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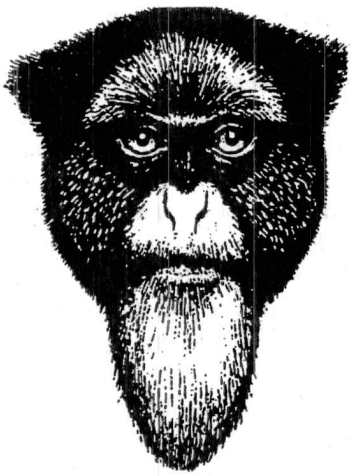

AFRICAN PRIMATES

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

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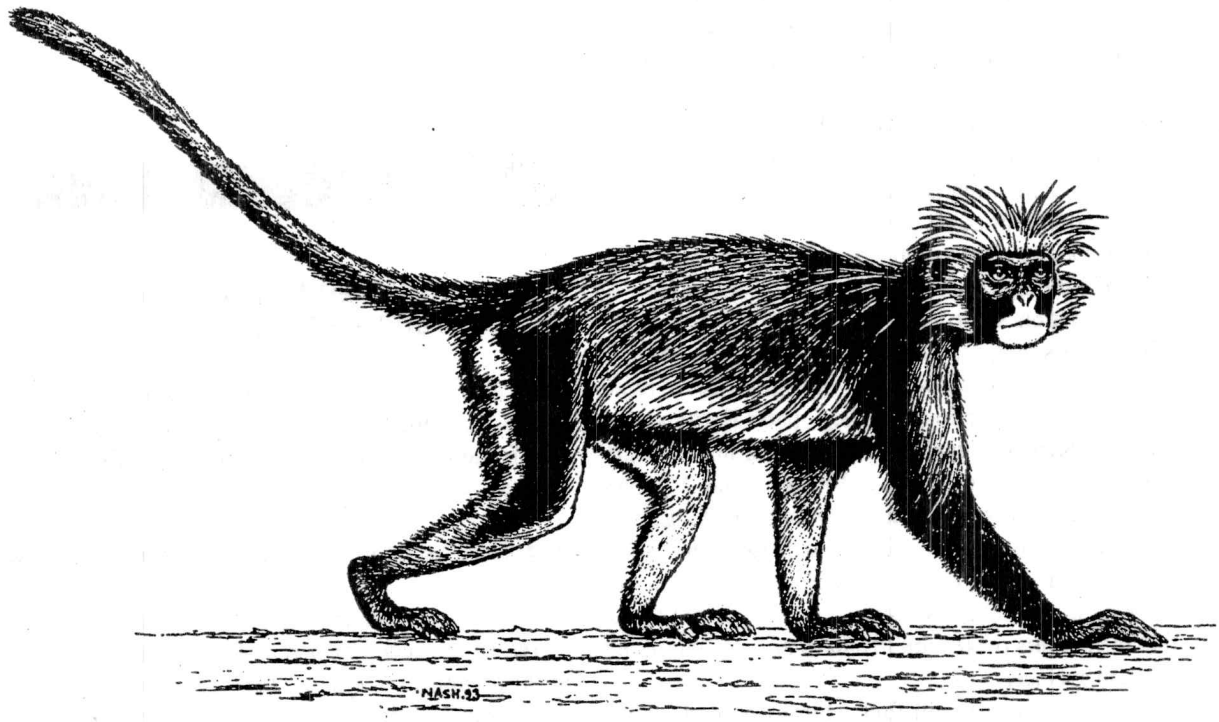

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EDITORIAL

LETTER FROM THE SENIOR EDITOR

Yes, this is the December 1996 issue of *African Primates*. In an effort to bring this newsletter up-to-date, the 1997 issue will be a double issue comprised of about 100 pages.

African Primates continues to provide a broad range of articles and notes relevant to primate conservation, particularly on primate numbers, distributions and conservation problems. In this issue you will find new information on red colobus (Zanzibar), hamadryas (Eritrea), gorillas (Cameroon), chimpanzees (Cameroon, Guinea, Uganda), pygmy chimpanzees (Democratic Republic of Congo), and crested mangabeys (Tanzania). In addition, there are articles on the status of primates in the Gran Caldera of Bioko Island, and on the role of sustainable harvest in conservation.

Unfortunately, there continues to be a great shortage of materials in French. In fact, this issue contains no articles, notes or news items in French. We hope that this situation will change in coming issues, as the majority of Africa's most interesting, unique and endangered primates, and many of the continent's most distinguished primatologists, are in Francophone countries. If you are fluent in French, please send articles and notes in French for publication in *African Primates*. Ideally, *African Primates* should have at least one-third of its articles, notes and news items in French.

Another situation noted with concern is the lack of materials submitted to *African Primates* on Africa's several species of savannah (non-forest) primates. While none of these species is thought to be globally threatened with extinction, some populations have been extirpated, while others occur in extremely low numbers. Also, a few species of these primates appear to be in rapid decline in particular countries (*e.g.*, patas *Erythrocebus patas* in Kenya, Uganda and Tanzania, and Barbary macaque *Macaca sylvanus* in Morocco and Algeria). In other cases, we continue to know almost nothing about the species' ecology, behaviour, and conservation status (*e.g.*, Somali galago *Galago gallarum*). If you are working on savannah primates in Africa, do not forget that the readers of *African Primates* are also interested in these species.

In this issue you will find a form which you must complete and return if you wish to continue to receive your free copy of *African Primates*. Please do this immediately. With more than 1,200 addresses now on the mailing list, and escalating production and distribution costs, it is necessary to up-date the mailing list. This will ensure that all addresses are current, and will confirm that everyone on the list wishes to continue to receive this publication.

The success of *African Primates* continues to depend primarily upon materials provided by its readership. Please consider making a contribution. The "Notes for Contributors" can be found on the inside back cover of each issue.

I continue to get large numbers of requests from young field primatologists concerning potential sources of funding for their projects. I invariably steer them to the "Funding and Training" section of *African Primates*. Here readers will find the most common sources of funding for primate field research and conservation—particularly small grants for young primatologists. Anyone looking for information on potential sources of financial support would do well to consult past issues of *African Primates*.

Thanks to all the contributors to this fourth issue of *African Primates*, to the Editorial Board, and to Stephen Nash for continuing to provide an excellent series of primate drawings for the cover. Special thanks go, once again, to the National Museums of Kenya for providing this Newsletter with a "home" in Africa, and to Zoo Atlanta for continuing to meet most of the costs of *African Primates*. We also thank the Margot Marsh Biodiversity Foundation for making a special contribution to this issue.

Tom Butynski

LETTERS

LETTER TO THE EDITOR: AFRICAN GREAT APE ECOTOURISM CONSIDERED

In *African Primates* 1(2), Tom Butynski posed a series of questions about great ape ecotourism. We would like to offer some comments and opinions on this subject to promote further discussion and research.

Is great ape ecotourism really a conservation tool?

We define a "conservation tool" as anything that increases the actual or perceived value and awareness of the organisms or systems to be conserved. Implicit in our working definition is that short-term increases do not result in long-term harm. Presumably the motivation to protect a resource is directly related to its value (or perceived value). Because great ape ecotourism brings foreign exchange into the apes' range states that might not otherwise be spent there, great ape ecotourism enhances the monetary value of the apes and so fulfills that aspect of our definition of a conservation tool. Additionally, great ape ecotourism may increase awareness about the plight of endangered species.

Is great ape ecotourism "good conservation?"

The application of great ape ecotourism, like any ecotourism programme, may include the potential for harm to the organisms or systems to be conserved. In that sense, great ape ecotourism could be harmful. Assessment of this aspect is crucial before judgment can be made.

Who really benefits?

Tourists and the entity which receives the revenue, and less directly, the animals and their ecosystem benefit. If the revenue generated is used to improve the existing conservation programme, or fund the maintenance or development of complementary programmes (*e.g.*, local education, guards' salaries and equipment, incentive programmes to rehabilitate poachers, veterinary services), the target organisms or systems will benefit. Frequently, however, it is not clear how revenues are distributed; assessment of this aspect is important in determining the impact of existing programmes.

How can conservation benefits be enhanced?

Conservation benefits may be enhanced in several ways: 1) increase the price tourists pay; 2) incorporate great ape ecotourism into packages that encourage tourists to stay longer and spend money in other national parks and attractions in the same country; 3) offer great ape tourists the opportunity to be more than one-time benefactors of wild great apes by including in the tour price a one-year membership to a conservation organisation; 4) develop or enhance methods to educate visitors and residents about the tangible benefits of ecotourism, both to the local economy and to the great apes' ecosystems. By making great ape ecotourism a long-term, positive and educational experience, benefits to all parties are maximised.

Is great ape ecotourism sustainable?

Ecotourism in general is still relatively new, and we are unaware of any systematic assessment of all facets of great ape ecotourism. A recent chapter by McNeilage (1996), however, addresses some of the issues. Only longitudinal, empirical measures of programme costs and benefits will answer the question of sustainability.

What is the scientific basis of great ape ecotourism?

A scientific foundation of great ape ecotourism is the psychological phenomenon of habituation. Burghardt (1992), however, demonstrated that observers had subtle, but persistent effects on the behaviour of black bears, even when the animals were "well-habituated." It has also been shown that habituated wild populations may be subject to different selection pressures than unstudied populations (Rasmussen, 1979). [Note: We recommend *The Inevitable Bond* (1992) as a good reference for those who manage ecotourism programmes].

The scientific basis of great ape ecotourism should focus on four distinct levels of long-term evaluation: 1) risk assessment, evaluation and reduction of medical threats to great apes (such as interspecific disease transmission); 2) assessment of behavioural and reproductive impact on "habituated" populations (McNeilage, 1996); 3) assessment of the educational and economic impact of great ape ecotourism both to range states and tourists; 4) minimisation of threats to tourists and local people.

What are the roles of economics and politics in great ape ecotourism?

Economics and politics can make or break great ape ecotourism programmes. Governments of developing nations are not likely to allow such programmes to exist without economic benefit to the country. Further, as the example of Rwanda shows, when socio-political pressures are great enough, even money-making operations may be jeopardised. Therefore, we see the responsibilities of ecotourism programmes as demonstrating clearly the value of the resource, generating long-term sustainable benefits to local economies, and providing a programme which is continually improved for the benefit of all.

What are the risks?

Although they have not yet, to our knowledge, been assessed comprehensively, risks associated with great ape ecotourism can be divided into four categories: 1) risks to the animals (behavioural, physiological, medical); 2) risks to the ecosystem; 3) risks to the range state (economic, political); 4) risks to the tourists and local people.

Have we evaluated the risks?

Risk identification has, to date, focused on health risks to the animals and risks of injury to tourists. These are now monitored and reported, but have not resulted in any tightening of regulations pertaining to gorilla tour groups. The existing guidelines, such as instructions to tourists on appropriate hygiene in the forest and restriction of access to the gorillas by persons who are obviously ill, were developed early in the programme, prior to any monitoring of the health of gorilla groups. Revision of these with respect to more recent data is probably warranted. Some of the other risks, for example, to the socio-economy, and the behaviour and health effects on the great apes, require longer-term evaluations or, until recently, invasive and expensive assessment methods. Recent *ex-situ* research has developed non-invasive methods to measure corticosteroid activity, for example (Wasser *et al.*, 1997). These techniques rely on collection of fresh fecal material, which may be obtained readily without disturbance to the animals.

How can risks be minimised?

Identification and evaluation of the potential risks outlined above is the first step in risk management. Based on this systematic evaluation, protocols for ecotourism programs should be strict and consistent. Visits should be carefully balanced among all "tourist groups", with enforcement of a minimum "rest interval." Tourist party size should never exceed eight, and should always be smaller than the size of the gorilla group visited. All efforts should be made to improve the educational component of the programme for tourists and local residents alike. Potential programme improvements might include: 1) regular tuberculosis testing for all trackers and guides; 2) guide uniforms distinctly different from the usual attire of the local population; 3) wearing of surgical masks by both tourists and guides during the period of close association with the animals; and 4) periodic opportunities for members of the local community to visit the gorillas free of charge. Other improvements, harder to regulate and enforce, are strictures on the distance maintained from the animals, and what behaviour is acceptable to direct to and receive from them.

Is great ape ecotourism an acceptable approach for highly-endangered populations?

As "charismatic megavertebrates," great apes can provide an "umbrella" for all other species of flora and fauna within the range. Because every taxon is irreplaceable, the question remains: "Are we placing the animals at short or long-term risk for short-term gains?" We believe it is possible to manage great ape ecotourism programs for the benefit of all entities. The only means of fulfilling this imperative, however, is through careful evaluation.

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ARTICLES

THE ZANZIBAR RED COLOBUS MONKEY *PROCOLOBUS KIRKII*: CONSERVATION STATUS OF AN ENDANGERED ISLAND ENDEMIC

Abstract: *Since 1991 we have studied one of Africa's most endangered primates, the Zanzibar red colobus* Procolobus kirkii. *Here we summarise some of our results on the status of this species and give our recommendations for its conservation. There are probably less than 2,000 Zanzibar red colobus remaining, only half of which live within legally protected forest reserves. In addition to the inherent problems of conserving small fragmented populations, we recognise four major threats to the Zanzibar red colobus: habitat loss, road kills, hunting and poorly managed tourism. Our conservation recommendations for the Zanzibar red colobus include the following: 1) constructing of speed breaks to reduce the mortality of red colobus due to vehicles; 2) increasing the size and conservation status of Jozani Forest Reserve; 3) establishing and enforcing better tourism regulations; 4) implementing conservation agendas that include village participation for areas outside of forest reserves; 5) increasing conservation training of Forestry and Environment staff; 6) resolving human-wildlife conflicts through scientific studies with farmer participation; 7) establishing a population monitoring programme for the red colobus; 8) reinvesting tourism revenue into protection and management of wildlife areas; 9) establishing a board or authority responsible for all protected areas in Zanzibar; and 10) stabilising the human population size on Zanzibar. The Zanzibar Sub-Commission for Forestry, in conjunction with CARE (Austria) and FinnIDA, has taken important steps toward the protection of the Zanzibar red colobus. We hope that our research and recommendations will assist in their future endeavours.*

Résumé: *Depuis 1991, nous avons étudié un des primates les plus menacés de l'Afrique, le colobe rouge de Zanzibar* Procolobus kirkii. *Ici, nous résumons quelques-uns de nos résultats sur l'état de conservation de cette espèce et donnons nos recommandations quant à sa conservation. Il reste probablement moins de 2,000 colobes rouges de*

Zanzibar et seulement la moitié vit actuellement dans des réserves forestières légalement protégées. En plus des problèmes inhérents à la conservation de petites populations fragmentées, nous reconnaissons quatre menaces majeures au colobe rouge de Zanzibar: la perte de l'habitat, la mortalité liée à la circulation routière, la chasse et le tourisme pauvrement aménagé. Nos recommandations sur la conservation du colobe rouge de Zanzibar comportent les points suivants: 1) la construction d'arrêts de vitesse («speed breaks») afin de réduire la mortalité des colobes rouges due aux véhicules routiers; 2) accroître la taille de même que le statut de conservation de la Réserve Forestière de Jozani; 3) établir et mieux structurer les règles du tourisme; 4) mettre en place un agenda de conservation favorisant la participation des villages extérieurs aux réserves forestières; 5) accroître la formation du personnel d'Environnement et Forêt sur la conservation; 6) résoudre les conflits humain-nature par des études scientifiques qui favorisent la participation des fermiers; 7) établir un programme de surveillance de populations pour le colobe rouge; 8) réinvestir les revenues touristiques dans la protection et l'aménagement d'aires sauvages; 9) établir un Conseil ou une Autorité responsable de toutes les aires protégées de Zanzibar; et 10) stabiliser la taille de la population humaine à Zanzibar. La Sous-Commission Forestière de Zanzibar, en collaboration avec CARE (Autriche) et FinnIDA, a pris d'importantes mesures afin de protéger le colobe rouge de Zanzibar. Nous espérons que notre recherche et nos recommandations les aideront.

Introduction

The Zanzibar red colobus monkey *Procolobus kirkii* (Fig. 1) is an endangered species (Oates, 1996a) restricted to the island of Zanzibar (Unguja) (Fig. 2). We studied this species intermittently from 1991–1996. Our research concentrated on several issues, including the: 1) floristic correlates of red colobus population density, group size and composition; 2) effect of red colobus feeding on coconut *Cocos nucifera* crops; 3) red colobus distribution; 4) long-term success of translocated monkeys; and 5) immediate and long-term conservation problems facing the red colobus.

Figure 1. Zanzibar red colobus adult female and infant (approximately 1 month old). Taken at Jozani, June 1996. Photo by Thomas T. Struhsaker.

Figure 2. Unguja Island, Zanzibar.

The purpose of this report is to summarise some of our results, with the main emphasis on conservation issues and recommendations.

Status of the Zanzibar Red Colobus

On the basis of craniology, vocalisations, and coat color, we consider *P. kirkii* to be a valid species. The only viable population of this species is restricted to the island of Zanzibar (Unguja). Ten to 12 red colobus may still survive in the Ngezi Forest on Pemba Island, being the remnants of a failed translocation attempt (Struhsaker & Siex, in press). None are in captivity.

Distribution on Zanzibar

We estimate that there are between 1,500 and 2,000 red colobus on Zanzibar. The great majority live in the two contiguous forest reserves of Jozani (22 km^2) and Unguja Ukuu (32 km^2), and the agricultural areas

immediately to the south (Kichanga, Pete village, Kiungani, Mungwi, Uzi island) and southeast (Kitogani, Muungoni, Muyuni) of the Jozani Reserve (Figs. 2 & 3). At least half of all the Zanzibar red colobus live outside of the legally protected Jozani and Unguja Ukuu Forest Reserves. The two protected forest reserves are managed by the Zanzibar Sub-Commission for Forestry (SCF, recently renamed the Forestry Sector of the Commission for Natural Resources).

Red colobus occur elsewhere on Zanzibar, but at much lower densities and usually in scattered and isolated populations. The most northerly populations occur in the Kiwengwa area on the east coast and there is a small isolated group in the mangrove swamp of Maji Mekundu just south of Mangapwani on the west coast. The most southerly group we have seen is in the small remnant forest called Mnyambiji (Myambizi), approximately 5 km west of Makunduchi.

Translocation

A translocated population of red colobus lives in the Masingini Forest Reserve on the northern edge of Zanzibar town. This is a small forest (5.5 km²) comprised of 2.3 km² of hardwood forest and 3.2 km² of planted softwoods. In Masingini, we have seen red colobus only in the hardwood forest. A total of 36 red colobus were reportedly translocated there in 1977, 1978 and 1981 (Silkiluwasha, 1981 and SCF records). In June 1994 we counted three groups totaling no fewer than 56 individuals, indicating that this was a successful translocation (Struhsaker & Siex, in press).

Habitat Selectivity

The highest population density of Zanzibar red colobus occurs in the southern end of the Jozani Forest Reserve and the small area of perennial gardens (shambas) contiguous with the southern border of the Reserve. Densities are approximately 240 individuals/km² in the southern end of the ground-water forest and nearly 750 individuals/km² in a 14 ha area of adjacent shambas. In other parts of their range, however, red colobus densities are much lower, (*e.g.*, most shamba areas, *Phoenix* palm swamp forest in the northern end of Jozani Forest, coral rag thicket, mangrove swamp).

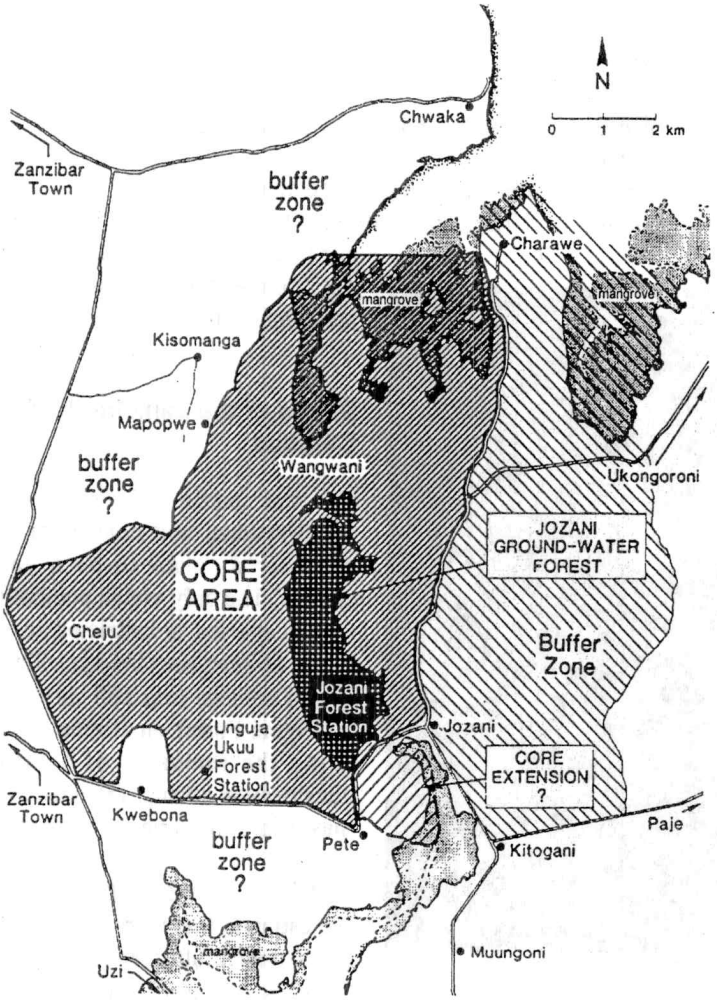

Figure 3. Proposed core conservation area and buffer zones for Jozani Forest Reserve, Zanzibar.

Conservation Problems

In addition to the intrinsic problems confronting relatively small, isolated, and fragmented populations, there are four basic threats to the Zanzibar red colobus: habitat loss, road kills, hunting, and poorly managed tourism.

Habitat Loss

The coral-rag thicket of Zanzibar is being destroyed rapidly, primarily by woodcutters and secondarily by agriculturalists. Commercial exploitation of these resources is often illegal and this illegal cutting frequently occurs within the government forest reserves. The great demand for fuelwood and charcoal for cooking in Zanzibar town is the market force driving this destruction. Furthermore, this demand is increasing as the human population increases on Zanzibar due to intrinsic growth (3–4%/yr) and immigration in response to employment opportunities associated with the burgeoning tourist industry. Even the construction of tourist facilities contributes to the destruction of the coral-rag thicket because fuelwood is used to produce the lime for white-washing the buildings. This tourist-related growth in construction also contributes to excessive exploitation of mangrove swamps because the termite-resistant

mangrove poles are widely used in building.

Although red colobus occur at low population densities in coral-rag thicket forest, this habitat is still the most common natural habitat remaining on Zanzibar. It, therefore, contains an important reservoir of red colobus. In addition, the coral-rag thicket is the main habitat for a number of other endemic or near-endemic species and subspecies, such as Ader's duiker *Cephalophus adersi*. Although perhaps not as important for monkeys as coral-rag thicket, the mangrove swamps also contain reservoirs of red colobus, serve as habitat corridors for their dispersal, and play a critical role in marine fisheries.

Vehicles and Road Kills

A major road runs near the southern end of the Jozani Forest Reserve and through the home range of the main group of red colobus that is viewed by tourists. This group, known as the South Shamba group, contained 75 individuals in 1996. It frequently crosses the main road as do at least two other red colobus groups in this area.

In the past, red colobus were occasionally killed by vehicles as they ran across the road. At that time, the road was not paved and had many potholes, making it difficult for vehicles to travel at high speeds. Over the past two years, however, this road has been gradually improved and in 1996 it was paved. As a result, vehicles now travel through the home range of these red colobus groups at high speeds (90–100 km/hr) and the incidence of road kills has increased. The forest guards resident at Jozani estimate that, since the road was paved, a red colobus is killed by a vehicle about once every 2–3 weeks. If correct, this means a loss of about 18–26 red colobus each year along this single 1.5 km stretch of road. Assuming that approximately 150 red colobus are susceptible to being hit by vehicles on this section of road, then these road kills may constitute an annual loss of 12–17% of this subpopulation. Although approximate, these estimates indicate that, in the core area of this endangered species, the most common cause of mortality is careless driving.

Hunting

We have no quantitative data on the impact of hunting on the Zanzibar red colobus population. The majority of inhabitants on Zanzibar are Muslim and are thus unlikely to kill monkeys to eat. There are, however, a number of non-Muslim immigrants from the mainland who now reside permanently on Zanzibar. Some of them are said to hunt red colobus with dogs and spears. In addition, we have also heard that villagers, including Muslims, kill red colobus and Sykes' monkeys *Cercopithecus mitis albogularis* because of the alleged damage they cause to crops.

The National Hunters' Association, *Wasasi wa Kitaifa*, is an organization under the Prime Minister's Office whose mandate is to kill all animals that are potential agricultural pests. The following account was related to us by the forest guards at Jozani. Each weekend the Government of Zanzibar provides two tipper lorries (dump trucks) that travel to a designated area, collecting as many villagers with spears and dogs as the lorries can accommodate. There are usually about 50–60 men and a similar number of dogs involved. Once at the site designated for hunting, they sweep the area killing every undomesticated mammal they encounter. This includes many species and individuals that cause little, if any, damage to crops. Furthermore, these hunts are sometimes done in areas where there is little, if any, agriculture.

In January 1996, at least one of these hunts occurred near the southern end of the Jozani Forest Reserve and near the area most frequently visited by tourists to view the red colobus. We were told that the hunters and their dogs killed two red colobus (adult male and adult female). Apparently, the dogs caught the monkeys and the hunters then clubbed and speared them to death. The carcasses were then loaded on a government vehicle and driven off with the hunters and their dogs. The following day one of us (TTS) was taken to a third red colobus (adult male) who had died only an hour or two earlier in the immediate vicinity of the hunting incident. He had bite wounds and perhaps machete (panga) or spear cuts as well, and may have been a victim of these hunters.

Two days after this hunt near Jozani, a representative from SCF appeared on local television and described the incident, explaining that this was contrary to law. Subsequently, the chairman of the National Hunters' Association apologised and admitted that a mistake had been made by some of the younger and less experienced hunters. No fines or other penalties were levied.

Tourism

As mentioned previously, tourism is increasing rapidly on Zanzibar. Most of this tourism centres on the beaches, particularly those on the east coast. There are two main routes to the east coast, one of which passes the southern end of Jozani Forest Reserve. While traveling to the east coast many tourists stop to view the red colobus at Jozani (12,000 tourists in 1996).

The main group (South Shamba) viewed by tourists is so well habituated that a number of the juveniles readily approach and make contact with tourists, even sitting on their shoulders and heads. This is the result of the forestry and tourist guides actively feeding the monkeys with leaves of an indigenous plant (Mkwamba, *Flueggea [Securinega] virosa*). Although this shrub is very accessible to the monkeys, when a branch of it is held up toward them by a person, the monkeys usually descend to feed on it. This initiates the interaction and the juveniles often proceed to climb on the tourists. So far, these interactions have been gentle. To our

knowledge, there have been no incidents of tourists being bitten or scratched by the red colobus. The entire interaction between tourists and the colobus is in striking contrast to the aggressive nature of those between tourists and baboons *Papio anubis* and *P. cynocephalus*, vervets *Cercopithecus aethiops*, and macaques *Macaca mulatta*, *M. fuscata*, and *M. fascicularis* elsewhere. There is, however, a very real possibility of disease transmission between humans and monkeys (in both directions) and, as these juveniles become adults, the risk of injury to the tourists may increase. Once a tourist is injured by a monkey, there usually follows a demand by the tourists for the monkey to be killed.

Conservation Recommendations and Implementation

Our recommendations can be roughly ranked according to degree of urgency, but we feel that positive action on all of them is required.

Road Kills

The substantial mortality of Zanzibar red colobus due to speeding and careless drivers represents both a serious loss to an endangered species and to the Zanzibar economy. Although one cannot put a monetary value on an endangered species, the red colobus living along the road at Jozani are an important source of revenue from tourists. At least 12,000 tourists came to see these rare monkeys in 1996. Each paid US$ 2 (T. Shs. 1,000) for an annual total income of US$ 24,000.

Road kills caused by careless drivers not only contribute to a possible population decline of this species, but generate adverse publicity for tourism. Most tourists would be greatly disturbed by the sight of a monkey being killed by a vehicle, particularly if no attempt was being made to prevent it. Furthermore, we do not know at what lower size limit a monkey group ceases to be attractive to tourists. An annual loss of 12-17% of the monkeys due to road kills would appear to exceed the annual recruitment due to births. Given these estimates and unless something is done to reduce red colobus mortality due to careless drivers, we predict that the red colobus groups living along the road at Jozani will eventually decline to a point where they are unlikely to attract a significant number of tourists. It must be emphasised that not only are the red colobus threatened by careless and speeding drivers, but so too are the residents and tourists of this area because they walk and cycle along this same road.

In June 1994 we recommended to the SCF that speed breaks (bumps) be constructed along a 2 km stretch of the main road between Pete and Jozani villages, approximately 1 km on either side of the entrance to the Jozani Forest Reserve. A minimum of six breaks are required, but 10 would be more effective. In 1996 this suggestion was made again in a request to the Deputy Principal Secretary of the Ministry of Agriculture, Livestock and Natural Resources. The suggestion of speed breaks at Jozani was endorsed at the ministerial level; however, as of October 1997 we are led to believe that the suggestion of speed breaks was finally rejected by the Board of Transportation.

An alternative of constructing overhead crossings using inexpensive ropes or cables has been suggested. However, this alternative is unlikely to be effective at Jozani because there are few large trees near the road to which ropes or cables could be attached. Furthermore, these "bridges" would not protect human pedestrians and cyclists. We also think the red colobus might never learn to use rope and cable bridges because they appear not to perceive the road and approaching vehicles as a threat. We have watched red colobus crossing this road hundreds of times and have never seen them look for approaching vehicles.

Increase the Size of Protected Area and Strengthen Its Status

The current area of the Jozani Forest Reserve that is officially protected against all forms of extractive exploitation is only about 22 km^2. In 1993 one of us (TTS) proposed that this core conservation area be expanded to include the adjacent Unguja Ukuu Forest Reserve, as well as an area of some 2.5 km^2 to the south of Jozani Forest that is comprised of a mixture of coral-rag thicket, shamba, and mangrove (Fig. 3). This would have resulted in a core area of 57 km^2 (only 3.5% of the area of Zanzibar Island). Although the issue of land acquisition and expansion of the reserve has been discussed, no tangible action has been taken to date. Because approximately half of the red colobus live outside legally protected reserves, it is critical to their conservation that adjacent land containing high densities of red colobus be incorporated into the reserve system. Negotiations on this issue are in progress between SCF, individual land tenants, and communities adjacent to the two reserves.

Approximately three years ago the SCF expressed its intention of upgrading the legal status of the Jozani Forest Reserve to the equivalent of a national park. Legislation has now been passed that will make this change possible. We hope this change in status will occur in the near future.

Regulate Tourists

Greater effort must be made to regulate tourists and to prevent physical contact and close proximity between them and the red colobus. Since we cautioned against the potential risks of this situation in 1994, there has been some progress in preventing contact and increasing the distance between tourists and the monkeys. This has been achieved by improved training of the guides from the SCF with technical and financial assistance provided by CARE (Austria). Nonetheless,

in 1996, guides from certain private tour companies still succeeded in persuading the SCF guides to allow occasional violation of regulations in 1996.

We recommend that no more than six tourists be allowed to visit a specific social group of red colobus at any one time. Tourists should not be permitted to approach closer than 5 m to the monkeys. Visitors with obvious signs of flu or other diseases should be excluded from the range of the habituated monkeys.

Conservation Outside Reserves

It is impractical to give total protection to the entire range of the Zanzibar red colobus because of their wide and fragmented distribution over the southern part of the island. Those areas outside forest reserves that still have red colobus require a different approach to conservation. The approach will vary from place to place, but in all areas outside reserves, conservation of the red colobus will depend largely on the cooperation and goodwill of the local people.

In those cultivated areas immediately adjacent to the Jozani Forest Reserve, it has been suggested that the revenue from tourists who come to see the monkeys and the forest should be shared with the local residents. In particular, revenue should be shared with those farmers who lease the land on which live the two main groups of red colobus most frequently visited by tourists. At present, all official fees (US$ 2/tourist) go to the government central treasury. The tenants on whose land the tourists most often view the colobus receive no part of these fees. Discussions on revenue sharing were first initiated between one of these tenants and SCF in 1993. In 1996, SCF presented a revenue-sharing proposal for approval to the Ministry of Agriculture, Livestock and Natural Resources. This was rejected and so another proposal was sent directly to the President's cabinet. Our understanding, as of October 1997, is that the cabinet has agreed to the revenue sharing plan. In the meantime, a request for special donations from tourists visiting Jozani, in addition to the US$ 2 fee, has succeeded in raising limited funds to be shared with the local community.

For those areas still having groups of red colobus that are more distant from Jozani it is more difficult to make specific recommendations. In these cases, effective conservation of red colobus is likely to depend more on education that aims to create tolerance and an ethic that is sympathetic to wildlife conservation. This, in turn, will depend on a much greater effort in conservation education of adults and school children in those rural areas that still have red colobus and other wildlife. At present, there is no systematic conservation education programme in these areas of Zanzibar.

Improved Management of Natural Resources

As described earlier, violations of the laws regulating the use of natural resources on Zanzibar are common and widespread. There seems to be a poorly developed tradition of law enforcement in this regard. No employee of SCF has powers of arrest. Violators can only be apprehended by the police. We frequently heard allegations of corruption against the authorities charged with enforcing the laws regulating natural resource use. This is a serious problem because ineffective or sporadic law enforcement encourages over-exploitation of the coral-rag forest, mangrove swamps, and wildlife, such as duikers, and the killing of totally protected species like the red colobus.

We suggest that the following steps might help alleviate this problem:

- give SCF officers legal powers to arrest offenders;
- increase penalties for offenders;
- levy higher fees for forest products and wildlife (fees should increase annually in accordance with rates of inflation);
- increase salaries of SCF officers to encourage improved performance;
- create a bonus system for SCF guards and members of the public who report violations leading to the confiscation of illegally acquired forest products and wildlife and/or the arrest and conviction of the offenders; and
- train SCF officers and guards in law enforcement.

An important additional approach to management includes village participation. Here villagers become involved in the management and protection of natural resource use. This is being attempted by SCF with the management of mangrove swamps on Zanzibar. It is too early to evaluate the success and problems of this approach, but it is also being discussed and considered as a means of managing woodcutting in the coral-rag and the hunting of duikers. The potential danger of this approach is the obvious conflict of interests. Those who exploit and profit from the resource are also the protectors, managers and regulators. It is likely to be successful only if there is effective supervision by some higher authority, like SCF, to prevent over-exploitation. Such supervision, through regular monitoring by SCF, is included in the formal plan of collaborative management that is currently being developed between SCF and the local communities.

An equally important problem concerns the determination of a sustainable level of harvest. No studies of any natural resource have been done in sufficient detail to determine these levels. Consequently, sustainable exploitation is being attempted in the absence of a solid scientific basis. Similarly, we are not aware of any attempts on Zanzibar to monitor scientifically the ecological effects of these attempts at sustainable harvest.

Village participation in the management of the Jozani Forest Reserve is currently being discussed by SCF,

CARE, and the residents of Pete and Jozani villages. Involvement of local residents in the cooperative management of strict conservation areas without extractive exploitation may have fewer problems because there is no question of determining sustainable harvest levels. There is, however, the potential for over-use and degradation of an area by allowing too many tourists to visit it in order to increase profits from gate receipts.

The current practices of the National Hunters' Association should be critically reviewed and revised. In particular, the indiscriminate killing of most, if not all, mammalian species should be terminated immediately as it is contrary to the principles of scientific wildlife management and conservation. If hunting is to be legally sanctioned, then it should be based on a scientific plan, including monitoring of the impact by qualified personnel other than the hunters. We understand that a government-sponsored closed-season on antelope hunting, including the collection of guns and hunting nets by the police and other authorities, has been proposed and will likely be implemented soon.

Training

Conservation is still a young discipline on Zanzibar. In general, both the SCF and Department of Environment have too few personnel with professional qualifications and practical experience in the areas of conservation biology and natural resource management. Steps are being taken to remedy this situation, primarily through overseas training. In our view, far more attention should be given to practical training on Zanzibar, (*i.e.*, training through research and implementation of conservation projects). Here too some progress has been made, such as with the training course in censusing red colobus that was given in 1996. Assigning SCF and Department of Environment staff members to work with foreign researchers on Zanzibar is likely to be more effective because of the greater investment of time and because they are dealing with practical problems specific to Zanzibar.

Resolving Human-Wildlife Conflicts

According to SCF officers, there is an increasing number of complaints about crop damage by red colobus. Our studies of the impact of red colobus on coconut yields demonstrate that these complaints are generally exaggerated and unwarranted. To the contrary, it would appear that red colobus feeding on coconuts, which is restricted to small and immature nuts, may increase the size of the crop for the farmers. There is a significant positive correlation between the extent that red colobus feed on young coconuts and the size of the final, harvestable crop of coconuts (Siex, 1995). This is likely due to a pruning effect, a practice recommended by the National Coconut Development Project on Zanzibar and one based on experiments showing the benefits of pruning to final yields of coconuts (Juma Issa, pers. comm.). Not surprisingly, our results are met with disbelief by many farmers.

The impact of red colobus on other crops (*e.g.*, mango, bananas, cassava) may, however, be detrimental to the final harvest by farmers. Here is an obvious and necessary area for research, which we strongly endorse. For the results of this research to influence the attitudes of farmers, we believe the farmers should participate in the research, (*e.g.*, as research assistants to qualified scientists who actually work in the field). We understand that a pilot project on this problem has been initiated by SCF. This will help address the disbelief many farmers have in research results. It will also clarify which species is actually doing the crop raiding. We believe that many of the accusations of crop raiding made against red colobus are unjustified. More likely, they are blamed for the damage caused by the more secretive and less conspicuous Sykes' monkeys who often accompany the large and noisy groups of red colobus as they pass through agricultural areas.

We also have concerns about conservation plans that attempt to integrate conservation with development. Although there has been a definite increase in awareness of the importance of the red colobus on Zanzibar, particularly in the vicinity of Jozani, we worry about some of the consequences of this increased awareness. Integrated conservation and development projects all too often run the risk of giving so much attention to the demands of the local people that they create a situation which is counter-productive to conservation (*e.g.*, Oates, 1996b). For example, we feel that the complaints and demands made by some of the villagers living near the Jozani Forest Reserve about crop damage by red colobus and other wildlife are often false or exaggerated. The common approach taken by government officials and donor agencies is all too often one of simply asking the local residents about their problems and needs. But there is also a need to study and collect objective data on the problem. Too much uncritical attention raises hopes among the villagers of financial compensation and encourages exaggerated claims.

While we initiated and strongly endorse the concept of sharing tourist revenues generated by Jozani with the local residents, we think that compensation for crop damage is an untenable approach primarily because of the problems of verification. Appeals for removal of red colobus should be resisted because of their very low numbers and limited distribution. Relevant here is the fact that humans are able to use 98% or more of Zanzibar Island as they please, while only 2% or less of the island is totally protected for all the other species against exploitation by people.

Population Monitoring and Island-Wide Survey

We recommend that a population monitoring programme

be established for the Zanzibar red colobus. In this programme, attention would focus on the core area of its distribution *(i.e.,* the Jozani area, but not exclude other areas with smaller populations). Two methods would be employed: line transect censuses and counts of individual social groups. The latter technique would be applied primarily to habituated groups. A capture, mark, and release programme would help refine our understanding of trends in dispersal, demography, disease and genetics. These censuses and counts should be conducted at least once each year. The results would provide information on demographic trends and problems of habitat degradation and loss which is critical to anticipating and dealing with conservation problems. Detailed studies and monitoring of the red colobus population in the Jozani area are particularly important because it is the largest and most viable population, and because it is a major tourist attraction and generator of revenue.

Related to the monitoring programme is a need for more detailed information on the distribution of, and threats to, the red colobus throughout Zanzibar. An island-wide survey has been initiated by SCF and the Department of Environment with a questionnaire that was sent to village leaders throughout the island.

Management and Funding of Conservation Areas

We strongly recommend that the Government of Zanzibar reinvest more funds into the protection and management of Jozani Forest Reserve and its adjacent wildlife areas. Equally important is the need for the Zanzibar Government to create a board or authority to deal specifically with protected areas throughout Zanzibar.

Human Population Growth

Most of the problems described can be attributed to the very rapid growth of Zanzibar's human population (3–4%/yr) on an island with inherently low overall potential for agriculture. There are many proximate problems and threats facing the Zanzibar red colobus and some of these are being addressed. However, the ultimate problem of a rapidly expanding human population is not being dealt with. Until this problem is given highest priority, the future of all wildlife on Zanzibar remains problematic at best, as does the quality of life for the people living there.

Conclusion

Although much remains to be done, the Zanzibar Government through the SCF, with assistance from FinnIDA and CARE , has taken important steps toward the protection of the Zanzibar red colobus. We hope this paper will help guide and challenge those who are concerned with the conservation of the red colobus and other wildlife on Zanzibar.

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CENSUS OF DIURNAL PRIMATES IN THE GRAN CALDERA DE LUBA, BIOKO ISLAND, EQUATORIAL GUINEA

Abstract: *Intensified hunting and habitat destruction since 1990 threaten seven species of diurnal primates native to Bioko Island, Equatorial Guinea. In this paper we report the results of a 1 week census of these primates conducted during 1996 in the most remote part of the island, the Gran Caldera de Luba, and we compare our results with those of a more extensive 1990*

census of the same area. The 40% reduction in the number of groups encountered, and especially the 56% reduction in the number of drill Mandrillus leucophaeus *groups encountered, underscores the need for immediate conservation action.*

Résumé: *Une chasse intense et une possible destruction de l'habitat depuis 1990 menacent sept espèces de primates diurnes natifs de l'Île de Bioko en Guinée Équatoriale. Dans cet article, nous présentons les résultats d'un recensement d'une semaine effectué en 1996 dans une région des plus éloignées de l'île, Gran Caldera de Luba, et nous comparons nos résultats avec ceux d'un recensement plus élaboré effectué en 1990 dans la même région. Une réduction globale de 40% chez les groupes de singes et, plus spécifiquement, la réduction de 56% des groupes de drills* Mandrillus leucophaeus *mettent en évidence le besoin immédiat d'actions de conservation.*

Introduction

The seven species of diurnal, non-human primates indigenous to Bioko Island (2,017 km^2), Equatorial Guinea (Fig. 1), are the drill *Mandrillus leucophaeus*, black colobus *Colobus satanas*, red colobus *Procolobus pennanti*, russet-eared guenon *Cercopithecus erythrotis*, crowned guenon *Cercopithecus pogonias*, greater spot-nosed guenon *Cercopithecus nictitans*, and Preuss's guenon *Cercopithecus preussi*. Because the island has been separated from mainland West Africa for more than 11,000 years (Eisentraut, 1973), at least four of these are represented by endemic subspecies (*M. leucophaeus poensis, P. pennanti pennanti, C. preussi insularis, C. erythrotis erythrotis*). Two others (*C. satanas satanas, C. nictitans martini*) might also be endemic subspecies (Butynski & Koster, 1994).

These monkeys have survived more than 1,000 years of human colonisation (Fegley, 1989) because large parts of this mountainous volcanic island are: 1) unsuitable for farming (hillsides too steep and storms too severe, especially on the windward southern end); 2) inappropriate for logging (monsoon forest trees too small); and, 3) difficult even for hunting (few access roads, steep cliffs, and no permanent water sources in the higher areas). However, when Eisentraut (1973) completed an extensive survey of Bioko's vertebrates during the island's last years as a Spanish colony, the loss of suitable habitat led him to express concern for the future of the monkey populations. By the mid-1980s, five primate species were listed as endangered: *M. leucophaeus, C. satanas, P. pennanti, C. erythrotis* and *C. preussi* (Oates, 1986; Lee *et al.*, 1988). This endangerment is exacerbated by the fact that these species are poorly represented in live zoological collections (ISIS, 1996).

The status of non-human primates on Bioko following Equatorial Guinea's independence in 1968 was not reviewed until 1986, when Butynski and Koster (1994) reported a surprising resurgence in numbers that they attributed to an increase in available habitat and a decrease in hunting. A second island-wide survey in 1990-91 by González Kirchner (1994) confirmed their findings, but warned of renewed hunting. Three additional primate surveys, all of more limited areas, were completed at about the same time: a 1990 survey in the Gran Caldera de Luba by Schaaf, Butynski and Hearn (1990); a survey along the southwestern coast by Schaaf, Struhsaker and Hearn (1992); and a 1992 survey

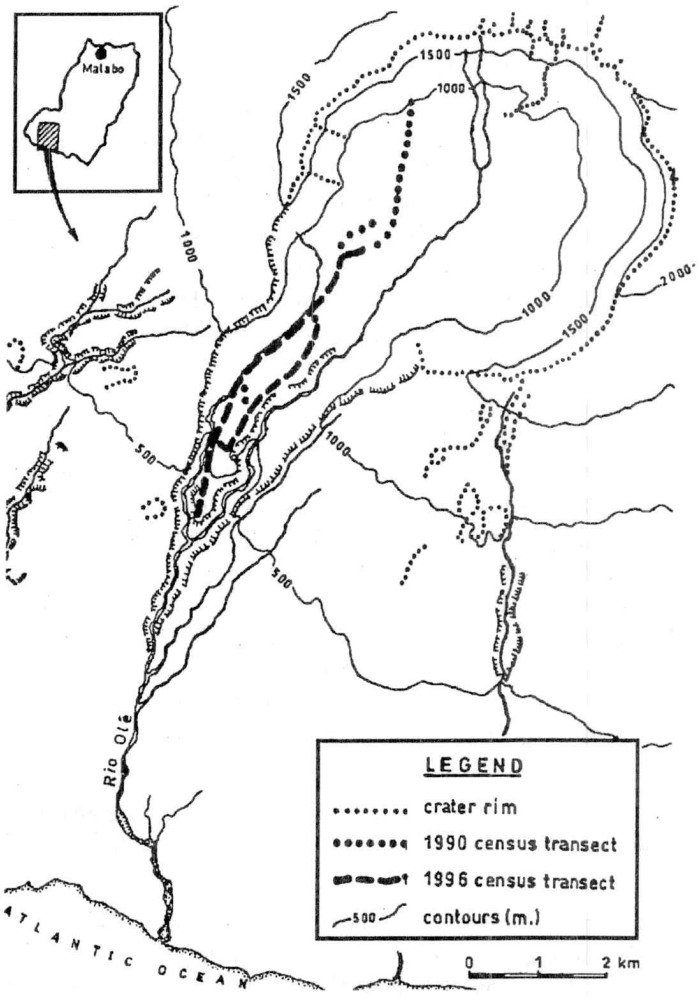

Figure 1. Map of the Gran Caldera de Luba, Bioko Island, Equatorial Guinea, showing the location of the census trails .

of the southeastern forests by Collel, Maté and Fa (1994). High levels of hunting were confirmed by a bushmeat market survey conducted during 1991 by Fa *et al.* (1995).

With the departure of the US Peace Corps in 1993, the US Ambassador in 1993, and the US Embassy in 1995, together with a dramatic reduction in the Spanish Research and Nature Conservation Programme, scientific investigations on the island dwindled rapidly. No new information on the status of Bioko's primates was collected after 1992. The survey we report here, a repeat of the 1990 census of Schaaf, Butynski and Hearn (1990) in the most remote part of the island, the Gran Caldera de Luba, was designed to assess the impact of hunting on diurnal primates during those intervening years.

Census Methods

During January 1996, with the assistance of the same two local guides, we retraced the route up the Rio Olé used in the 1990 survey and established the same basecamp in the neck of the Caldera (Fig. 1). Trails were cut in the same locations, with the exception of the northernmost extension, which was too distant from the base camp to census. Although we found only one tag from 1990, cut saplings with regrowth from the stump marked most of the previous routes. Routes were walked, usually once per day beginning at 0800 h, for a total of 26.3 km. We spent 23.8 h on census. The mean rate was 1.10 km/h.

The methods for the primate census were essentially the same as those described for the 1990 survey (Butynski, 1990; Schaaf *et al.*, 1990). Three students, Christine Strater, Elizabeth Hearn and Cindy Trotta, assisted with the survey. We recorded the time and location of all contacts with monkeys and, whenever possible, the species, number of individuals, estimated distance and direction from the first clearly seen monkey to the observer, perpendicular distance between the monkey and the trail, and the monkey's height above the ground. Polyspecific associations were scored when groups were within 50 m or less of each other. A total of 6.5 km of trail was re-opened, measured and marked.

Census Results

Primate groups were contacted 31 times, for an overall encounter rate of 1.18 groups/km. In 26 of these encounters, a positive visual identification was made to give a frequency of 1.02 identified groups/km. Nine (35%) of these encounters were with polyspecific associations.

The most commonly encountered monkey was *P. pennanti* (0.49 groups/km), followed by *C. erythrotis* (0.42 groups/km), *C. satanas* (0.27 groups/km), *C. pogonias* (0.19 groups/km) and *M. leucophaeus* (0.04 groups/km) (Fig. 2). We neither saw nor heard *C. preussi* at any time during our visit. We did not see *C. nictitans* in the Caldera, but we did see one group, in a mixed association with *C. erythrotis*, along the Rio Olé.

The frequency of association with groups of other species was highest for *C. pogonias*, where all five encounters were with other groups. Four (57%) of the seven encounters with *C. satanas* were polyspecific associations, and seven (54%) of 13 encounters with *P. pennanti* were polyspecific associations. *C. erythrotis* was in polyspecific associations in four (36%) of 11 encounters. *M. leucophaeus* was alone in our single encounter with a group while on census.

Although we found shotgun shells near our campsite, neither the campsite nor our route into the Caldera had been used recently. Leoncio Riaco Richard, one of our guides, told us that the people from his Bubi village of Ureca had not been into the Caldera for several years. Ureca is the only village in southern Bioko. Local sources did report that the Caldera floor could be reached by new routes down the north wall. To investigate this possibility, we visited a campsite nearer

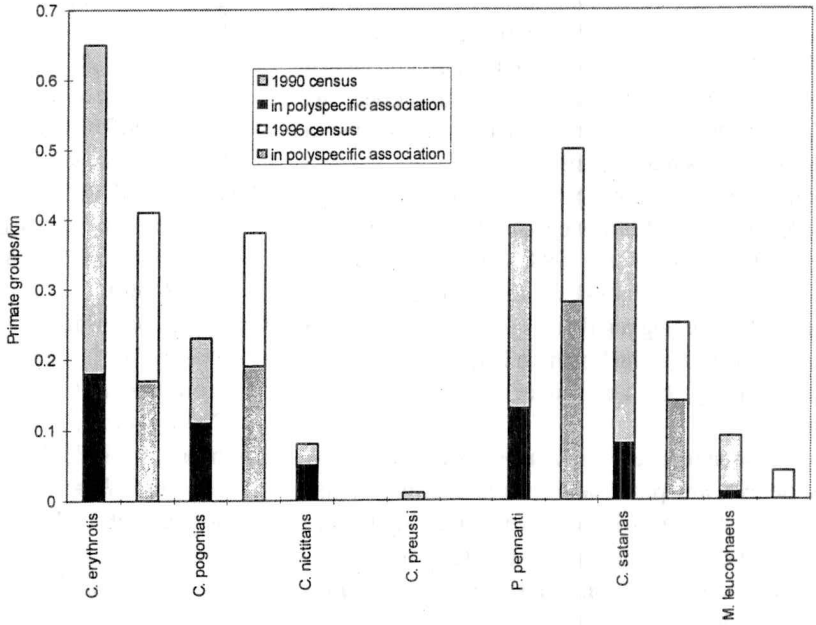

Figure 2. Frequency of encounters with groups of primates during censuses in the Gran Caldera de Luba in 1996 compared with frequencies of encounters in 1990 (Schaaf et al., 1990).

the north wall along the western branch of the Rio Olé, but saw no evidence of use.

Bushmeat Market Survey

The fresh primate carcasses offered for sale in the Malabo (capital city) bushmeat market were counted on 14, 15, 16 and 30 January, resulting in a total of eight *C. erythrotis*, seven *C. satanas*, five *M. leucophaeus* and three *P. pennanti*. Only one market vendor was located, although Juste *et al.* (1995) reported two; one collecting from Luba (the southwestern side of the island), and the other from Riaba (the eastern side of the island). As *P. pennanti* was rare in their Riaba data, we believe that our vendor was the same as their Luba vendor. Our average of 5.75 monkeys/day is similar to the average of 6.21 monkeys/day calculated from the numbers given by Juste *et al.* (1995).

Discussion

When we compared our results to the 1990 Gran Caldera census (Schaaf *et al.*, 1990) we found an overall reduction of 40% in primate group encounters from 2.0 to 1.2 groups/km. Our results are also lower than those reported from the Gran Caldera by Butynski and Koster (1994) in 1986 (2.2 encounters/km), and by González Kirchner (1994) in 1990 (3.25 groups/km).

Some species appear to have suffered a greater decline than others. We found a 56% reduction in *M. leucophaeus*, a 35% reduction in *C. erythrotis*, and a 27% reduction in *C. satanas*. Although all of these species are threatened, the situation of *M. leucophaeus* is especially critical. Other reports (Butynski & Koster, 1989; Collel *et al.*, 1994; Fa *et al.*, 1995; Juste *et al.*, 1995), as well as our own brief market survey, confirm that *M. leucophaeus* is over-represented as a bushmeat species. Since we observed no loss of habitat near the Gran Caldera de Luba, we conclude that this decline in *M. leucophaeus* is due to hunting.

In our report to the government of Equatorial Guinea (Hearn & Berghaier, 1996) we join others (Butynski & Koster, 1994; Collel *et al.*, 1994; Gonzalez Kirchner, 1994; Juste & Fa, 1994) in recommending the enforcement of hunting regulations for the two protected areas (Pico Basilé and the Southern Highlands) as a first step to ensuring the survival of these endangered primates.

Because monkey meat is a valuable source of income to local people, any proposal to restrict hunting should also propose strategies for compensating the hunters for their financial loss. A rough estimate of the annual value of primate bushmeat sales can be calculated using the totals reported by Fa *et al.* (1995) and the prices quoted to us in the Malabo market. Thus, 551 drills @ US$ 24; 1,283 cercopithecines @ US$ 7; and 862 colobus @ US$ 12 give annual sales of about US$ 33,000. We are exploring alternatives to hunting that might prove economically rewarding, so that monkeys in the trees become more profitable than monkeys on the dinner table (Hearn & Berghaier, 1996).

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HAMADRYAS BABOONS *PAPIO HAMADRYAS* IN ERITREA

Abstract: *Hamadryas baboons* Papio hamadryas *have a restricted range in north-eastern Africa and south-western Arabia. They are able to survive in highly degraded habitats, but even here they come into conflict with farmers. After several decades of civil war, the status and distribution of hamadryas in Eritrea, Ethiopia, Somalia and Sudan is unclear. In a short term survey of about 350 km in the central highlands of Eritrea, we found groups of hamadryas at seven sites. Group size, social organisation and ranging were similar to that reported from Ethiopia. It seems that the hamadryas baboon is the only large wild mammal still present in good numbers in the central highlands.*

Résumé: *Les babouins hamadryas* Papio hamadryas *sont classés comme rares par l'UICN à cause de leur distribution restreinte au nord-est de l'Afrique et au sud-ouest de l'Arabie. Ils survivent dans des habitats largement perturbés et dégradés et pourtant, même là ils entrent en conflit avec des fermiers. Après plusieurs décennies de guerre civile, le statut et la distribution des hamadryas en Érythrée, Éthiopie, Somalie et au Soudan sont incertains. Dans un court recensement de quelques 350 km dans les hauts plateaux centraux de l'Érythrée, nous avons repéré des groupes d'hamadryas à sept endroits. La taille du groupe, l'organisation sociale et l'aire de répartition étaient similaires à celles rapportées d'Éthiopie. Il apparaît que le babouin hamadryas soit le seul grand mammifère sauvage encore présent en grand nombre sur les hauts plateaux centraux.*

Introduction

Hamadryas baboons *Papio hamadryas* are restricted to eastern Ethiopia, Eritrea, south-eastern Sudan, Djibouti and Somalia. They are also found in south-western Saudi Arabia and Yemen (Wolfheim, 1983). Most of these areas have been, or still are , inaccessible due to political instability. Following 30 years of civil war in Eritrea, information on the status and distribution of primates and other wildlife in this country is much needed.

Methods

In June 1995, we spent two weeks in Eritrea to prepare a field project on the socio-ecology of hamadryas. The main aim of this trip was to conduct a preliminary habitat classification and a test of the usefulness of remote sensing in a survey of hamadryas (Zinner & Torkler, 1996). In the course of the classification, we made three round trips from Asmara, in an area covered by the 180 x 180 km Landsat MSS image that we used for our test (Fig. 1). We visited areas south (Dekemhare, Tsorena, Adi Keyh), east (Nefasit, Ghinda, Massawa) and north (Serejeka, Filfil) of Asmara. We described vegetation types, determined our position by GPS, and asked local people about the hamadryas whenever the habitat seemed suitable for them. In total, we drove 350–400 km.

Results

In the course of this survey, hamadryas were seen at seven sites (Fig. 1). The estimated size of four groups ranged from 30 to more than 150 members (mean = 68 ± 57). This is within the range observed by Kummer (1968) in his study of Ethiopian hamadryas (group size = 12–156). Spatially distinct subgroups of one or two adult males with one to four females and their young were observed. This is typical of hamadryas social organisation (Kummer, 1968). We also found new-born

infants, as well as older infants and cycling females, in the same one-male units. This suggests that these hamadryas do not have synchronised reproduction, as supposed by Kummer (1968).

One of the groups of 40 to 50 hamadryas lived close to Asmara, the capital of Eritrea. Early in the morning, the entire group was seen at a garbage dump just 3 km east of the city. People working at the dump confirmed that the hamadryas visit the dump almost every morning when there is not much human activity. After spending 2–3 hours searching for edible scraps, they began to move along the steep slopes towards the other side of the valley where they drank at a small pool formed by the first rains of the season. On their way they fed mainly on the cactus *Opuntia ficus-indica*, which provided them with additional water. During our visit, *O. ficus-indica* had only a few unripe fruits and no flowers. The hamadryas fed on the young fleshy platyclades. This plant is probably one of the main food and water sources for the hamadryas during the long dry season.

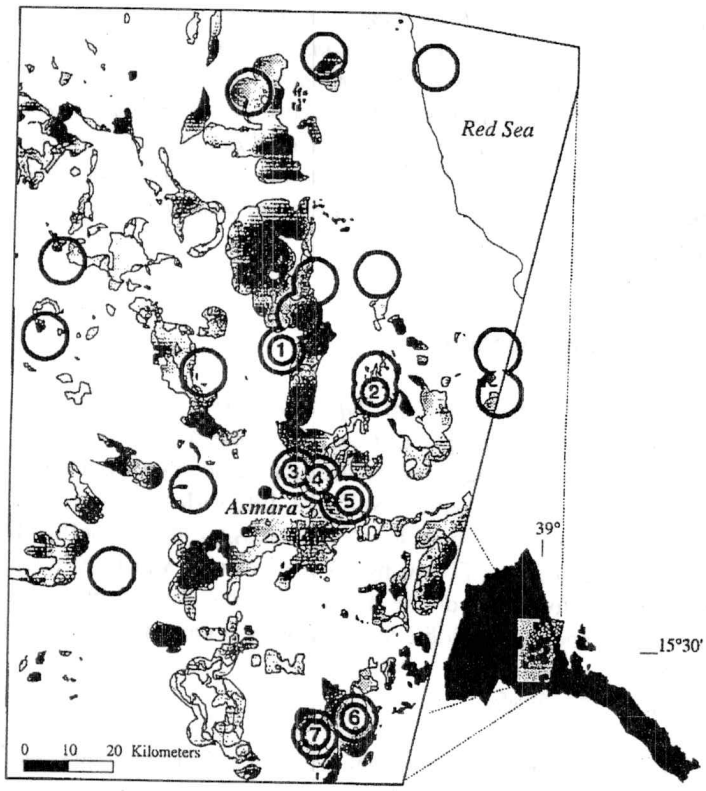

Figure 1. Hamadryas sightings and areas of suitable hamadryas habitat in Eritrea. Historical (empty circles, from Yalden et al., 1977) and recent sightings (1995): 1= Filfil, 2=Gahtieley, 3=Asmara dump, 4=Asmara-Massawa road, 5=Nefasit, 6 and 7=May Aini. Shaded areas represent suitable hamadryas habitat following the habitat classification of Zinner and Torkler (1996).

Apparently, *O. ficus-indica* was introduced to Eritrea by the Italians during their colonial period (Fichtl & Admasu Adi, 1994). In this heavily degraded environment, *O. ficus-indica* and another exotic cactus, *Opuntia cylindrica*, are the only plants that cover the slopes. The situation is similar over large parts of the Eritrean highlands. It would be interesting to investigate whether *Opuntia* spp. and hamadryas have formed a close ecological relationship, with *Opuntia* spp. providing food and water, and the hamadryas distributing its seeds. Other baboons, such as *Papio anubis*, also feed on *Opuntia* (Forthman-Quick & Demment, 1988, Barton 1989). It seems that this plant has become a key resource for hamadryas in some parts of Eritrea.

Opposite the dump, we found the steep sleeping cliff of the group (30–40 m high). Starting at about 1500 h, the hamadryas spent several hours on the slopes close to the cliff feeding on *O. ficus-indica* or digging for grass corms on top of the cliff. The area above the cliff adjoins the agricultural area just outside Asmara. During the growing season (July–December) the hamadryas cause some crop damage. In Saudi Arabia and Yemen, hamadryas became dependent on garbage dumps and caused severe problems in nearby villages and fields (Al-Safadi, 1994; Biquand *et al.*, 1994). A similar situation may occur at the Asmara dump in the future.

A large group of more than 150 individuals was seen from the road between Asmara and Massawa at Kilometre 12. They were moving slowly on the hillsides in an easterly direction. Isolated individual eucalyptus trees *Eucalyptus* sp. grow in this area, but *O. ficus-indica* was again the dominant plant.

In the May Aini Valley (Fig. 1), the hamadryas spent the nights on steep cliffs of table mountains. Local people told us that hamadryas raid the fields on nights when there is bright moonlight. We also found hamadryas in a dense forest patch close to Filfil. This forest is a small relict of the former moist forest at the eastern slopes of the Eritrean rift escarpment. As far as we know, it is an unusual habitat for hamadryas and they may have been merely passing through the forest on their way to water.

In all places where we found hamadryas they spent the nights on steep cliffs. Local people confirmed this observation. No evidence was found of hamadryas spending nights at sites that offered no protection against predators, as was reported by Kummer *et al.* (1985) for some places in Saudi Arabia where predators have been extirpated. The behaviour of the Eritrean hamadryas could be interpreted as a reaction to the continued presence of large predators, particularly leopards *Panthera pardus*.

Further Activities

Hamadryas were the only large species of wild animal seen in the areas that we visited. In a nation-wide survey on primates and other wildlife in 1998, we will investigate whether other parts of Eritrea are similarly impoverished. The Eritrean highlands and the escarpment have historically been centres of hamadryas distribution. At the same time, the region was, and remains, the main agricultural area of the country. Therefore, conflicts between hamadryas and farmers are inevitable. Our planned analysis and mapping of the current distribution of hamadryas in relation to types of land-use will be useful for management decisions.

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SURVEY OF GORILLAS *GORILLA GORILLA* AND CHIMPANZEES *PAN TROGLODYTES* IN THE RÉSERVE DE FAUNE DU DJA, CAMEROUN

Abstract: *The Réserve de Faune du Dja in Cameroun covers 5,260 km² of lowland tropical forest where few systematic surveys of large mammals have taken place. We adapted line-transect census methods to survey gorillas* Gorilla gorilla *and chimpanzees* Pan troglodytes *during 6 months of 1994 and 1995, and found that the Dja Reserve harbours important populations of both. The mean group size for chimpanzees was 2.2 ± 1.9 weaned individuals and their distribution seemed to be relatively even. Nest site density was 41.63/km², indicating a population of 0.79 weaned chimpanzees/ km² (0.60–1.04/km²). Mean gorilla group size was 3.7 ± 3.1 weaned individuals. The overall density of nest sites was 36.37/km² which translates to 1.71 weaned gorillas/km² (1.02–2.86/km²). Preliminary results indicate populations of roughly 3,000 weaned chimpanzees and 2,500 weaned gorillas in the Dja Reserve. Gorilla distribution was uneven and concentrations of nests were found between 15 and 25 km from villages. Vegetation type and human presence seem to determine gorilla distribution in the Dja.*

Résumé: *La Réserve de Faune du Dja au Cameroun couvre 5,260 km² de forêt tropicale des plaines basse altitudes dans lesquelles peu d'inventaires systématiques des grands mammifères ont été effectués. Nous avons adapté les méthodes de recensement par transect linéaire pour échantillonner les gorilles* Gorilla gorilla *et les chimpanzés* Pan troglodytes *pendant six mois entre 1994 et 1995. Nous avons trouvé que la Réserve du Dja héberge d'importantes populations des deux espèces. La taille moyenne d'un groupe de chimpanzés a été évaluée à 2.2 ± 1.9 individus sevrés et leur distribution apparaît relativement continue. La*

densité des nids est de 41.63/km², indiquant une population de 0.79 chimpanzé sevré/km² (0.60-1.04/km²). La taille moyenne des groupes de gorilles était de 3.7 ± 3.1 individus sevrés et la densité globale des sites de nidification s'élève à 36.37/km², ce qui correspond à une densité de 1.71 gorilles sevrés/km² (1.02–2.86/km²). Une estimation préliminaire indique que des populations d'environ 3,000 chimpanzés sevrés et 2,500 gorilles sevrés sont présents dans la Réserve du Dja. La distribution des groupes de gorilles est discontinue et des concentrations de nids ont été trouvées entre 15 à 25 km des villages. Le type de végétation et la présence humaine apparaissent importants dans la détermination de la distribution des gorilles du Dja.

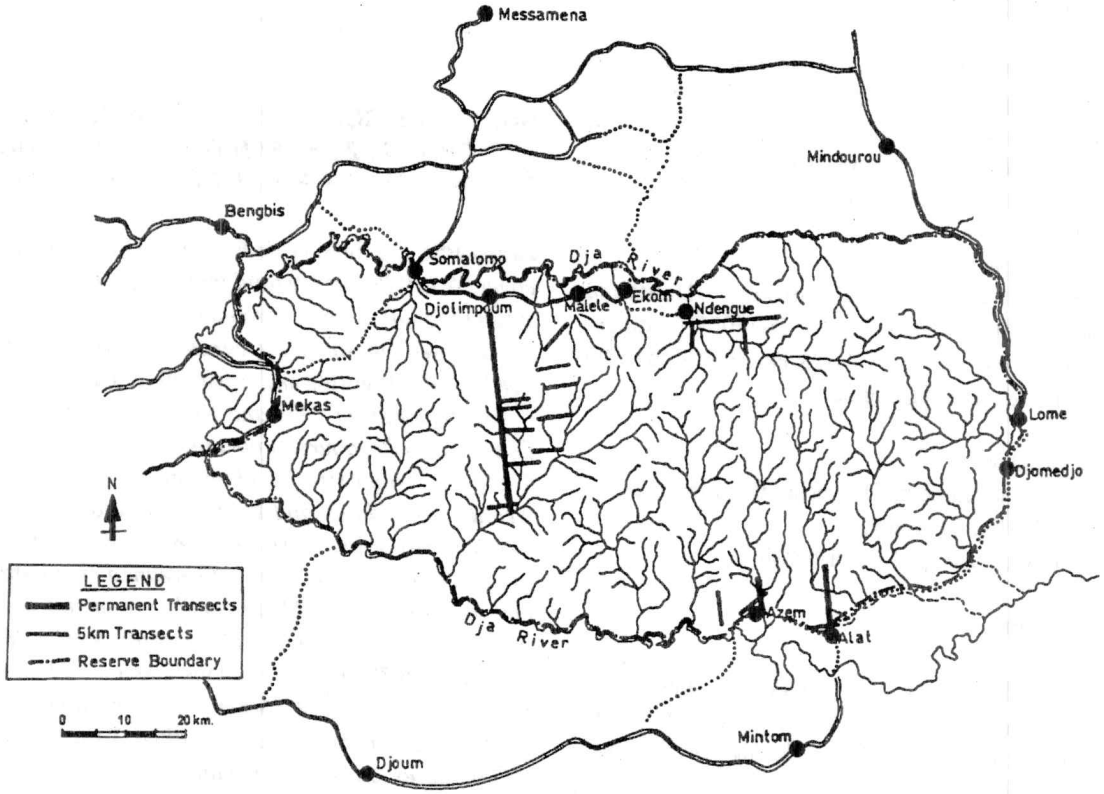

Figure 1. Map of Réserve de Faune du Dja, Cameroun.

Introduction

The fauna of the Réserve de Faune du Dja (5,260 km²) in south-east Cameroun (Fig. 1) is poorly known. Gartlan and Struhsaker (1972) presented preliminary information on primates of the Dja. At least 10 species of diurnal primates (*Miopithecus talapoin*, *Cercopithecus cephus*, *Cercopithecus nictitans*, *Cercopithecus pogonias*, *Cercopithecus neglectus*, *Cercocebus albigena*, *Cercocebus galeritus*, *Colobus guereza*, *Pan troglodytes troglodytes*, *Gorilla gorilla gorilla*) were already known to occur in the Dja. Gartlan (1989) noted, however, that no systematic inventories had been carried out in the Reserve.

Methods

The published literature on techniques for assessing the density of populations of animals using line-transects is abundant (*e.g.*, Tutin & Fernandez, 1983), whilst the theory of line transecting is discussed, critically evaluated, and presented with models and survey designs by Buckland *et al.* (1993). We adapted line-transect census methods developed by Tutin and Fernandez (1983) to survey gorillas and chimpanzees during six months of 1994 and 1995. Seventeen transects, with a combined length of 95 km, were each surveyed twice for ape nests, at intervals of 5–7 months. A critical point to note with current census techniques is that strip-width is not predetermined: all animals or objects seen should be recorded, irrespective of their distance from the centre line of the transect. "Effective strip widths" are estimated *post hoc* by analysing perpendicular distance from the transect to the animal or object sighted, and "detection functions" determined (*i.e.*, the probability of detecting an object that is at distance y from the random line). This differs from surveys where a strip of a fixed width is searched. However, an

important assumption of the DISTANCE model (see below) is that all objects of interest which lie on or above the centre line are detected with certainty (Buckland *et al.*, 1993). Violation of this assumption leads to underestimation of density, and renders the model inapplicable.

Because of the importance of detection of all objects on the line, and because of the reduced importance of "outliers" at relatively large distances from the transect line, most effort can be put into searching near the centre line of the transect. During this survey, particular effort was made to find all nests present at any individual nest site. Once a nest was detected, observers left the centre line to carry out a thorough search and record all nests whether or not they were visible from the transect centre line. Perpendicular distances to the centre of each nest site were calculated from the perpendicular distances measured to each nest. It should be noted that this differs from analyses of individual nest density, per Tutin and Fernandez (1983).

Due to the large size of the Dja Reserve and the short duration of this study, extrapolation was to be made from a relatively small sample; thus, sampling of both the habitat and the animal populations had to be random (Buckland *et al.*, 1993). Transects were stratified according to distance from the nearest village, as recommended by Barnes and Jensen (1987), and orientated to lie across the drainage pattern with the intention of sampling a representative proportion of all vegetation types. GIS information was collected with an Ensign ExL GPS manufactured by Trimble Navigation. The field team consisted of one or two researchers accompanied by a local guide, plus two to four transect cutters and a compass bearer. Collecting data on animal signs is compatible with cutting of transects, and is in fact desirable, as animals may begin to use established transect lines as paths of travel. Such a change in animal movements would increase the density of signs located close to the centre line.

Data were analysed with the computer software package DISTANCE (Laake *et al.*, 1994), which produced estimates of the densities of ape nests from perpendicular distances recorded on transects. Densities of gorillas (G) and chimpanzees (C) were calculated from nest site densities (N) output by DISTANCE using the formula: G or C=(N x mean group size)/mean longevity of nest sites. The mean duration of chimpanzee nests in northeastern Gabon was found to be 113.5 days (Tutin & Fernandez, 1983) and this figure was applied to our data. Mean longevity of gorilla nest sites varies with the types of nests constructed, but we chose the 78 days mean estimated from long-term studies at Lopé (Tutin *et al.*, 1995). Mean group sizes were calculated from the number of nests at fresh nest sites only, including some sites found away from transects.

Results

Chimpanzees

Mean group or party size for chimpanzees was 2.16±1.92 weaned individuals (N = 62, range = 1–9, median = 1), and the overall density of nest sites was estimated to be 41.63/km². As chimpanzee (tree) nests have a greater longevity, this translates to a density of 0.79 weaned individuals/km² (0.60–1.04/km²). To estimate the population for the Reserve as a whole, we took the lower limit of density estimates (0.60 weaned individuals/km²) suggesting a population of about 3,000 weaned chimpanzees for the Dja. Densities in different sectors were highly variable and seasonal differences were pronounced (Table 1). Despite this variation, the distribution of chimpanzees was considered to be relatively even when compared with that of other large mammal species.

Table 1. Chimpanzee densities in four sectors of the Reserve de Faune du Dja, Cameroun (1994–95).

Sector	Month sampled	Transect length (km)	No./km²	Month sampled	Transect length (km)	No./km²
Djolimpoum	May	25.0	0.69	December	23.1	0.95
Malele	June	25.0	0.35	December	23.0	0.55
Ndengué	July	24.7	1.33	December	24.7	0.56
Alat	August	20.0	2.04	January	20.0	0.67

We recorded vegetation type along transects and noted that the forest was often dense with secondary growth (22.8%), including an abundance of the lianescent herb *Haumania danckelmaniana*, and thickets of rattan *Ancistrophyllum secundiflorum*. A monotonous topography seems to have contributed to the formation of swamp vegetation that is dominated by species of *Raphia* or by *Cyperus* and *Pandanus* (9.0%). Seasonally inundated forest, where *Uapaca* spp. trees are common, also covers a substantial area of the Dja (7.5%). Dry forest formed 55.0% of the transect sample. Chimpanzees showed a strong preference for nesting in mature dry forest (75.8% of nest sites) and a disproportionately low number of nests were located in secondary and seasonally inundated forest ($x^2 = 22.8$, df = 2, $p<0.0001$).

Gorillas

We estimated an overall density of 36.4 gorilla nest sites/km². Using fresh nest sites only, including some sites found away from transects (N=33), mean gorilla group size was 3.7 weaned individuals (range = 1–12). Combined with site density, this translates to 1.7 weaned gorillas/km² (range 1.02–2.86/km²). The majority of gorilla nests (61 of 94 sites; 64.9%) were found in two concentrations; one occurred between 15 and 25 km from villages, which coincided with a 700 m wide *Cyperus-Pandanus* marsh. The other was a river basin where *Raphia* swamps, forest, secondary gaps, old secondary forest with *H. danckelmaniana* and *A. secundiflorum*, and thickets predominated. In this sector the mean density of weaned gorillas was high at 5.01/km².

In this same sector, a large difference in density was found between sampling periods (July: 7.88/km²; December: 2.69/km²). An overall density of 0.47 gorillas/km² (0.23–0.99/km²) was calculated, excluding these two concentrations as they were considered to be unrepresentative of the reserve as a whole. If an extrapolation is made from this estimate to the entire reserve, the gorilla population is estimated at 2,472 weaned individuals.

The proportion of nests built in secondary forest and light gaps was only slightly higher than if gorillas' choice of nest site were random. Gorillas showed a strong tendency to nest in seasonally inundated and swamp forests which represented only 16.5% of the forest (42.4% nest sites; $x^2 = 20.39$, df = 2, $p < 0.0001$). Most nest sites were found at Ndengué (7.88 gorillas/km² in July) and 49% of these were in *Raphia* swamp.

Discussion

Chimpanzees

The estimate of 0.79 weaned chimpanzees/km² concurs with population estimates available for other regions of Central Africa. Tutin and Fernandez (1983) estimated the density of chimpanzees in Gabon to be 0.49/km² (0–1.78/km²); White (1994) found 0.2–1.1/km² for Lopé, and Stromayer and Ekobo (1991) reported 0.15–0.34/km² in south-eastern Cameroun.

Almost all tree nests found during the present study were attributed to chimpanzees, and we must consider the possibility that tree nests could have been misclassified following the recent finding of Tutin *et al.* (1995) that "due to the longer life span and greater visibility of tree nests, a proportion of gorilla nest sites 'convert' to chimpanzee nest sites when only tree nests remain visible". Consequently, gorilla nest sites could be mistaken for chimpanzees' nests during surveys, so that chimpanzee numbers would be over-estimated. It also remains to be established how often gorillas build tree nests. It is probable that some tree nests were misclassified during the present survey, especially given the very low number of tree nests attributed to gorillas. Only six tree nests found in the Dja were in association with ground nests, and could thus be confirmed to have been built by gorillas.

Several tree nests were seen to persist for more than six months (at least 183 days; N = 10 sites). The decay rate used to estimate abundance has a strong influence on the density estimates obtained, so if nest duration in the Dja turns out to be greater than 113.5 days, we will have over-estimated the size of the chimpanzee population. To obtain a more accurate estimate of density, studies of nest decay are now needed from this site.

Gorillas

Comparative estimates of gorilla densities from other studies range from 0.44 gorillas/km² in Gabon (but up to 9.16/km²; Tutin & Fernandez, 1983), 0.89–1.45/km² in Central African Republic (reaching 5.6/km² in light gaps and up to 10.96/km² in secondary forest, Carroll, 1988); 1.6/km² also in CAR (Fay, 1989), 1.2/km² in northern Congo (2.4/km² in swamp forest, Fay & Agnagna, 1992) to 2.6/km² in the Likoula Swamps (Fay *et al.*, 1989). Vegetation type and distance from human population are the two major factors identified as influencing the distribution of elephants *Loxodonta africana* in tropical forest (Barnes & Jensen, 1987; Barnes *et al.*, 1991), and the same may be true for gorillas. High local densities in swamp forests were confirmed by Blake (1993) who found 5.88 gorillas/km² in *Raphia* dominated swamp, and 2.88/km² in *Raphia-Uapaca* forest. Lahm (1993) also showed that gorillas have a greater association with inundated and riverine forests than with secondary vegetation. Gorillas in the Dja showed similar tendencies with respect to vegetation type.

There may be several reasons why vegetation type plays such a major role in determining ape distribution. We begin with the observation that there is a relative lack of nesting material in dry forest. *H. danckelmaniana* occurs at high density in dry forest and stems of this particular species are covered with spines. The spines may make them less suitable for nesting than other species of Marantaceae that are abundant in swamps and seasonally inundated forest, such as *Marantochloa* spp. and *Halopegia azurea*. *Cyperus-Pandanus* marsh areas provide both food and refuge, whilst the secondary forest, light gaps, and *Raphia* swamps provide abundant herbaceous food. Fay *et al.* (1989) found that gorillas feed extensively on *Pandanus candelabrum* and other plants common in the Likouala Swamps of northern Congo. Similarly, herbaceous foods are common in the swamp forests of the Dja.

Blake (1993) explained gorillas' use of the Likouala Swamps as a modification of the gorillas' behaviour to avoid areas of human impact. Lahm (1993) also suggested that gorillas in northeastern Gabon survived by taking refuge from hunters in swamps, marshes and

seasonally inundated forest. Species that are seldom hunted are nonetheless affected by the general disturbance of human activity. Both game and non-game species survive by adopting strategies to avoid human contact, such as changes in habitat use (Lahm, 1993). Whilst no attempt was made to evaluate hunting intensity during the present study, it is known that hunting occurs in the Reserve and that hunters regularly cross the Dja River to check their trap lines. We received reports that hunters were particularly active in the northeast and in parts of the south due to a high local demand for bush meat. We also found many snares in the south, although snares may not be a good indicator of the level of hunting of apes and elephants, which requires firearms. The lack of any significant relationship during this survey between large mammal densities and distance from the nearest village may be because hunters in the Dja are known to travel up to 40 km to check their snare lines (G. Ngandjui & P. Muchaal, pers. comm.), and hunters will certainly travel farther for the "grande chasse". Most parts of the Dja are less than 40 km from a village, whereas in northeastern Gabon hunting is usually concentrated within 10 or 15 km of villages (Lahm, 1993).

If gorilla distribution is patchy with localised high densities, how do we predict their distribution in other parts of the Reserve? In this study, nest sites were concentrated on transects between 15 and 25 km from villages. The estimate of 1.71 weaned gorillas/km^2 is surprisingly high, given the impression gained during fieldwork. Gorillas were encountered only twice during the surveys, although we often heard chest beats during the night while camping far from villages and in dense vegetation close to a river. The lower end of the estimate is considered the best general indicator of gorilla density (0.47/km^2), but even this may not be appropriate for the entire Reserve.

Conclusions and Recommendations

It is clear that the Dja Reserve harbours important populations of gorillas and chimpanzees, and that the gorillas show a strong tendency to nest in seasonally inundated and swamp forest. These are habitats that provide abundant food, nesting material, and refuge from hunters. It would be unwise to extrapolate from these preliminary density estimates to the Reserve as a whole. Therefore, these results should be viewed with extreme caution. Further longer-term studies are needed to evaluate the patchiness of gorilla distribution and the importance of each vegetation type in sectors of the Dja that we were unable to visit.

A problem of particular concern is the killing of gorillas, chimpanzees, elephants and monkeys in southeastern Cameroun. All are hunted for their meat, and occasionally for trophies. We recommend that species priorities be established for all conservation actions, and that local people be taught to differentiate between threatened species and others which are more abundant. Under no circumstances should sport hunting be allowed in this region.

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A BIOLOGIST'S PERSPECTIVE ON THE ROLE OF SUSTAINABLE HARVEST IN CONSERVATION

Abstract: *Sustainable harvest is a misunderstood and misused concept that has too often mistakenly been equated with effective conservation. This essay calls attention to recent publications that support a well-known, but generally ignored understanding of the severe limitations and general failure of attempts at sustainable harvest. Based on 35 years of experience with tropical conservation, I believe one of the main reasons the concept of sustainable harvest has gained preeminence in today's conservation arena is not because it has a well-established history of success, but because the development agencies that support this approach have far more money to offer than do organisations that advocate a more holistic approach to conservation with an emphasis on protection of entire ecosystems without exploitation. If extractive reserves are to play any significant role in conservation, then harvest levels must be established from the perspective of conserving all members of the old-growth community rather than just the commodity being harvested.*

Résumé: *La récolte durable des ressources est un concept mal compris et mal utilisé qui a, trop souvent, été mis sur le même pied que la conservation efficace. Le présent essai attire l'attention sur de récentes publications qui montrent les limites importantes du concept de récolte durable et l'échec habituel de cette méthode, une chose bien connue mais souvent ignorée. Sur la base de 35 ans d'expérience en conservation tropicale, je crois que la raison principale pour laquelle le concept de récolte sélective est omniprésent dans les sphères d'activités de conservation d'aujourd'hui, n'est pas parce qu'il s'agit d'une méthode à grand succès, mais plutôt que les agences de développement qui appuient cette approche ont plus d'argent à offrir que les organisations qui favorisent une approche plus holistique de la conservation, c'est-à-dire une approche qui priorise la protection d'écosystèmes entiers sans possibilité d'exploitation. Si les réserves ont un rôle important à jouer dans la conservation, alors les taux de récolte sélective devraient être établis en fonction d'une conservation de tous les membres d'une communauté mature et non en fonction de la seule commodité de ce qui est récolté.*

"Sustainable harvest" is one of the most commonly misunderstood and misused concepts in today's conservation arena. It is generally meant to refer to activities that involve the extraction of a natural resource in such a manner that the resource in question is not depleted and can renew itself so that similar levels of exploitation can occur indefinitely. This article addresses several of the more important misconceptions surrounding the idea that sustainable harvest is an important strategy for conservation and offers an explanation as to why the concept is currently so popular.

Unfortunately, the concept of sustainable harvest has too often been equated with effective conservation. To the contrary, sustainable harvest is invariably an activity whose objective is the material welfare of a select group of humans. Sustainable harvest does not necessarily have anything to do with conservation of other species except in a coincidental and passive way. Rarely is consideration given to the impact of so-called sustainable harvests on other, non-marketable species that are part of the ecosystem being exploited.

Four years ago Robinson (1993) provided an excellent critique of the concept of sustainable development and showed how it is generally incompatible with the goals of conservation. In spite of this and other forceful arguments and case studies showing how sustainable development projects can be counter-productive to conservation (*e.g.*, Wells & Brandon, 1992; Oates, 1995, 1997; Brandon, 1997; Kramer *et al.*, 1997; Noss, 1997), the "sustainable development" movement as a purported

conservation strategy is gaining in popularity and is being funded at higher levels than ever before.

In the case of tropical forests, the sustainable harvest of timber has been given recent attention in semi-popular articles (McRae, 1997; Rice *et al.*, 1997), overviews by foresters and plant ecologists (Dickinson *et al.*, 1996), scientific tomes (Struhsaker, 1997), and policy perspectives by international development agencies (CIDA, 1997). One clear message from these publications is that the relevance of sustainable harvest to conservation remains very much open to question. My objective here is to highlight some of the key issues that must be considered if future attempts at sustainable harvests are to make a meaningful contribution to the conservation of old-growth or mature ecosystems.

First, are any harvests of natural resources sustainable? Long-term and critical evaluations of attempts at sustainable harvest are painfully scarce and generally do not support the concept. That most, if not all, attempts at sustainable harvest have failed, whether they concern marine fisheries (Larkin, 1977; Ludwig *et al.*, 1993) or tropical timber (Struhsaker, 1997) does not deter advocates of integrated conservation and development projects (ICDPs) and the "conservation-through-use" ("use it or lose it") perspectives from continuing to invoke the concept in the name of successful conservation.

The second issue concerns what is perhaps the greatest criticism of the sustainable harvest concept, namely that it represents a narrow perspective. Sustainable harvest is generally thought of in reference to a relatively small proportion of all the species living within the ecological community being exploited (Robinson, 1993). For example, discussions of sustainable harvest of timber in the tropics rarely consider anything but the tree species being harvested (*e.g.*, Dickinson *et al.*, 1996; but see Rice *et al.*, 1997 and Struhsaker, 1997 for exceptions).

In fact, timber-production forests are usually not compatible with sustainable conservation of the other non-harvested species (plant or animal) that depend on old-growth forest. Harvest systems can be developed that yield tropical timber over at least 2–3 cuts, but these systems have never been shown to conserve the full complement of old-growth species (Struhsaker, 1997). These intensively managed forests more closely resemble tree plantations than natural forests. They are often impoverished in terms of plant and animal species (Struhsaker, 1997). The flora and fauna that follow heavy logging are usually dominated by colonising ("weed") species and not those adapted to old-growth forest (Struhsaker, 1997). As Peter Ashton is quoted: "Let's not pretend that sustained-yield forestry and biodiversity preservation are in any way compatible" (McRae, 1997).

Because the generally used concept of sustainable harvest is not readily demonstrable and is of limited value in developing conservation management plans, a third important issue must be addressed. When developing harvest systems of natural resources, one must establish a reference point or perspective and carefully consider all of its consequences. If one's objective is to produce only timber, then studies and management plans need only be concerned with those species relevant to the regeneration, growth, and reproduction of the timber species being exploited. On the other hand, if one's objective is the sustainable conservation of old-growth species, then it is this community of species that must be evaluated and studied, not just the timber species being logged.

The fourth point, and an important caveat with regard to the implementation of sustainable harvests in the conventional sense, is that as market demands increase, whether due to increasing human populations or increasing levels of consumption *per capita*, the temptation is to increase the harvest levels accordingly (Struhsaker, 1997). What was considered as a sustainable (*i.e.*, sufficient) harvest 5–10 years ago, will likely be inadequate for contemporary and future market demands. In response to escalating economic pressures, as well as those from society and politicians, sustainability is redefined and harvest levels increased accordingly (Larkin, 1977; Ludwig *et al.*, 1993). This is particularly so for tropical countries where human populations are increasing at 3–4% per year. But it also occurs in wealthy, temperate-region countries that have relatively low rates of population growth, such as the United States and Canada.

Given the preceding points, we must ask a final question. Why is the concept of sustainable harvest as a conservation strategy so widely advocated? Too often the success of integrated conservation and development projects, or other sustainable harvest projects, is equated to the project's fund-raising capabilities because management policy and practice are usually influenced in proportion to the availability of funds. Correspondingly, these project designs tend to be shaped and driven by the donors and, because the wealthiest donors come from the development industry (*e.g.*, World Bank, United States Agency for International Development, Department for International Development [UK], European Community, Norwegian Agency for Development, Swedish International Development Agency, Japan International Cooperation Agency, Overseas Economic Cooperation Fund [Japan]), they assume a development perspective. In other words, the paradigm of conservation through development, including the sustainable harvest concept, originated with individuals and organisations primarily concerned with human welfare and economic growth (an anthropocentric perspective) and not with biological conservation (a holistic perspective).

Based on 35 years of experience with tropical conservation, I believe one of the main reasons the

concept of sustainable harvest has gained preeminence in today's conservation arena is not because it has a well-established history of success, but because development agencies have far more money to offer than do conservation organisations that advocate a more traditional and holistic approach. In other words, funding, rather than the goals of conservation, has become the predominant objective of the implementing organisations.

An additional force that encourages and fosters the "development" approach to conservation is the rapidly growing human population in the tropics. Because rapidly growing and/or high-density human populations usually represent the most serious threat to old-growth forests in the tropics (Bruenig, 1989; Struhsaker, 1997), as well as to other ecological communities, they must be dealt with in some way. Rather than address the ultimate and underlying issue of population control and planning, the "development" approach encourages plans based on simplistic or inappropriate concepts of economic growth and sustainable harvest (Robinson, 1993). Combined with the population problem is an increasing concern for indigenous peoples (Kramer & van Schaik, 1997), which further encourages the "development" approach to conservation.

Sustainable harvest is offered by its proponents as a concept that resolves conflicts between conservationists and exploiters through compromise. The very real risk is that, unless dealt with in a far more objective and holistic (less anthropocentric) manner, the current patterns of sustainable harvest will continue to drive our old-growth species and ecosystems to extinction. In terms of effective conservation of old-growth species, there is no substitute for totally protected areas. Realising that not all remaining old-growth habitats will be given total protection, buffer zones and other forms of extractive reserves can play important roles in conservation. They are, after all, better options than total conversion to monocultures. These extractive areas will, however, only play a significant role in conservation if the harvest levels are established from the perspective of conserving all members of the old-growth community and not just the commodity being harvested.

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DESCRIPTIONS OF THE DWARF GALAGO SPECIES OF TANZANIA

Abstract: *Based on field research in Tanzania (1992–1995) (Honess, 1996), this paper describes two new species of galago and elevates two other galagos from subspecies to species. These four new species are established on the basis of species-specific vocalisations, reproductive morphology and body measurements.*

Résumé: *Basé sur une recherche effectuée sur le terrain en Tanzanie (1992–1995) (Honess, 1996), le document decrit deux nouvelles espèces de galago et a promu deux autres galagos, qui etaient jusq'à lors des sous-espèces, au niveau d'espèce. L'établissement de les quatre nouvelles espèces est basé sur le espèces-spécifiques vocalisations, la morphologie reproductrice ainsi que les dimensions corporelles.*

Introduction

A study of galagos (Primates: Galagonidae (Olson, 1979)) in Tanzania (1992–1995) located populations of unknown taxonomic identity. Further research determined that two of these represent new species, while two others, previously classified as *Galagoides zanzibaricus granti* and *Galagoides demidoff orinus*, required elevation to full specific status (Honess, 1996). Kingdon (1997) published the two new species in a manner which formalises Honess as their author. This paper justifies these taxonomic changes in detail. Marked behavioural differences, especially in vocalisations, illustrate the taxonomic distinctiveness of these new species. This is confirmed by independent measures of morphological differences in comparison with well established species.

Several researchers show a strong link between differences in the taxonomic status of galagos and both their vocal profile (all loud calls in the vocal repertoire) (Bearder *et al.*, 1995) and main advertisement calls (Courtenay & Bearder, 1989; Zimmermann, 1990; Bearder *et al.*, 1995). Special consideration is given to advertisement calls because their primary functions of attracting companions and repelling rivals are of key importance to the Specific Mate Recognition System (Paterson, 1985). They are often the most frequently heard calls and may provide the most rapid assessment of species identity during surveys.

The taxonomic relevance of differences in penile morphology has been demonstrated for galagos (Dixson & Van Horn, 1977; Dixson, 1989) and for primates in general (Dixson, 1987). Considerable differences are seen in the overall shape of the penis, and in the presence or absence and arrangement of penile spines.

At the start of this study a review of the group (Nash *et al.*, 1989) identified 11 species of galagos in three genera: *Otolemur crassicaudatus* and *O. garnettii*; *Galago senegalensis*, *G. gallarum*, *G. moholi*, *G. elegantulus* and *G. matschiei*; *Galagoides demidoff*, *G. thomasi*, *G. zanzibaricus* and *G. alleni*.

New Taxa Identified Within the Family Galagonidae

Galagoides demidoff orinus and *Galagoides zanzibaricus granti* can be elevated to the full species status of *Galagoides orinus* and *Galagoides granti*, respectively, on the basis of comparison with *G. demidoff demidoff* and *G. zanzibaricus zanzibaricus*, respectively. The differences observed are consistent with species level differences illustrated for other galago taxa (Honess, 1996). These differences include those observed in species-specific vocalisations and penile morphology (Honess, 1996) and in body measurements (see Tables 1 & 2). Neither of the two new species described by Honess (1996), below and published in Kingdon (1997) appear in any previous classification.

Table 1. Comparison of the body weight and length measurements of galagos described in the text (data ranges and standard deviations were generally not available from sources). Sources: (1) Jenkins (1987); (2) Honess (1996); (3) Olson (unpubl. data); (4) Honess (unpubl. data).

Species	Body weight (g)	Head-body length (mm)	Tail length (mm)	Hindfoot length (mm)	Ear length (mm)
G. granti (1)	134 (n=5)	155 (n=17)	226 (n=17)	57 (n=17)	36.6 (n=17)
G. udzungwensis (2)	135.5 (n=2)	147 (n=3)	230 (n=3)	61.5 (n=3)	28 (n=3)
G. rondoensis (2)	59.8 (n=5)	107 (n=7)	183.6 (n=8)	44.9 (n=8)	27.7 (n=7)
G. d. demidoff (3)	72 (n=40)	130.2 (n=69)	180.9 (n=69)	46.3 (n=68)	23.7 (n=67)
G. z. zanzibaricus (3)	150.8 (n=21)	155 (n=47)	221.7 (n=47)	58.1 (n=45)	36.7 (n=46)
G. orinus (4)	N/A	155 (n=1)	180 (n=1)	47.7 (n=1)	25 (n=1)

Table 2. Comparison of the cranial dimensions (mm) of type specimens of the species of galago described in the text together with figures for G. d. demidoff *and* G. z. zanzibaricus. *Sources: (1) Thomas & Wroughton (1906); (2) Honess (1996); (3) Olson (unpubl. data); (4) Lawrence and Washburn (1936).*

Species	Greatest length	Basal length	Zygomatic breadth	Mastoid breadth	Brain case height	Palate length	Front canine to back of m^3 (upper)
G. granti (1)	45	35	28	23.5	—	18+	15.6
G. udzungwensis (2)	41.9	—	26.7	22.5	16	—	15
G. rondoensis (2)	35.5	—	20.2	18.5	14	—	12
G. d. demidoff (3)	34.3 (n=105)	25.3 (n=105)	22.2 (n=105)	—	16.3 (n=105)	12.0 (n=106)	—
G. z. zanzibaricus (3)	40.7 (n=55)	30.7 (n=55)	26.5 (n=54)	—	18.7 (n=54)	14.9 (n=57)	—
G. orinus (4)	39.2	27.4	—	18.9	—	14.0	13.7

Each species is described separately. The formal details of the species are given first, followed by the diagnosis and details of the species' behaviour and morphology that illustrate their distinct identity.

Genus: *Galagoides* A. Smith, 1833

The Matundu Galago

Species: *Galagoides udzungwensis* Honess, 1997.

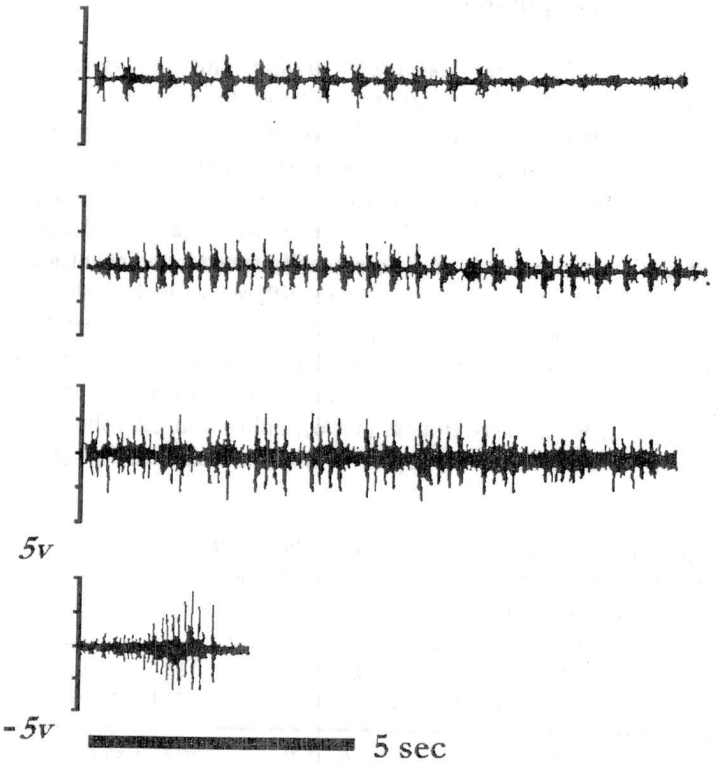

Figure 1. Comparison of oscillograms of the advertisement calls of four species of galagos (top to bottom): Galagoides udzungwensis, G. rondoensis, G. granti, *and* G. demidoff.

1997 *Galagoides udzungwensis* Honess, in Kingdon, *The Kingdon Field Guide to African Mammals*, pp. 106–107.

This species is named after the Udzungwa Mountains, the area of the type locality. The common name is after the forest reserve where the species was first identified.

Taxonomic Note: This species is placed in the genus *Galagoides* based on cranial similarities to established species in that genus (P. Jerkins, pers. comm.). A second specimen (M.707) exists at The Zoological Museum, Copenhagen, Denmark.

Holotype: Male (full wet specimen) ZD.95.251, Natural History Museum, London.

Type Locality: Ichima, Kilombero District, Morogoro Region, Tanzania (8°01'S, 36°31'E).

Distribution: Known from lowland forest on the eastern side of Udzungwa (as above), Uluguru (7°00'S, 37°45'E) and East Usambara Mountains (10°07'S, 37°30'E), Tanzania (Honess, 1996).

Diagnosis: Of similar body size, *G. udzungwensis* can be distinguished from *Galagoides granti* by its shorter ears. In contrast to *G. granti*, the tail has no blackish brown tip, though it is marginally darker distally than the greyish-brown of the rest of the tail. In *G. granti* the tail is unusually long, bushy and long-haired (20–25 mm) (Thomas & Wroughton, 1906), whereas in *G. udzungwensis*, although similarly very long, it is more sparsely covered with shorter hairs. The orbital rings present in *G. granti*