

Full Length Research Paper

Using fruiting Ape food trees (*Myrianthus holstii*) to count sympatric mammals at Kahuzi-Biega National Park, Eastern Democratic Republic of Congo

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Received 29 December, 2023; Accepted 21 June, 2024

Understanding the diversity and distribution of flora and fauna, and their interactions, is a prerequisite for a successful protected area management program. Between 2020 and 2022, camera traps were installed at 34 different stations in front of fruiting *Myrianthus holstii* trees, a species whose fruits are eaten by various mammal species. A total of 699 photos and videos were recorded. At least 23 mammal species were identified to have visited the fruit *Myrianthus* trees. *Cephalophus dorsalis*, *Cricetomys gambianus*, *Gorilla beringei graueri*, *Allochrocebus lhoesti*, and *Pan troglodytes schweinfurthii* were the most frequent with high relative abundance index (RAI). The activity period for most observed 10 mammal species revealed 60% of diurnal, 30% nocturnal, and 10% of cathemeral species. The amount of *M. holstii* fruits (estimated by the tree DBH) did not influence the visit frequency of mammal species. Ripe fruits of *M. holstii* may attract a wide diversity of sympatric mammals inhabiting Kahuzi-Biega National Park (KBNP). This study suggests that fruiting trees with camera traps may be used as a cost-effective approach to conduct census of sympatric mammals.

Key words: Camera traps, mammals census, fruiting trees, Kahuzi-Biega National Park.

INTRODUCTION

Kahuzi- Biega National Park (KBNP), in the eastern part of the Democratic Republic of Congo is home to critically endangered Grauer's gorillas (*Gorilla beringei* subsp. *graueri* Matschie, 1914, Hominidae), endangered Chimpanzees (*Pan troglodytes* subsp. *schweinfurthii* Giglioli, 1872, Hominidae) and thousands of flora and

other fauna species of exceptional diversity, making it one of the most important ecologically richest regions in Africa and worldwide (Plumptre et al., 2016).

To plan science-based conservation actions in KBNP, it is necessary to document the biodiversity found there and understand the relationship between fauna and flora.

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In this perspective, several wildlife inventories have been conducted in the KBNP in the past (Emlen and Schaller, 1960; Hall et al., 1997; Inogwabini et al., 2000; Plumptre et al., 2007, 2016; Kujirakwinja et al., 2011; Spira et al., 2018). Although often conducted at a very high human and financial cost, the results of these surveys have increasingly contributed to the implementation of conservation strategies for the park. However, many species of forest mammals are elusive, inhabiting dense vegetation habitats and often occurring at extremely low densities or range in harsh and inaccessible areas. Nocturnal species, in particular, may leave indirect signs that can elude observers. Surveys for these animals can be highly challenging, yet effective and reliable methods for rapidly assessing species richness and abundance are essential for determining conservation priorities (Silveira et al., 2003).

Animal diversity has been assessed either randomly in large areas using transects, or direct observation in areas of animal concentration, such as bays and saline regions. (Ngaba, 2015). During the fruiting season, many plant species that produce fruits preferred by animals may attract different animal species, some to feed on the fruit and others to hunt prey that come to eat the fallen fruits.

Myrianthus trees are abundant in KBNP. They attract a large number of wild mammal species in association with their fruit, foliage and shade, thus acting as feeding, recreation and hunting grounds. *Myrianthus* fruit is an important food source for wild animals at various sites across Africa (Rode et al., 2006; Rothman et al., 2007; Reiner et al., 2014; Yamagiwa and Basabose, 2006). At KBNP, Basabose (2002) reported *Myrianthus holstii* fruits are among the top three fruit species in the diet of *P. t. schweinfurthii*. They are, therefore, ideal sites for observing animals for a variety of purposes such as research (animal ethology, interactions between species, structuring, etc.), economic (development of tourism, etc). The main question is whether the sites colonized by *Myrianthus* trees at KBNP guarantee viable and sustainable sites for research and the development of ecotourism. To date, apart from great apes, no other animal species visiting or consuming *Myrianthus* fruits has been documented.

This study aims to assess the diversity of mammal species that frequent fruiting trees of *M. holstii* using camera traps at KBNP.

METHODOLOGY

Study area

The study area (2°5' S, 28° 45' E; between 2,050 and 2,350 m above sea) is located in the upland sector of Kahuzi-Biega National Park (KBNP), Democratic Republic of Congo (Figure 1). The vegetation of the area consists of bamboo *Arundinaria alpine* K. Schum. (Poaceae) primary forest and secondary forest *Cyperus latifolius* Poir. (Cyperaceae) swamps. Detailed descriptions of the vegetation are given by Casimir (1975) and Spira et al. (2018).

Data collection

The study was carried out over an 11-month period (June–November 2020, June–July 2021, and August–November 2022) during the fruiting seasons of *M. holstii*. Cameras traps (Bushnell Trophycam HD aggressor models, <http://bushnell.com>) were installed at 34 different stations in front of fruiting *M. holstii* trees at a distance ensuring a better view on what was happening around the *Myrianthus* tree. Each camera trap was installed in front of one (1) to three (3) fruiting *Myrianthus* trees. A total of 53 *M. holstii* trees were surveyed. The distance between two camera traps was at least 250 m, and they were positioned 10 to 15 meters away from fruiting *Myrianthus* trees. Each camera station received only one trap during the survey. Camera traps were randomly placed on fruiting *Myrianthus* trees ensuring each camera was separated from another camera trap by at least 250 meters.

At each installation station, the camera was oriented to the fruiting *Myrianthus* trees at 0° or 180° (North–South direction), this direction helped to avoid solar rays affecting the camera lens. It often uses a deviation of $\pm 20^\circ$ to compensate for observation problems due to certain obstacles such as windfalls, dense vegetation and streams (N'goran et al., 2020; Monk et al., 2021). The camera traps were configured in hybrid mode (video and photo). These cameras were attached to trees located in front of the target fruiting *Myrianthus*, at a height of 40–60 cm above the ground. The camera traps were removed 30 days later and then placed elsewhere in a new station using the same procedure. They were relocated to maximize the chances to record new species. To assess the fruit availability (fruit amount) for each targeted fruiting *Myrianthus* tree, Diameter at Breast Height (DBH) was used. Basal area $[(1/2DBH)^2 \times \pi]$ has been used as a good estimation of canopy volume and an indicator of fruit availability (Basabose, 2002).

Data analysis

Species richness

Photos and videos were viewed on the computer using VLC Media Player video and Camera Base 1.7 softwares. Identification of animal species was enabled using the African Mammal Guide (Kingdon, 2016) and red list IUCN (2008) for the animal status. When the animal was seen in videos or photos, it could be identified (full name of the species known or scientific name and vernacular name) as indicated by N'goran et al. (2020). Successive detections of the same species separated by more than 30 min were considered independent events. Indeed, 30 min has been commonly used as a threshold for independence in this type of study (O'Brien et al., 2003; Tobler et al., 2008; Meek et al., 2014; Djami et al., 2023) except in the case of individuals of different sex and age. The identification of all the species observed allowed us to determine the species richness and a list was composed.

The diversity of mammals frequenting *Myrianthus* trees in the park was assessed using the Shannon–Wiener index (H') and the Pielou index. The Shannon–Wiener index (H') quantifies the biodiversity richness of the study environment (Tuomisto, 2010; Kouakou et al., 2021), using the following formula:

$$H' = -\sum p_i \times \ln(p_i)$$

where p_i is the proportional abundance or percentage importance of the species.

Proportional abundance is calculated as follows: $p_i = n_i/N$; n_i = number of individuals of a species in the sample; N = total number of individuals of all species in the sample. This index was calculated on the basis of the species identified.

Pielou's equitability index was calculated using the following

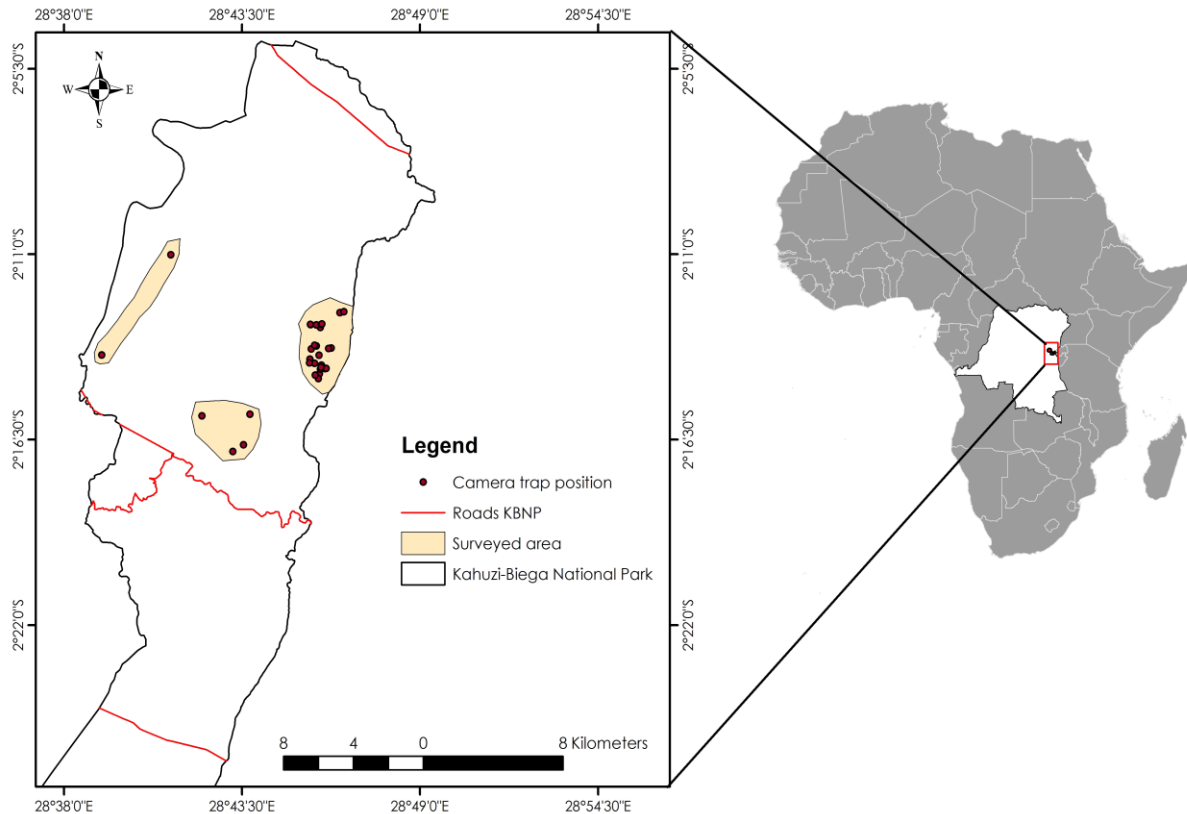


Figure 1. Position (sites) of camera traps installed on fruiting *Myrianthus* trees.

formula: $J = H'/H'_{\max}$.

Relative abundance index (RAI)

The relative abundance index was calculated as follows:

$$RAI = \frac{A}{N} \times 100$$

where A represents the total number of captures (detections) of a species by all cameras, and N is equal to the total number of captures for all species detected during the study period (Liu et al., 2013).

Correlation between fruit amount and mammal species frequency visits

A Spearman correlation test was used to determine the relationship between the amount of fruits on *Myrianthus* trees, and the frequency visit of animal species.

Activity periods

The activity periods were determined according to the classification of Gomez et al. (2005) (Table 1). In the study area, the sunrise occurs around 6:00 am and the sunset around 6:00 pm local time. Following Ross et al. (2013), daytime activity was classified as taking place between 7:00 am and 5:00 pm and nocturnal activity

between 7:00 pm and 5:00 am; the remaining periods are referred to as "crepuscular".

This study was carried out in a circular statistical analysis using Oriana 4.02 software for the 10 mammal species with at least 20 recordings or captured events (Lenher, 1996; Kovach, 2011). Species with less than 20 recordings were not considered in this analysis. The average vectors were determined (in our context, hours of activity around which the data are concentrated). N'goran et al (2020), show that the mean vector has two properties: the mean angle (μ), which represents the average of the activity times of each species expressed in hours of the day, and the length (r), which indicates a concentration of observations around the mean. The length varies between 0 and 1. A smaller value of r indicates that the observations are not concentrated around the mean.

Rayleigh uniformity test (Z test) was also performed to test the significance of the activity periods classification using the formula $Z = nr^2$; where n is the number of observations and r is the length of the mean vector. A higher value of Z indicates a low probability that the data is uniformly distributed. The significance level ($p < 0.05$) indicates an unequal distribution of the data around the mean. The Rao spacing test (U) was used to see whether the spacing between adjacent points around the circle is roughly equal. The low probabilities indicate a non-uniformity of spacing and, therefore, a reduction in the distribution of data.

RESULTS

Capture frequency and species richness

During the surveys, 699 video and still photographs

Table 1. Classification of activity periods of mammal species with at least 20 recordings or total capture events ($N \geq 20$) according to Gomez et al. (2005).

Activity period	Definition
Diurnal species	Less than 10% of sightings at night
More diurnal than nocturnal species	10 to 30% of sightings at night
Cathemeral species	30 to 70% of sightings at night
More nocturnal than diurnal species	70 to 90% of sightings at night
Nocturnal species	Over 90% of sightings at night
Crepuscular species	50% of observations at dusk

(captures) of mammal species with 23 identified species was obtained and at least three unidentified rodents from a total of 751 camera days (Table 2). The number of mammal species increases with the number of stations (Figure 2). Among mammals, Artiodactyls represent 33.76%, followed by Rodents (32.47%), Primates (29.33%), Carnivorous (4.29%) and Chiroptera (0.14%) (Figure 2). Generally, *Cephalophus dorsalis* Gray, 1846 ($n = 131$) was the most frequent species on *Myrianthus* trees, followed by *Cricetomys gambianus* Waterhouse, 1840 ($n = 79$) and *G. beringei* subsp. *Graueri* Matschie, 1914 ($n = 71$), *Allochocebus lhoesti* Sclater, 1899 ($n = 51$), *P. troglodytes* subsp. *Schweinfurthii* Giglioli, 1872 ($n = 47$), etc. The camera traps also captured four domestic dogs (*Canis lupus familiaris* Linnaeus, 1758) and two poachers.

The species accumulation curve trend (Figure 3) shows that this study has not yet captured all the species, which frequent the fruiting *Myrianthus* trees.

Analysis of the Shannon diversity index shows that, overall, the *Myrianthus* sites at PNKB are frequented by diverse species ($H' = 2.46$). In terms of Equitability, *Myrianthus* trees are evenly frequented by mammal species ($J = 0.78$).

RAI for species frequenting fruiting *Myrianthus* trees

The highest RAI was found for Bay Duiker (*C. dorsalis*, 18.74%) followed by those of *C. gambianus* (11.30%) and *G. beringei* subsp. *graueri* (10.16%). The lowest RAI was found in March, that is, cane rat (*T. swinderianus*), Servaline Genet (*G. servalina*), African Striped Weasel (*P. albinucha*) and *E. labiatus*, with RAI=0.14% for each.

Correlation between DBH and species frequency on *Myrianthus* plants

The DBH of fruit trees provides information on fruit availability. The results indicate a very weak negative correlation (Spearman's $\rho = -0.059$, $P > 0.05$) between DBH and the frequency of wild animals on *Myrianthus*

trees (Figure 4). This study, therefore, shows that the frequency of animal species is independent of the amount of the fruits (assessed by DBH of the tree).

Activity Period of wild animal species

The distribution of captures, according to the daytime, shows that the mammal species observed around the fruiting *Myrianthus* trees were nocturnal, diurnal or cathemeral. Grauer's Gorilla, Common Chimpanzee, Owl-Faced Monkey, L'hoest's Monkey, Red River Hog, and Carruther's Mountain Squirrel are mainly diurnal (Table 3 and Figure 5). Those diurnal species represent 60% of recordings. However, Bay Duiker, Gambian Giant Pouched Rat and African Porcupine are nocturnal (30%). A tendency towards cathemeral activity was observed in the Giant Genet (*G. victoriae*) representing 10%.

A circular statistical analysis using Oriana 4.02 software was carried out for the 10 mammal species with more than 20 recordings or capture events. Table 4 shows the results from Rayleigh's uniformity test and Rao's spacing test. These analyses indicate that the hours of activity obtained from the 10 mammal species are significantly non-uniformly distributed ($P < 0.05$), and the data are essentially concentrated at a certain period of the day depending on the species ($P < 0.01$). The hours of activity for each species were concentrated around the mean vector (mean hour around which the species' hours of activity are concentrated).

DISCUSSION

Recent biodiversity inventories were conducted across 61% (406,250 ha) of KBNP (both lowland and upland sectors) by Spira et al. (2018), who recorded over a period of four years (2014-2017) 46 mammal species. In the study, it was recorded over a period of three years (2020-2022) a total of 23 non-human mammal species, and at least three unidentified rodents visiting *Myrianthus* fruiting trees, located in three zones representing only 4,789.34 ha in the upland sector of KBNP. This represents over 50% of all mammals recorded by Spira et

Table 2. Species richness and relative abundance of the different mammal species that visited targeted fruiting *Myrianthus* trees at the study site of KBNP.

Class	Order	Family	Species	Common name	Diet	Status UICN	Nb Cam	Event (n)	RAI (%)
Mammals	Primates	Hominidae	<i>Gorilla beringei graueri</i> Matschie, 1914	Easten Lowland Gorilla	H/F	CR	12	71	10.16
		Hominidae	<i>Pan troglodytes schweinfurtii</i> Giglioli, 1872	Common chimpanzee	H/F	EN	15	47	6.72
		Cercopithecinae	<i>Cercopithecus hamlyni</i> Pocock, 1907	Owl-faced Monkey	H	VU	16	30	4.29
		Cercopithecinae	<i>Cercopithecus mitis</i> Wolf, 1822	Blue Monkey	H	LC	3	4	0.57
		Cercopithecinae	<i>Allochrocebus lhoesti</i> Sclater, 1899	L'hoest's Monkey	H	VU	17	51	7.30
		Hominidae	<i>Homo sapiens</i> Linnaeus, 1758	Human	O	-	1	2	0.29
	Artiodactyls	Antilopinae	<i>Cephalophus dorsalis</i> Gray, 1846	Bay Duiker	F/H	NT	21	131	18.74
		Antilopinae	<i>Cephalophus nigrifrons</i> Gray, 1846	Black-fronted Duiker	H	LC	3	4	0.57
		Bovidae	<i>Tragelaphus scriptus</i> Pallas, 1766	Bushbuck	H	LC	2	2	0.29
		Suidae	<i>Potamochoerus porcus</i> Linnaeus, 1758	Red River Hog	O	LC	4	20	2.86
	Rodents	Nesomyidae	<i>Cricetomys gambianus</i> Waterhouse, 1840	Gambian Giant Rat	H	LC	20	79	11.30
		Hystriidae	<i>Atherurus africanus</i> Gray, 1842	African Porcupine	H	LC	9	37	5.29
		Tryonomidae	<i>Thryonomys swinderianus</i> Temminck, 1827	Marsh Cane Rat	H	LC	1	1	0.14
		Sciuridae	<i>Funisciurus carruthersi</i> Thomas, 1906	Carruther's mountain squirrel	H	LC	9	28	4.01
		Sciuridae	<i>Paraxerus sp</i> Forsyth Major, 1893	Squirrel	H	LC	5	49	7.01
		Sciuridae	<i>Xerus erythropus</i> E. Geoffroy Saint-Hilaire, 1803	Sriped Ground Squirrel	H	LC	2	5	0.72
		Murinae	<i>Unidentified Rats</i>	Rat	H	LC	17	98	14.02
	Carnivores	Herpestidae	<i>Atilax paludinosus</i> Cuvier, 1829	Marsh Mongoose	C	LC	3	9	1.29
		Herpestidae	<i>Galerella sanguinea</i> Rüppell, 1836	Slender Mongoose	C	LC	1	5	0.72
		Viverridae	<i>Genetta victoriae</i> Thomas, 1901	Giant Genet	C	LC	7	21	3.00
		Viverridae	<i>Genetta servalina</i> Pucheran, 1855	Servaline Genet	C	LC	1	1	0.14
		Mustelidae	<i>Poecilogale albinucha</i> Gray, 1864	African Stiped Weasel	C	LC	1	1	0.14
		Canidae	<i>Canis lupus familiaris</i> Linnaeus, 1758	Hunting Dog	C	LC	1	2	0.29
	Chiroptera	Pteropodidae	<i>Epomophorus labiatus</i> Temminck, 1837	Megachyroptera	F	LC	1	1	0.14

Total number of camera trap sites in this present study is 34. D: Diet; H: herbivore; C: carnivore; O: omnivore; F: frugivorous; EN: endangered; VU: vulnerable; NT: near threatened; LC: least concern; RAI: relative abundance index; IUCN: International Union for Conservation of Nature; Nb cam: number of camera traps; n: number of captures/events.

al. (2018) using a traditional transect method over a four-year period. Given the small area sampled, these results suggest that ape fruiting trees may be used to count sympatric mammal species for a

rapid census, when facing limited resources and time. Fruiting trees, which fruits are eaten by apes, are also visited by numerous mammal species to eat ripe fruits.

Carnivora species such as *Atilax paludinosus*, *Guzmania sanguinea*, *Grevillea victoriae*, *Genetta servalina*, *Poecilogale albinucha* and human hunters, with domestic dogs (*Canis lupus* subsp.

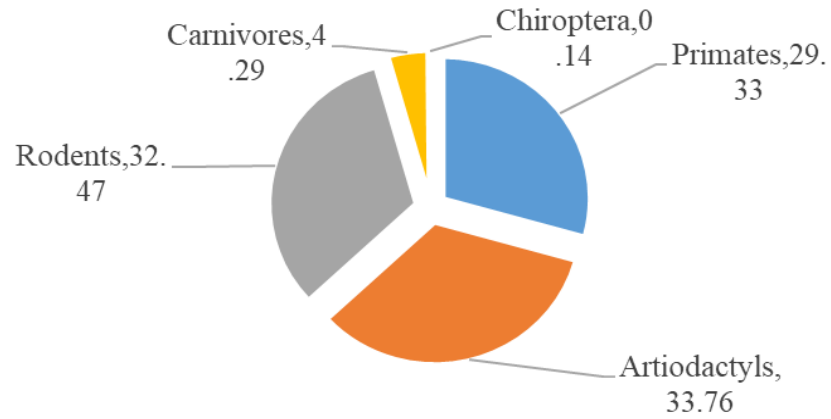


Figure 2. Proportion of mammal orders captured next to *Myrianthus* trees.

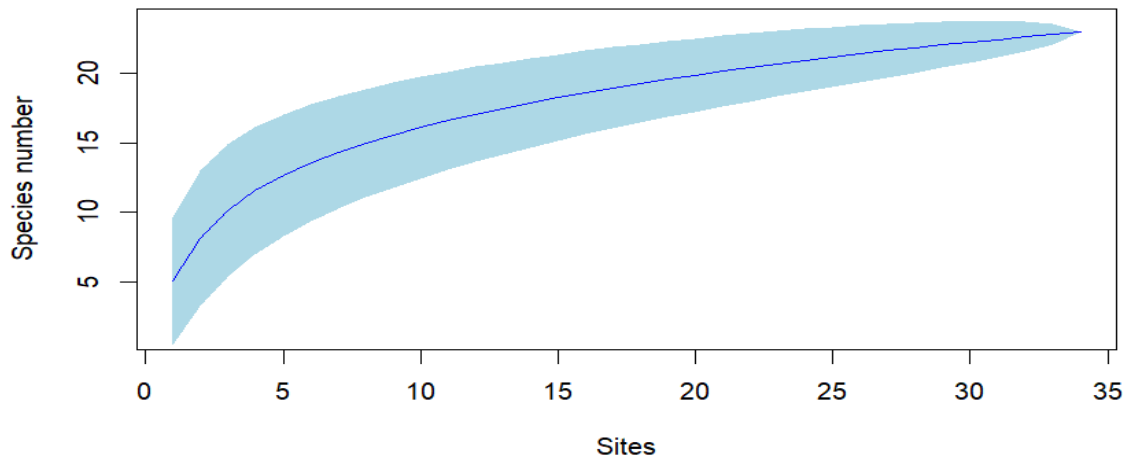


Figure 3. The species accumulation curve on the sites sampled (Rising curve).

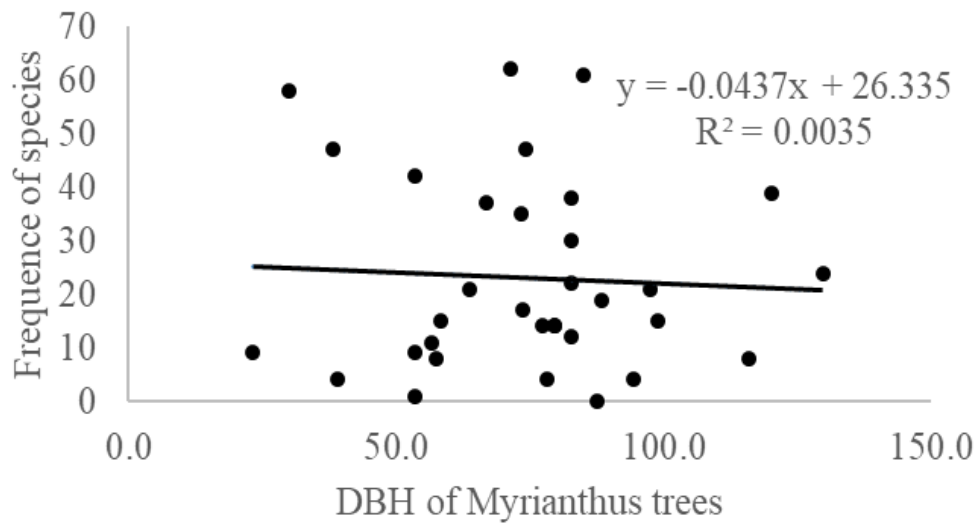


Figure 4. Correlation between the DBH of *Myrianthus* trees and the animal species frequency ($R^2 = 0.0035$).

Table 3. Activity periods of mammal species (with N ≥ 20) recorded by camera traps on fruiting *Myrianthus holstii* trees.

Species	(N)	% of capture events per activity period			Classification
		Daytime (n)	Night (n)	Crepuscular (n)	
<i>Gorilla beringei graueri</i>	71	98.6 (70)	0	1.4 (1)	Diurnal
<i>Pan troglodytes schweinfurtii</i>	47	100 (47)	0	0	Diurnal
<i>Cercopithecus hamlyni</i>	30	96.7 (29)	0	3.3 (1)	Diurnal
<i>Allochrocebus lhoesti</i>	51	94.1 (48)	5.9 (3)	0	Diurnal
<i>Cephalophus dorsalis</i>	131	11.5 (15)	80.9 (106)	7.6 (10)	More Nocturnal
<i>Potamochoerus porcus</i>	20	70 (14)	5.0 (1)	25.0 (5)	Diurnal
<i>Cricetomys gambianus</i>	79	0	89.9 (71)	10.1 (8)	More Nocturnal
<i>Atherurus africanus</i>	37	0	91.9 (34)	8.1 (3)	More Nocturnal
<i>Funisciurus carruthersi</i>	28	100 (28)	0	0	Diurnal
<i>Genetta victoriae</i>	21	14.3 (3)	61.9 (13)	23.8 (5)	Cathemeral

N: Total events; n: daytime/night/crepuscular events.

familiaris), use fruiting trees as hunting spots, where they frequently visit to catch and kill small antelopes and rodents. Omnivores may visit fruiting trees either to feed on ripe fruits (Koike et al., 2008) or to prey on small mammals visiting the same trees for feeding on fallen ripe fruits. Carnivores have been reported to generally favor areas where prey is abundant, such as grasslands, forest borders and wetlands (Winterbach et al., 2013; Ripple et al., 2014). Presence of trees bearing ripe fruits may attract a variety of prey influencing the seasonal movements of carnivores (Ripple and Beschta, 2003 ; Ray et al., 2005). Shannon's diversity index and Pièlou's equitability index revealed that fruiting trees of *M. holstii* may be used to study the diversity of sympatric mammal species inhabiting the upland sector of KBNP. The results suggest that ape fruiting trees may be used to study the socio-ecology of sympatric mammals. This study may be a pioneering step towards a large-scale mammal census in the KBNP.

This study clearly classified different mammals according to their activity period. Rayleigh's uniformity test and Rao's spacing test show that activity hours obtained from 10 mammal species, with more than 20 sightings, are significantly non-uniformly distributed and data are mainly concentrated at a certain period of the day depending on species. Similar results were obtained by N'goran et al. (2020) for species such as *C. dorsalis*, *Atherurus africanus*, *P. troglodytes* and *Potamochoerus porcus* in Taï National Park, Côte d'Ivoire. The results indicate that six species, including Grauer's gorilla, common chimpanzee, owl-faced monkey, lhoest monkey, carruther's mountain squirrel and red-river hog, are mainly active during the day. In addition, nocturnal activities are observed from African porcupine, bay duiker, Gambian giant rat and the giant genet. Activity periods obtained in this study are similar to those reported in other studies (Bruce et al., 2018; Hedwig et al., 2018; N'gora et al., 2020; Monket et al., 2021). Diurnal activities observed in the morning hours of *C.*

dorsalis are thought to be the result of shifts in the timing of the end of activities of certain individuals. This is because some *C. dorsalis* individuals start activities later than others; therefore, they leave them later (Feer, 1989). Some individuals of *A. lhoesti*, observed at night, seem to be flushed out of their resting site by poachers or armed groups, who sometimes illegally mine minerals in the park (Kujirakwinja et al., 2011).

The study estimated the relative abundance of different mammal species. Species with the highest RAI were *C. dorsalis* (18.74%), followed by *C. gambianus* (11.30%), *G. beringei* subsp. *Graueri* (10.16%), *C. lhoesti* (7.30%), and *P. troglodytes* subsp. *schweinfurtii* (6.72%). These species are also the most common species seen around fruiting *Myrianthus* trees. *C. dorsalis* has also been recorded among the frugivorous duiker species in Taï National Park (Chatelain et al., 2001).

Previous studies have shown that tree size influences the amount of fruit (Nacoulma et al., 2011; Gaoue and Tickin, 2008). However, the results showed that animal visit around *Myrianthus* trees is independent of tree size or fruit amount. In fact, fruits are consumed when they are most needed, and not when they are more abundant (Campbell, 1986).

Conclusions

This study highlights the importance of ape fruiting trees (*Myrianthus*) distribution on mammals' ecology at KBNP. A list of mammal species visiting these trees was drawn up. These include *C. dorsalis*, *C. gambianus*, *G. beringei* subsp. *Graueri*, *C. lhoesti*, and *P. troglodytes* subsp. *schweinfurtii* with higher relative abundance values. In addition, most of these frugivorous animal species frequently visit *Myrianthus* trees bearing ripe fruits in search of fruits, while others (e.g. carnivora species and human hunters) are visiting these trees to hunt small animals feeding on *Myrianthus* fruits. This study is the

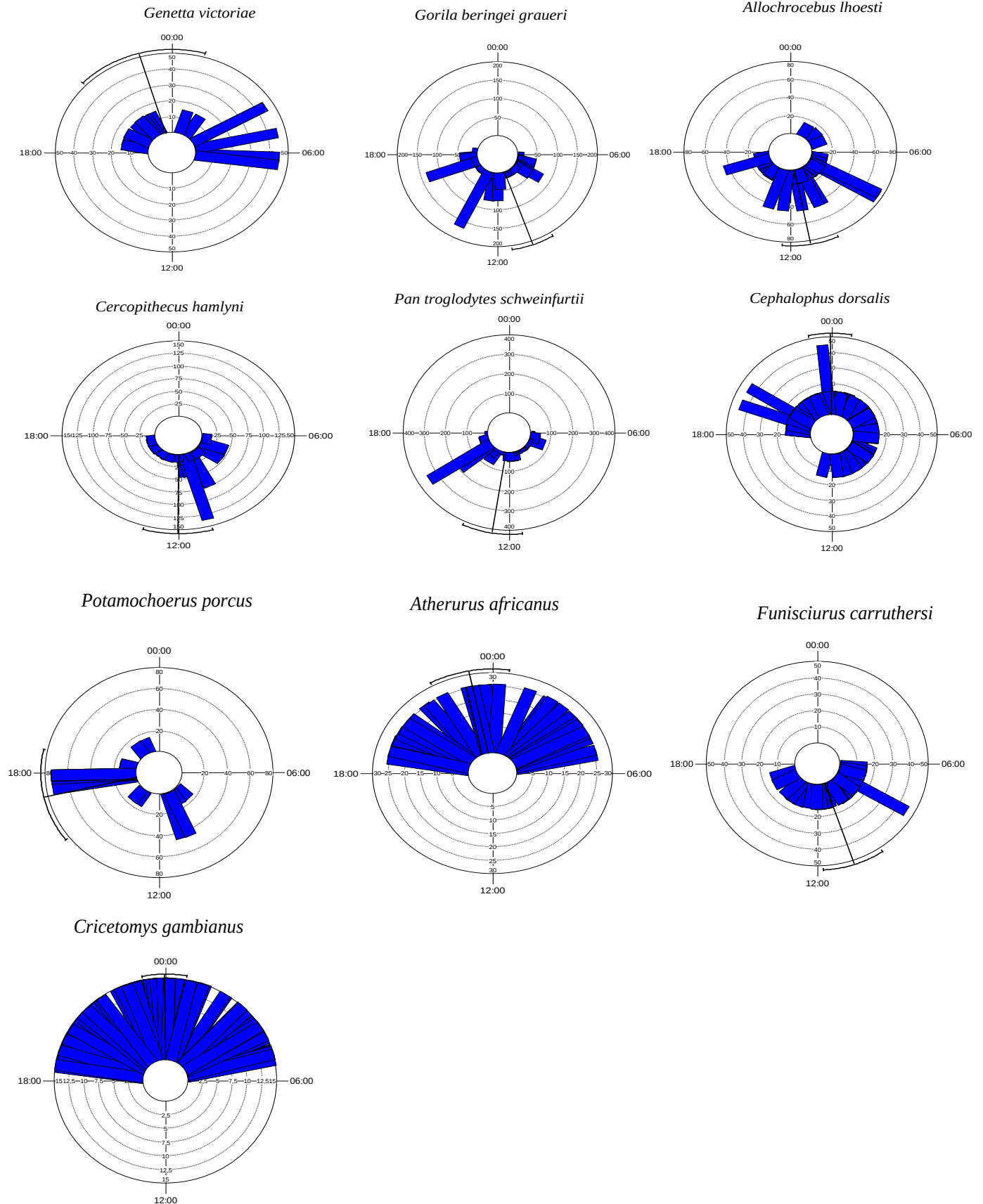


Figure 5. Circular representation of activity periods for 10 species with at least 20 capture events.

Table 4. Results of circular statistical analysis of activity period for species with more than 20 observations or capture events ($N \geq 20$).

Group	Species	r	Average vector (h)	Circular variance	Circular standard deviation	Confidence Interval 95% (h)	Z	U (μ)
Primates	<i>Allochrocebus lhoesti</i>	0.646	11 :17	0.354	03 :34	10:17, 12:17	21.28, $P < 0.05$	187,437, $P < 0.01$
	<i>Cercopithecus hamlyni</i>	0.714	12 :01	0.286	03 :08	10:54, 13:08	15,294, $P < 0.05$	193,117, $P < 0.01$
	<i>Gorilla beringei graueri</i>	0.672	10 :39	0.328	03 :24	09:51, 11:27	32,062, $P < 0.05$	212,622, $P < 0.01$
	<i>Pan troglodytes schweinfurtii</i>	0.634	12 :36	0.366	03 :38	11:32, 13:40	18,866, $P < 0.05$	213,959, $P < 0.01$
Bovidae	<i>Cephalophus dorsalis</i>	0.553	23 :56	0.447	04 :09	23:10, 00:41	40,003, $P < 0.05$	186,749, $P < 0.01$
Carnivore	<i>Genetta victoriae</i>	0.519	22 :56	0.481	04 :22	20:49, 01:03	5,383, $P < 0.05$	199,146, $P < 0.01$
Suidae	<i>Potamochoerus porcus</i>	0.621	17 :08	0.379	03 :43	15:27, 18:49	7,724, $P < 0.05$	211,367, $P < 0.01$
Rodents	<i>Atherurus africanus</i>	0.615	23 :15	0.385	03 :45	22:00, 00:30	13,994, $P < 0.05$	206,485, $P < 0.01$
	<i>Cricetomys gambianus</i>	0.673	23 :57	0.327	03 :23	23:12, 00:42	35,797, $P < 0.05$	219,161, $P < 0.01$
	<i>Funisciurus carruthersi</i>	0.757	10 :45	0.243	02 :51	09:42, 11:48	16,044, $P < 0.05$	197,056, $P < 0.01$

r is a length of Mean vector, Z the uniformity test, U the Rao spacing test and μ the spacing test.

first-ever informing on activity periods of several mammal species at KBNP. They are either diurnal, nocturnal or cathemeral. This pioneering study paves the way for furthermore systematic ecological studies.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENTS

The authors thank all those who contributed to the work, the whole Primate Expertise team for their support in carrying out this study. They thank their partners Wild Earth Allies (WEA) for all their support, including funds sourced from many

generous individuals for this work. They also thank the Congolese Institute for Nature Conservation (ICCN), Kahuzi-Biega National Park management for authorizing this study to be undertaken in the park and also the park rangers and guides support during field works.

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