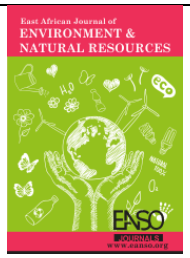

East African Journal of Environment and Natural Resources
eajenr.eanso.org
Volume 8, Issue 1, 2025
Print ISSN: 2707-4234 | Online ISSN: 2707-4242
Title DOI: https://doi.org/10.37284/2707-4242

EAST AFRICAN NATURE & SCIENCE ORGANIZATION

Original Article

Drive Safari Dynamics: Investigating the Impact of Time, Season, and Loop on Diurnal Mammal Sightings in Mole National Park

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Article DOI: https://doi.org/10.37284/eajenr.8.1.2700

Date Published: *17 February 2025*

Keywords:

Ecotourism, Wildlife, Protected Areas, Diurnal Mammals Sighting, Tourists Preference.

ABSTRACT

Understanding the impact of time, season, and loop on diurnal mammal sightings is crucial for informing effective wildlife management strategies to optimize tourist experiences. This study, therefore documented the effect of time, season and loops on the sighting of diurnal mammal species during drive safari at Mole National Park (MNP). The variables (time, season and loops) were investigated to disclose their influence on sightings. Day drive safari was used as a study method for observation and counting the animals for 1 hour minimum and a maximum of 4 hours; questionnaires were also used to solicit information on tourists' preference for diurnal mammal species to sight. The data gathered was analyzed using R version 4.3.1. A one-way ANOVA function in the car package was used to determine significant differences between variables. Seventeen diurnal mammal species were sighted in the loops of MNP. The season had no significant effects on sighting diurnal mammals in most loops except in the Burugbani and Zaina loops. Time of day had no significant influence on the sighting of diurnal mammals, but loops had a significant effect. Kobs were the most abundantly sighted diurnal mammal species in all the loops. Grey Duiker and Hartebeest were sighted only at the Burugbani and Asibey loops, respectively. Roan Antelopes were sighted at both the Asibey and Burugbani loops. Diurnal mammal abundance was highest in the Asibey loop, whereas the Zaina loop recorded the least. The African Savanna Elephant was the most expected diurnal mammal species to be sighted among tourists. In conclusion, MNP is a refuge for several diurnal mammal species that tourists can see during drive safaris. Management of Mole National Park should consider adjusting safari routes and times to coincide with peak animal activity periods, as identified in the study. This is essential in enhancing visitor's experience. We further recommend minimising the frequency and timing of loop visits to reduce disturbance to animals and maximize sighting opportunities.

APA CITATION

Nortey, N., Aikins, T. K. & Imoro, Z. A. (2025). Drive Safari Dynamics: Investigating the Impact of Time, Season, and Loop on Diurnal Mammal Sightings in Mole National Park. *East African Journal of Environment and Natural Resources*, *8*(1), 69-84. https://doi.org/10.37284/eajenr.8.1.2700.

Article DOI: https://doi.org/10.37284/eajenr.8.1.2700

CHICAGO CITATION

Nortey, Nii, Timothy Khan Aikins and Ziblim Abukari Imoro. 2025. "Drive Safari Dynamics: Investigating the Impact of Time, Season, and Loop on Diurnal Mammal Sightings in Mole National Park". *East African Journal of Environment and Natural Resources* 8 (1), 69-84. https://doi.org/10.37284/eajenr.8.1.2700

HARVARD CITATION

Nortey, N., Aikins, T. K. & Imoro, Z. A. (2025) "Drive Safari Dynamics: Investigating the Impact of Time, Season, and Loop on Diurnal Mammal Sightings in Mole National Park", *East African Journal of Environment and Natural Resources*, 8 (1), pp. 69-84. doi: 10.37284/eajenr.8.1.2700.

IEEE CITATION

N., Nortey, T. K., Aikins & Z. A., Imoro "Drive Safari Dynamics: Investigating the Impact of Time, Season, and Loop on Diurnal Mammal Sightings in Mole National Park", *EAJENR*, vol. 8, no. 1, pp. 69-84, Feb. 2025. doi: 10.37284/eajenr.8.1.2700

MLA CITATION

Nortey, Nii, Timothy Khan Aikins & Ziblim Abukari Imoro. "Drive Safari Dynamics: Investigating the Impact of Time, Season, and Loop on Diurnal Mammal Sightings in Mole National Park". *East African Journal of Environment and Natural Resources*, Vol. 8, no. 1, Feb 2025, pp. 69-84, doi:10.37284/eajenr.8.1.2700.

INTRODUCTION

Protected Areas (PAs) are clearly defined geographical spaces that are recognized, dedicated, and managed through legal or other effective means to achieve the long-term conservation of nature, with associated ecosystem services and cultural values (Wong, 2019). As endearing creatures that draw visitors worldwide, mammals are a key element in promoting ecotourism. Today, mammals are animals that, despite their astonishing diversity of form and habitat, share a long list of characteristics that no other organisms share, such as the presence of mammary glands, a single bone in the lower jaw, and the neocortex of the forebrain. (Kemp, 2005; Brinck et al., 2019). The African Savanna Elephant (*Loxodonta africana*) is one example of a mammal species that substantially contributes to tourism. Visitors worldwide travel to witness these magnificent creatures in their natural environment, such as PAs.

Ecotourism is the "responsible travel to natural areas, which conserves the environment and sustains the well-being of local people" (Bagul, 2009). Ecotourism has emerged as a major source of self-sufficiency for global PAs such as Mole National Park (MNP) in Ghana, which frequently uses wildlife-based ecotourism as its primary source of revenue. Achieving tourists' satisfaction has become a strong driving goal in managing many PAs (Acquah et al., 2016; Maciejewski & Kerley, 2014). Tourists' satisfaction has become a powerful motivator in managing many PAs. Wildlife experience, which includes sightings by tourists using drive safari in National Parks, is one way to satisfy visitors Maciejewski and Kerley (2014).

Mole National Park (MNP) is Ghana's largest and most prestigious protected area, recognized for its contribution to providing different ecosystem services, including habitat for several plant and animal species and ecotourism (Obeng et al., 2021).MNP falls within Category II in the International Union for Conservation of Nature (IUCN) system of Protected Areas classification and is managed mainly for ecosystem protection and recreation (Acquah et al., 2016). Research on common mammal species seen during a game drive safari in MNP is limited. Information on the mammalian species that can be sighted at the loops during drive safari in MNP is unavailable to tourists upon arrival in the park. Information on the time of day to see the diversity of mammals and the season of the year to see mammals are not available to tourists. Also, no study exists to establish which mammal species tourists prefer to see during their game drive safaris in the park. These areas are worth researching to uncover information for tourists and other park users.

The study's findings will help visitors have first-hand information on some diurnal mammals available in MNP and guide them in deciding which

Article DOI: https://doi.org/10.37284/eajenr.8.1.2700

loops to choose for their drive safari. The findings of this study are relevant for species-targeted tourism activities. Also, this work will help reduce the time used during drive safari since targeted species could be traced to enhance tourist satisfaction. This study, therefore, aimed at documenting the common diurnal mammal species that can be sighted during drive safari, determines how seasons (dry and wet), time of day (early morning and late afternoon), and sample sites (loops) influence sighting in MNP and determines tourists' choice of diurnal mammal species to sight during drive safari.

MATERIALS AND METHODS

Study Area

Location

The research was conducted in MNP in Ghana's Savanna Region. The park lies between latitude 09 12' - 10 06' N and longitude 01 25' - 02 17' W and has a total area of four thousand eight hundred and forty square kilometres (4,840 km^2). The park is approximately twenty-six (26) kilometres from Damongo, the Savanna regional capital, and ranges in elevation from 120 to 490 meters above sea level. The park is bounded by three administrative Regions: The Upper West, the Savannah, and the North East. The park is also bordered by four political Districts: West Gonja District, West Mamprusi District, Sawla-Tuna-Kalba District, and Wa East District. MNP, Ghana's largest and most developed protected area, is surrounded by 33 communities(Agyei-Ohemeng et al., 2017; PAPACO, 2010; Obour et al., 2016).

Climate

The climate is semi-arid and experiences an unimodal rainfall distribution. The rainy season starts in May and ends in October, with a mean annual rainfall of 900 mm to 1,000 mm (Oboubie & Barry, 2005). The region experiences a long dry season from November to April. Temperatures are at the lowest in December and January with a mean of 27°C and Maximum temperatures reach about 40°C around mid-March to April. The relative humidity is about 80% at night and 70% during the afternoon in the rainy season; in the dry season, it is at 50% and 20% at night and afternoon, respectively (Amoako *et al*., 2023).

Vegetation and Topography

MNP's primary vegetation type is open savanna woodland with a grass layer that can grow up to 3 m tall during the rainy season and is burned periodically. Boval, or low, open grassland, is typically found in locations with shallow soils and iron pan. Most streams have narrow areas of riverine forest growing along them. Other plant groups, such as marshes and floodplain grasslands, occupy only small areas (Schmitt & Adu-Nsiah, 1993). *Terminalia avicennioides* and *Vitellaria paradoxa* are examples of plant species that dominate this habitat: semi-evergreen forest-riparian woodland that can grow up to 25 m tall and at least 50 m wide near the Mole River. The region (MNP) is rich in flora and fauna, with about 740 plant species (Awuah & Speed, 2017). The terrain is mostly flat, with the Konkori Escapement running north-south. The elevation varies between 120 and 490 meters above sea level (Mole National Park Management Plan, 2016).

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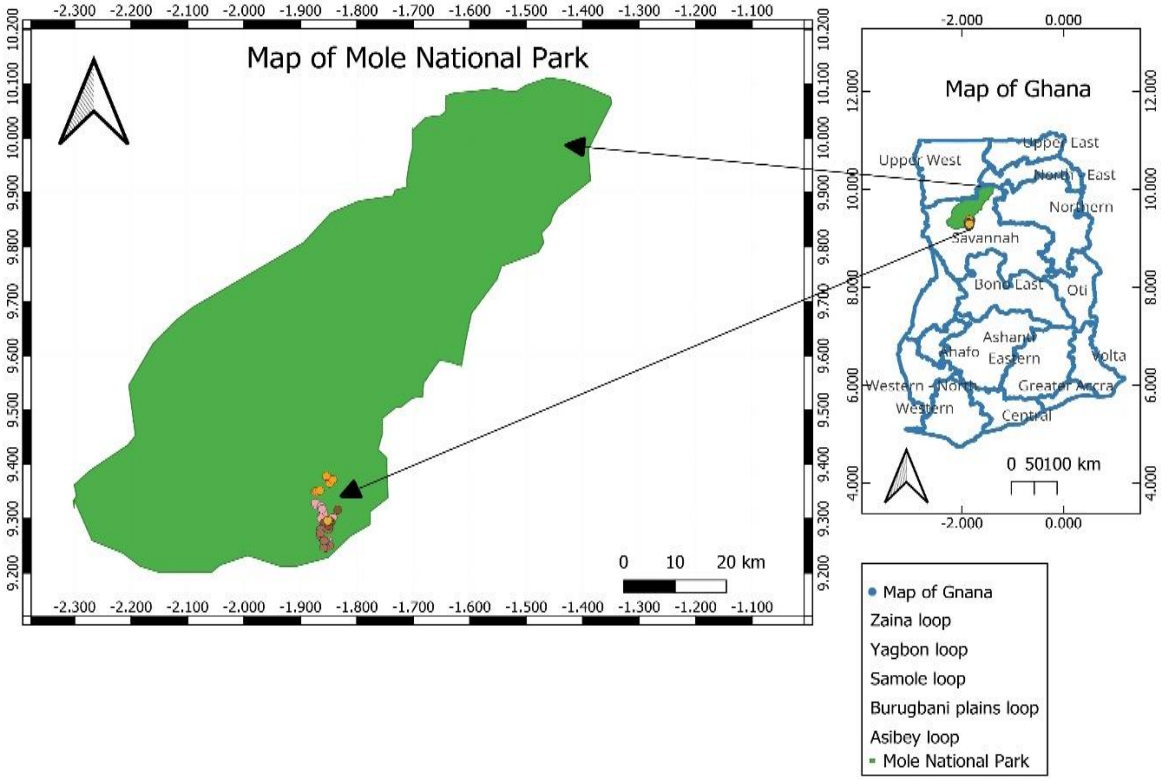
Figure 1: Study Area Map



Site Selection and Data Collection

The study was conducted in five loops, namely Samole, Burugbani, Yabon, Zaina and Asibey loops. These were purposively selected because of their accessibility throughout the year and being the frequently used loops for tourism in the park. The loops were created in a way to access almost all of the park's ecological diversity. Samole loop, roughly 9 km from the park's information centre, often requires a two-hour safari drive. The loop has unique vital areas such as marshy areas, flood plains, the Samole River, water sources like dams (one and two), riverine forests, and salt licks like the Big Saltlick Site.

Burugbani loop has a large area of underlying rock components (laterite rocks). It serves as the source of the plain land and inhibits the growth of tall grasses, trees, bushes, and other flora (Jenny, 1994). Wilson (1991) suggests that one of the main causes of the changes in flora across the loop is the substantial nutrient leaching in the plain's deep sandy soils. Due to the loop's poor accessibility, especially during the wet season, about a three-hour safari drive is typically required to complete a 9 km distance. Tour guides are familiar with the loop because of its distinctive topography and abundance of waterbucks. It is also called the "waterbuck area" in addition to its evident features. This might be because water sources are readily available since waterbucks (*Kobus ellipsiprymnus*) are a species that thrives in water areas (personal communication: Abubakari Osman, Tour Guide, MNP).

The Yabon loop is about 8 km long, and safari drives typically take 2 hours. This loop joins the entry road by rounding the park's administration block and connecting it to the Zaina loop. Once more, this loop is over high terrain with few key areas like Richard's Salt Lick and the Mognori River.

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Zaina loop is unique among the loops because of its lovely scenery and vegetation. It takes about 2 hours to complete the 7 km loop via safari drive. There is boval vegetation on this loop as well. All plant communities on a flat iron pan with areas of shallow soil are included in the boval vegetation. In such areas, which are flooded and rich in species during the rainy season but severely water-stressed during the dry season, only annual species may compete (Schmitt & Adu-Nsiah, 1993). Available water sources in this loop are Zaina dams 1 and 2 near Zaina Lodge. The terrain is mountainous/highland(.

Finally, the Asibey loop covers over 16 km. This loop is the longest and often requires a four-hour safari drive. It has the most open vegetation, fewer riverine forests, areas of grasslands, and enough water sources among the examined sites. It also appears to be the most unique regarding wildlife richness (Personal observation).

Among other safaris, such as foot and night drives, day drive safari was used as a study method for observing and counting the animals. The study deployed this method because it is the commonly used ecotourism activity by tourists, to get access to distant places where foot safaris seem impossible. Good observations were made closely while in the safari vehicle and on the ground. In the company of tourists on tour for game viewing, counting mammal species sighted was done during each safari. The minimum game drive safari duration was 1 hour, with a maximum of 4 hours. Safaris were carried out utilizing a convenience/chance method; the available safari trip was used until sixty (60) safaris were completed. Explicitly, the convenience/chance method is seen as necessary to allow us to join the safari vehicles and to help experience what the tourists experience. Data was collected for early morning (7:30 am) safaris and late afternoon (3:30 pm) safaris for both the early dry and late rainy seasons, respectively, for thirty (30) days and fifteen (15) days per season.

Again, twenty-seven (27) questionnaires were administered to visitors who were about to embark on a day drive safari to give their most preferred mammal species they would like to see. Questionnaires were administered using a convenient approach, and the available tourists were solicited to respond to the questions voluntarily. To avoid interfering with tourists' privacy, we worked with tourists willing to participate in this research. Thirteen (13) questionnaires were distributed to Ghanaian tourists, accounting for 48.1% of the total, while fourteen (14) questionnaires were given to foreign tourists (51.9%). All respondents consented to participate in the research before the questionnaires were given to them.

Statistical Data Analysis

The data gathered was analyzed using R version 4.3.1. A one-way ANOVA function in the car package was used to determine if there were significant differences between variables: loops (Asibey, Burugbani, Samole, Yabon, and Zaina), seasons, and time. Again, the GGplot2 package displayed box plots to help determine visual relationships or differences between variables. Additionally, post hoc pairwise comparisons (Tukey's post hoc test, using the emmeans package, Lenth 2019) were used to determine the differences between time and season and among loops. Results were presented in tables, box plots, and bar graphs.

RESULTS

Common Diurnal Mammal Species Sighted on Drive Safari in Mole National Park

Out of the sixty (60) safaris made during the study, 6,375 diurnal mammals were spotted. This number of mammals comprised 17 diurnal mammalian species, including both large and small. Among the species, Kobs were sighted most (2,468 times), while Grey Duiker was sighted once (table 1). One species sighted (African Savanna Elephant) is classified as endangered according to the IUCN Red List of Threatened Species. Two other species (Patas Monkey and Buffalo) are classified as near threatened. The rest of the species is classified as least concern.

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Table 1: Common Diurnal Species of Mammals in Mole National Park

Common Name	Scientific Name	IUCN Red List Category	Total Number Counted
Kobs	*Kobus kob*	Least concern	2,468
African Savanna Elephant	*Loxodonta africana africana*	Endangered	513
Olive Baboon	*Papio anubis*	Least concern	498
Bushbuck	*Tragelaphus scriptus*	Least concern	479
Warthog	*Phacochoerus africanus*	Least concern	465
Green Monkeys	*Chlorocebus sabaeus*	Least concern	432
Waterbuck	*Kobus ellipsiprymnus*	Least concern	324
Patas Monkey	*Erythrocebus patas*	Near Threatened	284
Forest Buffalo	*Syncerus caffer nanus*	Near Threatened	269
Marsh Mongoose	*Atilax paludinosus*	Least concern	192
Hartebeest	*Alcelaphus buselaphus*	Least concern	128
Ground Squirrel	*Xerus erythropus*	Least concern	127
Roan Antelope	*Hippotragus equinus*	Least concern	109
Slender Mongoose	*Herpestes sanguineus*	Least concern	42
Red-Flanked Duiker	*Cephalophus rufilatus*	Least concern	26
Tree squirrel	*Sciurus aestuans*	Least concern	18
Grey Duiker	*Sylvicapra grimmia*	Least concern	1

Plate 1: Some Mammals Sighted in Mole National Park (Source: Field Survey, 2022/2023)

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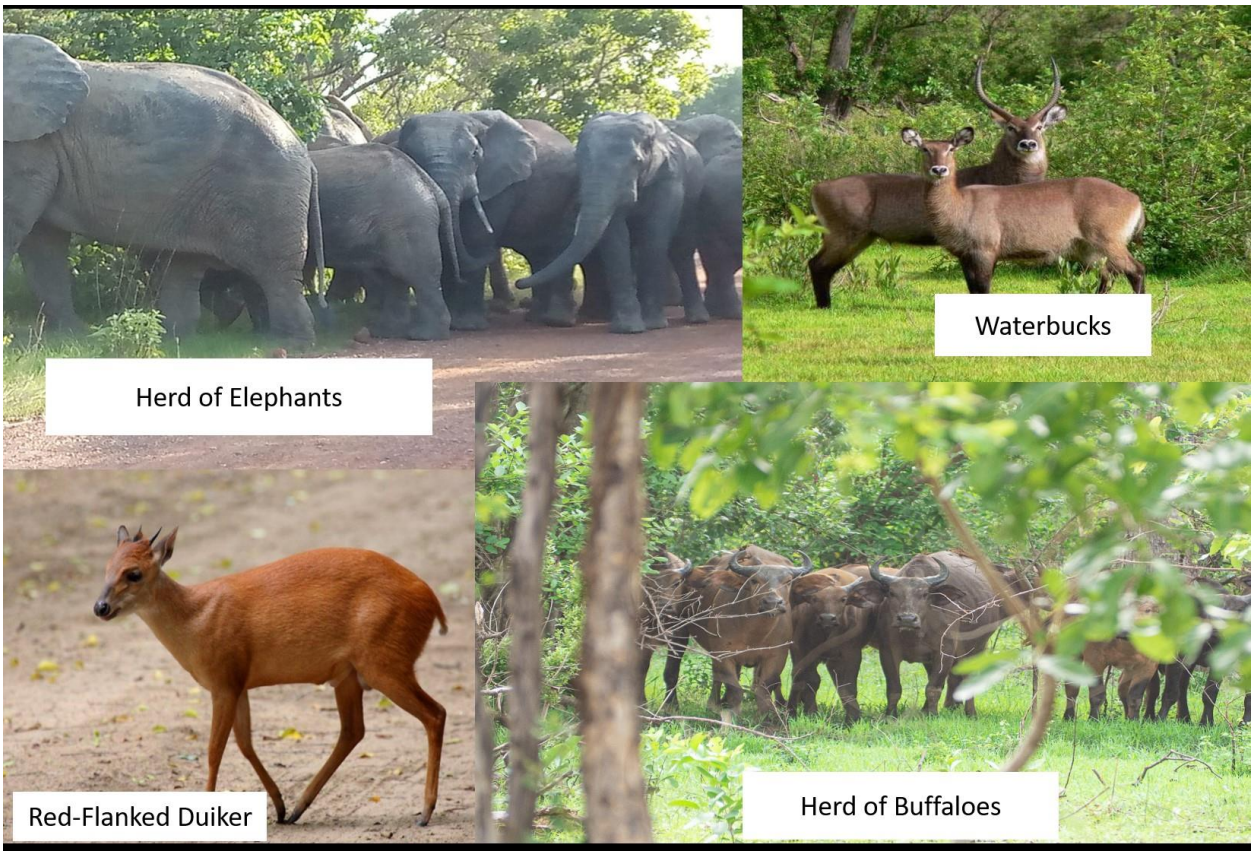

Effect of Season on Sighting of Diurnal Mammals in MNP

In general, the abundance of mammals counted on the loops did not significantly vary ($p = 0.361$) according to the seasons of the year (dry and wet). However, at Burugbani and Zaina loops, there were significant differences ($P< 0.05$) in the abundance of mammals between the wet and the dry season, with more species sighted in the dry season than in the wet season.

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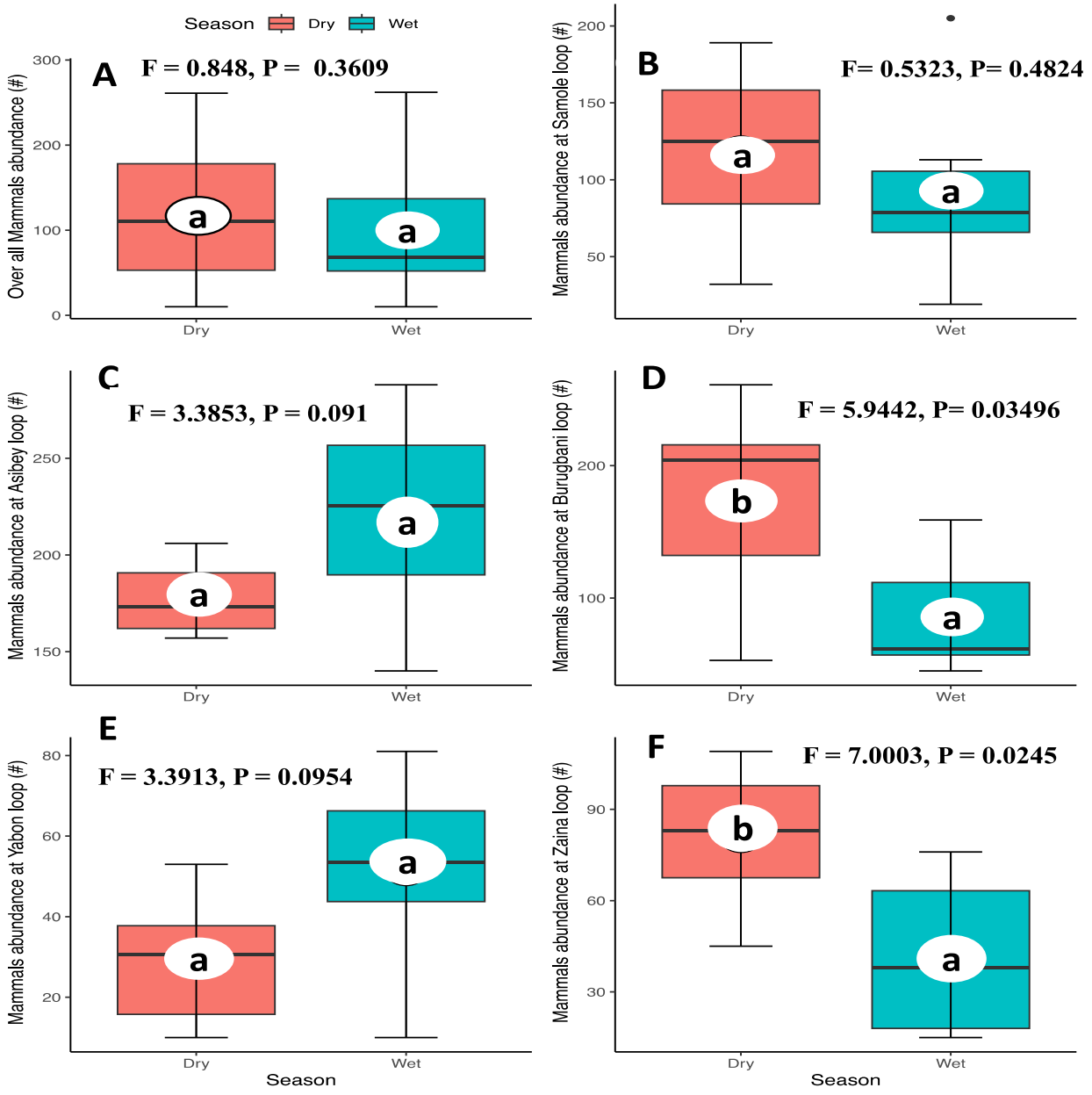
Figure 2: Effect of Season on the Sighting of Diurnal Mammals in Mole National Park.



Effect of Time of Day on Sightings of Diurnal Mammals in Mole National Park

The abundance of mammals sighted on the driving safari did not vary significantly (p = 0.940) by the time of day (afternoon and morning). Similarly, the time of the day did not influence the abundance of mammals sighted at the Asibey, Burugbani, Samole, Yabon, and Zaina loops during game drive safaris.

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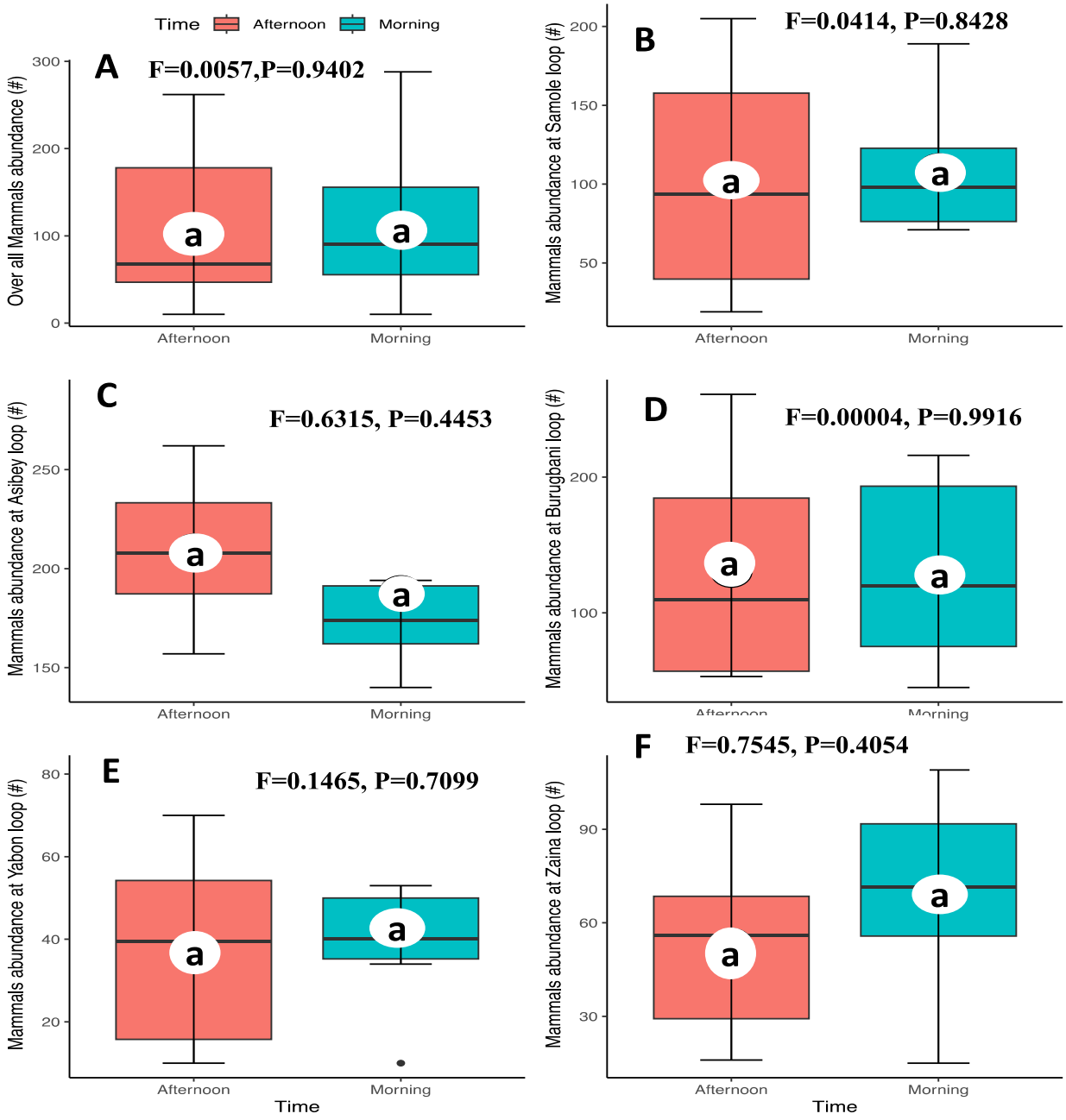
Figure 3: Time Effects on Sightings of Diurnal Mammals in Mole National Park



Effects of the Loops on Sighting of Diurnal Mammals

The abundance of mammals sighted varied significantly (P<0.001) among the various loops. The Asibey loop had a significantly higher abundance of mammals than all the loops. The abundance of mammals at the Burugbani loop was significantly higher than at the Yabon and Zaina but not at the Samole loops. Samole loop had a significantly higher abundance of mammals than Yabon but not Zaina. However, there was no significant difference in abundance between Yabon and Zaina loops (figure 4).

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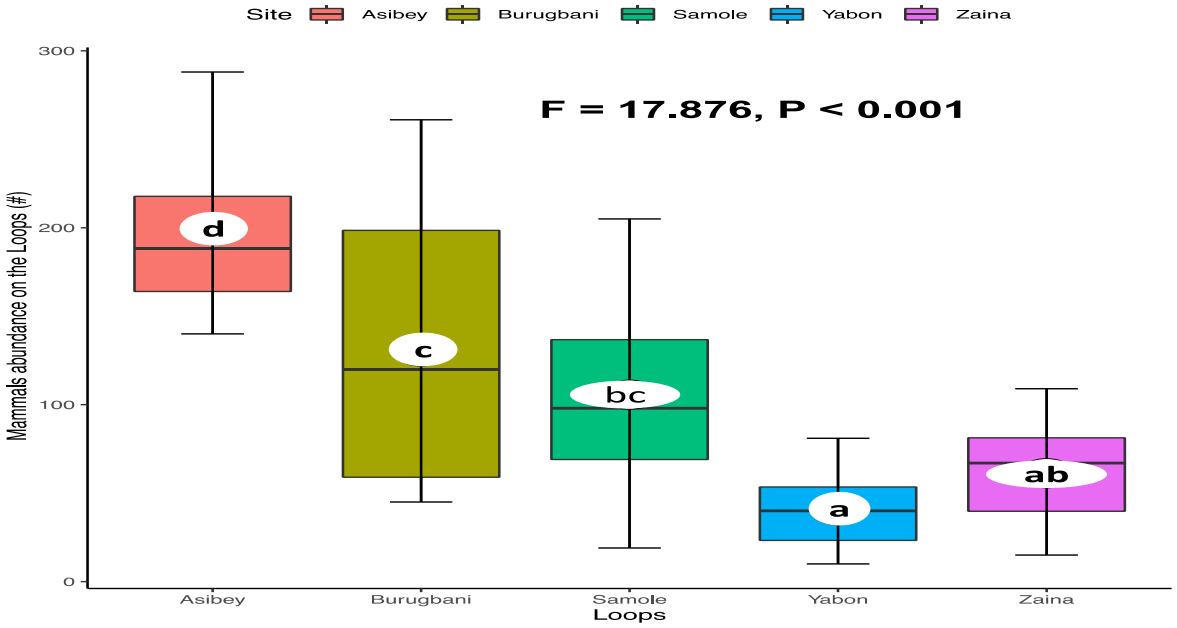
Figure 4: Effects of the Loops on Sighting of Diurnal Mammals



Mammal Species Sighted Within Loops in Mole National Park

Table 2 shows the abundance of individual diurnal mammals within the loops in MNP. In all the loops, Kobs were the most abundant species sighted. Grey Duiker was only sighted at the Burugbani loop, and Hartebeest was only on the Asibey loop. However, Roan Antelope was sighted on both the Asibey loop and Burugbani loop, but more were spotted on the Asibey loop.

Table 2: Mammal Species Sighted Within Loops in Mole National Park

Animal	Asibey loop	Burugbani loop	Samole loop	Yabon loop	Zaina loop
Green Monkey	181	85	40	85	38
African Savanna Elephant	198	72	110	35	98
Tree Squirrel	0	10	8	0	0
Waterbuck	115	158	51	0	0
Bushbuck	150	85	129	47	54
Kob	693	583	767	248	181
Warthog	121	172	65	69	52
Olive Baboon	182	127	79	87	23
Buffalo	189	56	23	0	0
Ground Squirrel	37	18	39	18	15
Slender Mongoose	23	11	0	8	0
Hartebeest	128	0	0	0	0
Red Flanked Duiker	14	11	1	0	0
Roan Antelope	88	21	0	0	0
Grey Duiker	0	1	0	0	0
Patas Monkey	86	68	49	41	40
Marsh Mongoose	48	50	0	65	29
TOTAL	**2,253**	**1,528**	**1,361**	**703**	**530**

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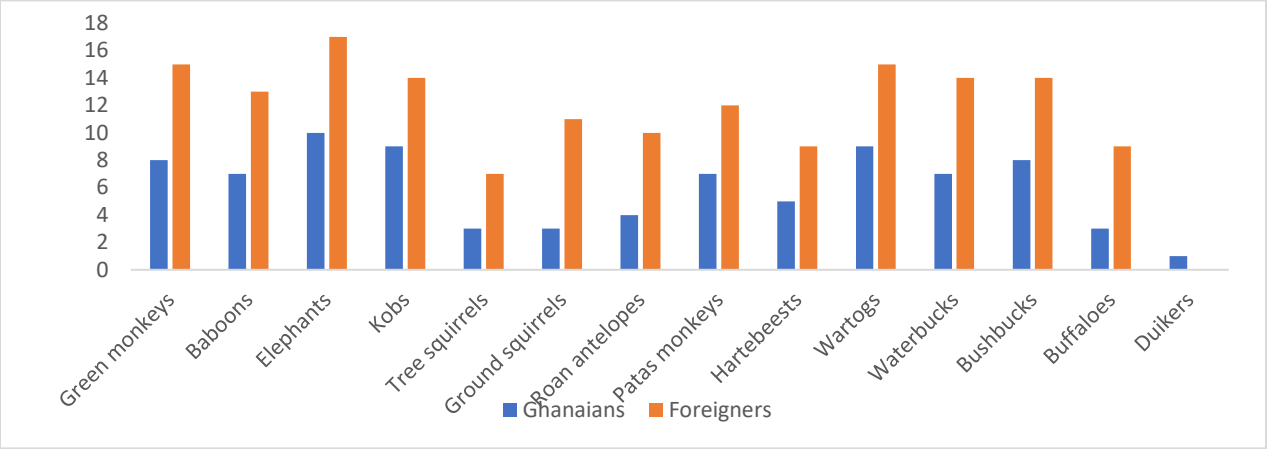
Tourists' Preferences of Diurnal Mammals in Mole National Park

We found that all the tourists (Foreigners and Ghanaians) preferred to see elephants over other diurnal mammals on drive safari. Kobs and Warthogs were the next species Ghanaians preferred to sight, whereas foreigners preferred to see Green Monkeys and Warthogs.

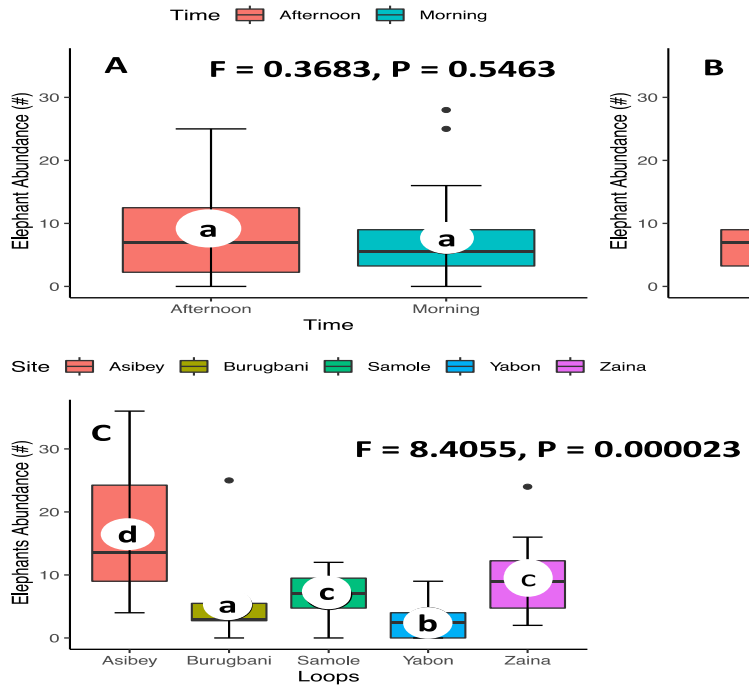
Figure 1: Tourists' Preferences of Diurnal Mammals in Mole National Park



Effect of Time, Season of Day and Loops on the Sighting of Elephants

The abundance of Elephants sighted was not influenced significantly by season (p = 0.369) and time of day (p = 0.546). In contrast, the abundance of elephant spotted varied significantly across the loops (0.000023). More elephants were sighted on the Asibey loop, while the Yabon loop recorded the least. Also, there was no significant difference in the sighting of elephants between the Samole and Zaina loops.

Figure 6: Effect of Season, Time of Day and Loops on the Sighting of Elephants



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DISCUSSIONS

We identified seventeen (17) diurnal mammal species in the loops during drive safaris. This number of species sighted is about 18% of the total number of mammal species (93 species) reported to occur in the park (Adewunmi et al., 2016). However, the findings of Adewunmi et al. (2016) included nocturnal species. The differences in the number and species of diurnal mammals sighted in the different loops could be attributed to differences in vegetation and habitats found along these loops. Slightly open vegetation and the availability of diverse plant species make animals more visible for sighting. The availability of salt licks also contributed to sightings in Asibey, Samole and Burugbani loops. This assertion aligns with Andrews and O'Brien (2012), who stated that the distribution and variety of mammals in Africa have traditionally been attributed to differences in vegetation or climate. Furthermore, work done by Morrison et al. (2015) and Bennett et al. (2017) suggested that the presence or absence of certain mammal species could be influenced by the type and abundance of flora in an area.

Also, we did not find significant differences in the abundance of diurnal mammals between the wet and the dry seasons at Asibey, Samole and Yabon loops. However, we found that more mammals occur on the Burugbani and Zaina loops during the dry season than during the wet season. The significantly higher number of mammals sighted in the dry season than the wet season at Burugbani and Zaina loops could be attributed to the abundance of water sources and open vegetation at these loops, thereby allowing tourists to see animals from afar. This observation aligns with the findings of Msoffe et al. (2014) in Tanzania's Serengeti National Park and Naidoo et al. (2016) in South Africa's Kruger National Park, who reported that more sightings occur during the dry season. Nevertheless, this finding is not in line with studies conducted by O'Brien et al. (2019) and Ogutu et al. (2016), who found a significantly higher number of species in the wet season than in the dry seasons in Namibia's Etosha National Park and Kenya's Maasai Mara National Park respectively.

The study found that sighting of diurnal mammals at MNP did not significantly vary with time of day (early morning and late afternoon). This could be attributed to the fact that the animals we studied were all diurnals. Hence, they actively fed early in the morning after they returned from their night sleep and late afternoon to prepare for night sleep.

There were significant differences in the abundance of diurnal mammals in the loops. The differences in sighting of diurnal mammals in the loops could result from resource composition (water sources, salt licks, vegetation), landscape and human activities. Some animals prefer lowland areas to highland areas since highland could interfere with their movement. Hence, more animals sighted in the Asibey loop could be attributed to its flat landscape with slightly open vegetation. In terms of human activities, both Samole and Zaina had more occurrences. Similar work by Mbaiwa (2013) stated that habitat type and landscape are essential factors in determining animal encounters. Tourists are likelier to see animals in broad/open savannahs than in dense woodlands or thickets. Muposhi et al. (2014) discovered that the presence of park rangers or tour guides can significantly enhance the number of animal sightings. According to them, these professionals understand animal behaviour and can guide tourists to areas where they are more likely to see animals.

The survey discovered that tourists had strong preferences and expectations for the types of diurnal mammals they want to see in MNP. The study found that the African Savanna Elephant was the most preferred and the most expected species by both local and foreign tourists during drive safaris in the loops of MNP. This could be attributed to the African Savanna Elephant being the largest mammal on earth, and many tourists might not have seen the elephant in its natural habitat. Through interaction with tourists during the survey, first-time

Article DOI: https://doi.org/10.37284/eajenr.8.1.2700

tourists remarked that they prefer to see African Savanna Elephants due to their unique looks, and they also wanted to know how the African Savanna Elephant differs from the Asian Elephant. This assertion concords with a study conducted by Okello et al. (2008), who reported that the African Savanna Elephant was highly preferred and sought after by tourists in Amboseli National Park in Kenya.

This finding is also consistent with Lindsey et al. (2007) and Saikim (2018), who limited ecotourism potential to sighting preferences among tourists to protected areas, implying that most tourists are primarily interested in sighting charismatic megafauna, which is restricted mainly to state or privately-owned parks like MNP. This finding further agrees with a similar study conducted by Maciejewski and Kerley (2014), who noted a strong preference for the African Savanna Elephant (*Loxodonta africana*) during game drives in Private Protected Areas in South Africa. The preference by the tourists could also mean that tourists' satiety is determined by the species they see and the activities/behaviours of the animals, such as foraging, mating and other social relationships. This assertion agrees with research conducted by Makonjio et al. (2008), who reported on how tourists become satisfied when they observe some unique activities such as mating, foraging, and social interactions of their preferred species. Some studies have reported that one of the factors leading to tourist happiness is to satisfy their preferences (Maciejewski & Kerley, 2014b; Saikim & Fiffy, 2018).

The African Savanna Elephant (*Loxodonta africana*) was discovered as the most preferred component in MNP based on tourists' preferences and expectations. According to the tour guides and park management, tourists have ever shown strong interest towards African Savanna Elephants (*Loxodonta africana*) over the years. Tourists' remarks indicated that their preferences for African Savanna Elephants were skewed to their unique, attractive features such as the trunk, tusks, ears, feet, head, legs, penis, and stature. Yet, all Ghanaian and foreign tourists liked to see African Savanna Elephants. Season and time of day (early morning and late afternoon) had no significant impact on African Savanna Elephant sightings (Figures 6A and 6B). This implies that tourists to MNP can see African Savanna Elephants regardless of the season or time of day. In contrast to this finding, Hopcraft et al. (2014) and Ofori et al. (2017) found increased African Savanna Elephant sightings during the wet season. Adu et al. (2019) also discovered that more African Savanna Elephant sightings occur during the dry season.

The study further investigated African Savanna Elephant sightings in the loops and found a significant effect of the loops on sightings. The highest number of African Savanna Elephant sightings were observed at the Asibey loop (devoid of human activities). The high numbers of African Savanna elephants sighted at the Asibey loop could be attributed to cows (female elephants) and their calves not finding comfort in human-dominated areas such as Samole and Zaina loops. Sinsin et al. (2002) highlighted the need to rethink and improve present wildlife conservation and management practices to ensure long-term protection and tourists' access to wildlife, including African Savanna Elephants.

CONCLUSIONS AND RECOMMENDATIONS

The study found that species such as *Kobus kob*, *Loxodonta africana*, and *Papio anubis* were frequently sighted during drive safaris in Mole National Park (MNP). Interestingly, seasonal variations had minimal impact on diurnal mammal sightings across most loops, except for Burugbani and Zaina loops, where dry season sightings surpassed those of the wet season. Moreover, the time of day did not significantly influence diurnal mammal sightings. However, location-specific differences emerged, with the Asibey loop yielding significantly higher mammal sightings compared to other loops. Notably, tourist preferences leaned

Article DOI: https://doi.org/10.37284/eajenr.8.1.2700

towards spotting the African Savanna Elephant (Loxodonta africana) during drive safaris, over other mammalian species."

Based on the study's findings, we recommend that the Management of Mole National Park consider adjusting safari routes and times to coincide with peak animal activity periods, as identified in the study. Also, developing seasonal safari plans to consider the variations in animal sightings throughout the year would be essential in enhancing visitor's experience. We further recommend minimising the frequency and timing of loop visits to reduce disturbance to animals and maximize sighting opportunities.

We recommend that long-term monitoring of animal populations and sighting trends should be done to inform adaptive management strategies. Also, expanding the study scope to include other factors influencing animal sightings, such as weather patterns, habitat conditions, and human-wildlife conflict, would help to understand the dynamics of drive safari sightings.

Acknowledgement

We express our deepest gratitude to Mr. Annan Abraham, who provided financial aid to the first author. We sincerely appreciate the assistance of Mr. Osman Abubakari (Mole National Park) in providing insightful and helpful information about the park and linking the first author to the management. We thank Mr. Tony Namwinbown for his support in producing the study area map. Carolyn Schultz and Abubakari Osman Provided pictures that were used in this manuscript.

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