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Population Sizes and Distribution of Primates in the Lower Tana River Forests, Kenya

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We studied the population size and distribution of diurnal primates in the lower Tana River forests, Kenya. They are the only remaining habitats for 2 threatened primates: the Tana River red colobus (Procolobus rufomitratus) *and the Tana River crested mangabey* (Cercocebus galeritus galeritus). *We conducted censuses in 73 forest patches from January through March 2001. We estimate population size of the red colobus to be 788 individuals in 82 groups and that of the crested mangabeys to be 2,070 individuals in 59 groups. The data suggest that over a 7-year period (1994-2001), there was an 18% increase in the crested mangabey population and a 5% decline in red colobus numbers. Further, the red colobus range has expanded both north and south, whereas that of crested mangabeys has only expanded south. Fifty-six percent of crested mangabeys and 46% of red colobus groups were inside the Tana River Primate National Reserve (TRPNR). Other primates encountered included 170 groups of Sykes' monkeys (Cercopithecus mitis), 70 groups of yellow baboons* (Papio cynocephalus) *and 4 groups of grivets* [Chlorocebus (Cercopithecus) aethiops]. *Mean group densities of the 2 endangered primates and of baboons were higher inside than outside the TRPNR, reinforcing the importance of TRPNR for their conservation. An intervention program is required to stem further decline in the red colobus population and to protect small isolated groups in forest patches outside TRPNR.*

KEY WORDS: Tana River; primate census; *Procolobus ruformitratus*; *Cercocebus galeritus galeritus*.

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INTRODUCTION

The critically endangered Tana River red colobus (*Procolobus rufomitratus* Peters, 1879) and the endangered crested mangabey (*Cercocebus galeritus galeritus* Peters, 1879) are endemic to forest patches along the lower Tana River, Kenya (IUCN, 2000; Marsh, 1976, 1978a). The need to conserve them and their unique habitat led to the creation of the 171-km^{2}Tana River Primate National Reserve (TRPNR) in 1976 (Marsh, 1976; Seal *et al*., 1991).

Due to increased community needs for forest resources and farmland, pressure for the remaining forest patches led to concern for their conservation status and that of the diverse fauna within, especially the red colobus and crested mangabeys. Over the last 3 decades, there have been 10 primates censuses to determine their distribution and demography (Andrews *et al.*, 1975; Butynski and Mwangi, 1995; Decker and Kinnaird, 1992; Groves *et al.*, 1974; Kahumbu and Davies, 1993; Kinnaird and O'Brien, 1991; Marsh, 1978b; Muoria *et al.*, 2003; Ochiago, 1991). The censuses were conducted on different numbers of forest patches; thus, results are difficult to compare. The most comprehensive census before our study surveyed 60 forest patches and recorded a decline in both red colobus and crested mangabey populations (Butynski and Mwangi, 1995).

We report results from censuses of diurnal primates conducted in 73 forest patches. We estimated the number of groups, population size, densities and distribution of 5 species in patches between Nkanjonja (1°45′ 05″ S, 40°07′ 14″ E) and Onkolde (1°45′ 55″ S, 40°06′ 55″ E) villages along the lower Tana River. We determined trends in population size and distribution for the 2 threatened taxa. Management and conservation measures towards the red colobus and crested mangabey populations both in and outside of TRPNR are urgently needed.

METHODS

Description of Study Site

There are >80 forest patches along the lower Tana River region, 27 of which are within TRPNR. They support several rare primate species. Of special concern is the vulnerable Zanzibar galago (*Galago zanzibaricus* Matchie, 1893) (Lee *et al.*, 1988) in addition to Tana River red colobus and crested mangabeys. Other primate species in the forests include Tana River Sykes' monkeys (*Cercopithecus mitis albotorquatus* de Pousargues, 1896), grivets (*Chlorocebus* (*Cercopithecus*) *aethiops* L., 1758), yellow baboons (*Papio cynocephalus cynocephalus* L., 1758), Garnett's galagos (*Otolemur*

garnettii Ogilby, 1838), and Senegal galagos (*Galago senegalensis* É. Geoffroy, 1796) (Butynski and Mwangi, 1994).

Marsh (1976) and Hughes (1984) detailed the ecology, climatic conditions and hydrology of the area. The maximum and minimum daily temperatures range between 30–38° and 17–25° C, respectively. January and February are the hottest and driest months. Annual rainfall ranges from 500 to 600 mm and is distributed bimodally with peaks in March–April and November–December. The forest patches are ground water dependent (Medley, 1993). The Tana River often changes its course, resulting in the formation of isolated inland oxbow lakes (Hughes, 1990), which affects forest dynamics because patches along the old riverbed dry up while new patches are established along the new river courses (Hughes, 1984). The current river course supports most of the forest patches in which the majority of primates occurs (Suleman *et al.*, 2001). Sometimes the forests are flooded for extended periods and most canopy trees fall or die, resulting in open patches in the canopy. As such, there is a mosaic of forest patches in various stages of succession. Only climax forests provide suitable habitat for Tana River red colobus and crested mangabeys (Decker, 1994). The overall size of forest patches have reduced significantly since 1994, when they ranged from 1 to 500 ha (Butynski and Mwangi, 1994) to current sizes of between 0.5 and 263 ha (Suleman *et al.*, 2001). Within the same period the reduction of forest area was greater out side TRPNR than in TRPNR (Suleman *et al.*, 2001). Reduction in forest size is due to increased human activities, including clearing for agricultural purposes, dyke construction, burning, and extraction of building materials (Muoria *et al.*, 2003).

Forest Numbering

Marsh (1986) and Butynski and Mwangi (1995) established a comprehensive system of forest numbering that we adopted. We denoted forests that experienced further fragmentation with prefixes (a, b, c) and considered ones those without clear delineation to be complexes. For instance, forests numbers 11, 13, 14 and 17 are the Mchelelo complex. In total, there were 86 forest patches and we censused monkeys in 73 of them.

Census Team Organization

The census team comprised 5 observer groups each with a primate spotter, a recorder or a local guide or both. We worked from 0630 to 1000 h and from 1500 to 1830 h when the primates were most active and therefore

easier to detect (Butynski and Mwangi, 1994). We predetermined census routes based on forest patch geography.

Interobserver Reliability Assessment

We held a precensus workshop in which all participants were trained on the census technique and data collection. We conducted 3 repetitive trial primate censuses in 3 forests within TRPNR to assess interobserver reliability. Simultaneously, the census team trained in identifying the most common plant species in the forests, while noting natural and anthropogenic effects on vegetation.

Census Method and Data Collection

We used the quadrat census method (Struhsaker, 1981) to count the primates. The method involves searching a forest patch and enumerating all primate groups in an effort to obtain a total count within it. We preferred this method because it has previously been used for primate censuses in Tana River (Butynski and Mwangi, 1995; Kahumbu and Davis, 1993; Marsh, 1978b) and allowed for data comparison. At the start of a primate census, observer groups synchronized their watches, agreed on a starting time and positioned themselves along the forest edge. We entered the name of the forest, reference number, date, start time, and names of observers onto census data sheets. Commencing at the same time, all observers walked parallel to one another (between 50–100 m apart depending on forest width) along predetermined routes (Brokelman and Ali, 1987; Struhsaker, 1981; Whitesides *et al.*, 1988). Also, depending on forest width, the number of groups were either increased or decreased to maintain the 50–100 m distance between them. The bigger forests were censused by 4–5 groups while the smaller forests needed only 2–3 observer groups. The observers moved at a speed of about 1km/h and made frequent stops to look and listen for primate vocalizations. One member of each group recorded the following information when primates were encountered: (i) species; (ii) time each encounter began; (iii) minimum number of monkeys in the group; (iv) age and sex of each monkey whenever possible; (v) tree species in which the monkey occurred; (vi) direction of movement; and (vii) time the encounter ended. We recorded compass bearings, time, and estimated distance from the observer for primates that vocalized but were not seen. We used a predetermined code of contact between neighboring observer groups during a census to avoid deviation from the predetermined trajectory, which could lead to

double counting of primate groups or affect spacing between observers leading to poor forest coverage. We censused forest patches without clear demarcation, e.g., the Mchelelo complex, sequentially on the same day as though they were one patch, whereas we censused simultaneously small forest patches close to one another via several teams. The counting teams discussed and summarized data soon after every census. In case of doubt about a census result, we repeated the census. The censuses covered 73 forest patches over 729 man-hours in 48 days.

Estimating Population Sizes and Densities

We estimated population sizes via mean group sizes calculated from repetitive counts of 52 groups of red colobus and 12 groups of crested mangabeys (Butynski *et al.*, 2000). Despite several primate censuses in the lower Tana, the most reliable estimates of mean group sizes for the red colobus and crested Mangabey were determined by Butynski *et al.* (2000). Their findings remain the most credible estimation of mean group sizes: 9.6 ± 0.618 (SEM, $n = 52$ groups) for red colobus, and 35.1 ± 4.6 (SEM, $n = 12$ groups) for crested mangabeys. Accordingily, we used the means of 9.6 and 35.1 for red colobus and crested mangabey, respectively, to estimate population sizes.

We calculated the population sizes of Sykes' monkeys and baboons via the only available estimation of group sizes: 17 and 70, respectively (Butynski and Mwangi, 1994). No information is available on group sizes of grivets. We only determined mean group densities for red colobus, crested mangabeys, baboons and Sykes' monkeys. Forest sizes are based on records of Suleman *et al.* (2001).

We used a two-tailed *t*-test (Zar, 1996) to compare densities of red colobus, crested mangabeys and Sykes' monkeys inside and outside TRPNR.

RESULTS

Tana River Red Colobus

We counted 788 red colobus (range 736-841) in 82 groups and 3 solitary individuals in 34 of the 73 forests (Table I, II). In 1994, there were 86 groups of red colobus. There has been a decline of 5% in the number of groups between 1994 and 2001. Mean group density for the red colobus is 0.05 groups/ha in TRPNR and 0.03 groups/ha out of TRPNR. The difference was not statistically significant ($t = 0.88$, $P = 0.38$, Table II). Red colobus

Table I. Distribution and abundance of groups of primate species in forest patches along the Lower Tana River, Kenya (January–March 2001)

Forest name	Forest. no.	Forest size (ha)	Red colobus *Procolobus rufomitratus*	Mangabey *Cercocebus galeritus galeritus*	Sykes' monkey *Cercopithecus mitis albotorquatus*	Babboon Papio *cynocephalus cynocephalus*	Grivets *Chlorocebus* (*Cercopithecus*) *aethiops*	Total	Census man-hours
# Nkanjonja	1	84.2	0	1	2	0	0	3	2
$ Wenje 1	2a	247.1	1	5	11(1)	3	0	20(1)	48
$ Wenje 2	2b	191.0	0	1	3(1)	2	0	6(1)	2
$ Wenje 3	2c	95.8	0	1	2	5	0	8	11
# Kipendi 1	3a	37.4	0	0	1	0	0	1	4
# Kipendi 2	3b	14.8	0	0	1	0	0	1	5.7
# Maroni west 1	4a	30.9	1	0	2	0	0	3	7.4
# Maroni west 2	4b	4.1	0	0	2	1	0	3	10
$ Maroni east 1	5a	38.7	0	3	2	0	0	5	10
$ Maroni east 2	5b	15.7	0	0	4(1)	1	0	5(1)	6.5
# Makere west	6	68.2	2(1)	0	3	0	0	5(1)	13
$ Kwechi	7	48.4	0	0	1	1	0	2	7.3
$ Makere east	8	19.2	0	1	2	0	0	3	1
$ Guru east	9	17.1	0	1	1	1	0	3	4
$ Guru north	10a	6.9	2	0	4	1	0	7	8.3
$ Guru south and central	10b	90.7	5	1	4(1)	1	0	11(1)	25.5
$ Mchelelo complex*	11,13, 14,17	207.8	7	2	8 (2)	5	0	22(2)	31
$ Mchelelo East	12	11.2	1	0	1	0	0	2	12
$ Unamed Woodland	15	12.3							
$ Sifa east	16	262.8	11	9	18	4	1	43	112
$ Maridadi	18	0	—	—	—	—	—	—	—
$ Hadribu	19	0	—	—	—	—	—	—	—
$ Baomo east	20	14.2	—	—	—	—	—	—	—
$ Baomo north	21	30.2	—	—	—	—	—	—	—
$ Baomo south	22	99.0	6	3	8	3	0	20	8
$ Lemu	23	27.8	—	—	—	—	—	—	—
$ Kitere	24	25.2	1	1	1	0	0	3	8
$ Kombeni	25	1.9	—	—	—	—	—	—	—

$ Mnazini north	26	60.3	1	2	5(1)	3	0	11(1)	24
$ Mnazini south	27	27.7	3	3	6	5	1	18	7.5
# Mnazini east	28	115.0	6	2	11	3	0	22	20
# Mnazini west	29	3.4	—	—	—	—	—	—	—
# Matalani north)	30	15.5	—	—	—	—	—	—	—
# Munguveni	31	18.5	—	—	—	—	—	—	—
# Kiyandu west	32	106.7	4	0	2	0	0	6	6
# Matalani south	33	2.3	0	0	0	0	0	0	0
# Kinyandu east	34	28.7	0	0	0	0	0	0	2.5
# Bubesa east	35	7.0	0	0	1	0	1	2	5.8
# Bubesa west 1	36a	15.2	2	0	1	0	0	3	3
# Bubesa west 2	36b	61.0	2	3	4	2	0	9(2)	16
# Mwina west	37	7.8	3	0	1	1	0	5	9
# Mikameni	38	20.7	0	0	2	1	0	3	2
# Peponi east	39a	55.0	0	0	1	1	0	1(1)	8
# Peponi west	39b	13.9	0	0	0	1	0	1	2.5
# Lazima north	40a	8.9	1	1	4	0	0	6	8
# Lazima south	40b	5.5	0	0	0	1	0	1	4.5
# Sera	41	59.0	0	0	0	0	0	0	0
# Lazima east	42	40.1	0	0	2	0	0	2	3
# Marembo west	43	49.2	1	2	5(1)	1	0	8(1)	14.3
# Marembo east	44	5.3	1	0	3	1	0	5	4
# Giritu woodland	45	79.2	0	0	0	0	0	0	0
# Sailoni 1	46	12.5	0	0	0	1	0	1	4
# Sailoni 2)	47	28.2	1	0	0	1	0	1	1.5
£ Kulesa east 1)	48a	19.3	2	1	3	1	0	7	2
£ Kulesa east 2	48b	8.8	0	0	0	0	0	0	4.5
# Kulesa west 1	49	11.1	1	1	1	2	0	5	4
# Kulesa west 2	50	28.1	0	0	1	1	0	2	4
# Maziwa north	51	43.5	0	0	0	0	0	0	0
# Maziwa south	52	21.3	0	1	4	0	0	5	3
# Wema west 2	53	7.6	0	0	0	1	0	1	4
# Wema west 2	54	18.5	2	2	4	3	0	11	8
# Wema west 3	55	45.1	0	1	0	0	1	6.7	6.7
£ Wema east 1	56	28.1	0	0	3	0	0	3	13.5
£ Wema east 1	57	15.9	0	1	0	0	0	1	6

Table I. (*Continued*)

Forest name	Forest. no.	Forest size (ha)	Red colobus *Procolobus rufomitratus*	Mangabey *Cercocebus galeritus galeritus*	Sykes' monkey *Cercopithecus mitis albotorquatus*	Babboon Papio *cynocephalus cynocephalus*	Grivets *Chlorocebus* (*Cercopithecus*) *aethiops*	Total	Census man-hours
#Hewani west 1	58	65.7	5	1	5	1	0	12	16
# Hewani east 2	59	11.4	1	0	1	1	0	3	5
£ Hewani east 22	60	4.2	1	0	0	0	0	1	1.25
£ Hewani east 3	61	9.6	0	0	0	0	0	0	0
# Hewani west 2	62	10.1	0	0	1	0	0	1	2.5
£ Hewani south 1a	63a	17.0	1	0	1	1	0	3	18
£ Hewani south 1b	63b	6.2	—	—	—	—	—	—	—
£ Hewani south 2	64	116.4	4	4	4	3	0	15	46
£ Bvumbwe north	65	136.5	0	1	3(1)	0	0	4(1)	18
£ Bvumbwe south 1	66a	160.8	0	0	1	0	0	1	4
£ Bvumbwe south 2	66b	17.3	0	0	1	0	0	1	2.7
£ Lango la Simba	67	79.2	1	0	0	1	0	2	16.7
£ Wema east 4	68	63.2	1	2	4–5(2)	0	0	7–8(2)	32
£ Mitapani 1	69	27.0	0	0	0	1	0	1	3
£ Mitapani	70	76.7	0	0	1	1	0	3	4
£ @Daruka Karicho	71	22.9	1	1	1	1	0	4	1
£ @Daruka karicho	72	28.6	1	0	0	0	0	1	5
£ @Daruka Karicho	73	28.6	0	0	0	0	0	0	1
£ @Daruka Karicho	74	16.1	0	1	0	0	0	1	3.3
£ @Onkolde	75	100.6	1	0	2(3)	2	0	5(3)	11.2
Total number of groups			82 (4)	59	170 (14)	70	4	385 (18)	728.7

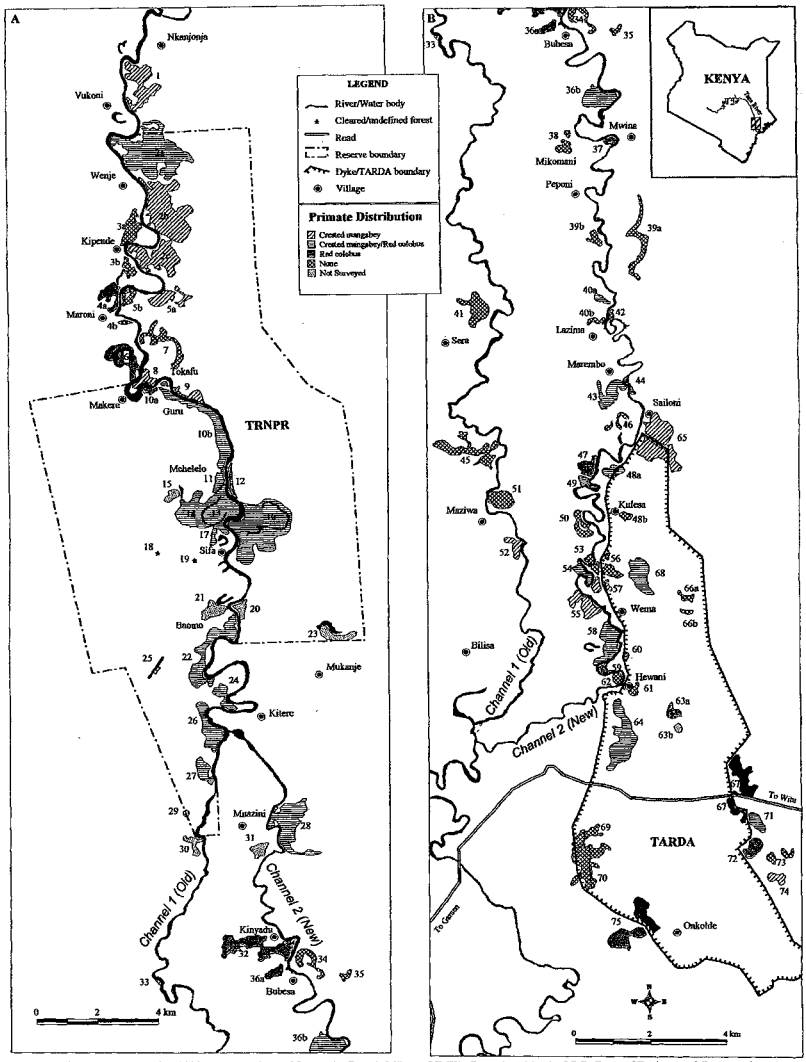
Note. Number (s) in parenthesis indicates the number of solitary monkeys. * the forest complex comprised of Mchelelo west, Congolani central and west and Sifa West forests;—the forest was not censused; $ Forests within TRPNR; $ Forests within Tana River Development Authority (TARDA) region; # Other forests in Lower Tana River; @ Forests not surveyed previously for primates.

Table II. Primate population sizes (*N*) and group densities (*d*) in and out of the Tana River Primate National Reserve (January–March 2001)

	Primate species													
	Red colobus (*Procolobus rufomitratus*)			Mangabey (*Cercocebus galeritus galeritus*)			Sykes' monkey (*Cercopithecus mitis albotorquatus*)			Baboon (*Papio cynocephalus cynocephalus*)			Grivets *Chlorocebus* (*Cercopithecus aethiops*)	
Forest category	*n*	*d*	*N*	*n*	*d*	*N*	*n*	*d*	*N*	*n*	*d*	*N*	*n*	*d*
Inside TRPNR	38	0.053	365 (341–388)	33	0.031	1,158 (1,005–1,311)	81	0.11	1,377	35	0.04	2,450	2	0.001
Outside TRPNR	44	0.034	422 (395–450)	26	0.014	911 (334–437)	89	0.15	1,513	35	0.04	770	2	0.002
Total	82 *3		787 (736–841)	59		2,069 (1,796–2,344)	170 *14		2,890	70		4,900	4	

Note. TRPNR = Tana River Primate Nature Reserve; n = number of primate groups observed; * = solitary individuals. Numbers in parenthesis show the population size range, *d* is the mean group density per hectare.

groups are more numerous outside (54%) than inside (46%) TRPNR. Red colobus groups occur from Wenje 1 (forest no. 2a; 1°45′55″ S, 40°06′ 55″ E) to Onkolde forests (forest no. 75; 2°18′ 42″ S, 40°11′ 06″ E) on the eastern bank of the river (Figure 1). On the western bank, the range extends from Maroni



Source: Landsat Image, September 2000; Interpretation and Layout by Dennis Milewa-(NMK); Ground truthing by I.P.R, Dept. of Ecology and Conservation

Fig. 1. Distribution of red colobus and crested mangabeys in forest patches along the lower Tana River from Nkanjonja to Onkolde.

West 1 (no. 4a; 1°49′ 12″ S, 40°06′ 23″ E) to Mnazini South (no. 27; 1°57′ 30″ S, 40°08′ 03″ E) along the old river channel (channel 1) and to Hewani West 2 (no. 62; 2°13′ 14″ S, 40°10′ 28″ E) along the new channel (Fig. 1).

Tana River Crested Mangabeys

We counted 2069 crested mangabeys (range 1796-2344) in 59 groups distributed in 30 forests (Table I, II), which is an increase of 18% over 50 groups in 1994. Crested mangabeys groups were more numerous (56%) inside TRPNR than outside (44%) TRPNR. Mean group density is significantly higher inside TRPNR (0.03 groups/ha) than outside TRPNR (0.01 groups/ha) ($t = 2.14$, $P = 0.04$, Table II). The species ranged between Nkanjonja (forest no. 1; 1°45′ 05″ S, 40°07′14″ E) and Daruka Karicho 4 (forest no. 74; 2°09′ 31″ S, 40°13′11″ E) on the eastern bank (Figure 1). On the west bank, they ranged from Guru South (forest no. 10a; 1°51′18″ S, 40°07′18″ E) and Maziwa South (forest no. 52; 2°11′23″ S, 40°08′35″ E) on the river channel 1 to Hewani West 1 (forest no. 58; 2°13′28″ S, 40°04′17″ E) on river channel 2.

Sykes' Monkeys

We recorded Sykes' monkeys in 53 of the 73 forests (Table I) with an estimated population of 2890 individuals in 170 groups and 14 solitary individuals (Table II). Eighty-one groups (47.6%) of Sykes' monkeys were within TRPNR. Sykes' monkey mean group density is 0.11 and 0.15 groups/ha in TRPNR and out side of TRPNR, respectively. The difference is not statistically significant ($t = 0.301$, $P = 0.764$).

Yellow Baboons

There were 70 groups of yellow baboons in 38 of the 73 forests (Table I). We estimated the total population of baboons in the lower Tana River forests to be *ca.* 4900 individuals. Baboon group density is the same in TRPNR and outside TRPNR (Table II).

Grivets

During the census, we observed Grivets only on the forest edges. We counted 4 groups in forests 55 (Wema West 3), 35 (Bubesa East), 27 (Mnazini South), and 16 (Sifa East): (Tables I and II).

DISCUSSION

Primate Population Sizes

Between 1994 and 2001 there was a 5% decline in the red colobus population, which we attribute to the disappearance of 4 red colobus groups. There has been substantial loss of forest habitat largely through clearance for farming, extraction of wood products and senescence. As an obligatory arboreal species, red colobus depend on mature primary forests for food, shelter and dispersal (Decker, 1994; Marsh, 1978b). Since 1994, loss of canopy trees in 2 forests outside TRPNR—Mnazini East (forest no. 28; 1°58′ 59″ S, 40°09′27″ E) and Hewani South 2 (forest no. 64; 2°14′32″ S, 40°06′55″ E)—has been accompanied by a total loss of 10 red colobus groups (96 individuals) from the area. Red colobus density of 0.05 individuals per ha inside TRPNR is greater than the density of 0.03 ind./ha outside TRPNR (Table II). The higher red colobus density in TRPNR may be due to better habitat because the forests have good canopy cover and tree composition versus forests outside TRPNR (Suleman *et al.*, 2001).

Over the same 7-yr period, the crested mangabey population has apparently increased by 18%, from 50 to 59 groups, but this should be viewed with caution. Their fission and fusion behavior confounds use of mean group size to estimate their population size. The density of crested mangabeys is significantly higher in TRPNR than outside TRPNR (Table II). Again, we infer that higher habitat quality may be the cause.

There is sufficient niche differentiation between crested mangabeys and red colobus to insure that an increase in one species would not negatively affect the population of the other species. Crested mangabeys are more dependent on the lower canopy and are generalist in their diet (Homewood, 1976). Red colobus are selective feeders that depend highly on top canopy trees such as *Ficus sp*., *Sorindeia madagascariensis*, *Pachystella msolo*, *Diospyros mespiliformis*, *Acacia robusta* and *Saba comorensis* and appear to be restricted to >10 m canopy height (Marsh, 1978; Medley, 1993).

Distribution

The range of red colobus has increased both north and south-wards on the eastern bank of river Tana. Previously, it was between Mchelelo East (forest no. 12; 1°58′02″ S, 40°08′29″ E) to the north and Mitapani 2 (forest no. 70; 2°15′18″ S, 40°10′44″ E) in the south (Butynski and Mwangi, 1995; Kahumbu and Davies, 1993). For the first time, we recorded the distribution farther north at Wenje (forest no. 2a: 1°45′55″ S, 40°06′55″ E) and south at

Onkolde (forest no.75: 2°18′42″ S, 40°11′06″ E). Although along the western bank red colobus were observed by Butynski and Mwangi (1995) as far north as Kipendi (forest no. 3a), we failed to record any individual there, which suggests reduced distribution on the western bank, probably attributed to severe degradation of the forest by humans or floods or both factors. Consequently, the forest habitats cannot sustain red colobus.

The distribution of crested mangabeys remains the same on the western bank of the river as reported by Butynski and Mwangi (1994). We also recorded them further south at Daruka Karicho 4 (forest no. 74). The new range may not be due to expansion but instead could be due to the lack of a previous census beyond forest 70 along the eastern bank. We recorded 2 groups of crested mangabeys (70 individuals) within the the southern range, indicating that this alone could not have been the reason for the population increase, which increased by 9 groups.

Apart from vervets, other primates seem to be in high numbers within the lower Tana River forests. It is possible that the generalist primates—baboons and Sykes'—could directly compete with taxa mangabeys and colobus for dwindling resources as the habitat deteriorates. Mangabeys may be affected more adversely due to resource overlap with the baboons (Wahungu, 1998).

Wieczkowski (pers. comm.) suggested that some groups of mangabeys may fuse and split in different times of the year, producing different mean group sizes in the same year.

We found that mean group densities of the 2 endangered primate species are higher inside TRPNR than outside TRPNR reiterating the importance of TRPNR in their conservation. Since we recorded higher densities in more intact forests within TRPNR, an intervention program is also required to stem further decline in red colobus habitat while involving local communities to protect smaller isolated groups in forest patches outside TRPNR.

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