journal/120101031/abstract

Kalema G. 1999. **Mountain Gorilla Veterinary Interventions - Conservation Vs Welfare?** *Gorilla Conservation News*. No. 13 May 1999.

Wild, R.G. and Mutebi, J.1996. **Conservation Through Community Use of Plant Resources: Establishing Collaborative Management at Bwindi Impenetrable and Mgahinga Gorilla National Parks, Uganda.** People and Plants Working Paper. 49 pp. UNESCO, Paris.

Available from: http://unesdoc.unesco.org/images/0011/001117/111731e.pdf [PDF]

2.7. Conservation and development

Mugyenyi O., Amumpiire A. and Namujuzi F. 2015. **Sustainable conservation of Bwindi Impenetrable National Park and community welfare improvement: Creating a win-win situation by increasing the community share of the gorilla permit levy and strengthening the governance of revenue sharing**, Kampala, ACODE Policy briefing paper series, No. 30, 2014.

Kabihogo, B. 2014. **In the midst of gorillas: improving relationships between people and parks.** In Hughes, O., Roe, D., and Thomas, D.H.L. (eds.) with Kabihogo, B., Kuria, David K., Imbayi Ligare, J., Nyiratuza, M., and Tinka J.A. (2014) Getting it together: how some local organisations in East Africa have succeeded in linking conservation and development. Natural Resource Issues No. 27. IIED, London.

Available at: http://pubs.iied.org/pdfs/17516IIED.pdf

Nicole, W. 2014. **Seeing the Forest for the Trees: How "One Health" Connects Humans, Animals, and Ecosystems**. *Environmental Health Perspectives*. 122(5).

Available at: http://ehp.niehs.nih.gov/122-a122

Nkemnyi, M.F., de Haas, A., Etiendem, N.D. and Ndobegang, F. 2013. **Making hard choices: balancing indigenous communities' livelihood and Cross River gorilla conservation in the Lebialem–Mone Forest landscape, Cameroon.** *Environment, Development and Sustainability*. pp 841-857.

This study evaluates the choices indigenous communities living adjacent areas of conservation interest face when the resources are under conservation consideration. These resources have been their main source of livelihood for decades, and it is often a hard decision to accept access restriction to what has previously been a common pool resource. Using the proposed Tofalla Hill Wildlife Sanctuary (THWS) in Southwest Cameroon, we evaluate in what ways the conservation of the critically endangered Cross River gorilla (Gorilla gorilla diehli) has affected local livelihood and vice versa. Data for this study were collected through questionnaires, interviews, focus group discussions and field observations. Descriptive and inferential statistical methods were used to analyse and explain quantitative data while content analysis was used to analysed qualitative data. The results revealed that strong ancestral and cultural attachment of indigenous communities to forest and forest resources makes it difficult for them to welcome activities that will restrict access to forest resources. Further analysis also shows that forest-dependent activities had an added value to local livelihood when combined with off forest activities. The added value that off forest activities contribute to local livelihood presents an opportunity for conservationists to design innovative solutions that balance conservation objectives and the livelihood aspiration of the communities. This could be a reasonable entry point to address existing negative local perception on gorilla conservation approaches in the THWS.

Available from: Springer Link.

Baker, J., Bitariho, R., Gordon-Maclean, A., Kasoma, P., Roe, D., Sheil, D., Twinamatsiko, M., Tumushab, G., van Heist, M. and Weiland, M.2013. **Linking protected area conservation with poverty alleviation in Uganda: Integrated conservation and development at Bwindi Impenetrable National Park,** Nova Science Publishers, Inc, New York.

Available at: ITFC.

Maekawa, M., Lanjouw, A., Rutagarama, E. and Sharp, D. 2013. **Mountain gorilla tourism generating wealth and peace in post-conflict Rwanda.** *Natural Resources Forum*. 37(2):127-137.

Today only around 880 mountain gorillas (Gorilla beringeiberingei) inhabit the Afromontane forests shared by Rwanda, Uganda and the Democratic Republic of the Congo (DRC). In this region, mountain gorillas serve as flagship species, attracting public support and international tourists as well as drawing attention to their habitat. This paper examines the prominent issues in mountain gorilla conservation and nature-based tourism in Rwanda in a post-conflict recovery context. Also analyzed are the critical issues of restoring and developing the capacities of institutions, improving the transboundary dialogue, and developing cooperation for the management of natural resources.

Available at: http://onlinelibrary.wiley.com/doi/10.1111/1477-8947.12020/abstract

Petruney, T., Brunie, A., Kalema-Zikusoka, G., Wamala-Mucheri, P. and Akol, A. 2014. **Informing the future of capacity building: lessons from an NGO partnership**. *Development in Practice*. 24(3):435-441.

Despite a recent surge in popularity, critical gaps remain in effectively building the capacity of organisations through global development projects. Two non-governmental organisations, FHI 360 and Conservation Through Public Health (CTPH), established a partnership focused on strengthening CTPH's organisational capacity to conduct high quality monitoring and evaluation and to effectively advocate for integrated population, health, and environment work. To help inform the design and implementation of future capacity building programmes, the partners describe their lessons learnt as illustrated through the five key capacity building steps: stakeholder engagement and partnership formation; capacity needs assessment; capacity plan design; plan implementation; and evaluation.

Available at: DOI: 10.1080/09614524.2014.89768

http://www.tandfonline.com/doi/abs/10.1080/09614524.2014.897687?ai=1gm&ui=4q39m&af=H

Baker, J. et al. 2011. **Park gazettement and Integrated Conservation and Development as factors in community conflict at Bwindi Impenetrable Forest**. *Conservation Biology*. 26(1):160-70.

Conflicts between protected-area managers and local people are common, but the drivers of conflict are rarely analyzed. This limits opportunities to identify strategies that reduce conflict and the magnitude of resulting threats to conservation. Integrated conservation and development (ICD) was adopted at Bwindi Impenetrable Forest, Uganda, to reduce conflict during gazettement of the national park, but the success of this approach remains contested. We retrieved documents of conflict written by park staff and local people from 1986 through 2000 (before, during, and after gazettement). We extracted data on 48 incidences of violent conflict and categorized them by gazettement period, area, instigator, and type to undertake a historical analysis of the triggers of violent conflict at Bwindi. Before and during gazettement, local villagers instigated most of the conflict incidents when law-enforcement efforts sought to halt commercial activities within Bwindi. No conflict arose from the arrest of villagers collecting subsistence resources during these periods. After gazettement, prohibitions on commercial activities continued to drive conflict even though villagers collecting subsistence resources were arrested more frequently than before gazettement, and local attitudes toward the park had improved following receipt of ICD benefits. Law-enforcement efforts targeted commercial activities to reduce this threat to Bwindi's mountain gorillas (Gorilla beringei beringei), although the activities remained important income sources for people in villages near Bwindi. Losing commercial income following gazettement therefore appeared to be their primary motivation for instigating conflict with park rangers. Prohibitions on subsistence resource use triggered conflict less often. Our use of typologies for a multivariate conflict analysis demonstrates that by identifying differences between effects of conservation as drivers of conflict, conflict analysis can enable a more strategic deployment of conflict-resolution measures that could further conservation efforts. At Bwindi targeting ICD toward individuals who lost benefits from commercial activities may strengthen the role of ICD in conflict resolution and conservation.

Available at: NCBI http://www.ncbi.nlm.nih.gov/pubmed/22044616

Elliott, J. and Sumba, D. 2011. **Conservation Enterprise: What Works, Where and for Whom?** 24 pp. IIED, London.

Community-based natural resource management (CBNRM) recognises that local communities are often best placed to conserve natural resources, as long as they stand to gain more than they lose from doing so. Conservation enterprises—commercial activities generating economic and social benefits in ways that help meet conservation objectives—seek to reinforce these incentives. The African Wildlife Foundation (AWF) has adopted conservation enterprise as a core part of its conservation strategy since the 1990s. It predominantly supports partnerships between local communities and the private sector, with the community retaining ownership and the private sector providing the management expertise and paying a combination of fixed and variable fees to the community for access to its resources. This study draws on the experience of the AWF and other organisations to assess what effect conservation enterprises can have on the livelihoods of local communities and how effective such initiatives are at poverty reduction. It finds that most of these enterprises cannot by themselves take people out of poverty, but can provide less tangible benefits, such as increased investment in health and education, strengthened community organisations and greater resilience in difficult times. A successful conservation enterprise needs to strike a balance between harnessing local skills and entrepreneurship and ensuring that the benefits are felt by the entire local community, particularly those who make the decisions about resource use. Some programmes can be specifically targeted at particular groups, but enterprises providing employment tend not to favour the poorest community members and the benefits may be captured by local elites. The evidence also shows that well-designed conservation enterprises can improve the conservation of some types of land areas and key, high value species—such as mountain gorillas—but are less effective at conserving biodiversity with a lower market value.

Available at: http://pubs.iied.org/pdfs/14613IIED.pdf [PDF]

Blomley, T., Namara, A., McNeilage, A., Franks, P. and Rainer, H. 2010**. Development AND Gorillas? Assessing fifteen years of integrated conservation and development in south-western Uganda**, 74 pp. IIED, UK.

Bwindi Impenetrable National Park and Mgahinga Gorilla National Park are two afromontane forests considered as extremely important biodiversity areas, with global significance, due to their population of highly endangered Mountain Gorilla. Threats to the two parks include uncontrolled exploitation of forest resources as well as fire damage and the indirect pressures of demand for land. Gazettement of the parks in 1991 caused high levels of conflict and resistance from the surrounding communities, seriously threatening the ability of the protected area authority to manage the parks. In response to these conflicts and threats, a range of “integrated conservation and development” (ICD) strategies have been applied in and around Bwindi and Mgahinga. This report summarises the findings of a study which aimed to test the effectiveness of these strategies in reconciling biodiversity conservation and socio-economic development interests. It confirms the validity of the assumption that linking local people to a resource and helping generate a steady stream of benefits increases willingness to manage and protect that resource, over the long term but notes inconclusive evidence that providing “alternative” livelihoods is an effective conservation strategy.

Available at: http://www.iied.org/pubs/display.php?o=14592IIED

Kalema-Zikusoka, G. and Gaffikin, L. 2008. **Sharing the Forest, Protecting Gorillas and Helping Families in Uganda.** Focus series, Issue 17. The Woodrow Wilson International Centre for International Scholars and USAID.

On the outskirts of remote Bwindi Impenetrable National Park in southwestern Uganda, endangered mountain gorillas forage in local gardens that run along the border of the park. Rapid population growth has pushed people to settle near the gorillas' habitat – sometimes leading to conflict. Our innovative community development program, Conservation Through Public Health, seeks to conserve these magnificent animals, and at the same time, improve the quality of life for Ugandans living near Bwindi. Trained community volunteers protect livelihoods dependent on ecotourism by monitoring diseases like

tuberculosis that can pass from humans to gorillas, potentially threatening the rare species' survival. Other volunteers teach couples how to use modern family planning methods that make it easier for them to provide for their children – and reduce the pressure on the forest and its inhabitants.

Available at: https://www.wilsoncenter.org/publication/issue-17-sharing-the-forest-protecting-gorillas-and-helping-families-uganda#sthash.e8g5Jich.dpuf

Madden, F. 2006. **Gorillas in the Garden: Human-Wildlife Conflict at Bwindi Impenetrable National Park**. *Policy Matters*. pp. 180-190. IUCN, Gland

Based on the author's experience working in Bwindi and adjacent areas and the extensive research she conducted globally to design a conflict prevention and mitigation programme for Bwindi, the article outlines selected factors that significantly contribute to conflict — including habituation of gorillas for ecotourism — and the inadequate policies addressing such conflict. The article offers management and policy recommendations to improve mitigation of conflict and thereby contribute to conservation efforts and the viable livelihoods of the local people. While they are tailored to the particular situation in Bwindi, these proposals should be of interest for those seeking to mitigate analogous conflicts between wildlife and the local poor in other protected areas in the same region and around the world.

Available at: http://cmsdata.iucn.org/downloads/pm4_1.pdf [PDF]

Adams, W.M. and Infield, M. 2003. **Who is on the Gorilla's Payroll? Claims on Tourist Revenue from a Ugandan National Park**. *World Development*. 31(1):177-190.

This paper discusses the competing interests in revenues derived from visitor wildlife tourism based on viewing the mountain gorilla (Gorilla gorilla beringei) in Mgahinga National Park, Uganda. Financial flows to local communities do reduce their sense of grievance at the park's creation, but do not compensate them for the costs of park creation. Different interests within and outside Uganda compete for wildlife tourism revenue and limit its capacity to fund the direct and indirect costs of gorilla conservation. The creation of multiscale multistakeholder partnerships for conservation built on revenue-sharing is a daunting institutional challenge.

Available at: https://doi.org/10.1016/S0305-750X(02)00149-3

Wild, R.G. and Mutebi, J. 1996. **Conservation through community use of plant resources: Establishing collaborative management in Bwindi impenetrable and Mgahinga gorilla national park, Uganda**. UNESCO, Paris.

This paper reports on a pilot process used by Uganda National Parks (UNP) in collaboration with CARE's Development Through Conservation Project (DTC) to establish collaborative forest management with communities surrounding Bwindi Impenetrable Forest and Mgahinga National Park in south west Uganda. The report begins by outlining the history of resource use and conservation in the two national parks concerned and then goes on to outline step by step the process used, which involved participatory work with various types of community organisations. Finally, the potential of collaborative resource management in Uganda is examined.

Available at: http://unesdoc.unesco.org/images/0011/001117/111731e.pdf [PDF]

2.8. Human-gorilla interaction

Hockings, K.J., McLennan, M.R., Carvalho, S., Ancrenaz, M., Bobe, R., Byrne, R.W., Dunbar, R.I.M., Matsuzawa, T., McGrew, W.C., Williamson, E.A., Wilson, M.L., Wood, B., Wrangham, R.W. and Hill, C.M. 2015. **Apes in the Anthropocene: flexibility and survival**. *Trends in Ecology and Evolution*. 30(4):215–222

We are in a new epoch, the Anthropocene, and research into our closest living relatives, the great apes, must keep pace with the rate that our species is driving change. While a goal of many studies is to understand how great apes behave in natural contexts, the impact of human activities must increasingly be taken into account. This is both a challenge and an opportunity, which can importantly inform research in three diverse fields: cognition, human evolution, and conservation. No long-term great ape research site is wholly unaffected by human influence, but research at those that are especially affected by human activity is particularly important for ensuring that our great ape kin survive the Anthropocene.

Available at: http://dx.doi.org/10.1016/j.tree.2015.02.002

Malone, N. M., Fuentes, A. and White, F. J. 2010. **Ethics Commentary: Subjects of Knowledge and Control in Field Primatology.** *American Journal of Primatology*. 72:779–784.

Our primate kin are routinely displaced from their habitats, hunted for meat, captured for trade, housed in zoos, made to perform for our entertainment, and used as subjects in biomedical testing. They are also the subjects of research inquiries by field primatologists. In this article, we place primate field studies on a continuum of human and all primate relationships as a heuristic device to explore the unifying ethical implications of such inter-relationships, as well as address specific ethical challenges arising from common research protocols ''in the field'' (e.g. risks associated with habituation, disease transmission, invasive collection of biological samples, etc.). Additionally, we question the widespread deployment of conservation- and/or local economic development-based justifications for field-based primatological pursuits. Informed by decades of combined fieldwork experience in Indonesia and the Democratic Republic of Congo, we demonstrate the process by which the adherence to a particular ethical calculus can lead to unregulated and ethically problematic research agendas. In conclusion, we offer several suggestions to consider in the establishment of a formalized code of ethics for field primatology.

Available at: http://www.ncbi.nlm.nih.gov/pubmed/20653003

Hockings, K. and Humle, T. 2009. **Best practice guidelines for the prevention and mitigation of conflict between Humans and Great Apes**. IUCN/SSC Primate Specialist Group (PSG), Gland.

One of the challenges facing great ape conservation is the rising level of interaction between humans and great apes, and the resulting conflicts that emerge. As human populations continue to grow and human development makes deeper incursions into forest habitats, such conflict will become more widespread and prevalent in the natural ranges of great apes, especially considering that the majority of great apes live outside protected areas. It is essential that we develop a comprehensive understanding of existing and potential conflict situations, and their current or future impacts on both great apes and humans. This will require the integration of quantitative and qualitative data on multiple aspects of human and great apes behaviour and ecology, along with a good understanding of local people's perception of the situation. Such knowledge can then be used to develop effective, locally-adapted, management strategies to prevent or mitigate human-great ape conflicts, whilst respecting both conservation objectives and socio-cultural-economic contexts. These guidelines outline a sequence of logical steps that should be considered prior to any form of human-great ape conflict intervention, and propose possible counter-measures to be used in the management of human-great ape conflicts.

Available at: UWA central library.

Kalema, G. 1998. **Birth of a Mountain Gorilla in Bwindi Witnessed by Tourists. The Link - Managing Protected Areas with Communities**. A newsletter of the Uganda Wildlife Authority Community Conservation Department. 2(2).

Available at: UWA central library.