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The Critically Endangered kipunji *Rungwecebus kipunji* of southern Tanzania: first census and assessments of distribution and conservation status

Running header:

Conservation status of kipunji

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The Critically Endangered kipunji *Rungwecebus kipunji* of southern Tanzania: first census and assessments of distribution and conservation status

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Abstract

We present the first assessments of the population, distribution and conservation status of the recently-described kipunji *Rungwecebus kipunji*, in forests in the Southern Highlands and Udzungwa Mountains of southern Tanzania. Surveys totalling 2864 hours and covering 3456 km of transect were undertaken to determine distribution and group numbers. Thereafter, 772 hours of simultaneous multi-group observational follows in Rungwe-Kitulo and Ndundulu forests enabled 209 total counts to be carried out. A sweep census was also employed in Ndundulu. We estimate some 1042 individuals in Rungwe-Kitulo, ranging from 26 to 39 individuals per group ($\mu = 30.65$; SE = 0.62; n = 34). In Ndundulu, we estimate 75 individuals, ranging from 15 to 25 individuals per group ($\mu = 18.75$; SE = 2.39; n = 4). We estimate a total kipunji population of 1117 animals in 38 groups, with 15 to 39 animals per group ($\mu = 29.39$; SE = 0.85; n = 38). The Ndundulu population may no longer be viable and the Rungwe-Kitulo population is highly fragmented with isolated sub-populations remaining in degraded habitat. We recorded areas of occupancy within Rungwe-Kitulo of 1079.4 ha and in Ndundulu of 198.6 ha,

giving a total of 1277.9 ha. We estimate the species' extent of occurrence to be 1769.1 ha, with 1240.8 ha in Rungwe-Kitulo and 528.3 ha in Ndundulu. We believe kipunji faces an extremely high risk of extinction in the wild and recommend the species and genus be classified by the IUCN Red List as 'Critically Endangered' CR A3cd; B1ab(i,ii,iii,iv,v).

Introduction

The recent discovery of the kipunji *Rungwecebus kipunji*, a new genus and species of monkey endemic to southern Tanzania (Jones *et al*., 2005; Davenport *et al.*, 2006), demonstrated how much there is still to learn of Africa's montane forests. Kipunji were first located and identified as a new taxon by teams working in the Southern Highlands and Udzungwa Mountains of Tanzania in 2003 and 2004, respectively (Jones *et al.*, 2005; Davenport, 2005; 2006; Davenport & Jones, 2005; Davenport *et al.,* 2005; 2006). The new taxon was initially placed in the genus *Lophocebus* (Jones *et al.*, 2005), the so-called baboon-mangabeys (Groves, 2001), however, a year later molecular and morphological analyses of a male kipunji killed by a farmer on Mount Rungwe led to the placement of kipunji in a new monospecific genus *Rungwecebus*, making it the first new genus of African monkey to be described in 83 years (Davenport *et al*., 2006).

Kipunji are large, group-living, forest-dependent and primarily arboreal monkeys, though on Mount Rungwe they do leave the forest on the ground to raid crops (Davenport, 2005; Davenport *et al*., 2005; 2006). They are a highland species, found in submontane and montane forest between 1300 and 2450 m (Davenport *et al.,* 2006) where they form multi-male groups often associating with other monkey species present: Udzungwa red

colobus *Procolobus gordonorum*, black-and-white colobus *Colobus angolensis*, and Sykes' monkey *Cercopithecus mitis* in the Udzungwa Mountains; *C. angolensis* and *C. mitis* in the Southern Highlands (Davenport & Jones, 2005; Davenport *et al.*, 2005). The diverse diet of kipunji includes ripe and unripe fruit, seeds, young and mature leaves, bark, lichen, moss and invertebrates (Davenport *et al.*, 2005; 2006; Davenport & Butynski, in press).

Despite the identification of two discrete populations, and the lack of data about the monkey's full range (Jones et al., 2005), we speculated that the kipunji may be severely threatened (Davenport, 2005). However, in order to implement appropriate conservation measures, we needed first to determine the full extent of the kipunji's distribution and abundance in both areas. We therefore carried out systematic investigations to provide quantifiable information for the first empirical assessment of the monkey's conservation status, both for the purposes of conservation in Tanzania, and in order to categorise kipunji for the first time on the IUCN Red List (IUCN, 2006).

Forest primates are notoriously challenging to survey accurately and a range of techniques has been suggested (Brockelman & Ali, 1987; Whitesides *et al.*, 1988; Rovero *et al.*, 2006; Plumptre & Cox, 2006). The cryptic nature of kipunji, its scarcity, fear of humans and predilection for the high canopy of montane forest exacerbate the difficulties. Nevertheless, on the basis of our experience in the field with the species and habitats, we selected the most accurate and comprehensive methods possible for meeting three primary objectives. These were; 1) to determine the full distribution of kipunji; 2) to

census the total population of the species and; 3) to provide the first comprehensive and quantitative assessment of the kipunji's conservation status.

Study area

This study was carried out in two forested areas 350 km apart. In the Southern Highlands, the sites were the Kitulo National Park (KNP; comprising the Kitulo Plateau and adjacent Livingstone and Numbi forests) 9^{0}00'-9^{0}16'S; 33^{0}43'-34^{0}03'E; as well as the forest reserves of Mount Rungwe 9º03'-9º12'S; 33º35'-33º45'E; Sawago 9º00'-9º03' S; 33º38'-33º40'E; Irenga 8º57'-9º00' S; 33º41'-33º43'E; Irungu 8º58'-9º00'S; 33º43'-33º47'E; Mporoto Ridge 8º58'-9º05'S; 33º26'-33º36'E; Madehani 9º18'-9º19'S; 34º03'-34º04'E; and Ndukunduku 9º06'-9º11'S; 34º03'-34º13'E. In the Udzungwa Mountains, the sites were Ndundulu and Nyumbanitu forests within the West Kilombero Scarp Catchment Forest Reserve (WKSCFR) 7º05'-7º08'S; 36º22'-36º27'E; and Luhomero forest within the Udzungwa Mountains National Park (UMNP) 7º03'-7º07'S; 36º27'-36º38'E. The habitats comprise submontane, montane, upper montane and bamboo forests between 1300 and 2500 m (Lovett & Pócs, 1993; McKone & Walzem, 1994).

Methods

Different methods were employed to determine total distribution and abundance. Distribution data were collected from May 2003 to September 2006 using presence /absence surveys. Census data were recorded between November 2005 and September 2006 using total counts made during group follows in Rungwe-Kitulo and Ndundulu, and an additional 7-day adapted sweep census in Ndundulu in March 2006.

Presence/absence surveys

Forests were selected for presence/absence surveys based on our prior knowledge of the areas, existing information from previous surveys, village interviews, and the habitat type, quality and altitudinal range from which kipunji were already known. The amount of survey effort at each site was largely proportional to the area being surveyed (Krebs, 1999). At each site, between two and five pairs (teams) of observers concurrently searched for kipunji along separate pre-planned routes using 1:50,000 topographic maps (Tanzania Surveys and Mapping Division, Series Y742), Garmin GPS units and binoculars. Only sightings were considered as positive presence. All animals identified by vocalisations were verified by sightings. New areas were surveyed each day, adjacent to the area covered the previous day. Some areas were revisited if they contained a high density of fruiting trees and other primates or if inclement weather had hindered earlier work. Survey routes followed wildlife trails, human tracks and off-track in order to survey a large area thoroughly. Each team walked slowly and quietly scanning the understorey and canopy for monkeys, and covering 1 - 2 km per hour, between 0650 and 1830 hrs. Surveying was paused in heavy rain. When an individual or group was detected, the observer remained until s/he was confident s/he had identified the species present. For all primates encountered, the species, group size estimate and location were recorded.

Census

In order to ascertain the total kipunji population as accurately as possible, we adopted the 'complete count' method, widely accepted as being the most accurate primate census technique (Plumptre & Cox, 2006). To further increase accuracy levels, we based our

collection methods on direct observations of individual animals only, thereby adapting the gorilla census methods developed by Harcourt & Fossey (1981) and McNeilage *et al.* (2001; 2006), who carried out complete counts of indirect sign. In this way, we aimed to arrive at a population number that was neither an estimate nor extrapolation based on density, but an absolute figure.

To count all individuals directly within every group, we aimed to locate and follow every kipunji group for a minimum of five consecutive days tracking all movements and distances with a GPS. Once a team located a group, it remained with it at a distance that enabled the team to maintain contact, but that minimised stress on the group (Cipoletta, 2003). Grid reference positions of the group were recorded routinely by GPS every 15 minutes. In addition, all observation data were geo-referenced and accompanied with a distance (m) and compass bearing between the observers and the animals. During the follows, the numbers of individuals in each group were counted daily, whenever the chance arose. The person counting was always the same in each team, reducing errors due to change of observers. In any particular forest block, kipunji groups were considered unique if 1) they were seen at the same time by different observation teams, spending more than 75% of the observation time at a distance of at least 300 m apart. This was verified *a posteriori;* 2) One team sees a group other than the one they are following, at least 400 m away, and later verifies that no other team had been near the group(s); 3) the groups were recorded more that 300 m apart, at the same time, and subsequently moved in different directions. In cases where there was any doubt, at least two teams returned to the locations at a later date to verify group identity.

In Ndundulu it is especially hard to locate and count kipunji due to the pristine nature of the forest and its higher and more closed canopy. We therefore also carried out an intensive sweep census to verify population size (Jones, 2006), a method facilitated by the relatively small area under consideration. Following the presence/absence surveys, we censused an area of 11 km^2 encompassing more than their known total extent of occurrence. Over seven consecutive days, three teams (2 observers each) walked parallel pre-planned linear reconnaissance transects between 100 and 300 m apart. As much as the terrain would allow, and using compass and GPS units, the teams followed the same direction but taking the path of least resistance when necessary, rather than cutting through thick understorey (Hall *et al*., 1998). When a monkey was detected, an observer left the transect in order to observe it, before returning to the transect and continuing along the same bearing. Teams walked transects and collected data in the same way as in the presence/absence surveys. Observers checked on each others' positions at pre-arranged times every two hours using walkie-talkie radios (Cobra Microtalk, USA). Each day, the observers shifted to an adjacent area and no areas were visited more than once.

Occupancy and occurrence

To provide the most accurate and appropriate estimate of total species range, we used an ArcView (ESRI, California) Geographic Information System (GIS) to plot and analyse all observation data from all groups recorded in the survey and census work. In Rungwe-Kitulo these data permitted a calculation of the area of occupancy, defined as the area within the species' extent of occurrence which is occupied by a taxon, excluding cases of

vagrancy (IUCN, 2006). The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may contain unsuitable or unoccupied habitats. Indeed, this is probably true for kipunji in the heavily degraded forests of Rungwe-Kitulo.

We used the Grid Method of area of occupancy representation and calculation (Horner & Powell, 1990; Zoellick & Smith, 1992; Powell, 2000), whereby a grid of individual cells is overlain on top of the animal observation points. As the size of the area of occupancy should be at a scale appropriate to relevant biological aspects of the taxon (IUCN, 2006), cell size should take into account, objective information about the radius of an animal's perception and knowledge for all the location data (Powell, 2000). As cell size is fundamental in analyses using grids (Vandermeer, 1981), we empirically calculated a cell size of 190 x 190 m based on our data of kipunji's daily movements (De Luca *et al.*, in press). Any grid cell which contained an observation point was thus included in the area of occupancy calculations, and the totals for each group summed.

A taxon's extent of occurrence is defined as the area contained within the shortest continuous boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon (IUCN, 2006). We estimated the extent of occurrence for kipunji by calculating the area of minimum convex polygons constructed around all areas of occupancy, using GIS. As this measure may exclude discontinuities within the overall distribution such as areas of unsuitable habitat (IUCN, 2006), in Rungwe-Kitulo the polygons were developed around neighbouring and overlapping

kipunji groups only and did not include heavily degraded forest between group clusters with no kipunji records.

Results

Presence/absence

Table 1 illustrates the search effort at each site between 2003 when the kipunji was first sighted during biodiversity inventories (Davenport, 2005; Jones *et al.*, 2005) and September 2006. The total number of team hours spent surveying at each site, the effort undertaken (km and hours), and whether kipunji were observed, are provided. A total of 3456 km were walked, with 3009 km and 447 km in the Southern Highlands and Udzungwa Mountains, respectively. A total of 2864 team hours (2497 and 367) were spent searching for the animals.

The surveys reveal that the kipunji appears to be restricted to a number of discrete portions of the forests of Mount Rungwe and the adjacent Livingstone (within KNP) in the Southern Highlands, and the Vikongwa area of the Ndundulu forest in the Udzungwa Mountains (see Figs 1 & 2). Despite extensive surveys, kipunji were not recorded (and are presumed to be absent) from the forest reserves of Sawago, Irenga, Irungu, Mporoto Ridge, Madehani and Ndukunduku, Nyumbanitu forest within WKSCFR, and the forests of Numbi and Luhomero in KNP and UMNP, respectively. Kipunji have not been recorded within UMNP, the closest record being a group 1.89 km outside the park boundary. The absence data are further supported by our socio-economic surveys and conservation work in the villages that are immediately adjacent to all the forests

mentioned above. None of the villages, environment committees, hunters or scientists with knowledge of the forests where kipunji were not observed, claimed any observations to the contrary (Machaga *et al.,* 2005; Jones, 2006).

Census

During the census between January and September 2006, a total of 1025 km were walked and 1238 hours spent following kipunji in Rungwe-Kitulo. We collected 2118 spatially-referenced field observations, representing a total of 149 group 'follows'. A total of 34 kipunji groups were identified. Some 205 counts were made of the 34 groups and the maximum counts are given in Table 2. We estimate a total of 1042 individuals in the Southern Highlands with a mean of 30.65 individuals per group (SE = 0.62; n = 34), ranging from 26 to 39 individuals per group. Of these, 501 individuals in 16 groups were counted in Rungwe and 541 individuals from 18 groups within the Livingstone forest of KNP. In Ndundulu, in the course of the seven-day census, 61.3 km were walked over 132.5 hours; 49 additional hours were spent following the 4 groups that were identified. We estimate a total of 75 animals with a mean of 18.75 individuals per group (SE = 2.39; n = 4), ranging from 15 to 25 individuals per group. We estimate therefore, a total kipunji population of 1117 animals, based on 209 counts of 38 groups during 772 hours of group follows, with a mean of 29.39 animals per group (SE = 0.85; n = 38), and group size ranging from 15 to 39 individuals. There was a clear and significant difference ($t = 4.81$; $df = 3$; $p = 0.017$) in the mean group size, between the Rungwe-Kitulo and the Ndundulu populations.

Occupancy and occurrence

The surveys and group follows permitted a determination of kipunji's area of occupancy, based on all observations made in the grid squares. We calculated areas of occupancy within Mount Rungwe of 671.5 ha, within the Livingstone Forest of KNP of 407.9 ha and within Ndundulu of 198.6 ha. The total for Rungwe-Kitulo therefore was 1079.4 ha, and the total species area of occupancy was 1277.9 ha based on all data collected over three years (Table 3). We estimate the extent of occurrence for kipunji for Mount Rungwe to be 815.4 ha, for Livingstone to be 425.4 ha, and for Ndundulu to be 528.3 ha. The total for Rungwe-Kitulo was 1240.8 ha and the total species extent of occurrence we estimate on present data to be 1769.1 ha.

Determining group home range size depends upon an understanding of the extent of overlap between groups, and is the subject of another publication (De Luca *et al.,* in press). However, a raw estimate of density derived from the census data and the estimated extent of occurrence gives 83.9 individuals per km^2 in Rungwe-Kitulo, and 14.2 individuals per km^2 in Ndundulu (Table 3). The combined species density (within their extent of occurrence and excluding home range overlaps) is 63.1 kipunji per km^2.

Discussion

Whilst extrapolative estimates of population size and speculative discussions on the range of kipunji have been made (Jones *et al.*, 2005; Davenport *et al.*, 2006), the results presented in this paper provide the first systematically derived data on the abundance and distribution of this new species and genus.

Many methods have been developed for censusing primate populations (Brockelman & Ali, 1987; Plumptre & Cox, 2006), and whilst line transect methods have become the most widely used for most species (Struhsaker 1981, 2002), there is still debate about data analysis and accuracy (Plumptre & Reynolds, 1996, Struhsaker, 1997; Buckland *et al.*, 2003; Plumptre & Cox, 2006; Rovero *et al.,* 2006). Given the conservation importance of the kipunji and the resources at our disposal, we performed a complete count after a long-term survey, thereby ensuring a much more accurate population estimate. Kipunji are shy, rare and primarily arboreal (Jones *et al.*, 2005; Davenport *et al.*, 2006; Davenport & Jones, 2005). However, the considerable effort undertaken in the surveys, our knowledge of the animal especially that gained during continuous study over two years, and supporting information provided by socio-economic research (Machaga *et al.,* 2005; Jones, 2006) all provide additional confidence in the accuracy of the data.

Meanwhile, the complete count method used to determine abundance, depends on locating every group and ensuring that each identified group is unique. The survey protocol carried out during the presence/absence surveys, the subsequent group follows, our knowledge of the forests concerned and remote sensing analyses used to determine habitat type and quality, all further support our contention that all currently existing groups in the Southern Highlands have been located. It is possible that there are groups in or near Ndundulu that remain undetected, although given the wide-ranging surveys and background research undertaken (Jones, 2006), it is, in our judgement, unlikely that there are many more.

A total population of just 1117 animals is extremely small. The status of the population in Ndundulu is particularly alarming, and given current thinking on primate population sizes (Harcourt, 2002), it may be that the Ndundulu population is no longer viable. The causes of this are as yet unclear and are currently being investigated. As previously reported, both the Rungwe and Livingstone forests are heavily degraded (Davenport, 2005; 2006; Davenport & Jones, 2005). The extent of connection between the various sub-populations is unknown, although based on remote sensing analysis of forest cover it is probably limited (Davenport *et al.*, in prep). Interestingly, the difference in mean group size between the Rungwe-Kitulo and the Ndundulu populations is statistically highly significant. This intra-specific variation is the subject of on-going research, however, it may be linked to the small total population size in Ndundulu, or to fragmentation, reduced resource patches and food availability in Rungwe-Kitulo, as demonstrated in other species (Chapman *et al.*, 2002; 2003; Struhsaker *et al.*, 2004).

Despite considerable survey effort, we were unable to extend the known range of the animal. Moreover, it would seem that kipunji is much more sparsely distributed than initially thought (Jones *et al.,* 2005). The total area of occupancy achieved by the sum of the occupied grid squares is just 12.78 km^2 and the total extent of occurrence (species range) is just 17.69 km^2. The very small extent of occurrence in Ndundulu and the patchy distribution in Rungwe-Kitulo give grounds for considerable conservation concern, not least because these data refer to a genus as well as a species.

The most important factor in assessing population and distribution is to indicate and quantify species rarity and extinction risk (Cowlishaw & Dunbar, 2000). According to IUCN (2006), a taxon is threatened when the best available evidence indicates that it meets any one of a number of criteria. The data reported here demonstrate a total extent of occurrence considerably less than 100 km², and estimates indicating severely fragmented sub-populations and a continuing decline, observed, inferred and projected, in the extent of occurrence; area of occupancy; area, extent and quality of habitat; the number of locations or subpopulations; and the number of mature individuals. Furthermore, we suspect a population size reduction of ≥80% to be met within the next 10 years, based on a decline in area of occupancy, extent of occurrence and quality of habitat, and the actual levels of exploitation from trapping by farmers (Davenport & Jones, 2005). As a consequence, we suggest an IUCN Red List assessment for kipunji of 'Critically Endangered' CR A3cd; B1ab(i,ii,iii,iv,v), with the species and genus facing an extremely high risk of extinction in the wild. This places the kipunji as the most threatened species of primate on the African mainland, alongside the Critically Endangered Tana River red colobus *Procolobus (r.) rufomitratus* (IUCN, 2006; Karere *et al.,* 2004). Moreover, *Rungwecebus* becomes the most threatened primate genus in Africa.

An estimated 541 individuals reside within the Livingstone Forest of Kitulo National Park. Recently, park management has begun, although the forest is severely degraded and fragmented (Davenport, 2006) and some of the kipunji sub-populations may already be isolated. Meanwhile, more than 51% of the total kipunji population lives in forest reserves with little management. Immediate focus should be applied to Mount Rungwe,

where edge effects, continued logging and a lack of corridors pose greater threats. Across Rungwe-Kitulo, the small, isolated sub-populations may be subject to a loss of genetic variability due to low effective breeding populations and the potential deleterious effects of inbreeding (Frankham, 2002). Whilst Ndundulu is in excellent condition due chiefly to its remote location (Davenport & Jones, 2005), the long-term viability of this 6.7% of the population must be considered uncertain at best, although whether any conservation measures could or should be applied in a largely undisturbed habitat is a moot point. The focus of current kipunji conservation work is the protection and restoration of the montane habitats of Mount Rungwe, research into the reasons for, and viability of, the extremely small Udzungwa population, conservation education and long-term monitoring.

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Biographical sketches

Tim Davenport has lived and worked in the UK, Uganda, Cameroon and Malawi, and is now Tanzania Country Director for the Wildlife Conservation Society (WCS). He has broad conservation interests and set up the WCS Southern Highlands Conservation Programme (SHCP) in 2000. He led the team which first discovered the kipunji in 2003.

Daniela De Luca is Technical Advisor for the WCS's SHCP. She has been carrying out research in Africa since 1990 and has worked in Uganda and Tanzania. She specializes in carnivore biology, threats, conservation and monitoring, but has also worked on primates, elephants, flamingos and dugongs, and managed conservation and development projects.

Trevor Jones has been working in the Udzungwas since 2002. He carried out the first ecological study of the Sanje mangabey, found kipunji in Ndundulu in 2004, and has worked on elephant corridors and community-based ecological monitoring. He is now studying predictors of large mammal distribution across the Udzungwas, and runs a long-term monitoring programme of threatened seabirds in northwest Scotland.

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Tables

Table 1. Total number of team hours spent, kilometres (km) walked and altitudinal range (m) covered in kipunji presence/absence surveys and group follows from 2003 to 2006, and kipunji presence (√).

Year(s)	Area	Distance (km)	Team hours	Altitude (m)	Kipunji presence
	Southern Highlands				
2003, 2004, 2005, 2006	Livingstone West	277	235	1610-2790	√
2003, 2004, 2006	Rungwe North	861	545	1520-2660	
2003, 2004, 2004, 2006	Rungwe South	879	884	1250-2980	√
2003, 2005	Mporoto	18	18	1500-2620	
2004	Numbi	73	69	2500-2730	
2004	Kitulo Plateau	38	17	1570-2920	
2004, 2005	Livingstone East	79	68	2110-2900	
2004, 2005	Livingstone North	185	149	1980-2890	
2004, 2006	Livingstone South	417	319	1820-2780	√
2005, 2006	Madehani	123	65	1670-2790	
2005	Irungu/Irenga	35	80	2580-2700	
2006	Ndukunduku	24	48	2200-2740	
	Total	*3009*	*2497*	*1250-2980*	
	Udzungwa Mountains				
2006	Luhomero South	69	57	1390-2000	
2006	Ndundulu South	69	57	1400-1790	
2006	Luhomero Central	18	15	2000-2500	
2005, 2006	Ndundulu Central	7	5	1800-2050	
2006	Nyumbanitu	28	22	1400-1800	
2005, 2006	Ndundulu East	87	71	1300-2000	
2005, 2006	Luhomero West	32	27	1700-2000	
2005, 2006	Ndundulu Vikongwa	137	113	1300-1800	√
	Total	*447*	*367*	*1300-2500*	
	GRAND TOTAL	**3456**	**2864**		

Table 2. Group identity number (ID), maximum number of individuals counted (∑), number of counts made per group (n) and number of hours spent per group follow (F) in Rungwe-Kitulo and Ndundulu.

ID	Count ∑	n	F (hrs)	Gp #	Count	n	F (hrs)	Gp #	Count	n	F (hrs)
Southern Highlands (SH)								**Ndundulu (Nd)**			
1	33	2	26.13	20	36	2	12.50	35	15	1	5
2	30	20	47.00	21	33	19	44.63	36	15	1	2
3	27	2	11.17	22	29	10	30.03	37	20	1	33
4	33	4	49.08	23	27	4	6.55	38	25	1	9
5	38	3	42.30	24	28	2	24.37	*Total*	*75*	*4*	*49*
6	29	21	41.05	25	26	8	5.00	*Mean*	*18.75*		
7	30	2	43.78	26	32	2	11.60	*n*	*4*		
8	39	6	9.37	27	27	4	1.53	*SE*	2.39		
9	25	10	3.42	28	29	2	1.50				
10	28	8	3.20	29	30	2	4.48	**SH and Nd**			
11	29	1	3.50	30	32	3	10.62	*Total*	*1117*	209	*772*
12	30	2	32.53	31	31	2	14.00	*Mean*	*29.39*		
13	35	5	35.60	32	25	2	3.82	*n*	*38*		
14	30	14	6.25	33	26	2	16.25	*SE*	*0.85*		
15	33	10	58.02	34	30	1	16.25				
16	32	1	15.35	*Total*	*1042*	*205*	*723.22*				
17	30	10	47.83	*Mean*	*30.65*						
18	32	16	32.00	*n*	*34*						
19	38	3	12.50	*SE*	*0.62*						

Table 3. Areas of occupancy (AoO) and extent of occurrence (EoO) in hectares (ha), and the density (individuals per km^2) for Mount Rungwe, Livingstone (within Kitulo National Park), combined Rungwe-Kitulo, Ndundulu and for the entire species (Total).

	AoO (ha)	EoO (ha)	Density kipunji / km^2
Rungwe	671.5	815.4	61.4
Livingstone	407.9	425.4	127.2
Rungwe-Kitulo	1079.4	1240.8	83.9
Ndundulu	198.6	528.3	14.2
Total	**1277.9**	**1769.1**	**63.1**

Figure and plate legends

Figure 1. Map illustrating the geographical range of the kipunji (extent of occurrence) in the Rungwe-Kitulo forests of the Southern Highlands.

Figure 2. Map illustrating the geographical range of the kipunji (extent of occurrence) in Ndundulu forest of the Udzungwa Mountains.

Figures

Figure 1.

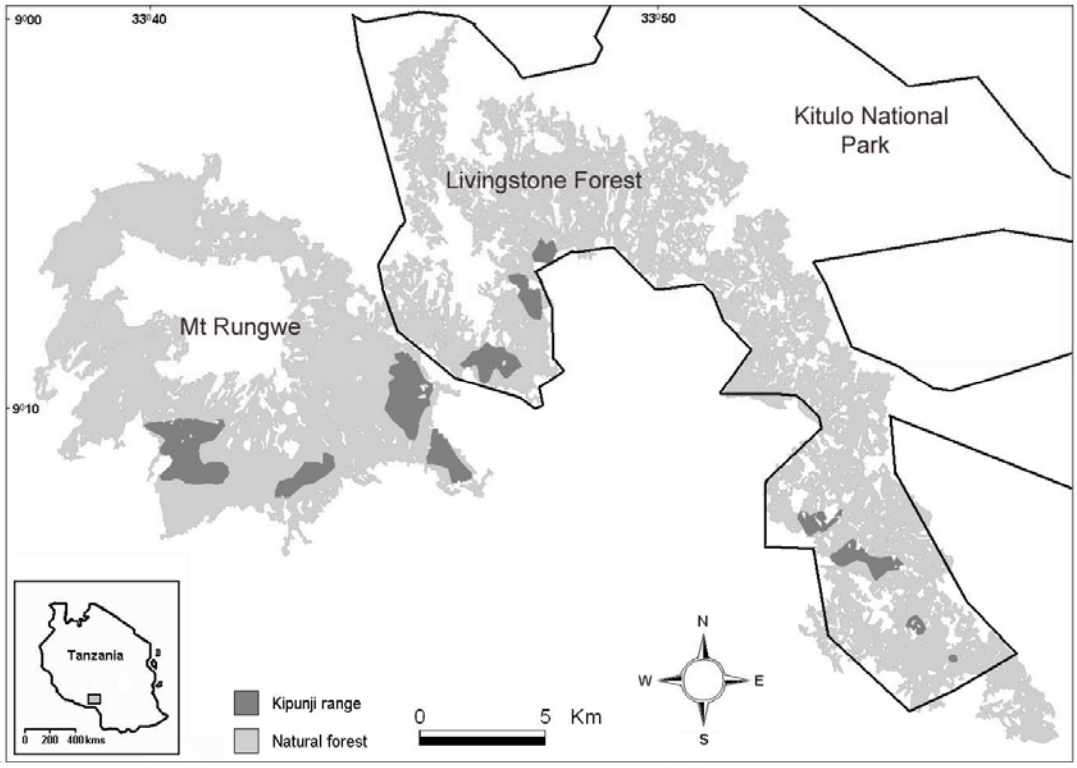

Figure 2.