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A baseline camera trapping survey of wildlife utilizing termite mounds in Marguba Range division of Old Oyo National Park

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Abstract

Camera traps (CTs) can capture nocturnal and elusive species of wild animals. However, records of the survey of termite mounds (TMs) and their users with CTs are uncommon. This study investigated TMs using the opportunistic encountering technique at Old Oyo National Park. For every encounter, a Garmin GPS 45 and meter rule was used to take the coordinates and dimensions respectively. Users of five randomly selected TMs, showing signs of geophagy, were surveyed with five CTs for 21 days twice. Data were analyzed using descriptive and inferential statistics. Our observation identified two types of TMs; conical (CTMs) and cathedrals (KTMs) which were not significantly ($p > 0.05$) different in numbers and dimensions. Of the 10 mounted CTs, only two recorded 50 animals from among 4 different species in 12 detections with a total of 152.8 trap nights. Cattle was the highest number of species trapped (31) with four detections (33.3 %), followed by 15 tantalus monkeys with 5 detections (41.6 %), three Kobs with two detections (16.6 %), and one African civet cat with detection (8.3 %). Across all the detections, only Kob was captured eating TMs. The activity pattern of Kobs and African civet cats was nocturnal. Meanwhile, those of the tantalus monkeys and cattle were diurnal. Cattle were found to have been utilizing more important areas of the park than wildlife. A more sophisticated strategy may be needed for the effective management of the keystone resources of the park.

Keywords: African civet, keystone resources, Kobs (*Kobus kob*), tantalus monkey (*Chlorocebus tantalus*)

Introduction

Wildlife is generally known to feed on either meat (carnivores) or plants (herbivores) and on both meat and plants (omnivores) (Robbin, 1983). Studies of wildlife feeding on soils from termite mounds (TMs) are frequently surfacing (Mahaney et al., 1999; Ketch et al., 2001). This special behavior, though does not have a place among the commonly classified feeding habits in wildlife, but however generally referred to as geophagy. The deficiency of the required nutrients in wildlife diets and competition for food within the habitat may have stimulated them to seek soils from TMs as an alternative source of nutrients (Krishnamani and Mahaney, 2000; Pebsworth et al., 2019).

Even though TMs can be easily noticed in both the urban and forest areas of the tropics, studies identifying wildlife utilizing them as a source of diet are very scarce, most especially with the use of camera traps (CTs). This is however not unexpected as the use of CTs in the study of wildlife is currently being adopted (2014). Existing literature commonly utilized binoculars which are limited in capturing nocturnal and elusive species for such studies (Ayotte et al., 2006). This study is therefore aimed at using CTs to identify wildlife utilizing soils from TMs at the Marguba range division of Old Oyo National Park and classified them based on their activity pattern.

Materials and methods

Study Area

Old Oyo National Park (OONP) occupies an area of 2,512km^2 to retain its qualification as the fourth largest park among the current seventeen national parks in Nigeria. The park is located in the southwest, Oyo State Nigeria with longitude 3°35'and 4°20´E and latitudes 8°10´N and 9°5´N. For effective management, the park is divided into five ranges; Marguba range (in Sepeteri town), Tede range (in Tede town), Oyo lle range (in Lgbeti town), Yemoso range (in lkoyi town), and Sepeteri range (in Igboho town). It has records of a different number of species of wildlife including Kob (*Kobus kob*), Roan antelope (*Hippotragus equinus*), African buffalo (*Syncerus caffer*), Red-flanked duiker (*Cephalophus rufilatus*), Oribi (*Ourebia ourebi*), Common duiker (*Sylvicapra grimmia*), Olive baboon (*Papio anubis*), Hartebeest (*Alcelaphus buselaphus*) and Bushbuck (*Tragelaphus scriptus*). Oyeleke et al. (2015) reported that all these animals are potential geophagic species. The two major rivers in the park are River Ogun and River Tessi from which other rivers drain (Adetoro, 2008). This study aimed to document the geophagy behavior among the species in the study area using camera trapping methodology.

Material and methods

Data Collection

Data were collected in two phases at the Marguba range division of OONP. The first phase (inventorying TMs along River Ogun) was carried out in February 2020 while the second phase (camera trapping) was carried out in January through February 2021.

Inventory and measurement of Termite mounds

An opportunistic encounter method was used to search for TMs by taking a walk within 5-10m width along each side of the R. Ogun in the Ibuya and Iyemosho area of the Marguba range division of OONP. Once a TM was encountered, a hand-held Garmin GPS was used to record the coordinates of the location and a measuring tape was used to measure its dimensions (height and diameter). Adopting the method of Dowuona et al. (2012), the shape of the TMs was identified and recorded in addition to their surrounding trees. Using wildlife geophagic signs (trails, droppings, marks, etc), 10 active TMs having evidence of geophagy were identified and selected for camera study.

Camera trapping

The research locations for camera settings comprise of 10 TMs randomly selected from among the active TMs earlier identified in the first phase of the study. Two 21-day camera trap surveys were carried out with no attractants so that a total of 10 TMs were surveyed with 5 cameras within 21 days in 2020 and again in 2021. Every 5 sets of camera traps positioned at 5 different TMs were checked after 21 days to retrieve digital photographs and replace batteries before being transported and re-positioned at another 5 different active TMs. The camera trap used has a passive infrared motion sensor with high-image storage of 32 GB Secure Digital (SDHC®) Memory Card. It is automatically triggered by the movement of heat-emitting objects that passed in front of it both day and night (24hrs/day) to record their presence in the form of images/video. It has a photo resolution of 12MP (4032 x 1080P) with a focal length of 6mm, a field of view (FOV) of 120^{o}) and a passive infrared (PIR) distance of 15m. Each camera was mounted on a tree at a height ±60cm off the ground depending on the distance from the TMs. All cameras were programmed to capture 3 photographs/video (considered as a single event in 10s per trigger) at the 1-minute interval with the inclusion of the date and time of capture.

Data analysis

Users Frequency at Termite Mounds

The formulae below were used based on the work of O'Brien et al. (2003) and Boydston (2005).

#Operational days of the camera (d) = Camera retrieval day – Camera setting day

A trap night = Every 24 hours period that a camera is operational

Total trap nights (TTN) = Trap night (c) x # Operational days of camera (d)

TTN (Sampling efforts) = Σ cd

Independent event = Consecutive photos of species detected > 30 min. apart

Percentage of occurrence = $\frac{\text{\#Independent photographic detection of a species}}{\text{\#Total detection of all species}} \times 100$

Activity pattern

Activity pattern is considered diurnal= Day time [Sunrise (0600 hours) - Sunset (1759 hours)]

Activity pattern is considered nocturnal= Night time [Sunset (1800 hours) -Sunrise (0559 hours)]

Any two or more images were considered as separate visits when the images were distinctively different (in size and species) or captured on different TMs and/or when the time interval was more than 30 minutes. The overall number of species detected and the number of detections were compared for the whole study period using percentage detections. Out of the 10 camera traps stationed at different locations, only the ones that captured activities relating to the objective of this study were used in the analysis. All species of animals were identified by Kingdon (2015).

The data collected were analyzed using descriptive and inferential statistics (with both basic arithmetic operations and Statistical Package for Social Sciences, 2017). Paired t-test was used to determine significant differences between means of the parameters.

Results

Termite mounds and surrounding trees

The result from the inventory of TMs presented in Table1 and Table 2 showed a total of 26 TMs identified during the survey around two major locations (Ibuya and Yemosho rock) in the Marguba range. Of the 26 TMs, 14 (54%) were found in the Yemosho rock area, while the remaining 12 (46%) were found in Ibuya area. Similarly, of the 26 TMs, 50% were of conical shape (CTM) and 50% were also of cathedral shape (KTM). The height and diameter of CTMs ranged from 1.1 - 1.82m and 1.0 - 2.4m respectively.

Table 1. Location, surrounding tree, and the dimension of the conical-shaped termite mound

Termite Mounds	Location	Longitude (º)	Latitude (º)	Elev. (m)	Major Surrounding Trees	Height (m)	Diameter (m)
TM1	Ibuya	N08.45174	E003.77708	305	African oak	1.52	1.77
TM2	Ibuya	N08.45558	E003.77797	297	African maple	1.71	1.00
TM3	Ibuya	N08.45614	E003.77869	299	Edible-stemmed vine	1.45	1.87
TM4	Ibuya	N08.45177	E003.77693	304	African balsam	1.82	1.10
TM5	Ibuya	N08.45262	E003.77690	302	African balsam	1.45	1.30
TM6	Ibuya	N08.45172	E003.77661	300	African star apple	1.60	1.30
TM7	Ibuya	N08.27102	E003.46599	300	African maple	1.10	1.90
TM8	Ibuya	N08.27467	E003.46380	299	Mango	1.78	1.75
TM9	Ibuya	N08.45590	E003.77773	302	Butter	1.70	1.70
TM10	Ibuya	N08.44590	E003.77304	309	African teak	1.25	1.80
TM11	Yemoso	N08.43341	E003.78307	308	Kapok	1.20	2.40
TM12	Yemoso	N08.43341	E003.78299	308	African oak	1.50	1.10
TM13	Yemoso	N08.44986	E003.77515	304	Gmelina	1.50	2.10
$\bar{x}$± S.D						1.51±0.22	1.62±0.43
Range						1.10 - 1.82	1.00 - 2.40

Elev. = Elevation

Table 2. Location, surrounding tree, and the dimension of cathedral-shaped termite mounds

Termite Mound	Location	Longitude (º)	Latitude (º)	Elev. (m)	Major Surrounding tree	Height (m)	Diameter (m)
TM14	Ibuya	N08.43689	E003.77827	300	Teak	1.80	1.80
TM15	Ibuya	N08.43422	E003.78306	308	African balsam	1.20	1.40
TM16	Yemoso	N08.43429	E003.78290	309	Kapok	1.00	1.60
TM17	Yemoso	N08.43421	E003.78282	305	Raphia palm	1.10	1.80
TM18	Yemoso	N08.43383	E003.78284	307	African breadfruit	1.90	1.60
TM19	Yemoso	N08.43377	E003.78293	307	Butter	1.10	2.20
TM20	Yemoso	N08.43396	E003.78299	307	Teak	1.70	1.30
TM21	Yemoso	N08.43380	E003.78330	307	African fan palm	1.70	1.80
TM22	Yemoso	N08.43355	E003.78315	308	Butter	1.60	3.20
TM23	Yemoso	N08.43343	E003.78317	308	African balsam	1.57	1.30
TM24	Yemoso	N08.27464	E003.46386	300	African greenheart	1.00	2.70
TM25	Yemoso	N08.27273	E003.46272	300	Neem	1.20	2.1
TM26	Yemoso	N08.27464	E00346386	300	Raphia Palm	1.70	2.1
$\bar{x}$± S.D						1.43 ± 0.33	1.92 ± 0.55
Range						1.00 -1.90	1.30 – 3.20

Elev. = Elevation

This was similar to the range of height (1.0 - 1.9) m and diameter (1.3 - 3.2) m of KTMs. The CTMs exhibited average mean (± standard deviations) in height (1.51 ± 0.22) m and in diameter (1.62 ± 0.43) like that of KTMs having similar mean (± standard deviations) both in height (1.43 ± 0.33) m and in diameter (1.92 ± 0.55) m. The CTMs have a series of surrounding trees including African oak, African maple, edible-stemmed vine, African balsam, African star apple, mango, butter, teak, kapok tree, and gmelina (Table 1), while the major trees surrounding KTMs include teak, African balsam, African oak, kapok, Raphia palm, African breadfruit, African fan palm, butter tree, African greenheart, neem and palm (Table 2). The result presented in Table 3 showed the comparison between the dimensions of CTMs and KTMs using t-test analysis. There was no significant difference (*P*>0.05) between CTMs and KTMs in terms of their height and diameter.

Table 3. Comparison of dimension between conical and cathedral TMs using t-test.

	Conical TMs ($\bar{x}$± S.D, n = 13)	Cathedral TMs ($\bar{x}$± S.D, n = 13)	P-Value	T-test
Height	1.51 ± 0.22	1.43 ± 0.33	0.49	ns
Diameter	1.62 ± 0.43	1.92 ± 0.55	0.14	ns

S.D: Standard Deviation; ns: no significant difference (p > 0.05)

Users of Termite mounds

Of the 10 camera traps stationed at different TMs locations (TM7, TM8, TM13-14, TM17-19, TM24-26), only two (at TM7 in 2020 and TM8 in 2021) detected one or more species of animals. The animals detected were cattle, Kobs, tantalus monkeys, and African civet cats (Table 4). For a number of 210 camera setting days with 152.8 trap nights, the two camera traps recorded 50 animals from among four different species with 12 detections. Out of the four species of animals detected, cattle were the highest species which was recorded 31 times with 4 detections (33.3 %). This was followed by 15 tantalus monkeys with 5 detections (41.7 %), 3 Kobs with 2 detections (16.7 %), and an African civet cat which appeared once (8.3 %). Across all the detections, only Kob was captured eating TMs (Fig. 3). The African civet cat appeared to be standing and watchful (Fig. 4). The cattle captured appeared to be passing by (Fig. 2), while the tantalus monkey appeared to be rejoicing in front of the camera around TMs (Fig. 1). It is worth mentioning that unidentified wildlife (which appeared to be African civets) was also detected by the camera stationed at TM8 (Fig. 5). The result of the activity pattern of the users shown in Table 5 revealed that cattle and tantalus monkeys were active in the day (diurnal) while Kobs and African civet cats were active at night (nocturnal).

Figure 1. Photographic image of a troop of tantalus monkey captured utilizing termite mound hill area

Figure 2. Photographic image of a herd of white Fulani cattle captured utilizing termite mound hill area

Figure 3. Photographic image of Kob captured eating termite mound (The arrow indicates the TMH)

Figure 4. Photographic image of African civet cat captured utilizing termite mound hill area

Figure 5. Photographic image of the unidentified wildlife (The arrow indicates the TMH)

Table 4. Photographic detection and percentage of species occurrence of termite mound users detected using camera traps

Camera Station	Date	Camera setting days	#Trap night	Species detected (Count)	# Geophagic Detection	# Detection	% Detection
TMH7	3rd - 31st March 2020	21	5.30	Cattle (7)	-	1	8.33
				Tantalus monkey (1)	-	1	8.33
TMH8	28th Jan.- 18th Feb. 2021	21	15.30	Cattle (24)	-	3	25.00
				Tantalus monkey (14)	-	4	33.33
				Kob (3)	1	2	16.66
				African civet (1)	-	1	8.33
TMH13	3rd - 31st March 2020	21	20.10	-	-	-	0.00
TMH14	3rd - 31st March 2020	21	16.70	-	-	-	0.00
TMH17	3rd - 31st March 2020	21	20.20	-	-	-	0.00
TMH18	3rd - 31st March 2020	21	17.30	-	-	-	0.00
TMH19	28th Jan.- 18th Feb. 2021	21	5.20	-	-	-	0.00
TMH24	28th Jan.- 18th Feb. 2021	21	14.00	-	-	-	0.00
TMH25	28th Jan.- 18th Feb. 2021	21	18.30	-	-	-	0.00

TMH26	28th Jan.- 18th Feb. 2021	21	20.40	-	-	-	0.00
TOTAL		210	152.80	Cattle (31)	1	4	33.33
				Tantalus monkey (15)	-	5	41.66
				Kob (3)	-	2	16.66
				African civet (1)	-	1	8.33
				50		12	100

Table 5. Activity pattern of species detected around termite mounds using camera traps

Order	Species	Scientific name	# Detection	# Nocturnal	# Diurnal	Classification
Artiodactyla	White Fulani cattle	*BostaurusAfricanus*	4	-	4	Diurnal
Primate	Tantalus monkey	*Chlorocebustantalus*	5	-	5	Diurnal
Artiodactyla	Kob	*Kobus Kob*	2	2	-	Nocturnal
Carnivora	African civet cat	*Civettictiscivetta*	1	1	-	Nocturnal

Discussion

Several authors including Raul et al. (2015) and Subi et al. (2020) have reported limited concern for the dimension of termite mounds, except for the work of Sarcinelli et al. (2009). However, the mean height and diameter of both the CTMs and KTMs in this study were far greater than that reported by Sarcinelli et al. (2009) respectively. The non-significant difference between the dimensions (height and diameter) of CTMs and KTMs in this study is an indication that the increase in sizes of TMs was not likely differentiated by their types (due to shape). Since all 26 TMs were encountered within 5-10m width of the river Ogun in the study area, this showed that TMs could also be found close to rivers like natural salt licks, as claimed by Mahaney and Krishnamani (2003). This may not be unconnected to the fact that the presence of water provides easy excavation by the geophagic animals.

All the TMHs were surrounded by at least one major tree. These trees may be serving as a support for the increase in their height and/or as a shade to prevent desiccation most especially during the dry season. There have been previous reports of such in herbaceous vegetation around natural salt licks (Taka et al., 2013). It appeared that termite mounds are much more prevalent in areas filled with abundant of trees than in exposed areas. This is in support of the findings of Axelsson and Andersson (2012) which showed a significant effect of forest edges on the presence of termite mounds. Another reason for having TMs around vegetation was suggested by Bignell et al. (2011) by serving as hides from predators and also as a relief to the non-flying termites (workers and soldiers) as well as the short-time flying termites from being overworked during foraging activities.

No less than three species of wildlife including tantalus monkey, Kob, and African civet cat were captured in this study. These species of wildlife had been earlier reported by Akinsorotan (2017) through a camera survey of large mammals in OONP. However, there is hardly any data available on wildlife utilizing termite mounds as much as the ones reported for natural salt licks, except for the work of Mahaney et al. (1999). The few detections (12) and a number of species (cattle, tantalus monkey, Kob, and African civet cat, n = 50) within 210 trap nights is an indication that the number of species of wildlife in the park might have greatly reduced due to poaching. This is in support of the findings of Akinsorotan (2017). Again, the majority of the animal detected are herbivores with the exception of the African civet cat, indicating that herbivores are mostly associated with TMs. Although, the tantalus monkey has the highest percentage detection than the cattle among the 12 detections, but the number of cattle (31) found utilizing TMs doubled that of the tantalus monkey. This may indicate a high level of illegal users (herds' men) in the park and is a call for intensification of park management. There have been earlier reports of the illegal grazing of the Fulani herdsmen by several authors in the park (Oyeleke et al., 2015; Akinsorotan, 2017; Adewale and Alarape, 2020). Although the duration of the study may be too short to allow more species to be captured, however, it was surprising that Kobs which are the most celebrated herbivores (being the representative symbol of the park) recorded the lowest percentage of detection. Kobs along with some other wildlife including the African civet cat have been earlier documented by other authors as users of salt licks in Kainji Lake National (KLNP), Nigeria (Lameed and Adetola, 2012; Ajayi and Ogunjobi, 2015).

The number of herbivores utilizing areas of the TMs in this study accounted for a greater percentage than the carnivores. Except in fewer cases, carnivores were rarely reported among the users of salt licks. There were several reports of herbivores as the major users of licks (Kreulen and Jager, 1984). The observation of Lameed and Adetola (2012) and Ajayi and Ogunjobi (2015) also corroborated this study. This suggests that the African civet cat found utilizing the TMs may not actually mean for the consumption of the TMs but rather to luck around awaiting its prey since carnivores are rarely being recorded as consumers of soil. The temporal pattern of TMs used by the four species of animals revealed that the visitation of Kobs and African civet cat occurred majorly in the night (nocturnal), while that of the cattle and tantalus monkey occurred during the day (diurnal). Further study may be needed to ascertain this claim as the data used in this study were not large enough. Contrary to the findings of this study, Ajayi and Ogunjobi (2015) recorded a number of Kobs during the daytime in KLNP. In the study area, some authors have earlier documented the presence of tantalus monkey, civet cat, Kobs, and cattle but not as users of TMs (Oyeleke et al., 2015; Ojo, 2016; Akinsorotan, 2017). The activity pattern of cattle captured early in the morning is an indication that the herdsmen may likely have passed the night over while herding their cattle or usually intrude in the park very early in the morning. However, this disturbance of cattle may have also restricted many wildlife (including Kobs) to night visitation.

Conclusion

The dimension of TMs was not significantly differentiated by their shapes. Since 42 days of the camera-traps survey of TMs recorded fewer species of visitors, it may be concluded that wildlife may unlikely visit TMs with high frequency as it has been recorded for several other salt licks. A comparison between the drivers of both licks in relation to their visitors may be necessary. The high number of cattle recorded in this study is an indication that the management of the park was weak as cattle seem to have dominated the park more than the wildlife for which the park was created. The use of camera traps not only provides great potential in revealing the presence and activities of both wildlife and poachers but will also help the management authority of the park generate reliable data for effective monitoring of the park if adopted and put to use.

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