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POPULATION AND CONSERVATION STATUS OF ENDANGERED ASHY RED COLOBUS IN UFIPA PLATEAU: UPDATES 10 YEARS AFTER FIRST REPORT

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ABSTRACT

For centuries, forests in Africa have been converted into farm lands and human settlements leading into habitat loss for forest dwelling mammals especially primates. Last century witnessed an extensive decline of primate populations worldwide mostly through habitat destruction. Here we present findings on the current population and conservation status of Ashy Red Colobus monkeys in Ufipa Plateau, southwestern Tanzania after ten years of first report. Using complete animal count and plotless visual assessment, we conducted surveys in each forest assessing for presence or absence of ashy red colobus in these forests and quality of their habitats. There was much disturbance in unprotected Mbuzi forest, reducing the once continuous forest into forest fragments and patches with no primates. In Mbizi, forest has been converted into commercial forest of exotic pine trees leaving remnants of natural forests as habitat for primates. A population size of 528 individual Ashy red Colobus were counted in Mbizi forest, indicating about 56% decline in population size, and mean group size of 26.4 indicate a 35% decline in 10 years. These findings highlight threats to Mbizi population and envisage local extinction of Mbuzi population and recommend for urgent conservation interventions in the area.

Key words: Ashy Red Colobus; Ufipa Plateau; Conservation status; Mbizi forest; Mbuzi forest.

INTRODUCTION

Non- human primates have lived in proximity with human for centuries and play a significant role in human livelihood, especially on forest survival and continuity; they act as potential pollinators and seed dispersers (Hill 2002). Biologically they have metaphorically kinship with human, provide insight on human evolution and adaptations as well as behaviour (Estrada *et al*. 2017). In some Asian and African communities, some species of non-human primates have cultural and religion value. For instance, temple macaques (*Macaca fascularis*) are considered to have spiritual values with Balinese Hindus, in Bali Indonesia (Fuentes 2010), and Hindus in India and Nepal (Lee and Priston 2005). Some other species are considered sacred and culturally protected, for instance ring-tailed Lemur (*Lemur catta)* in Madagascar (Fuentes 2012), and Cross River Gorilla (*Gorilla gorilla*) in Cameroon and DR Congo (Lee and Priston 2005, Etiendem *et al*. 2011). However, ever increasing and changing needs of human have endangered the ability of human co-existing with non-human primates. While some primate species are culturally worshiped in shrines and temples, some such as baboons (*Papio spp*) guenons (*Cercopithecus spp*), colobus (*Piliocolobus spp*) and Chimpanzee (*Pan troglodytes*) are shot in the forests for food (Nasi *et al*. 2011, Ordaz-Németh *et al*. 2017)

or in farms accused of crop raiding, hence increase threats to their survivorship. Although threats to vulnerability vary from one species to another depends on species' diet, social system, body size and habitat requirement (Rovero *et al*. 2012); a comprehensive assessment on the conservation status of mammals in the world has indicated that of all land mammals, primates are at the highest risks of extinction (Schipper *et al*. 2008). The most common threats to this risk being habitat loss, fragmentation, and degradation (Schipper *et al*. 2008, Rovero *et al*. 2012, Estrada *et al*. 2017); with hunting as an additional common threat in Central and West African (Magnuson 2005, Linder and Oates 2011) and East Africa Regions (Rovero *et al*. 2012).

Generally, decline in primate populations due to destruction and fragmentation of habitat has been widely documented (Struhsaker 1997, Arroyo-Rodríguez and Diaz. 2009, Dunham 2011, Schwizter et al. 2011, Arroyo-Rodríguez *et al*. 2014). Habitat degradation and fragmentation reduces the total area of continuous forest and create barrier for movement patterns, it increases edge effect which in turn reduce habitat quality (Fahrig 2003). This has much effect on canopy-depended species such as ashy red colobus, to these monkeys; habitat quality greatly influences the group size; with large groups found in well-protected areas (Fahrig 2003), and canopy alteration affects their local abundance (Rovero and Struhsaker 2007). Thus, they are likely to be the first animals to die out in highly disturbed habitat (Struhsaker 1997, Fahrig 2003).

Ashy red colobus stands as globally endangered species with rapid population decline due to habitat loss (Struhsaker and Grubb 2013). Thirty years ago, the population of ashy red colobus was thought to be divided into five subpopulations, but spread in about 1,000 km in East Africa (Rodgers 1981). The five subpopulations were described to have restricted range covering the discrete forests in western Uganda, and western Tanzania along the shore of Lake Victoria, in Gombe and Mahale National Park, and at Mbizi and Misheta on the Ufipa Plateau (Rodgers et at. 1984). Studies described the population of ashy red colobus being vulnerable throughout its range, estimating the population size to about 20,000 individuals', with the population in Kibale National Park considered as the largest (17,000 individuals) (Struhsaker 2005, Lwanga *et al*. 2011, Schwizter *et al*. 2019). Recently, a significant decline in the population of ashy red colobus both number of individuals and groups has been reported across the entire range of their occurrence from Kibale to Mahale ecosystem to Ufipa plateau (Mitani *et al*. 2000, Struhsaker 2005, Davenport *et al*. 2007, McLester *et al*. 2019); mainly due to loss of their habitat through deforestation and partly due to predation from Chimpanzee (Watts and Mitani 2000).

In Tanzania, Ashy red colobus were known to occur in the greater Mahale ecosystem (Gombe and Mahale National Park), and in the Ufipa plateau in Misheta and Nsangu forests (Rodgers 1981). Following extensive habitat destruction in Nsangu and loss of forest in the Misheta, the population in these to forests is considered extinct (Davenport *et al*. 2007); however, in the same study a new sub population was discovered at Mbuzi forest, 55 km North of Mbizi Forest (the only known habitat for the southernmost population of ashy red colobus). A recent study has reported a significant decline on the subpopulation in the greater Mahale ecosystem as well, less than 400 individuals were encountered at four sites only: Bangwe, Bujombe, Issa valley and Kalobwe (McLester *et al*. 2019). The south most subpopulation of ashy red colobus in the Ufipa plateau has been subjected to two scientific investigations focusing on their conservation status and distribution: Rodgers *et al*. (1984) studied the population of ashy red colobus in the Mbizi forest in 1980 by surveying less than 15% of Mbizi forest and produced 250 individuals; Davenport *et al*. (2007) studied the same population by a

survey which found 1,217 individuals at Mbizi forest and reported on a new subpopulation at Mbuzi forest with 157 individuals, making a total of 1,354 known population of ashy red colobus in the Ufipa Plateau. Two other studies on habitat use and feeding behaviour of the two subpopulations have been conducted by Kibaja (2012 and 2014 respectively). However, a study by Davenport *et al*. (2007) reported severe habitat degradation in both Mbizi and Mbuzi subpopulations, the conditions which pose great threat on the existence of these primates in the area.

Red colobus species are highly threatened primates across their range of occurrence throughout Africa. This study focused on two subpopulations of ashy red colobus monkeys living in two forests with different protection regime in the Ufipa plateau: The subpopulation in legally protected Mbizi forest, of which its conservation status has been reported twice by Rodgers 1981 and Davenport *et al*. 2007; and the newly discovered subpopulation in unprotected Mbuzi forest. The aim of this study is to provide current conservation status of ashy red colobus in the Ufipa plateau, 10 years after data provided by Davenport *et al* (2007). Our specific objectives were: (**i**) to determine the abundance and composition of ashy red colobus in the two study forests (**ii**) to provide conservation recommendations which may reduce anthropogenic pressure and interference to the forests from adjacent communities.

MATERIAL AND METHOD

Study area

We studied the southmost subpopulation of ashy red colobus from October 2018 to August 2019 in the two forest fragments: Mbuzi and Mbizi forests in the Ufipa Plateau covering approximately 3,571 ha, in the Rukwa Region, Southwest Tanzania (Fig 1). The two forests are separated by unique vegetation mosaic of montane grassland, woodland and savanna (Rodgers 1984 cited in Davenport *et al*. 2007).

Mbizi forest, which is legally protected under Tanzania Forest Services (TFS) Agency, is located at 7°40´S, 31°40´E, and is about 14 km north of the town of Sumbawanga. The forest incorporates 2,930 ha of montane forest, lies between 2,100 to 2,441 m a.s.l on the escarpment overlooking Lake Rukwa valley (Davenport *et al*. 2007). Natural vegetation of Mbizi forest represents the easternmost portion of congolian forest in Tanzania, with *Euphorbia obovalifolia* protruding high in the canopy characterizing the vegetation in the area (Davenport *et al*. 2007). However, the forest has been heavily logged over years (Davenport *et al*. 2007, Kibaja 2012, Kibaja 2014) and recently most part of it has been converted into commercial forest through planting of pine trees in previously disturbed part of the forest.

Mbuzi forest, which currently has no any legal protection status, is situated on the eastern ridge of the Ufipa plateau at 07°29´S, 31°32´E in Nkasi district, about 54 km northwest of Mbizi forest. The forest lies between 1,990 and 2,122 m a.s.l. and estimated to cover an area of about 611ha (Davenport *et al*. 2007); (Fig 1).

Data collection

A number of methods were used to determine the abundance of ashy red colobus and the quality of habitat in which they live in the two forests in the Ufipa Plateau. The first method was visual survey in the two forests to ascertain presence or absence of ashy red colobus in those forests, this was done for two days in each forest in August 2018. Another method was complete census for determination of ashy red colobus' abundance which was conducted later in October. Then vegetation survey for evaluation of habitat quality in both forests was conducted in the same month.

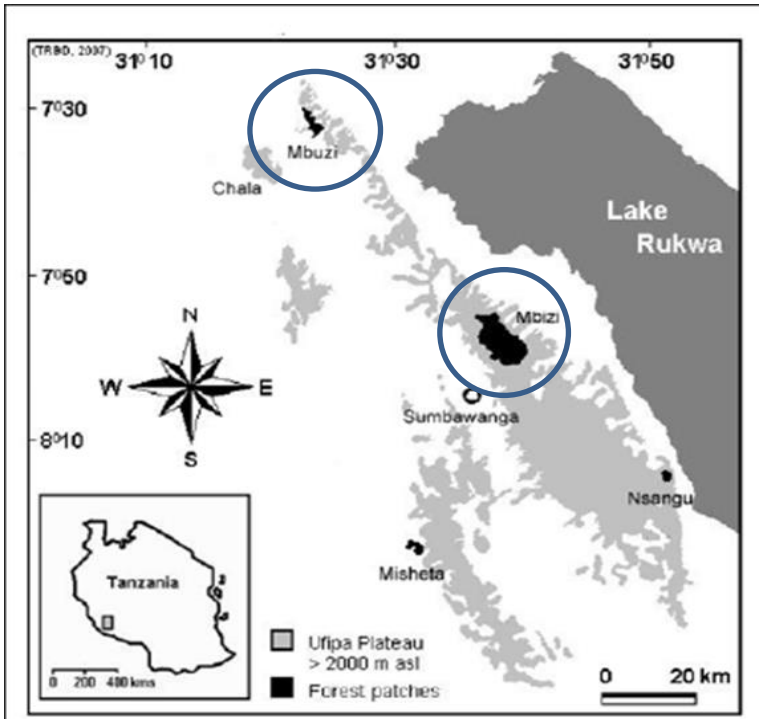

Figure 1: Map of Ufipa Plateau, Southwest Tanzania, showing the location of Mbuzi and Mbizi forests and other sites once inhabited by Ashy Red Colobus Monkeys (**Source**: Davenport *et al*. 2007).

Survey for determination of Presence or Absence of Red colobus

The two forests were surveyed for the presence or absence of ashy red colobus monkeys. The survey was based on prior knowledge of forest requirements of ashy red colobus from surveys particularly by Davenport *et al*. (2007), interviewing villagers, particularly those who worked with Kibaja (2014), and farmers who cultivated close to the forests, and prior survey on habitat quality. Three teams composed of three observers each (one experience researcher, one experienced field assistant and one local assistant who have the knowledge of the forest) concurrently searched for ashy red colobus in pre-planned route using 1:50,000 topographic maps of Mbizi forest (Topographic Sheet: 207/1. 207/3, 207/4; Ministry of Natural Resources and Tourism, Tanzania Forest Reservices, Sheet SB-36), global position system (GPS) and pair of binoculars. The survey was conducted for six days in the south west part and south east part of the forest. New areas were surveyed each day adjacent to the areas surveyed the previous day; the survey was conducted in such a way that the teams were at least 500m away from each other in every survey day. Because there were no human tracks and animal trails were difficult to follow, the survey teams used GPS to create survey routes. Surveys began at around 7:00 am every day by each Team walking slowly, scanning forest canopies and understories and ends up at around 5: 00pm. When group or an individual encountered, observers stayed with them for a while for the group to calm down, and then take records of location and size of the encountered group.

For Mbuzi forest presence/absence survey was conducted for one day only because of the severity of habitat destruction in this forest.

Animal count/census

For accuracy, and to establish absolute figure rather than estimated number, of population size of ashy red colobus in Ufipa plateau, we adopted complete count techniques, whereby census data were collected based on direct observations of individual animals. This

technique was also used by Davenport *et al*. (2007). This method is recommended as the most accurate method for primate census especially in fragmented habitats (Plumptre and Cox 2006, Davenport *et al*. 2007, Buckland *et al*. 2009). Once the group allocated, the team maintained enough distance to reduce stress but keep contact with the group; then number of individuals, sex and age composition of the group was recorded as well as habitat type and GPS position of the areas where the group was observed. Other information such as other nearest primate species and major group activities were also recorded. To avoid double count, a group was considered different if (i) was seen by two different observation teams at the same time more than 300m apart (ii) two observation teams were close to each other at least less than 300m apart, one team see the group but the other team confirm they did not see the group.

Assessment of vegetation and human disturbances (Habitat quality analysis)

We used visual-based plotless analysis to evaluate vegetation of the two forests of Mbuzi and Mbizi to assess the quality of the habitat for ashy red colobus. Plot-less vegetation analysis is recommended as one of suitable techniques for vegetation analysis in areas where vegetation is sparse or not easily accessed (Hijbeek *et al*. 2013). We used species habitat requirements as indictor of habitat suitability for ashy red colobus. This was possible because we had prior knowledge on habitat requirement of ashy red colobus monkeys from Kibaja (2012), Kibaja (2014) and Davenport *et al*. (2007).

At Mbuzi forest we used Point Centre Quarter Method for vegetation survey; we had three random points where we scanned the surrounding within 100 m radius for tree structure and canopy cover. At Mbizi forest visual-based vegetation survey was carried out simultaneously with animal counts within transects. In this forest we assessed for patch size, ground vegetation cover, canopy cover, tree structure, forest connectedness, and estimated the distance of forest fragment to the nearest river (permanent water source). Agriculture activities and plantation of pine tree were only human disturbances recorded at Mbuzi forest; while agriculture, livestock keeping and human settlement were recorded at Mbuzi forest.

Data analysis

Data from animal counts were analysed as both total groups and individuals encountered and as mean of individuals encountered and groups encounter rate. With such a small area, we considered complete count and mean encounter rate per survey as reliable index of population size comparison between the two study sites, this is in line with other similar primate studies (e.g., Chapman *et al*. 2000, Rovero *et al*. 2006, and Rovero *et al*. 2012). Census data were also used to analyse for mean group composition as a useful indicator for population status and understanding of animal social organization. We used simple descriptive analysis to present data on mean group and individual encounter rate and population range of encountered group.

RESULTS

Habitat quality

Surveys for determination of habitat quality (vegetation and human disturbance) and presence or absence of ashy colobus in the two forests indicated higher disturbance in unprotected Mbuzi forest, very little of the previously existing forest was left. Some few indigenous trees were found forming forest remnants/patches (Plate 1), but no primate was seen in the area. Also observed in the area is the beginning of establishment of human settlement (Plate 2) and some other human activities (Plate 3, 4 and 5). Human forest disturbance observed in Mbizi forest was minimum except for few cultivation activities close to the forest and plantation of pine trees in the previous degraded nature forest.

Plate 1: Patches representing leftover of Mbuzi forest

Plate 2: Human settlements in Mbuzi Forest

Plate 3: Livestock keeping in Mbuzi forest

Plate 4: Pit sawing in Mbuzi forest

Plate 5: Tree falling in Mbuzi forest

Plate 6: Bee keeping in Mbizi forest

Presence or absence of red colobus

Data from surveys inside the forest and interviews with villagers and farmers close to the Mbuzi forest confirm the absence of ashy red colobus on the ridge of Mbuzi forest. Personal communication with Kibaja indicated that some groups have been seen in the forest down in the escarpment; however, this has never been confirmed. In the protected Mbizi forest where the government runs a recovery program through plantation of pine trees, ashy red colobus were present in the remaining part of the natural forest that has been left to recover and regenerate as it has been reported in previous studies (i.e. Davenport *et al*. 2007, Kibaja, 2012).

Animal count (for abundance and composition)

Presence/absence survey in Mbuzi forest revealed no record of ashy red colobus, and therefore animal count was not conducted in that forest. Approximate 109 km of transect were surveyed in the Mbizi forest in two different zones; northeast of forests (First Camp) and Southeast camp (Mponda camp) during animal counts. A total of 20 groups of ashy red colobus monkeys were encountered, 6 groups were observed in the northeast/first camp part of the forest, and 14 groups were observed in the southeast part of the forest (Mponda camp). Table 1 provides information on the part of the forest where the group was observed, group identification, geographical location (GPS codes) and group size. A total of 151 individual ashy red colobus were recorded in the northeast part (First Camp) of the forest, while a total of 377 individuals were recorded in the southeast part of the forest (Mponda camp), making a total of 528 individual ashy red colobus counted in Mbizi forest. The mean group size recorded in Mbizi forest was 26.9 (n=20; SD= 10.62; range 14-52 individuals), with group encounter rate per day being higher in the southeast part, Mponda camp.

Table 2 provide information of group composition, a total of 190 adults were recorded and counted in Mbizi forest giving a mean of 9.5 across all groups encountered in Mbizi (n=20), and a mean of 12.6 per group amongst those groups were adults (n=15). Moreover, a total of 38 infants were counted, providing a mean of 1.9 across all groups encountered in Mbizi, and a mean of 3.8 for groups were infants (n=10). A mean ratio (expressed in percentage) of infants to group size across all group is 6.4%, ranging from 0 to 21%; whereas the mean number of infants to number of adults in the group across all group is 13.9, ranging from 0% to 41.7% (n=20). During animal count, the teams failed to get close enough to categories animals in various sex classes in four different groups encountered in various dates, however this did not have effect of the animal count as the teams managed to get the overall group counts in each of these groups (Table 2).

Human disturbances on habitat

From survey, a number of anthropogenic activities were recorded, however much of these activities were recorded in Mbuzi forest than in Mbizi forest. In Mbuzi forest, extensive human activities such as cultivation of maize, wheat and beans were recorded. Livestock grazing (Plate 3) and pit sawing (Plate 4) and tree felling for expansion of farms (Plate 5) were other human activities recorded extensively practices in Mbuzi forest. There were no much human activities observed in Mbizi forest except for few cultivation activities close to the forest and plantation of pine trees in the previous degraded nature forest, as well as ecological friendly beekeeping project (Plate 6). However, despite of the habitat destruction in Mbizi forest, few other animals were recorded in the forest; Diademed (Blue) monkeys, *Cercopithecus mitis stuhlmannii* and Harvey's red duiker, *Cephalophus harveyi*.

Table 1: Forest part surveyed, group identity number, location in eastings and northings and maximum number of individuals counted (group size) per group in Mbizi forest.

Forest Part	Group ID	Location (GPS codes)		Group size
First Camp	1	354811	9130067	22
	2			26
	3	354939	9229473	17
	4	353843	9130604	33
	5	354297	9129884	23
	6	352569	9132043	30
		Total individuals		**151**
		Mean of individuals		**25.16**
				(SD= 5.77)
Total group encountered	**6**	**Group encounter rate**		2 groups/day
Mponda Camp	7	353302	9128278	52
	8	353512	9128244	41
	9	354373	9127757	36
	10	354446	9127033	30
	11	353047	9128551	17
	12	352383	9128192	23
	13	353232	9127237	15
	14	356091	9128791	12
	15	355629	9128903	14
	16	356474	9127289	22
	17	355928	9127738	33
	18	356117	9128387	40
	19	355032	9126139	14
	20	355453	9126708	28
		Total individuals		**377**
		Mean of individuals		**26.9**
				(SD= 12.29)
Total number of groups encountered	**14**	**Group encounter rate**		6.3 groups/day
Mbizi Forest (first camp + Mponda camp)		Mbizi forest Overall number of individuals		**528**
		Mean of overall individuals		**26.4**
				(SD= 10.62)
Total number of groups encountered	**20**	Average encounter rate		**3.3 groups**

Table 2: Group Identity number, maximum number of individual counted (Σ) in parenthesis age composition of counted individuals, In/G ratio of infants per group in percentage and In/Ad ratio of infant per adult in a group.

ID	Group count	Σ (Adults)	Σ (Infants)	Σ (Subadults)	Σ (Juveniles)	In/G (%)	In/Ad
1	22	10	2	3	7	9.1	5.0
2	26	0	0	0	0	0.0	0.0
3	17	8	0	5	1	0.0	0.0
4	33	14	0	7	12	0.0	0.0
5	23	15	5	3	0	21.7	3.0
6	30	12	5	4	9	16.7	2.4
7	52	23	8	7	14	15.4	2.9

ID	Group count	Σ (Adults)	Σ (Infants)	Σ (Subadults)	Σ (Juveniles)	In/G (%)	In/Ad
8	41	17	5	6	13	12.2	3.4
9	36	17	5	4	10	13.9	3.4
10	30	15	0	7	8	0.0	0.0
11	17	15	0	8	0	0.0	0.0
12	23	2	0	10	11	0.0	0.0
13	15	5	2	1	3	13.3	2.5
14	12	2	0	6	4	0.0	0.0
15	14	8	1	2	2	7.1	8.0
16	22	10	2	4	6	9.1	5.0
17	33	17	3	5	8	9.1	5.7
18	40	0	0	0	0	0.0	0.0
19	14	0	0	0	0	0.0	0.0
20	28	0	0	0	0	0.0	0.0
Total	**528**	**190**	**38**	**82**	**108**		
Mean		9.5 (n_1=20) 12.6 (n_2=15)	1.9 (n_1=20) 3.8 (n_2=10)	4.1 (n_1=20) 5.1 (n_2=16)	5.4 n_1=20) 7.7 (n_2=14)	6.4% (n_1=20)	2.4 (n_1= 16)

DISCUSSION

This study is the second study on the population size and conservation status of ashy red colobus, *Piliocolobus rufomitratus tephrosceles* in Mbuzi and Mbizi forests following up the study conducted in 2006 by Davenport *et al*. on assessment of their population size, conservation status, distribution and abundance across the Ufipa Plateau (Mbuzi, Mbizi, Misheta and Nsangu forests). Extensive habitat destruction including land clearance for human settlement was observed in Mbuzi forest; to large extent, this level of habitat destruction may be explained by lack of legal protection and the forest being far from both Nkasi District and Rukwa administrative region make the forest easily accessed by livestock keepers who seek for new land for cultivation. These anthropogenic activities led into poor quality of the habitat and made this forest unsuitable habitat for ashy red colobus monkeys, which like other colobines species are more sensitive to habitat quality. The significance impact of anthropogenic activities particularly habitat loss, degradation and fragmentation to nonhuman primates have been widely documented (Hill 2002, Anderson *et al*. 2007, Arroyo-Rodríguez and Diaz 2010, Dunham 2011, Rocha et al. 2017, Estrada *et al*. 2017). For ashy red colobus, decline in habitat quality has significant impact on their population density and group size (Struhsaker 1997, Chapman et al. 2000, Davenport *et al*. 2007, Lwanga *et al*. 2011); this may also explain the none observation of ashy red colobus monkeys in this forest, although a population size of 137 individuals was reported in 2006. Moreover, decline of habitat quality have significant impact on the feeding behaviour of ashy red colobus and may turn them into crop raiders (Kibaja, 2014).

Given a small area of Mbizi forest and much smaller area covered by natural forest, the population size of 528 individuals established by this study in Mbizi forest is very low compared to the population of 1217 individuals established by Davenport et al in 2006; this indicates more than 56% decline of population size in Mbizi forest within 10 years. The observed decline in both number of individuals, groups and group sizes is largely linked with forest degradation and fragmentation in the area, because like all other red colobus species, ashy red colobus are poorly adapted to habitat loss and degradation (Anderson, 2007; Struhsaker and Ting, 2020). Decline in number of groups especially in the southwest part of the forest near Mponda camp observed in this study compared to number of groups in 2006

encountered in around the same area in 2019 (Figure 3), coupled with another observed decline in mean group size, 40.56 individuals per group in 2006 to 26.37 individuals per group in this study clearly indicate unstable and declining population in Mbizi forest, a number of reasons can explain this rapid population decline in Mbizi forest. Firstly, much as destructive human activities such as charcoal making, firewood collection and burning have been greatly reduced in the forest, the planting of pine trees and cultivation around the forest create more fragments of naturally forests which became islands in which primates groups are trapped due to edge effect. Although forest fragmentation may have different impact to different primate species; for colobines monkeys who are relatively arboreal species depending much on fruits, leaves and seeds; forest fragmentation may have negative impact. Their occupancy to the forest patches is very much affected by forest edges and canopy tree species composition (Mbora, 2004, Anderson, 2007). Secondly, probably the population size and mean group size are little larger than reported because of difficulties in accessing some other areas covered in 2006. However, a simple comparison on the maps (Figure 3), provide highlights on the decline in population, especially in the northeast part where there is high habitat destruction and conversion of forest into commercial forest through pine plantation.

Concentration of ashy red colobus in the southwest and west part of the forest as observed in this study (Figure 3), can be explained by the fact that forest patches/fragments in the southwest are generally larger and wetter composed more with tall trees with large canopies, which are favorable habitat requirement of red colobus. Similar characteristics were observed in the west of Mbizi forest. It was further observed that in Mbizi, east of the forest is the part were more logging occurred in the past and current more pine plantation, hence make this part of the forest more accessed by human and impose a threat to red colobus. Ashy red colobus, like most other colobines are very sensitive to habitat quality, and usually they tend to avoid extensively degraded forest as it has been seen in Kibale National Park (Chapman *et al*. 2000; Mitani *et al*. 2000) or tend to form a significantly smaller groups in areas like that (Anderson, 2007).

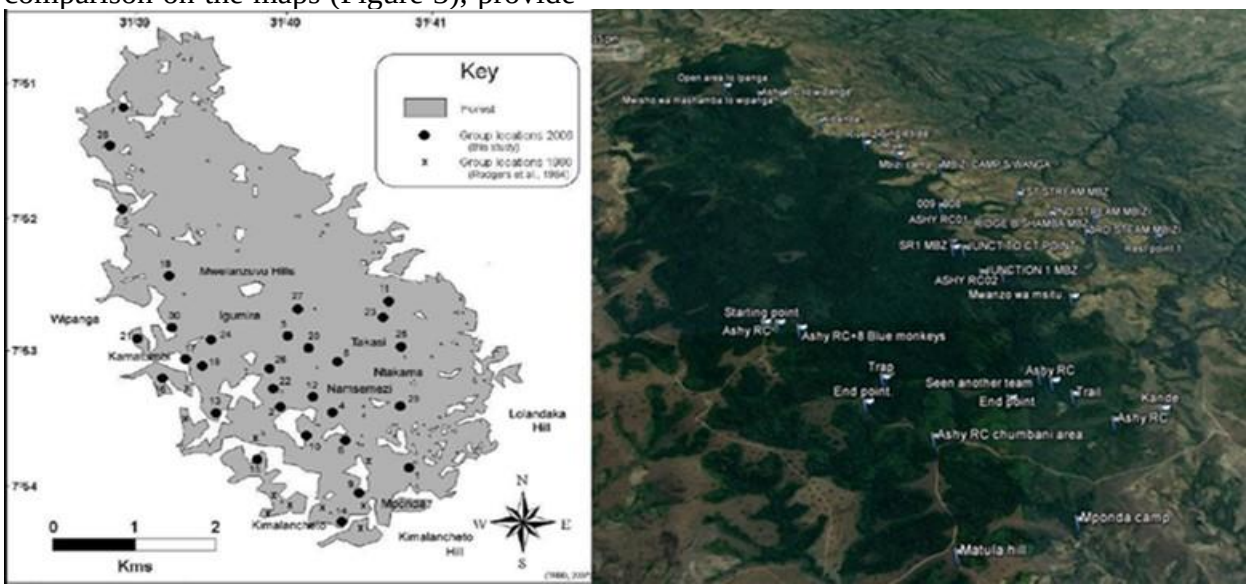

Figure 3: A map of Mbizi forest indicating the distribution of Ashy red colobus group at different times; in the right in the distribution of red colobus in 2006 as reported in Davenport et al (2007) and left in the distribution of red colobus observed in this study (2019)

During the study we encountered a relatively small number of infants compared to the number of adults capable of breeding (Table 2). Environmental stress due to food availability and change in forest structure in Mbizi forest is undoubtedly responsible for the observed lower number of infants. Even though different primate species can respond differently to human disturbances, to cercopithecines and colobines severe habitat destruction may lead into physiological stress which in turn may lead into higher infant mortality and infertility in females (Lea *et al*. 2015; Young *et al.* 2020).

CONCLUSION

It is evidently that the population of ashy red colobus is highly threatened in the Ufipa plateau, and the population in Mbizi forest is declining while that of Mbuzi forest which was newly discovered in 2006 is either locally extinct in the areas or very much restricted in gullies in the escarpment as reported by Kibaja (Pers. Comm). Both situations are undoubtedly linked to the continuing severe habitat destruction in Mbuzi forest and forest fragmentation in Mbizi forest. The fact that Mbuzi forest has no legal protection status has opened it to severe destruction mostly cultivation, livestock keeping and rapid conversion into human settlements. Our worries are that, if the situation remains as it was observed, ashy colobus population in this forest will follow suit of what has been reported to have been occurred on the population of this monkeys in Misheta and Nsangu forest. As for Mbizi forest, no doubt this is the only remaining hope of ashy red colobus in the Ufipa plateau and the southernmost population. However, unsustainable human activities observed in Mbizi forest poses a great threat to ashy red colobus population in this forest. In that regard, immediate management interventions are recommended to rescue small remaining patches of forest in Mbuzi. As for Mbizi forest, the current legal protection of this forest is important but management system of the forest should allow the growth of tall, closed canopy trees which are interconnected for the survival of this sensitive forest dwelling primate species.

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