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The Recently Described Highland Mangabey, *Lophocebus kipunji* (Cercopithecoidea, Cercopithecinae): Current Knowledge and Conservation Assessment

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Abstract: The highland mangabey (*Lophocebus kipunji*), described and named in 2005, is the first monkey to be discovered in Africa since 1984. This species, endemic to Tanzania, was independently discovered by two research groups, one working in Ndundulu Forest in the Udzungwa Mountains, the other ~350 km to the southwest in the Rungwe-Livingstone Forest in the Southern Highlands. *Lophocebus kipunji* is an arboreal omnivore with a morphology and vocal repertoire distinct from other mangabeys (*Lophocebus* spp. and *Cercocebus* spp.). Although few data are available, studies of its molecular biology, ecology, behavior, and conservation status are underway. *Lophocebus kipunji* is Critically Endangered as a result of hunting and loss of habitat, which have produced small and fragmented populations. Efforts to improve the conservation status of both Ndundulu Forest and Rungwe-Livingstone Forest are ongoing, as well as augmentation of community-based conservation programs with expanded law enforcement. Research, long-term monitoring, effective law enforcement, and additional conservation projects are all essential to the long-term survival of *L. kipunji*.

Résumé: Le mangabé des montagnes (*Lophocebus kipunji*), recensé et nommé en 2005, est la première espèce de singe découverte en Afrique depuis 1983. Cette espèce endémique de la Tanzanie a été découverte par deux groupes indépendants de chercheurs, l'un travaillant dans la forêt Ndundulu des montagnes de l'Udzungwa, et l'autre à environ 350 km au sud-est de là, dans la forêt Rungwe-Livingstone située dans les montagnes méridionales. Le *L. kipunji* est un omnivore arboricole caractérisé par une morphologie et un repertoire vocal distincts de ceux des autres mangabés (*Lophocebus* spp. et *Cercocebus* spp.). Même s'il n'existe que peu de données pour l'instant, des études sont actuellement en cours concernant la biologie moléculaire, l'écologie, le comportement et l'état de conservation de cette espèce. Le *L. kipunji* est en Danger Critique d'Extinction du à la chasse et la perte d'habitat, qui ont produit des populations peu nombreuses et fragmentées. Des efforts sont en cours visant à améliorer le statut de conservation des forêts Ndundulu et Rungwe-Livingstone, ainsi qu'à augmenter les programmes communautaires de conservation et le respect des lois. La recherche, le suivi à long-terme, l'application des lois et d'avantages de projets de conservations constituent des éléments essentiels à la survie du *L. kipunji.*

Key Words: Highland mangabey, *Lophocebus kipunji*, Tanzania, conservation, Udzungwas, Southern Highlands

Introduction

Two decades spanned the interval between the discovery of the sun-tailed monkey (*Cercopithecus solatus*), in Gabon in 1984 (Harrison 1988), and the discovery in 2004 of the next new species of African monkey, the highland mangabey, in two widely separated forests of Tanzania: Ndundulu Forest in the Udzungwa Mountains, and Rungwe-Livingstone Forest in the Southern Highlands. The highland mangabey has since been described and named *Lophocebus kipunji* Ehardt, Butynski, Jones and Davenport, 2005 (in Jones *et al.* 2005), and is now the subject of research and conservation attention. *Lophocebus kipunji* (Fig. 1) joins Tanzania's other endemic mangabey, the Sanje mangabey (*Cercocebus sanjei*) (Ehardt *et al.* 2005, Ehardt and Butynski 2006), as one of the world's most threatened primates.

Davenport *et al.* (2006) reported that molecular data from a subadult male *L. kipunji* (killed by a farmer's trap while crop-raiding in Mount Rungwe, Southern Highlands) support the reclassification of this monkey as '*Rungwecebus kipunji*'. We, and several experts in primate taxonomy and molecular biology, are not in agreement with this reclassification into a new genus at present (Disotell *et al.* in prep.), and the original

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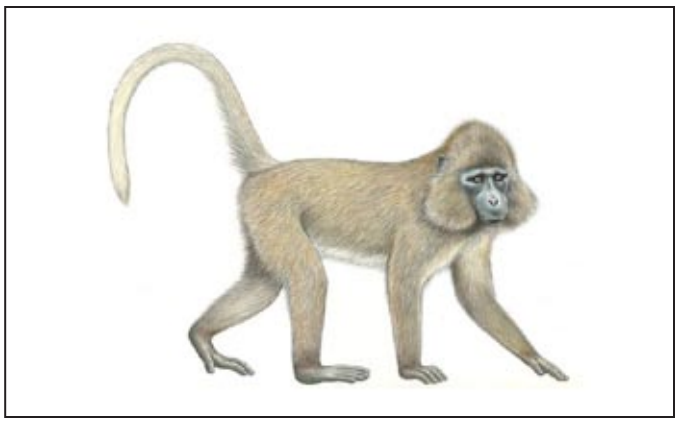

Figure 1. The highland mangabey, *Lophocebus kipunji*. Drawing by Stephen D. Nash.

taxonomic designation as *Lophocebus kipunji* is, therefore, maintained for this report.

This paper (1) reviews our current knowledge of *L. kipunji*, (2) summarizes present and planned research and conservation efforts, (3) assesses the conservation status of *L. kipunji*, and (4) presents recommendations for conservation action.

Species Description

The original description of *L. kipunji* is based on observational and photographic data (Jones *et al.* 2005). Acquisition of the dead subadult male by Davenport and colleagues in the type locality of Mount Rungwe has permitted a more detailed description of the morphology of this taxon (Davenport *et al.* 2006). The following is a composite of these descriptive data.

Lophocebus kipunji is an arboreal, medium-sized, mainly brown monkey with a black face, high crest of hair on the crown, and long tail. Muzzle is bare, elongated, and black. Maxillary suborbital fossae are pronounced. Cheek-whiskers are long, extending laterally and curving downward. Eyelids are black, eyes are brown. A very prominent, long, broad, erect crest of hair on crown; rises to a point in some individuals. Elongated shoulder pelage (cape or mantle) occurs in some adult males. Head, dorsum and limbs are medium to dark grey-brown or rufous-brown. Center of ventrum and distal half of tail are white to off-white. Forearms are dark grey-brown. Hind limbs are dark rufous-brown. Hands and feet are black. The tail is smooth, with a slight tuft at the tip in some adults. The tail is typically held up and curved backward when standing, sometimes also during locomotion; otherwise it is carried loosely and extends parallel to the body; seldom held vertical or arched forward over the back. Hairs are long and straight, without banding or speckling. There is no adult sexual dichromatism; adult males are moderately larger than females. Pink ischial callosities are fused in males, unfused in females.

No adult specimens are yet available. The length of the head plus body is estimated to be 85–90 cm in adults. Tail length of a subadult male is ~57% of total length (Davenport *et al*. 2006). Adult male body weight is estimated at 10–16 kg. Skull and scapula of subadult male examined by Davenport *et al*. (2006) have features characteristic of *Lophocebus* (Groves 1978; Fleagle and McGraw 1999, 2002).

Phenotypic differences between the two *L. kipunji* populations appear to be few. The degree of offset in color on the ventrum (white/brown) may be sharper in individuals at Ndundulu, and some Rungwe-Livingstone animals have a small, off-white patch on the upper chest.

Lophocebus kipunji is readily distinguished from the other two species of *Lophocebus* mangabeys (grey-cheeked mangabey, *L. albigena,* and black mangabey, *L. aterrimus*) (Grubb *et al.* 2003) by its coloration and by the shape of the crown pelage (Groves 2001). *Lophocebus kipunji* differs from all *Cercocebus* mangabeys in lacking the pale eyelid skin (i.e., pinkish, off-white, or flesh-colored) that contrasts with the color of the face. In addition, *L. kipunji* is arboreal, whereas all *Cercocebus* spp. are semi-terrestrial (Groves 1978, 2001; Harris and Disotell 1998; Fleagle and McGraw 1999, 2002).

Perhaps the most distinctive characteristic of *L. kipunji* is that, in contrast with all other *Lophocebus* spp., and all *Cercocebus* spp., it lacks the "whoop-gobble" loud call emitted by adult males (Waser 1982; Range and Fischer 2004). Comparison of a sonogram of a low-pitched loud-call of adult *L. kipunji*, termed the "honk-bark," with loud calls of other studied mangabey species indicates that the "honk-bark" is qualitatively and quantifiably dissimilar (Jones *et al.* 2005). According to Davenport *et al.* (2006), the call exhibits some structural congruence to the "roar-grunt" of *Papio* (Byrne 1981).

As mentioned above, the basis of the original description of *L. kipunji*, establishing its taxonomic status and name, was observational and photographic data (Jones *et al.* 2005). Subsequent to publication of the description, concern was expressed by Timm *et al.* (2005) and Landry (2005) that this procedure was not in accordance with the *International Code of Zoological Nomenclature* (ICZN 1999). Their primary concern was that, because no physical voucher specimen was available and used for the description, the name was "not available." In fact, we consulted extensively with A. Polaszek, the President of the International Commission on Zoological Nomenclature (ICZN), as well as with several eminent primate taxonomists, to ensure ICZN-compliance before publishing the description and assigning the name solely on the basis of observations and photographs. These consultations were motivated by our concern that there not be any requirement for a dead physical specimen, because our observations indicated that both populations of *L. kipunji* were very small and, therefore, highly threatened. As discussed in the published response (Polaszek *et al*. 2005) to Timm *et al*. (2005) and Landry (2005), the Code does indeed permit holotypes to be "illustrations" such as *individuals in photographs*:

"Designation of an illustration of a single specimen as a holotype is to be treated as designation of the specimen illustrated; the fact that the specimen no longer exists or cannot be traced does not of itself invalidate the designation" (4th edition, ICZN 1999; Article 73.1.4).

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As such, dead specimens are *not* required. Wakeham-Dawson *et al*. (2002) fully discussed the unavailability of dead physical specimens in relation to the description and validity of assigned names.

We reiterate here the full code-compliance of such descriptions of threatened taxa, or of those for which the collection of specimens is otherwise impractical, impossible, or unethical, to reinforce the fact that description and classification of newly discovered taxa need not be delayed until voucher specimens are obtained. Description and taxonomic designation of threatened taxa are important at all levels in assisting with the prioritization and implementation of conservation actions, and with garnering support for these actions. Given that newly discovered taxa are likely to be threatened, conservation scientists need to be cognizant of allowance under the code for designation of surviving specimens as holotypes. The authors and their colleagues are currently carrying out research to supplement the current evidence related to the taxonomic status of *L. kipunji*. This involves the collection of molecular data (from feces and hair obtained through non-invasive sampling methods) and acoustic data (from recordings of species-specific vocalizations). Such data can contribute to further validation of newly described taxa, especially when no physical specimens are available.

Distribution, Abundance, and Habitat

Lophocebus kipunji occurs in two populations separated by about 350 km of largely non-forested land (Fig. 2) (Jones *et al*. 2005; Davenport *et al.* 2006). One population occurs in submontane forest from about 1,300–1,750 m a.s.l. in the southern part of Ndundulu Forest (7°39′–7°51′S, 36°27′–36°42′E; about 180 km² of closed forest) in the Udzungwa Mountains of south-central Tanzania (07º40′–08º40′S, 35º10′–36º50′E, about 10,000 km², Burgess *et al.* 1998). The other population occurs in degraded submontane and montane forest from about 1,750 m a.s.l. to at least 2,450 m a.s.l. in the Southern Highlands of southwestern Tanzania. This population occupies two forested areas: Mount Rungwe and Livingstone (designated Rungwe-Livingstone) (09º07′–09º11′S, 33º36′–33º55′E, about 562 km², including Kitulo Plateau).

Some *L. kipunji* on Mount Rungwe are living at a higher elevation (2,450 m a.s.l.) than reported for other populations of *Lophocebus* spp. The low temperature at 2,450 m a.s.l. in Rungwe-Livingstone can reach –3ºC, and rainfall can total 2,900 mm annually, the highest in Tanzania. Both Ndundulu and Rungwe-Livingstone experience distinct wet and dry seasons, with the driest months from June through October.

Only three groups of *L. kipunji* have been confirmed in Ndundulu, and these occur in an area of about 3 km². The total geographic range of *L. kipunji* at Ndundulu is unlikely to be more than 50 km². Sixteen groups of *L. kipunji* have been located in Rungwe-Livingstone (Davenport *et al*. 2006), spread over an area of about 70 km². The range in Rungwe-Livingstone is fragmented, with the two main areas connected by the narrow Bujingijila Forest Corridor, which is being degraded. The subpopulations in Livingstone are separated by as much as 20 km (Fig. 2). Neither the Ndundulu population nor the Rungwe-Livingstone population is likely to consist of more than 500 animals each. The world population of *L. kipunji* is, therefore, very likely far fewer than 1,000 individuals (Jones *et al.* 2005).

At Ndundulu, the submontane forest is pristine, with trees often reaching a height of 30 m, some over 40 m. The dominant tree is *Parinari excelsa.* Other trees (and shrubs) present include *Bersama abyssinica*, *Cassipourea gummiflua*, *Cola stelecantha*, *Craterospermum longipedunculatum*, *Dicranolepis usambarica*, *Ixora scheffleri*, *Myrianthus* sp., *Oxyanthus speciosus*, *Piper capense*, *Psychotria* sp., *Strombosia scheffleri*, *Strychnos* sp., *Tarenna pavettoides*, *Tarenna quadrangularis*, *Uvariopsis* sp., *Vitex amaniensis*, and *Zanthoxylum gilletii.*

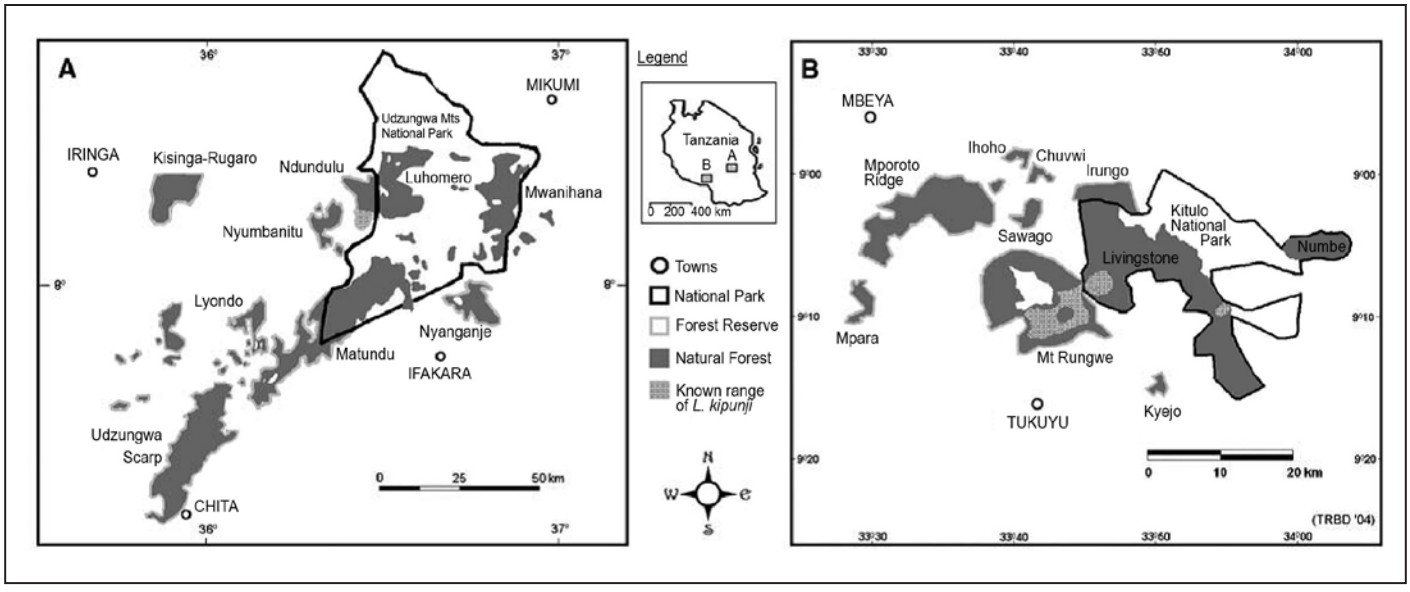

Figure 2. Maps of the known range of the highland mangabey, *Lophocebus kipunji*, in Ndundulu Forest, Udzungwa Mountains (A), and Rungwe-Livingstone Forest in the Southern Highlands, Tanzania (B). *Science* journal provided permission to reprint the maps, first published in Jones *et al.* (2005)

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The submontane and montane forest habitat of *L. kipunji* in Rungwe-Livingstone is severely degraded, with significant areas of broken canopy and secondary forest, thick undergrowth, and few tall trees. Here, some of the more common trees are *Agauria salicifolia*, *Albizia gummifera*, *Aphloia theiformis*, *Bersama abyssinica*, *Chrysophyllum gorungosanum*, *Ficalhoa laurifolia*, *Ficus thonningii*, *Ilex mitis*, *Macaranga kilimandscharica*, *Maesa lanceolata*, *Myrianthus holstii*, *Myrica salicifolia*, *Neoboutonia macrocalyx*, *Nuxia congesta*, *Parinari excelsa*, *Pittosporum viridiflorum*, *Podocarpus latifolius*, *Polyscias fulva*, *Prunus africana*, *Syzygium guineense*, and *Trichocladus ellipticus* (see McKone and Walzem 1994).

Survey work to more precisely determine the distribution and abundance of *L. kipunji* is continuing both at Ndundulu (T. Jones pers. comm.) and Rungwe-Livingstone (T. Davenport pers. comm.).

The forest of the Udzungwas and the Southern Highlands are rich in endemic and threatened species of plants and animals. Within the Udzungwas, Ndundulu is especially important for the long-term survival of the Udzungwas' two endemic birds — the Udzungwa forest partridge (*Xenoperdix udzungwensis*, an Endangered species of a monospecific genus) and the rufous-winged sunbird (*Cinnyris rufipennis*), Vulnerable. At least seven other globally threatened species of birds are also present (Dinesen *et al.* 2001; Baker and Baker 2002).

Ecology and Behavior

Lophocebus kipunji is predominantly arboreal, only rarely going to the ground. It occupies mid- and upper-canopy, retreating to the high canopy and becoming still and quiet when disturbed from the ground. The highland mangabey may be substantially frugivorous in diet, eating both ripe and unripe fruit. Preliminary observations in both Ndundulu and Rungwe-Livingstone indicate that *L. kipunji* also feeds on shoots, leaves, flowers, bark, moss, lichen, and invertebrates (Jones *et al.* 2005; Davenport *et al.* 2006). In Rungwe-Livingstone, where there is significant encroachment by agriculture, the mangabeys also raid crops such as maize, beans, and sweet potatoes (Davenport *et al.* 2006).

Social structure is multimale. Group size is not well known for Ndundulu; rough counts of two groups in this forest produced estimates of 12 and 17 animals (C. Ehardt unpubl. data). Davenport *et al.* (2006) reported group sizes of 30–36 individuals (mean = 32.3, n = 3) for Rungwe-Livingstone. If the observed group size differences between the Ndundulu and Rungwe-Livingstone populations are eventually confirmed, they may be related to the effects of severe habitat degradation and loss in Rungwe-Livingstone. Results of a preliminary study indicate that the mean home range size for five groups in Rungwe-Livingstone is 54 ha (range = 24–99 ha) (Davenport *et al*. 2006).

In Ndundulu, *L. kipunji* associates with three other diurnal, arboreal monkeys: Peter's Angola colobus (*Colobus angolensis palliatus*), Moloney's white-collared monkey (*Cercopithecus mitis moloneyi*), and Udzungwa red colobus (*Procolobus gordonorum*, Vulnerable, IUCN 2006) (C. Ehardt unpubl. data). Sympatric, diurnal, arboreal monkeys in Rungwe-Livingstone include *C. a. palliatus* and *C. m. moloneyi*; *L. kipunji* forms associations with these species, including sleeping in neighboring trees (Davenport *et al.* 2006).

Lophocebus kipunji has a number of vocalizations, including the "honk-bark" loud call given by adults when they meet conspecific groups. This suggests that the "honk-bark" is functionally similar to the "whoop-gobble" of other mangabeys in facilitating group spacing (Waser 1982; Range and Fischer 2004). In Ndundulu, *L. kipunji* also emits a high-pitched, sharply abbreviated "chirp," possibly an alarm call, heard, as it is, when crowned eagles (*Stephanoatus coronatus*) call or soar above (C. Ehardt unpubl. data). The crowned eagle — Africa's 'monkey-eating eagle' — is common in the Udzungwas, being heard or seen virtually daily. Crowned eagles are probably the most significant predator of arboreal monkeys in Africa, including *L. kipunji* in the Udzungwas and the Southern Highlands. Other vocalizations include "screams" given during intragroup agonistic encounters, "chutters" given within groups when foraging, and "squeals" (C. Ehardt unpubl. data). A prolonged series of continuous, high-pitched squeals was given by an adolescent mangabey as it moved rapidly through the trees and bridged a river in pursuit of the rest of its group, which had already crossed and moved about 100 m distance onto a ridge (C. Ehardt unpubl. data).

Conservation Assessment and Recommendations

Assessment of the conservation status and the development of conservation activities are guided by full taxonomic designation, as well as by knowledge of the ecological factors impacting the viability of recognized taxa. The taxonomy and conservation status of African primates (Grubb *et al.* 2003) was reassessed during a workshop, *Primate Taxonomy for the New Millennium*, held in Orlando, Florida, in 2005. The workshop was organized by the IUCN/SSC Primate Specialist Group and sponsored by the Disney Institute. Through the workshop assessments the mangabeys emerged as one of two groups of African monkeys that are broadly and significantly threatened, as well as characterized by considerable debate about their taxonomic distinctions. With funding from the Critical Ecosystem Partnership Fund, the authors are compiling two sets of data that will contribute to further resolution of mangabey taxonomy: fecal samples are being collected for molecular analyses (phylogenetic and population, in collaboration with Todd Disotell at New York University and Jeffrey Rogers at the Southwest National Primate Research Center), and recordings of vocalization are being obtained for sonographic analyses (in collaboration with Jean-Pierre Gautier of Université de Rennes, Station Biologique). These data will be correlated with the existing morphometric data (Groves 2001; Fleagle and McGraw 1999, 2002) in an effort to bring greater resolution to mangabey taxonomy, including that of *L. kipunji*. Not only are these studies important for addressing debates

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about generic and species designations for the mangabeys overall, and for identifying novel patterns of genetic diversity important to conservation policy, they will also address the complex phylogenetic, phylogeographic, and theoretical issues surrounding the *Lophocebus-Papio-Theropithecus* and *Cercocebus-Mandrillus* clades.

Irrespective of its final taxonomic designation, *L. kipunji* is classified as Critically Endangered under criteria B1ab(iii) (IUCN 2006). The extent of occurrence (both populations combined) is believed to be less than 100 km² (B1); the species is fragmented (B1a) into two populations that are about 350 km apart, and one of these is further fragmented into subpopulations; and the extent and quality of habitat continues to decline (B1b(iii)), significantly so in Rungwe-Livingstone.

The most significant threat to *L. kipunji* is the destruction of its forest habitat, a process that has proceeded virtually unabated in Rungwe-Livingstone for many years. Agricultural encroachment coupled with illegal logging, charcoal production, and hunting, continue to degrade and destroy the forests of the Southern Highlands. Forest loss is also such that the narrow Bujingijila Forest Corridor that joins Mount Rungwe to Livingstone is on the verge of disappearing, and links between sites in Livingstone are also threatened. Loss of these connections will further fragment the Rungwe-Livingstone population, making it increasingly unlikely to survive over the long term (Davenport *et al.* 2006). One result of the degradation and loss of habitat is probably an increase in the rate of crop-raiding by *L. kipunji*. This will further exacerbate the threat as farmers attempt to protect their crops using traps and other means. As the habitat declines, hunting pressure will also increase, as poachers focus on the few large mammals that remain.

Mount Rungwe is designated a Forest Reserve by Tanzania, although the level of protection is not congruent with even this official status. Either the protected status of Rungwe must be elevated and enforced immediately, or other means must be found to effectively manage the Mount Rungwe Forest. The Livingstone Forest is now within the recently gazetted Kitulo National Park. The main impetus for establishing this park, however, was protection of the Kitulo Plateau, not the Livingstone Forest. It is essential for the Tanzania National Parks (TANAPA) to rapidly and effectively address the ongoing pressures in Livingstone Forest in order to prevent extirpation of *L. kipunji*. A critical component of protection should be the initiation of systematic, long-term monitoring of the Rungwe-Livingstone Forest. This must, however, be preceded, with great haste, by effective law enforcement to remove the most immediate and significant threats.

The situation in Ndundulu is not as critical as it is in Rungwe-Livingstone, although the *L. kipunji* population in this forest reserve is already extremely small. The Danish ornithologists who conducted extensive bird surveys in Ndundulu in the early 1990s (Dinesen *et al.* 1994, 2001) had only three chance sightings of *L. kipunji* over the many months they spent camping and intensively working in the forest. (Our Danish colleagues were the first to discover *L. kipunji,* in Ndundulu, although their ornithological expertise did not permit recognition that this was a new species of primate. It also was the precise locations of their sightings of what they presumed to be the Sanje mangabey, provided to us by Lars Dinesen and Thomas Lehmberg, that were directly responsible for the subsequent location and identification of the new species in Ndundulu.) Although ongoing survey work (by T. Jones and C. Ehardt) may locate additional groups beyond the three currently confirmed in Ndundulu, it is likely that the population will be found to comprise far fewer than 500 individuals, and quite possibly fewer than 100.

The habitat destruction and hunting that are seriously affecting the Rungwe-Livingstone population are not significant in Ndundulu, although Wahehe people from the village nearest to the forest (Udekwa) have hunted and used forest resources in the northern and western areas of Ndundulu. We have encountered poachers during fieldwork in other forest reserves in the Udzungwas, and even in the adjacent forest (Mt. Luhombero) within the Udzungwa Mountains National Park (UMNP). There is concern that if Ndundulu's protective status is not upgraded, the risks to the already small population of *L. kipunji* will remain, or increase. TANAPA has indicated willingness to extend the boundaries of UMNP and officially take responsibility for protecting Ndundulu. TANAPA is currently sending rangers to patrol Ndundulu, with sanction from the Division of Forestry and Beekeeping. The regional and district forestry offices are also working closely with the people in Udekwa village who now have official responsibility for community-based management of Ndundulu. Fees to enter Ndundulu for research or tourism are collected by the Village and deposited in a bank account designated for this purpose by the district forestry office in Iringa. The village chairman and committees propose how these funds might be used for community activities. These proposals are subject to approval by forestry officials.

Tanzania requires that communities responsible for management of forest resources consider and approve any change in protective status of the forests, such as incorporation into national parks that are managed and controlled by TANAPA. Although we and others working in the Udzungwas have been encouraging the Ministry of Natural Resources and Tourism to further ensure effective and long-term protection of Ndundulu's flora and fauna (including a number of endemic species) by incorporating it into UMNP, the newly expanded efforts at community-based conservation may work against this proposal. What will be required in this new context are sufficient monitoring data, vigilance, and oversight to assess the policy's efficacy and to ensure sustainability of Ndundulu's biodiversity.

Lophocebus kipunji is Critically Endangered. Its existence is threatened by continued and severe degradation and loss of its forest habitat, by habitat fragmentation, and by hunting. In efforts to reverse these threats, the research and conservation activities outlined above will continue with, we hope, the sustained support of donor organizations and that of the Tanzanian people.

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