

ISSN 1093-8966



AFRICAN PRIMATES

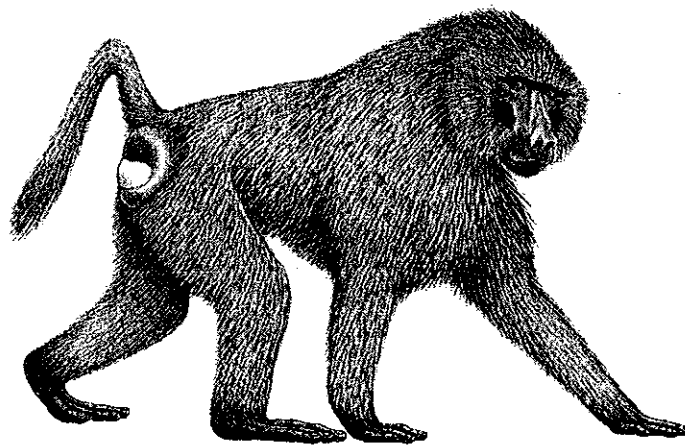
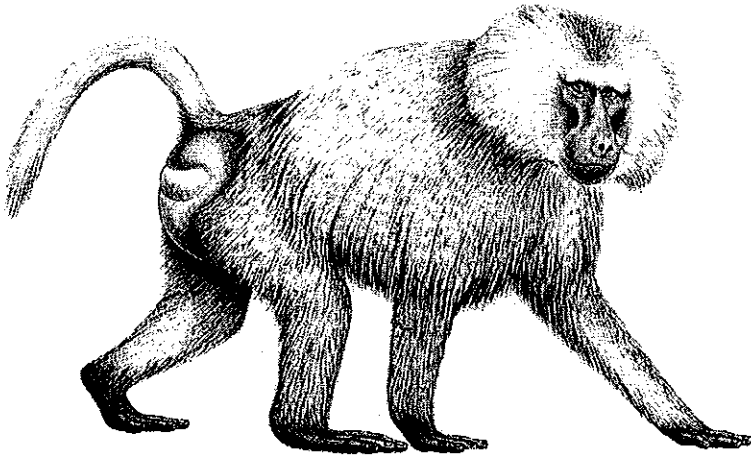
*The Journal of the Africa Section of the
IUCN/SSC Primate Specialist Group*

Volume 5, Numbers 1&2

2001

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This issue of *African Primates* was kindly sponsored by the Margot Marsh Biodiversity Foundation.

African Primates is produced and distributed by Zoo Atlanta's Conservation Action Resource Center (ARC) and the National Museums of Kenya's Institute of Primate Research and Centre for Biodiversity. The Chairman and Editors extend their thanks to Zoo Atlanta and the National Museums of Kenya for this generous support.

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ARTICLES

A NEW POPULATION OF GORILLAS GORILLA GORILLA AND OTHER ENDANGERED PRIMATES IN WESTERN CAMEROON

Abstract. *The extensive forests of the Yabassi region are still relatively pristine, especially that of Ebo (1400 km²) and Ndokbou (over 1000 km²). Preliminary faunistic surveys carried out in December 2000-February 2001 revealed the unexpected presence of a small population of gorillas *Gorilla gorilla* in the north of Ebo; the only other population present today north of the Sanaga is that of the Takamanda area on the Nigerian border (*G. g. diehli*) some 180 km to the north, while *G. g. gorilla* occurs only south of the Sanaga. Other primates of interest include drill *Mandrillus leucophaeus* (possibly the largest population now in western Cameroon), Preuss's monkey *Cercopithecus preussi*, red colobus *Procolobus ?preussi* and chimpanzee *Pan troglodytes*. All of these are still widespread and particularly common in Ndokbou and Ebo. Commercial hunting for the Douala market by the few peripheral villages and localized logging operations are nevertheless serious threats. Partial protection of some species (starting with gorilla) should be encouraged with the support of the local people.*

Résumé. *Les grandes forêts de la région de Yabassi sont parmi les mieux préservées de l'ouest du Cameroun, surtout celles d'Ebo (1400 km²) et Ndokbou (plus de 1000 km²). Une étude préliminaire de la faune en décembre 2000-février 2001 a révélé la présence inattendue d'une petite population de Gorilles *Gorilla gorilla* dans le nord de la forêt d'Ebo; jusqu'ici la seule population connue au nord de la Sanaga était celle de Takamanda à la frontière nigérienne (*G. g. diehli*), quelque 180 km plus au nord, tandis que la race nominale n'est connue qu'au sud de la Sanaga. Le Drill *Mandrillus leucophaeus* est répandu partout et reste assez nombreux à Ebo et Ndokbou; il s'agit peut-être de la population la plus importante dans l'ouest du Cameroun. Il en va de même pour le Cercopithèque de Preuss *Cercopithecus preussi*, le Colobe bai *Procolobus ?preussi* et le Chimpanzé *Pan troglodytes*. Toutes ces espèces sont menacées par la chasse, surtout commerciale, exercée par les villages périphériques, et une reprise locale de l'exploitation forestière. Une protection partielle de certaines espèces pourrait être envisagée avec le soutien des populations locales.*

Gorillas

We undertook biodiversity surveys during December 2000-February 2001 in the Yabassi area of western Cameroon for WWF-Cameroon's Cross River-Sanaga Project. During these surveys we encountered hunters who claimed that gorillas *Gorilla gorilla* occur in the area. Published records of gorillas in this region involved only the small, endangered population of Cross River gorillas *G. g. diehli* on the Nigeria-Cameroon border, with *G. g. gorilla* appearing some 450 km south of the Sanaga River. Some of the hunters concerned were immigrants from the east of Cameroon, where they were familiar with the species. Our own long experience of working in Africa (including gorilla areas of Congo-Brazzaville and Cameroon) led us to take these claims seriously. We, therefore, set out to verify them.

The area is situated in the vast expanse of forest stretching from Yabassi (Nkam Department) to Ndikiniméki (Mbam Department). It consists mainly of three contiguous blocks of forest: Makombé (c. 600 km²), Ndokbou (at least 1,000 km²) and Ebo (1,400 km²). To the west of Makombé is another big block of forest (c. 650 km²) spreading from the Nkam River to Mont Nlonako at 1825 m (in the vicinity of Nkongsamba). The three main forests have a few hunting villages along their borders, but are otherwise uninhabited. The relief is steep, especially in Ndokbou and Ebo, where many hills are over 1000 m (to 1304 m).

None of the hunters interviewed around the Makombé forest had ever encountered gorillas; one inhabitant even commenting that they were known only to the south of the Sanaga. The first mention of gorilla came from Didier Oré, a professional hunter based at Ndokmen Nord who had hunted widely in the Nkam Department for the past 6 years. Didier comes from eastern Cameroon (Bélabo near Bertoua) where the gorilla is common. He had seen infant gorilla in Bélabo raised by people (including his aunt who had breast-fed an orphan!). He has encountered gorilla in the Littoral Province only once (unlike chimpanzees *Pan troglodytes* which he encountered throughout). He said that in November 1997 he had encountered a group of four feeding near the summit of "Mont Sinaï" in the Ndokbou forest. He also reported the killing of several gorillas in the north of Ebo forest by commercial hunters based to the south at Eboh and Mamba. We verified this later when we interviewed hunters at Eboh.

Jean-Paul Minyal (also from Bertoua), based at Eboh, shot an adult male gorilla and an adult female gorilla in about 1997. These were smoked and sold to the middlemen who arrive on the bush-taxi from Douala. Another Easterner, "Mr Armand", from Mamba, had reportedly shot three gorillas at about the same time. We were unable to interview these people personally, as they were away on leave in Eastern Province.

We visited "Mont Sinai" (4°34'N, 10°30'E) on 29 January (a 3-day walk from Ndokmen Nord). We saw the clearing near the summit where Didier claimed he had first encountered the gorillas; a prairie of *Aframomum*. Didier said he relocated the group later that same day in a swampy area near the Grand Nouya (with Marantaceae and *Aframomum*). At the time of our visit, the *Aframomum* were not fruiting, and the area was much used by elephants. Although we found no signs of gorillas during this brief visit, we were convinced of the authenticity of this sighting as Didier showed himself to be knowledgeable and reliable in the days he spent with us.

Inhabitants of Ndokmen Nord reported to us the killing of a gorilla in December 2000 in the forest south of Iboti (a smoked foot travelled on the bush taxi to Douala). The people of Lognanga had also seen other parts of the same animal on their bush taxi to Douala (Iboti hunters send bush meat in both directions). Another gorilla is said to have been shot in the forest south-east of Logndeng in 1999 by a young man who had never encountered a gorilla before. He took fright when he saw what he had shot and left most of it in the forest after detaching an arm to show his friends. Finally, one of our porters from Ndokmen (Gaston Mouellé) had visited this forest with his cousin (the Chief of Logndeng). He told us that he was shown fresh nests of gorillas.

Our next move was to organise an expedition into the north-eastern hills of Ebo Forest, where those recent killings mentioned above had taken place. The young Chief of Logndeng (Emmanuel Nguillé Moukaisedi) was our guide (9-12 February). He proved to have a remarkable knowledge of his forest and its gorillas. Within hours of getting to the Békob area (4°34'N, 10°30'E) he showed us gorilla nests. In all, we saw eight nests (3 plus 2 plus 3) on the edge of swamp forest (with some *Raphia*), with much herbaceous understorey (Marantaceae, *Aframomum*). All nests were 50-80 cm above the ground. They were perhaps a couple of months old. The Chief was very surprised that he could not find fresher nests. He put this down to the unusual abundance of elephants, which must have disturbed the gorillas. One fresh gorilla track could not be followed for long as it was obliterated by elephant spoor.

The Chief claims to have seen gorillas on many occasions; even "two groups in a day was not unusual in the Békob area". He also recounted watching a group feed peacefully on the other side of the stream (in the swamp forest), taking no notice of him. He also said that he has met gorillas at night. According to him, the area used by gorillas today is confined to the hills between the headwaters of the Grand Nouya and Ekem Rivers, around the old village sites of Békob, Masseng (north of Békob) and Ndogbaembi (south-east of Békob, at the source of the Ekem). This is an area of roughly 60 km². All of the villages in this region were deserted during the Bamiléké War of 1959-60. The forest of Ebo is now virtually uninhabited. These hills are sometimes

called "les collines du brouillard", as they are over 900 m and attract much mist in the rainy season. Questioned on the occurrence of gorillas in the Ndokbou Forest (Mont Sinai), the Chief commented that perhaps a group had wandered down the Grand Nouya Valley in that direction, but he was not aware that they were regular in Ndokbou.

On the matter of hunting, the Chief also confirmed that too many gorillas had been shot in recent years. He was aware of about eight killings by the hunters of Iboti and Logndeng, in addition to quite a few by the professional hunters from Eboh, Mamba and also Massok (in the south-east). All of these killings had taken place in the same area, even though this forest "belongs" only to the people of Iboti and Logndeng. This encroachment by "foreign" hunters is much resented by the local people. In the past, gorilla was considered as "Royal Game", and shooting one required the authorization of at least four Chiefs. E. Nguillé Moukaisedi recounted one such event, that took place long before he was born (he is 37). One old solitary male had been condemned to be shot. Porters were recruited in advance and asked to build a good stretcher. The animal was shot with an elephant gun, transported whole back to the house of the Chief in Logndeng, and a morsel of the meat was sent to the Sous-Préfet at Yingui as a present. Today, such taboos have broken down, as the authority of the local chiefs is no longer respected by some young people or by an increasing population of foreign hunters.

To summarize, the centre of distribution of gorillas in the Yabassi area is today in the hills in the north-east of Ebo Forest (between the headwaters of the Grand Nouya and Ekem Rivers). Their status in south Ndokbou Forest (connected to the Ebo Forest by the Grand Nouya Valley) requires further study. It is clear that we are dealing with a very small population, as only the villagers of Logndeng and Iboti are familiar with the species (in addition to a few professional hunters who enter the same area from elsewhere). People questioned at Lognanga (who hunt in the hills immediately to the east of Békob) had never seen gorillas, although they had heard about their presence. Only one of the MINEF (forestry department) staff questioned, Benjamin Noya (25 years of service with MINEF, now based at Kopongo), had ever heard of gorilla in the region. He reckoned gorillas existed in south Ebo in the past, and had been pushed north by the professional hunters operating in the south.

Hitherto, published records of gorillas in this region involved only the small population (*G. g. diehli*) on the Nigeria-Cameroon border, about 180 km north of Yabassi, in the area between Afi and Takamanda (Groves & Maisels, 1999; Sarmiento & Oates, 1999). The nearest gorillas to the south are about 250 km away. The Humboldt University Museum (Berlin) holds three old specimens from "über Edea" (Sarmiento & Oates, 2000), *i.e.* "above Edea". These may have originated from the

Ebo population or other populations near Edéa that have since been extirpated. There are also old specimens from Bafia and Sakbayémé (where the species certainly does not survive today). Otherwise, all other populations of gorillas are south of the Sanaga River, indeed south of the Nyong (localities in Groves, 1970). Prescott et al. (1994) mention a sighting of gorillas in 1992 on the main road between Edea and Douala. This is an area with degraded forest and high human density, and it is difficult to imagine gorillas there. Gorilla meat is indeed sold in the Douala area (originating from Yabassi and Takamanda), but chimpanzees are so often mistaken for gorillas that such a sight record cannot be accepted on present evidence. Figure 1 shows the present and historical distribution of gorillas in Cameroon and Nigeria, as currently known.

Other Endangered Primates

Red colobus *Procolobus ?preussi*. Apparently not recorded west of the Nkam River, but widespread from the Nkam to the east and south. Reported by hunters from near the Makombé and Ebo Rivers, as well as in hills such as "Mont Sinai", and right down in the south of the Ebo Forest. Hunters say this monkey is one "qui bouffe les cartouches" (*i.e.*, hard to kill in one shot), a comment we heard at Eboh as well as at Yingui. This species is said to be decreasing everywhere as a result of over-hunting. Several were seen by F.D.-L. and our field assistant on 26 and 27 December in a large polyspecific association of monkeys resting on the Ndouo/Nkam confluence (west of Toumbassala). The animals observed were as follows: underparts, arms and legs entirely washed with brick red; cheeks white with long hairs (whiskers); upperparts not well seen but clearly darker than underparts. Some forms of red colobus are known to be variable in colour, and this population is not well illustrated in fieldguides. Hunters who know it well could not recognise it from Haltenorth & Diller (1980). Its calls were not heard anywhere. Called "Souiniam" in Banen. Red colobus were evidently very common in

Yabassi in the past. Napier (1985) lists some 80 specimens (housed in British museums) that were collected in 1939, from Ndokyam hills, Yabassi District (4°15'N, 10°15'E) and north-east of Yabassi, Ndokfass district (4°15'N, 10°15'E)

Red-eared monkey *Cercopithecus erythrotis*. Much less noisy than other *Cercopithecus* spp. and likely to have been under-recorded during our survey. Seen from the Ndouo/Nkam confluence to the east and south, including the hills south of Ndokiti 3 (in Makombé), and in the far south of Ebo between our camp on the Ekem River and Eboh village. Still reported everywhere by hunters.

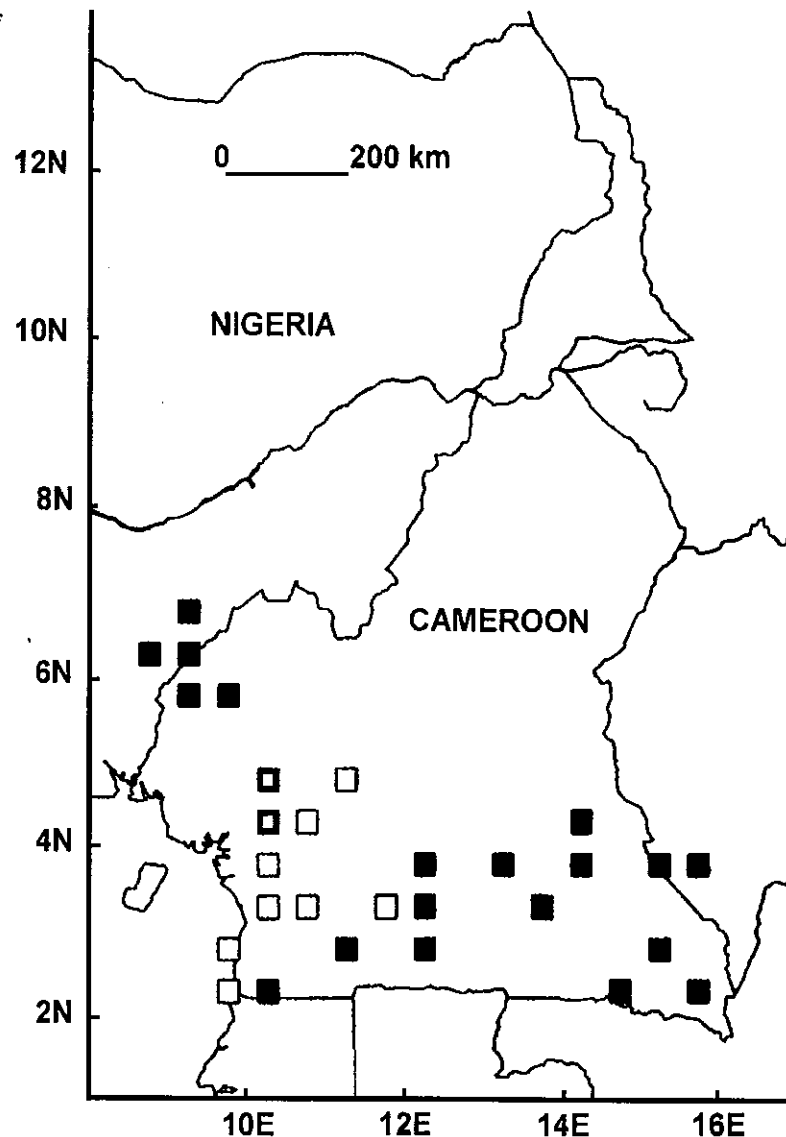


Figure 1. Distribution of gorillas in Cameroon and Nigeria (plotted by 15' squares). The distribution of the newly discovered population in the Yabassi area is shown by black and white squares, while areas from which there are certain historical records of gorillas, but where they are now thought to be extinct, are represented by open squares. These data are from Groves (1970) and other published sources.

Preuss's monkey *Cercopithecus preussi*.

Present in the Ndokbou and Ebo Forests where it is locally common. This monkey is mainly terrestrial and not easy to see. It is best located from the "dusk call" which is a loud, two-note "ouou-owe" given by group adult males. We heard four different males calling daily around our camp below Mont Kak, and at least three calling near Békob. This species was much more discreet in the south of Ebo, with only one heard on the Ebo River (between Eboh village and the Ekem confluence). One seen near our camp (Ekem) but none heard. This monkey is clearly over-hunted in that area. Preuss's monkeys were also seen between the "Petit" and "Grand Nouya" in Ndokbou Forest. It is unclear what the present situation is in the Makombé Forest as some hunters claim *C. Preussi* is still present and others say it is not present. We did not encounter any in that area. At Badjoki (Nlonako), our guide, Germain Ngoh, told us the last one in the area was shot about 25 years ago. Other hunters interviewed at Nkondjock confirmed its absence. Like the drill *Mandrillus leucophaeus*, this species is caught in snares as well as hunted with shotguns and dogs. The dogs force the animals up a tree from which they cannot move; whole groups can be exterminated in one session. Called "Teng" in Banen.

Drill *Mandrillus leucophaeus* (called "Cyno" throughout the Francophone zone).

Reported from throughout the area, although much scarcer in Nlonako and Makombé than at Ndokbou and Ebo. A small group was seen by children in February near Badjoki (Nlonako), but hunters admit the species will be extinct soon if they continue to shoot them. Tracks of a single adult were examined near the Ndouo/Nkam confluence. They were reported as having become scarce in the Makombé Forest (Ndokiti 3), mostly occurring now near the Makombé River away from the road. The situation is very different in Ndokbou where tracks of large groups were seen in several places between the Mbas River and "Mont Sinai", and some were heard on the slopes of the mountain. Similarly, there were recent tracks left by a large group on Mont Kak (900-1000 m), on the way to Békob, and on the hill west of our camp on the Ekem River. Groups of over 30 animals were mentioned as "normal" by all hunters interviewed in Ndokbou and Ebo Forests. Our guide from Eboh, Marc Bikoué, claimed to have shot four out of a large group in 1998. It was obvious that, 3 years later, a large group was present again on the same hill. Young animals caught alive in snares are often kept as pets; we heard of two cases in Yingui and another one (male) in Lognanga. South of the Ebo Forest, drills are still found near Ngonga, according to Benjamin Boya (Chef de Poste, MINEF, Kopongo).

Chimpanzee *Pan troglodytes*.

Reported from all forests by hunters, but have become

scarce in Nlonako and Makombé Forests (where we heard none). Heard near the Grand Nouya in Ndokbou. Four clean sticks, c. 50 cm long, left on the side of a termite hill on "Mont Sinai" were presumably left by chimpanzees. A noisy group was heard several times daily on the slopes of Mont Kak, and individuals from two sub-groups seen briefly there at a distance of c. 20 m. At least two groups were heard near Békob. Chimpanzees were clearly more discreet in the south of Ebo Forest, where none were heard and where the species is more systematically hunted by commercial hunters. At Badjoki, a young chimpanzee was deliberately obtained by killing the mother. This animal was kept in the village for several months until it was time to get rid of it (which is apparently easy) by selling it to a trader. A young chimp was also held at Yingui. We heard of other cases at Eboh (which had been sold).

Conclusion

The highest concentrations of primates were found in the forests of Ndokbou and Ebo. These forests are presently unprotected and threatened (in part) by logging concessions. Further research is needed urgently to assess the status and precise distribution of gorillas and other primates. Even though hunting for bush meat is widespread in the region, we feel that the protection of selected species could be improved with the collaboration of the local villagers and MINEF staff.

Acknowledgments

Our fieldwork was undertaken for WWF-Cameroon's Cross River-Sanaga Project (supervised by Dr Atanga Ekobo). We are grateful to the many officials and inhabitants of the Yabassi region who helped us, in particular Chief E. Nguillé Moukaisedi of Logndeng, and Didier Oré and Gaston Mouellé of Ndokmen Nord. Dr Esteban Sarmiento (American Museum of Natural History) commented on aspects of gorilla distribution, and Dr. Angela Meder helped with the literature.

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Post-script: Jacqui Groves (in litt.), who is studying gorillas in the Takamanda region of SW Cameroon, paid a brief visit to Bekob early in 2002, and was able to collect gorilla hairs for DNA analysis.

In February 2003 the Ebo Forest was revisited by the Chief of Logndeng at the request of J-F. and I. Lagrot. The Chief covered the whole area where gorillas are known to occur and found only 17 nests (in three groups, only one of which was fresh). The local MINEF

representative in Yingui reported an increase in gorilla poaching, estimated at present to be about one animal/week. The chances of survival of this tiny population are looking extremely poor.

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Gazetteer of main Yabassi region localities mentioned in this paper:

Badjoki	4°48'N,9°56'E	Bafia	4°46'N,11°13'E
Békob	4°21'N,10°25'E	Eboh	4°10'N,10°16'E
Edéa	3°48'N,10°08'E	Ekem River	4°06'N,10°15'E
Iboti	4°27'N,10°27'E	Kopongo	3°57'N,10°07'E
Lognanga	4°23'N,10°32'E	Logndeng	4°27'N,10°22'E
Mamba	4°08'N,10°07'E	Massok	4°07'N,10°28'E
Mbas River	4°36'N,10°26'E	Mont Kak	4°29'N,10°20'E
Mont Nlonako	4°53'N,9°55'E	Mont Sinaï	4°34'N,10°30'E
NdikiniMéki	4°46'N,10°50'E	Ndokiti 3	4°42'N,10°16'E
Ndokmen Nord	4°31'N,10°22'E	Ndouo/Nkam confluence	4°43'N,10°08'E
Ngonga	4°04'N,10°23'E	Nkondjock	4°51'N,10°14'E
Nkongsamba	4°57'N,9°56'E	Toumbassala	4°42'N,10°09'E
Yabassi	4°27'N,9°58'E	Yingui	4°33'N,10°17'E

PRIMATES OF ERITREA—CURRENT DISTRIBUTION AND HABITAT

Abstract: During a zoogeographic survey in central Eritrea (1997-1999) we gathered information on the occurrence of larger mammals and birds, the distribution and abundance of non-human primates, the ecology of primate habitats, and the relationship between people and non-human primates.

At least three non-human primate taxa are still present in Eritrea, hamadryas baboons *Papio hamadryas*, olive baboons *Papio anubis*, and grivet monkeys *Chlorocebus aethiops aethiops*. We could not confirm *Galago sp.* The present geographical distribution of the three taxa does not deviate significantly from their historical distribution. Hamadryas have been our main focus. An estimated 13,600 hamadryas live in the area surveyed. The density in parts of the survey area seems higher than in the region Kummer (1968) surveyed in Ethiopia. Hamadryas baboons are present at all altitudes in four of five eco-geographic zones (range 0-2600 m). Annual rainfall over the range varies from 100 to 1000 mm. The distribution of hamadryas overlaps broadly with

the main area of human settlement and agriculture. Olive baboons replace hamadryas in the South-western Lowlands. Intermediate morphotypes, most likely representing hybrids, were found in a 70-90 km wide area. Genetic analyses provide evidence for genetic transfer between the two taxa. Grivets are sympatric with both baboon taxa. Primates are legally protected like all other wildlife, but in 88 % of the hamadryas sites, people reported problems with baboons and chase or, sometimes, kill them.

Eritrea is a primary country for conservation of hamadryas. Although it may appear that there are too many hamadryas in parts of the Eritrean countryside, Eritrea has a special responsibility for the survival of this primate on a global level.

Résumé: Lors d'un inventaire zoogéographique au centre de l'Érythrée (1997-1999), nous avons recueilli des informations sur la présence des gros mammifères et des oiseaux, la distribution et l'abondance des primates non-humains de même que leur habitat, et la relation entre les gens et les primates non-humains.

Au moins trois taxons de primates non-humains sont

encore présents dans l'Érythrée, soit les babouins hamadryas, *Papio hamadryas*, les babouins olives, *Papio anubis*, et les singes vervets, *Chlorocebus aethiops aethiops*. Nous n'avons pu confirmer la présence d'espèces de *Galago*. La distribution géographique actuelle des trois taxons n'est pas significativement différente de leur distribution historique. Nous avons concentré nos efforts sur les babouins hamadryas. Environ 13,600 babouins hamadryas vivent dans la région inventoriée. La densité dans certaines parties inventoriées apparaît supérieure à celle présentée par Kummer (1968) en Éthiopie. Les babouins hamadryas sont présents à toutes les altitudes dans 4 des 5 zones éco-géographiques inventoriées (étendue de 0 à 2600 m au-dessus du niveau de la mer). La pluviométrie annuelle dans la région varie de 100 à 1000 mm. La distribution des hamadryas chevauche largement les zones d'établissements humains et d'agriculture. Les babouins olives remplacent les hamadryas dans les basses terres du sud-ouest. Des morphotypes intermédiaires, représentant probablement des hybrides, ont été trouvés sur une zone de 70 à 90 km de large. Des analyses génétiques supportent l'hypothèse d'un transfert génétique entre les deux taxons. Les singes vervets sont sympatriques avec les deux espèces de babouins. Les primates sont protégés par la loi en Érythrée, comme toute forme de vie sauvage, mais dans 88% des zones où vivent les hamadryas, les gens rapportent qu'ils ont des problèmes avec ces singes et se permettent de les chasser ou occasionnellement de les tuer.

L'Érythrée est un pays important pour la conservation des babouins hamadryas. Quoiqu'il peut apparaître qu'il y ait trop d'hamadryas dans certaines régions de campagne, l'Érythrée détient une responsabilité à l'échelle globale quant à la survie de cette espèce de primate.

Introduction

The Central Highlands of Ethiopia and Eritrea have been refuge areas for plant and animal species during glacial times. This region has had a profound effect upon the evolution, composition, and distribution of the flora and fauna of NE Africa. Here we find a unique assemblage of montane species, including many endemic and threatened taxa (Yalden *et al.*, 1996). In the surrounding drier lowlands, a mixture of species of different zoogeographic regions meet: species of the East Africa savannas, of the Sub-Saharan savanna belt, of the North Africa deserts, and of the Somali-arid Zone. Even species of the Palaearctic Region are present (Yalden *et al.*, 1996). The number of mammalian taxa recorded from the Ethiopian Region has risen steadily during the past 30 years, as a result of both taxonomic revisions and new discoveries. Yalden *et al.* (1996) recognised 277 terrestrial mammal species, but state that these numbers are still strictly provisional.

Most of the biogeographic work of recent decades in

Ethiopia was confined to the central parts of Ethiopia. Information on species status in the northern areas is outdated and incomplete. In 1993 this northern region became the independent state of Eritrea, but most of the relevant information on species distribution and abundance is still missing (table 1). For most of the taxa, information was never collected or derives from sources older than 50 years.

To overcome this data deficiency, the Ministry of Agriculture started a series of wildlife surveys. In this context, we focussed on primates and gathered information about their distribution and abundance in central and eastern Eritrea, particularly on hamadryas baboons *Papio hamadryas*. Additionally, we were interested in the gross ecological condition of primate habitats.

Eritrea

Eritrea (120,000 km²) is located in NE Africa on the coast of the Red Sea. It holds an estimated human population of 3.8 million. Eritrea encompasses several eco-geographical zones, which differ in altitude and distance from the Red Sea, and thus in annual rainfall and plant productivity.

In the east, the Coastal Lowlands stretch to 40 km inland with its south-eastern extension, Dankelia, an inhospitable, volcanic area with a low annual rainfall (100–300 mm) and high temperatures. About 40 km inland, the Eastern Escarpment rises rapidly to 3000 m, extending in the north into the Arid Highlands with 200–500 mm annual rainfall, and in the south, into the Moist Highlands with 300–1000 mm annual rainfall (including the Hamasien Plateau and the catchment areas of the Anseba and Mareb Rivers). This is the main area of human settlement and agriculture. The terrain in the Western Escarpment drops steeply from 2200 m to 1000 m into the North-western Arid Lowlands (200–500 mm annual rainfall). This extends in the west to the Sudanese border (where it reaches an altitude of 200 m), and to the South-western Moist Lowlands (300–900 mm annual rainfall), home to Eritrea's last elephants *Loxodonta africana* (Shoshani *et al.*, submitted).

Primate Taxa

There are historical reports of the occurrence of six primate taxa in Eritrea: bushbaby *Galago* sp., black-and-white colobus *Colobus guereza*, grivet monkey *Chlorocebus aethiops aethiops*, gelada *Theropithecus gelada*, olive baboon *Papio anubis*, and hamadryas baboon. The presence of *Colobus* is doubtful because there is almost no suitable habitat for this species in Eritrea, and *Galago* and *Theropithecus* have not been confirmed (Yalden *et al.*, 1977).

The taxonomy of the genus *Papio* is under discussion

Table 1. Historical and present numbers and status of larger mammal species in Eritrea.

Order	Present in 1830–1974	Status in 1995–2000		
	Yes	Present	Prob. extinct	Unknown
Primates	6	3	2	1
Carnivora	27	13	4	10
Proboscidea	1	1*	0	0
Tubulidenta	1	1	0	0
Hyracoidea	2	1	0	1
Sirenia	1	1	0	0
Perissodactyla	2	1*	1	0
Artiodactyla	21	7	3	11
total	61	28	10	23
%		45.9	16.4	37.7

* < 100 individuals. Historical data from Yalden *et al.*, (1977, 1980, 1984, 1986, 1996) and Game Regulation (1959). Current data from Ministry of Agriculture, Asmara, Eritrea, and authors' surveys.

(Sarmiento, 1998; Grubb *et al.*, 2003). We follow Groves (2001), classifying all five *Papio* types as species. Another problem exists for the superspecies *Chlorocebus* (= *Cercopithecus*) *aethiops*. The taxonomy of this genus and its Africa wide radiation is currently under examination (Fedigan & Fedigan, 1988; Kingdon, 1997; Groves, 2001, Grubb *et al.*, 2003).

Methods

Survey

We conducted surveys during October and November 1997, March and April 1998, October 1998, and June 1999. DZ also visited Eritrea in February 2000. To gather information about baboons' and grivet monkeys'

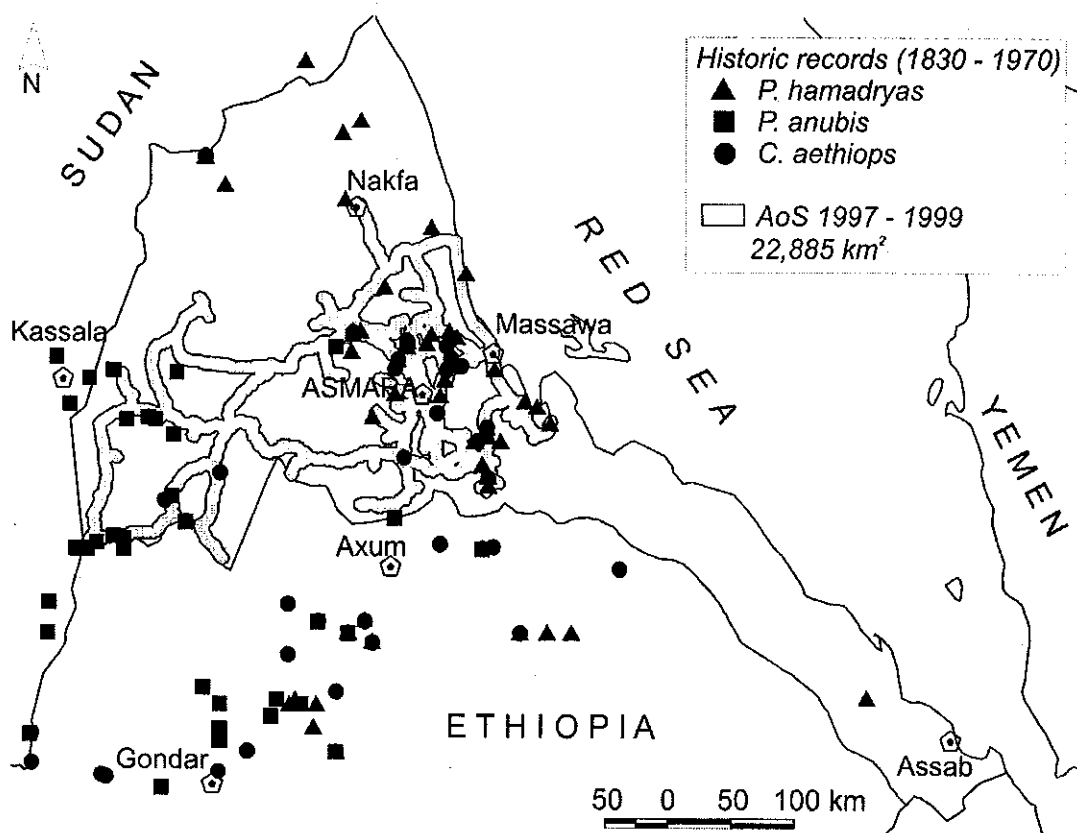


Figure 1. Historic distribution (1830–1970) (Yalden *et al.*, 1977) of *Papio hamadryas*, *Papio anubis* and *Chlorocebus aethiops aethiops* in Eritrea and our area of survey (AoS) (1977–1999).

sleeping sites, and predator and other wildlife presence, we interviewed local administrators and people in villages along the main roads and paths. People were normally well informed about baboons and grivets because, in most areas, these primates damage crops. We visited the sleeping sites of baboons and grivets, and used GPS to record their position and altitude. We tried to estimate the number of primates that use each sleeping site. We took notes on the surrounding vegetation and the nearest watercourse and human settlements. In addition, we recorded all other sites where we found evidence of primates. Evidence of other larger mammals and birds were recorded opportunistically (*e.g.*, Zinner, 2001). The survey was limited to the central parts of Eritrea due to logistic and security problems. The area of survey (AoS, 22,885 km², figure 1) extended about 5 km to both sides of the main roads and paths.

At ten hamadryas and two olive baboon sites we collected the feces of 74 hamadryas and 18 olive baboons for a preliminary population genetic analysis. We sequenced parts of the mitochondrial hypervariable region I (Hapke *et al.*, 2001). This maternally transmitted marker provided data on the sex-specific dispersal patterns in the baboons and on their phylogenetic relationships.

Habitat Description

In our description of primate habitats, we used data from several sources. Average altitude of homeranges and maximum difference of elevation in homeranges were calculated from an elevation model of Eritrea (pixel size: 0.9 x 0.9 km) to the nearest 100 m (U.S. Geological Survey 1997). Data on annual precipitation were from the National Map of Eritrea 1:1,000,000 (1995) and from meteorological stations of the Ministry of Agriculture, Eritrea.

As an approximation of habitat quality we used the Normalized Difference Vegetation Index (NDVI). The NDVI is a measure of the amount and vigor of vegetation at the surface, determined by near infra-red satellite images. The magnitude of NDVI is related to the level of photosynthetic activity in the observed vegetation. In general, higher values of NDVI indicate greater vigor and amounts of vegetation. Thus, areas with higher NDVI normally have a higher plant productivity (Kidwell, 1990). Pixel size of images after rectification was 7.6 x 7.9 km. We used data for 10 years, starting in 1982, to calculate the minimum, maximum and average NDVI for each pixel of the surface area of Eritrea (U.S. Geological Survey, 1997).

A vegetation classification of the survey area was carried out. We used the classification system from the Eritrean Ministry of Agriculture, which was adopted from FAO (1997). This is based on White's (1983) classification for African environments (table 2). From about 100 randomly chosen sites within our AoS, we categorized vegetation as reference points for the

subsequent classification of Landsat MSS (Zinner & Torkler, 1996a) and Landsat TM satellite data. Positions of settlements are from sources of the Ministry of Agriculture and maps. Rivers were digitised from the 1:500,000 maps of the Soviet Army (1979).

GIS Analysis

We defined a certain area around each sleeping site as primate "homerange". On a map we placed each baboon sleeping site in the center of a circle 3 km in radius. This yielded a 28.3 km² area as a hypothetical homerange of the respective baboon group. Similarly, grivet monkey sleeping sites were placed in the center of a circle with a 0.5 km radius (0.8 km²). These homerange sizes were selected on the basis of data from other baboon and grivet studies (Cheney, 1987). Subsequently, we described each "homerange" by altitude, annual rainfall, NDVI, and the proportion of vegetation classes within the respective circles.

For a description of primate habitats, we determined the proportion of vegetation classes and habitat quality within these homeranges, and compared these with the proportion of vegetation classes and the habitat quality within Eritrea and within the area of survey.

Results

Primate Distribution

We found 77 hamadryas sleeping sites. These were located at all altitudes of all ecological zones, except the South-western Moist Lowlands (figure 2). Here olive baboons replace hamadryas. We encountered 13 groups of olive baboons in the South-western Moist Lowlands. In the area between the two baboon taxa, we found (at seven sleeping sites) morphologically intermediate forms, most likely hybrids. We found grivet monkeys at 46 sites in all eco-geographical zones except the Coastal and North-western Arid Lowlands. Hamadryas and olive baboons have generally exclusive geographic distributions, whereas grivets are sympatric with both taxa of baboons.

Overall, the current geographic distributions of the three primate taxa seems not to deviate from their historic distributions (figure 1) as reported by Yalden *et al.* (1977). There are, however, at least two historical records of olive baboons deep in the current distribution for hamadryas: one 20 km south of Adi Quala at the Mareb River (Mayo 1876 [in Yalden *et al.*, 1977]), and another 20 km southwest of Keren (Sordelli 1902, Parisi 1917 [in Yalden *et al.*, 1977]).

Genetic Relationships Among Baboons in Eritrea

The population genetics study revealed two different lineages of mt-DNA haplotypes; monophyletic clades A and B (Hapke *et al.*, 2001). They are both present at all hamadryas sample locations (figure 3). We found identical sequences (haplotypes) in hamadryas groups

Table 2. Vegetation and groundcover types according the Eritrean Ministry of Agriculture, and the corresponding FAO (1997) and White (1983) classes.

Abbr.	Class	Description	FAO class	White class
CF	Closed or medium closed forest	Stands of more than 5 m height composed of more than two crown layers of trees. Crown cover exceeds 40%. Corresponds to mountain forest.	Mixed broadleaved and coniferous Species	Afromontane forest (<i>Juniperus procera</i> forest and associated spp.)
CW	Closed to medium closed woodlands	Woody vegetation composed of one or two layers of trees. More than 40% crown cover. Mean height above 5 m.	Savanna and woodland	Undifferentiated Sudanian/Ethiopian woodland, <i>Acacia/Commiphora</i> deciduous bushland and thicket
OW	Open woodlands	Woody vegetation of one or two layers with crown cover 10–40%. Mean height is generally above 5 m.	Savanna and open woodland	Undifferentiated Sudanian/Ethiopian woodland, <i>Acacia/Commiphora</i> deciduous bushland and thicket
BL	Bush/shrublands	Woody vegetation less than 5 m height with or without scattered trees. Crown cover over 10%.	Scrub forest/savanna	<i>Acacia/Commiphora</i> deciduous bushland and thicket
GL	Grassland/wooded grassland	Low shrubs or trees and some seasonal grass following the rains. Woody vegetation cover does not exceed 10%.	Natural range/grassland and savanna	Sudanian grassland
BS	Barren soil	Bare soil with sparse seasonal non-woody and woody vegetation, < 10%.	Barren	Many classes (desert, volcanic soils, dunes, etc.)
AG	Agriculture	Rain-fed and irrigated agricultural areas, tree crops, e.g. banana, citrus.	Agricultural land	Cultivation
TP	Tree plantation	Stands of more than 5 m height composed of one tree species (mainly <i>Eucalyptus</i>)		
UR	Other (urban areas, roads, etc.)		Other areas	Many units (urban, etc.)

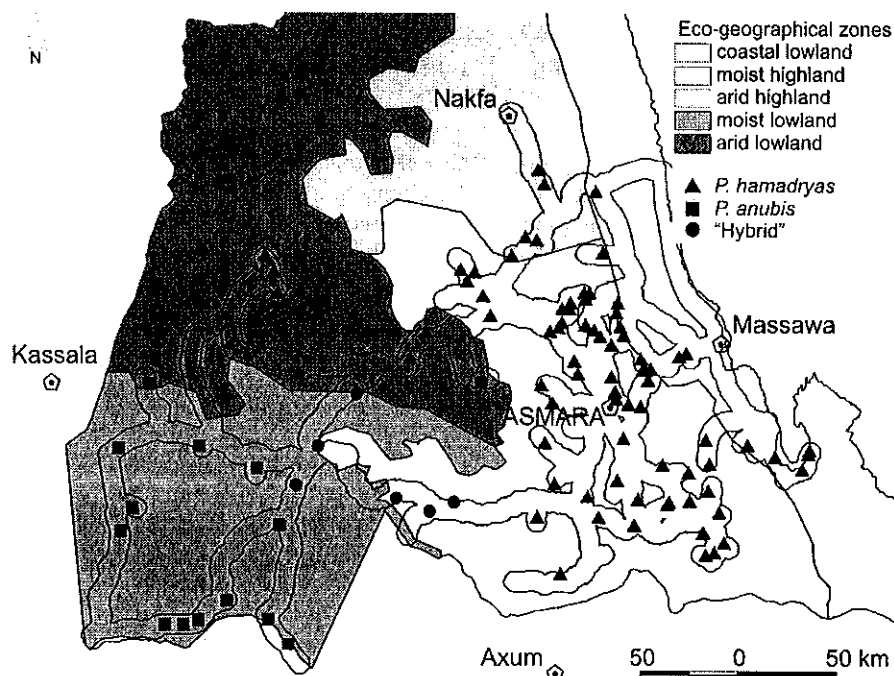


Figure 2. Distribution of *Hamadryas* baboons, olive baboons, and intermediate baboon forms (hybrids) in central Eritrea 1997–1999.

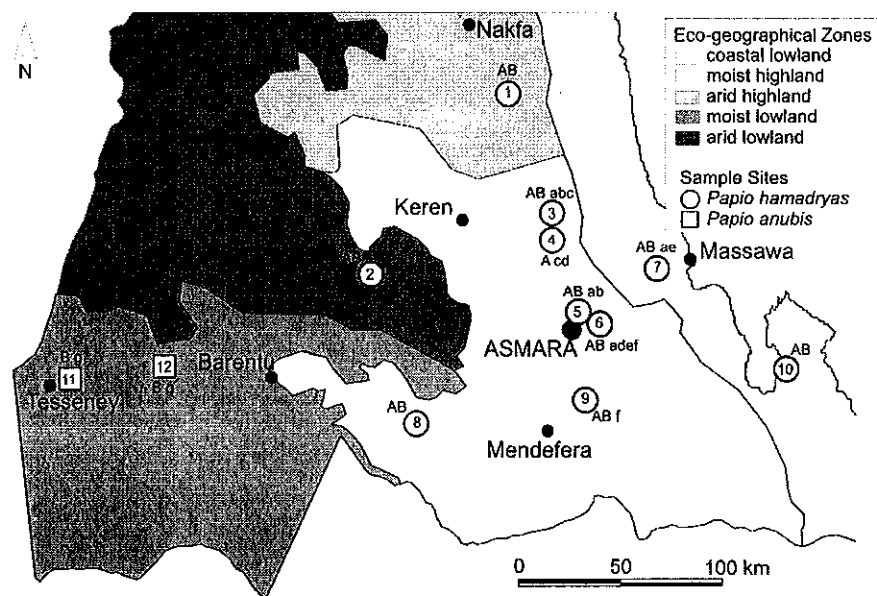


Figure 3. Distribution of mt-DNA hyp 1 haplotypes at sampling locations in central Eritrea. Sampling locations 1–10 are hamadryas sites, and 11 and 12 are olive baboon sites. A and B represent the two monophyletic clades. The occurrence of identical haplotypes are depicted with a–g.

up to 56 km apart. This provides evidence for female dispersal in hamadryas. A second result is that the sequences of the Eritrean olive baboons all fell within one of the two hamadryas clades (B). This suggests that transfer of this maternal marker occurs not only among sub-populations of hamadryas, but also between hamadryas and olive baboons (Hapke *et al.*, 2001). Thus, some degree of hybridization may exist. This would explain the intermediate morphotypes which we found between the two “pure” forms. An ongoing study may provide more insight on baboon phylogeny and taxonomy.

Population Density

Since hamadryas live in a multi-level fission-fusion social system, we used the size of the sleeping aggregations to determine population or deme size. In some cases these aggregations may correspond to what Kummer (1968) called bands. At 51 of 77 sites, we estimated the number of baboons at sleeping cliffs. The number ranged from 10 to 800 individuals, with a mean

of 176.7 (SD = 167.9). From this figure, we estimated a total population of at least 13,600 hamadryas in our area of survey. In the part of the area of survey located in the Moist Highlands, hamadryas reach an estimated population density of 1.1 baboons/km², in the Coastal Lowland 0.9 baboons/km² and in the Arid Highland 0.3 baboons/km². The social organization of the Eritrean hamadryas is the same as the classical picture for hamadryas (Kummer 1968). That is, one-male units within larger social groups (Zinner *et al.*, 2001b).

For the most intensively studied areas, we estimated homerange sizes and population densities. For the Furrus area (15°01'N, 38°58'E), we calculated a density of 10 baboons/km² and for the Durfo area (15°22'N, 38°57'E) 24 baboons/km². These densities are higher than reported for hamadryas in Ethiopia, yet the maximum density seems not to reach the maximum densities for olive, yellow or chacma *Papio ursinus* baboon populations (table 3).

At three out of seven sites we estimated aggregation size for the “hybrid” baboons (\bar{x} = 166.7, SD = 117.2, range 80–300). Olive baboon groups averaged much

Table 3. Densities of *Papio* spp. (Wolfheim, 1983 and this study)

Taxon	Baboons / km ²
Olive baboon, <i>Papio anubis</i>	1.1–63.0
Yellow baboon, <i>Papio cynocephalus</i>	9.7–60.0
Guinea baboon, <i>Papio papio</i>	2.0–15.0
Chacma baboon, <i>Papio ursinus</i>	2.3–43.2
Hamadryas baboon, <i>Papio hamadryas</i> (Ethiopia)	1.8–3.4
Hamadryas baboon, <i>Papio hamadryas</i> (Eritrea)	10.2 and 23.9

Table 4. Altitude and annual rainfall for hypothetical homeranges of hamadryas baboon, olive baboon and grivets in Eritrea.

Taxon	n	Altitude (m)		Rainfall (mm/year)	
		Range	Median	Range	Median
Hamadryas	77	33–2736	1550	100–1000	400
"Hybrids"	7	638–1250	1100	400–600	600
Olive	13	626–853	779	250–800	750
Grivet	46	604–2575	1296	400–1000	600

smaller than hamadryas groups ($x=30.1$, $SD=22.5$, range 6–75, $n=9$). However, in some cases, it is very likely that the parties we encountered were subgroups of larger groups. Grivet group size was assessed at 25 of 46 sites. Average group size was 9.7 animals ($SD=4.6$, range 3–22). At one site we found a solitary adult male (Zinner *et al.*, 2002).

Primate Habitats

Hamadryas are found from sea level to 2700 m. Olive baboons live below 900 m (Zinner *et al.*, 2001a) (table 4). "Hybrid" baboons are found from 650 m to 1250 m. Grivets occupy similar altitudes as the baboons, but are not present below 500 m in the Coastal Lowlands (Zinner *et al.*, 2002).

In mountainous areas, the maximum elevation difference within a hypothetical hamadryas homerange is 1400 m, with an average of 638 m. In some of their homeranges the baboons have to move over this elevation gradient on a daily basis; when they go down to a water source or disperse for foraging, and up again to their sleeping cliff. Average maximum elevation differences in olive baboon and grivet homeranges are much smaller (189 m and 152 m, respectively).

Hamadryas live in areas with an average of 400 mm rain/yr (range 100–1000 mm). Olive baboons (750 mm) and grivets (600 mm) live in areas with a tendency for higher rainfall, but hamadryas also use areas with the highest rainfall in Eritrea (*c.* 1000 mm/year). The differences in annual rainfall pattern also affect plant productivity, as measured by the NDVI (table 5).

As expected, Eritrea achieves only poor NDVIs, with the poorest condition in the Coastal Lowlands and the best in the Moist Highlands and Moist Lowlands. On average, primate homeranges tend to have NDVIs higher than the national average of 0.084. The difference in

minimum NDVI between hamadryas and olive homeranges is not significant ($t_{\min}=-1.45$, $df=88$, $p=0.152$), but minimum NDVIs for grivet homeranges are higher than those for hamadryas ($t_{\min}=-2.23$, $df=121$, $p<0.05$). However, the average and maximum NDVIs for hamadryas homeranges are lower than those for either olive baboons ($t_{\text{av}}=-3.31$, $df=88$, $p<0.01$; $t_{\text{max}}=-5.48$, $df=88$, $p<0.001$) or grivets ($t_{\text{av}}=-3.45$, $df=121$, $p<0.001$; $t_{\text{max}}=-2.26$, $df=121$, $p<0.05$). This suggests that hamadryas are able to live in less productive habitats than olive baboons or grivets.

The dominant ground cover classes in Eritrea are bush- (BL) and grassland (GL), followed by barren soil (BS), whereas wooded areas are only marginally represented (below 2%) (figure 4). According to the Ministry of Agriculture, Eritrea's forests suffered a demise from 30% of total land area at 1900 to less than 3% in 1990 (EAE, 1995). In the area of survey the distribution of ground cover classes deviates from the national distribution, indicating that the area of survey is not representative for all of Eritrea. In the area of survey, bushland is the dominant vegetation class, followed by agricultural areas and grassland. In particular, the frequency of grassland and barren soil is reduced compared to Eritrea as a whole. The distribution of vegetation classes in primate homeranges resembles, of course, that found in the area of survey. However, several interesting deviations occur. In hamadryas and grivet homeranges, the proportion of wooded areas (CF or CW) is higher than in the area of survey, as well as the proportion of bushland in olive baboon homeranges. In grivet homeranges, the proportion of grassland is lower and the proportions of tree-plantation, agricultural and urban areas are higher.

In large areas of the eastern part of the hamadryas

Table 5. Normalized Difference Vegetation Indices (NDVI) of hamadryas, "hybrid", olive baboon, and grivet homeranges. NDVI classes: -0.028 to 0.105 = very poor plant productivity; 0.106 to 0.155 = poor plant productivity, low; 0.156 to 0.205 = poor plant productivity, high; 0.206 to 0.259 = moderate plant productivity, low; 0.260 to 0.313 = moderate plant productivity, high; 0.314 to 0.366 = good plant productivity, low; 0.367 to 0.420 = good plant productivity, high).

Taxon	n	Minimum NDVI		Maximum NDVI		Average NDVI	
		Mean	SD	Mean	SD	Mean	SD
Hamadryas	77	0.094	0.045	0.218	0.085	0.128	0.061
"Hybrid"	7	0.103	0.024	0.271	0.078	0.150	0.024
Olive	13	0.112	0.015	0.376	0.120	0.188	0.057
Grivet	46	0.111	0.036	0.254	0.079	0.164	0.049

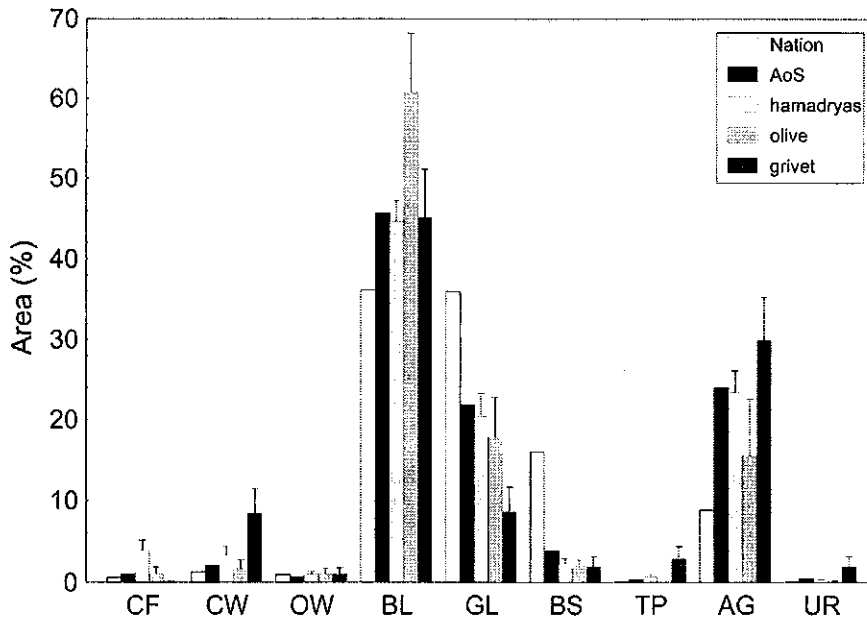


Figure 4. Proportion of vegetation and ground cover classes in Eritrea (Nation and area of survey, AoS) and in homeranges of hamadryas, olive baboons, and grivet monkeys (means+SE). Classified area: 23,070 km²; hamadryas homeranges: n=77, 2,141 km²; olive baboon homeranges: n=13, 351 km²; grivet homeranges: n=46, 34 km². CF = closed/medium closed forest; CW = closed/medium closed woodland; OW = open woodland; BL = bush-/shrubland; GL = grassland/wooded grassland; BS = barren soil; TP = tree plantation; AG = agriculture; UR = settlements, roads.

distribution in Eritrea, prickly pear (*Opuntia* sp.) is one of the dominant plants. Here it covers at least 9% of the average hamadryas homerange. This plant was introduced to Eritrea probably 100 years ago. Baboons and grivets eat the sweet fruits and fleshy young shoots of this thorny plant. Water content of *Opuntia* is 96 to 98%, which makes it an important water source for the primates, particularly during the long dry season. We found *Opuntia* close to baboon sleeping cliffs, as did Kummer (1995) in Ethiopia. This suggests that baboons are important dispersers of *Opuntia*. To what degree baboons modify their own environment is not clear, but they seem to have an important impact on the vegetation of their homeranges. From an evolutionary point of view, the interaction between baboons and *Opuntia* is a recent and interesting case of mutualism.

Water

Under the arid climatic regime of Eritrea, water becomes a limiting resource. Eritrea's rivers are all

seasonal, with the exception of the Setit or Tacazze River at the Ethiopian border. All other rivers have water only during the short rainy season. There are no natural lakes and only a few artificial dams, mainly in the moist highlands. Baboons and grivets must drink at least every other day, depending on the available moisture in their diet. Their homeranges, therefore, must include at least one source of surface water. Water is mostly found in valleys, where water from rains or from underground springs is available year round in holes and in rocky crevices. Additionally, within dry rivers, elephants, warthogs *Phacochoerus africanus* and the baboons dig for water. People also dig here for water and construct small clay troughs to water their cattle. Baboons drink here frequently and, in a few places, it seems that they depend on man-made water sources. Therefore, we used the distance to the nearest (dry) river as an approximation of habitat quality in terms of water sources (table 6). The distance between sleeping sites and the nearest site with a high potential for surface

Table 6. Distances between primate sleeping sites and (dry) rivers in Eritrea

Taxon	n	Distance to (dry) river	
		Median (m)	Range (m)
Hamadryas	77	1,093	1-5,818
"Hybrid"	7	1,045	9-1,764
Olive	13	415	29-2,725
Grivet	46	459	14-3,348

water did not exceed 5,818 m for hamadryas, with an average distance of 1,093 m. The maximum distance for olive baboons was 2,725 m, and for grivets 3,348 m. On average, olive baboons ($z=2.09$, $p=0.036$) and grivets ($z=2.18$, $p=0.029$) were found significantly closer to rivers and riverine vegetation than hamadryas. There probably were, however, at least some small water sources closer to primate sleeping sites that we did not find.

People and Primates

For people and non-human primates, the availability of water is the main limiting factor. Since water is scarce in Eritrea, people and non-human primates often depend on the same water sources. Parts of Eritrea have a long agricultural and pastoral history. Thus, baboons and grivets have lived in close proximity with people for centuries, and have adapted to some degree to the presence of each other. On-the-other-hand, there are problems between humans and baboons and grivets.

To highlight this, we used the average distances between primate sites and the nearest settlement and agricultural area (table 7). At several sites, primates live close to villages. In some places, grivets live within settlements. In some areas the sleeping sites of baboons and grivets lie very close to fields and gardens. This indicates the high potential for problems between primates and the local people.

From the inquiries during our survey, we learned that primates cause problems in almost all areas. People complained about hamadryas raiding crops (88% of sites). It was also reported that they take young goats and sheep (79% of sites). At 55% of the sites, hamadryas and people use the same water source. This is of special concern, because the potential for disease transmission is high, particularly at open water reservoirs. The situation for olive baboons looks better. Only a few people reported problems with them, most probably because of the lower human population density in the range of the olive baboons. Grivets are recognised as raiders of gardens and plantations, such as banana and citrus.

At 70% of the hamadryas sites, people stated that they chase and kill baboons in response to crop raiding or as a means of prevention (Zinner *et al.*, 2000). Although hunting is illegal, primates and other wildlife are killed with poison. In some cases, baboons and grivets are kept as pets. It was reported that the fat of the baboons' callosities is used in traditional medicine as a cure against sprains and dislocations. In contrast to many

other African countries, in Eritrea primates are not eaten.

Discussion

Although olive baboons in Africa are distributed over a variety of habitats from rainforest to semi-desert and high mountains, within Eritrea, hamadryas seem to be the ecologically more adaptive taxon. They occupy the widest range of habitats in Eritrea, from the marginal dry and hot coastal lowlands to the sub-humid and moist mountains of the Eastern Escarpment and the Central Highlands. Hamadryas in Saudi Arabia and Yemen show a similar altitudinal distribution and ecological plasticity (Biquand *et al.*, 1992; Al-Safadi, 1994). In contrast, olive baboons in Eritrea are confined to the moist and low lying areas in the south-west, with relatively high plant productivity.

Grivets have their northern most distribution in Eritrea. They share the habitat with both baboon taxa. Since they depend much more on trees as sources of food and as sleeping sites than the baboons (Dunbar & Dunbar, 1974), they are more restricted in their range. In most parts of our survey area, we found grivets in valleys, where they forage in the riverine trees, particularly in large fig trees. They also use tree-plantations (*e.g. Eucalyptus*) where there is an undergrowth of *Opuntia*. Grivets do not only search for their food in different parts of the habitat, but also feed on more different parts of plants than do the more terrestrial baboons (Dunbar & Dunbar, 1974). This reduces interspecific competition with baboons, facilitating sympatry. We expect much more competition between the two taxa of baboons because there is broad overlap in diet and habitat use (Kummer, 1968; Barton *et al.*, 1993). Not surprisingly, olive and hamadryas baboons are parapatric.

The current distribution of the three primate taxa in central Eritrea correspond with their respective historic distribution in this region (Yalden *et al.*, 1977). It is not clear whether the two historic records of olive baboons deep in the current distribution for hamadryas are due to a recent reduction of olive baboon distribution and expansion of the hamadryas distribution or to misidentification. It is unknown which factors prevent the two taxa of baboons from expanding their ranges.

In a 70 to 90 km wide area between the geographic ranges of hamadryas and olive baboons we found

Table 7. Distances between primate sleeping sites and the nearest settlement and the nearest agricultural area in Eritrea.

Taxon	n	Distance to settlement		Distance to agriculture	
		Median (m)	Range (m)	Median (m)	Range (m)
Hamadryas	77	3,551	813–13,356	677	0–14,657
"Hybrid"	7	5,228	2771–6,664	1,826	0–6,676
Olive	13	5,294	803–25,708	1,265	0–14,610
Grivet	46	2,858	58–24,609	297	0–8,402

intermediate morphotypes. In the eastern part of this area, closer to "pure" hamadryas, the baboons look similar to hamadryas, but males have darker faces compared to the bright vermilion faces of "pure" hamadryas males. In the western part of the area, closer to "pure" olive baboons, males of the intermediate form have a dark coat mantle, dark faces and carry their tails in the typical "broken" manner of olive baboons. Hybrid zones between hamadryas and olive baboons are also known from Ethiopia, in particular from the Awash area (Nagel, 1973; Sugawara, 1979; Phillips-Conroy & Jolly, 1981). Kummer (1968) found a similar gradient in pigmentation in hamadryas from west to east in Ethiopia. Whether all intermediate morphotypes in Eritrea represent hybrids or locally different ecotypes is not yet clear. However, the most eastern intermediate types achieve very high hybrid scores, where scores increase from more hamadryas- to more olive-like morphotypes (Nagel, 1973).

Our analysis of mitochondrial DNA provided evidence for some degree of hybridization between hamadryas and olive baboons in Eritrea. This genetic analysis revealed evidence for transfer of a maternal marker among sub-populations of hamadryas (Hapke *et al.*, 2001). However, the mechanism of female dispersal is still unclear. Some form of female transfer may exist in hamadryas. Taking the strict herding behavior of hamadryas males into account, it seems unlikely that solitary females move between groups. It seems more likely that females transfer when baboon groups meet and adult males from one group kidnap juvenile females from the other group. It is possible that the transfer of genetic material between sites of hamadryas and olive baboons are enhanced by human activity. At various places we found people who kept baboons as pets and who took them to different places when moving with the livestock, thus providing a basis for long distance transfer.

Because of its limited distribution, the IUCN/SSC Primate Specialist Group classifies hamadryas as Near Threatened (IUCN, 1996, 2000). Eritrea is one of the primary countries for the hamadryas, Eritrea, therefore, has a special responsibility for the survival of this taxon on a global level. The Eritrean Ministry of Agriculture is planning national parks that will include primates (EAE, 1995). However, under the severe ecological conditions in Eritrea, an increasing human population, an extension of agricultural activities, and a further reduction of woodland, competition among people, baboons and grivets will increase. In the near future, this may lead to primate population control programs.

Acknowledgements

We thank the Ministry of Agriculture, the Department of Environment, the Biology Department of the University of Asmara, the Demining Department, and the German Embassy in Eritrea, for guidance,

administrative help and logistic support. For stimulating discussions we thank E.W. Heymann, O. Schülke, J. Shoshani and J. Ganzhorn. Additional thanks go to Tom Butynski and two anonymous referees for improving this paper. We also thank all donors for their financial assistance. The work in Eritrea was made possible by grants from: Deutsche Forschungsgemeinschaft DFG, Germany (Ga 342/7-1 and Zi 548/3-1), Acciones Especiales del Ministerio de Educación y Cultura (APC98-0012), Spain, and agreement between Universidad Autónoma de Madrid and Deutsches Primatenzentrum.

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RED-TAIL MONKEY CERCOPITHECUS ASCANIUS DISTINGUISHING CHARACTERS AND DISTRIBUTION

Abstract: Red-tail monkeys are found in swamp, riverine, and montane forest 10° north and 10° south of the equator. They are absent from the interior of primary forests preferring to be in secondary vegetation. As is typical of many *Cercopithecus* species, red-tails are polytypic with five distinctive types known: black-cheeked red-tail *C. ascanius ascanius* from south of the lower Congo at elevations below 500 m asl; black-nosed red-tail *C. ascanius atrinasus* from north-west Lunda district Angola in the Wamba and Lue River valleys below 850 m asl; Katanga red-tail *C. ascanius katangae* from south of the equator between Kasai and Lualaba Rivers at 500–1300 m asl; Schmidt's red-tail *C. ascanius schmidti* from north of the Congo and east of the Lualaba Rivers reaching the Eastern Rift at elevations between 400–2500 m asl; Congo Basin or orange-nosed red-tail *C. ascanius whitesidei* from the Congo Basin below 500 m asl. Despite a rich nomenclature the boundaries between the distinctive red-tail types are poorly known. As such, red-tail taxonomy remains unresolved.

Resumé: Les singes à queue rouge vivent dans les marais, les forêts riveraines et montagnardes entre 10° au nord et 10° au sud de l'équateur. Ils sont absents des zones intérieures de forêts primaires, préférant vivre près des zones de forêts secondaires. Comme c'est le cas pour plusieurs espèces du genre *Cercopithecus*, les singes à queue rouge sont polytypiques et 5 formes sont actuellement connues: les queues rouges à joues noires, *C. ascanius ascanius*, vivant au sud du Congo inférieur à une élévation moyenne de 500 m au-dessus du niveau de la mer; les queues rouges à nez noir, *C. ascanius atrinasus*, vivant au nord-ouest du district Lunda en Angola, dans les vallées des rivières Wamba et Lue à une élévation moyenne de 850 m au-dessus du niveau de la mer; les queues rouges de Katanga, *C. ascanius katangae*, vivant au sud de l'équateur entre les rivières Kasai et Lualaba à une élévation moyenne comprise entre 500 et 1300 m au-dessus du niveau de la mer; les queues rouges de Schmidt, *C. ascanius schmidti*, vivant au nord de la rivière Congo et à l'est de la rivière Lualaba jusqu'au rift, à une élévation moyenne comprise entre 400 et 2500 m au-dessus du niveau de la mer; les queues rouges à nez orangé ou du bassin congolais, *C. ascanius whitesidei*, vivant dans le bassin du Congo à une élévation moyenne en deçà de 500 m au-dessus du niveau de la mer. En dépit de cette riche nomenclature, les frontières entre les différents types de queues rouges sont peu connues. Comme telle, la taxinomie des queues rouges demeure non résolue.

Introduction

The genus *Cercopithecus* encompasses a large number of species, all confined to the tropics and subtropics of sub-Saharan Africa. Many *Cercopithecus* species are polytypic (*i.e.*, represented by a number of distinct populations each corresponding to a different geographic region) and taxonomically unresolved. In zones of contact the relationships between distinctive populations comprising these polytypic species is unknown or poorly known. As such, it is not known whether some distinct populations are in fact distinct species and merit a revised conservation status. What follows is a review of red-tail monkey *Cercopithecus ascanius* distribution and distinguishing external characters based on a study of museum specimens and a review of the literature. Because red-tail monkeys fit the mold of a polytypic *Cercopithecus* species with an ambiguous alpha taxonomy, it is hoped that this review will focus attention on resolving *Cercopithecus* taxonomy and stimulate an interest in gathering the data necessary to do so.

Distribution

Red-tail monkeys are distributed in lowland, swamp, riverine, and montane forests of tropical Africa south and east of the lower Congo and Ubangi Rivers (figure 1). They also occur in riverine forests north and east of the Ubangi River bend. Unlike the lower Ubangi and Congo Rivers, the upper Ubangi does not present a barrier to red-tail dispersion. The northern, southern and eastern limits of red-tail distribution are defined by an absence of evergreen forests, long dry seasons (= five months) and decreased rainfall (<1000 mm/year). Red-tails are present in Angola, Burundi, Central African Republic (CAR), Democratic Republic of Congo (DRC) (Lernould, 1988), Kenya, Rwanda, Sudan, Tanzania, Uganda, and Zambia. Claims that they are present west of Sangha River in Cameroon and near the north-eastern border of People's Republic of Congo are most likely based on misidentifications. Presumed *C. ascanius* x *C. cephus* hybrids covering large areas of the Sangha-Ubangi Forest (Colyn 1994) do not exist (Colyn, 1999). Absence from the western equatorial forest block between the Sangha and Ubangi River (Sangha-Ubangi Forest; Colyn, 1999) and from mangrove and swamp forests circumscribing the Congo River Delta is presumably linked to the presence of moustached monkey *Cercopithecus cephus*.

Localized Distribution

Red-tails inhabit forests of relatively high rainfall (=1300 mm/year) along edges of rivers, streams, swamps, or roads. They depend mainly on tall trees for shelter and secondary growth for food. They are absent from the

interior of primary forests where secondary vegetation is uncommon (Schouteden 1947; Butynski, 1985). Small patches of forest or even exotic tree stands (*i.e.* *Eucalyptus* sp.; Haddow 1952; Baranga, 1993; EES pers. obs. in Uganda) may provide shelter. Along both the Western (Albertine) and Eastern (Gregory) Rifts, and the north shore of Lake Victoria, red-tails occur in small isolated forest patches devoid of other monkeys. Although this monkey may move and feed in the forest canopy or on the ground, it is usually found at the top

of the nose and on the lateral orbital rims. The bare facial skin is usually blue or purple and less commonly brown/black. A tuft of orange-red or white hairs usually springs from the ear helix. The throat, limbs, proximal tail, and undersurface of the body may be white, cream, or light gray. Individual hairs on the dorsum of the head, body, limbs and tail, are translucent, white or light gray basally, grading into black distally. The black distal half of each hair has from one to four bands of orange, straw-yellow, or cream. According to width, spacing, and color

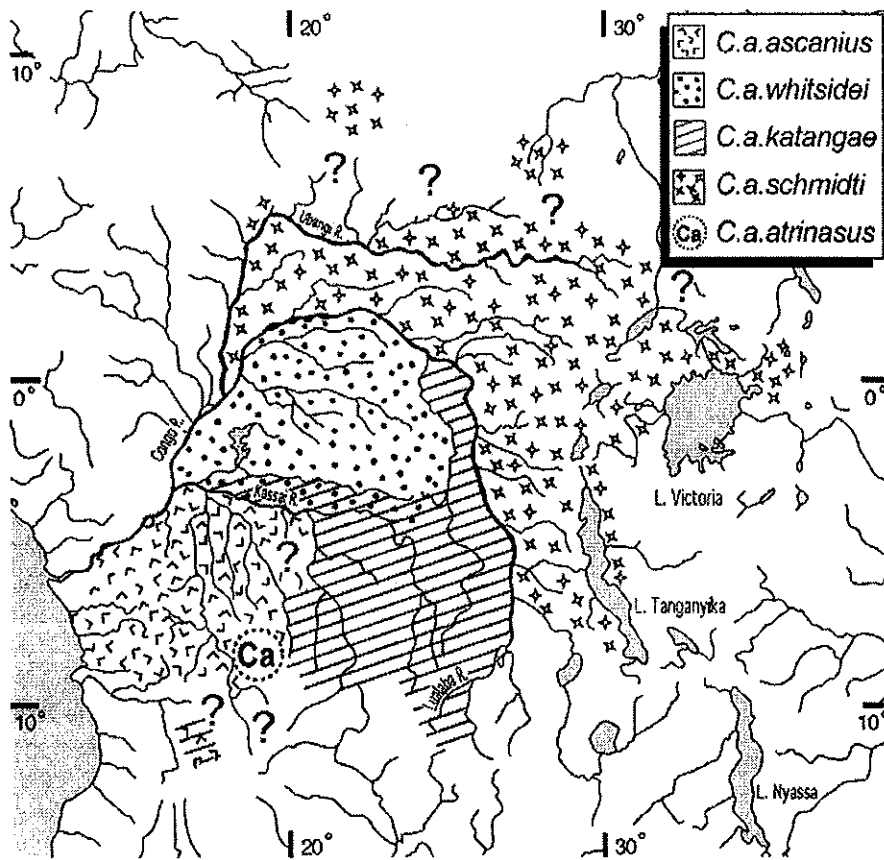


Figure 1. Red-tail monkey *Cercopithecus ascanius* distribution map.

of the understory approximately 10–20 m above ground (Haddow, 1952; EES pers. observation). Relative to other monkeys it commonly associates with, red-tails usually occupy small diameter supports farthest from the bole and closest to the tree crown (EES pers. obs.).

Description

The red-tail monkey has a heart-shaped nose spot and partially red or orange-red tail. Most subspecies also have a temporal hair whorl (*i.e.*, a rosette of hairs radiating from a central area on the temple), sub-ocular patch, black fronto-temporal band, and black cheek/lower-jaw band/line that frames and adorns the face (Figure 2). The fronto-temporal band stretches from ear to ear and forms inferiorly directed peaks on the bridge

of bands on hairs, the dorsum takes on an olive-brown hue, with yellow highlights on the head and red highlights on the body, respectively. Overall, the dorsal coat can be referred to as agouti (Groves, 2001). The dorsal surface of the hind limbs is usually lighter in color than that of the forelimbs. The tail tip is black dorsally, but orange banding of black hairs on the ventral side produces red highlights. Hands and feet, including fingers and toes, are black to dark brown dorsally, with black hairs variably possessing single white bands. Pedal hairs are always longer than manual ones. Manual hairs may be sparse on the middle and distal phalanges. Body skin, including the callosities, is brown to black. Adult male scrotal skin is blue.

Natal coat is soft, woolly, and gray-brown. Palm and sole skin is pink. Bare facial skin a much lighter tone of blue than in the adult. Although in newborns the nose spot is already apparent, there is no trace of red in the tail. Adult color pattern appears as early as 3 weeks of age (Haddow, 1952) and is fully developed in infants with erupted first deciduous (milk) molars.

No clear differences in coat color pattern exist between males and females. Males are larger (table 1) and heavier than females (table 2) with a longer cheek tooth row length and a proportionately larger canine. For both sexes, tail length is, on average, 62% of total length and 163% of trunk length. Forelimb length (humerus + radius) is, on average, 79% of hind limb length (femur + tibia). The third finger is longest, followed by fourth, second, and fifth finger in order of decreasing length. The third and fourth toes are nearly

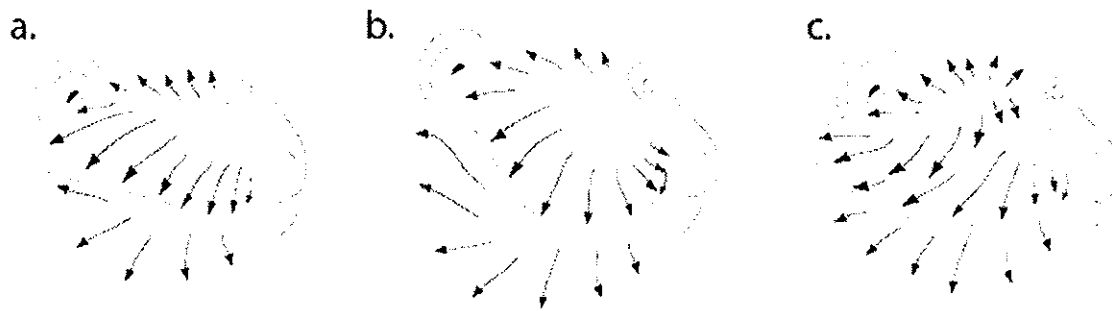


Figure 2. Differences in facial hair patterns among: (a) a generalized Cercopithecine, (b) *C. a. schmidti*, and (c) *C. a. atrinasus*, highlighting both the rosette of hairs radiating from a central area on the temple and the cheek/lower-jaw band/line seen in most red-tail subspecies (adapted from Kingdon, 1997).

subequal in length and considerably longer than subequal second and fifth toe.

Five subspecies of red-tail monkey are currently recognized (Groves, 2001). Each subspecies exhibits distinct pelage characters (table 3) and their range limits roughly coincide with major rivers (figure 1).

The five subspecies are:

Cercopithecus ascanius ascanius, Audebert
1799, no locality, probably Angola

1845 *Cercopithecus melanogenys*, Gray, no locality

1863 *Cercopithecus histro* Reichenbach, no locality

1886 *Cercopithecus picturatus*, Santos, Quimpalala,
Angola.

The “black-cheeked red-tail” *C. a. ascanius* is found mainly south of the lower Congo and Kasai Rivers in

riverine forest crossing lowland rain forest mosaics and undifferentiated woodlands at elevations below 500 m. North of this range, some monkeys from between the Kasai and Lukenie Rivers may be referred to *C. a. ascanius* (Lonnberg, 1919; Schouteden, 1948). This suggests an area of admixture with *C. a. whitesidei*. In DRC, typical black-cheeked red-tails are found west of the Kwilu (Cuilo) River. Non-typical ones are found between the Kwilu River and the west bank of the upper Kasai River. These animals suggest an area of admixture with *C. a. katangae*. Canzele, Angola, 30 km from Camabatela, (8°17'S, 15°11'E), is the most southwestern locality where black-cheeked red-tails have been collected. As suggested by *C. a. ascanius* x *C. a. atrinasus* hybrid localities these monkeys probably reach the Kwilu River's west bank at about 19°E (Machado, 1969). Native reports of red-tails west of the Kwango (Cuango)

Table 1. Body measurements in four subspecies of redtail monkeys (*Cercopithecus ascanius*)

Subspecies	Source	Sex	Total length	Head & trunk	Tail length	Hindfoot
<i>C. a. ascanius</i>		Male (3)	1322 (mean) 1275–1345 (range)	497 445–545	825 775–900	152 145–157
		Female (1)		470	650	125
<i>C. a. schmidti</i>	Haddow 1952	Male (38)	1271 (mean) 1080–1380 (range)	475 430–515	795 600–920	142 135–155
		Female (37)	1078 (mean) 930–1185 (range)	408 340–485	670 540–790	124 110–140
	Allen 1925	Male (23)	1270 (mean) 1160–1390 (range)	476 430–630	795 645–930	141 130–150
		Female (10)	1090 (mean) 1020–1160 (range)	410 380–460	680 630–755	125 118–135
<i>C. a. katangae</i>		Male (2)	1268 (mean) 1250–1285 (range)	485 470–500	782.5 750–815	144.5 144–145
		Female (1)	1060	430	630	121
<i>C. a. whitesidei</i>		Male (1)	1320	535	785	144
		Female (1)	1210	443	767	135

Table 2. Body weights (g) in two subspecies of redtail monkeys *Cercopithecus ascanius*.

		<i>C.a. schmidti</i>		<i>C.a. katangae</i>	
		**mean	range	**mean	range
Colyn 1994	male	3688 (37)	2950–4750	3714 (32)	2200–4900
	female	2785 (155)	2100–3750	2965 (155)	1800–3950
*Haddow 1952	male	4137 (38)	3175–6350	Not	Not
	female	2903(37)	1814–3856	Available	Available

*Haddow weights are after removal of stomach and its contents.

**Numbers of sampled specimens are in parentheses.

River may place them as far from the equator as 11°S (Machado, 1969).

Black cheek whiskers, white nose spot, white temporal whorls, grayish or yellowish sub-ocular patch, and a broad black fronto-temporal band characterize *C.a. ascanius*. Bare facial skin occurs only on the periocular area and is light blue. Hairs on the underside of the body, limbs and proximal aspect of the tail are whitish gray variably producing a silver coat. Hairs on the dorsum are gray proximally, black distally and present one to four orange or cream-colored bands. As a result of the progressive loss of bands on individual hairs the dorsal forelimb coat grades to black on forearm and hand. The dorsal hind limb coat color grades into gray on leg and foot, as a result of reduction in the number of bands on individual hairs to one, and progressive whitening of band color. Tail coat color grades into dark red or

maroon dorsally, and into orange-red ventrally. The dorsal surface is devoid of banded hairs on the distal half of the tail.

Cercopithecus ascanius atrinasus, Machado, 1965. Zovo. Angola.

The black-nosed red-tail *C.a. atrinasus* monkey is known from nine individuals collected within a small area (~2500 km²) in the extreme northwest of Lunda District, Angola. This area is in and around the valleys of the Wamba and Lué Rivers and fully within the distribution of *C.a. ascanius* (Machado, 1969). Although the type locality of Zova (8°07'S, 18°04' E, 850 m asl) is close to the DRC border, the monkey has never been reported from DRC (Machado, 1969).

Distinguished from other subspecies by absence of a distinct sub-ocular patch, otherwise this monkey

Table 3. Distinguishing pelage characters in the five recognised sub-species of redtail monkeys *Cercopithecus ascanius*.

Character	<i>C.a. ascanius</i>	<i>C.a. atrinasus</i>	<i>C.a. katangae</i>	<i>C.a. schmidti</i>	<i>C.a. whitesidei</i>
Nose spot	white	black	white	white	yellow/orange/red
Temporal whorl	present	present	present	absent	present
Subocular patch	variable	absent	present	absent	indistinct
Black frontal band	broad	broad	absent	present	diffuse
Black temporal band	variably broad	variably broad	variably present	present	indistinct
Facial skin	blue	blue	dark blue to purple	blue	blue
Cheek hair	black	black	black banded cream/white	white, cream	black tipped cream
Black lower jaw band	broad	broad	tapering below ear and diffuse	sharply marked variably narrow	diffuse
Ear hairs	luxuriant, bright orange/red	??????	sparse, light orange tan	variably white tufted	sparse light orange tufted
Shoulder hairs	black with light ticking	black with light ticking	agouti	agouti	agouti
Forearm ventrum	grey to brown	grey to brown	variably cream to light brown	iron grey to dark brown	light grey/brown
Leg ventrum	grey	grey	cream/white	grey/brown	cream/white
Tail ventrum	proximal third light grey; distal two-thirds orange-red	proximal third light/grey; distal two-thirds orange-red	proximal half cream/white; distal half orange-red	proximal third grey; distal two-thirds orange-red	proximal third cream/white; distal half orange-red
Tail dorsum	proximal third agouti; distal two-thirds orange-red	proximal third agouti; distal two-thirds orange-red	proximal half agouti; distal half black	proximal third agouti; distal two-thirds orange-red	proximal quarter to third agouti; middle third to half maroon; distal quarter to half black
Tail tip	>2 cm orange banded black	>2 cm orange banded black	fifth to sixth of distal tail length black ¹	2–6 cm black	fifth to eighth of distal tail length black ¹

¹may be lightly interspersed with orange(red), and orange banded hairs.

resembles black-cheeked red-tails in all respects (Machado, 1965, 1969). *C. a. atrinasus* is not bounded by any natural geographic barriers and seems to imperceptibly grade into both neighboring *C. a. ascanius* and *C. a. katangae*. Justifiably so, Machado (1965) tentatively referred to it as a 'form' and did not give it subspecific status. Color variants are relatively common in *Cercopithecus* facial markings (Pocock, 1907; Rahm, 1970; Colyn, 1988) and may explain this monkey's distinctiveness. More details of its distribution, especially in DRC, should clarify its taxonomic status.

Cercopithecus ascanius katangae Lonnberg, 1919. Katanga, Kinda, DRC

The Katanga red-tail (*C. a. katangae*) is found mainly south of the equator between the Kasai and Lualaba Rivers at 500–1300 m a.s.l. In Angola it crosses the upper Kasai and has been collected as far west as the east (right) bank of the Kwilu River where it admixes with *C. a. atrinasus* (Machado, 1969). Farther west of this it grades into *C. ascanius* (Machado 1969). To the east its northern distribution extends along the forest block between the Lualaba and Lomami Rivers and is limited by the fork of these two rivers at 0°46'N. To the west its northern limit reaches the fork of the Sankuru and Kasai Rivers. Centrally its northern limit occurs between the Sankuru and Lomami Rivers (Machado, 1969) around the headwaters of the Lukenie River, in an area of transition with *C. a. whitesidei*.

The Katanga red-tail's southern distribution is poorly known. Reports from local inhabitants place it at 11°S latitude across central and eastern Angola. This agrees with its occurrence in Zambia where it is reported along streams in dry evergreen forests in northwestern Mwinilunga District at about 11°S, 24°W (Ansell, 1978). Locals report that it crosses the upper Kwango River reaching as far west and south as the left bank of the upper Cuanza River (Machado, 1969) are just as likely to pertain to *C. a. ascanius*.

The Katanga red-tail is distinguished by a tail dorsum with a black distal half that lacks any tint of red. The tail ventrum may be white to cream for the proximal half of its length, grading distally into fiery-orange then red. A black tail tip may comprise as much as 25% of tail length both dorsally and ventrally. Undersurfaces of the body and limbs are white to cream. Fronto-temporal band is deficient above the brow and retained only above temple and ear. Black tipped hairs radiate anteriorly from the temporal whorl and sharply underscore posterior border of sub-ocular patch. Lateral cheek band begins as wide black spot at sides of nose, upper lip and mouth, but strongly tapers dorsally to disappear below ears. Temporal whorl and grizzled yellow or gray sub-ocular patch, is as in *C. a. ascanius*. The patch is comprised both of black tipped cream-banded gray hairs and of cream hairs double-banded black. The facial skin is a

dark purple-blue. Hairs on crown and body have a white to light gray basal half. They are commonly double-banded cream or orange, but a minority of hairs may be single or triple-banded. Banded hairs may be found throughout the dorsum of the limbs including hands and feet.

Cercopithecus ascanius schmidti Matschie, 1892 Mengo, Uganda.

1913 *Lasiopygia ascanius kaimosae* Heller, Lukosa River, near Kaimosi, Kenya.

1913 *Cercopithecus (Rhinostictus) schmidti mpangae* Matschie, Mpanga Forest, Uganda.

1913 *Cercopithecus (Rhinostictus) schmidti sassae* Matschie, Ishasha River, Uganda.

1913 *Cercopithecus (Rhinostictus) schmidti erkamer* Matschie, Ituri Forest, DRC.

1914 *Cercopithecus schmidti montanus* Lorenz, Mayema Forest, DRC.

1914 *Cercopithecus schmidti ituriensis* Lorenz, Ituri Forest, DRC.

1917 *Cercopithecus schmidti rutshuricus* Lorenz, Rutshuru Plains, DRC.

1919 *Cercopithecus schmidti orientalis* Lorenz, unclear origin.

Schmidt's red-tail *C. a. schmidti* has the widest geographic and altitudinal distribution of the five subspecies. It is found between 400–2500 m a.s.l. in forests north of the Congo and east of the Lualaba Rivers. Throughout the eastern half of its range it is found at elevations higher than 1300 m a.s.l. East of the Western Rift, woodlands, shrublands, and grasslands limit its distribution. In Uganda, however, the small patches of isolated rain, swamp, and riverine forests occurring between Lake Kyoga and the northern shore of Lake Victoria permit a narrow latitudinal expansion eastwards along the equator into montane forests on the western side of the Eastern Rift. In Kenya it has been collected as far eastwards as the Mau Escarpment (35°36'E) where it ranges into its highest elevations. Towards the north it reaches Mt. Elgon, and towards the south the Maasai Mara (Eley, 1989), possibly extending into bordering parts of Tanzania.

North of the Congo River, it has a western distribution limited by the Ubangui River. North of the western equatorial forest block, however, Schmidt's red-tail is found west of this river reaching Bangui at 18°37'E longitude (Colyn 1999). Its northern limit is poorly documented, but is known to extend past the Uele and Mbomu Rivers. It has been collected as far north as 8°10'N latitude in the Manovo-Gounda-St. Floris National Park CAR (Fay, 1988). In Sudan, Kock (1968) reports populations slightly north of 6°N latitude along the Tonj (Ibba) River.

East of Lake Tanganyika its southern limit is the Wansisi Mountains (6°45'S) (Kano 1971). West of the Lake, it has been found in the Marungu Mountains at roughly 8°0'S'. Its southern distribution is poorly known and there is no information as to its possible

overlap with *C. a. katangae*.

It is distinguished by a tail with a gray underside proximally, and absence of a temporal whorl and of a grizzled sub-ocular patch. Cheek hairs are white or cream colored, with black tips that form a sharply demarcated jaw line. The jaw line runs backwards from mouth to nape of neck passing caudal to ear. Ear tufts are usually white or cream and less commonly orange or red (Allen, 1925). Black hairs, devoid of bands, cover dorsum of hands, feet, and ulnar side of forearm. Brown hairs cover the distal one-third of ventral forearm. The middle two-thirds of the tail has a slightly darker shade of red on its dorsum than on its ventrum. Although a black tail tip is usually present, it comprises less than 10% of tail length. Considering its distinctiveness, more detailed studies in areas of overlap (with *C. a. katangae* and *C. a. whitesidei*) may show Schmidt's red-tail to be a unique species.

Cercopithecus ascanius whitesidei Thomas 1909.
Ikau, Upper Lualaba River, DRC

1913 *Cercopithecus (Rhinostictus) ascanius kassaicus* Matschie, Pogge Falls, DRC

1913 *Cercopithecus (Rhinostictus) ascanius omissus* Matschie, Sankuru River, DRC

1913 *Cercopithecus (Rhinostictus) ascanius cirrhorrhinus* Matschie, Lower Lomami River, DRC

1913 *Cercopithecus (Rhinostictus) ascanius pelorhinus*, Matschie, no locality.

The Congo Basin or orange-nosed red-tail *C. a. whitesidei* is distributed widely in swamp and lowland forests below 500 m a.s.l., mainly south and east of the Congo River and west of the Lomami River. The Lukenie River marks its southern boundary, but monkeys that fit its description are known from south of this river grading into *C. a. katangae* and *C. a. ascanius*. A yellow nose spot in animals from the forest block between the Lomami and Lualaba Rivers may indicate a transition zone with *C. a. katangae* (Colyn, 1988). Monkeys with a white tail ventrum from the right (north) bank of the Congo River suggest possible admixture with *C. a. schmidti*.

The Congo Basin red-tail is distinguished from the other red-tails by a yellow, orange, or red nose spot. In most other respects it resembles the Katanga red-tail but is further distinguished from it by the following characters. The middle third of the dorsal tail coat grades into maroon or chestnut-red before turning into black distally. Along the middle third of the tail there is transverse grading of the coat from maroon dorsally, to brick red laterally, to orange-red ventrally. Chin coat is darkened by presence of black hairs. Fronto-temporal line is broad, especially in animals skirting the left bank of the Congo River and those inhabiting islands within this river. The mesial nasal line leading to nose spot often contains white hairs.

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¹ Noak (1887) reported an orange-tailed unspecified *Cercopithecus* from the Marungu Mountains, which Matschie (1893) assigned to *C. schmidti*.

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SYNONYMS REDUCE THE NUMBER OF SUBSPECIES IN THE GUENON *CERCOPITHECUS MITIS*

Abstract: *Guenons assigned to Cercopithecus mitis sensu lato include many subspecies. At least eleven of those recognised in recent reviews, however, are not valid. The proposed synonymy is as follows: C. m. albogularis (synonym: kibonotensis), C. m. albotorquatus (synonyms: zammaranoi, phylax), C. m. erythrachus (synonyms: nyasae, stevensoni, schwarzi), C. m. labiatus (synonym: samango), C. m. mitis (synonym: pluto), C. m. stuhlmanni (synonyms: neumanni, elgonis, maesi).*

Resumé: *Les guenons assignées à Cercopithecus mitis sensu lato inclut plusieurs sous-espèces. Au moins 11 de celles récemment reconnues dans la littérature ne sont toutefois pas valides. Nous proposons les équivalences suivantes : C. m. albogularis (synonyme: kibonotensis), C. m. albotorquatus (synonymes: zammaranoi, phylax), C. m. erythrachus (synonymes: nyasae, stevensoni, schwarzi), C. m. labiatus (synonyme: samango), C. m. mitis (synonyme: pluto), C. m. stuhlmanni (synonymes: neumanni, elgonis, maesi).*

Introduction

Guenons variously called mitis, pluto, blue, diadem or Sykes's monkeys, or by the Zulu name samango, have been assigned to a single species *Cercopithecus mitis* including numerous subspecies. Preliminary reviews of the literature and examination of museum specimens suggest that the species can be divided into several sections or groups of subspecies whose vernacular names are taken from Hill (1966) and Dandelot (1974 [not 1971 as sometimes cited]):

- Albogularis section (*white-throated guenon, often treated as a separate species, e.g. by Hill 1966*):
- C. m. albotorquatus* de Pousargues, 1896 (Pousargues's or Zammarano's white-throated guenon)
 - C. m. kolbi* Neumann, 1902 (Kolb's guenon or monkey)
 - C. m. albogularis* (Sykes, 1831) (Sykes's or Kilimanjaro blue monkey, white-throated guenon)
 - C. m. monoides* I. Geoffroy Saint-Hilaire, 1841 (maritime white-throated guenon)
 - C. m. francescae* Thomas, 1902 (northern Malawi blue monkey)
 - C. m. moloneyi* Sclater, 1893 (Moloney's guenon)
 - C. m. erythrarchus* Peters, 1852 (Nyasa white-throated guenon, Stairs's or Mozambique monkey, samango)
 - C. m. labiatus* I. Geoffroy Saint-Hilaire, 1842 (samango, white-lipped guenon)

Heymansii section:

C. m. heymansii Colyn & Verheyen, 1987

Mitis section:

C. m. opisthisticus Sclater, 1894 (rump-spotted guenon)

C. m. mitis Wolf, 1822 (diadem or pluto monkey)

Boutourlinii section:

C. m. boutourlinii Giglioli, 1887 (Boutourlini's guenon)

Stuhlmanni section:

C. m. stuhlmanni Matschie, 1893 (blue or Stuhlmann's monkey)

C. m. schoutedeni Schwarz, 1928 (Schouteden's guenon)

C. m. doggetti Pocock, 1907 (Doggett's or silver guenon)

C. m. kandti Matschie, 1905 (golden, bamboo, or Congo red monkey)

These monkeys have been reviewed by Hill (1966), Dandelot (1968, 1974), Rahm (1970), Napier (1981), Lernould (1988), Kingdon (1997), and Groves (2001), who have listed the following additional subspecies (authors who consider a name to be valid are indicated in parentheses):

Albogularis section:

C. m. samango Wahlberg in Sundevall, 1845 (Hill, Kingdon)

C. m. kibonotensis Lönnberg, 1908 (Hill, Dandelot, Rahm, Napier, Lernould, Kingdon, Groves)

C. m. zammaranoi De Beaux, 1924 (Dandelot, Rahm, Napier, Lernould, Kingdon, Groves)

C. m. phylax Schwarz, 1927 (Hill, Rahm, Napier, Lernould, Kingdon, Groves)

C. m. nyasae Schwarz, 1928 (Hill, Dandelot, Rahm, Napier, Lernould, Kingdon)

C. m. schwarzi Roberts, 1931 (Hill, Rahm, Napier, Groves)

C. m. stevensoni Roberts, 1948 (Rahm, Napier)

Mitis section:

C. m. pluto Gray, 1848 (Kingdon)

Stuhlmanni section:

C. m. neumanni Matschie, 1905 (Kingdon)

C. m. elgonis Lönnberg, 1919 (Kingdon, Groves)

C. m. maesi Lönnberg, 1919 (Hill, Dandelot, Rahm, Napier, Kingdon)

Colyn (1991) also revised *Cercopithecus mitis* and recognised *C. m. elgonis* as valid but did not include the *albogularis* section in his study.

Until the species is fully revised, it may be useful to update its systematics as far as possible by eliminating the eleven subspecies listed above, which I believe are not valid.

Material and Methods

My conclusions on synonymy are based on the literature and the examination of specimens in the Natural History Museum, London (tables 1, 6). These are identified by four-figure or two-figure codes prefixed by the acronym BM. Napier (1981) gives a complete list of these specimens. Napier (1981) and G.M. Allen (1939) provide full details on authors of names, references, and type localities of subspecies. Of specimens referred to *Cercopithecus mitis stuhlmanni* and *C. m. elgonis* from Uganda and Kenya (tables 6 & 7), I examined 33 out of the 43 listed by Colyn (1991) in his review of these monkeys. Where nominal subspecies are supposed to be differentiated on the basis of dimensions but are here regarded as synonymous, Coefficients of Difference between samples have been found to lie below 1.28. This is a conventional subspecific level (the 75% rule) which, it is recommended, should be raised to 1.50 (Mayr, 1969), indicating about 95% joint non-overlap of populations. Very few skulls are available or have been reported in the literature. Skull measurements were taken to the nearest mm, though some published measurements are given to the nearest 0.1 mm.

***Cercopithecus mitis albogularis* (material examined: table 1)**

Semnopithecus albogularis Sykes, 1831, with no type locality but since restricted to Zanzibar.

Cercopithecus albogularis kibonotensis Lönnberg, 1908. Kibonoto = Kibongoto, near Mt Kilimanjaro, Tanzania.

Most authors recognise *C. m. kibonotensis* as a larger mainland subspecies differing only in size from the insular *C. m. albogularis*. Measurements of the two nominal taxa are given in table 2. Only very small samples are available. The mainland population averages larger but the null hypothesis (that the populations are not subspecifically distinct) is not threatened.

***Cercopithecus mitis albotorquatus* (material examined: table 1 & 3)**

Cercopithecus albotorquatus de Pousargues, 1896. No locality.

Cercopithecus rufotinctus Pocock, 1907. Based on a captive imported from Mombassa.

Cercopithecus (Insignicebus) albogularis zammaranoi De Beaux, 1924. Bidi Scionde, lower Juba River, Somalia.

Cercopithecus leucampyx phylax Schwarz, 1927. Patta Island, Kenya.

Schwarz (1927) regarded the type of *rufotinctus* as an erythristic variant of *C. m. zammaranoi* (the latter becoming a junior synonym) and found material of *C. m. rufotinctus* from Jubaland, southern Somalia, in the

Berlin and Frankfurt museums. When he examined the type of *albotorquatus* (Schwarz 1928), he realised that it was a further synonym. As *albotorquatus* has precedence over *rufotinctus* and *zammaranoi*, it becomes the valid name for the subspecies. Wild-shot specimens from the Tana River in various museums were identified as *C. m. albotorquatus* on the basis of Schwarz's systematic work. Only later did Dandelot (1968, 1974, in litt. to Hill 1966, pers. comm. to Napier 1981) draw a distinction between captive *zammaranoi* and other specimens referred to *C. m. albotorquatus*. Hill (1966) quoted Dandelot (in litt. 1960), who observed that live specimens from Somalia in the Jardin du Plantes, Paris, were rather small in size with a completely olive-green back lacking any trace of rufous tint. The white collar was smaller than in the type of *C. m. albotorquatus* and the under parts were ashy grey. Dandelot (1968, 1974) described *C. m. zammaranoi* as a good race, the smallest

white throat patch; dark olive diadem, whiskers, and crown, with darker nape; absence of a white collar; shoulders and back dark olive but becoming yellower posteriorly; no color contrast below tail; and 50% of tail black distally.

The original description of *C. m. zammaranoi*, which is lengthy and detailed (De Beaux, 1924), stated that 'Il passaggio tra bianco ventrale e grigio dorsale sul collo è graduale, perchè i pelli bianchi guingono fino all'area dorsale ma sono celati da peli parzialmente colorati' [The transition from the white ventral to the grey dorsal colour on the neck is gradual, because the white hairs reach up to the dorsal area but are hidden by partly-coloured hairs]. This seems to be sufficient indication of an incomplete white collar. For the dorsal coloration De Beaux stated: 'La tinta gialla del dorso aumenta in direzione cranio-caudale e raggiunge il massimo d'intensità nella region lombo-sacrale ove la colorazione

Table 1. Material (skins and skulls) of nominal subspecies of *Cercopithecus mitis* (albogularis section) examined in the Natural History Museum, London.

Nominal subspecies	Collection numbers	Locality
<i>C. m. albogularis</i>	BM 20.6.10.1	Tanzania, Tumbatu I
<i>C. m. albogularis</i>	BM 24.12.15.3, BM 55.332, BM 64.1015	Tanzania, Zanzibar I
<i>C. m. kibonotensis</i>	BM 08.9.26.1	Tanzania, Moshi,
<i>C. m. kibonotensis</i>	BM 92.10.18.7, BM 51.369	Tanzania, near Mt Kilimanjaro
<i>C. m. kibonotensis</i>	BM 72.52 & 53	Kenya, near Mombassa
<i>C. m. albotorquatus</i>	BM 12.7.10.1, BM 51.690-694	Kenya, Tana River, near Sankuri
<i>C. m. nyasae</i>	BM 94.1.25.1 (type of <i>nyasae</i>) & BM 94.1.25.2	Malawi, Fort Lister
<i>C. m. nyasae</i>	BM 95.12.7.5 & 6	Malawi, Chiradzulu
<i>C. m. nyasae</i>	BM 02.8.3.1	Malawi, Lake Chilwa
<i>C. m. nyasae</i>	BM 08.5.1.1	Malawi, Fort Johnston (= Mangochi)
<i>C. m. nyasae</i>	BM 34.1.11.1 & 2	Malawi, Lichenya Plateau
<i>C. m. erythrarchus</i>	BM 07.6.2.109 & 110	Mozambique, Beira
<i>C. m. erythrarchus</i>	BM 08.1.1.3, 4, 5 & 6	Mozambique, Tambarara
<i>C. m. erythrarchus</i>	BM 34.1.11.3	Mozambique, Namuli Mtn
<i>C. m. stevensoni</i>	BM 08.7.19.3	Zimbabwe, Chirinda Forest
<i>C. m. schwarzi</i>	BM 06.4.3.1	South Africa, Woodbush Hills

subspecies of *Cercopithecus mitis*, with an olive-hued coat and white throat. Napier (1981) relied on De Beaux (1924) and Dandelot (pers. comm. 1978) for the description of '*C. m. zammanaroi*', recorded as having a

d'insieme è di oro vecchio' [The yellow tint of the back increases in a cranio-caudal direction and reaches its greatest intensity on the lumbar-sacral region where the colour altogether is old gold]. De Beaux's (1924)

Table 2. Range (with mean and standard deviation in parentheses) of skull measurements, of nominal subspecies of *Cercopithecus mitis*.

Measurements (mm)	<i>C. m. kibonotensis</i>	<i>C. m. albogularis</i>	Coefficient of difference
Males	N = 5	N = 4	
Greatest length without incisors	107-114 (110.5 ± 2.87)	101-113 (105.4 ± 4.97)	0.650 (< 75% joint non-overlap)
Zygomatic width	71-77 (73.6 ± 2.61)	72-76 (73.3 ± 2.31)	0.055 (< 75% joint non-overlap)
Females	N = 3	N = 5	
Greatest length without incisors	93-98 (95.0 ± 2.65)	91-95 (89.2 ± 6.47)	0.637 (< 75% joint non-overlap)
Zygomatic width	61-68 (64.3 ± 3.51)	59-61 (60.2 ± 0.76)	0.967 (< 84% joint non-overlap)

Table 3. Comparisons between skins of *Cercopithecus mitis albotorquatus* from the Tana River, Kenya.

Collection number	Lumbar region	Red patch under base of tail extends onto thighs	Underparts	Other features
BM 12.7.10.1	Dark brown	None	Dark ashy grey	Legs dark grey, crown not very yellow
BM 51.690	Deep ochre	Present	Uniformly buffy	Neck as described for the type of <i>zammaranoi</i> , Crown very yellow
BM 51.691	Red brown	Present	Grey with buffy median line	
BM 51.692	Olive, speckled	None	Uniformly grey	
BM 51.693	Reddish ochre	Present	Grey with tufts of buff	
BM 51.694	Red-brown	Present	Buffy	Crown very yellow

description evidently differs from Dandelot's (1968, 1974) account of this taxon.

Variation in skins from the Tana River is summarised in table 3. The pelage of *C. m. zammaranoi* whether described by De Beaux (1924) or by Dandelot (1968, 1974) lies within the range of variation of this sample, which includes (1) olive, old gold or red lumbar region; (2) dark ashy grey to light buffy underparts; (3) presence or absence of both a red patch underneath the tail at the base and a red suffusion on the inner thighs; and (4) a well-marked or poorly demarcated half-collar. Skull measurements of *C. m. zammaranoi* compared with those of *C. cf. albotorquatus* are given in table 4. Once again, only very small samples are available. The Tana River specimens may average larger in some measurements, but the null hypothesis is not challenged and metrical differences are far below the conventional subspecific level.

Several authors have recognised *C. m. phylax* as a valid small island race but Dandelot (1968:19) thought it was synonymous with *C. m. albotorquatus* 'in view of the similarity of characters and the proximity of this island [Patta] to Somalia'. *Cercopithecus m. phylax* was described as having a dark olive head, upper parts dark reddish brown, russet tuft under base of tail, black arms, mouse grey legs, under parts white, and a white part-collar round neck. Skull measurements of the holotype compared with those of the only available female *C. m. albotorquatus* are given in table 5. Some of these measurements may have been taken differently, but they are quite insufficient to suggest that insular and mainland populations are subspecifically different. The holotype of *phylax* actually appears slightly larger than the mainland specimen. The pelage falls within the range for Tana River monkeys. There is no case for distinguishing a subspecies on Patta.

This survey shows that a relatively small subspecies *Cercopithecus mitis albotorquatus* includes *rufotinctus*, *zammaranoi* and *phylax* as synonyms. Individual variation has led to the creation of four nominal subspecies but so

far, no convincing evidence has been presented to show that their differences reflect geographic variation.

Cercopithecus mitis erythrarchus (material examined: table 1)

Cercopithecus erythrarchus Peters, 1852. Inhambane, coastal Mozambique.

Cercopithecus stairsi Sclater, 1892. Delta of the Zambezi, Mozambique.

Cercopithecus albogularis beirensi Pocock, 1907. Beira, Mozambique.

Cercopithecus stairsi mossambicus Pocock, 1907. Mozambique town, Mozambique.

Cercopithecus leucampyx nyasae Schwarz, 1929. Fort Lister, Mlanje, southern Malawi, 3500 feet.

Cercopithecus leucampyx schwarzi Roberts, 1931. Mariepskop, Pilgrims Rest District, eastern Transvaal, South Africa.

Cercopithecus mitis stevensoni Roberts, 1948. Mount Selinda, Melsetter District, eastern Zimbabwe.

The nominal subspecies *C. m. erythrarchus*, *C. m. nyasae*, *C. m. schwarzi* and *C. m. stevensoni* are all dull-coloured, with shoulders grey; back and crown olive; arms, hands, feet, and most of the tail black; legs grey; and underparts whitish or pale grey. They have been compared by a number of authors. According to Roberts (1948:63, 1951), *C. m. stevensoni* resembled *C. m. schwarzi* but seemed greyer below because of grey banding on the white ventral hairs. It differed from a specimen of *C. m. nyasae* from Mlanje in being less grey below and less dark above. Roberts (1931:222) noted that *C. m. schwarzi* differed from *C. m. erythrarchus* in having buffy-yellow (not red) ischial hairs extending 4-6 inches along the underside of the tail but not onto the upper side. The buffy-yellow colour was less conspicuous or absent in some skins. According to Dandelot (1968:11) 'The absence of a russet tinge round the base of the tail in adult males of *C. m. nyasae*, as well as the grey under-parts, perfectly distinguish this subspecies from

Table 4. Range (with mean and standard deviation in parentheses) of skull measurements, of adult males of nominal subspecies of *Cercopithecus mitis*.

Skull measurements (mm)	Type and paratype of <i>C. m. zammaranoi</i> (De Beaux, 1924)	Specimens (BM 51.690, 692, 693) of <i>C. m. albotorquatus</i>	Coefficient of difference
Greatest length without incisors	96, 95 (95.5 ± 0.71)	97-103 (99.0 ± 3.46)	0.839 (< 82% joint non-overlap)
Basal length	71.8, --	73-79 (75.7 ± 3.01)	
Zygomatic width	66, 69 (67.5 ± 2.12)	66-74 (68.5 ± 4.33)	0.155 (< 75% joint non-overlap)
Nasal length	15, 20 (17.5 ± 3.54)	19, 19, --	

C. m. erythrarchus. Napier (1981:98) was more sceptical; *nyasae*, *erythrarchus* and *stevensoni* were only weakly distinguishable; *C. m. nyasae* differed from *C. m. erythrarchus* in having yellow rather than buffy speckling of diadem and whiskers, and a yellow-brown instead of a grey-brown or reddish-brown back; red colour can extend round the base of the tail in both nominal subspecies (I have confirmed this in some BM specimens; it can also be absent altogether); *C. m. stevensoni* differed from *C. m. erythrarchus* in darker diadem and whiskers, a crown and nape not darker than whiskers, and red not extending round base of tail (but present in a specimen of *C. m. stevensoni* from Vumba; Roberts, 1948). According to Napier (1981), *C. m. schwarzi* differed from *C. m. stevensoni* in the less dark diadem and whiskers, incipient collar in some specimens (not mentioned by Roberts, 1931), crown and nape darker in relation to the whiskers, and red hairs at tail base (also not mentioned by Roberts, 1931).

General descriptions of pelage in different populations do not appear to take account of individual variation, so that there is very little indication of differences between populations and therefore of geographic variation. In material examined, individual variation is greater than regional variation among the four nominal taxa, while specimens from different regions can be virtually identical (e.g. a '*nyasae*' BM 08.5.1.1. from Fort

Johnston, Malawi, and an '*erythrarchus*' BM 08.1.1.5 from Tambarara, Mozambique).

Cercopithecus mitis labiatus

Cercopithecus labiatus I. Geoffroy Saint-Hilaire, 1842. Africa. Nomen nudum.

Cercopithecus labiatus I. Geoffroy Saint-Hilaire, 1843. Africa (= South Africa).

Cercopithecus samango Wahlberg in Sundevall, 1844. Near Port Natal (= Durban), Kwazulu-Natal, South Africa.

Recent authors have almost all accepted the synonymy of this subspecies, including Roberts (1951), Dandelot (1968, 1974), Rahm (1970), Napier (1981), Lernould (1988), and Groves (2001). Hill (1966) used the name *C. m. samango* in preference to *C. m. labiatus* as he was unaware of the valid use of this name in 1843. Kingdon (1977) also listed *C. m. samango*, making no mention of *C. m. labiatus*.

Cercopithecus mitis mitis

Cercopithecus mitis Wolf, 1822. Based on a captive specimen.

Simia leucampyx Fischer, 1829. 'Guinea' (= Angola).

Cercopithecus pluto Gray, 1848. Angola.

Kingdon (1997) listed subspecies *C. m. mitis* and *C. m. pluto* under his '*C. m. mitis* cluster', but *pluto* is a

Table 5. Skull measurements of subspecies of *Cercopithecus mitis*.

Measurement (mm)	Female holotype of <i>Cercopithecus m. phylax</i> (Schwarz 1927)	Female of <i>C. m. cf. albotorquatus</i> (BM 51.694, Tana River)
Greatest length	91.9	87 (83 without incisors)
Basal length	59.5	61
Zygomatic width	56.1	56
Length of upper cheek-tooth row including canine	28.8	28
Length of lower cheek-tooth row without canine	27.7	25
Palate length	28.1	35
Breadth of braincase	50.9	47
Occipital width	50.3	47

synonym of *mitis* (see De Barros Machado & Crawford-Cabral, 1999).

Cercopithecus mitis stuhlmanni (material examined: tables 6 & 7)

Cercopithecus stuhlmanni Matschie, 1893. North of Kinyawanga, north-west of Lake Albert, Congo-Kinshasa.

Cercopithecus otoleucus Sclater, 1902. Mt. Lotuke, Didinga Hills, Sudan.

Cercopithecus neumanni Matschie, 1905. 'Kwa Kitoto, northern Kavirondo'. Actually the Nyando Valley near Muhoroni, 30 miles east of Kisumu, Kenya.

Cercopithecus leucampyx carruthersi Pocock, 1907. Ruwenzori East, 10,000 feet, Uganda.

Cercopithecus princeps Elliot, 1909. Fort Portal, Mpanga Forest, Toro, Uganda.

Lasiopyga leucampax [sic] *mauae* Heller, 1913. Summit of Mau Escarpment, between Londiani and Sirgoit (= Sorget), Kenya.

Cercopithecus (Mona) leucampyx schubotzi Matschie, 1913. Mawambi, Ituri River, Congo-Kinshasa.

Cercopithecus leucampyx elgonis Lönnberg, 1919. Kenya side of Mt Elgon.

Cercopithecus leucampyx maesi Lönnberg, 1919. Supposedly from Kutu, Lake Leopold II (= Lake Mai-Ndombe) district, Congo-Kinshasa, but this is an error. Probably from Sake region, north-west of Lake Kivu (Colyn, 1990).

Most of the nominal taxa listed in the synonymy of *C. m. stuhlmanni* (above) have not been considered to be valid subspecies in recent years, with the exception of *C. m. elgonis*, *C. m. neumanni* and *C. m. maesi*.

Colyn & Verheyen (1987) identified the type of *C. m. maesi* as a long-haired upland specimen, a 'hybrid' between *C. m. stuhlmanni* and *C. m. schoutedeni* (described from Kwidjwi or Idjwi Island, Lake Kivu, Congo-Kinshasa). The latter is endemic to the Kivu basin and only on Idjwi is it protected from the genetic introgression evident in specimens recorded from the Kivu mainland (Rahm, 1970, Colyn, 1991). At least 45 topotypical *C. m. schoutedeni* and 16 mainland specimens have been collected (Schwarz 1928, G.M. Allen & Loveridge 1942, Rahm, 1970, Colyn 1991). Schwarz (1928) and Colyn (1991) thought that *maesi* and *schoutedeni* were not synonymous. Nevertheless, it would be useful to categorise the degree of resemblance to *C. m. stuhlmanni* or to topotypical *C. m. schoutedeni* among mainland specimens in order to confirm that *C. m. maesi* is a junior synonym of *C. m. stuhlmanni* and not a senior synonym of *C. m. schoutedeni*.

In the following discussion, it is convenient to place specimens attributed to *elgonis*, *mauae*, *neumanni*, *princeps* and *stuhlmanni* in five regional groups, Ituri, Ruwenzori Mtns, Uganda, Mt Elgon and Kenya (table 6). Lönnberg (1919) differentiated *C. m. elgonis* as a

distinct subspecies, based on three syntypes in the Congo Museum, Tervuren. It was treated as a synonym of *C. m. stuhlmanni* by Schwarz (1928) and by Allen & Lawrence (1936), who compared seven skins from Mt Elgon with one from Ruwenzori. Later *C. m. elgonis* was once again regarded as a distinct subspecies (Colyn 1991:155) diagnosed by black underparts, lack of ear tufts, dark hind limbs, and black throat patch. According to Colyn (1991), *C. m. elgonis* occurs on Mt Elgon and the Kenya highlands, intermediates or hybrids between *C. m. stuhlmanni* and *C. m. elgonis* on Ruwenzori and in Kenya, including BM 72.72 from Kakamega, and *C. m. stuhlmanni* in Congo-Kinshasa, Uganda, and Kenya. The latter includes the types of *neumanni* and *mauae* and presumably other specimens originally assigned to *neumanni* (table 6). Specimen BM 72.78 (Kaimosi) was identified as *C. m. stuhlmanni* on p. 228 of Colyn's (1991) paper but as *C. m. elgonis* on p. 155 (table 6).

In specimens assigned to *C. m. elgonis*, the tail tends to be less black and more speckled (table 7), there is often a 'saddleback' color pattern (relatively pale dorsum contrasting with black legs) including speckled shoulders, the ear tufts are absent or virtually absent, and the throat patch is black, but these are not absolute distinctions from specimens assigned to *C. m. stuhlmanni*. The only possible diagnostic character of *C. m. elgonis* appears to be the dark underparts.

Few specimens from Ruwenzori were available (table 6). Some at least approach the *elgonis* morphotype in their speckled shoulders, poorly developed ear tufts, dark hind limbs, and black belly though none are regarded as 'pure' *elgonis* by Colyn (1991). The few Uganda specimens approach the *elgonis* morphotype only in poorly developed ear tufts and contrasting dark legs. Out of 17 skins for which Mt Elgon was given as the collecting locality (Colyn 1991), one was from the Kibale Forest, Uganda, and 11 were from Kaptagat, Uasin Gishu Plateau, Kenya, so that only five were syntypes or topotypes of *C. m. elgonis*. It cannot be said that variation in the Mt Elgon population is well known. One topotype (BM 31.11.1.2, table 7) does not agree with the diagnosis, so while it might appear from Colyn's (1991) analysis that 'pure' *C. m. elgonis* alone occurs on Mt Elgon, this is not the case. In the larger sample from the Kenya highlands several specimens conform with the *elgonis* morphotype, though some have a speckled grey, not black, ventral coloration together with contrasting upperparts, corresponding with the nominal form *C. m. neumanni*. In the original description (Matschie 1906), *C. m. neumanni* was said to differ from *C. m. stuhlmanni* as follows: hairs of the brow-band narrowly banded with dusky grey, not grey-white; hairs on ears grey, not white; hind legs darker and only slightly speckled; and the speckled belly pelage mouse-grey instead of olive-grey. Elliot (1913) saw the type specimen and noted 'The buff is most conspicuous on the back,

Table 6. Material of *Cercopithecus mitis stuhlmanni* (including *C. m. neumanni* and *C. m. elgonis*) examined in the British Museum, London, or cited

Region	Names used by Colyn 1991	Specimens	Localities
Ituri Forest, Congo-Kinshasa	<i>C. m. stuhlmanni</i> .	BM 30.11.11.50-53, 55, 57	Near Beni
Upland Forest of Ruwenzori	'Possible hybrids' between <i>C. m. stuhlmanni</i> and <i>C. m. elgonis</i>	BM 13.3.16.1, BM 36.3.16.2 BM 93.3.5.1	Nyamugas 'Near Lake Ruwenzori
Other localities in Uganda	<i>C. m. stuhlmanni</i>	BM 6.7.1.1, type of <i>carruthersi</i> BM 72.68 BM 1.8.9.17, BM 7.4.6.7 & 7.4.6.6, type of <i>C. m. princeps</i> . BM 66.3620	Kibale Fore Mpanga Fo Masindi
Mt Elgon (Uganda/Kenya border)	<i>C. m. elgonis</i>	BM 10.4.1.8 BM 31.11.1.2	South face Mt Elgon at Mt Elgon
Kenya highlands west of Gregory Rift	<i>C. m. elgonis</i> ,	Three syntypes of <i>C. m. elgonis</i> , in Teruren. BM 72.70, 71, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, & 159 BM 72.73, 74, & 75 BM 72.76 & 77 BM 72.69 BM 72.78 BM 72.72	Kaptagat Kipkabus Marindas F Rotik Farm Kaimosi Kakamega
	<i>C. m. elgonis</i> or <i>C. m. stuhlmanni</i>		
	'Hybrid' between <i>C. m. stuhlmanni</i> and <i>C. m. elgonis</i>		
	Not identified.	BM 13.10.18.8	Upper Mare
	<i>C. m. stuhlmanni</i>	Type of <i>C. m. neumanni</i> Cf. <i>neumanni</i> (Matschie 1913) Cf. <i>neumanni</i> (Heller 1913) Cf. <i>neumanni</i> (Hollister 1924) Type of <i>mauae</i>	Vicinity of N Mau Forest Kakamega Lukosa (=) Mau Escarp

which may be said to be almost of that hue.' These comments indicate a silverback pattern which with the black legs and speckled mouse-grey underparts characterise other Kenya specimens (table 7), particularly a skin from Kaimosi (BM 72.78). The nominal subspecies *C. m. mauae* was distinguished from *C. m. neumanni* only by an olivaceous suffusion of the dorsal pelage (Heller 1913) and probably lies within the range of variation of skins from Kaptagat (table 7).

Colyn (1991) suggested that monkeys of Elgon and Ruwenzori were relicts of a formally widespread population from which the subspecies *C. m. opisthostictus* (southern Congo-Kinshasa and Zambia), *C. m. mitis* (Angola) and *C. m. boutourlinii* (Ethiopia) have also evolved. These three agree with *C. m. elgonis* in their black underparts and absence of ear tufts but lack the derived features of head pelage identified by Colyn (1991) that characterise the *stuhlmanni* section of *C. mitis*, including *C. m. elgonis*. If Colyn's (1991) hypothesis is to be sustained, it seems necessary to assume that the ancestral form of *C. m. elgonis* possessed primitive features of head pelage which were then swamped by introgression with *C. m. stuhlmanni*. Whether or not there has been introgression of two morphotypes in East Africa, a geographical division can not be made between putative parental populations *C. m. stuhlmanni* and *C. m. elgonis*, and no hybrid zone can be identified. Whether or not they were once allopatric subspecies, *C. m. stuhlmanni* and *C. m. elgonis* can no longer be treated as such, because they are sympatric. They are not sympatric species, so must be regarded as variants within a single subspecies, *C. m. stuhlmanni*. There may be some uncertainty in defining *stuhlmanni/elgonis* 'hybrids'. Therefore the name *elgonis* is best regarded as a synonym of *C. m. stuhlmanni*, following Hill (1966), Dandelot (1968, 1974), Rahm (1970), Napier (1981) and Lernould (1988), and the same may be said for *carruthersi*, *mauae*, and *neumanni*.

Monkeys from near Lake Manyara in Tanzania should not have been referred to *C. m. neumanni* by Swynnerton & Hayman (1951), according to Rahm (1970), because they belong to the *albugularis-stuhlmanni* hybrid swarm (Booth 1968). Comparing it with the Ethiopian *C. m. boutourlinii*, Kingdon (1997) recently described *C. m. neumanni* as a 'similar (hybrid?) population in Tanzania,' presumably referring to the same hybrid swarm.

Conclusion

Of the subspecies discussed in this paper, *C. m. kibonotensis*, *C. m. zammaranoi* and *C. m. phylax* have been differentiated by size, yet the material on which these taxa were named was sparse in the extreme, few more specimens are now available for study, and evidence for subspecific status is quite inadequate. Different descriptions of the supposedly distinctive pelage of *C. m. zammaranoi* have been published and

fall within the range of variation of *C. m. albotorquatus*. The nominal forms *C. m. nyasae*, *C. m. schwarzi* and *C. m. stevensoni* are not separable as distinct subspecies from *C. m. erythrarchus*. The names *C. m. pluto* and *C. m. samango* are widely recognised as junior synonyms, not as valid subspecies. The subspecies *C. m. stuhlmanni* does show geographic variation but it is felt that nominal subspecies *C. m. elgonis* and *C. m. neumanni* are not sufficiently discrete to be regarded as valid taxa, while *C. m. maesi* is a name based on intergrades with *C. m. schoutedeni*. Thus eleven subspecies which have recently been considered to be valid are reducible to synonyms.

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Table 7. Data on pelage of *Cercopithecus mitis stuhlmanni* from East Africa (material from the Natural History Museum, London, and the literature).

Region	Shoulders	Ear tufts	Hind limbs	Contrast with back	Underparts	Distal percentage of tail black without white speckling.
Ituri	Wholly black color of crown extends to nape and shoulders.	Prominent, yellowish.	Speckled down to feet.	No contrast between dorsum and hindlimb pelage.	Grey, speckled with white.	35-65%.
Ituri (13 specimens, Lönnberg 1919)	Speckled on head or shoulders, or had darker upperparts.					
Ituri (50 adult skins, J.A. Allen 1925).	Most had whole upper surface of head, nape, and shoulders to arms uninterruptedly black.	Scanty or abundant; pale yellowish-white to deep reddish-ochre.				
Ruwenzori	All black, or speckled.	Little or none.	Much less speckled than in Ituri specimens.	More contrast between pelage of back and hind limbs.	Ashy-grey or black, speckled.	35-60%.
Uganda	Black, unspeckled.	Little or none.	Less speckled.	More contrast between pelage of back and hind limbs.	Grey, speckled with white.	30-60%.
Mt Elgon (syntype of <i>C. m. elgonis</i> Lönnberg, 1919)			Black, scantily ticked with narrow white rings on the thighs without markings on the lower parts and feet.		Lower parts of body sooty blackish with rich grey wool shining through.	Hairs banded with white over nearly all of tail; only extreme tip black.
Mt Elgon (BM 10.4.1.8)	All black	Poorly developed	Dark grey, speckled.	More contrast between pelage of back and hind limbs.	Ashy-grey, little speckled, not contrasting with black chest.	31%
Mt Elgon (BM 31.11.1.2)	Speckled	None	Well speckled	Legs and body equally speckled, not contrasting.	Speckled, not darker than upper parts.	All speckled but end third missing.
Kenya	Speckled	Poorly developed, short, grey BM 13.10.18.8 (Mara River)	Less speckled	More contrast; 'silverback' pattern in some skins (or olivaceous suffusion over the pelage).	Females: ashy-grey, virtually unspeckled, contrasting with black chest.	0% (BM 72.85, Kaptagat); 16-40% in remaining 13 specimens
Kenya (BM 72.78)	Speckled	Short, grey	Less speckled	'Silverback' pattern	Adult males: black ¹ . Light grey speckled with white.	18%
Kenya (BM 72.72)	Speckled	Short, grey	Less speckled		Light grey speckled with white.	50%
Kenya (type of <i>neurmanni</i>)		Short, grey	Less speckled	'Silverback' pattern.	Mouse-grey, speckled.	

¹ But speckled grey with median black tract in BM 72.74 (Kipkabus).

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PRIMATES OF THE CENTRAL NIGER DELTA, NIGERIA

Abstract: A series of surveys were conducted on the central Niger Delta in 1994, 1995 and 1996, to establish the distribution of the newly discovered Niger Delta red colobus *Procolobus badius epieni*. During the surveys, information on other primates, the condition of the forest, and human activities was also collected. The forests of the Delta face heavy logging pressure and all primate populations are affected, especially the red colobus which is already Endangered. This unique ecosystem, presently without a single protected area, deserves more interest that will, hopefully, lead to the development of a management plan and protection.

Resumé: Des inventaires ont été menés au centre du Delta Niger en 1994, 1995 et 1996 afin d'établir la distribution de l'espèce nouvellement découverte de colobe rouge *Procolobus badius epieni*. Lors de ces inventaires, nous avons noté toutes informations sur les primates, les conditions de l'habitat et les activités humaines. Les forêts du Delta font face à de l'exploitation forestière intensive et toutes les populations de primates en sont affectées, particulièrement le colobe rouge qui est déjà considéré comme en danger. Cet écosystème unique, qui ne jouit d'aucun statut de protection, mérite que l'on s'y attarde. Ces efforts pourraient, nous l'espérons, mener au développement d'un plan d'aménagement et de protection.

Introduction

Up to the beginning of this decade, little research had been conducted on the distribution of mammals in the Niger Delta. Surveys for Sclater's guenon *Cercopithecus*

sclateri were the first to touch on the most northern part of the Delta (Oates, 1989; Werre, 1991; Oates *et al.*, 1992). During these surveys the Taylor Creek area was visited along the Niger and Nun Rivers, and the white-throated monkey *Cercopithecus erythrogaster*, mona monkey *Cercopithecus mona*, and putty-nosed monkey *Cercopithecus nictitans* were observed, and the red-capped mangabey *Cercocebus torquatus*, olive colobus *Procolobus verus*, and chimpanzee *Pan troglodytes* reported as present (Oates, 1989; Werre, 1991).

These efforts were followed by a survey conducted by Powell (1993, 1995) that covered most of the Delta. His survey uncovered a number of species new to the Delta or even to Nigeria, and most surprisingly, an unknown population of red colobus which is considered to be a new subspecies, the Niger Delta red colobus *Procolobus badius epieni* (Powell, 1997; Grubb & Powell, 1999).

At the beginning of 1994, a group of primatologists from the City University of New York visited the Delta specifically to confirm the presence of the Niger Delta red colobus which was observed near the town of Gbanraun (Oates, 1994). In July 1994, I started a 2 month-long survey of the central Niger Delta in order to determine the distribution and status of the red colobus, and to investigate the possibility of conducting a long-term study of the monkey's behavior and ecology. I returned in November 1995, and completed the survey in February 1996. During this survey I also collected data on all other primates present, other mammals, the condition of the forest, and human activities.

The Niger Delta

The Niger Delta can, broadly, be divided into three major ecological zones: the coastal barrier island zone, the mangrove zone, and the freshwater forest zone (Powell, 1993):

1. The coastal barrier islands are large sand banks along the Atlantic coast, covered with freshwater forest. Along most of their perimeter lies a narrow band of mangroves, but the interior consists of swamps that are only fed by rainwater. The faunal and floral assemblages on these islands are poorer than those of the freshwater forests further inland.
2. The mangrove zone is comparatively species poor, and often considered to have low habitat variation. In the Delta, however, a large number of freshwater forest islands dot the mangrove zone making it less homogeneous than is often assumed. *C. mona* appears to be the only monkey in this zone.
3. The freshwater forest zone, which forms the largest part of the Niger Delta, can be divided into three sub-zones, each characterized by some distinct differences in their floral and faunal assemblage. The sub-zones are:
 - a. The flood forest zone, which is inundated by the annual Niger River flood and dries out during the dry season. The endangered *C. erythrogaster* is found here.

- b. The eastern flank, which is thought to have been typical flood forest when the Orashi River was a major tributary of the Niger River, is also inundated by floodwaters at the end of the wet season. Sclater's monkey, an Endangered species, occurs in this zone, as does the chimpanzee (also an Endangered species) (Powell, 1997; Bocian, 1998).

- c. The marsh forest zone consists of fresh water forest that is not, or little, influenced by the Niger Flood. The Niger Delta red colobus occurs in this zone.

The Survey

The central section of the Niger Delta, the marsh forest zone, is both remote and swampy. As a result, it took about 4 months to establish the distribution of the red colobus (figure 1). The data collected during the survey, supplemented with information from Powell (1993, 1995), indicate that the red colobus is limited to ca. 2,000 km². The boundaries of the distribution area appear to be natural, and not caused by human activities.

Other than the red colobus, I observed *C. mona*, *C. nictitans*, and *C. torquatus*. I received reports from hunters of the presence of *C. erythrogaster* and *P. verus*. Two nocturnal primates, probably the potto *Perodicticus potto* and a dwarf galago *Galagoides* sp., were reported but never observed. Some hunters reported the presence of two "types" of primate resembling a potto, making it possible that the Calabar angwantibo *Arctocebus calabarensis* was also present.

During the survey it became clear that not only was it difficult to see the red colobus, but that the forest in their geographic range was heavily exploited: all swamps were logged (Werre & Powell, 1997).

The swamps here harbour a preferred timber species, "abura" *Hallea ledermannii*, which is logged throughout the Delta and, in many cases, had disappeared altogether. When "abura" becomes scarce the loggers switch to other species such as *Alstonia boonei*, *Coelocaryon preussii*, *Pycnanthus marchalianus*, and *Anthostema aubryanum*.

The area's most important socio-economic activity is fishing. As a result, hunting is not widely practiced. Although every town has hunters, there are rarely more than one or two individuals who pursue this activity seriously. Though all monkeys are hunted, those hunters that know red colobus, "epieni" in the Ijaw language, indicated that this species was generally avoided because of the toughness of its meat and, probably more importantly, the animal's unpleasant odor.

Status of Primate Populations

The combination of habitat destruction and a small geographic range has put the red colobus population into

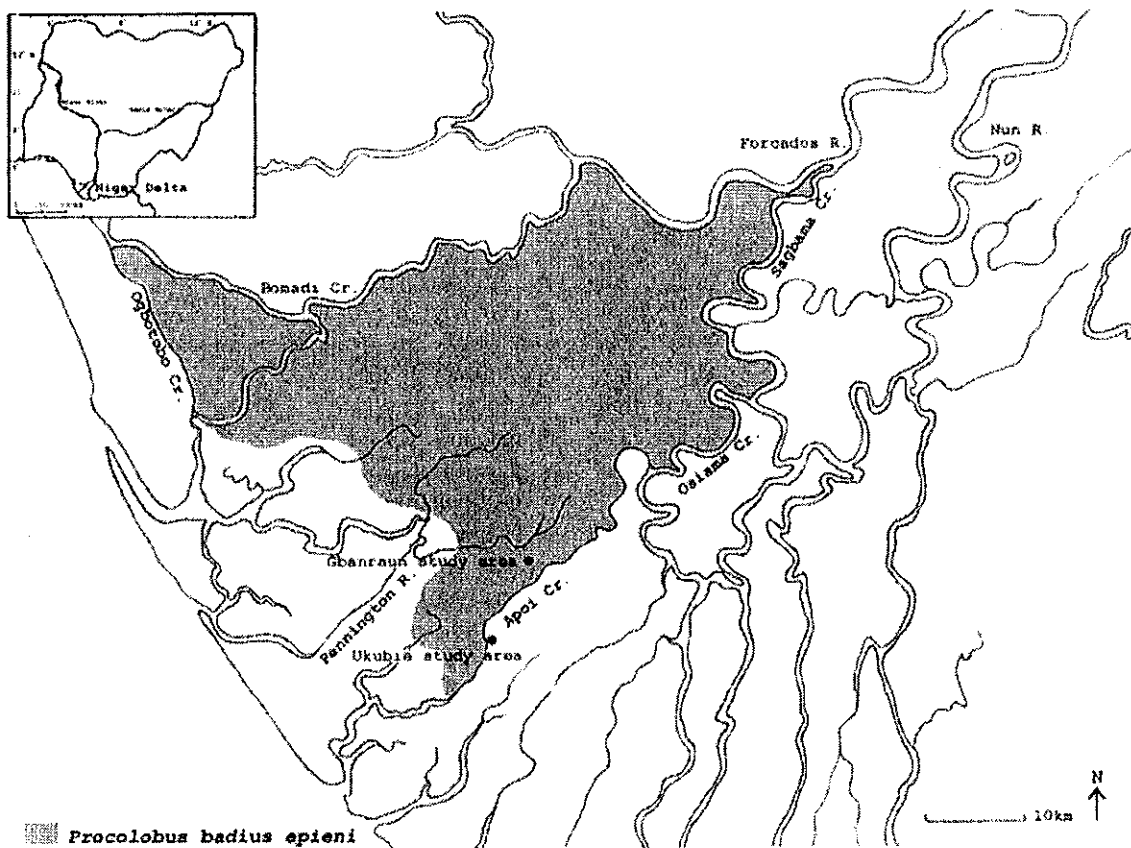


Figure 1. Map of the central Niger Delta showing the study areas and distribution of the Niger Delta red colobus *Procolobus badius epieni*.

a precarious position. Observations of the monkeys suggest that, on average, a group of about 50 animals inhabits a home range of approximately 80 ha. Under this scenario, approximately 125,000 red colobus could be present. The results of the survey indicated, however, that in most places the animals have become rare or extirpated. These observations, linked to the fact that no completely undisturbed marsh forest remains, makes it likely that the present population is below 10,000 animals, which qualifies the population as an Endangered subspecies (Oates, 1996, IUCN, 2000).

Though the populations of other species are also decreasing, they seem to be doing better. *C. nictitans* was most often observed or heard, suggesting it is the central Delta's most abundant primate. Though *C. mona* is well known by all hunters in the Delta, it appears to occur at much lower densities than in other Nigerian rain forests where it is generally the most common primate. The status of *C. erythrogaster* was more difficult to determine. I am under the impression that this monkey has always been rare in the central Delta. Fewer hunters reported the presence of *P. verus* but a small number of accurate descriptions were recorded. Though it is difficult to observe this secretive monkey, their density is undoubtedly low.

Study Area

Following the survey, I established a study area in relatively undisturbed forest near the town of Gbanraun for the study of a group of red colobus. Hunters interviewed indicated that they were familiar with the same primate species as observed elsewhere in the Delta. At the study site the calls of a dwarf galago were heard at irregular intervals around the camp and the animals were twice seen from a great distance. The call was recorded and compared with a tape produced by S. K. Bearder (1992) which contained calls of other dwarf galagos. The call I recorded did not match those of any dwarf galago present on the tape.

Because it was impossible to census populations from transects in the swamp, I used spot sightings to arrive at a rough estimate of density within the study area (table 1). *C. nictitans* was the most common guenon at the study site, often occurring in mixed species groups with *P. badius*, or *C. torquatus* and/or *C. mona*. The study area of about 140 ha was used fully or partially by six different groups of *C. nictitans*, each of approximately 15 monkeys, and partially by one group of about 15 *C. mona*.

C. torquatus was mainly found in the drier sections of the study area, where it was common. Four groups of about 15 animals each occupied sections of the study area. Though the *C. torquatus* formed mixed species

Table 1: Estimated densities of diurnal primates at the Gbanraun Study Area (140 ha), Niger Delta, Nigeria.

Species	# groups	Total animals.	Total animals in study area	Animals/ha
<i>Cercopithecus mona</i>	1	16	10	0.08
<i>Cercopithecus nictitans</i>	6	90	60	0.48
<i>Cercocebus torquatus</i>	4	60	45	0.36
<i>Procolobus badius</i>	4	205	150	1.20

groups with both *C. nictitans* and/or *C. mona* they were never observed together with *P. badius*. The red colobus was abundant at the study area and constituted, by far, the largest portion of primate biomass. In total, four different groups, ranging in size from 30 to 80 individuals, occupied home ranges that fell partially or fully within the study area.

Though hunters reported *P. verus* and *C. erythrogaster* as present, these species were not observed in the study area. It appears that the great number of creeks and rivers in the red colobus geographic range form at least short-term boundaries, resulting in a patchy distribution of the primate species present.

Discussion

Because the density estimates in table 1 are based on spot sightings they cannot be compared with estimates from other sites, or be used for predictions for the rest of the central Delta. They do, however, suggest that primate densities in relatively undisturbed forest can be high. Due to the pressure on the Delta's forests, the number of areas where primates occur at such densities must be decreasing rapidly. A conservation effort for the area is, therefore, much needed.

The Delta provides an interesting environment for the study of primate ecology and behavior. With the establishment of the Gbanraun study site it has become feasible to study not only red colobus, but also *C. mona*, *C. nictitans* and *C. torquatus* here. Moreover, the pronounced ecological variation over short geographical distances within the red colobus geographic range adds to its interest as an area for studies of primate ecology and behavior. Because the Delta is a difficult place to conduct research, the Gbanraun study area provides an excellent opportunity, and incentive, to conduct more primate studies. Presently, a discreet conservation effort linked with a community development project is being developed for Gbanraun, which will facilitate research in this area. Without a doubt, more interest in this unique, little known, ecosystem will provide sorely needed support for conservation in the Niger Delta.

Acknowledgments

The survey and red colobus study were conducted with

generous funding of the Nigerian Agip Oil Company Ltd. (NAOC), Primate Conservation International Inc., the Zoological Society for the Conservation of Species and Populations, and the Margot Marsh Biodiversity Foundation. The Niger Delta Wetlands Center made it possible for me to work in Nigeria and they, as well as NAOC, generously supplied me with logistical support. The Nigerian Conservation Foundation and Pro Natura are presently supporting the development of a conservation/community development program. I would also like to thank the many inhabitants of the Niger Delta who provided both the support and assistance to complete this project.

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de terrain faites par Lumsden quant à la morphologie et le comportement des animaux recueillis.

Introduction

W.H. Russell Lumsden joined the Yellow Fever Research Institute (subsequently named the East African Virus Research Institute (EAVRI)) in Entebbe, Uganda, in 1947, where he took over the post of Entomologist, recently vacated by A.J. Haddow. From 1953–1955 he made extensive collections of galagos as part of an ongoing investigation into their role as possible hosts in yellow fever transmission (Lumsden & Hewitt, 1954; Lumsden, 1955; Lumsden *et al.*, 1955; Haddow & Ellice, 1964). These collections extended over a distance of ca. 1400 km in eastern Africa, from Pemba Island in the north (Tanzania) to Chikwawa in the Shire Valley in the south (Malawi) and sampled nearly 650 animals. Some animals were shot or died during the collection process, and these were presented to the Natural History Museum (NHM), London. Others were released after their measurements and life history details had been recorded. The field protocols for all of these animals have been lodged in the Department of Mammals at the NHM, and remain an important source of population data for several galagonid species [*e.g.*, ecological and reproductive data for the *Otolemur* protocols have been analyzed and summarized in Masters, Lumsden & Young (1988)], as well as providing contextual data for the associated museum specimens. Russell died on 13 May 2002 in Edinburgh. This near-complete manuscript, describing the ecology of his field sites, was found among his papers. My only significant editorial contribution has been to add the NHM numbers of animals collected at the various sites, and to alter the taxonomy in accordance with Jenkins (1987), under which the voucher specimens have been accessioned in the NHM collection, so that the information might be incorporated more readily by galago researchers.

GALAGO (GALAGONIDAE) COLLECTIONS IN EAST AFRICA (1953 – 1955): ECOLOGY OF THE STUDY AREAS

Abstract *Between February 1953 and July 1955, W.H.R. Lumsden systematically sampled galago populations at six eastern African localities as part of an ongoing investigation of the potential role of these primates in the transmission of yellow fever. Both the field protocols listing the details of the animals captured and the associated voucher specimens have been lodged in the Department of Mammals at the Natural History Museum, London. This paper provides ecological information on the study sites in the light of the particular species found there, and records some of Lumsden's field observations regarding the morphology and behaviour of the animals collected.*

Resumé: *Entre février 1953 et juillet 1955, W.H.R. Lumsden a recensé systématiquement des populations de galagos dans six localités de l'Afrique de l'Est dans le cadre d'un projet visant à comprendre le rôle potentiel des primates dans la transmission de la fièvre jaune. Les protocoles de terrain détaillant les animaux capturés et les spécimens qui leur sont associés ont été déposés au Département des Mammifères du Musée d'Histoire Naturelle de Londres. Cet article rapporte l'information écologique des sites d'étude à la lumière des espèces trouvées en ces lieux, de même que quelques observations*

Newala District, Tanzania—10° 56' S, 39° 18' E (February to April, 1953)

Topography

An isolated plateau, about 50 km²; a sandstone block bounded by an escarpment, with its surface gently undulating at about 650 m altitude, 300 m above the surrounding plain; very porous, so that no surface water stands except at two unusual localities where there are impervious layers and, respectively, a lake and a small forest.

Climate

Range of daily temperature maxima 22°–28° C; mean annual rainfall 950 mm—very dry from June to October.

Vegetation

Patchy cultivation—mainly cassava and millet—interspersed with secondary bush and often very dense thicket; the result of leaving areas fallow for several years to re-establish fertility. Scattered relict *Clorophora excelsa*; groups of mango trees *Mangifera indica* round some hut groups; some cashew nut *Anacardium occidentale* plantations; small areas of woodland of Gilman's (1949) classification: open, dry, with tall grass, and the commonest tree *Pterocarpus angolensis*. Similar *Pterocarpus* woodland with grass on the scree of the escarpment. The plateau forest is open, mainly of *Pterocarpus* and *Azelia* spp. and bamboo clumps; head-high grass below.

Human Population

About 150,000 living in groups of grass huts and in a few small villages.

Galagonid Population

Otolemur crassicaudatus montei. Associated with the larger trees of the scree woodland and with mango trees on the plateau; reported common in forest. The stomachs of three animals shot in the wild contained, respectively, leaf debris, seeds identified as *Sterculia setigera*, and mango fruit.

Galago zanzibaricus zanzibaricus. [Groves (2001) referred these specimens to *G. granti* on the basis of pelage coloration, although they were slightly separated morphometrically from typical *G. granti* in a principal components analysis. How they fare relative to typical *G. zanzibaricus* is not recorded.] Occurs in dense thicket on the plateau and on the escarpment scree. This species is associated with nests about 35 cm in diameter, made of fresh green leaves, found about 3 m from the ground; local people aver that the nests are deserted as soon as the leaves wither. Possibly also associated with nests of liane fibre covered with leaves and twigs. Nests may house several animals: one group was comprised of four adult males and one animal of unknown sex (destroyed by shot); another, one female and two young; one mixed species group, one male *G. zanzibaricus* with a pair of *G. demidoff*. No nests were found in hollow trees; few trees were large enough. Of 11 animals shot in the field during the day, eight had empty stomachs. In the remaining three, all shot before 13:00, the stomachs contained small quantities of chitinous insect debris. One also contained fruit/flower debris.

Galago demidoff. [These are represented as *G. rondoensis* in Groves' (2001) recent revision, characterised by small body size, longer ears and tail, and a reddish tinge to the tail. Groves' designation follows that of Honess (1996). Groves (pers. comm.) states: "There is an intrinsic interest that of this new species, the Lumsden series form the bulk of the museum sample

of it (worldwide!)."]

Very similar in habitat and habits to *G. zanzibaricus*; also frequents nests of green leaves in low dense thicket, the one nest seen tenanted by three adult females; once associated with *G. zanzibaricus* (see above). One of five animals shot in the wild between 10:00h and 12:00h had red fruit debris in its stomach; the other stomachs were empty.

Total collection: seven *Otolemur crassicaudatus montei*, three added to NHM collection (specimens ZD.1954.732–ZD.1954.734); 21 *Galago zanzibaricus zanzibaricus*, 10 added to NHM collection (specimens ZD.1954.735–ZD.1954.744); six *Galago demidoff*, four added to NHM collection (specimens ZD.1954.746–ZD.1954.749); one *Galago* sp. (specimen ZD.1954.745). Other primates collected: *Cercopithecus mitis*, *Cercopithecus aethiops*, *Papio cynocephalus*

Morogoro, Eastern Province, Tanzania—6° 48' S, 37° 40' E (July, 1954)

Topography

Foothills of the Uluguru Mountains and adjacent plain on sandy clay loam soil; altitude about 600 m.

Climate

Rainfall: 1,250 mm likely to be exceeded in four years out of five.

Vegetation

Natural vegetation of the plain is a high-grass/low-tree combretaceous/papilionaceous woodland with *Combretum*, *Stereospermum*, *Lonchocarpus*, *Acacia* and *Terminalia* spp., with local patches of *Isobertinia* *Brachystegia* woodland (miombo); extensively cleared for sisal and food cultivation. On the lower foothills are mission compounds and the gardens of the residences of expatriates, with many exotic amenity and fruit trees and a terraced forest nursery, the whole broken up by plantings of *Cassia* spp. and other small trees, particularly in ravines of small streams. Many mango and citrus trees with occasional coconut and ornamental palms (*Roystonea* sp.). A few small relics of ground-water forest are preserved as 'sacred groves'. Higher on the hillside, the natural transition from *Combretum* and other woodland to mountain forest composed of *Allanblackia*, *Macaranga*, *Parinari*, *Albizia* and other spp. (at about 1,800 m) is obscured by clearing for cultivation on steep hillsides, which may leave relict single trees. There are two small forest reserves.

Human Population

African local village population (about 40,000 within 20 km at the 1948 census) and expatriates of the local headquarters.

Galagonid Population

Otolemur garnettii panganiensis. Mainly occurs in the zone of cassias, small trees and gardens. Food: No information, all animals trapped.

No lesser or dwarf galagos seen, despite several night reconnaissances.

Total collection: 12 *Otolemur garnettii panganiensis*, three added to NHM collection (specimens ZD.1964.955–ZD.1964.957). Other primates collected: *Cercopithecus aethiops*.

Zanzibar Island, Tanzania—6° 10'–6° 25' S, 39° 17'–39° 33' E (July and August, 1954)

Topography

A low-lying island about 90 x 20 km, nowhere above 120 m altitude, 44 km off the East African mainland. The higher western part of the island is of fertile loamy soils on gentle slopes on low ridges; the lower eastern part is less fertile 'coral rag' country, with a thinner sandy soil and coral outcrops.

Climate

Equable. Range of daily temperature maxima 23°–31° C. Rainfall: 1,300 mm likely to be exceeded every 4 years over all the island except its south-east tip which is slightly drier; wet seasons mainly mid-October to end of December and mid-March to mid-May.

Vegetation

Extensive coconut, clove and *Colocasia* plantations and other cultivation, with many kapok *Ceiba pentandra* trees on fertile western side of the island; shifting cultivation interspersed with low bush on the coral rag in the east. The bush is variable in character: sometimes nearly open grassland with small isolated trees, sometimes with much dense low thicket, occasional *Pteris*. There are occasional small patches of forest and one larger forest reserve (Jozani). The coast is mostly narrow (50 m) sandy beach backed by *Pandanus* sp., but there are small mangrove forests in the few creeks. The east coast has some narrow strips of open coconut plantation above the beach.

Human Population

About 480,000 in 1978. Agriculturalists and fishermen.

Galagonid Population.

Otolemur garnettii garnettii. Very abundant, especially in the west of the island in coconut grove country. Occurs in human settlements, even in the middle of the town of Zanzibar. Locally common in the coral rag country to the southeast; seen frequently in mango and kapok trees. The stomachs of the 12 animals shot in the wild were

empty in three cases; of the remaining nine, food materials found were: fruit debris (mango, pawpaw, breadfruit, citrus)–7; insect debris–7; seeds–3. Loud call: repeated hoarse croaks—"cahk cahk cahk"—often followed by a cadenza of similar sounds but each shorter and less regular. There is also a low double growl—"ho you"—quite slow which lasts about 1.5 seconds. Commonly travels on ground, occasionally in broad daylight, sometimes jumping on hind legs only, as much as 2 m, like a kangaroo. Roosts in the daytime in the tops of bushes or in the foliage of trees.

Galago zanzibaricus zanzibaricus. Appears to be rare and not known to locals in the west of the island in the main coconut grove country; occurs widely in bush, low forest and in groves of small coconut trees in the eastern and southern part of the island in the coral rag country. Also found sometimes in mango and coconut trees. Manner of movement more akin to scurrying along branches or midribs of leaves than the free jumping of the mainland lesser galago species. Call: a double or triple chirring, creaking sound somewhat like a cork in a bottle-neck. Nests: makes nests of green leaves, which show several tooth marks at their severance, sometimes brought from trees other than in which the nest occurs, at about 2 m height in bushes in secondary growth; sometimes coconut fibre or ferns are used. Also nests in hollow pawpaw or coconut trees at 6 to 10 m height, without nest material; and similarly in the axils of coconut tree fronds. The complement of one such nest, for which all five of the group were captured, was two adult males, one adult female and one subadult of each sex. In all of nine animals shot in the field, the stomach was empty.

No dwarf galagos found.

Total collection: 105 *Otolemur garnettii garnettii*, 28 added to NHM collection (specimens ZD.1964.927–ZD.1964.954); 31 *Galago zanzibaricus zanzibaricus*, 11 added to NHM collection (specimens ZD.1964.971–ZD.1964.981). Other primates collected: *Ptilocolobus badius*, *Cercopithecus mitis*, *Cercopithecus aethiops*.

Pemba Island, Tanzania—05° 00'–5° 55' S, 39° 14'–39° 50' E (August, 1954)

Topography

A low-lying island, nowhere over 100 m altitude, about 60 km off the East African mainland and 48 km NE of Zanzibar. Most of the island is composed of a confusion of small hills of loamy sand, each around 40 m altitude, and separated from one another by innumerable narrow steep valleys. The slopes, though short, are of loose loam, very steep and with few secure footholds. A strip along the north and east coasts and some of the small

island, is of the lower, flatter, 'coral rag' country: thin soil on a substratum of denuded coral.

Climate

Equable, very similar to that of Zanzibar. Range of daily temperature maxima 23°–32°C. Rainfall in excess of 1,300 mm in 4 out of 5 years; wet seasons mainly mid-October to end of December, and mid-March to mid-May.

Vegetation

The hill/valley part of the island is thickly covered with clove *Jambosa caryophyllus* and coconut *Cocos nucifera* plantations, interspersed with food crops and some bush. The clove trees are larger than those in Zanzibar, up to 21 m, as Pemba escaped the hurricane of 1872, which Zanzibar did not (Pakenham, 1984). Any wind is very diminished among the heavy clove vegetation and the humidity is always high. In the north of the island are two small forest reserves with trees up to 30 m. Some small areas of heath, with a heather about 1 m tall. Sporadic *Borassus aethiopum*. The extreme north-west and the eastern strip on 'coral rag' is covered by bush, rough grass or low forest regenerating after moving cultivation, which is often of cassava. Sometimes the cassava cultivation is in small pockets of soil among pinnacles of coral up to 2 m tall. Extensive coconut plantations in the north on the flat ground. Mangrove forests in the many creeks of the sea coast.

Human Population

About 206,000 in 1978.

Galagonid Population

Otolemur garnettii garnettii. Very red pelage noted. Abundant, especially in clove and coconut plantations. Present on at least one of the Matumbini Islands. In two of 14 animals shot in the wild the stomachs were empty; for the remainder the following food material was found: insect debris (once a tettigoniid grasshopper)–5; slug/snail debris–5; fruit/flower debris–3; seeds–3; leaf debris–2; centipede debris–1; one animal had its throat full of ants.

Galago zanzibaricus zanzibaricus. Not found. Although several local residents said that they knew this species in Pemba, none were discovered despite extensive searches and the offer of a reward for specimens brought in. Many leaf nests were examined but were apparently not of this species; the leaves of the nests found had been cut off with a single shear whereas the leaves of the nests of this species on Zanzibar are characterised by multiple tooth marks at the severance. One of the Matumbini Islands south of Pemba was also searched.

No dwarf galagos found.

Total collection: 173 *Otolemur garnettii garnettii*, 29 added to NHM collection (specimens ZD.1964.898–ZD.1964.926). Other primates collected: *Cercopithecus aethiops*.

Balovale, Zambia—13° 33' S, 23° 07' E (May to June, 1955)

Topography

Flat plain at about 1,050 m altitude, east of the upper Zambezi River, intersected by the flood plains (dambos) of its eastern tributaries.

Climate

Wet season from October to April with a peak in February, very dry from May to September; mean annual rainfall 1,136 mm. Mean maximum daily temperature 30°C, mean minimum daily temperature 15°C.

Vegetation

Two main areas sampled: (a) Divalata, 27 km NNW of Balovale, *Isoberlinia paniculata-Brachystegia* woodland on Kalahari sands (Trapnell *et al.*, 1950); well developed, trees up to 20 m tall, high but sparse grass on the ground. Locals differentiate the woodland into 'mbunda' (as above) and 'mavunda'—a denser growth of smaller trees (?*Cryptosepalum* sp.) with many lianes. (b) At Chitokoloki, 17 km SE of Balovale, on the eastern bank of the Zambezi River, *Baikiaea plurijuga* forest on transitional Kalahari sands (Trapnell *et al.*, 1950). Along the banks of the Zambezi and its tributaries there is a 'banktop' forest, about 50 m wide bordered on the riverside by a single line of ?*Syzygium* sp., 8–10m tall, with other trees on the short slope above. *G. moholi* is particularly abundant in this environment.

Human Population

Scattered population of 62,000 in the District (1954) or about 2.5 persons/km², living in small groups of huts of mud and thatch, occasionally brick-built, practising shifting cultivation mainly on mavunda areas. Small villages mainly situated at river crossings. Much scattered cultivation, mainly of cassava with some bananas, around settlements.

Galagonid Population

Otolemur crassicaudatus montei. In mbunda the species shelters in hollow trees, and sometimes in indigenous bee hives of bark; in mavunda it is more often found in the tops of trees. Of 14 animals shot in the wild, one had an empty stomach; food materials found in the other 13 were: gum–9; insect debris (isopteran and acridid)–7; seeds–1.

Galago moholi. Mainly in mbunda, particularly abundant in the woodland along the edges of dambos and in

'banktop' forest. The species shelters in 'nests' in hollow trees, the nest often on a platform plug of leaves. Nest holes range from 1–13m above ground level, with most found between 3–8m. Only about 20% of the nests found were occupied. The inhabitants of 122 nesting holes were recorded. The distribution of the sexes in these nesting groups was as follows: 2M–4; 1M–41; 3M, 1F–1; 2M, 1F–5; 2M, 2F–4; 1M, 1F–8; 1M, 2F–6; 1M, 3F–2; 1F–35; 2F–5; 3F–1. Thus the most common nest populations were, in order: single males (34%), single females (29%) and male/female pairs (15%), and the mean group size was 1.6 animals. The species frequents mainly the lower levels of the thicket vegetation and often descends to the ground. Of eight animals shot in the wild, the stomach was empty in two. Food materials found in the other six were: insect debris (once formicoid)–6; leaf debris–1. Loud call recorded as: "kik-kik-kik-kik" often repeated, harder and harsher than that of *G. zanzibaricus* in Zanzibar.

On a night hunt with headlamps, 12 *G. moholi* were seen along a 6 km stretch of road. Assuming that the method discovers all *G. moholi* within 20 m of the road, the population/km² will be $12 \times (1/(6 \times 0.04)) = 50$; this is probably an underestimate. One *O. crassicaudatus* was seen for each six *G. moholi*, giving the former a population density of 8/km². No dwarf galagos were seen.

Total collection: 21 *Otolemur crassicaudatus monteiri*, six added to NHM collection (specimens ZD.1964.958–ZD.1964.963); 231 *G. moholi*, 19 animals added to NHM collection (specimens ZD.1964.987–ZD.1964.1005). Other primates collected: *Papio cynocephalus*, *Cercopithecus aethiops*.

Chikwawa, Shire Valley, Malawi—16° 10' S, 34° 45' E (June and July, 1955)

Topography

Valley of the southward-flowing Shire River, traversed by its many tributaries, approximately 150 m altitude, and lower adjacent marginal hill country to northeast and southwest.

Climate

No detailed information. A fairly dry region; the flora has affinities with Sudanese vegetation.

Vegetation

On recent alluvium on the valley floor: parkland and woodland with *Acacia albida*, *Sterculia appendiculata*, *Cordyla africana* and *Kigelia pinnata* predominant; heavily cultivated for food crops, cotton and, especially near the river, bananas; few thickets. On terrace alluvium further from the main river: woodland with *Sclerocarya caffra*, *Acacia spirocarpa*, *A. nigrescens*, *A. xanthophloea* (especially near tributary rivers) and

Pterocarpus stevensoni predominant, with breast-high grass below; moving cultivation in this vegetation type regenerating to thickets, sometimes very dense with many lianes, completely obscuring overhead—'crypt' thicket. On piedmont colluvium: tall forest with well developed understorey and thicket with *Terminalia sericea*, *Ostryoderris stuhlmanni*, *Pilostigma thonningi* and *Sclerocarya caffra* predominant; sometimes much cultivated and then open. On sandstone and shale in the foothills: tall, open woodlands with little understorey and short grass associated with *Colophospermum mopane*, *Pseudoberlinia globiflora*, *P. angolensis* and *Terminalia sericea*; tall woodland with thickets associated with *Kirkia acuminata*, *Adansonia digitata*, *Brachystegia* sp., *Commiphora* sp. and *Cassia* sp.; thicket on ridges with *Grewia*, *Commiphora*, *Dahlbergia* and *Euphorbia* spp.

Human Population

Valley floor heavily populated with large villages.

Galagonid Population

Otolemur crassicaudatus kirkii. Associated with woodland with thickets: on the valley floor, with *Acacia spirocarpa*, *A. nigrescens* and *Pterocarpus stevensoni*; in the foothills, with *Kirkia acuminata* and *Grewia/Commiphora/Cassia* thicket. Common also in mixed *Cassia*/indigenous trees in expatriates' compound at Chikwawa. Most often seen in *Acacia* spp. trees at night. Food materials found in the stomachs of 19 animals shot in the wild included: insect debris (including large caterpillars)–9; seeds–4; acacia gum–4; fruit fragments–3; leaf debris–2. Five stomachs were empty.

Galago zanzibaricus granti [Groves (2001) referred these specimens to *Galago nyasae*, also on the grounds of pelage coloration.] Associated with thickets: on terrace alluvium, with *Acacia nigrescens*, *A. spirocarpa*; in foothills found in *Kirkia acuminata/Adansonia* woodland with dense thicket. Food materials found in stomachs of seven animals shot in the wild included: insect debris–3; leaf debris–3; gum–1.

No dwarf galagos were found.

Total collection: 35 *Otolemur crassicaudatus kirkii*, seven added to NHM collection (specimens ZD.1964.964–ZD.1964.970); seven *Galago zanzibaricus granti*, five added to NHM collection (specimens ZD.1964.982–ZD.1964.986). Other primates collected: *Cercopithecus aethiops*, *Papio* sp.

Acknowledgments

For information, maps and notes freely made available by many government medical, forestry and agricultural experts, at this distance in time all inevitably nameless,

acknowledgement is gratefully made; as is also the help given by many local authorities to the logistics of the expeditions. More recently, Dr W.J. Eggeling, Dr J.B. Hall, and Mr R. G. Sangster, all at one time foresters in Africa, have kindly gone over some of the entries and made suggestions and additions. JCM thanks Prof. Colin Groves for his comments on the manuscript, and Ms Raksha Maganbehari for secretarial assistance.

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THE RELEASE OF WILD-BORN ORPHANED CHIMPANZEES *PAN TROGLODYTES* INTO THE CONKOUATI RESERVE, REPUBLIC OF CONGO

Abstract: *Habitat destruction and the subsequent increase in the lucrative yet illegal bushmeat trade continue to threaten wild chimpanzee populations. The hunting of African great apes appears to be increasing still. This trade has caused a persistent rush of orphaned apes toward sanctuaries, where their future is limited in captivity. Considering both the seriousness of this problem and the immense cost of caring for these orphans, HELP-Congo (Habitat Ecologique et Liberté des Primates), a Congolese non-governmental organisation, has been using reintroduction as a tool to address the fate of orphaned chimpanzees. So far, 20 chimpanzees have been reintroduced at four different times in the Conkouati Reserve, Republic of Congo. Since the first chimpanzees have been released, a team of scientists and local field research assistants closely monitors them. To date, more than 6,000 h of direct observation have been carried out. The overall survival rate is in excess of 75%. This scientific monitoring aims at providing data on chimpanzee reintroduction and will help to design guidelines for the decision-making process, the preparation, and the implementation of chimpanzee reintroduction. In this paper, we describe the protocol followed by HELP to release 20 chimpanzees between 1996 and 1999.*

Resumé: *La destruction de l'habitat et l'accroissement subséquent mais illégal de la vente de viande de brousse continue de menacer les populations de chimpanzés sauvages. La chasse des grands singes africains semble encore être en croissance. En considérant le sérieux de ce problème et les coûts faramineux des soins à prodiguer aux orphelins, l'organisation non-gouvernementale congolais HELP-Congo (Habitat Écologique et Liberté des Primates) utilise la réintroduction comme moyen pour assurer la survie des chimpanzés orphelins. Jusqu'à maintenant, 20 chimpanzés ont été réintroduits à 4 moments différents dans la Réserve Conkouati en République du Congo. Une équipe de scientifiques et d'assistants de recherche locaux suivent ces chimpanzés de près depuis le moment où les premiers ont été relâchés. À ce jour, plus de 6,000 h d'observation directe ont été accumulées et le taux de survie dépasse les 75%. Le suivi scientifique a pour objectif de fournir des données sur la réintroduction des chimpanzés et contribuera à*

définir des lignes directrices dans les processus de décisions, de préparation et d'implantation de programme de réintroduction de chimpanzés. Dans cet article, nous décrivons le protocole suivi par HELP lors de la relâche de 20 chimpanzés entre 1969 et 1999.

Introduction

Wild chimpanzee *Pan troglodytes troglodytes* populations in Africa are declining rapidly due to deforestation, habitat fragmentation, and the bushmeat trade. Reintroduction is generally problematic and is a relatively unexplored prospect for chimpanzees. Recently, a release program was launched by a Congolese organisation, Habitat Ecologique et Liberté des Primates Congo (HELP Congo), with the aim to re-establish captive, wild-born orphaned chimpanzees in the Conkouati Reserve in the Republic of Congo. In this paper we describe the procedure that was followed to release 20 chimpanzees into a site called 'the Triangle'. Before being released, the chimpanzees were placed on three forested islands in the Conkouati lagoon, where they spent from 6 to 9 years before being released. Candidates for the release were selected after a complete medical assessment. The first chimpanzees, four females and one male, were released in December 1996. To date, 20 individuals have been released in the Triangle. Fourteen, including the first five, are alive and well 3 years post-release. Two of the chimpanzees died and four disappeared. The 14 chimpanzees that are followed on a daily basis are all well adapted to free-living conditions.

The project has had positive benefits for other fauna and flora of the Triangle thanks to effective protection of the area. Poaching and deforestation have decreased significantly. The approach followed by HELP's staff may offer useful experience for other reintroduction programs for captive chimpanzees.

Background

HELP Congo is a Congolese non-governmental organisation that was created by Alette Jamart in 1989 in response to the lack of facilities for an increasing number of orphaned chimpanzees confiscated by the Congolese authorities. The main objective of HELP was to return the chimpanzees to their

natural environment. In 1991, HELP was given permission by the Ministry of Water and Forests to create a Sanctuary on the shore of the Conkouati Lagoon, 180 km north of Pointe Noire (figure 1). Since 1991, the chimpanzees have been transferred directly to the Sanctuary at Conkouati. In 1994, HELP had 48 chimpanzees at the Sanctuary. All of the chimpanzees at the Sanctuary are thought to have originated from the Kouilou region, within which is the Conkouati Reserve (Ministry of Water and Forests, unpublished data).

Description of the Release Method

The release project involved a number of activities and followed four important steps.

- (1) *Pre-release period and rehabilitation on islands*
 - a) *Nursery*: Infant chimpanzees (under 3 years old) stayed initially in the nursery created on the mainland

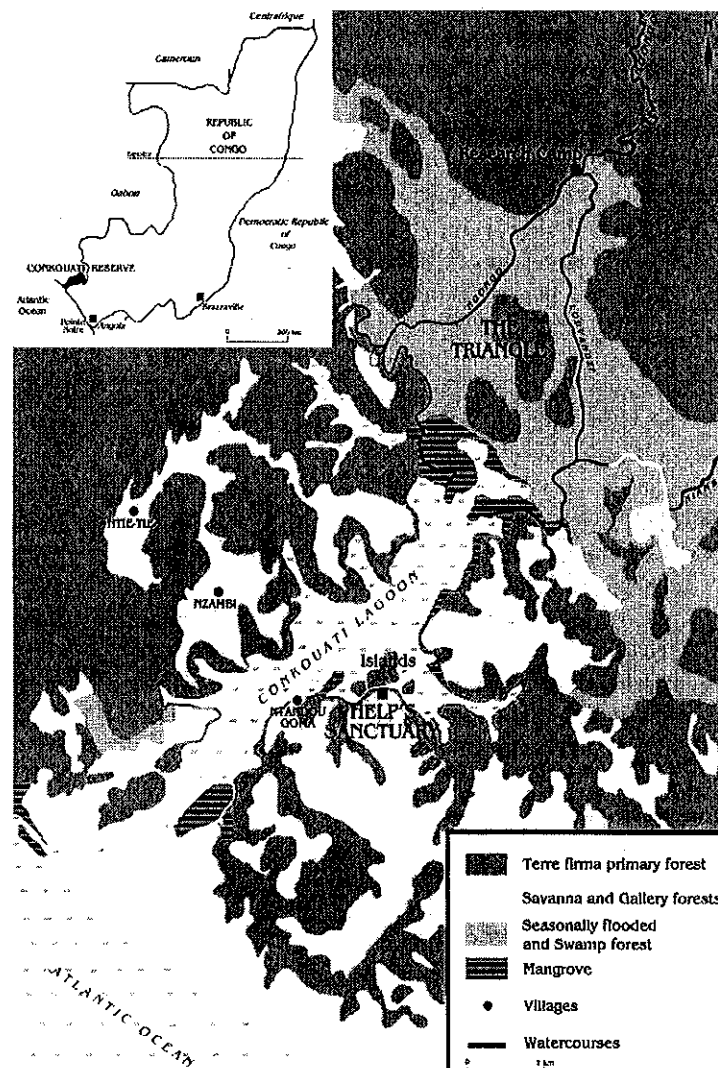


Figure 1. Location of the Conkouati Lagoon and 'the Triangle' in the Republic of Congo (from Tutin et al. in press).

at the Sanctuary, located in the Conkouati Lagoon (figure 1). They slept in cages at night and spent their days visiting nearby forest patches accompanied by caretakers, with the aim of recovering from the physical and psychological trauma of capture, and creating social bonds among the animals.

- b) Rehabilitation on islands: After reaching 3 years of age, chimpanzees were placed on three forested islands in the Lagoon where they roamed freely, but remained dependent on supplementary feeding, as the islands do not provide sufficient natural food. On the islands, the chimpanzees are able to further develop their social bonds, learn how to build nests, and due to the natural vegetation on the islands, became familiar with various edible plant species.

(2) Selection of the release site

In 1994 and 1996, Dr Caroline Tutin selected a release site that provided sufficient resources for the released individuals, without affecting species already present. The site selected is named the "Triangle", and is an area of about 21 km² with natural boundaries (rivers) that do not isolate it completely from the surrounding forest (1,000 km²), as natural bridges exist and animals can easily cross the river. The local chimpanzee population density was estimated to be 0.17-0.33 individuals/km², equivalent to an average of 3-7 wild chimpanzees using the site (Tutin *et al.* in press). The low population density of wild chimpanzees (due mainly to the poaching pressure in the Reserve) combined with the high diversity and abundance of chimpanzee foods suggested that additional individuals could be introduced without negatively affecting the resident fauna and flora. A research camp was built just outside the Triangle.

(3) Procedures for the release

- a) Selection of candidates: In order to have a good chance of surviving in the wild, candidates for release must be competent at finding food and avoiding natural predators. We decided to release suitable candidates in small groups composed of individuals that had formed strong associations. Based on the behaviour of the species (dispersal of females, philopatry of males), the adolescent females were the most appropriate candidates. Some individuals were judged to be unsuitable for release for behavioural or health reasons.
- b) In order to allow efficient long-term post-release monitoring, we investigated levels of genetic variability, relatedness and parentage within the sanctuary population using nuclear markers (Goossens *et al.* 2000, Goossens *et al.* submitted). Among the released individuals, the mean relatedness was very low, indicating that the released individuals were on average unrelated

(Goossens *et al.* submitted), thereby decreasing the possibility of inbreeding. Ultimately, we aim to genetically tag and track released individuals by non-invasive means, to monitor their social integration into the wild population, and to assess their reproductive success (Goossens *et al.* submitted).

- c) Capture: Capturing the chimpanzees from the islands was conducted by administering anaesthetics by manual injection or by dart from a blow pipe (Vidal *et al.* in prep). The anaesthetised chimpanzees were transported to the Sanctuary for medical examination (see below), pre-release treatment, and fitting of radio-collars.
- d) Veterinary screening: A major concern with any reintroduction project is to control diseases that have potential to jeopardise the health of human and/or wildlife populations. A complete medical evaluation and preventive medicine program were implemented for all the chimpanzees at HELP's Sanctuary following the recommendations of the IUCN "Veterinary Specialist Group" and "Reintroduction Specialist Group". The first veterinary evaluation was conducted in April 1996 by Drs M. Ancrenaz and J. Paredes assisted by colleagues from Centre International de Recherches Médicales de Franceville (CIRMF), Gabon. The medical exam consisted of the following: tuberculin test, faecal evaluation, de-worming treatment, vaccination for poliomyelitis and tetanus, serology analysis for Hepatitis A, B, C and retrovirus, haematological and blood chemistry analysis, and hair collection for DNA analysis. The results showed that the health of the colony was excellent, and that individuals did not harbour any pathogen that might compromise the release. Immediately following their capture on the island and before release, all candidates for reintroduction went through a final health screening for major pathogens, and were vaccinated for poliomyelitis and tetanus.
- e) Release: After medical screening, the chimpanzees were transported by boat to the release site. The precise release location within the Triangle was chosen with regard to the topography (non-inundated area) and the location of seasonal food resources. For the most recent release in January 1999 the animals were placed in a holding cage to monitor them as they awoke from the anaesthetic, to reduce stress, and to facilitate contacts with the previously released chimpanzees living in the Triangle.

(4) Post-release period

Monitoring of released chimpanzees is necessary to assess their adaptation to their new environment. They are located by radio-tracking (Telonics) and followed on a daily basis at distances varying from 5-100 m. Data on their movements, nests, activities,

and social interactions are collected (unpublished data). Particular attention is paid to feeding behaviour. Their physical condition is continually monitored, and faecal samples are collected to monitor intestinal parasites.

Results and Discussion

The first chimpanzees (four females and one male) were released in December, 1996, followed by three other groups in January, 1997, November, 1997 and January, 1999. To date, HELP has released 20 chimpanzees (16 females and four males) in the Triangle. Fourteen of the 20 released individuals are alive and well, including the first five, 3.5 years post-release. Two of the chimpanzees died: a juvenile male who fled immediately after being released and whose skeleton was located 3 km away (the cause of his death is unknown); and an infant who disappeared 5 months after being released with her mother. An un-collared male disappeared at about the same time. Three females aged between 6 and 7 years fled immediately after being released and have not been located since. It is possible that they have integrated into the wild population. To summarise, confirmed mortality is 10%, and actual mortality is probably between 15-20%, although it could be as high as 30%.

The 14 chimpanzees regularly followed by observers have all adapted to free-living conditions and are healthy. They have eaten at least 137 different plant species (117 species eaten for their fruits, and 32 species for their leaves), two mammal species (rodents), three bird species, and at least 13 different insect species (especially ants), honey and eggs (Vacher-Vallas *et al.* in prep). This high diversity in diet is similar to that observed for wild chimpanzee populations across Central Africa. After only 9 months the released individuals were already familiar with approximately 85% of the food items available to them (Vacher-Vallas *et al.* in prep). Their activity budgets resembled those of wild chimpanzees, as do their grouping patterns. They met wild conspecifics on many occasions. Released females associate regularly with wild males during periods of oestrus, but none has so far given birth.

After almost 4 years, there are no signs of negative impacts on food plants or on any of the sympatric fauna. In reality, due to the presence of the monitoring team and resultant protection of the site, observations of primates (gorillas *Gorilla gorilla*, mandrills *Mandrillus spinx*) and elephants *Loxodonta africana* have increased substantially (Maissels, unpublished data).

Conclusion

From a welfare perspective, the release project is a success as 14-17 chimpanzees have regained their

freedom and have adapted successfully to living in the wild. From a conservation perspective, the project has important benefits for the protection of the whole of the Conkouati Reserve, including all its native fauna and flora. Additionally, HELP's experience may serve as a model for other projects that relocate small groups of animals, or restore corridors linking patches of remnant habitat occupied by isolated populations. Within the next 2-3 years, 18 other chimpanzees will be released. To achieve this, HELP is looking for financial and logistical support.

Acknowledgements

We wish to thank all the people who made this project possible, notably N. Chabeuf, C. Chatelain, C. Doumenge, J. Pearce and M. Taty. J.-J. Fontaine and S. Descamps provided considerable support in Pointe Noire and France, respectively.

CIRMF Gabon provided logistical support and expertise for health checks. Many people contributed to data collection, particularly during the post-release period: P. Aczel, S. Didier, E. Dilambaka, G. Gomas, J.-P. Malanda, Y. Massala, A. Mayet, N. Moutogo, S. Pambo, A. Taty, E. Tchidango and P. Vallas.

Finally, we would like to thank PROGECAP (GEF-Congo under the auspices of the World Bank) and The World Society for the Protection of Animals, the Brigitte Bardot Foundation, the Animal Protection Society (SPA), The International Primate Protection League, The Humane Society International, Cleveland Zoo, Amneville Zoo, Beauval Zoo, Virbac, Gorilla, and Air Gabon for their financial assistance.

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NOTES

ROBUST CHIMPANZEE *PAN TROGLODYTES SCHWEINFURTHII* IN OTZI FOREST RESERVE, NORTHERN UGANDA

Otzi Forest Reserve (03°35'–03°49'N; 31°47'–31°57'E) is situated 18 km northeast of Moyo Town, entirely within Metu County in the north of Moyo District (figure 1). Otzi Forest Reserve covers an area of 188 km² with an altitudinal range of 760–1667m (Davenport & Howard, 1996). The forest is located on an escarpment overlooking the confluence of the Achwa River with the White Nile

as it flows northward, and is bounded to the northeast by the international border with Sudan. The vegetation is broadly classified as *Butyrospermum-Hyparrhenia* and *Combretum* savanna with undifferentiated semi-deciduous thicket and riverine forest (Langdale-Brown *et al.*, 1964). Some 261 tree species are known from the forest, 20% of which are considered forest-dependent (Davenport & Howard, 1996). Approximately 8% of the Reserve is bushland (> 4 m), 40% grassland, and 52% forest / woodland (National Biomass Study, 1996). Steep gradients, harsh terrain, and deep gullies in the central and northern portions of the Reserve have provided some natural protection from human encroachment (Davenport & Howard, 1996).

Otzi was visited on three occasions (July 1993; April and May 1994; February 1995) by members of the Uganda Forest Department's biodiversity inventory teams as part of a national assessment of the flora and fauna of Uganda's major forests (Davenport & Howard, 1996; Howard *et al.*, 1997, 1998, 2000). This work was aimed at evaluating sites in terms of their importance for biodiversity conservation and guiding decisions on the establishment of new forest Nature Reserves. Otzi was ultimately ranked highly for biodiversity conservation and water catchment (Howard *et al.*, 2000), and has since also been designated as an 'Important Bird Area' (Byaruhanga *et al.*, 2001). During the first visit in 1993, rumours (some of long standing) of the presence of the robust chimpanzee *Pan troglodytes schweinfurthii* in Otzi were brought to our attention. According to residents north of Otzi Range, for example, a chimpanzee was allegedly killed east of Otzi Peak and west of Iligwa Range, as far back as 1962. We were able to corroborate this information through sightings of chimpanzees, investigations of nests, and discussions with local villagers.

In July 1993, three chimpanzee nests were observed ca. 10 m above the ground, west of Iligwa. A month later, an adult male was observed between cairns 74 and 75 near the Apipi River. In September of that year, nests were also seen in Oyo, north of Iripi Hill, between the Lea Valley and Lliba Range. This area of lowland *Combretum* is favoured by local residents for hunting, cultivation and honey collection. Additionally, 12 nests were observed in dense gallery forest vegetation near Abuse Peak. Vocalisations were followed up at this site and one chimpanzee (sex unknown) was observed. Towards the end of the year, five nests were recorded alongside the Apipi River, and in January 1994 another chimpanzee was seen to the east of the Reserve in the Nyeri Valley.

According to local residents, chimpanzees are less commonly observed between the months of July and October, although the reasons for this are unclear. They are also very rare in the southern portion of the Reserve, a low altitude area dominated by grassland and with greater human accessibility. It is claimed that chimpanzees migrate to the steep ravines behind Nyeri

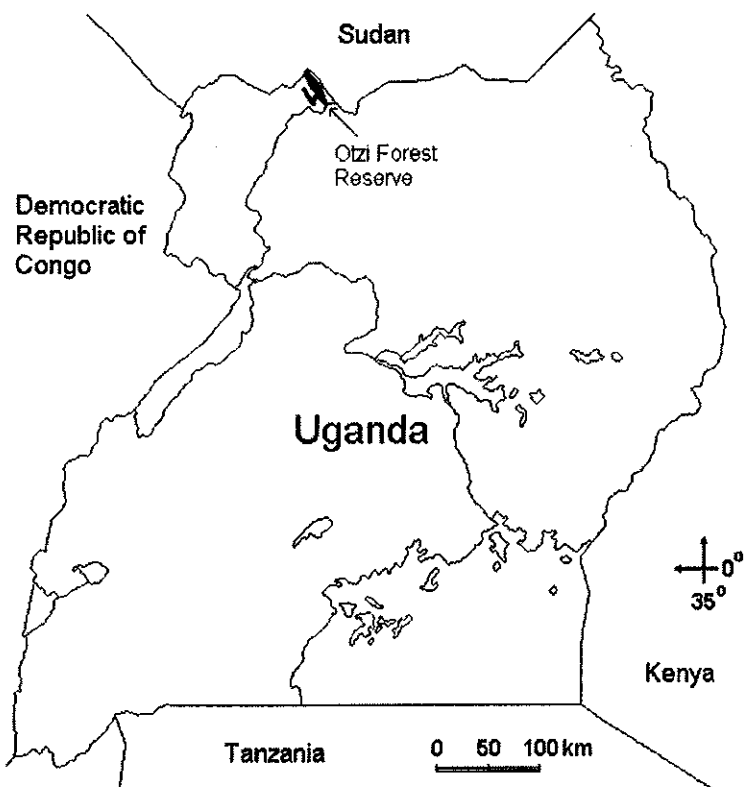


Figure 1. Map of Uganda showing the location of Otzi Forest Reserve (shaded).

Mountain in the north of the Reserve in the dry season, where there are permanent water sources.

Based on these data, the existence of chimpanzees in Otzi was reported to the Uganda Forest Department (Davenport, 1995). Uganda is recognised as an important country for chimpanzees, with an estimated population of 4,000 to 5,000 animals. Recent censuses, however, are suggesting that slightly higher numbers may occur (Plumptre & Reynolds 1996; Plumptre *et al.*, 2000, 2001, Butynski, 2001). Otzi's chimpanzees do not represent the most northerly population of eastern chimpanzees, as isolated records do occur from extreme southwest Sudan and southeast Central African Republic, and the far north of the Democratic Republic of Congo (Kortlandt, 1983; Lee *et al.*, 1988; Butynski, 2001). Two decades of civil war throughout southern Sudan has undoubtedly affected chimpanzee populations there, although to what extent it is not possible to say. However, Otzi's chimpanzees are the most northeastern population thus far documented (perhaps the most eastern). Moreover, this population extends the range of this species in Uganda by more than 180 km to the north of Rabongo Forest in Murchison Falls National Park, the nearest known location in the country.

Otzi Forest Reserve is an important source of building materials, especially bamboo poles, and other non-timber forest products such as medicinal plants (Davenport & Howard, 1996). These are particularly

significant for villagers living in the two enclaves in the south (UTM grids: UV710030 and UV715045). Much of the north and east of the Reserve, however, is remote, relatively inaccessible, and thus sparsely populated on the periphery. The integrity of the forest is not, therefore, considered to be as threatened as other reserves in the district (Davenport & Howard, 1996).

Uganda has experienced considerable, much publicised, political upheaval since independence. Largely eradicated south of the Nile, insecurity remains a problem throughout the North. This, coupled with the war in contiguous Sudan, has meant that biologists have only rarely visited Otzi over the past 40 years. Given such geographic and scientific isolation, it is perhaps not surprising that Otzi's chimpanzees have (to the best of our knowledge) remained unrecorded for so long. It is not known how many chimpanzees inhabit the Reserve, although it is probable that the population is not large. Indeed, assuming a typical density found elsewhere of 1-2 individuals per km², and the amount of potentially suitable

vegetation in the Reserve, it is unlikely that this population exceeds 200 animals. Their current status remains unclear. Further investigation is warranted, particularly if this population is to be afforded greater protection.

Acknowledgments

These data were collected during biodiversity inventory work carried out by the Uganda Forest Department. Funding was provided by the European Union (Project 6100.31.42.015) and the Global Environment Facility (Project UNO/RAF/006/GEF). We wish to thank Lee Saunders for assistance in the field, Tom Butynski for comments and for encouraging this publication, and two anonymous referees for their valuable comments on an earlier draft.

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COMPOSITION OF GORILLA *GORILLA BERINGEI* GROUPS MONITORED BY KARISOKE RESEARCH CENTRE, 2001

Introduction

As information about the group composition and social behaviour of western lowland gorillas *Gorilla gorilla* has emerged (e.g., Parnell, 2002), researchers have had to rely on incomplete published information about mountain gorilla group compositions when comparing the different species. The purpose of this paper is to provide an update on the demographic composition of the research population in Rwanda. We hope to make this an annual programme so that researchers and local park authorities have ready access to this information. All data come from the Karisoke long-term records.

Groups were monitored on a daily basis in 2001, with the exception of some days between June and August when visits to the gorillas were suspended because of insecurity. As a result, the data presented here represent a complete listing of demographic changes to the three research groups in 2001.

Table 1 lists the individual composition of three mountain gorilla groups currently monitored by staff of the Dian Fossey Gorilla Fund International at Karisoke Research Centre in Rwanda. These individuals or their ascendants formed most of the population studied by Dian Fossey beginning in 1967. The columns in the table show the name given to each individual, a 3-letter identity code, a 3-letter identity code for the mother's name, and a 3-letter identity code for the family name (based on matriline), plus the sex, date of birth, and age of each individual as of 31 December 2001. In some cases, an individual's age is approximate because the birth date was estimated when the individual was first seen. In order to note birth date accuracy, an index that describes the error around a birth date is listed in the column 'Birth Error'. We include one solitary silverback, as he is easily identifiable, interacts with two of the research groups, and left Pablo's Group only 3 years ago.

Between January 1, 2001 and December 31, 2001 the number of individuals in the Karisoke Research

Centre-monitored research population increased by five among three groups. Details of demographic changes in each group follow.

Beetsme's Group

Beetsme's Group increased from 24 to 27 animals, with two births, two immigrations and one death. The immigrant females, Ukuri and Mahirwe, were both under 8 years old at the time of transfer, and both came from Pablo's Group. There were three silverbacks in this group until Beetsme died on June 15th, at the estimated age of 35 (birth error = 5). There are two other silverbacks in this group, Kuryama and Joli Ami.

Pablo's Group

Pablo's Group saw two births, and two subadult females transferred to Beetsme's Group, so there was no overall change in the size of the group. This group, however, remains the largest ever recorded, at 47 individuals and had reached 48 before Mahirwe emigrated in December.

Shinda's Group

Shinda's Group increased from 22 to 24 with the event of two births. This group is remarkable in having six

silverback males. All are in their natal group, as they were born in Group 5, which split in 1993 to become Pablo's and Shinda's groups (e.g., Robbins, 2001).

Acknowledgements

We thank the Rwandan Office of Tourism and National Parks (ORTPN), and the Karisoke Research Centre trackers, especially Barabwiriza Faustin, Hategekimana Jean-Damascène, Hitayesu Emmanuel and Uwimana Fidèle, and assistants Hilary Swarts and Christelle Chamberlan.

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Table 1: Research gorilla group composition in Virunga Volcanos, Rwanda, 31 December 2001.

NAME	ID	Mother	Matriline	Sex	Birth date	Birth Error [†]	Current Age (years)
Beetsme's Group (27 members)							
3 SBs, 7 AFs, 5 BBs, 1 SAM, 3 SAFs, 1 JUV, 7 INFs*							
Titus	TIT	FLO	FLO	m	24-Aug-74	0	27.4
Bwenge	BWE	GIN	PET	m	22-Mar-90	0	11.8
Inziza	IZZ	GIN	PET	f	07-Jul-94	2	7.5
Papoose	PAP	unk	PAP	f	01-Jan-64	4	38.0
Shangaza	SHA	PAP	PAP	f	15-May-80	2	21.6
Pato	PTO	PAP	PAP	m	18-Jan-00	0	2.0
Kuryama	KUY	PAP	PAP	m	16-Aug-86	0	15.4
Bukima	BKA	PAP	PAP	f	03-Jul-94	2	7.5
Gufasha	GUF	PAP	PAP	f	13-Sep-98	2	3.3
Ikazi	IKZ	PAP	PAP	f	18-Dec-01	0	0.0
Fuddle	FUD	unk	FUD	f	01-Jan-68	5	34.0
Mawingu	MAW	FUD	FUD	f	06-Mar-82	0	19.9
Kirahure	KIR	MAW	FUD	m	30-Aug-91	0	10.3
Isaro	ISR	MAW	FUD	f	17-May-99	1	2.6
Joli Ami	JOA	FUD	FUD	m	23-Feb-88	0	13.9
Umushikirano	RAN	FUD	FUD	m	10-Aug-92	0	9.4
Taraje	TAR	FUD	FUD	f	01-Jun-99	1	2.6
Tuck	TUC	EFF	EFF	f	15-May-72	1	29.6
Vuba	VUB	TUC	EFF	m	28-Aug-93	0	8.3
Dushirehamwe	DSR	TUC	EFF	m	25-Jul-97	1	4.4
Urwibutso	URS	TUC	EFF	m	05-Apr-01	0	0.7
Ukuri	UKU	MAH	EFF	f	01-Oct-93	0	8.2

NAME	ID	Mother	Matriline	Sex	Birth date	Birth Error	CurrentAge (years)
Jenny	JEN	SIM	MSX	f	18-Aug-81	0	20.4
Ubwigenge	UBI	JEN	MSX	m	01-Jul-90	0	11.5
Tuyizere	TZE	JEN	MSX	m	28-Aug-94	2	7.3
Turakora	TRK	JEN	MSX	m	08-Oct-98	1	3.2
Mahirwe	MHW	BSH	AMR	f	15-Jul-94	2	7.5
Pablo's Group (47 members)							
3 SBs, 17 AFs, 3 BBs, 4 SAMs, 6 JUVs, 14 INFs							
Pablo	PAB	LIZ	LIZ	m	31-Aug-74	0	27.3
Umurava	UMR	PTY	MAR	m	04-Jan-86	0	16.0
Turatsinze	TUR	PTY	MAR	m	18-Mar-91	0	10.8
Gicurasi	GIC	PTY	MAR	m	11-May-95	2	6.6
Puck	PUC	EFF	EFF	f	15-Dec-68	1	33.0
Cantsbee	CAN	PUC	EFF	m	14-Nov-78	0	23.1
Intwali2	INT	PUC	EFF	f	12-Feb-86	0	15.9
Kureba	KRB	INT	EFF	m	03-Oct-98	0	3.2
Makuba	MAK	PUC	EFF	f	20-Aug-89	0	12.4
Isabukuru	ISA	PUC	EFF	m	12-Oct-92	0	9.2
Mafunzo	MAF	PUC	EFF	m	18-Jun-99	0	2.5
Maggie	MAG	EFF	EFF	f	15-Jun-80	1	21.5
Rukundo	RUK	MAG	EFF	m	07-Nov-94	2	7.1
Afrika	AFR	MAG	EFF	m	20-Apr-00	0	1.7
Mahane	MAH	EFF	EFF	f	20-Oct-84	0	17.2
Twihangane	TWH	MAH	EFF	m	21-Apr-97	0	4.7
Turakomege	KOM	MAH	EFF	m	09-Dec-00	0	1.1
Umuco	UMC	TUC	EFF	f	24-Aug-89	0	12.4
Iyambere	IYA	UMC	EFF	m	08-Dec-00	0	1.1
Umwana	UMW	FLO	FLO	f	01-Jun-83	0	18.6
Muzeneza	MNZ	UMW	FLO	m	15-Mar-93	1	8.8
Gushimira	GSH	UMW	FLO	f	04-Sep-96	0	5.3
Ruhuka	RUH	UMW	FLO	f	15-Oct-99	0	2.2
Gitebe	GIT	CLO	FLO	f	31-Mar-88	0	13.8
Ishavu	ISH	CLO	FLO	m	08-Jul-01	0	0.5
Bishushwe	BSH	AMR	AMR	f	18-Jun-85	0	16.5
Kubaha	KBH	BSH	AMR	m	11-Oct-98	0	3.2
Cyiza	CYI	unk	CYI	f	01-Jan-68	6	34.0
Mudakama	MUD	CYI	CYI	f	14-Nov-86	0	15.1
Bikereri	BKR	MUD	CYI	f	07-Jun-96	0	5.6
Giraneza	GIR	CYI	CYI	m	25-Oct-94	2	7.2
Faida	FAI	CYI	CYI	m	10-Oct-00	0	1.2
Umutsatsi	UMU	GUY	GUY	f	15-May-84	1	17.6
Mapendo	MAP	UMU	GUY	m	01-Sep-94	2	7.3
Musilikale	MSK	UMU	GUY	m	01-Apr-98	3	3.8
Gutangara	GUT	UMY	UMY	f	30-Dec-83	0	18.0
Tamu	TAM	GUT	UMY	f	25-May-96	0	5.6
Urugwiro	UGW	GUT	UMY	m	05-Jan-01	0	1.0
Nzeli	NZE	IGT	UMY	f	09-Sep-85	0	16.3
Umutekano	TEK	NZE	UMY	f	13-Nov-99	0	2.1
Mukecuru	MUK	MUK	unk	f	unk	5	unk
Mitimbili	MIT	MUK	unk	f	15-May-96	0	5.6
Umwe	UME	MUK	unk	f	13-Mar-00	0	1.8
Ginseng	GIN	AUG	PET	f	14-Aug-80	0	21.4
Irakoze	IRA	GIN	PET	m	04-May-00	0	1.7
Ntobo	NTO	KUG	KUG	f	26-Oct-91	0	10.2
Urugero	URG	NTO	KUG	m	26-Jun-00	0	1.5
Shinda's Group (24 members)							
6 SBs, 7 AFs, 3 BBs, 1 SAM, 1 SAF, 2 JUVs, 4 INFs							
Shinda	SHI	MAR	MAR	m	28-Feb-77	0	24.8
Gwiza	GWI	LIZ	LIZ	m	20-Oct-87	0	14.2
Inshuti2	INS	SIM	MSX	m	04-Feb-88	0	13.9
Twizere	TWI	SIM	MSX	m	07-May-92	0	9.7

NAME	ID	Mother	Matriline	Sex	Birth date	Birth Error	CurrentAge (years)
Pandora	PAN	unk	PAN	f	01-Jan-60	6	42.0
Amahoro	AMH	PAN	PAN	m	03-May-86	0	15.7
Kubaka	KUB	PAN	PAN	f	06-Mar-90	0	11.8
Tegereza	TEG	KUB	PAN	m	25-Oct-99	0	2.2
Twibuke	TBK	PAN	PAN	m	01-Jun-98	3	3.6
Walanza	WAL	unk	WAL	f	01-Jan-69	6	33.0
Ugenda	UGE	WAL	WAL	m	20-Oct-87	0	14.2
Nahimana	NAH	WAL	WAL	f	07-Mar-92	0	9.8
Kurudi 2	KRD	WAL	WAL	f	23-Apr-96	0	5.7
Kwiruka	KWR	unk	KWR	f	01-Jan-77	5	25.0
Ntambara	NTA	KWR	KWR	m	21-Feb-87	0	14.9
Ugutsinda	UGU	KWR	KWR	m	15-Oct-90	1	11.2
Wageni	WAG	KWR	KWR	m	31-Jan-95		6.9
Imvune	IMN	KWR	KWR	m	15-Aug-99	3	2.4
Kubyina1	KBY	unk	KBY	f	01-Aug-81	4	20.4
Urugamba	URU	KBY	KBY	m	11-Jun-91	0	10.6
Kanama	KAN	KBY	KBY	f	19-Aug-95		6.4
Sagamba	SAG	KBY	KBY	m	07-Sep-01	0	0.3
Pasika	PAS	PAP	PAP	f	01-Apr-91	0	10.8
Umutuzo	UMZ	PAP	PAP	f	06-Sep-01	0	0.3
Solitary males							
Ineza	INZ	PIC	PIC	m	28-Jan-86	0	15.9
TOTALS: 13 SBs, 31 AFs, 11 BBs, 6 SAM, 4 SAF, 9 JUVs, 25 INFs							

*AGE/SEX CLASSES given are those used at Karisoke for long-term records:

INF infant female / INM infant male:	0-3.5 years
JUF juvenile female / JUM juvenile male	3.5-6 years
SAF subadult female / SAM subadult male	6 - 8 years
AF adult female	> 8 years
BB blackback male	> 8-12 years
SB silverback male	> 12 years

†BIRTH ERRORS are given by a 0-6 index as follows:

0= known, exact date or within a week (± 4 days)
1= know the month of birth (± 15 days)
2= know the 3 month period in which the birth occurred (± 1.5 months)
3= know the year in which the birth occurred (± 6 months)
4= individual first seen as a pre-reproductive immature (± 1.5 years)
5= individual first seen at 8-12 years old (± 2 years)
6= individual first seen at 12-20 years old (± 4 years)

SPECIES AND SUBSPECIES OF PRIMATES DESCRIBED SINCE 1990

Thirty-eight primates (species and subspecies), have been described in the last 10 years: ten from Madagascar, eight from Africa, seven from South-east Asia, ten from the

Brazilian Amazon (seven of them marmosets), and three from the Brazilian Atlantic forest. Froehlich *et al.* (1998) record the existence of a new macaque species occurring in the Central Sulawesi peninsula, Indonesia, but its formal description has yet to be published (see also Supriatna & Hendras, 2000). Please note that this list is presented without any judgement as to the validity or otherwise of the various primates described.

Prosimians

- | | |
|---|--|
| 1. <i>Pseudopotto martini</i> Schwartz, 1996 | False potto |
| 2. <i>Tarsius diana</i> Niemitz, Nietsch, Warter & Rimpler, 1991 | Dian's tarsier |
| 3. <i>Galagoides rondoensis</i> Honess, 1996 | Rondo dwarf galago* |
| 4. <i>Galagoides udzungwensis</i> Honess, 1996 | Matundu dwarf galago* |
| 5. <i>Microcebus ravelobensis</i> Zimmerman, Cepok, Rakotoarison, Zietemann & Radespiel, 1998 | Lac Ravelobe or golden-brown mouse lemur |

- | | |
|---|-----------------------------------|
| 6. <i>Microcebus tavaratra</i> Rasoloarison, Goodman & Ganzhorn, 2000 | Northern rufous mouse lemur |
| 7. <i>Microcebus sambiranensis</i> Rasoloarison, Goodman & Ganzhorn, 2000 | Sambirano mouse lemur |
| 8. <i>Microcebus berthae</i> Rasoloarison, Goodman & Ganzhorn, 2000 | Berthe's mouse lemur |
| 9. <i>Cheirogaleus ravus</i> Groves, 2000 | Large iron-grey dwarf lemur |
| 10. <i>Cheirogaleus minusculus</i> Groves, 2000 | Lesser iron-grey dwarf lemur |
| 11. <i>Phaner furcifer pallescens</i> Groves & Tattersall, 1991 | Western fork-crowned lemur |
| 12. <i>Phaner furcifer parienti</i> Groves & Tattersall, 1991 | Sambirano fork-crowned lemur |
| 13. <i>Phaner furcifer electromontis</i> Groves & Tattersall, 1991 | Amber mountain fork-crowned lemur |
| 14. <i>Avahi unicolor</i> Thalmann & Geissmann, 2000 | Unicolor avahi |

*The first descriptions were in "Honest, P. E. 1996. Speciation Among Galagos (Primates: Galagidae) in Tanzanian Forests. Ph.D thesis, Oxford Brookes University, Oxford, UK". While here attributed to Honest (1996), both forms were described and illustrated in Kingdon (1997). Not accepting the validity of a doctoral thesis as a formal published description, the authorship is also attributed to "Honest, 1997" by Groves (2001), referring to the descriptions in Kingdon (1997). Honest and Bearder (1996) also published the descriptions of these species, but issue 2(2), 1996, of *African Primates* was published after Kingdon (1997).

Old World monkeys

- | | |
|---|----------------------------------|
| 15. <i>Miopithecus ogouensis</i> Kingdon, 1997 | Northern talapoin |
| 16. <i>Cercopithecus cephus ngottoensis</i> Colyn, 1999 | Ngotto moustached monkey |
| 17. <i>Cercopithecus erythrogaster pococki</i> Grubb, Lernoould & Oates, 1999 | Nigerian white-throated guenon |
| 18. <i>Macaca pagensis siberu</i> Fuentes & Olson, 1995 | Siberut macaque |
| 19. <i>Colobus badius semlikiensis</i> Colyn, 1991 | Red colobus |
| 20. <i>Procolobus badius epieni</i> Grubb & Powell, 1999 | Niger Delta red colobus |
| 21. <i>Presbytis melalophos bicolor</i> Aimi and Bakar, 1992 | Sumatran sureli |
| 22. <i>Semnopithecus auratus ebenus</i> Brandon-Jones, 1995 | Wulsin's ebony leaf monkey |
| 23. <i>Pygathrix nemaeus cinerea</i> Nadler, 1997 | Grey-shanked douc langur |
| 24. <i>Rhinopithecus roxellana hubeiensis</i> Wang, Jiang & Li, 1998 | Hubei golden snub-nosed monkey |
| 25. <i>Rhinopithecus roxellana qinlingensis</i> Wang, Jiang & Li, 1998 | Qinling golden snub-nosed monkey |

New World monkeys

- | | |
|--|-------------------------------|
| 26. <i>Callithrix nigriceps</i> Ferrari and Lopes, 1992 | Black-headed marmoset |
| 27. <i>Callithrix mauesi</i> Mittermeier, Ayres & Schwarz, 1992 | Maués marmoset |
| 28. <i>Callithrix argentata marcai</i> Alperin, 1993 | Marca's marmoset |
| 29. <i>Callithrix saterei</i> Souse e Silva Jr & Noronha, 1998 | Sateré marmoset |
| 30. <i>Callithrix humilis</i> Van Roosmalen, Van Roosmalen, Mittermeier & Fonseca, 1998 | Black-crowned dwarf marmoset |
| 31. <i>Callithrix manicorensis</i> Van Roosmalen, Van Roosmalen, Mittermeier & Rylands, 2000 | Manicoré marmoset |
| 32. <i>Callithrix acariensis</i> Van Roosmalen, Van Roosmalen, Mittermeier & Rylands, 2000 | Rio Acari marmoset |
| 33. <i>Leontopithecus caissara</i> Lorini & Persson, 1990 | Black-faced lion tamarin |
| 34. <i>Callicebus bernhardi</i> Van Roosmalen, Van Roosmalen & Mittermeier, 2002 | Prince Bernhard's titi monkey |
| 35. <i>Callicebus stephennashi</i> Van Roosmalen, Van Roosmalen & Mittermeier, 2002 | Stephen Nash's titi monkey |
| 36. <i>Callicebus personatus barbarabrownae</i> Hershkovitz, 1990 | Biond titi |
| 37. <i>Callicebus coimbrai</i> Kobayashi & Langguth, 1999 | Coimbra-Filho's titi monkey |
| 38. <i>Cebus kaapori</i> Queiroz, 1992 | Ka'apor capuchin |

Acknowledgments

The authors thank Ardith Eudey, Jörg Ganzhorn, Thomas Butynski, Douglas Brandon Jones, Jatna Supriatna and Geffrey Froehlich for helping in compiling this list.

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STATUS OF SYKES'S MONKEY *CERCOPITHECUS MITIS* *ALBOGULARIS* IN THE TAITA HILLS, KENYA

Introduction

The forests of Taita Hills, the most northern outlier of the Eastern Arc Mountain forests, are currently under threat from human activities that promote subdivision, conversion and fragmentation. The constant increase in human population pressure has led to a concomitant need for more agricultural land and forest products. These forests are important because of their high species diversity, levels of local and regional endemism, and as water catchment areas. Endemism has been noted in plants (Beentje, 1988), insects (Marc De Meyer, pers. comm., 1998), millipedes (Vandenspiegel, 2001), birds (Brooks *et al.*, 1998) and mammals (Lovett, 1997). Since loss of diversity is likely to follow habitat disturbance (Lawton *et al.*, 1998), data on current status are very valuable if particular species are to be conserved.

Methods

During September 1997 and August 1998 when we were studying small mammals of the Taita Hills complex (03° 20'S, 38° 15'E), we became interested in a race of the Sykes's monkey *Cercopithecus mitis alboگularis* found in these forests. During this time we managed to visit eight fragments. Seven of the fragments were within the main Dawida (Dabida) Massif, namely Ngangao (135.9 ha), Chawia (93.6 ha), Fururu (8.4 ha), Ndiwenyi (4.2 ha), Macha (4 ha), Mwachora (3 ha) and Iyale (1.6 ha). The eighth fragment, Mbololo (178.8 ha), is separated from Dawida by a deep valley.

We walked through the forest until a group of monkeys was encountered. We then carefully followed the group and observed their activity patterns for periods of about 3 hours per day. These observations occurred mainly during the afternoons to late evenings in the Dawida Massif, and morning to early afternoon in Mbololo. In most months these observations were carried out for three consecutive days in the case of the Dawida fragments. In Chawia and Ngangao Forests, observations were carried out in October and November 1997, and from January to August 1998. Mbololo was visited in October 1997, and in April and July 1998.

Results

We observed Sykes's monkeys for 930 h during the study. We recorded the presence of these monkeys in only three

of the eight fragments: Mbololo, Ngangao and Chawia. These were the largest of the eight fragments. In Chawia Forest the same group was always encountered and was recognizable by a male with a characteristically shortened tail. This large group had at least 30 individuals. Ngangao Forest appeared to have two to three social groups comprising about 20 individuals each. However, we could not reliably identify the different groups. These groups may have had overlapping home ranges, but the groups appeared to mostly use different parts of the forest. On two occasions we observed two groups engaged in an aggressive inter-group encounter in which threats, but no physical confrontation, were observed. Following these encounters, groups either moved back in the direction from which they came or detoured from their apparent path and moved on, but in different directions from each other.

As in the case of Ngangao, it was not easy to identify the individual groups in Mbololo, but we encountered at least two different groups and it is likely there were more. The groups comprised at least 20 individuals. Other forest sites visited included Fururu and Ndiwenyi in October and November 1997, and January to April 1998. In addition Iyale, Macha and Mwachora were visited between January and April 1998 but no records of these monkeys were made (table 1).

Discussion

The occurrence of Sykes's monkeys is now restricted to the three largest remaining forest fragments of the Taita Hills. Their distribution in multiple forest fragments suggests that they were once widespread in the Taita area. The increase in human population with the resultant forest encroachment, coupled with recent dry climatic conditions, may be the most important factors in the fragmented distribution of these monkeys. Casual observations suggest that the Sykes's monkey cannot survive in forest fragments smaller than 94 ha. A forest of 94 ha supported only one monkey group. This finding is supported by Lawes *et al.* (2000) who found that the minimum critical patch area for occupancy by the samango monkey *Cercopithecus mitis labiatus* in forest fragments in South Africa was 44.4 ha. A further decrease in forest cover within the Taita Hills has led to the disappearance of this monkey from the smaller fragments, threatening their persistence in the region. This is aggravated by the fact that, at least in Ngangao, neighbouring farmers kill the monkeys in an attempt to prevent crop raiding. The long-term effects of forest disturbance on their survival should be investigated. Such studies should tie the landscape-level patterns of fragmentation to local behavioural and ecological process in order to explain the risk of extinction that these monkeys are currently facing and the urgency with which conservation action is required.

Table 1: Forest fragments surveyed for the presence of Sykes's monkey *C. m. albogularis* in the Taita Hills. The smaller the fragment, the higher the degree of disturbance.

Forest	Area (ha)	Maximum altitude(m)	Mean time per session (h)	No. sessions	Total time (h)	Estimated no. animals/group	No. groups	Surrounding matrix
Mbololo 03° 20'S, 38° 26'E	178.8	2200	4	3	12	≥ 20	≥ 2	Pinus plantation, dry bushland
Ngangao 03° 22'S, 38° 20'E	135.9	2150	3	78	234	≥ 20	≥ 2	Agricultural fields, steep cliffs
Chawia 03° 28'S, 38° 28'E	93.6	1600	3	78	234	≥ 30	1	<i>Eucalyptus</i> , agricultural fields
Fururu 03° 24'S, 38° 20'E	8.4	1400	3	30	90	—	0	<i>Eucalyptus</i> plantation
Ndiwenyi 03° 24'S, 38° 21'E	4.2	1600	3	30	90	—	0	Open agricultural fields.
Macha 03° 25'S, 38° 21'E	4.0	1650	3	30	90	—	0	Mixed plantation
Mwachora 03° 25'S, 38° 22'E	3.0	1630	3	30	90	—	0	Open agricultural fields
Iyale 03° 23'S, 38° 19'E	1.6	2100	3	30	90	—	0	Mixed plantation

Acknowledgements

The Taita Hills Biodiversity Project (THBP) gave us the opportunity to study small mammals in the Taita Hills during which we made these observations. We would like to thank Benny Bytebier, the Project Manager for organizing the fieldwork.

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TRIBUTES

W.H. RUSSELL LUMSDEN (1914–2002)

Professor William Hepburn Russell Lumsden died on 13 May 2002 in Edinburgh. He was 88 years old. Russell made a major contribution to our understanding of the

nocturnal primates of East and Southern Africa by his astute observations and meticulous records of all the animals he encountered during his study of yellow fever transmission in the region. A substantial portion of the primates from these areas that currently make up the collection in the Natural History Museum, London, were contributed by Russell and his team of field workers. But unlike most museum specimens, these were accompanied by detailed field records as to the time and place of their collection, habitat characteristics, gut contents, reproductive status, and the numbers and identities of animals found in association. Although Russell's specialisation was in the field of tropical medicine (where he distinguished himself both in protozoology and virology) his earlier training in zoology left him with a deep appreciation of the role of systematics and biogeography in resolving issues relating to biodiversity and the structure of ecological communities. He had a wide range of interests and was never daunted by new challenges that required him to learn a whole new range of skills—like teaching himself to operate Microsoft Windows at the age of 80! Perhaps what those of us who were privileged to know him will remember most, however, was the tremendous warmth and generosity of spirit that flowed from him, coupled with a contagious excitement at any new intellectual challenge. He was an inspiration and a great man.

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RUEBEN RWANZAGIRE, UGANDAN GORILLA TRACKER, IS REMEMBERED

Roveri (Rueben) Rwangagire was a Forest Guide in Uganda and in the late 1950s and early 1960s served as tracker and advisor to many who visited the mountain gorillas on the slopes of Mgahinga in the Virunga Volcanos. His contribution to a better understanding of mountain gorillas, and to what would now be termed "gorilla tourism", was detailed and recorded by Walter Baumgärtel, proprietor of the Traveller's Rest, a small hotel in Kisoro, south west Uganda, in his books, *Up Among the Mountain Gorillas* (1976) and "Unter Gorillas" (1977).

Walter Baumgärtel died in Europe in November 1997 and his life and work were described in an extensive obituary and tribute to him by P. V. Tobias and H. S. R. Glaser (*South African Journal of Science* 95, March 1999).

The fate of Rueben Rwangagire remained uncertain

until late in 2000 when, following our inquiries, a friend from Kisoro reported that he was no longer alive. This was sad news as we had always hoped to meet Rueben as part of our study on the history of mountain gorilla research. Notwithstanding this disappointment, we made a trip to Kisoro in April 2001 and stayed at the Travellers' Rest. The hotel has recently been attractively renovated as part of a joint project between the Diocese of Kisoro and the Austrian Government. With the assistance of local contacts, we located Rueben's home where his family still lives. We met his widow and were shown the spot near his house where Rueben is buried. His grave is marked simply by lava boulders. The next day Rueben's son came to see us, bringing with him a photograph and a certificate. The photo depicted the presentation to Rueben of a Certificate of Honour "in recognition of the loyal and valuable service rendered by him to the Uganda Protectorate." The award was made in 1962 by the last Governor of Uganda, Sir Andrew Cohen, on behalf of Queen Elizabeth, and depicts Rueben, in a suit, surrounded by British and Ugandan dignitaries.

This was a moving and memorable visit to Kisoro and we felt pleased that we had been able to honour a man who played such a key role in the study of mountain gorillas. It is, we feel, important that those early pioneers, particularly Africans, are not forgotten.

John Cooper & Margaret Cooper

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FUNDING

PRIMATE SOCIETY OF GREAT BRITAIN CONSERVATION GRANT

PSGB awards small grants in support of primate conservation. Individual awards are in the range of £250-750. Proposals are invited for grants to assist: 1) research of benefit to primate conservation; 2) short surveys to identify locations of value to primate conservation; and 3) projects involving conservation education relevant to primates. Group training projects, undergraduate expeditions and commercial/adventure missions will not normally be supported. Grants will be awarded to members of PSGB or to citizens of primate range states who are sponsored by a member. Closing dates for applications are the last day of February and the last day of August. Application forms and more details of rules, eligibility, etc. are available at: <http://www.psgb.org> or can be obtained from Dr Anna Feistner, Durrell Wildlife Conservation Trust, Les Augres Monor, Trinity, Jersey JE3 5BP, UK.

RECENT LITERATURE

BOOK REVIEW

A Road Through Mali Kuli, by Agi Kiss. 2001. 1st Books Library. Bloomington, IN., USA. ISBN 0-7596-4992-8.

Are you a primatologist who works in Africa? And do you ever read detective stories? Here is one with everyone you know in it.

Not, of course, real people. The characters have their own lives and personalities, which are not quite like any real person, and are far from simple. But make up a cocktail of passionate primatologists, who may or may not be quite as pure as they say. Add politicians: corrupt or not quite so corrupt. Add villagers, brave and poor and hopeful, or poor and hopeful and scheming. Throw in the AID gang, the diplomats, the lumber contractor, and assorted animal welfare crusaders. Also bonobos, not in their home country, but in the fictitious Republic of Rumura. Finally, see it all through the eyes of our intrepid heroine, Carol Simmons, an ex Peace-Corps worker who has kept up her activism by supporting a women's village co-operative movement in Rumura. "Her cap of salt-and pepper hair might have added ten years to her age, except that the simple, Dutch-boy cut shaved them off again. She let her gaze move downwards and saw a few pounds that hadn't been there fifteen years before, either. 'Well, nobody stays twenty forever,' she thought to herself. 'Who would even want to?'"

There are some 45 named characters, counting the grey parrot. The plot twists like the snakebacks on the road which villains plan to bulldoze through the rainforest reserve of Mali Kuli. The road is set to make a lot of money—for somebody. There is a dastardly and mysterious plot to catch a baby bonobo in Mali Kuli, and sell it—to whom? There is mistaken identity, and of course murder. And sex and love and heroism, though the heroes are also possible suspects. It's a bit more complicated than your average detective story, as though Agi Kiss isn't holding much back for the sequel. Perhaps the author sees conservationists' lives as intrinsically complicated.

Agi Kiss knows whereof she speaks. Her day job is working on African Environment for the World Bank. Never mind her day job: I can't wait for the sequel.

Alison Jolly

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Or from <Amazon.com> at \$14.50.

Agi Kiss' previous book is a children's story about medicinal plants in East Africa: *A Very Special Place*. Oxford, MacMillan Education, 1997.

OTHER BOOKS

The Center for Applied Biodiversity Science (CABS) at Conservation International (CI), Washington, DC, has published the third issue of the publication series, *Advances in Applied Biodiversity Science*, Series Editor, Philippa Benson. *Sustainable Forest Management: A Review of Conventional Wisdom* (29pp, 2001) was written by Richard E. Rice, Cheri A. Sugal, Shelley M. Ratay and Gustavo A. B. da Fonseca. This monograph argues that almost no logging in the tropics (except plantations) can be considered sustainable, and considers why sustainable forest management has met with such limited success, despite much effort over the past two decades. It begins with a brief overview of the scope and diversity of efforts to support sustainable forest management, and then considers one of the most important obstacles to its broader adoption—its lack of financial attractiveness. In the last chapter the authors discuss the conditions under which sustainable forest management represents an appropriate conservation tool based on its environmental impacts, and include a brief review of its cost effectiveness compared to other options. They conclude that sustainable forest management has limited usefulness as a conservation strategy, and that before it is promoted in a given area it should be carefully evaluated against other conservation options. *Contents:* 1. Introduction; 2. The History of Sustainable Forest Management; 3. The Economics of Sustainable Forest Management; 4. Policies Intended to Encourage Investments in Sustainable Forest Management; 5. The Conservation Effectiveness of Sustainable Forest Management; 6. Conclusion. *Available from:* Nedra Johnstone, Center for Applied Biodiversity Science, Conservation International, 1919 M Street NW, Suite 600, Washington, DC 20036; e-mail: <n.johnstone@conservation.org>.

Primate Taxonomy, by Colin P. Groves, April 2001. Smithsonian Institution Press, Washington, DC. ISBN 1 56098 872 X (cloth). Price: US\$65.00. This is a remarkable book—a landmark in our understanding of primate diversity. It is divided into two parts. The first, titled "The Theory of Primate Taxonomy", is a series of chapters on taxonomy in general, using primates as examples. Chapter 1 - What taxonomy is meant to do and how it should do it, pp.3-14; Chapter 2 - Taxonomic ranking and nomenclature, pp.15-25; Chapter 3 A brief

history of primate taxonomy, pp.39-53; Chapter 4 - Taxonomy of primates above the family level, pp.54-61. As pointed out by Groves in his preface, "...primatology does not stand on its own. Part One of this book could be for mammalogists in general, ornithologists, and any other student of sexually reproducing animals..." The second part is titled "Putting Primate Taxonomy into Practice", and reviews the taxonomy to subspecies level of the Malagasy lemurs, the Loriformes, the Tarsiiformes, the Platyrrhini, the Old World monkeys—Superfamily Cercopithecoidea, and the Hominoidea. There is an appendix "A Word about Fossil Primates", and finally a glossary. In all, 360 species and 601 taxa are listed (there are more primates however - a number were described after his book went to print). For each group of primates, taxonomy is discussed at the family and subfamily level. The genera are divided into species groups where appropriate. Scientific name, author, synonyms, diagnosis, and distribution are given for each species. Similar the treatments are given to subspecies except that common names are not provided. As Groves himself points out (p.37), an understanding of primate diversity (and not just species) is vital if we are to conserve it. This book is a must for all primatologists. *Available from:* Smithsonian Institution Press, PO Box 960, Herndon, VA 20172-0960, Tel: 1 800 782 4612.

Infanticide by Males and Its Implications, edited by Carel P. van Schaik & Charles H. Janson, 2000, 450pp. Cambridge University Press, New York. ISBN 0 521 77295 8 (Hardback). ISBN 0 521 77498 5 (Paperback). Price: Hardback \$130, Paperback \$47.95. *Contents:* S. B. Hrdy, Foreword; C. P. van Schaik & C. H. Janson, *Infanticide by males: Prospectus. Part I. Introduction:* V. Sommer, The holy wars about infanticide. Which side are you on? And why?; C. P. van Schaik, *Infanticide by male primates: The sexual selection hypothesis revisited;* C. P. van Schaik, *Vulnerability to infanticide by males: Patterns among mammals. Part II. Infanticide by Males: Case studies. Part III. Behavioral Consequences of Infanticide by Males. Part IV. Infanticide by Females. Part V. Conclusion:* C. H. Janson & C. P. van Schaik, The behavioral ecology of infanticide by males.

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INSTRUCTIONS FOR AUTHORS

African Primates publishes information relevant to the conservation of non-human primates and their ecosystems in Africa. Its aim is to facilitate the exchange of information and ideas among primatologists and conservationists working with primates in Africa. It is hoped that this journal will enhance the conservation of African primates:

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Tables, figures and photographs are encouraged. All require complete, but concise captions listed on a separate sheet. Most articles should be accompanied by a map that shows all the place names mentioned in the text.

Figures, such as maps and sketches, should be drafted in black ink, lettered clearly to allow for reduction, and 'camera-ready', or in electronic form (e.g., jpeg, tif, gif).

Photographs should be either black-and-white or colour prints, or in electronic form. All photographs must be sharply focused and of high quality. Each photograph should be labelled with a photographer credit.

References should be an alphabetical list of only those publications cited in the text. They should conform to the format used in previous issues of *African Primates*. Article titles and titles of serial publications must be given in full.

Author information:

Each author should provide name, affiliation, address, telephone number, fax number, and e-mail address (if available).

Please have at least two senior colleagues review your draft manuscript. You should revise the manuscript accordingly prior to submission.

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Front cover illustration: Hamadryas baboon *Papio hamadryas* and olive baboon *P. anubis*. Drawing by Steven Nash. See article on pages 7-17.

Logo: De Brazza's monkey *Cercopithecus neglectus*. By Steven Nash.

African Primates is produced in collaboration with **Conservation International**, 1919 M Street NW, Suite 600, Washington, DC 20036, USA, and with the **IUCN Eastern Africa Regional Office**, P.O. Box 68200, Nairobi, Kenya.

AFRICAN PRIMATES

The Journal of the Africa Section of the IUCN/SSC Primate Specialist Group

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