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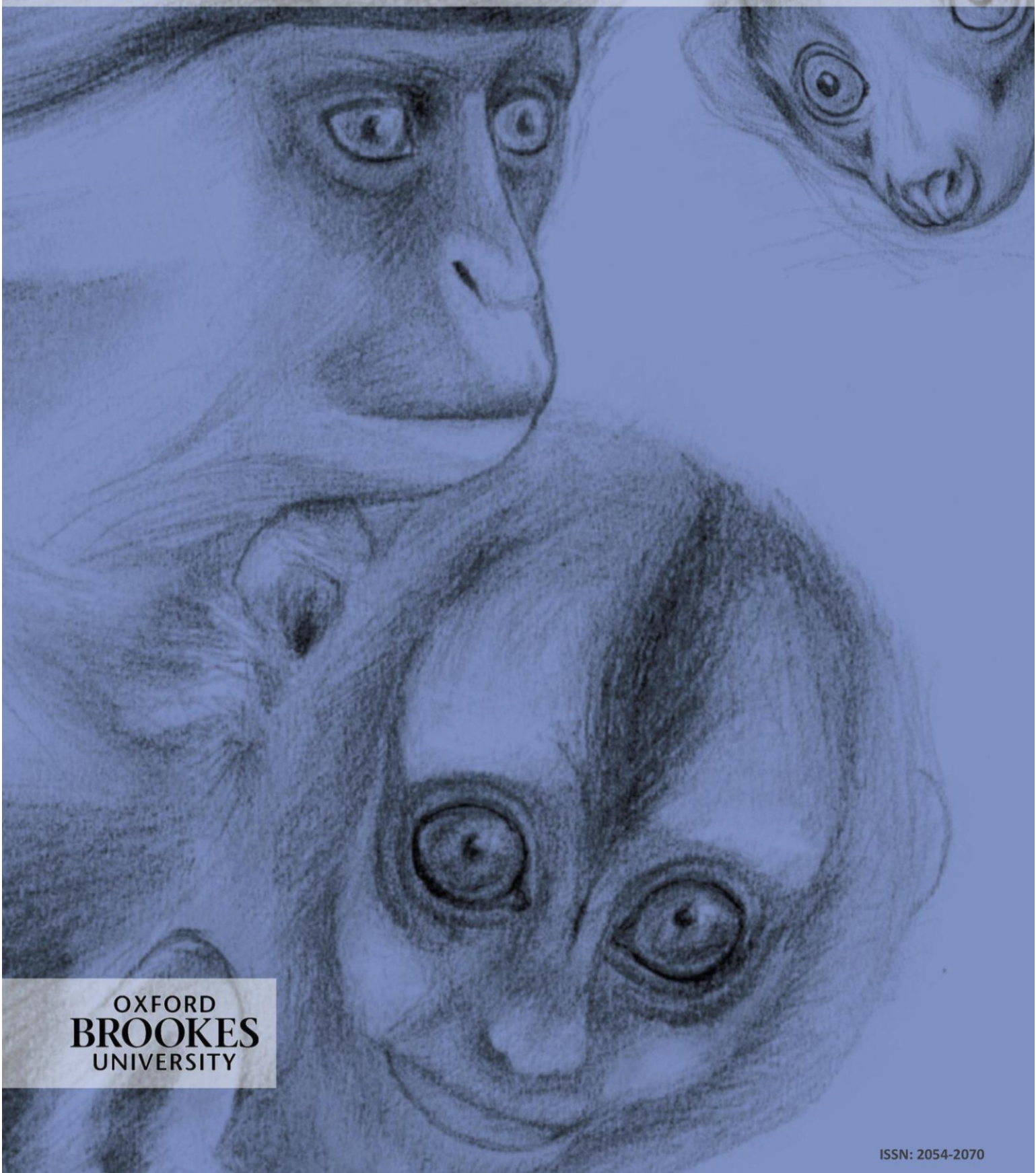

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MSc Programme
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Address
Canopy c/o Vincent Nijman
Faculty of Humanities and Social Sciences
Oxford Brookes University
Oxford
OX3 0BP
UK

Website
MSc Primate Conservation:
www.brookes.ac.uk/primates

Front Cover Design
Hellen Bersacola (Switzerland)
hellenbers@gmail.com

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Letter from the editors

We warmly welcome you to the spring 2013 edition of Canopy, the in-house journal produced by students of the MSc in Primate Conservation at Oxford Brookes University. This issue focuses on topics related to the captive care of primates, from genetic analysis for species identification to enclosure design. The studies took place in captive settings in the UK, the US, and Indonesia.

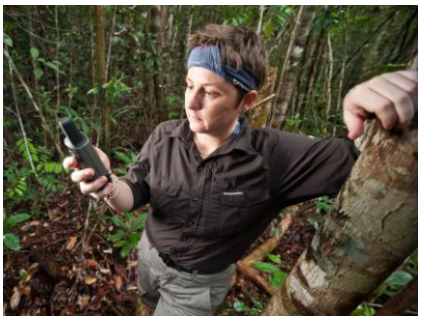
This issue was inspired by the Captive Management and Rehabilitation module, taken by students in the second semester of the MSc course. This module covers management and rehabilitation of primates and the implications for conservation. Dr Susan Cheyne, the leader of the Captive Management and Rehabilitation module, has kindly written the introduction letter to this issue. Susan serves on the Captive Care Working Party of the Primate Society of Great Britain (PSGB) and is also the Director of Gibbon and Felid Research and Conservation at the Orangutan Tropical Peatland Project (OuTrop) in the Sabangau Forest in Central Kalimantan, Borneo.

We are proud to include an article by Andrea Dempsey, a senior keeper at ZSL London Zoo and a current student of the MSc course. Her article provides insight into the daily activities of zoo keepers, highlighting the passionate dedication of those in the captive care field and the challenges they face.
We would like to thank everyone who has dedicated their time and efforts in preparing this issue. We would also like to thank the organisations and institutions who made the research presented in this issue possible.

Sincerely,
The editors

Magdalena Svensson
Hannah Young
Denise Spaan
Carina Morris
Megan Du Trevou
Andrea Dempsey

Magdalena, Megan, Denise, Hannah & Carina



Letter from the module leader

Primates have been kept in captivity and lived with humans as early as the 4th millennium BC in Egypt and from 900 BC in China. Captive management is a broad topic encompassing zoos and wildlife parks, sanctuaries, rescue centres, rehabilitation and reintroduction projects, retirement centres for laboratory primates and semi-free ranging situations, all with links to conservation. My module reviews good practice in the management and rehabilitation of captive primates, with links to the survival of declining populations in the wild. Emphasis is given to the effects of the captive environment on behavioural traits and welfare. Topics covered include: welfare and stress in captivity; housing and husbandry; enclosure design; environmental enrichment; nutrition and feeding; social management; reproduction; interactions with humans and training; reintroduction, rehabilitation and translocation, disease, ecological disruption and social change.

Captive management of primates must now take place in a global context to help not only the sharing of information but the maintenance of genetic diversity through the Studbooks and Taxon Advisory Groups (TAG's). There are many inherent challenges to keeping primates in captivity, the ethics of doing so and how we provide a suitable environment for these primates. By reviewing new methods of environmental enrichment, taking part in practical's and field trips to Cotswolds Wildlife Park and the Monkey Sanctuary in Cornwall, the students are exposed to the range of issues surrounding keeping primates in captivity.

Advances in the fields of technology are having big impacts on captive primates e.g. maintaining health through non-invasive techniques, employing computers to provide enrichment and the need to provide a stimulating environment for primates is a constant challenge. Enclosure design is an upcoming field whereby enclosures need to be designed for multiple users: primates, visitors, researchers etc.

This rapidly developing and very broad topic lends itself to study in many ways. Past student projects have focused on a wide variety of captive issues including genetics, behaviour, tool use, diet, parasite loads, visitor impacts, learning skills in socially impaired primates, stereotypic behaviour disorders, training of primates for effective husbandry and breeding to name but a few. Indeed many ideas/techniques for potential use on wild primates are first trailed in captivity e.g. deterrents to crop-raiding or the use of radio collars.

The wealth of possible research projects with captive primates is broad and Brookes' students are contributing to the global knowledge for managing primates in captivity.

Dr Susan M. Cheyne
Module leader for Captive Management and Rehabilitation

The effect of enclosure design on the behaviour and space use of zoo-housed gibbons (Hylobatidae): implications for welfare and rehabilitation

Matilda Hearn
Cohort 10/11
mystified_4@hotmail.com

Maintaining behavioural diversity in a captive setting is essential if endangered species are to be successfully reintroduced. Animals will not survive in the wild if they do not perform important natural behaviours such as predator avoidance and foraging (Rabin, 2003). Studying behaviour and space use is an effective method of determining the animals' preferences, requirements and internal states (Seidensticker & Doherty, 1996; Ross *et al*., 2009). This information can then be used to improve existing enclosures and also to facilitate the design of exhibits that meet the biological requirements of the animals, therefore maximising their welfare (Seidensticker & Doherty, 1996; Ross *et al*., 2009). Encouraging and maintaining natural behaviours in captivity is crucial in order to maximise the welfare of the animals and to facilitate any future attempts at reintroduction, preventing extinction in the wild.

This study investigated the effect of enclosure design on the behaviour, space use and substrate use in 29 gibbons (*Symphalangus syndactylus, Nomascus leucogenys, Hylobates pileatus, Hylobatis agilis* and *Hylobates moloch*) housed in two UK zoos: Twycross Zoo and Howlett's Wild Animal Park. Groups were observed for periods of one hour. During this time, instantaneous scans took place every five minutes. During each scan sample, the location, behaviour and substrate use of each individual was recorded.

The results showed that enclosure design can significantly affect certain behaviours displayed by zoo-housed gibbons, as well as use of space and use of substrates. Gibbons housed in larger, more naturalistic enclosures were more active and spent more time foraging compared to those housed in smaller, less enriched environments. They also spent more time in the top sections of their enclosures, and less time on the floor. Wild gibbons spend 50-65% of their time in the upper canopy (Gittins, 1983). This should be reflected by captive gibbon populations if they are to be viable for reintroduction. All groups observed for the current study spent the majority (47-73%) of their time in the middle sections of their enclosures. Ogden *et al.* (1993) claimed that space use may be affected by specific husbandry practices, such as feeding location. The gibbons observed for the current study may have spent the majority of their time in the middle sections of their

enclosures because their food was presented in these areas. Gibbons housed in smaller, less enriched enclosures spent a considerable amount of time sitting on the floor picking grass. This behaviour may have developed in response to the lack of enrichment, as it was never observed in the enclosures where enrichment was provided daily.

Social behaviour was not affected by enclosure design. Vocalising was more frequent among gibbons housed in close proximity to other groups compared to those with no visual access to other gibbons. Stereotypic behaviours were more frequent in enclosures that featured large glass viewing windows and no hiding places. Stereotypic behaviours were never observed in enclosures that allowed the animals to get away from the crowds. There were significant differences between the enclosure styles in use of platforms, ropes and ground for resting and in use of stiff branches for locomotion. All gibbons showed a preference for stable substrates, such as stiff branches, for both resting and locomotion, even when more natural materials were available. This may be because captive gibbons are accustomed to stiff substrates, and can have problems balancing on substrates that are not stable (Moore & Moore, 1992; Cheyne *et al.,* 2008). However, stiff brachiation apparatuses may not be the most appropriate choice for gibbons that are to be reintroduced, as trees will invariably move when used for brachiation, and gibbons must be able to balance if they are to survive in the wild (Cheyne *et al.,* 2008).

Based on the present results, it is recommended that:

1) Gibbon enclosures should be furnished with natural foliage, such as trees, in order to increase foraging behaviour. This will allow the gibbons to become accustomed to natural materials used for brachiation, increasing their viability for future reintroduction.

2) Resting areas should be provided in the top levels of the enclosures in order to encourage zoo-housed gibbons to use these areas. Food should also be placed as high as is feasible at meal times.

3) Feeding enrichment should be provided for zoo-housed gibbons to also increase foraging behaviour. Enrichment devices should be placed in the top levels of the enclosures, as this will encourage the gibbons to use these areas.

4) Gibbon enclosures should not be placed within visual range of one another, as this is likely to be stressful for any territorial species.

5) Gibbon enclosures should feature quiet areas where they can hide from visitors, as this may reduce stereotypic behaviour. The most effective way to achieve this may be to

keep indoor areas closed to the public, as well as providing hiding places (such as tunnels or dense foliage) in the main enclosures. If it is necessary to keep indoor areas open to the public, viewing windows should be soundproof (and, if funding is available, made from one-way glass) in order to minimise stress caused by visitor noise and behaviour.

All of these measures are expected to improve the welfare of captive gibbons and will also encourage natural behaviours. Encouraging and maintaining natural behaviours in captivity is crucial in order to maximise the welfare of the animals and also to facilitate any future attempts at reintroduction to prevent extinction in the wild. The above recommendations will benefit individual animals in the short term, and may increase the likelihood that future rehabilitation efforts of captive gibbon populations will succeed.

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The influence of visitor crowd size, activity and noise level on the behaviour of seven lemur species, housed in either a visitor walk-through enclosure or closed exhibit at a public zoo

Katie Major
Cohort 11/12
katie.major@live.co.uk

Zoos are a fundamental component for conserving species threatened with extinction, primarily through public conservation education (Smith *et al.,* 2008), captive breeding programmes (Ganzhorn *et al.,* 2001) and by providing financial support to conservation initiatives (Gusset & Dick, 2011). These objectives are not possible without high welfare or physically and psychologically healthy animals. However, the vast number of individuals who visit zoos worldwide may be affecting the behaviour of zoo populations, and consequently, their welfare (for a review see Davey, 2007).

Research shows that visitor effects the influence of visitor presence on the behaviour of captive species impacts on primates (Choo *et al.,* 2011). For example, large crowd size reduces the visibility of siamangs (*Hylobates sydactylus*) and white-cheeked gibbons (*Hylobates leucogenys*) (Smith & Kuhar, 2010), whereas gorillas (*Gorilla gorilla gorilla*) show an increase of undesirable behaviours (Carder & Semple, 2008). Furthermore, noisy visitors result in a larger frequency of visitor-directed behaviours by Bornean orangutans (*Pongo pygmaeus*) *(*Birke, 2002). Few studies have examined visitor effects on zoo lemur populations (a primate included in breeding programmes worldwide due to threat of extinction) or in visitor walk-through enclosures.

The current research examined the influence of visitor crowd size, activity (whether visitors were active or passive) and noise level on seven species housed at Cotswold Wildlife Park and Gardens, the majority of which participate in breeding programmes. Five species (black lemurs (*Eulemur macaco*) [A]*;* collared brown lemurs (*Eulemur collaris*) [B]; crowned sifakas (*Propithecus coronatus*) [C]; red-bellied lemurs (*Eulemur rubriventer*) [D]; and ring-tailed lemurs (*Lemur catta*)[E]) were housed in a visitor walk-through enclosure and two species (greater bamboo lemurs (*Prolemur* simus) [E]*;* and white-belted ruffed lemurs (*Varecia vareigata subcincta*) [F]) were housed in closed exhibits. Chi-square tests were utilised to examine associations between visitor effects, the behaviour, and the enclosure use of each species.

Large crowd size altered behaviour of all species housed in the walk-through enclosure, impacting on either visibility or social behaviours, but had

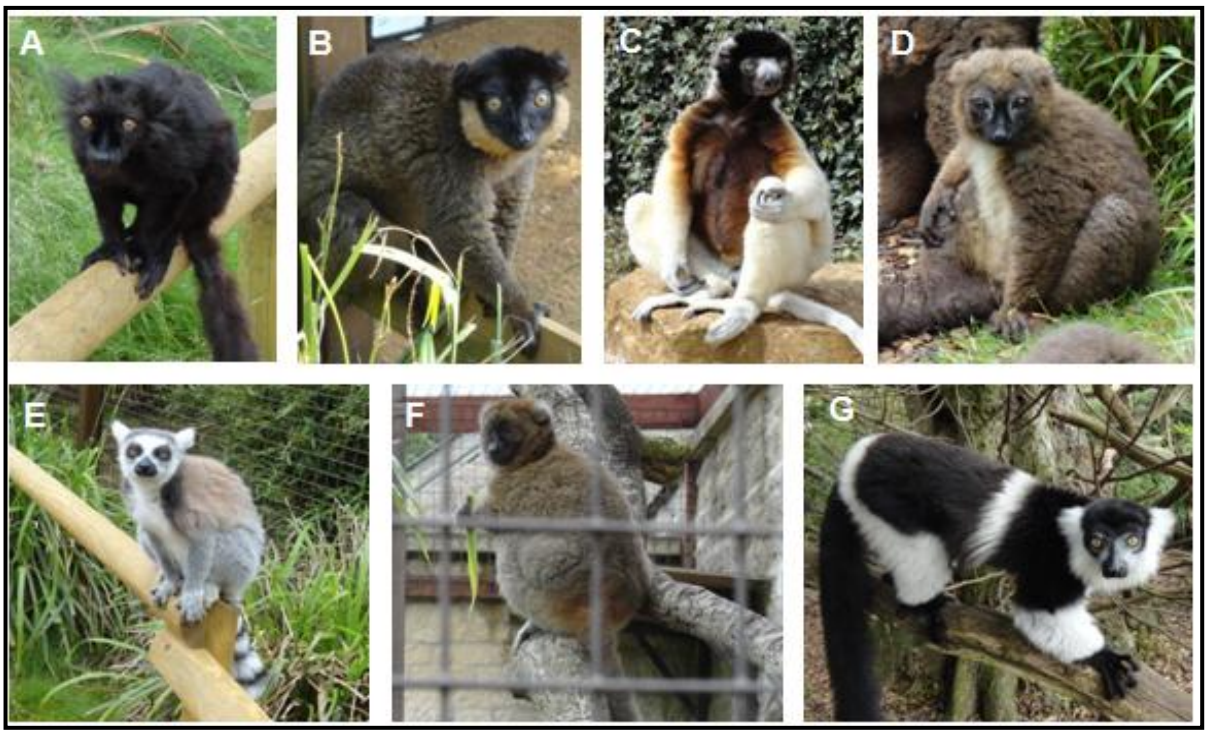

Figure 1. Lemur species studied (see text for species identification)

no influence on species in closed exhibits. This suggests that enclosure design can mitigate the effects of crowd size, which supports Choo (2011), who found that visitor effects on orangutans differed depending on their housing.

Conversely, visitor noise influenced all the species studied. Noisy visitors increased feeding and foraging for the majority of species, indicating that visitor noise had a larger impact on behaviour than crowd size, regardless of enclosure type. Changes in enclosure use by species was low, which is similar to Mallapur *et al*. (2005) who also found no differences in the spatial location of lion-tailed macaques in response to visitor presence. However, species did show increased terrestrial activities during visitor presence. Finally, in contrast to previous findings on visitor-directed behaviour (Hosey & Druck, 1987; Mitchell *et al*., 1992) visitor activity did not influence the exhibition of visitor-directed behaviours by species. Overall, visitor effects had the largest impact on the black and red-bellied lemurs.

Visitor presence was shown to influence the behaviour of lemur species, yet these visitor effects were reduced for species housed in closed exhibits. Understanding visitor effects on zoo lemur species is important for maintaining high welfare, thereby benefiting the conservation objectives of zoos. This is essential for species included in breeding programmes, as reduced welfare can decrease life expectancy

and lower reproduction success (Mason, 2010). Further research on the extent of visitor effects, with specific focus on noise level and enclosure design, is needed.

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The life of a primate keeper at ZSL London Zoo

Andrea Dempsey
Senior Zookeeper and current MSc student
andrea.dempsey@zsl.org

I have worked at ZSL London Zoo since 2005 and volunteered before that. It was as a volunteer that I first met a primate. I was given the opportunity to give the gorillas their dinner. I can still remember that day, the day I decided to change my career, my life and fulfill a childhood dream, and I have never looked back.

Being a primate keeper is not a job, it is a vocation. It is not cuddling monkeys, in fact far from it. We keep a healthy professional distance from our animals, allowing them to act as naturally as they can in a captive environment. To be honest, it is just a lot of poo shoveling!

Figure 1. Andrea Dampsey hand rearing the white-naped mangabey called Conchita

Although no day is the same, it is no 9-5. We always expect the unexpected when we walk into work, but there ***is*** one constant, that every day the welfare and well being of the animals in our care is our priority.

The day starts with a morning meeting, where a team of us discuss any significant events from the day before, any medication and important issues.

From there, we check the animals we are looking after for that day and give them their breakfast, observe them for any problems which may have occurred overnight and give any medication they might need. Administrating medication holds responsibility, making a mistake in dosage or identification of the animal is very serious.

The rest of the morning is spent cleaning paddocks and inside dens. Although not very glamorous an important part of a keeper's role is noting faeces consistency which can indicate health status. The amount of food left can help us to adjust and provide appropriate food quantities, and maintain high standards of hygiene which is crucial for the animals' welfare.

The morning can provide an opportunity for training. Training our animals is an incredibly useful tool, allowing us to perform veterinary and husbandry procedures with the co-operation and trust of the animal. Giving the animal complete control of the situation allows for us to perform hand injections of insulin and general anaesthetic, box training for export, ultra-scanning for pregnancy, weighing for accurate medication dosage and checking overall health.

The afternoon can hold a range of activities, from further training to enclosure maintenance to shoveling ten tons of sand. However, one of our key jobs is providing enrichment for our animals. Enrichment encourages our animals to exhibit natural behaviours. Though our primates are in captivity they should still experience as wild an existence as possible. There is a wide variety of enrichment that can be provided from the simple but effective scatter of seeds on the ground (which encourages foraging), to more complex puzzles feeders. It is important to adapt enrichment to the species (for example, providing a scatter feed on the ground to a totally arboreal species would not be suitable), and to maintain a constant variety of ideas. One of the most fulfilling and natural enrichment that keepers can provide is browse, especially to the folivorous primates such as colobus and langurs. Providing an innovated and structured enrichment programme can be enjoyable to both primate and keeper!

The last hours of the day are spent giving the primates their evening feed. The diets of the primates are carefully calculated and we try to present the food in the most naturally species-specific manner. It is crucial that we check on the animals before we leave for the night, as we won't seem them again for at least 12 hours.

Over the years working at ZSL I have had many highlights and, of course, sad days. There is no way of getting around it, animals do die. Although you remain professional at all times I remember my team leader giving me some excellent advice early on in my career. She said "The day you do not get upset over losing an animal is the day you should leave zoo keeping."

To name one highlight is hard, but I would say that hand rearing a white-naped mangabey called Conchita is definitely one of them. It is rare that hand rearing is considered due to the implications that can occur such as imprinting and abnormal behaviours. However, this species is endangered and relies on a healthy and large captive population to survive. Hand rearing is no easy task – for the first month she was fed every two hours! Many sleepless nights and I was not even on maternity leave! It was a huge task but it was very rewarding when she was successfully reintroduced back to the group and then in October 2011 moved to Germany to start her own breeding group.

Being a zookeeper is not confined to the collection you work at either. There are many opportunities to travel to conferences to share and learn, as well as visiting conservation projects. At ZSL we have over 120 conservation programmes and each year one keeper is sent to a project of their choice. In 2008 I was lucky enough to travel to Ghana to visit the Endangered Primate Centre run by the West African Primate Conservation Action, a conservation NGO which saves three of West Africa's most endangered primates – the roloway monkey, Miss Waldrons Colobus and the white-naped mangabey. Having the chance to experience first hand the conservation work that is being supported by zoological collections really made me feel proud of my work and of the work of ZSL.

On an almost daily basis, I am told I have the best job in the world. I am not sure about that, but I do know that I work with some of the most amazing animals in the world and contribute to their conservation, for which I am incredibly privileged.

There is no course or training programme that can make you a good zoo keeper, it's not an exact science. It is about trusting your instincts, the other keepers, and sometimes your heart.

An exploration of the utility of genetic analysis (mitochondrial COII gene) for the purposes of identification of species and origins of capuchins (*Cebus,* Primates) housed in a sanctuary in the UK.

Lauren E. Lansdowne
Cohort 11/12
lauren_harnett@yahoo.co.uk

This project was largely inspired by the work of Ruiz-García *et al.* (2010). In the authors' previous research a large number of genetic samples were collected from wild Platyrrhine monkeys of known geographic origin. Through the construction of phylogenetic trees based on the mitochondrial COII gene, they were able to demonstrate the presence of distinct genetic populations within the animals' ranges. By sequencing the COII gene for over 100 confiscated primates in Bogotá, Colombia (*Aotus*, *Cebus*, and *Saguinus*), they were able to determine the geographic origin of most of the monkeys. This information was then used to guide decisions for release sites, demonstrating how genetic analyses can be used to directly aid conservation efforts.

Wild Futures Monkey Sanctuary is based in Looe, Cornwall, UK. The sanctuary currently houses twenty nine capuchins, the majority of which have been rescued from the pet trade. The origin and even species (and/or subspecies) of the majority of the capuchins remains uncertain as accurate histories are often absent.

The goals of the project were:

-To identify the species (and possibly subspecies) of each capuchin currently at Wild Futures Monkey Sanctuary.

-To identify the geographic origin of each individual capuchin, or if captive bred, that of its maternal line.

-To acquire information of relevance to future decisions regarding the housing and grouping of individual capuchins, with the goal of improving captive population building and individual welfare.

-To compile data of use to organizations such as Wild Futures and the RSPCA in their work to achieve a ban on the keeping of primates by private individuals in the UK.

-To frame an empirical understanding of the precise nature of the genetic origin of capuchins present in the UK, of use to groups concerned with the wider sourcing and international trade of capuchins.

Sample Collection

Hairs were directly plucked from 24 capuchins. Sterile gloves were worn, and changed for each sample. Hairs were stored in a clean paper envelope, sealed with tape. For details on hair collection and storage, see Goossens *et al.* (2011).

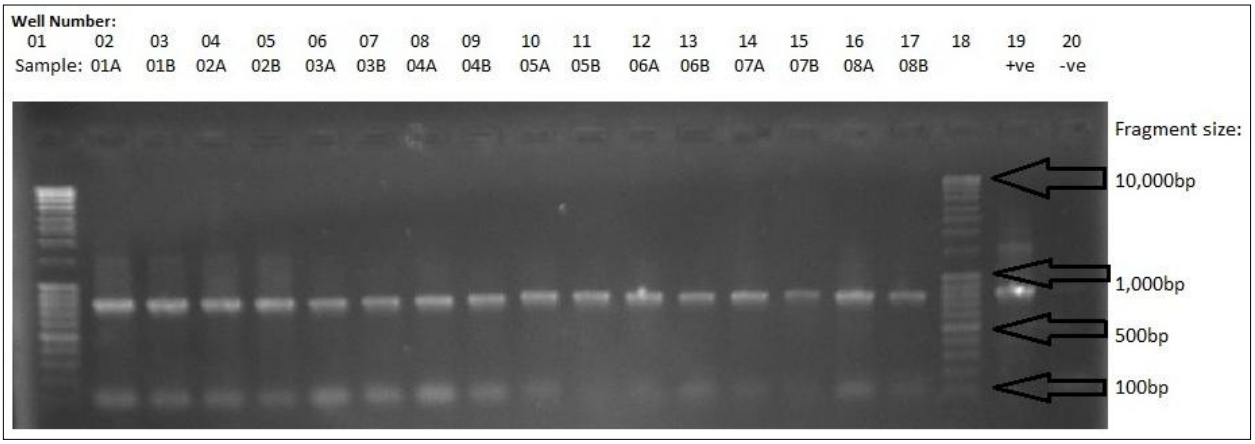

Figure 1: PCR products of samples 01A - 08B subject to electrophoresis in 1.2% agarose gel, stained with ethidium bromide and visualised under UV light. A single band of expected size is visible for each sample, indicating successful amplification. Some samples also show 'smearing' behind the band. DNA ladder manufactured by Fermentas Life Sciences (UK): MassRuler™ DNA Ladder Mix (SM0403).

DNA Extraction, Amplification and Purification

DNA was extracted from the hair samples using a Qiagen© QIAamp DNA Investigator Kit, following the manufacturers' guidelines. The extracted DNA was then subject to the Polymerase Chain Reaction (PCR) in order to amplify the COII gene. A Qiagen© *Taq* PCR Core Kit provided the materials necessary. PCR was performed using primers L6955 (5'-AACCATTTCATAACTTTGTCAA-3') and H7766 (5'-CTCTTAATCTTTAACTTAAAAG-3') (Adkins and Honeycutt, 1994; Ruiz-García *et al*. 2010). Both positive and negative controls were included. 5µl of extraction eluate was then subject to agarose gel electrophoresis in order to confirm successful amplification.

PCR products were initially purified using a Qiagen® QIAquick® PCR Purification Kit. Later in the project, samples were cleaned using the in-house service offered by the DNA sequencing laboratory.

The amplified products were sent for sequencing externally, at Source BioScience Laboratories, UK.

Analysis of the PCR products via gel electrophoresis confirmed successful amplification of DNA (Figure 1). Unfortunately however, DNA sequences were not obtained. The sequence chromatograms (Figure 2) showed multiple overlapping signals, indicating either: (i) DNA from more than one individual was present in the samples; or (ii) more than one sequence of DNA had been amplified. In order to eliminate the former, new extractions were performed, with single hairs being cleaned following forensic science protocols (Gagneux *et al.,* 1997; Higuchi *et al.,* 1988). These new extractions still failed to yield clear sequence data.

The 'smears' which can be seen behind some of the bands in the gels suggest that unintended regions of DNA were being

amplified. To address this issue, new primers were designed (FCOIIN: 5'-AAAACGCTACATCCCCCATT-3' and RCOIIN: 5'-GATTTAATCGGCCTGGGATT-3'). These primers are internal to the COII gene, and are highly specific to the COII gene of *Cebus* spp. They were used to conduct a new round of PCR, and Nested PCR following amplification with L6955 and H7766. Regrettably sequences were still not obtained.

The low melting temperatures of L6955 and H7766 necessitated the annealing temperature of the PCR to be 50^{o}C. Such a low temperature increases the risk of spurious amplification: at lower temperatures, primers may bind more easily to segments of DNA for which they do not exactly match. Touchdown PCR starts with a higher-than-optimal annealing temperature, which is reduced every two cycles. This helps limit the opportunity for non-specific binding (Don et al., 1991). Surprisingly, all samples failed to yield a PCR product visible on an agarose gel. The positive control however produced a very clear band with no visible smearing. Repetition of the Touchdown PCR with a larger number of cycles did not improve results.

The cause(s) of the failed sequencing remain unknown, and further work was not feasible in the time available for this project. However, the possibility remains for future work to optimise the laboratory procedures. If successful, sequences may yet be obtained, and the goals set out above can still be achieved. Recommendations for further

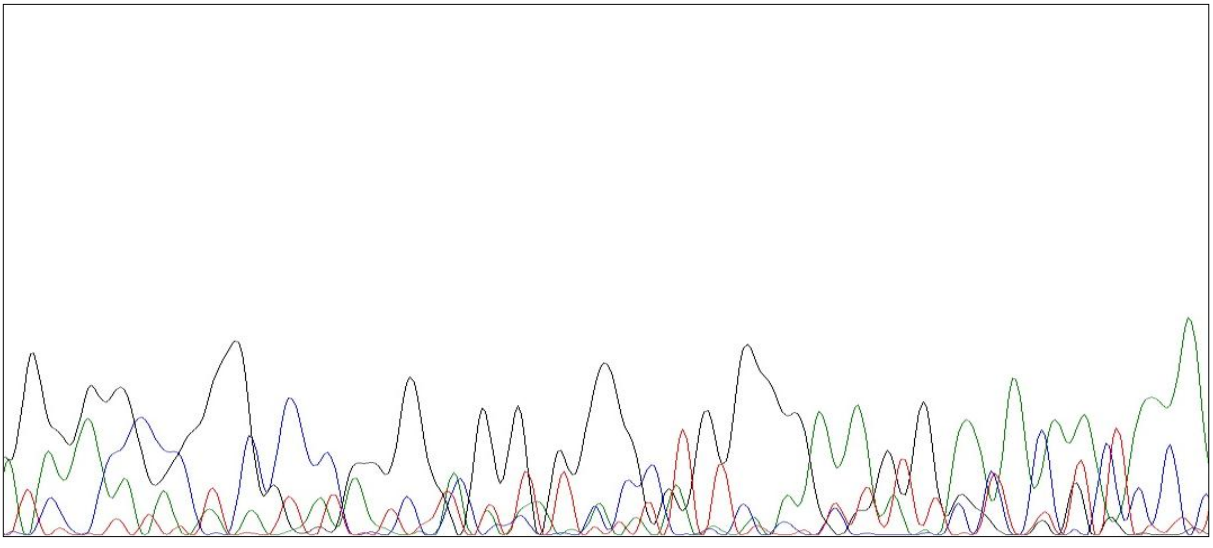

Figure 2: Segment of sequencing chromatogram for sample 01A. Multiple over-lapping peaks prevent accurate sequence data being obtained.

products, and designing novel primers.

The potential contribution of phylogenetic and phylogeographic studies to conservation endeavours is significant. In addition to informing decisions of release sites for live animals, the ability to identify the species and origin of an individual can be crucial in wildlife forensics.

By determining genetically distinct populations, and then identifying individuals, conservationists are better equipped to determine regions and populations which are most suitable for release candidates. In primates this has been demonstrated by Ruiz-García *et al.* (2010) for New World monkeys, and Wyner *at al.* (1999) for *Varecia variegata variegata*.

The trade in pet primates, and its associated consequences, are not unique to the UK. It is a global problem which requires a global solution. Investigation of the trade routes and species involved, including genetic analyses, are needed in numerous countries. Armed with sufficient information, decisions can then be made as to appropriate conservation action.

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Pet primates: What are the key health Issues and how does veterinary training in the UK ensure their welfare?

Amy Parker
Cohort 11/12
missamyparker@gmail.com

The exotic pet industry is booming, and with an estimated 15,000 pet primates in homes throughout the USA and up to 7,454 privately kept in the UK, it has become a profitable and growing industry (Mott 2003; RSPCA/Wild Futures 2010). However, the suitability of primates to private ownership remains questionable, with several sources suggesting that keeping a primate in the home can lead to compromised welfare and a lack of specialist veterinary care may well lead to serious health issues for the primate (Ballard 2003; Serpell 2004; Soulsbury *et al.,* 2009; Hess 2011).

Although laws are in place in the UK to protect the welfare of animals, legislation currently allows several small primate species to be kept in the home without any form of permit, with other species licensable at a small fee (DEFRA 1976; 2006; 2007). Conversely, state laws in Florida appear, on face value, to be stricter, with all species requiring a permit, documented evidence of high levels of welfare and 1,000 hours of hands-on experience (FWC, 2011). The dietary, health and behavioural needs of primates have been shown to be complex and the welfare of privately housed primates may be considerably compromised by a lack of understanding of these needs (eg Wood *et al.,* 2003; Gonzales *et al.,* 2005; Wolfensohn & Honess, 2005; Smith *et al.,* 2008; Hosey *et al.,* 2009; Soulsbury *et al.,* 2009; Kleiman *et al.,* 2010). Part of this research therefore attempted to ascertain the success of these laws by assessing the state of health of ex-pet primates arriving at sanctuaries both in the UK and in Florida.

Wild Futures Monkey Sanctuary has designed and maintains a datasheet to monitor the range of conditions, both medical and behavioural, of primates arriving at its centre. In order to build on the data Wild Futures has collected, a duplicate datasheet was sent to one further UK-based and four US based rescue centres in order to establish any correlations in dietary and welfare needs not being met by owners of privately housed primates across the two countries. The data show that all but four subjects from the UK and all USA subjects were reported to have at least one medical or behavioural condition on arrival and it is suggested that, at least in the case of the individuals of this study, the welfare needs of pet primates are not being fully met by owners in either country. The conclusion was that Florida's more stringent laws do not reflect higher welfare in rescued

pet primates.

This research project further investigated how the training that UK vets receive helps to ensure the welfare of pet primates under their care. In order to do this, an online survey was sent to 169 UK vets across different specialism, including small-animal vets, in order to identify the level of exotic-animal medical training received by vets who currently treat pet primates. The questionnaire also attempted to determine how confident these vets feel in doing so, as well as ascertain what action vets who have never previously treated pet primates would take if asked to do so by a client.

The results of the 50 responses received showed that the majority of surveyed vets who had never before treated a primate would refer a client to a specialist vet if they were asked to treat one. With regard to those vets that do treat pet primates, a positive correlation was found between area of specialism and confidence levels, with zoo and exotics vets more confident in treating primates than those that primarily treat small animals. Hands-on experience with primates prior to vet training was also shown to enhance confidence levels. No correlation was detected between the frequency with which primates were treated and confidence levels. A range of reference tools used by vets when treating primates was also identified.

The overall conclusion of my research was that while the majority of vets that have no prior experience working with primates would choose to refer primates to specialist vets if asked to treat one, and that those that do treat primates predominantly have post-graduate qualifications in exotic medicine, primates in both the UK and in Florida nonetheless arrive at sanctuaries with compromised health and behavioural patterns due to their captive environment, indicating that tighter laws do little to protect the welfare of pet primates. It is therefore the conclusion of this study that the area for concern lies with the owners, through either a lack of understanding of the behavioural, environmental and nutritional needs of primates or a lack of veterinary attention received by their pets. It is suggested that the UK government further investigate the suitability of primates as pets, licensed or licence-free, as well as how stricter measures

Figure 1. Ex-pet capuchin housed at The Talkin' Monkeys Project, Florida, whose canines were removed by his owners to prevent biting.

for their welfare can be enforced. Further research into pet primates within the home and consultations with owners are therefore recommended in order to help identify the key medical and behavioural issues that primates are facing in the domestic environment in order to mitigate them before their welfare is compromised.

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Sociosexual behaviour as an indicator of abnormal behaviour in captive bonobo (*Pan paniscus*) groups; a preliminary assessment.

Tom Pinfield
Cohort 11/12
tom_858@hotmail.co.uk

Bonobo (*Pan paniscus*) groups are characterised by high sexual activity, female dominance, strong female bonds and subordinate males (de Waal, 1988; Blout, 1990; Parrish, 1994). Social hierarchy is more often maintained through affiliative and altruistic behaviour than through agnostic dominance (de Waal, 2008). Sociosexual behaviour is the most effective of these whilst being a fundamental aspect of the species' behavioural repertoire, which incorporates every group member and is used in varying contexts. Heterosexual interactions are as frequent as homosexual, and they include juveniles, infants and incestuous partner combinations (de Waal, 1988; Palagi, 2006; Hare *et al.*, 2007; Paoli *et al.*, 2007; Stevens *et al.*, 2008). Interactions extend beyond the ventro-dorsal mounting seen in most primate species, and include oral sex, genital massages, masturbation and mouth kissing, as well as an additional two copulatory positions, ventro-ventral and opposite mounting (de Waal, 1988; Blount, 1990). Frequent sexual contacts and interactions have been suggested to be critical in maintaining the equilibrium of social groups, as well as a characteristic of captive groups receiving correct husbandry (Parrish, 1994).

Maintaining captive populations of any species requires strict husbandry procedures, yet repetitive routines with little variation can lead to animals developing detrimental physical, psychological and behavioural abnormalities (Hosey *et al.*, 2009). One technique used to assess welfare levels is studying the frequency of species-specific behaviours (Rees, 2011). In order to assess whether such abnormalities are present in bonobos, studying their sociosexual behaviour may represent an accurate indicator, specifically, investigating whether species-specific behaviours are exhibited as a response to specific stimuli, as has been demonstrated in previous studies. Assessing bonobo welfare in this way has not been reported previously. If shown to be effective, it represents a useful tool for keepers and researchers alike because the behaviours are easy to identify and the associated stimuli are predictable and, to some extent, controllable. The observations reported here may also be of interest from a conservation standpoint because the species is currently listed as endangered meaning all captive individuals, including those in this study, are part of the international breeding programme (CITES, 2012; Caley, Pers. Comm.). Stereotypical behaviour has been shown to be linked with a reduced breeding and rearing success (Meyer-Holzapfel, 1968); therefore the presence of the former in the subjects in this study could inhibit Twycross Zoo's wider conservation responsibilities.

Observations were conducted over a 10 week period from the 4 June 2012 through to the 6 August 2012 at Twycross Zoo, Warwickshire, UK. A focal continuous sampling technique (Altmann, 1974) was used to observe the subjects. Nine of the subjects were observed for a total of 7 hours, 20minutes but two of the subjects were observed for only 7 hours. A total of 80 hours were completed. Sessions lasted for 15 minutes in length, with a five minute break between each. The participants, type of behaviour and associated stimuli for each interaction were recorded. If subjects were out of sight for more than two minutes a new session was started and the time was made up during the next session. All data were recorded on predesigned collection sheets with the 15 minute intervals being marked using the stopwatch feature on a Casio F – 91W watch. 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 (Fowler *et al.*, 1998).

An extensive repertoire of sexual contacts were recorded, with a significant difference observed in the overall frequency of behaviours exhibited by each group ($p<0.05$).To explain group-level differences, Stevens *et al*., (2008) postulated that captive groups with a higher mean age exhibited less sexual behaviours. This was found to be consistent with the groups in this study; group A with a higher mean age exhibited 163, compared to 304 by group B with a lower mean age. Ventro-ventral mounting was exhibited most frequently for both groups (n=208 combined) which is in line with the observations of de Waal (1988), Parrish (1994) and Hohmann & Fruth, (2000). Other behaviours observed were genito-genital rubbing, mutual penis rubbing, ventro-dorsal mounting, opposite mounting, ventral present, masturbation, concave back, oral sex, mouth kissing and genital massages.

A highly significant association was observed between the previously described stimuli and the sociosexual behaviours exhibited as a response to them ($p<0.05$). Food anticipation resulted in the highest number of sexual contacts (n=173 combined), which corresponds with the most widely reported stimuli for sexual activity for both wild and captive bonobos and supports the tension regulation hypothesis (Kuroda, 1984; de Waal, 1988; Parrish, 1994; Paoli *et al.*, 2007). Post agnostic behaviour was the second most effective stimuli (n=117 combined), complimenting the conclusions proposed by de Waal (1988) and Hohmann & Fruth (2000); that these behaviours contain reconciliatory properties. Other stimuli included the presence of food items and enrichment items, affiliative social interactions and pre-agnostic interactions. From a conservation perspective these results are encouraging because there is no evidence to suggest that the captive environment is having a detrimental effect on the subject's welfare.

Little research has been applied specifically to bonobos, yet stereotypical behaviours can include regurgitation and reingestion, self-injurious behaviour, coprophagy, excessive grooming, rocking and hair loss (Miller & Tobey, 2012; Clark, 2011; Sakamaki, 2011). These behaviours are detrimental to the individual animals and are distressing for visitors because they expect to see animal behaving in a way which is species-specific (Ings *et al.*, 1997). Caution should be taken with wild–captive comparisons for two reasons; many species' wild behavioural repertoires are unknown, thus prohibiting comparisons to be made, or worse, resulting in erroneous theories of how they *should* behave in captivity; secondly, for species where these data are available, encouraging these behaviours in captive animals using enrichment is difficult, time consuming and expensive (Veasey *et al.*, 1996; Hosey *et al.*, 2009). Crucially, this is not the case for bonobos; sociosexual behaviour, and the stimuli associated with it are well documented in wild and captive specimens (Kuroda, 1984; Hohmann & Fruth, 2000) and can be studied without changing the husbandry routines already in place.

The central prediction of this report was that sociosexual behaviour could serve as a species-specific tool to aid in the identification behavioural abnormalities. Though preliminary, the results obtained indicate this to be correct. The repertoire of behaviours, the stimuli associated with them and the social functions of these are consistent with previous studies. This assessment is by no means comprehensive, and a study focusing entirely on abnormal behaviours would be a logical next step to expand on these data. Likewise, a study focusing specifically on mother-infant dyads would present more detailed findings regarding rearing behaviours. However, this technique is a useful baseline because the behaviours and the contexts they occur in are predictable, meaning abnormalities would be easy to identify. Though no stereotypical responses were recorded, it is recommended that the outside access and general husbandry routines are rotated more frequently and made less structured than what they are currently to prevent them from developing.

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The use of temperament scoring to improve survivorship for reintroduced slow lorises (*Nycticebus* spp.)

Amanda Gray
Cohort 11/12
abethgray@gmail.com

The International Animal Rescue Indonesia operates the Ciapus Primate Centre (CPC), a unique rescue centre on the island of Java where slow lorises are confiscated from the illegal pet trade, rehabilitated, and reintroduced into suitable habitat. The IUCN classifies the Javan slow loris (*Nycticebus javanicus*) as Endangered, while the Bornean slow loris (*N. menagensis)* and the greater slow loris (*N. coucang*) are both Vulnerable (Nekaris & Shekelle, 2008). CPC houses these three species and reintroduces only those who show a strong potential to survive. Unfortunately, most of the lorises arrive at the centre with clipped teeth, which is brutally performed by traders in order to "tame" them. This prevents many species-typical behaviours such as social grooming and tree gouging (Nekaris *et al.,* 2009). Severe abnormal behaviour further contributes to the already challenging feat of adequately caring for these nocturnal and venomous primates, with many slow loris rescue centres reporting mortality rates of 95-100% (Nekaris & Jaffe, 2007).

It is not only captive care that is trying; reintroduction is particularly difficult for slow lorises, as even small bouts of captivity can be detrimental (Teixeira *et al.,* 2007). The IUCN recognises reintroduction as a valid conservation method to boost dwindling populations, however, most programs are not successful (Armstrong & Seddon, 2007). Assessing temperament before releasing animals and comparing it with survival rates can be an effective way to predict survivorship. "Temperament" may refer to a variety of personality traits, but in the present study it refers only to boldness and shyness, wherein bold individuals respond to unfamiliar situations with exploratory or non-hesitant behaviour and shy individuals become quiet, vigilant, and/or retreat (Wilson *et al.,* 1993; McDougall *et al.,* 2006). A study of this nature has never been conducted for slow lorises, thus it is unknown if boldness or shyness improve survivorship after reintroduction. Considering that lorises are often described as a "shy" and cryptic species, it is perhaps expected that shyness would not be detrimental to survival (Nekaris & Bearder, 2010). Nevertheless, some degree of boldness is necessary in many species in order to find mates and food (Boon *et al.,* 2008; Fedy & Stutchbury, 2004).

I collected all data at CPC, which is home to roughly 100 lorises between May 25, 2012 and July 30, 2012. I adapted the methods of Bremner-Harrison *et al.* (2004) for use with slow

lorises. I used instantaneous scan sampling with 30-second intervals, within 30-min observations (Altmann, 1974). I randomly assigned when individuals would be observed, as well as the order of novel stimulus presentation. Individuals were never observed more than once per night and I recorded all behaviours, latency to approach novel object, and overall closest distance to the novel object. Established ethograms were adapted to create a list of bold, cautious, and neutral behaviours (Gray, 2012). I observed seven individuals, 3 females (Amy, Gadog, and Tebe) and 4 males (Bang One, Charles, Erwin, and Passa). All were adult *Nycticebus coucang* except Charles, an adult *N. javanicus*. All individuals in this study had fully intact teeth and may be candidates for release in the future.

Because lorises rely heavily on olfactory cues (Fisher *et al.,* 2003; Nekaris & Beader, 2010), I chose to adapt the novel objects used by Bremner-Harrison *et al.* (2004) to include novel smells. The novel objects in this study were crumpled pieces of paper containing essential oils. I used two essential oils: lavender and white musk. I dipped the essential oil dipping stick into the bottle twice and thoroughly smeared the oil onto the crumpled paper when assembling the novel objects. Additional stimuli were added to some conditions to measure temperament. The seven conditions were: unscented paper (crumpled paper with no smell); lavender; white musk; lavender with an unfamiliar human present; white musk with an unfamiliar human present; lavender with the recorded sound of a dog bark; and white musk with the recorded sound of a dog bark.

Using Kendall's coefficient of concordance, I found a low level of concordance for boldness scores across all conditions ($W = 0.297$, $\chi^2_6 = 8.914$, $P = 0.178$), meaning there were dissimilar rates of boldness amongst stimuli presented (Figure 1).

Sex had no effect on boldness scores, as demonstrated by a Mann-Whitney U test ($U = 250$, $Z = -0.347$, $P = 0.729$; mean ranks for male and female were 24.57 and 23.16).

The mean boldness scores were not strongly correlated with mean latency to approach ($r_5 = -0.464$, $P = 0.294$) or the mean closest distance to the novel objects ($r_5 = -0.357$, $P = 0.432$). Latency to approach and closest distance had a strong positive correlation, meaning those who took longer to approach the objects also kept a further distance and were less likely to make contact with the novel objects ($r_5 = 0.929$, $P = 0.003$). I determined the cut-off for "bold" individuals to be the mean of all scores combined, 50.27%. All individuals falling above this mark are considered bold, whilst those below are considered shy. Under this method, four lorises are considered bold, and three are considered shy (Figure 2).

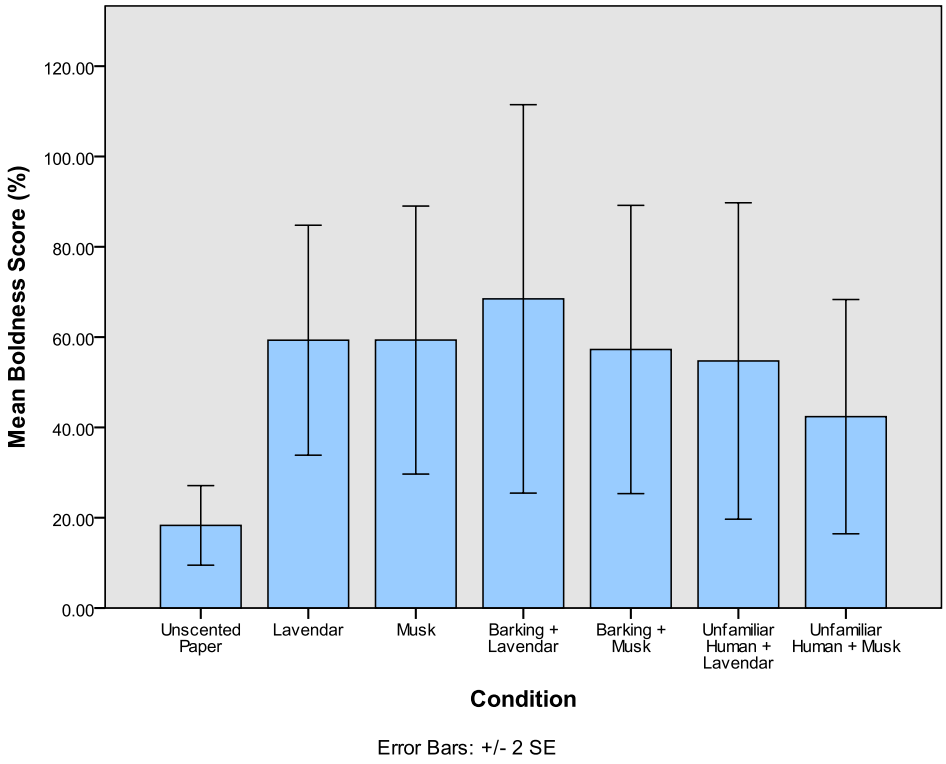

Figure 1. The averages of boldness scores for all individuals for each condition.

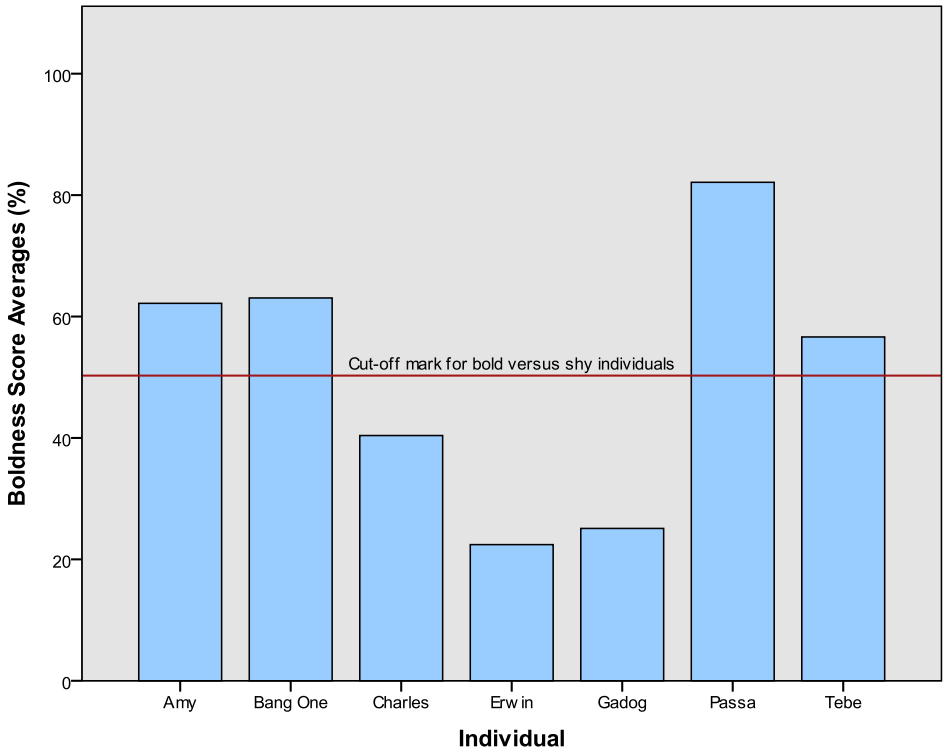

Figure 2. Overall boldness scores for each individual. The red reference line indicates the cut-off mark for what constitutes a bold or shy individual. The average for all boldness scores combined is 50.27%, thus any individual below this mark is considered shy, whilst those above are considered bold.

Although this was a small pilot study, many lessons were learned. This study provides a starting point for assessing boldness scores in lorises and using this information to improve reintroductions, which has not been previously attempted. Boldness scores were not correlated with closest distance or latency to approach; this is likely due to a lack of effectiveness in the novel objects, at least to some degree. For this reason and for greater ease in Kendall's W analysis, it would be helpful to use stimuli that are similar in their effect on the lorises.

It is unlikely that the lack of bold behaviour for the unscented paper is due to fearfulness, but is perhaps because the lorises were "indifferent" to the stimulus, as described by Ehrlich (1970). Despite the lack of interest or bold behaviour directed at the unscented paper, the lorises did tend to respond to the other novel, and even potentially alarming, stimuli in a curious and emboldened fashion, rather than cautiously. This is consistent with previous studies that examined loris behaviour in the presence of novel objects (Ehrlich, 1970; Jaenicke & Ehrlich, 1972). This is somewhat counterintuitive, as lorises are known for their shy, cryptic behaviour (Nekaris & Beader, 2010). The habituation to captive environments may be at work, which could make lorises bolder than they would be in the presence of predators and rivals in the wild (Teixeira *et al.,* 2007). Because the lorises at CPC are all rescued from the illegal pet trade, it is impossible to know what each of them has been exposed to, making the notion of "novel" objects challenging. For this reason, I suggest that importance be placed on how alarming the stimulus is in addition to novelty.

The next steps are twofold. The results I have presented for the individuals in this study can be compared against post-release data to look for any potential relationship between boldness and long-term survival. More importantly, establishing a more effective set of novel objects will allow for a standardized method of establishing boldness scores. If this can be achieved before the lorises from this study are released, re-assessing their boldness and comparing the results to those shown here could assist in the development of temperament protocol.

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