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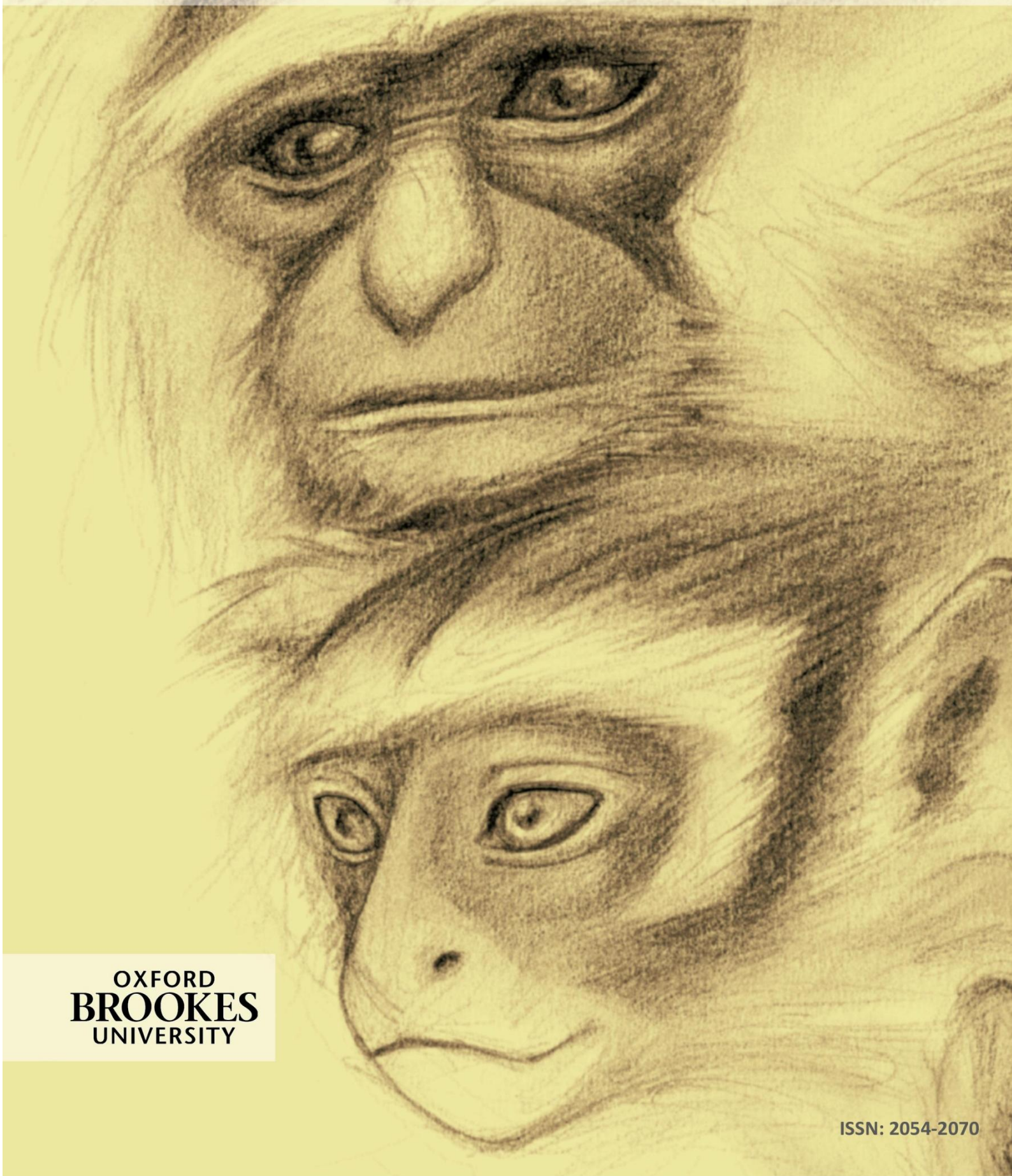

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Letter from the editors

Welcome to the 2013 winter edition of Canopy, the in-house journal of the MSc in Primate Conservation at Oxford Brookes.

The fifteenth century brought about the unearthing of two mysterious continents, one dark and one with rumoured gold. The world was once a grand and exciting place. Voyages at sea brought back tales of distant and foreign lands filled with strange and enigmatic creatures. Stories of thrilling adventures captured the imagination and prompted pioneers to delve into the unknown. It has since been pronounced that there are no new worlds to conquer and that the age of exploration has come to an end. Faster and better access to information now dominates the stage as the world grows increasingly smaller.

Has the era of discovery come to a conclusion or are we merely entering a new phase of revelation? The famous French novelist Marcel Proust once said that "*The only real voyage of discovery consists not in seeking new landscapes but in having new eyes"*. This is the role of the scientist, to observe the wonder set right before us. As primatologists, it is our responsibility to delve into the sometimes cryptic realms of species. To explore previously untouched worlds that lay hidden from the public eye. The thirst for knowledge allows us to strive for greater understanding and to contribute to a brighter future for primates.

In this issue of Canopy, we revisit the continents that sparked humanities love for exploration. The articles are located in either Africa or South America. All the studies were conducted by students in the MSc program and cover a diverse range of interests. This issue also contains an interview with Dr. Gladys Kalema-Zikusoka, a renowned gorilla veterinarian in Uganda.

We hope you find this issue informative and inspiring and that it highlights to the wider primatological community the achievements of the MSc in Primate Conservation.

Best Wishes,
The Editors

Magdalena, Kathleen, Georgia, Katarzyna, Fiona & Caroline

Letter from the Course Tutor

It is hard to believe that the MSc in Primate Conservation is in its 14th year! Our course goes from strength to strength, and this year we welcome students not only from the UK, EU, USA, Canada, but also from Bolivia, Colombia, and South Africa. This year's cohort comes with an extensive knowledge of primates, having worked in rescue centres and field sites all over the world, but with a particular emphasis on the Neotropics and Africa. They thus have decided to dedicate this first issue of Canopy to the diverse primates found in these two geographic areas.

This year's course will bring many exciting events for our students. They already have visited Apenheul Primate Park in the Netherlands; in a few months' time, the MSc cohort will take over Wild Futures in Cornwall, learning to care for primates from their dedicated and expert staff. They also have the task ahead of them to help in the organisation of the Primate Society of Great Britain Spring Meeting, and look thoroughly forward to welcoming you to Oxford Brookes University.

Many challenges face the future of primates. We are really proud that many of our alumni over the last few months have been putting forward tremendous efforts to continue their primate conservation work. For example Ganga Regmi from Nepal presented his work at the Student Conference on Conservation Science: New Hope for Conservation in Bejing, China, 2013. Alison Hanes has been promoting her work with the excellent Rwanda-based conservation charity Art of Conservation. Corrin LaCombe has been expanding her efforts to advertise conservation charities through her Primate Connections calendar programme. Silvy van Kuijk recently won the award for Best Poster at the European Federation of Primatology Meeting in Antwerp. Thirza Loffield and Harry Hilser are both heading up major aspects of the Sulawesi-based Selematkan Yaki. Helen Buckland continues her never-ending battle to save Sumatran Orangutans through the charity SOS. And in the last year, Josia Razafindramanana accepted the prestigious Whitley Award for Conservation. This is to time only a few and we cannot be prouder of our Primate Conservation graduates!

We will expect no less from our current cohort, who are passionate and driven in their will to work towards positive conservation goals. We wish them the best of luck as they enter their second semester and their field work.

Prof Anna Nekaris
Course Tutor, MSc Primate Conservation

Gestural head movements in captive bonobos (*Pan paniscus*); use, function and evolutionary implications

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Despite an increased focus on the gestural repertoire of great apes, head gestures as a communicative agent in their own right have been largely ignored. Head gesture have been described in the gestural repertoire of chimpanzees (*Pan troglodytes*), bonobos (*Pan paniscus*) and gorillas (*Gorilla gorilla*) (Tomasello *et al.*, 1997; Pika *et al.*, 2005), but not orangutans (*Pongo pygmaeus*) (Liebal *et al.*, 2006; Cartmill & Byrne, 2010). The three currently attributed to the African apes are 'head nod', 'head bow' and 'head shake'; head nod being when the head is moved vertically up and down; head bow being when the head and torso is moved backwards and forwards and head shake being when the head is moved laterally from right to left or left to right (Schneider *et al*., 2010). Yet contrary to what is understood about other manual gestures, it appears they do not share the same flexibility and intentionality, instead being tied to contexts in the same way as vocalisations (Pika *et al*., 2005; Tomasello, 1994).

Previously described in chimpanzees by de Waal (1982 pp. 22-23), so called preventative headshakes were recorded in a mother-infant dyad but the author was unable to rule out the possibility of human influence affecting this behaviour. Conversely Schneider *et al*. (2010) recorded 13 preventative head shakes, exhibited by four individuals from three different captive groups. Methodological constraints prohibited statistical analyses of these data and resulted in speculative conclusions being presented, yet the apparent intentionality and flexibility demonstrated in these actions contest the theories which suggested them to be tied to specific behavioural or social contexts. Consequently the aim of this study was to expand on these data by documenting instances of intentional communication in captive bonobos with regards to the usage of communicative head gestures and, by

focusing on recipient responses, further understand their social function.

Observations were conducted over a 10 week period from the 4th June, 2012 through 6th August, 2012 at Twycross Zoo, Warwickshire, UK. A focal continuous sampling technique (Altmann, 1974) was used to observe individual subjects for 14 hours, equating to 154hours of total observation time. The head gesture, the recipient and the recipient responses of each gesture were all recorded, along with the functional contexts in which signals occurred (Following Pika *et a.l,* 2005; Liebal *et al.,* 2006). All statistical tests were two tailed and a null- hypothesis was rejected at an alpha level of 5%. Nonparametric analyses were used because data were not normally distributed, hence the assumptions for parametric testing were not met and the sample sizes were too small.

A total of 501 gestural headshakes were observed and grouped into the three previously described categories. Headnods were used most frequently with 282 (56.4%) being recorded, followed by headbow with a 120(24%) and lastly lateral headshakes with a 99 (19.8%), though no gesture category was performed significantly more often than any other (Friedman test $x2(2) = 5.070$, $p>0.0845$). The headnod, headbow and lateral headshake gestures were present in the gestural repertoire of all 11 subjects and were observed at least twice in each.

Regarding the signallers usage of gestures, a significantly higher proportion of headbows were recorded in the agnosim context (Wilcoxon signed rank test: $p<0.05$), and a significantly higher proportion of headshakes were observed in the preventative context than any other ($p<0.05$). No functional context was found to support a significantly higher frequency of headnods. Regarding recipient response, subjects responded to headnods with behaviours categorised as access significantly more often ($p<0.05$), responded to headbows with behaviours categorised as agnosim significantly more often ($p<0.05$), and responded to headshakes with behaviours categorised as preventative significantly more often than ($p<0/05$).

The findings from this study indicate that the communicative repertoire of captive bonobos includes the usage of three mutually distinct and manually different head gestures. Though the specific behaviours and functional contexts differ, the results obtained are concurrent with previous studies which highlighted a significant prominence of certain communicative signals, in specific functional contexts, generating consistent behavioural responses from a recipient (Pika *et al.*, 2005; Tomasello *et al*., 1994; Liebal *et al.*, 2006). Such results have previously been interpreted as examples of intentional communication being demonstrated; that is the signaller is aware of the behavioural or social context and uses an appropriate signal in order to elicit a specific behavioural response from the recipient (Tomasello *et al.*, 1994; Call & Tomasello, 2007). These data are the first to show that different head gestures have the same intentional properties as other forms of manual gesture have.

These observations support the gestural hypothesis as proposed by Hewes (1973). The close similarities between the gestural repertoire of bonobos and humans in particular reinforces this, because the Pan line, which also includes chimpanzees, split off from the line that produced our own species ~ 6 million years ago (Patterson *et al.*, 2006). Considering this close phylogenetic relationship, communicative signals present in both were likely present in the repertoire of a common ancestor, facilitating the identification of shared evolutionary ancestry and further challenging the supposition that results from studies focusing on ape vocalisations offer insights in to the evolution of our own spoken language.

Of particular relevance from this study are the results concerning the headshake and headbow gestures, and the behavioural responses of the recipients to each signal. Lateral headshakes in human communication carry with them an almost uniform message of negation or prevention which is understood and reacted appropriately to by a recipient, albeit with some cultural exceptions (McClave, 2000; McClave *et al.*, 2008) Use of lateral headshakes by the bonobos in this study were similar both in terms of usage and also

recipient response; ie, signallers used a lateral headshake when trying to prevent a social partner from engaging in a specific action or a behaviour, and the recipients responded appropriately by changing, stopping or altering said behaviour. Headbows in human communication can be used to express anger, aggression or dominance on behalf of the signaller, and anger, aggression or submission on behalf of the recipient (Lee & Marsella, 2009; Mignault & Chaudhuri, 2003). Use of headbows by the bonobos in this study were again similar in terms of usage and recipient response; ie, signallers used headbows in the moments leading up to and during aggressive interactions and expressions of dominance, and the recipient responded appropriately by directing aggressive behaviours back to the signaller, or by assuming a submissive role in the interaction.

These data show that two types of head gesture are used by humans and bonobos in the same contexts, for the same goals, with the use of almost identical manual actions. Indeed, inter-species similarities were also observed in the behavioural responses of the bonobos to the two signals, to what has been shown previously with human behavioural responses. Whilst this is known to be the case for other manual gestures, these are the first systematic observations of a similarity existing with the two species headshakes and headbows. As Schneider *et al*. (2010) postulated, it is possible that these could potentially represent primitive precursors to evolution of our own communicative strategies. The findings from this study further support this statement. Moreover it provides a more detailed description of the preventative function lateral headshakes have, and expands on these with the observations that bonobos also use headbows in a way which closely resembles their social function in human social communication. It is recommended that similar studies to this should be applied to wild specimens of the same species, but also the closely related chimpanzee in order to expand on these data and facilitate more rigorous cross-species comparisons.

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The use of deslorelin, a GnRH agonist, to reduce aggression in male chacma baboons (*Papio ursinus*) to improve animal welfare in a captive setting

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Social housing for nonhuman primates is long-established as one of the most important aspects for maintaining positive, healthy living environments. The reputation of baboons (genus *Papio*) as pests and vermin across Africa has continually led to more baboons arriving at The Centre for Animal Rehabilitation and Education (C.A.R.E.) in Phalaborwa, South Africa. C.A.R.E. rehabilitates these young baboons to return to the wild. However, due to issues in securing release permits, troops have had to remain at C.A.R.E. beyond sexual

maturity. Some of the males are at risk of being removed from their troops as they have become too aggressive towards fellow troop members.

Aggression plays an important role in many nonhuman primate communities, often used as a tool to aid in individual or species preservation (Giammanco *et al*., 2005; Honess & Marin, 2006). Within the central nervous system there are testosterone receptors found in the neurons of the hypothalamic nucleus, which determine the level of aggression in an individual (Giammanco *et al*., 2005). This connection demonstrates the relationship between testosterone levels and aggression as testosterone levels are associated with behavioural traits like aggression (Beehner *et al*., 2005). This is also supported by Simpson (2001) who writes, "In general, castration leads to a decrease in aggression whilst replacement of testosterone restores the behaviour" (p. 33).

While testosterone and aggression levels are important in primate societies, elevated levels may cause problems in captive populations, as other troop members are unable to escape from aggressive situations. Male baboons are usually twice as big as females (Virgadamo *et al*., 1972) and have canine teeth longer than some large felids compared to body size (Plavcan & Ruff, 2008). Aggressive interactions due to elevated testosterone levels become more dangerous in captivity when baboons are equipped with strength and alarming canine teeth.

Deslorelin (brand name Suprelorin®; Peptech Animal Health) is an implant inserted subcutaneously, first developed as a contraceptive agent for veterinary practices. Deslorelin functions like the naturally occurring gonodotrophin-releasing hormone (GnRH), which controls hormone secretions involved in fertility. As the deslorelin implant releases into the system, it blocks the creation of follicle stimulating hormones (FSH) and luteinizing hormones (LH) (European Medicines Agency, 2012). Through this process, the level of testosterone circulating in the blood decreases, halting sperm production and potentially lowering aggression as the implants' effects mimics those following surgical castration (Metrione *et al*., 2008). Deslorelin is a super agonist, meaning it can have a potency of more than 100 times that of GnRH agonist (Padula, 2005).

In males, GnRH agonist implants may first cause an increase in testosterone but is then followed by a period of chronic suppression (Asa & Boutelle, 2012). The risks with the implant include itching, and moderate swelling at the implant site for up to a few weeks after implantation (EMA, 2012). Deslorelin implants are reversible and are accepted and supported

by the American Zoo and Aquarium Association Contraception Advisory Group as a method of contraception. Though temporary suppression of reproductive functions is a helpful, the decline in aggression is of the most concern for this study.

Previous studies have confirmed the effectiveness of deslorelin implants, both as a contraceptive tool and as a way to reduce aggression-related behaviours in male animals. Deslorelin successfully reduced testosterone levels in male cheetahs (Bertschinger *et al*., 2006), dogs (Junaidi *et al*., 2003; Junaidi *et al*., 2009), variable flying foxes (Metrione *et al*., 2008), a bearded dragon (Rowland, 2011), ferrets (Vinke *et al*., 2008), rabbits (Spankowski *et al*., 2010) and lion-tailed macaques (Norton *et al*., 2000). A similar GnRH agonist was also used to reduce aggressive behaviours in bull elephants (De Nys *et al*., 2010).

As a result of the reputation of baboons in South Africa and resistance from the local Nature Conservation (which is fuelled by the overall public dislike of baboons), C.A.R.E. has struggled to obtain permits, required by South African Nature Conservation, to release troops for the last few years. Baboons remain listed under Appendix II of CITES, but are not really provided any protection under the law. Interactions between humans and baboons in South Africa often end in conflict, fuelling the public's distain. This view of baboons has created a very lengthy release permit process, in turn creating the need for sexually mature troops to remain at the centre longer than ideal. At the time males would normally disperse from their natal groups and search for alternative troops, troops at C.A.R.E. remained housed together as release permits are sought.

C.A.R.E.'s goals include, in accordance with many other rehabilitation centres, creating as natural an environment as possible for the animals while they remain in captivity. This approach provides the animals with a better chance of adapting to living in the wild once released. Unfortunately, the number of baboons at C.A.R.E., paired with the difficulties in obtaining release permits, means the centre must look for alternative methods in order to continue social housing for certain troops. Deslorelin implants have the potential to be an effective alternative.

Deslorelin is reversible, with each implant lasting from two months to two years, depending on dosage. For animals that are due to be released, this is of extreme importance. Reintroduced animals should mirror those in the wild; this includes having the ability to reproduce. According to the IUCN /SSC Re-introduction Specialist Group, the most important aspect of a reintroduction program is that any "effort should be to re-establish self-

sustaining populations of primates in the wild and to maintain the viability of those populations" (2002, p. 32). Thus, any attempt to control the behaviour of animals in captivity that are due to be released back to the wild should be completely reversible to make sure they are able to act naturally and continue reproducing once released.

The ten males chosen were individuals from three different troops. All three troops had multiple sexually mature males and the males displayed elevated levels of aggression, making them ideal for the implant.

The data was collected from 20/12/12 to 04/01/13 and 29/04/13 to 15/07/13. A total of 395 data collection hours were recorded. 30-minute focal animal observations with continuous recording were conducted on each male daily Monday to Saturday between 10:00 and 15:00. The focal sampling method was chosen so as to not only determine the frequency of aggressive behaviours but also to determine overall activity budgets of each male. Focal sampling was chosen over all-occurrence sampling as the presence or absence, and the length of affiliative behaviours was of interest as well. The order of the troops was random each day, as well as the order of the males within each troop.

From 29/04/13 to 15/07/13, data was recorded using "Animal Behaviour: The Professional Solution" software developed for iPhones and iPads. The software allowed for the input of personalised ethograms and subject categories in four different sampling techniques: focal animal sampling, scan sampling, focal behaviour sampling, and *ad libitum* sampling. Each behaviour received its own touch screen key and as the focal animal changed behaviour, a new key was touched, recording the time start and stop of the behaviour, as well as the receiver and other modifiers (if applicable). Each focal sample was recorded as an Excel log and stored within the device used.

A registered veterinarian was present to handle all of the implants and health checks. The implant was placed on the right side of the neck. The area was first shaved, washed with scrub soap, and disinfected with clorexidene. An alcohol wipe was then used to prevent abscess formation. The implant comes packaged fully-loaded in a trocar. It is inserted between a fold of skin that is lifted near the base of the neck. Using the trocar, the implant was inserted subcutaneously. Finally, to prevent the possibility of the implant being groomed out by another troop member, the implant was massaged to move it further from the skin's surface.

To construct weekly activity budgets for all ten males individually, the total percentages of time spent engaging in the behaviours per week

were calculated. Once the totals were calculated for each individual, weekly median percentages of the aggressive and affiliative behaviours of all ten males were calculated. The median percentages were then transferred to graphs in order to obtain a visual representation of the changes in behaviours per week. Weekly activity budgets were calculated overall by summing individual weekly percentages of specified behaviours and then calculating the mean. For analysis, resting, travelling and feeding were left alone while other activities were grouped into "Other". This was done to determine if the implant affected the behaviours observed often in primates: travelling, resting, and feeding.

Data were statistically analysed with SPSS (version 19) using non-parametric correlation statistics as the data were non-normally distributed. Spearman's rank correlation test was used to determine the relationship between aggressive and affiliative behaviours and the week. To determine the significance of behaviours pre- and post-implant, a binomial test was performed based on aggressive behaviours observed over seven hours. As each male was observed for a total of seven hours pre-implant, the frequency per seven hours was calculated for the post-implant data. All tests were two-tailed, with the significance level set at $p < 0.01$. The interquartile ranges were calculated and reported for each median percentage.

Each male showed a decrease in the percentage of time they were observed engaging in aggressive behaviours over the eleven weeks, though there were individual variations (Fig. 1). No aggressive acts were recorded during week eleven, the last week of observations, for any of the males. Quentin, Ozzie, and Denny showed the longest period of time without engaging in aggressive acts; none was recorded after week seven.

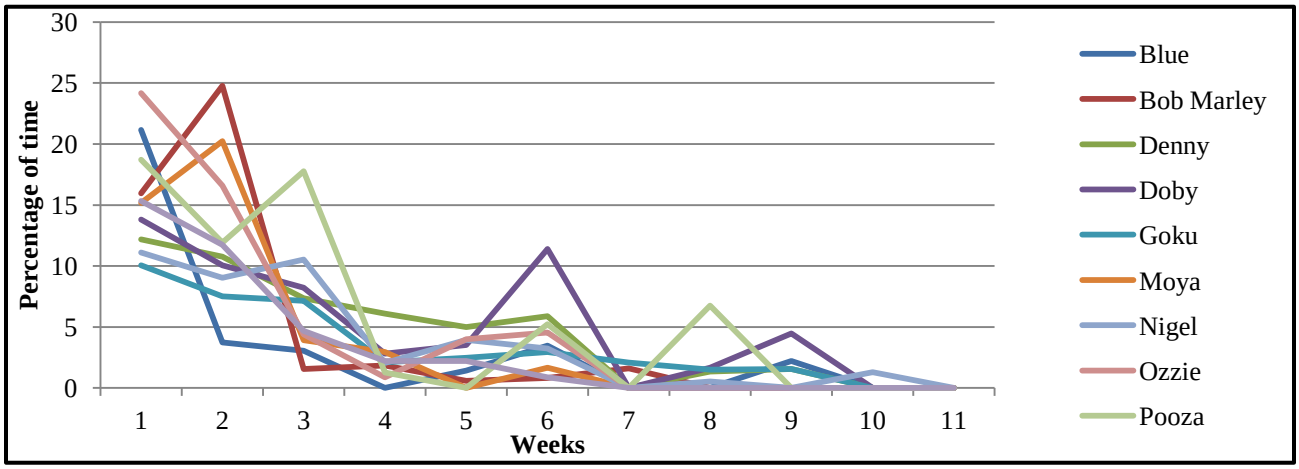

Fig. 1. % of time engaged in aggressive behaviour by week by individual chacma baboon (*P. ursinus*) male at C.A.R.E.

Results of the binomial test show significant decreases in the frequencies of aggressive behaviours observed prior to the implant to after the implants were given.

Overall, there was an increase in the percentage of time males spent engaging in affiliative behaviours (Fig. 2). However, there was a high level of variation among individuals. Three of the males showed a spike in affiliative behaviours observed between weeks six and seven. The percentage of time calculated at week eleven for each individual was higher than the percentage of time calculated at week one for all individuals.

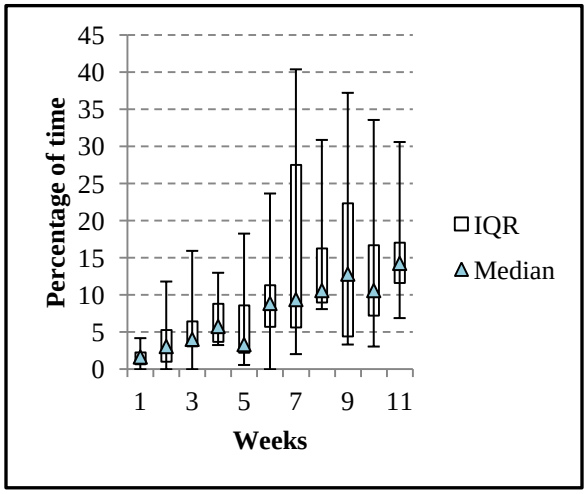

Fig. 2 Weekly cumulative median percentage of affiliative behaviour from all ten implanted males, including interquartile ranges and error bars (December 2012-July 2013).

A Spearman's rank correlation test shows significant correlations between aggressive behaviours, affiliative behaviours and weeks. There was a statistically significant negative correlation between aggressive behaviour and weeks ($r_s = -0.917$, $p < 0.01$, $n = 11$) showing that aggression decreased as the number of weeks with the implant increased. There was also a statistically significant correlation between aggressive behaviour and affiliative behaviour ($r_s = -0.898$, $p < 0.01$, $n = 11$). As aggression decreased, affiliative behaviour increased. Finally, there was also a statistically significant correlation between affiliative behaviour and the number of weeks ($r_s = -0.957$, $p < 0.01$, $n = 11$). More affiliative behaviour was observed in the weeks after the implant was given. Data shows that aggressive behaviour decreased by week and affiliative behaviour increased by week. Correlation tests demonstrate that as aggressive behaviour decreased, affiliative behaviour increased.

The results of this study show that deslorelin implants are a safe, successful method for reducing aggression in male baboons. This reduction in aggressive behaviours has allowed nine of the ten males to remain in social settings, and will allow the tenth male to return to social housing. Following the implant, all ten males showed a substantial reduction in aggressive behaviour and many also showed a large increase in affiliative behaviours.

Rehabilitation centres and sanctuaries will continue to operate out of necessity; nonhuman primate species will carry on needing help. These facilities deal with a

multitude of issues surrounding animal welfare and husbandry. Males become too aggressive towards conspecifics or humans and alternatives to single housing must be explored. Deslorelin implants have proven effective in many animal species and the results of this study support previous research. While the best outcome is reintroduction to the wild for these baboons, until that is possible the baboons should remain in as nature an environment as possible. Removing individuals from their troops greatly reduces the level of animal welfare and can have long lasting effects. If an animal is away from their troop for too long, reintroducing them to the troop may not be possible. In addition, obtaining permits for single male releases is difficult. Even if a permit is granted, without the support of conspecifics once released, the single male may face great challenges alone in the wild.

While this study benefits the baboons at one centre, the results of it have major implications for other captive care facilities as well. Deslorelin implants are relatively non-invasive implants as it has been shown to last as long as two years, meaning the animal only has to be darted and handled by humans very infrequently. Also, no adverse side effects have been noted, supporting the use of deslorelin implants even more.

Lastly, the conservation implications of the deslorelin implant is very apparent as it is reversible. The reversibility of deslorelin implants is incredibly attractive to rehabilitation centres and should be emphasised as one of the biggest benefits of the implant. Any centre that wishes to return its animals to wild can appreciate the need for the animals to be able to reproduce and act like their wild counterparts. Surgical castration, while understandable for animals that will never be released, is not a viable option for future wild animals. Social housing is one of the fundamental aspects of nonhuman primates and every step should be taken to make sure the animals can remain in that setting. Deslorelin implants are a safe and successful alternative for reducing aggressive within male baboons, allowing them to remain with their social troops.

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Living on the edge: Critically Endangered San Martin titi monkeys (*Callicebus oenanthe*) show a preference for forest boundaries in C.C. Ojos de Agua, Peru

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The San Martin titi monkey (*Callicebus oenanthe*) is a medium sized arboreal primate that lives exclusively in the department of San Martin in Peru (Fig. 1). Hunting and habitat loss due to deforestation and fragmentation severely imperil this Critically Endangered primate (Veiga *et al*., 2013). Research has determined the small distribution range of the species (Mark, 2003; Rowe & Martinez, 2003; Bovéda-Penalba *et al*., 2009; Vermeer *et al*., 2011) and density estimates are available for one small reserve (Aldrich *et al*., 2008), but little else is known about *Callicebus oenanthe*. However, to implement effective conservation programmes for the species, habitat requirements should be understood and more information is needed on the numbers in which the species still occurs.

Fig. 1. *Callicebus oenanthe*. By Eduardo Pinel.

The current study investigated the habitat requirements and population density of *C. oenanthe* in conservation concession Ojos de Agua in the district of San Martin. In a three month period (April 16 to July 14 2013) one main hypothesis was tested: *Callicebus oenanthe* in Ojos de Agua prefers the boundary between primary and secondary forest over forest interior. Subsequently, the study also investigated a possible population density difference between primary and secondary forest.

These hypotheses were tested by estimating population density in the area using a triangulation survey method. This survey method is a way to assess primate density by using their vocalisations to pinpoint the location of the groups, following the methods of (Brockelman & Ali, 1987) and (Aldrich *et al*., 2008). 15 listening areas were located in such a way that they served a double purpose. Seven points were placed in primary forest and eight in secondary forest. At the same time, seven points were located in the interior of a habitat type, while the other eight points were located on boundaries of primary and secondary forest. Each listening area (*A*) comprised 3 listening points 200 m apart

forming a triangle, each manned by one researcher. The three observers recorded titi monkey vocalisations between 06:00 and 09:00 am or until 30 minutes after the last group finished calling. From each call heard, the start and end time, compass bearing, and distance were noted. Areas were surveyed on 3 consecutive days to ensure all groups in the area would be heard at least once.

Only singing events heard within a boundary of 200 m around all listening points were included in the analysis because it is only possible to distinguish two groups vocalising close together from a distance of maximum 250 m (Robinson, 1981). Vocalisations from all listening points with start times within 5 minutes of each other forming 2- or 3-way triangulations were mapped. From all mapped calls, the number of groups per area (*n*) could be identified. Population density (D) was calculated using $\boldsymbol{D = \frac{n}{p(m)\ x\ A}}$ where *p(m)* is the proportion of groups expected to sing in *m* days. *P(3)* was determined from all data collected throughout this study by calculating an average proportion of groups expected to sing during three days for each listening area.

An Independent Samples T-test showed no significant difference (p=0.941) in group density between primary forest (0.116 groups/ha or 11.6 groups/km^2) and secondary forest (0.109 groups/ha or 10.9 groups/km^2). However, a significant difference (p=0.001) in group density was found between forest boundaries (0.261 groups/ha or 26.1 groups/km^2) and forest interior (0.036 groups/ha or 3.6 groups/km^2). This confirms that more groups of *C. oenanthe* in Ojos de Agua are found in the edges between primary and secondary forest than in forest interior.

The general density of *C. oenanthe* in Ojos de Agua is 0.114 groups/ha or 11.4 groups/km^2. An average of 2.88 individuals/group was seen throughout the study, which leads to an average of 0.328 individuals/ha, or 32.8 individuals/km^2. The conservation concession has a total of 2550 hectares of forest cover within its boundaries. This means that there are approximately 836 individuals within conservation concession Ojos de Agua.

This study shows that *Callicebus oenanthe* in Ojos de Agua prefers the boundaries between primary and secondary forest over forest interior. This result could be explained by a preference for certain food resources that are found partly in primary, and partly in secondary forest. Secondary forest often has a greater abundance of fleshy fruits and insects (Schwarzkopf & Rylands, 1989; Zunino *et al*., 2007), which make up a large part of the diet for the species. However, local guides mentioned that fruiting Manchinga trees (*Brosimun alalicastrum*, family Moraceae) are another important food source for primates in the area, and this tree is only found in primary forest. Also, the height of the primary forest's canopy is required for a good transmission of early morning duets and offers protection against predators (Cowlishaw & Dunbar,

2000). It should also be considered that the transmission zone between primary and secondary forest may have a unique microclimate beneficial to the species.

Conservation concession Ojos de Agua is one of the three largest protected areas where the species is known to occur. Consequently, the area is of great importance to the conservation of the species. Even though the secondary forest adjacent to the conservation concession is not part of the protected area, this study shows that it is a crucial factor to the survival of the species. Unfortunately, in the next 2 to 3 years all secondary forest will be cleared for agricultural purposes. This severely limits the available preferred habitat for the species. It is therefore of high importance to determine how adaptable the species is to changes in their habitat. Only then will we know if the San Martin titi monkeys in C. C. Ojos de Agua have a chance of survival in the near future.

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Western lowland gorilla (*Gorilla gorilla gorilla*) diet and activity budgets: effects of group size, age class and food availability in the Dzanga-Ndoki National Park, Central African Republic

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Variation in food availability, climate and anthropogenic activities alongside body size and group size, are known to influence primate diet diversity and activity patterns (Brockman & Van Schaik, 2005). Primates in tropical rainforest face local, seasonal and inter-annual variation in food availability and as a result they frequently show more flexible behaviour and can modify their diet and activity patterns in order to survive (Van Schaik *et al*., 1993; Hemingway & Brynum, 2005). Knowing how primates of different group sizes exposed to fluctuating food availability modify their diet and activity pattern to survive is therefore a key element to understanding their socioecology. Western lowland gorillas (WLGs) are critically endangered (IUCN, 2012) from habitat destruction, poaching and disease outbreak (Walsh *et al*., 2003), yet little is still known on WLG behaviour due to the difficulties in habituating this subspecies to the presence of human observers (Doran-Sheehy *et al*, 2007). However, only recently more studies have been carried out on direct observation and have shown that WLG diet and activity patterns vary with seasonal changes in fruit availability (Doran-Sheehy *et al*., 2009; Masi *et al*., 2009). However, because of the lack of habituated groups, no study has been able to investigate how the effect of group size might influence diet and activity patterns. My main aim is to investigate how group size may affect WLG diet and activity patterns while providing information that will contribute to conservation management of gorilla habitats. I aim at comparing particularly two habituated groups of WLGs ranging about 10 km apart in the Dzanga-Ndoki National Park. One main research question will be answered: How will the diet and activity budgets of a smaller WLG group differ from that of a larger one if both are faced with similar conditions of food availability? I predicted that frugivory decreases with increased group size and influences diet and activity budgets accordingly (increased diet breadth and time feeding since relying on alternative/lower quality food)

Research was conducted at Bai Hokou (2^{0}50'N, 16^{0}28'E) and Mongambe (2°55'N, 16°23'E) situated in the Dzanga-Ndoki National Park (DNNP) in south-western Central African Republic. The park is part of Dzanga-Sangha Protected Areas (DSPA) and co-managed by the CAR government and WWF. DSPA are a

subset of a complex of protected areas called the Sangha Tri-National (TNS) named a World Heritage Site by UNESCO in 2012. The Regional Action Plan for the Conservation of Chimpanzees and Gorillas in Western Equatorial Africa outlines the TNS as an exceptional priority area for the conservation of WLGs and calls for capacity building of national researchers. The climate is characterized by a three-month dry season and a long rainy season. Annual rainfall in 2011 was 1200 mm with average temperatures of 26.3 °C (Bai Hokou long term data).

I collected the data from July 2011 to January 2012 on two habituated groups of WLGs: group Makumba in Bai Hokou and group Mayele in Mongambe. At the time of the study, group Makumba had nine individuals (one silverback, two adult females, one black back, four juveniles and one infant), while group Mayele had 15 individuals (one silverback, four adult females, three sub-adults, four juveniles and three infants; Breuer *et al*., 2009). I monitored along permanent transects the phenology of new leaves and fruit production (as indicator of food availability) of 365 individual trees of 32 species of important gorilla food trees (occurring for more than 1% of gorilla feeding time) in Bai Hokou, and 314 trees of 34 species in Mongambe within the home range of each study group. Each tree was marked with tags and revisited once per month. Behavioural data were collected by continuous focal animal sampling (Altmann, 1974) during half-day observation periods choosing a different focal animal on daily rotation and balancing morning and afternoon observations for both study groups. Data were collected on activity (feeding-including foraging and food processing, travelling, resting, social (playing, vocalisations, and displays) and other (vigilance, nest construction, drinking and any other activity) and the food consumed (species and type)

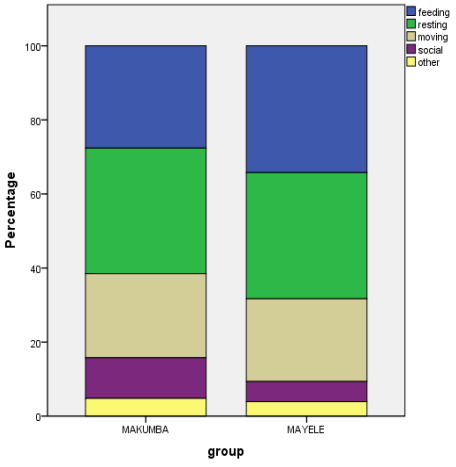
Based on previous research, for statistical analyses the study period was divided into two seasons: High Fruit (HF) season (July and August 2011) and the Low Fruit (LF) season (October 2011 to January 2012). For phenological data, the percentages of trees fruiting and leafing per month per site were calculated. Since the data were not normally distributed, Wilcoxon Signed Rank Test was used to compare phenological profiles for the two sites. For focal follows, for each individual gorilla the daily, average monthly and average seasonal percentages of time spent in each activity were calculated as well as the daily proportion of feeding time spent on each food category. Daily, average monthly, and average seasonal food diversity in diet was calculated as the average number of different food species consumed by each individual gorilla per focal sample. To analyse differences between the two groups in seasonal activity budgets I used Mixed Model Repeated

Measures ANOVA with activity as the dependent variables and group and season as independent predictors. One dependent variable was tested per model. The same analysis was used to test for group differences in seasonal diet with proportion of time spent feeding on each food type as dependent variable and season and group as independent indicators.

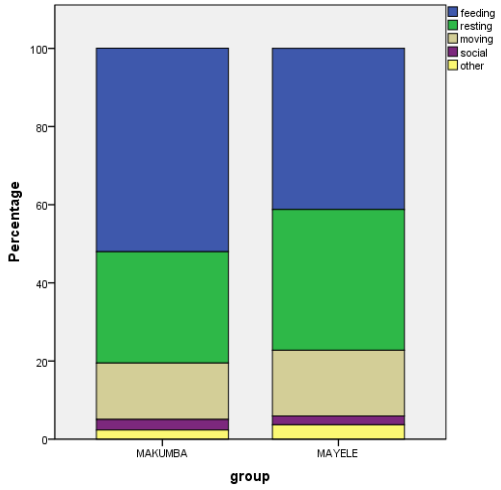
I found no significant difference between the proportion of major gorilla food trees leafing in Bai Hokou (32.5%) and Mongambe (28.3%) during the six months of study (Wilcoxon signed-rank test: Z = 0.734, P = 0.463, N = 6). Also we found no significant difference between the proportion of major gorilla food trees fruiting in Bai Hokou (17.1%) and Mongambe (15.3%) (Wilcoxon signed-rank test: Z = 0.734, P = 0.463, N = 6).

Feeding time varied significantly between seasons. Both groups spent more time feeding during the LF than the HF season. However, we found no significant difference in the proportion of time each group dedicated to feeding.

Season had no significant effect on the time gorillas spent resting. Also we found no significant difference in the overall time both Makumba and Mayele spent resting. Time spent traveling varied significantly with season. Both groups spent significantly more time traveling during the HF than the LF season. However I found no significant difference between the proportions of time each group spent traveling. Seasonal differences also significantly affected the time gorillas spent for social behaviours. Both groups spent significantly more time for social activities during the HF season but I found no significant difference between the proportions of time each group spent for social activities. Season had no significant effect on the time the gorillas spent for other activities. The effect of group on the time spent for other activities was non-significant.



a)



b)

Fig. 1: Activity budgets of the Makumba and Mayele groups of western lowland gorillas during the high fruit (a) and low fruit (b) seasons

As expected the proportion of feeding time dedicated to fruits consumption varied significantly between seasons. Fruits consumption was higher during the HF season than the LF season. However both groups did not differ significantly on the proportion of time dedicated to fruit consumption. The effect of season on leaves consumption was significant. Both groups spent more time consuming leaves during the LF than the HF season. However the effect of group on overall leaf consumption time was not significant. I found no seasonal or group differences in the percentage of time spent feeding on stem. Bark consumption was also significantly affected by season. Bark consumption was minimal during the HF season but increased during the LF season especially for the Mayele group. Time spent feeding on insects did not differ between the two seasons or groups. Termites (*Cubitermes sp*.) and different species of ants were the only two types of insects consumed. I found a trend in the time spent feeding on other food items between seasons. Mayele tended to spend more time than Makumba feeding on other food types. The number of species consumed by the gorillas was not affected by season and the number of species consumed per day was not significantly different between Makumba the groups.

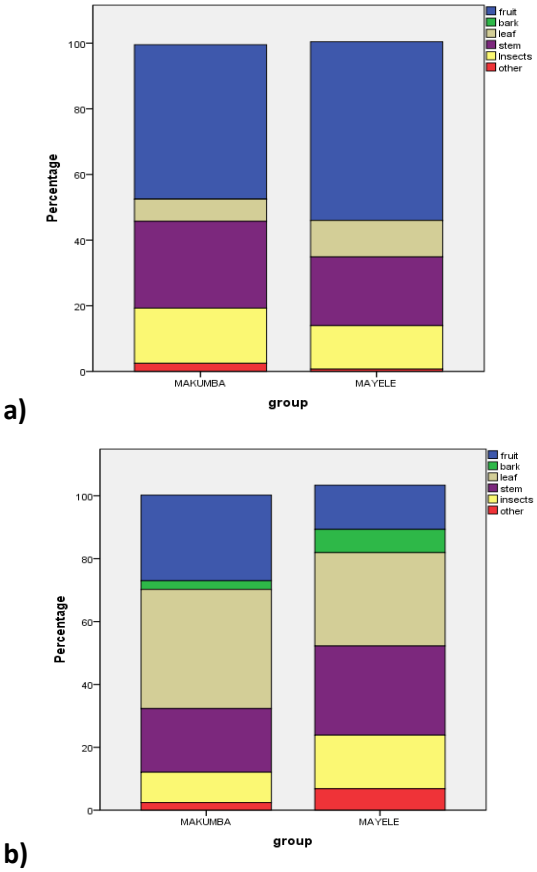


Fig. 2: Diet composition of the Makumba and Mayele western gorilla groups during the high fruit (a) and low fruit season (b) as depicted by the percentages of time spent feeding on each food type

Bai Hokou and Mongambe do not significantly differ in availability of major WLG food showing that both groups even though spaced about 10 km apart are exposed to similar conditions of varying food availability between seasons. Some aspects of their activity budgets vary between seasons but contrary to my prediction both small and large group respond similarly. Irrespective of group size, WLGs feed less, travel more and socialize more during HF season in comparison to the LF seasons but the time spent resting does not vary between seasons or groups. Therefore WLGs respond more to changes in food

availability than group differences. Based on the proportion of time spent feeding on different food items, fruits (35.7%) constitute the greatest proportion of western gorilla diet, followed by stems (24%), leaves (21%) insects (14%), and a very small proportion by bark (2.5%). The high proportion of fruit in diet shows that WLGs track fruit when available therefore cutting down these fruit trees will greatly affect their diet. Stems of terrestrial vegetation and insects are staple WLG food and their proportion in the diet does not show any seasonality. Irrespective of group size, WLGs cope in the face of changing food availability by adapting their diet to suit seasons but increasing group spread seems the best strategy at this small difference of group size. More studies are however required involving other groups of differing sizes to have a better idea on diet diversity and group size effect on their ecology. This information is vital for calculating area and range requirements to conserve viable populations of WLGs as well as to safeguard tree species for populations out of protected areas (such as logging concessions) given the fast rate of deforestation as a result of urbanization and large development projects.

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People-wildlife conflict around CERCOPAN: the farmers' perspective, Iko Esai and Ekperem communities, Cross River State, Nigeria

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Nigeria has lost over 90 percent of its tropical lowland forests due to human activities and more than half of the remaining forest is located within Centre for Education, Research and Conservation of Primates and Nature (CERCOPAN). In 1995, CERCOPAN was founded. It is a non-governmental organization whose primary focus include; (1) environmental education (2) primate rehabilitation (3) community rainforest conservation and (4) research (CERCOPAN 2012).

In spite of the incredible biodiversity and extinction risk, Nigeria's remaining rainforest receives very little conservation attention from the government. Although CERCOPAN has recorded huge successes; it is faced with huge challenges. One of these challenges is human wildlife conflicts (HWC). It is vital to take into account people's needs as well as those of wildlife in other to mitigate crop raids (Hill, 1997; 2000). The recent calls for evidence based conservation emphasizes on considering every aspect of the conflict (Campbell-Smith *et al*., 2012). HWC issues are unique in every case because communities, groups, and individuals experience different vulnerability levels (Hill, 1997). Peoples' perceptions and expectations shape the way they behave and respond to wild life crop raids, hence it is important to explore farmers' perceptions and expectations (Hill, 2004).

In Africa, conflict between wildlife and agriculturalists has existed for very long time but the degree of the conflict has increased even more, in the past 30 years as forest habitats are increasingly converted into farmlands (Hill, 1997). In Nigeria, human living standards have been declining since 1975 with 70% of the population living in poverty while 75% of populations living in the rural areas depend on forests or peasant agriculture for survival (Ewhrudjakpor, 2007; Oriola, 2009).

This study was conducted in two communities (Iko Esai and Ekperem) in the rainforests of Cross River State south-eastern Nigeria. Iko Esai and Ekperem are located adjacent to the Oban Division of the Cross River National Park, Akamkpa local government. Iko Esai is the host community for CERCOPAN. Economic loss is a poor indication of the impact of crop raids to farmers. Other costs can include; (1) increased need to guard fields which takes away time that could be used on farms, (2) disruption of schooling when children are

required to guard fields, (3) increased risk of injury due to wildlife and accidents, (4) and increased chances of contacting diseases like malaria (Hill, 2004).

The major food crops in both villages are yam (*Dioscorea spp.*), maize (*Zea mays*), banana (*Musa* spp.), cassava (*Manihot esculenta*), water yam (*Dioscorea* spp.), plantain (*Musa* spp.) and cocoyam (*Xanthosoma* spp.). Lesser cash crops include cocoa (*Theobroma cacao*) and oil palm fruit (*Elaeis guineensis*) but mostly people cultivate food crops in excess of what they need for subsistence and sell the surplus to generate cash. In both villages people inherit farmlands from their parents and ancestors according to traditional customary tenure. People can also go into the forest and cut down unprotected forest to establish new farmlands. However, Iko Esai is the only community in the area that has now adopted a land use plan which restricts people from clearing more forests to create new farmlands.

Every adult I met in both villages has a farm. However, most people are industrious and have additional activities that provide them with income. Most times they do not express the other casual activities as occupations. For instance, the person who sells palm-wine for a few weeks will not say he has another occupation even though it provides income. The community depends on forests for much of their livelihood.

Permission was obtained from CERCOPAN management to carry out this study. On arrival in each of the villages, I held meetings with the Village Head / Village Chieftain of each village to explain and introduce myself and told them the purpose of my visit. Only after permission had been granted did take up residence in the village and approach potential participants.

Interviews with villagers were conducted alongside research assistant. The presence of the research assistant was essential since he acted as a translator and ensured that the purpose of data collection was fully explained and questions were asked appropriately and politely, respecting local culture.

Data collection was carried out from 11th May 2012 until 20th June 2012. Within this time period, I resided in Iko Esai to allow time to create rapport and adequate socialization in the communities. Time not spent interviewing was dedicated to creating rapport and establishing acquaintances in every village. I also used this time to verify my data through participant observation and informal discussions with local people. Living in the villages alongside my participants, and mixing with them informally helped make them comfortable about my presence and go on with their normal activities (Newing 2011).

Semi-structured interviews can be a powerful tool for obtaining data on people's viewpoints,

attitudes, and behaviour (Newing 2011). With the aid of my research assistant(s), this technique was used to gather information from willing participants in each of the two villages. The flexibility of the approach allowed questions to be tailored to the interviewee, retaining appropriateness to each individual.

All interviews were conducted within the homes of the participants. This was so because the study was conducted at the end of the planting season and most people rarely go to their farms during this period but also rarely stay at home during the day time. Interviews took, on average 15 to 20 minutes and the questions focused on people's farming strategies and experiences of crop-damage by vertebrates and farming and farmers' perspectives of conflict.

A strict protocol was observed prior to, and during, each interview. Firstly, the aims of the research were briefly explained to the potential interviewee. They were then asked if they wished to be interviewed, and only if they answered positively did the interview proceed. One interview was administered per household.

I also informed the participants that their identity would be anonymous in all reports and publications unless otherwise with their permission. The information provided to the participants is also presented in the Participant Information Sheet. Question structure for the interview was outlined in an interview outline which I used as a guide for the interviews. I took notes during each interview considering interruptions, the interviewee's reaction and if there was anything different in the environment. I also did my best to present topics for conversation in a neutral fashion without suggesting a personal standpoint.

An understanding of the culture and lifestyles in the villages made it evident that valid information should be collected per family, not per individual, and hence heads of families were sought as potential interviewees. Their shared knowledge of the family lifestyle gave the most complete information on farming, livelihood strategies and problems associated with both, dependency and resource use. Also, women were often timid and reluctant to talk even in situations where the women are the head of their families. Time spent residing in the villages prior to data collection allowed acquaintances to be made with many villagers, which subsequently made it easier to approach potential participants and request an interview. It was easier to be accepted in Iko Esai and people were more eager to be interviewed than in Ekperem.

Participant observation with personal experience of people living their lives can remedy unintentional and intentional biases (Newing, 2011). By combining formal interview techniques with participant

observation I was able to triangulate my data to compare what I was told during interviews with what I saw or heard during day to day interactions.

The majority of data collected were qualitative and hence are analysed through interpretation and comparison and presented descriptively. Some data were analysed quantitatively by attributing by creating categories and entered into SPSS version 19 to generate descriptive statistics and frequencies. Chi square tests were performed on data that allowed quantitative statistical analysis. Data are presented as the percentage of interviewees that gave a particular response to the basic questions in the interview outline. Responses are grouped into categories and only responses that could be unambiguously categorised were included in analyses (McLennan & Hill,2012).

Data were collected using semi-structured interviews (n=137) and participant observation. I used random selection technique and compared respondents from Iko Esai with respondents from Ekperem.

Approximately 60% of farmers interviewed are wholly dependent on agriculture for their subsistence. Respondents claim poverty as their major problem more than crop raiding. Most respondents cultivate cocoa, yam, cassava and plantain. The results are significant at the level suggestive that a higher percentage of respondents who report farming as their only occupation cultivate a greater variety of crops. More than three quarter (88%) of respondents reported to have problems with farming but only ten percent said the problem is crop raiding. When later asked if they experience wildlife on their farms, 90% of respondents said yes and 15% of this figure said its monkeys. The deterrence reported includes; guns, traps, fence, prayer and chemicals.

The rainforest of Cross River State is fundamental to the lives of the communities that reside within them. For a conservation program to be efficient and sustainable, it is important to consider the need of the people as it relates to dependence on forest resources. Even if the actions humans activities including hunting, and farming destroy forest resources, these people need to survive and the only option they have for now is the forest. I acknowledge that the area is a hotspot and endangered, but the needs of the people also needs to be considered.

The over dependence on wildlife as the primary source of protein in both communities can be replaced with domesticated alternative protein sources which can sometimes be more accessible, and sustainable for the long run. Additionally, the misconception that meat from wildlife is healthier can be changed over time with proper education.

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Interview with Dr Gladys Kalema-Zikusoka, the Ugandan gorilla veterinarian

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On the evening of 15th October, we attended a fundraising evening at a local school to raise funds for Conservation Through Public Health (CTPH). The keynote speaker was Dr Gladys Kalema- Zikusoka, founder of CTPH and a renowned gorillas vet. Prior to the talk, we were fortunate enough to have an hour with Dr Gladys and what follows is an account of our interview.

Dr Gladys, what inspired you to become involved with wildlife?

Since an early age Gladys was enamoured by Uganda's wildlife and re-established the Kibuli Secondary School wildlife club at the age of 12. Her brother often brought home animals, which she cared for within their home and this was to be the beginning of her career with animals Gladys travelled to England to train as a veterinarian with the Royal Veterinary College, London. She believed that people valued animals more in England and she was provided with more opportunities to gain practical experience. During her training, she saw practice at Twycross Zoo, London Zoo and Longleat Safari Park. To gain work experience, Gladys returned home where she worked at The Uganda Wildlife Education Centre. During her time here, she conducted her first wildlife study in Budongo, investigating intestinal helminth parasites in chimpanzees. Following this, Gladys worked on a similar project, but this time researching intestinal helminth parasites and bacterial abundance in Bwindi gorillas. She compared parasite richness in both habituated and unhabituated gorillas, the former being visited by tourists. This provided Gladys with a better understanding of both the positive and negative effects of ecotourism, on local wildlife and human populations.

What career path did you take after graduations?

A year after her graduation in 1995, Gladys became the first wildlife vet in Uganda, employed by the Ugandan Wildlife Authority, where the idea and practice of veterinary care for wildlife was a very new concept. Gladys set up a veterinary unit to provide care for the wildlife present within the national parks, game and forest reserves and controlled hunting areas. It was during this time that Gladys and her team encountered a group of sick gorillas which presented with severe cases of alopecia and pruritis. She contacted a Rwandan friend who was a doctor and asked if she had any ideas on what the disease could be. Her friend suggested that it could be scabies (sarcoptic mange), which most commonly presents in people who live in areas of poor sanitation and hygiene. This anthroponotic disease, was thought to have been contracted when the gorillas came into contact with local peoples clothing and possibly faeces. The disease was confirmed following skin scrapings and biopsies carried out during the post mortem of a deceased infant that had sadly succumbed to the disease. The remaining three gorillas in the group were treated with intramuscular injections of ivermectin and recovered.

What events transpired that led to the establishment of CTPH?

In July 2000, there was another outbreak of sarcoptes mange within a recently habituated group of 15 gorillas, which were treated successfully. It was this second outbreak that prompted Gladys to set up Conservation Through Public Health, an organisation than appreciates the need to treat both gorilla and human populations, in order mitigate risks of disease transmission.This year marks the ten year anniversary since the launch of (CTPH).

What are the objectives of CTPH?

The organisation works by educating local communities on good hygiene and sanitation and also provide family planning clinics. These clinics are run by local women, providing them with a voice within the community, previously dominated by men. At the same time, teams carry out wildlife monitoring and collect monthly faecal samples from the gorillas. They analyse these samples (in a laboratory within the park) to ascertain whether parasites and infections are present and can then treat accordingly. It is important to point out that whilst these teams provide care to the gorillas, they only intervene in cases where the infection would be fatal to gorillas or could spread to the human population. The people that collect samples, are usually part of the conflict resolution teams, who are trained on techniques of faecal collection and observe the gorillas for clinical signs of illness. These conflict resolution teams respond to issues that can arise when gorillas are found in gardens and educate people on the risks associated with getting too close to the gorillas (disease transmission). In the future, Gladys says they hope to establish a community health and gorilla conservation centre and develop a curriculum in the integrated population, health, and environment approach (PHE), that they are currently using in the Bwindi community. Whilst it is difficult to define and quantify success, recent census results indicate that there has been an increase from 300–400 mountain gorillas in Bwindi and we wanted to understand Gladys's opinion on why this has been the case.

Do you feel positive that we can save the mountain gorilla?

She replied "yes, especially with the inclusion of local communities and partners in conservation." In addition to this she felt that improved censusing techniques such as 'double sweep methods' and inclusion of genetic testing of faecal matter has helped. Poaching has also reduced which could be attributed to finding alternative sources of income for local communities such as benefits received through ecotourism. Since education has increased, attitudes have improved towards the conservation of gorillas and as a result, more children are now attending school. To elaborate, in the past children have protected the land from crop raiding incidences, but now with the addition of conflict resolution teams, these incidences have been reduced, enabling more children to attend school. The reduction in poaching can also be attributed in part, to the improved healthcare programmes now in place. Previously, families have gone into the forest to poach gorillas for use in traditional medicine.

Our final thoughts

Gladys has been globally recognised for her pioneering work with CTPH. We feel very fortunate to have met such an inspirational woman who has achieved so much and are excited about the future of both Gladys's career and the future of the mountain gorillas. The conservation initiatives that have proven successful at Bwindi can surely be implemented in other areas of high human densities, which have high levels of human and non-human primate conflicts.

University Events

Seminar Series

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

23 Sept	**Dr Susan Cheyne** (OuTrop)
30 Sept	**Felicia Ruperti**
7 Oct	**Martin Fahy** (Oxford Brookes University)
14 Oct	**Dr Christos Astaras** (WildCru)
28 Oct	**Kristi McGrath** (Omaha's Henry Doorly Zoo and AQ)
4 Nov	**Dr Amy Dickman** (WildCru)
11 Nov	**Dr Christoph Schwitzer** (Bristol Zoo Gardens & Bristol Conservation and Science Foundation)
18 Nov	**Dr David Chivers** (University of Cambridge)
25 Nov	**Dr Matt McLennan** (Oxford Brookes University)
2 Dec	**Dr Thurston C. Hicks** (Max Planck Institute for Evolutionary Anthropology)

2013-2014 Cohort of the MSc Primate Conservation

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