



Primate Ecology and Genetics Group South Africa

*Annual Meeting, 25-27 June 2010
The Edge, Hogsback*

From 25-27 June 2010, the University of Fort Hare hosted the 8th annual meeting of the Primate Ecology and Genetics Group (PEGG), South Africa's primatological society. PEGG was established in 2002 by Judith Masters, Professor of Zoology at UFH, and Trudy Turner, Professor of Anthropology at the University of Wisconsin, Milwaukee, and now has a sufficient professional membership that it has been affiliated to the International Primatological Society as a voting member organisation.

South Africa is what primatologists refer to as a "habitat country". We have at least six distinguishable groups of indigenous primates, including the greater and lesser bushbabies, the chacma baboon, the vervet monkey, the coastal forest samango monkey, and the Afromontane samango. The latter is the country's only endangered primate population, as the forests to which it is adapted (like the yellowwood forests of Hogsback) are fragmented and under threat of deforestation.

Primatology is a broad and varied field that draws expertise from a range of academic disciplines. While most zoologists study primates as one of the several mammal groups that pursue an arboreal lifestyle, many psychologists and anthropologists prefer to focus on the characteristics they share with human ancestors and relatives (genetic, behavioural, structural or physiological). Since South Africa is one of the cradles of human evolution, primatology should be a popular topic, and yet it is a relatively neglected field. UFH offers one of the very few undergraduate courses in Primatology available at South African universities.

PEGG provides a forum for professional primatologists working in South Africa, and drawn from countries as far flung as France, Italy, the US and Australia, as well as for non-professionals who form a crucial network active in the rescue and rehabilitation of injured and displaced primates. At the annual meeting, ideas, news and techniques are exchanged, collaborations and networks are established, and the international scientific community is made more aware of South African primates and Primatology.

Judith Masters

Abstracts of papers presented

Editors: Judith Masters and Luca Sineo

What can chromosomes tell us about the origins of primates?

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Our study investigated the usefulness of chromosome painting data in analysing phylogenetic affinities among the orders included in Euarchontoglires (Primates, Rodentia, Scandentia, Lagomorpha and Dermoptera). We applied Maximum Parsimony and Bayesian inference in the comparison of karyotypic similarities and differences visualised among 41 Euarchontaglires species and one monotreme outgroup. In total, 161 characters were identified on the basis of presence/absence of human orthologous segmental associations. The inclusion of this large sample covering a wide phylogenetic spectrum revealed that some syntenies previously reported as synapomorphic are in fact homoplastic traits. The high levels of homoplasy reflected in our data suggest that the same associations occur repeatedly. Karyotype evolution is relatively rapid, making it more informative about shallow rather than deep divergences.

Morphological and molecular interpretations of the evolution of Madagascar's lemurs

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With the growth of molecular technology, the use of morphological data in phylogenies has slipped from favour. However, analysed in combination with molecular data, well-chosen morphological characters can act to strengthen the historical signal in molecular data, particularly at depths where the molecular signal becomes ambiguous. We present the results of a Bayesian analysis of 3543 mtDNA bp and 42 multistate morphological characters to investigate inconsistencies in strepsirhine phylogenetic models. Our analysis provides a well-supported tree, with most branches having 90-100% support. It also gives four Malagasy strepsirhine families, not five. Our use of morphological characters allows us to trace the evolution of key adaptive character suites during the radiation of this group, with a view to reconstructing their ancestral states. Body size, hind limb proportions and locomotor adaptations, basicranial flexion, dietary adaptation, and activity rhythm all show reiterative evolution in several strepsirhine lineages, complicating ancestral reconstructions. We present a reconstruction of the clade ancestor using phylogenetically independent contrasts, which contradicts the common perceptions of the model strepsirhine ancestor.

The evolution of body size and Madagascar's mouse and dwarf lemurs

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The small size of Cheirogaleidae, a family of lemurs endemic to Madagascar, has traditionally been interpreted as primitive. Here we propose that it is a consequence of a secondary reduction of body size (dwarfing) from a *Lepilemur*-sized ancestor, due to a reduced developmental period (progenesis and acceleration). Recent phylogenies place Lepilemuridae as the sister-taxon to Cheirogaleidae. Dwarfing was accompanied by changes in shape, including a proportionally smaller and less specialised body, a larger head, very large orbits, and a more conical snout, resulting in a paedomorphic appearance. The skulls of red-tailed sportive lemurs, *Lepilemur ruficaudatus*, show ontogenetic shape changes (heterochrony) that predict the sizes and shapes of adult cheirogaleids. As is commonly found in insular dwarfs, cheirogaleids, and in particular the smallest species, had proportionally smaller brains than *Lepilemur*. Our phylogeny implies that cheirogaleid evolution involved at least four dwarfing events. The first led to a cheirogaleid ancestor – similar in size and shape to extant *Phaner*, *Mirza*, and the largest

forms of *Cheirogaleus* – derived from a larger form similar in size to extant *Lepilemur*. Three subsequent events of hyper-dwarfism led independently to living *Allocebus*, *Microcebus*, and the smallest forms of *Cheirogaleus*, respectively. We conclude that dwarfism in cheirogaleids is probably a response to insularity, combined with the high degree of unpredictability in food availability that has been recorded in Madagascar.

***Microcebus griseorufus*: generalist or specialist?**

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Because specialisations are viewed as evolutionary dead-ends, generalist features are often considered primitive. Mouse lemurs (genus *Microcebus*) are believed to have retained a series of primitive characteristics, such as small body size, nocturnal activity, solitary social structure, and a promiscuous mating system. The reddish-grey mouse lemur (*Microcebus griseorufus*) inhabits the south of Madagascar, a region known for its very seasonal and unpredictable rainfall. The species can be considered omnivorous, its diet including gum, fruits, nectar and insects. However, animals rely almost exclusively on gums during periods of seasonal or unpredictable droughts, a food type known to require specialisations. Moreover, opportunism itself can be viewed as an adaptation to unpredictable changes. *M. griseorufus* exhibits generalist characteristics (omnivorous diet, including introduced species) which can be interpreted as a specialisation to highly unpredictable environments. These observations indicate that notions of generalist and specialist species are ambiguous.

Sex-specific behavioral patterns during development in wild lowland woolly monkeys (*Lagothrix poeppigii*)

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Juvenile primates must begin early to form the social bonds and behaviors that will help them survive as adults. In taxa with male philopatry and female dispersal, males are predicted to socialize more and form strong bonds with other co-resident males, while forming bonds with groupmates is expected to be less important to females. Under these expectations, we predicted that 1) developing males would spend more time in proximity to other groupmates than comparably aged females; 2) that immature males would participate in more affiliative interactions, such as play and grooming, than

immature females; and 3) that immature males would spend a greater proportion of these activities with other males. We tested these predictions by exploring social behavior and proximity relationships between age-sex classes in a taxon that shows elements of both male philopatry and female dispersal: wild lowland woolly monkeys (*Lagothrix poeppigii*) in Amazonian Ecuador. Proximity and social behavior data were recorded during 278 hours of focal animal observation in three social groups over a period of 18 months. Juveniles consistently had a higher number of neighbors compared to non-juveniles, both overall (within 10 meters) and in close proximity (within 1 meter). *Lagothrix* females had significantly more neighbors overall, while *Lagothrix* males show a gradual, statistically significant decrease in the number of individuals in proximity with increasing age. Contrary to predicted patterns, immature males received less grooming than comparably aged females. There was no observable difference in play frequency between immature males and females, though adult males showed a preference for play with immature males. Overall, these results suggest that bonds between co-resident male woolly monkeys begin early in development, but also that juvenile females play a greater social role within their natal groups than expected.

Preliminary data on cytogenetics and cytotaxonomy of *Cercopithecus albogularis labiatus* (Samango monkey)

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The systematic status and phylogenetic relationships of the *C. mitis* “species group” are contentious. The species group effectively includes very different species (*C. nictitans*, *C. mitis*, and *C. albogularis*) with wide, reciprocally remote distribution in Africa, and high regional variability (very high numbers of subspecies or local types). On the basis of morphology, four good species are recognisable: *C. mitis*, *C. albogularis*, *C. nictitans*, *C. doggetti*. On the contrary a recent molecular study recognised the *C. mitis* species grouping as a valid one, although chromosome studies had already suggested that the situation may be more complicated. Genomic reorganisation has great importance in the differentiation of species, as the organisation of genetic information in chromosomes, and in gametes, is a crucial factor in hybridisation.

As the first step of the “Samango Project” (a collaboration between the Universities of Palermo and Fort Hare), formed to investigate the geographical differentiation of the populations of *C. albogularis* within the widely scattered and isolated fragments of South African mist belt forests, we performed a preliminary karyological analysis of the chromosomes of *C.a. labiatus* (CAL) individuals derived from the Eastern Cape and Mpumalanga. Giemsa-Trypsin banding was performed after tissue culture. CAL chromosomes were compared with *C. mitis* chromosomes. The diploid number

in CAL is 72, as in *C. mitis*; the karyotypes are very similar but differ in a number of rearrangements. It is noticeable that karyotypes of CAL from the two South African localities differ by intrachromosomal rearrangements. The high level of chromosome polymorphism in these species is well-known.

These preliminary data confirm that genomic organisation is polymorphic and probably regionally distinctive. Our results stimulate the application of more sophisticated molecular approaches as a proximate step, and the extension of the sampling to other populations of “*Intsimango*”, especially to the neighbouring *C. a. erythrarchus*.

Intraspecific variation in the samango monkey (*Cercopithecus mitis*) in South Africa

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Understanding taxonomic relationships among animals is essential in assessing their conservation status and evolutionary relationships. The aim of this study was to explore subspecific differences between the two South African *C. mitis* subspecies, *C. m. erythrarchus* and *C. m. labiatus*. *C. m. labiatus* is South Africa’s only endangered primate taxon, primarily because it is restricted to isolated fragments of Afromontane forest, which are encroached upon by logging and other agricultural activities. The study will focus on morphological and genetic variation.

Morphological differentiation could indicate differences in adaptation, and elucidate different habitat requirements in the two subspecies, which would aid conservation planning.

To study morphological variation, a series of measurements was taken from 71 skulls obtained from three South African museums, and subjected to multivariate analysis. Based on a rather small sample size for *C. m. erythrarchus* (n=6), the skulls of the two subspecies were morphologically distinguishable with a high degree of repeatability, indicating differences in morphological adaptation. As a result, I concluded that *C. m. labiatus* cannot be translocated to areas inhabited by *C. m. erythrarchus* without problems, and *vice versa*. I intend to increase my morphological sample size to a minimum of 100 specimens, including more of the other southern African subspecies, and to investigate genetic variation using mtDNA sequences and phylogeographic analysis, as part of the “Samango Project”.

The spatial, feeding and behavioural ecology of the samango monkey (*Cercopithecus mitis labiatus*) in Afromontane forest patches in Hogsback, Eastern Cape, South Africa

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The samango monkey, *Cercopithecus mitis*, is restricted to forest habitat throughout Africa. As a result of forest reduction, the two southern African subspecies, *C.m. erythrarchus* and *C.m. labiatus*, have experienced a 50% population decline in South Africa over the last 100 years. The latter subspecies is endemic to South Africa and is listed as endangered. I plan to determine whether *C.m. labiatus* populations centred around Hogsback, Eastern Cape, are in need of active conservation management, and how this may be achieved; and whether ecological differences between the two southern African subspecies justify their taxonomic differentiation. Over one year I will monitor two troops, with variable access to food resources associated with human settlement (e.g. oak trees). Ear tags will ensure individual identification, while radio-collars on four individuals per troop will enable me to locate the troops to record behavioural, feeding and spatial data.

Population genetic structure of vervet monkeys in the southern and central regions of South Africa

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Chlorocebus aethiops is one of the most widely distributed primate species in Africa. Vervets are frequently found near human establishments which reside within their ranges. This close proximity to humans regularly leads to human / non-human primate conflict. Many animals end up in rehabilitation centers due to injury or being orphaned as a result of such conflict. The aim of many of these centers is to re-introduce rehabilitated animals to the wild. During such re-introductions, care should be taken not to disrupt the natural patterns of genetic diversity among the natural populations. The aim of this study is therefore to determine the level of genetic differentiation among conspecific vervet populations in the south-eastern regions of South Africa, as part of a bigger project to determine levels of differentiation across South Africa. For this purpose samples were taken from three localities in the Free State Province (Soetdoring Nature Reserve (NR), Gariep Dam NR and the Parys area), two Eastern Cape locations (Tsolwana NR and Baviaanskloof NR) and one in Kwa-Zulu Natal (St. Lucia area). Using drop-traps we

trapped and sampled 82 animals from these areas. Six microsatellite markers as well as the mitochondrial control region will be sequenced to assist in identifying the levels of genetic variation. Preliminary results generated from the Eastern Cape and Free State data indicate that most variation (90.36%) occur within populations, indicating low variation between populations. The final results will be used to quantify levels of differentiation among regional vervet monkey populations, and to identify suitable recipient populations for re-introduction of rehabilitated animals if appropriate.

Geographic variation in the scrotal coloration of vervet monkeys

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Currently, the bulk of our knowledge regarding the physiological underpinnings and behavioral correlates of scrotal color is based on experimental studies of Caribbean vervet monkeys, *Cercopithecus aethiops sabaesus*, which lack the striking blue coloration that characterizes the vervet monkeys of southern Africa, *C. a. pygerythrus*. In this study, we examined the geographic variation of scrotal color by collecting digital images from wild-caught and captive vervet males on the Caribbean island of St. Kitts and from wild populations in five Africa countries.

Among both the Caribbean and African populations, younger males had dull indigo or blue scrota. Interestingly, as the testes descend and males mature, color diverges with the Caribbean population becoming faint blue or mostly white in color, while the African populations developed a richer color, ranging from aquamarine to violet. Both captive and wild adult *C. a. sabaesus* on St. Kitts exhibited white or faint blue coloration suggesting that captivity did not play a role in male color variation. These data suggest that color development varies significantly among these subspecies and that field studies of African populations are essential for understanding the potential signaling function of blue scrotal coloration in this species.

Seasonal variation in fecal testosterone and cortisol levels of male vervet monkeys (*Cercopithecus aethiops*): A test of the Challenge Hypothesis

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The challenge hypothesis, which has been successfully used to explain patterns of testosterone secretion in response to social stimuli in monogamous bird species, predicts that males will exhibit temporarily elevated levels of testosterone at critical social periods, such as at dispersal or during competition for reproductive opportunities. However, due to the physiological costs associated with sustaining high levels of testosterone for extended periods of time, we should expect periods of high testosterone secretion to be counterbalanced by decreased secretion levels during noncritical periods. Additionally, social challenges have been shown to induce the stress response in mammals. In males, asserting social dominance through aggressive and agonistic interactions and competing for access to females during peak reproductive periods have been demonstrated to directly increase cortisol levels. Thus, we can predict that testosterone secretion and behavioral aggression are positively correlated with cortisol production. However, in seeming contradiction to this prediction, multiple studies have shown that increases in cortisol via HPA axis activation inhibit testosterone concentrations, i.e. the social stress hypothesis. The aim of this research is to evaluate how social challenges associated with reproduction affect hormonal concentrations and behavior in males. In this study, testosterone and cortisol concentrations from a group of vervet monkeys (*Cercopithecus aethiops*) living in the Soetdoring Nature Reserve, South Africa, will be analyzed noninvasively from fecal samples using enzyme immunoassay techniques and compared across seasonal periods, i.e. mating and postmating periods. Further, the pattern of male steroid production will be compared with behavioral data measuring male dominance interactions and female sexual behavior.

A preliminary survey of *Erythrocebus patas* in Anbesa Chaka, Bambesi Woreda of Benishangul-Gumuz Region, Western Ethiopia

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A preliminary survey conducted in Benishangul-Gumuz Region, Bambesi woreda, Western Ethiopia, found two groups of patas monkeys (*Erythrocebus patas*). Each of the two groups had one adult male; one of them consisted of 33 individuals, whereas the other had a total of 23 individuals including the adult male, adult and sub-adult females and infants. From the structure of the two groups and the season at which they were observed, they probably had their newborns, and belong to patas species found

elsewhere. However, the long black fur coloration along the shoulder, back and upper forelimbs of the males is different from any of the four different subspecies, i.e., *E. patas patas*, *E. patas villiersi*, *E. patas pyrrhonotus* and *E. patas baumstarki*, and others found in Athi plains, south east of Nairobi and east of the rift valley, which have pink faces and a blue nasal spot and not given subspecific names. Thus, it is reasonable to think of the Benishangul patas as subspecies, as they are distinct from the other subspecies.

Preliminary results on the genetic structure of baboons on the Suikerbosrand Nature Reserve; with notes on the efficacy of DNA extraction from faecal samples

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The Suikerbosrand Nature Reserve (SBR) in South Africa hosts a population of 600-750 baboons. These animals have effectively been isolated since 1974, due to agricultural development on surrounding land. One of the aims of genetic management of this population is to use faecal samples and individual multilocus genotypes to estimate troop size. A vital prerequisite for this project is therefore to optimize techniques for genotyping baboons from faecal material. We first collected baboon faecal samples from fresh to one-week old in a controlled sampling environment. These samples were then preserved using three commonly used storage techniques, followed by DNA isolation. The quantity (ng/ μ l) and purity (260/280 ratio) of DNA was determined using Nanodrop-based analyses, and the samples were then genotyped at eight microsatellite loci. Absolute DNA yield was highest when samples were stored in silica. Amplification of baboon microsatellite from samples stored in 95% ETOH were however much more successful compared to results from silica. This conflicting outcomes for quantitative and qualitative analyses shows that total DNA concentrations do not necessarily reflect the amount of target DNA in a total DNA isolate. The results nevertheless confirm that microsatellite loci can be studied in faecal samples that are up to one week old. We then applied the results from the optimization trials to estimate the size of a baboon troop from SBR. Thirty-six faecal samples were collected in the sleeping area of the study group over a period of four days. We amplified eight microsatellite loci in all samples, with amplification repeated 5-7 times to account for false alleles and allelic dropout. From the total of 36 samples collected, and using a probability of identity (PI) as estimator, 24 unique genetic profiles for could be identified, giving a valuable estimation of total troop size.

Intraspecific phylogeography of the Chacma baboon (*Papio ursinus*)

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Papio ursinus exhibits a wide degree of regionally distributed, physical and behavioural variation across its range. It has been suggested that geographic variation often results, as geographically separate populations develop unique behavioural adaptations to their local environment. This study is aimed at assessing genetic structure across the geographic range of the chacma baboon and seeks an understanding of the microevolutionary processes that may lead to diversification within chacma. Samples were collected from unique localities in South Africa, Namibia, Botswana and 500bp of the mitochondrial hypervariable region (D-loop) were sequenced. The construction of split parsimony networks recover a deep divergence event within chacma, separating this taxon into two lineages; northern and southern; a pattern which has also been observed in mitochondrial Brown region data. Haplotype groups are geographically localized suggesting a limited amount of gene flow between sampling localities. These results suggest that, despite being a generalist species, behavioural adaptation to local habitat limits the dispersal distances of individuals and consequently gene flow between populations and may be the primary driver of variation within chacma.

Stress and reproduction in a managed population of chacma baboons in the Cape Peninsula

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Chacma baboons in the Cape Peninsula of South Africa live in close proximity to humans and come into regular conflict with them. In an attempt to reduce this conflict, active management of the population includes the employment of baboon monitors, who herd baboons away from urban areas. Females in this population thus experience frequent contact with humans, both during raiding events and during herding by monitors. These events are potential stressors for the baboons. Moreover, due to the closed nature of the population in an area that is increasingly being used by humans, dispersing males often stay in natal areas leading to overflow of males in some troops. Additionally, as part of management strategies, males are sometimes relocated among troops. This situation is particularly applicable to the baboon troops in the Tokai Forest, three of which are the subjects of this study. Female baboons in Tokai experience relatively high levels of aggression and threat of infanticide from frequently changing male residence, and this possibly also impacts stress levels in females. The main goal of this study is to

investigate the effects of the above potential environmental and social stressors on social behaviour, measures of stress, and reproductive output in females. Here, I provide six months of preliminary comparative data on three out of four troops that inhabit the Tokai Forest. The three troops vary in their demographic composition, sex ratio, and level and type of contact with humans. Preliminary observations suggest that the troops may differ in life history parameters such as infant survival, as well as in their behavioral strategies. For example, females vary across troops in their choice of male versus female partners with which to form close social ties, and this appears to depend on the sex ratio of the troop. The results of this study can help inform future management decisions to design successful strategies so as to manage the population effectively while minimizing potential negative impacts on the stress levels and reproduction of females.

The distribution of the chacma baboon prior to anthropogenic change

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The distribution of the chacma baboon (*Papio ursinus*) in southern Africa is not known with any precision. Though generalized distribution maps have been developed, these are often poorly defined patches or simply a homogenous distribution across southern Africa. Little is known about the finer scale distribution required for conservation planning, basic ecological knowledge and comparison. Distribution descriptions are a core element for general species knowledge, including population estimates, habitat types, habitat loss/expansion and even population stability. This is an important issue as the chacma baboon's conservation status is presently in a state of flux, with anecdotal evidence indicating that many local populations have become extinct and others are in decline.

The aim of this research is to develop a predicted distribution of the chacma baboon in southern Africa prior to anthropogenic change. This will provide a benchmark for comparisons with present day distributions. Using Geographic Information Systems (GIS), a set of parameters that influence and define the distribution have been established and delimited. A model was developed based on these parameters, showing the areas likely to have been inhabited by the chacma baboon prior to European influence. The results suggest two possibilities. First, the current notion of the chacma baboon being a mountain baboon is unlikely, and may result from anthropogenic impacts on their range. Second, baboons are remarkably adaptable animals that prefer cooler temperatures, which may have lead to them inhabiting the cooler, less disturbed areas of the mountains. In either case, it is likely that many areas inhabited today would have been selected against in the recent past and that anthropogenic influence may be more powerful than previously believed.

The Imfene Baboon Conservation and Education Initiative: A way forward

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The United Nations Educational, Scientific and Cultural Organization (UNESCO) argues that science and technology education is an important component in attaining sustainable development and poverty reduction. They also state that educational systems are faced with the challenge of science and technology education that has lost relevance by not adapting to current scientific and technological developments. We agree with this assessment. Furthermore, not only are global conservation efforts failing generally, but in the species that we study, *Papio hamadryas*, there is very little conservation effort at all. Existing conservation efforts are simply inadequate for behaviorally plastic and highly mobile species such as baboons. In light of these facts, we propose a strategy that will further not only baboon conservation, but broader conservation goals as well. This strategy aims to: 1) teach conservation and scientific principles to school children, 2) pro-actively address baboon conservation, and thereby 3) promote conservation in general. If successful, the outcome of this strategy will be generations of children who have real empathy for their natural environment, who understand and embrace conservation issues, and who are equipped with the necessary scientific literacy to lead us to a sustainable future.

Primate behaviour in captivity

Kouamou Moise

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The Mvog-Betsi Zoo-Botanical Garden is a conservation site that harbours within its periphery many faunal and floral species. The animal species in the zoo include big cats, reptiles, various birds species and primates, which are the focus of this conference. Almost all of the primates in the MBZBG are orphans of the bush-meat trade. Their behaviour vis-à-vis others of their kind in the wild has been influenced in many ways. Taxa present include mandrills, drills, de Brazza's monkeys, olive baboons, putty-nosed guenons, tantalus guenons, agile mangabeys and grey-cheeked mangabeys. A cross section of the primates present at the MBZBG are class A primates. Nevertheless, the conservation of the Cameroon biodiversity does not limit itself only to primates of this class, and the MBZBG captive conservation site works to conserve all threatened primates and other faunal species from their worst enemy, *Homo sapiens*. In as much as this centre remains the ideal for the conservation of primate orphans of the bush-meat trade, the centre will not relent in its effort to re-introduce these animals into their natural habitat.

