



Original Article

Movement, Feeding Behaviour and Threats of *Colobus guereza* Ruppellin at Seasonally Dry Riverine Forest of Engare-Olmotonyi and Arboreta of the Forestry Training Institute's Olmotonyi's Campus in Northern Highlands of Tanzania.

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Article DOI: <https://doi.org/10.37284/eajfa.5.1.547>

Date Published: ABSTRACT

10 February 2022

Keywords:

Movement,
Feeding,
Behaviour,
Threats,
Colobus Guereza,
Engare-Olmotonyi
seasonally Dry,
Riverine Forest,
Arboreta,
Northern Highlands,
Tanzania.

The observation of feeding and movement behaviour of wild fauna is significant in the process of understanding the ecosystems. The movement and feeding behaviour of An assessment on the movement, feeding behaviour, and threats of *Colobus guereza* was done in Engare-olmotonyi seasonally dry riverine forest and arboreta at the Forestry Training Institutes-Olmotonyi in northern Tanzania. The movement and feeding behaviour were monitored for 30 days from mid of September to October 2020. Sleeping and waking up times, trees fed by *C. guereza*, and trees they slept on were recorded and estimated for their height and canopy cover (light or dense). The human threats were also recorded. The findings revealed that *C. Guereza* members were waking up between 6.30 am and 6.58 am, depending on the condition of the sky (clear or cloudy). When the sky was clear they wake up between 6.30 and 6.45 am, and 6.45 am to 6.58 am on cloudy sky days. They slept on the highest canopy trees and were feeding on tender or mature leaves depending on the type of species. The flowers and fruits of *Jacaranda mimosifolia*, *Albizia gummifera* (J.F.Gmel.) C.A.Sm., *Cussonia holstii* Harms ex Engl and leaves of *Lagenaria abyssinica* (Hook.fil.) C.Jeffrey were found to be fed by *C. guereza*. As soon as they wake up, they both of them urinated. Then, young *C. guereza* were found to be directed to move before adults just after they had urinated. The height of trees the *C. guereza* were found to jump on and or sleep ranged from 24 ± 10 m, with an average height of 17 m. The tallest trees ranged from a height of 24 ± 20 m; while the medium had a height of $\leq 20 \pm \leq 15$ m. Most of the tallest trees were *Albizia gummifera* (J.F.Gmel.) C.A.Sm., *Jacaranda mimosifolia* D.Don; *Cussonia holstii* Harms ex Engl.; and *Eucalyptus maidenii* F. Muell. The threats to *C.*

guereza were cutting of trees as their food and habitat and illegal routes that disturbed their behaviour of feeding and movement. The direction of *C. guereza* movements and sleeping depend most on the trees. Further study is needed to evaluate the plant species being fed at different seasons, protect the existing trees, and restore the forest gaps.

APA CITATION

Kayombo, C. J., Kivuyo, T., Giliba, R. A., Kyando, S. J., Lugumira, E., & Gwau, H. S. (2022). Movement, Feeding Behaviour and Threats of *Colobus guereza* Ruppellin at Seasonally Dry Riverine Forest of Engare-Olmotonyi and Arboreta of the Forestry Training Institute's Olmotonyi's Campus in Northern Highlands of Tanzania *East African Journal of Forestry and Agroforestry*, 5(1), 22-31. <https://doi.org/10.37284/eajfa.5.1.547>.

CHICAGO CITATION

Kayombo, Canisius John., Tumaini Kivuyo, Richard A. Giliba, Sefania J. Kyando, Emmanuel Lugumira, & Hussein Said Gwau. 2022. "Movement, Feeding Behaviour and Threats of *Colobus guereza* Ruppellin at Seasonally Dry Riverine Forest of Engare-Olmotonyi and Arboreta of the Forestry Training Institute's Olmotonyi's Campus in Northern Highlands of Tanzania". *East African Journal of Forestry and Agroforestry* 5 (1), 22-31. <https://doi.org/10.37284/eajfa.5.1.547>.

HARVARD CITATION

Turyahabwe, R., Asaba, J., Mulabbi, A., Mulabbi, A., Mulabbi, A., & Paul, M. G. (2022), "Movement, Feeding Behaviour and Threats of *Colobus guereza* Ruppellin at Seasonally Dry Riverine Forest of Engare-Olmotonyi and Arboreta of the Forestry Training Institute's Olmotonyi's Campus in Northern Highlands of Tanzania", *East African Journal of Forestry and Agroforestry*, 5(1), pp. 22-31. doi: 10.37284/eajfa.5.1.547.

IEEE CITATION

R. Turyahabwe, J. Asaba, A. Mulabbi, A. Mulabbi, A. Mulabbi, & M. G. Paul, "Movement, Feeding Behaviour and Threats of *Colobus guereza* Ruppellin at Seasonally Dry Riverine Forest of Engare-Olmotonyi and Arboreta of the Forestry Training Institute's Olmotonyi's Campus in Northern Highlands of Tanzania", *EAJFA*, vol. 5, no. 1, pp. 22-31, Feb. 2022.

MLA CITATION

Kayombo, Canisius John., Tumaini Kivuyo, Richard A. Giliba, Sefania J. Kyando, Emmanuel Lugumira, & Hussein Said Gwau. "Movement, Feeding Behaviour and Threats of *Colobus guereza* Ruppellin at Seasonally Dry Riverine Forest of Engare-Olmotonyi and Arboreta of the Forestry Training Institute's Olmotonyi's Campus in Northern Highlands of Tanzania". *East African Journal of Forestry and Agroforestry*, Vol. 5, no. 1, Feb. 2022, pp. 22-31, doi:10.37284/eajfa.5.1.547.

INTRODUCTION

Observing where the wild fauna lives is an important part of understanding the natural ecosystems (Malmstrom, 2010). *Colobus guereza* is a large, shaggy black and white monkey with a grim expression, glossy black colour with white brown and full beard framing gray-skinned face (Estes, 1999). The species is distributed across equatorial Africa and from northern Tanzania to Abyssinian highlands, in forest habitats from sea level to 3000 m a.s.l. Its ecology is on mature trees of a few different trees enables *C. guereza* to inhabit a wide range of habitats, including secondary and riparian forests with very little diversity and a prolonged dry season, unfit for other monkeys, because its needs can be met within very small forest patches on cleared land clumps of gallery forest along rivers

flowing through sub-desert, and in secondary woodland (Butynsk & De Jong, 2015).

It has been reported that the *C. guereza* are distributed in several countries including; Central African Republic, Chad, Congo, Ethiopia, Gabon, Kenya, Nigeria, Rwanda, Sudan, Tanzania, Uganda, and the Democratic Republic of the Congo (Struhsaker, 2011). *C. guereza* is found on a wide range, from lowland tropical rainforests, as well as riverine galleries and evergreen thicket forests (Kingdon, 2015). It has been known that the juvenile *C. guereza* are fair game for crown hawk eagles, but resident male defends troop, rushing eagle that land near (Estes, 1999). The *C. guereza* makes aggressive displays to other predators, including people but when thoroughly alarmed sky-dive into the undergrowth. *C. Guereza* are found in

forests and savanna woodlands within and to the north of the moist forests of central Africa, often extending into highland or montane forests (Jensz and Finly, 2011). The *C. guereza* is internationally not threatened according to the IUCN, even though this species is locally threatened in parts of its range (Finley, 2011). It has been pointed that most fauna species under protected areas are meant to be recorded without collecting to sustain their life (Spawls et al., 2018).

Movement and Feeding Behaviour of *Colobus guereza* Ruppellin

The *C. guereza* moves with the bounding motion of a squirrel, at different speeds (Thorington and Darrow, 2000). A jumping *C. guereza* holds its elbows akimbo and lands on its oversized feet with legs together and flexed to absorb shocks (Barker, 2018). The troops daily ranging takes it along the regular pathway from a central sleeping tree to sunning and forage trees and back (Johanson et al. 2015). The *C. guereza* troops of montane populations leave their sleeping tree to sunning and forage trees and back (Estes, 1999). The *C. guereza* prefers feeding on young to old foliage, and fruits make up to 1/3 of its diet in season, but its advantage over other monkeys including red *Colobus* monkeys is the ability to digest mature foliage too fibrous, distasteful, or toxic for other monkeys (Fashing, 2001). The *C. guereza* eats 25 to 33% of its weight in leaves per day, yet spends less time feeding than the associate velvets (30 to 45% of all time)

(Fashing, 2001). As leaf eaters, they spend 99% of feeding time just sitting on branch plucking leaves, long tails hanging down like the lichens that clothe the cloud forest.

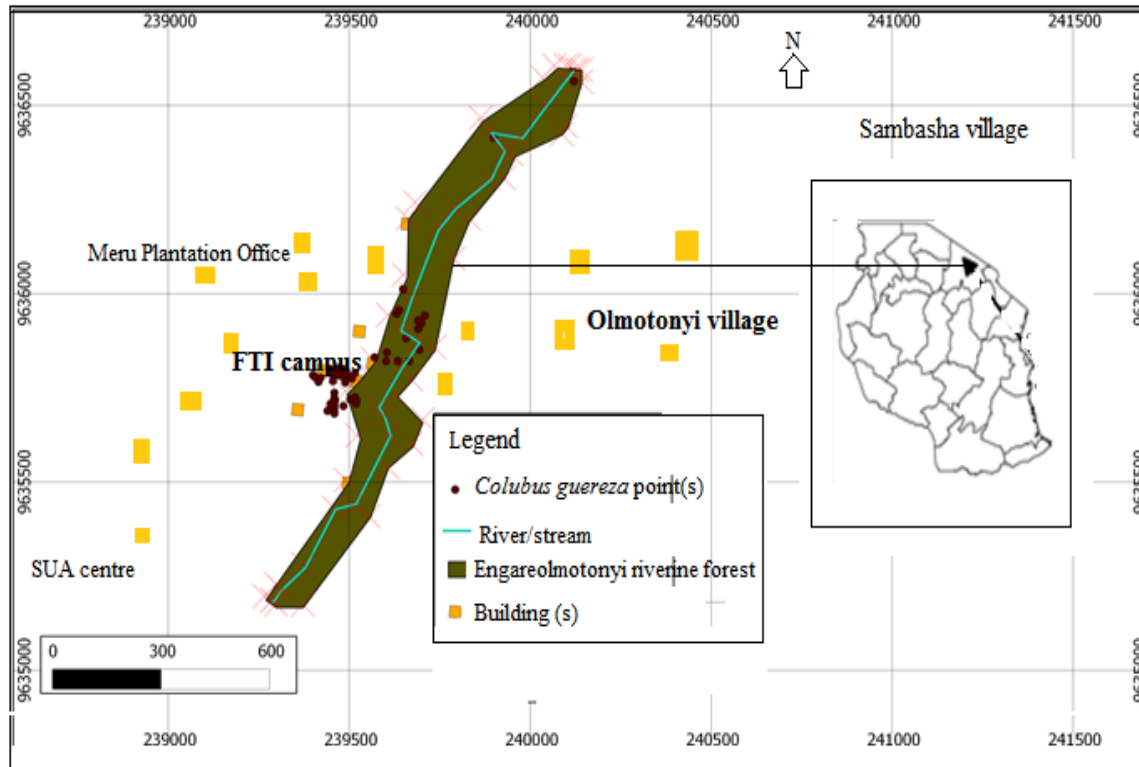
Problem Statement and Justification

There have been stories on the presence of *Colobus guereza* in several countries including Tanzania, while little researchable information exists on their movement and feeding behaviour. This study intended to assess the feeding, and movement behaviour of *C. guereza* in seasonally dry riverine forest of Engare-Olmotonyi and arboreta of Forestry Training Institute, campus in northern Tanzania. The information from this study will create awareness on their availability, movement, and plants fed and hence building strategies on how to protect the fed plants to sustain the existing *C. guereza* group.

MATERIAL AND METHODS

Description of Study Site

It is located at 37M 9636004; UTM 239677, with an altitude range of 1550 to 1700 m a.s.l. (Garmin GPS). It occupies the area of the Forestry Training campus, bordering the Mwinyi arboretum on the southeast, Meru plantation on the south east, north, and northeast; on the east and west it borders the buildings belonging to the Forestry Training Institute-Olmotonyi.

Figure 1: Study area of Engare-olmotonyi seasonally dry riverine

The vegetation is seasonally dry riverine dominated with trees of *Albizia gummifera* (J.F.Gmel.) C.A.Sm., *Croton megalocarpus* Hutch, *Calodendrum capense* (L.f.) Thunb. *Acokanthera oppositifolia* (Lam.) Codd., *Ehretia cymosa* Thonn, *Croton macrostachyus* Hochst. ex Delile, and *Cussonia holstii* Harms ex Engl. Interrupted with exotics of *Jacaranda mimosifolia* D.Don, *Euclaptytus maidenii* Fmuell. The woody climbers include *Pterolobium stellatum* (Forssk.) Brenan, *Toddalia asiatica* (L.) Lam, *Caesalpinia decapetala* (Roth) Alston, *Phytolacca dodecandra* L'Hér. The shrubs found at Engareolmotonyi River at Forestry Training Institute Olmotonyi included *Grewia similis* K.Schum *Abutilon longicuspe* Hochst. ex A.Rich., *Hoslundia opposita* Vahl., and *Maerua triphylla* A.Rich. The herbaceous plants are *Thunbergia alata* Bojer ex Sims, *Tragia brevipes* Pax, and *Lagenaria abyssinica* (Hook. f.) C. Jeffrey (herbaceous climbers), *Hypoestes aristata* (Vahl) Sol. ex Roem. & Schult., *Achyranthes aspera* L.,

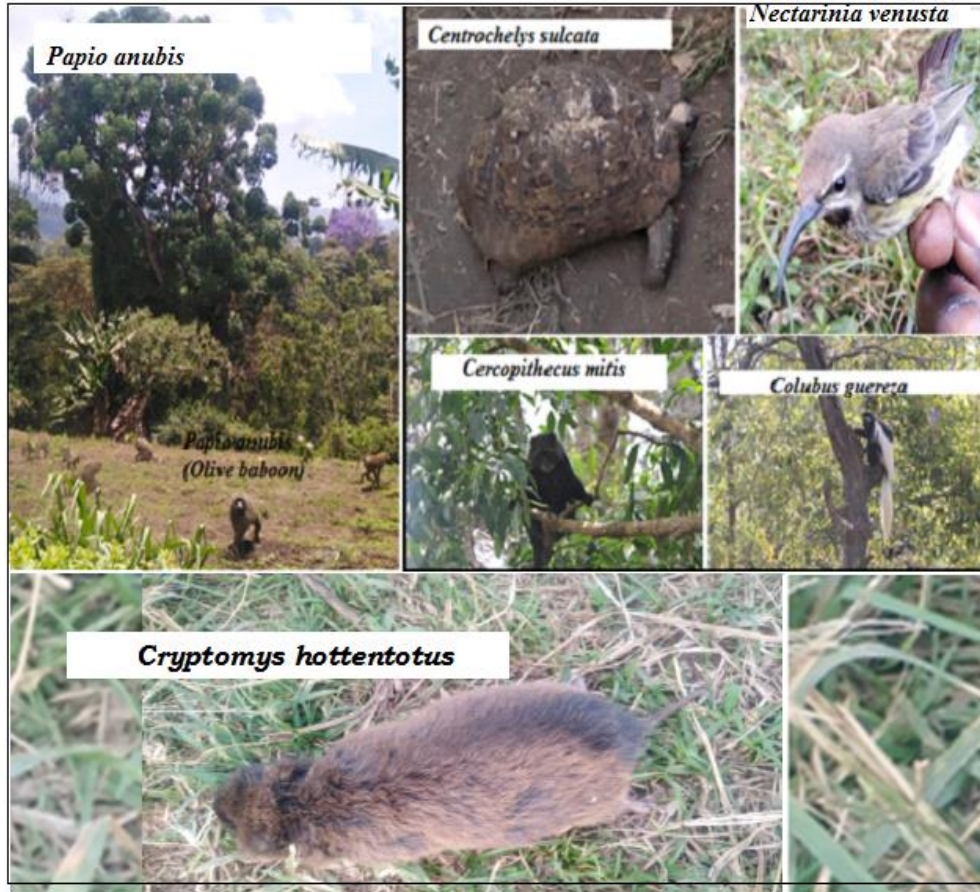
Galinsoga parviflora Cav., *Girardinia diversifolia* (Link) Friis, and *Ocimum gratissimum* L. Grasses include *Cynodon dactylon* (L.) Pers., *Setaria megaphylla* (Steud) Dur. & Schinz. The tree species within the buildings botanical garden (arboretum) are *Jacaranda mimosifolia* D.Don, *Syzygium guineense* (Willd.) D C, *Persea americana* Mill., *Calodendrum capense*, (L.f.) Thunb., *Croton sylvaticus*, *Schinus molle* L., *Olea capensis* L., *Brachychiton rupestris* (T.Mitch. ex Lindl.) K.Schum., and *Prunus serotina* (Kunth) Koehne

Fauna Species

The area harbours high fauna diversity including the threatened species of *Xerus inauris* (African pygmy squirrel) in the family Sciuridae; *Centrochelyssulcata* (African spurred tortoise). The others are *Papio anubis* (Olive baboon), *Cryptomys hottentotus* (African Mole-rat), the *Nectarinia venusta* (Variable sunbird), *Centropus superciliosus*

(White browed caucal) and *Cercopithecus mitis* (Plate 1), a variety of insects.

Plate 1: Fauna of Engare-olmotonyi riverine and within building forest



Data Collection Method and Analysis

A survey on the movement and feeding behaviour of *Colobus guereza* was done in the Afromontane vegetation of Engare-olmotonyi seasonally dry riverine forest at the Forestry Training Institute's campus in northern Tanzania. The movements and feeding behaviours were monitored for 30 days from mid of September 2020 to 16 October 2020, from 6.00 am to 7.00 pm. The sleeping and waking up times, trees fed by *C. guereza*, and trees they slept on were recorded and estimated for their height and canopy cover (light or dense). The disturbances discouraging their stay were also recorded.

The min-height of trees was calculated through $AHT = \frac{THAT}{TNT}$ where AHT = average height of trees; THAT = total height of all trees; TNT = total number of stems.

RESULTS

Waking up and Sleeping Time of *Colobus guereza*

The waking up time is from 6.30 am to 6.58 depending on the condition of the sky. When the sky is clear they wake up between 6.30 and 6.45 am, but when the sky is clouded, they wake up from beyond 6.45 am to 6.58 am. If the sky is cloudy and drizzly,

they may wake up but continue hiding in dense trees.

Sleeping Time and Place

The first action they make before going to sleep nearly all of them urinate. They sleep on tall trees with an average height of 17 m tall and beyond, at the highest canopy. The canopy cover may range from light but not very light, and on dense tree canopies. The trees preferred included *Jacaranda mimosifolia* D.Don, *Albizia gummifera* (J.F.Gmel.) C.A.Sm., and *Cussonia holstii* Harms ex Engl. These trees are tall and their tender leaves and flowers are also preferred as their food. They are 12 in total, and when sleeping each of them goes on a separate branch of the same tree or nearby tree in case the tree has fewer branches, with the oldest of them that seem to bet biggest of all sleeps some distance from all others on a nearby separate tall tree. And if the tree canopy does not satisfy the

carrying capacity, they separate into two groups of five (5) and seven (7).

Movement Behaviour

In the morning after urinating the young ones are directed to start jumping forward towards the direction of preference and the biggest jump lasts. Their movement is on trees, except wherever there are gaps they could walk for a short distance and jump on the tree they want to feed on or just to pass on to the next trees. As they woke up after urinating, they start feeding on the tree of preference, all the way to the afternoon. The height of trees the *C. guereza* were found to jump on and or sleep ranged from 24 ± 10 m, with an average height of 17 m. The tallest trees ranged from a height of 24 ± 20 m; while the medium had a height of $\leq 20 \pm \leq 15$ m. Most of the tallest trees were *Albizia gummifera* (J.F.Gmel.) C.A.Sm; *Jacaranda mimosifolia* D.Don; *Cussonia holstii* Harms ex Engl; and *Eucalyptys maidenii* F. Muell .

Plate 2: Movement behaviour of *Colobus guereza*



In the evening from after 3.00 pm to before 6.40 pm, they may spend few minutes walking or playing with each other on the ground, and then jump on the trees as they see either any person or anything walking around.

Feeding Behaviour and Parts Fed by *Colobus guereza*

The *C. guereza* feed on plant parts while also jumping from one branch to another on the same tree they are feeding on. They sometimes feed even on herbaceous plant parts especially the herbaceous climbers like on leaves of *Lagenaria abyssinica* (Hook.f) Jeffrey (Table 1), trees tender and mature leaves, and fruits (Table 1).

Plate 3: *Colobus guereza* feeding on trees



Cussonia holstii



Jacaranda mimosifolia

Of all plants, *Cussonia holstii* (Plate 3) was known to be the most preferred tree species as food for them, followed by *Jacaranda mimosifolia* D.Don (Plate 3), *Pterolobium stellatum* (Forssk.) Brenan,

Albizia gummifera (J.F.Gmel.) C.A.Sm, *Vachelia xanthophloea* Benth, *Lagenaria abyssinica* (Hook.f) Jeffrey and *Ehretia cymosa* Thonn was found to be the least preferred.

Table 1: Table of fed plants

Botanical name		Part they fed on			%	
		Observed	Leaves (TL/LF)	Fruit(s) (FR)		Flower (FL)
<i>Albizia gummifera</i> (J. F. Gmel.) C. A. Sm	4		TL		7.3	
<i>Bersama abyssinica</i> Fresen	1			FR	FL	1.8
<i>Cussonia holstii</i> Harms ex Engl.	23		TL	FR		41.8
<i>Ehretiacymosa</i> Thonn	1		LF	FR		1.8
<i>Jacaranda mimosifolia</i> D.Don	17		TL		FL	30.9
<i>Lagenaria abyssinica</i> (Hook.f) Jeffrey	2		LF			3.6
<i>Pterolobium stellatum</i> (Forssk.) Brenan	5		TL	FR		9.1
<i>Vachelia xanthophloea</i> Benth	2		TL			3.6
Total	55	8	4	2	100	

The Fabaceae family had the largest number of species preferred by *Colbus guereza*, while the rest had only one species each (Table 2). This study revealed that a total of two families (Fabaceae and Cucurbitaceae) are known to accommodate species

edible by human beings too, while three of them were not known to be eaten by human beings as food but also not known significantly to contain toxic constituent.

Table 2: Total number of species per family

Family	Total species fed	%
Fabaceae	3	37.5
Araliaceae	1	12.5
Boraginaceae	1	12.5
Bignoniaceae	1	12.5
Cucurbitaceae	1	12.5
Melanthaceae	1	12.5
Total	8	100

Threats of *Colobus guereza* and their Habitat

The identified threats were tree cutting that removes their habitats and routes as they always stay, feed, and sleep on tall trees, and the gaps disturb their behaviour of movement; uncontrolled solid disposal may damage their habit; buildings involve the removal of trees and hence damaging tall trees that among them offer food for them; footpaths when extended too much can damage seedlings, saplings and offer access to the interior trees that are being cut because of being accessible easily; car roads block the pathways of *C. guereza*.

DISCUSSION

The findings on separate sleeping of the *C. guereza* at Engare-olmotonyi seasonally dry riverine forest matches with the findings by Reichard (1997) who found that most primate group members usually slept in separate trees, and, except for females with infants, they never shared a sleeping place; the majority of sleeping trees were used only once, and fewer were selected repeatedly by the same or other group members, and usually females with infants went into a sleeping tree first, then juveniles and last were mostly sub-adult and adult males. Groups of *C. guereza* often sleep in dense trees near

commonly used food sources, which might reduce the time and energetic costs of travel (Hippel, 1998). The waking up range of *C. guereza* depends on the clouds cover, whether open or closed sky. When the sky is closed the darkness stays longer than normal days of open sky and hence delaying the working uptime. The sleeping is also dependent on the clouds cover; when the sky is cloudy the darkness starts earlier than when it is open sky. *C. guereza* feed on a variety of plant species (Harris & Chapman, 2007). Gron (2009) found that *C. guereza* was feeding on fruits and leaves of the tree of preference. Fashing (2000) pointed out that *C. guereza* usually feeds on leaves and fruits, and rarely on barks of trees. The other studies such as by Ibrahim (2017) found that *C. guereza* was feeding on leaves, fruits, and flowers, and bark. It has been pointed out that the geographical location of Black and white colobus monkey is among factors threatening the *C. guereza*, as they usually live mainly in third-world countries, so economics is a factor that affects their conservation, because home countries have high demand on the forest natural resources including land for cultivation and wood materials for construction, and land for settlement (Amani, 2006). The study done by Gron (2009) revealed that threats from human disturbances

including grazing damaged the undergrowth in the forests.

CONCLUSION AND RECOMMENDATIONS

Colobus guereza are born on trees, live on trees and die on trees. The movement and feeding depend on the preference and part of a particular tree. The tallest trees are most preferred for movement and sleeping, while ground movements are only for a short time and especially when crossing the tree lines gaps or across buildings. Waking times depend on the state of the sky, whether clear or cloud. Human activities threaten their habitats and food source of trees for various uses. Conservation strategies such as restoration of forest gaps, regular patrols, and ecotourism as non-woody income generating interventions are encouraged.

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