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USE OF CAMERA TRAPS IN MONITORING HUMAN-WILDLIFE INTERACTIONS AROUND THE NAIROBI NATIONAL PARK KENYA

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Abstract: With the human populations in Africa constantly increasing, protected areas are faced with the threat of encroachment. The areas neighbouring wildlife parks have been converted to human settlements with varied anthropogenic activities. Expansive conversion of land for agricultural practices and clearance of space for infrastructural development around protected areas have resulted in increased human-wildlife interactions and potential conflicts. This study employed the use of camera traps on 3 farms on the southern border of the Nairobi National Park-Kenya to find out which wildlife species stray into the community areas, how frequently the species visit the area, what anthropogenic activities are practised and what potential conflicts can be associated with specific species. The images captured were analyzed using the Timelapse software. The common species observed were ungulates (zebras and giraffes) and carnivores (lions, jackals and hyenas). The ungulates visited the area during the day while most carnivores were seen at night. The main human activity in the area is livestock rearing. Dirt road networks in the area are frequently used by humans and shared with wildlife thus the potential conflicts were livestock predation and threats to human lives. Based on our results additional camera traps are recommended to be installed in more locations and should be used over a long period of time to monitor human-wildlife interactions with the aim of finding better mitigation methods for their coexistence.

Keywords: human-wildlife conflicts, carnivores, predation, ungulates, crop damage, anthropogenic activities

1. Introduction

Camera traps are technological devices that have been used globally to study various aspects of biodiversity conservation (McCallum 2013). They are widely used for monitoring wildlife biodiversity in various ecosystems (Schneider et al. 2020). They capture images of a wide range of species, including mammals, birds, reptiles, and even insects, providing a comprehensive understanding of the ecosystem's health and composition. Researchers have used them to conduct population surveys for example, in estimating population sizes and densities of different species (Agha et

al. 2018). By analyzing the frequency and distribution of captured individuals, scientists can infer population trends and make informed conservation decisions (Zwerts et al. 2021). Researchers also use camera traps to observe and document animal behaviour in the wild (Caravaggi et al. 2017, Agha et al. 2018). This includes activities such as feeding, mating, territorial marking, and interactions with other species. They come in handy when studying elusive species that are difficult to study directly without causing disturbance to them (Vermeulen et al. 2014, Caravaggi et al. 2017). This information is crucial for understanding the ecology and social dynamics of various wildlife populations. The anti-poaching and wildlife crime units have been able to monitor threatened and endangered wildlife species by the use of camera traps enabling them to detect and record illegal activities (Kamminga et al. 2018, Wich et al. 2021), providing evidence for law enforcement. Studies on habitat quality changes (Sun et al. 2021), connectivity and wildlife movement (Palencia et al. 2021) have also been done using camera traps. These are very important in designing effective conservation strategies and understanding the impact of landscape changes on wildlife movement.

Globally, camera traps have been used to study animal behavior at different magnitudes with Africa having the lowest number of cameras compared to the other continents (Agha et al. 2018). In Asia and America, the abundance of jaguars has been closely monitored using them (Silver et al. 2004). Some camera traps have even been able to capture images of animals that were thought to be extirpated from some areas, which is important for biologists since they can put in place management strategies to ensure the recovery of such species. In Africa, Agha et al. (2018) found that most camera traps had been set up in South Africa, Namibia and Tanzania with the area around the Sahara Desert being the least studied in the continent.

In Kenya, camera traps alongside other technological tools such as GPS collars and DNA analysis have been used to monitor elephants, zebras and wildebeest movement across landscapes (Nyumba et al. 2013). They have been very helpful in studying human-wildlife conflicts since they are versatile and easy to install in community areas (Von Hagen 2018). In the area around the Nairobi National Park, camera traps have been used to monitor animal movement and track the paths utilized for migration purposes (Parham 2015). This has enabled the wildlife managers to understand the human-wildlife interactions in the area which greatly determines the mitigation methods to be used in controlling the conflicts (Agha et al. 2018).

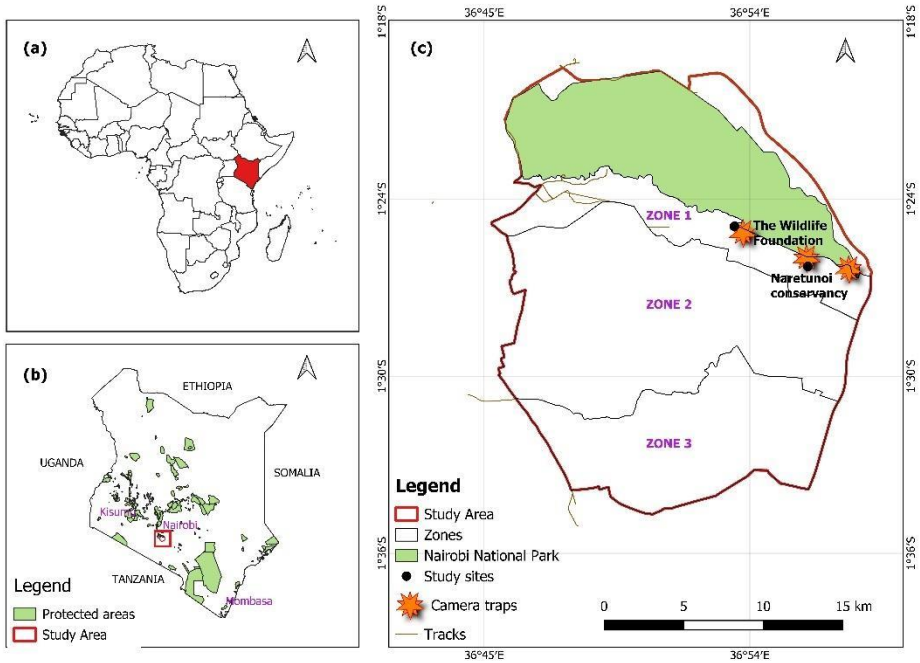
The main objectives of this study were to detect the wildlife species that crossed into the community areas that border the Nairobi National Park to the South, how frequently they visited the area and the type of anthropogenic activities practised in the community area.

2. Materials and methods

2.1. Study area

The study was carried out in the Naretunoi Conservancy which forms part of the community areas that border the Nairobi National Park to the South (*Figure 1.*). The southern boundary of the park is unfenced. The area is dominated by human settlements with most of the inhabitants being the Maasai people whose main source of livelihood is livestock rearing combined with small-scale mixed farming (Wandaka et al. 2019).

Figure 1.: Map of the study area. (a) Location of Kenya on the map of Africa; (b) Protected areas in Kenya with Nairobi National Park marked in red; (c) Location of the camera traps in the study area.



2.1.1. Field Data Collection

Three UOVision Green 30 trail cameras were installed on three farms that border the Nairobi National Park on the Southern part during the wet season of January-March 2024. The cameras were strategically placed facing the dirt roads based on recommendations by Edwards et al. (2021), who found out that wildlife species, especially carnivores, were more detectable along paths and roads than if cameras were placed off-road.

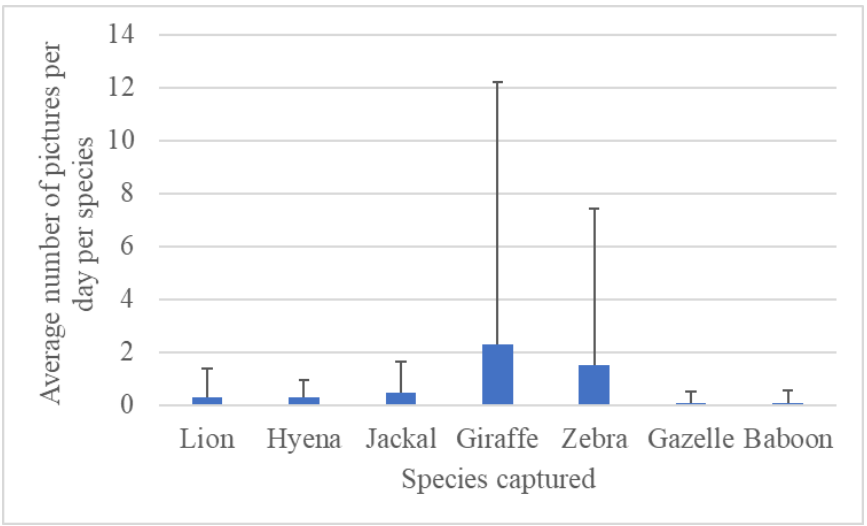
The farms were selected after interviews with members of the local community, based on the frequency of use of the adjacent trails by wildlife.

Pictures were extracted from the cameras after every two weeks. The pictures were then uploaded into the Timelapse software version 2.3.1.0 (Greenberg et al. 2019) which was used to identify the types of species (both domestic and wild ones) and the number of individuals seen on each photo. We also registered whether there is human presence in the pictures. We analysed the frequency of the visits as the number of pictures captured per day on a given species.

For both, wild and domestic species the number of pictures on the species per day were compared by Friedman-ANOVA due to the non-normal distribution of the datasets, which was tested by the Shapiro-Wilk test. Pairwise post-hoc comparisons were performed between the species using Wilcoxon-tests.

3. Results

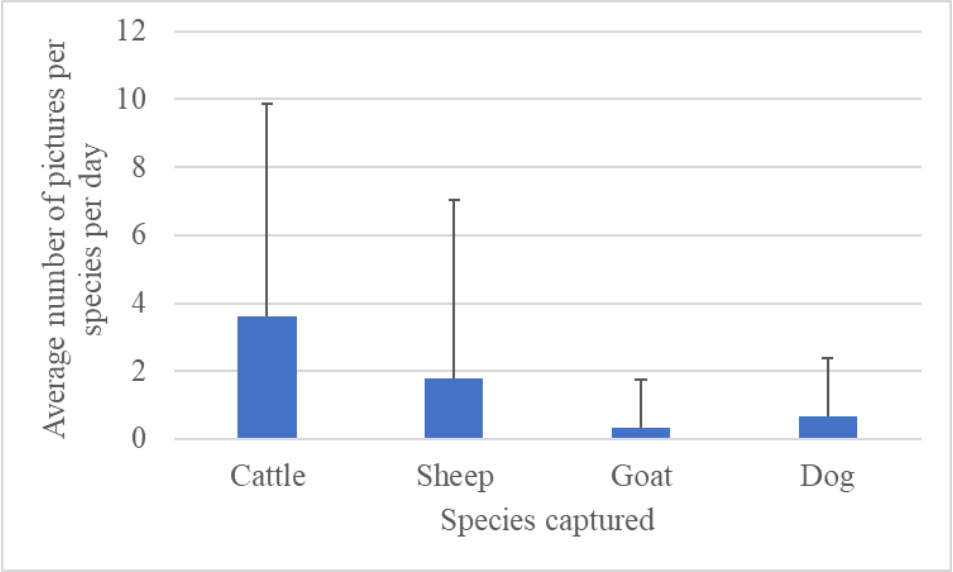
Figure 2.: Frequency of wildlife species visiting the community area in the Naretunoi Conservancy



The frequency of visits significantly varied between species (Friedman ANOVA: df=6, χ^2=6.82, p=0.003 for wild species; df=3, χ^2=19.35, p<0.001 for domestic species). The most common wild animals that were found outside the park on the Southern boundary were large ungulates comprising Masai Giraffes *(Giraffa camelopardalis tippelskirchi*) and the plain zebras (*Equus quagga*) while carnivores seen included lions (*Panthera leo*), black-backed jackal (*Canis mesomelas*) and the spotted hyenas (*Crocuta crocuta)*. Due to the high variation among days (many days without visits for the species), only the values of gazelle/baboon and all other species showed significant differences (p<0.05) from each other (*Figure 2.*). Ungulates

could be seen during the day and night while the carnivores were mainly captured at night.

Figure 3. Frequency of the camera trap visits by the livestock species that are commonly reared by the community members in the Naretunoi Conservancy.



The pictures further indicated that the main anthropogenic activity practised in the area is livestock rearing. The most common livestock species appearing in the pictures were cattle and sheep. Both of them occurred significantly more frequently in the area than goats or dogs ($p<0.05$). *Figure 3.* illustrates the camera trap visits of livestock that are reared by the community and the occasions that they were captured on the camera traps. It should be noted that the graphs are a representation of the length of time spent by different species in front of the cameras rather than the number of individuals.

4. Discussion

The commonly seen species were ungulates which mainly comprise giraffes and zebras. The reason for this could be the search for pasture or for a hiding place in the community areas to be attacked by carnivores in the small space within the park. The presence of the A*cacia drepanolobiumin* the area is also a major attraction for the giraffes. Similar images have been captured by Karlin et al. (2015) who used camera traps to aid in population counts for the giraffes and zebras which is a great indicator of species abundance within and outside the park over time.

The presence of these species in the community area is also a sign that there could be an increased potential for human-wildlife conflicts related to crop damage since grazers like zebras can be attracted by crops planted on local farms (Ogutu et

al. 2018). Mailu et al. (2010) also state that crop damage incidents were the most common form of conflict in the Naivasha area of Kenya where most of the free-ranging wild ungulates occurred. Another potential conflict could be the spread of zoonotic diseases from wild animals to livestock since they share common grazing grounds (Odeniran et al. 2016). This may lead to great economic losses to farmers which contributes to negative perceptions about wildlife conservation. Conflicts over pastures especially with the ongoing unpredictable weather patterns and land use changes which have made drought episodes to become more frequent (Ogutu et al. 2014). The farmers have gotten into conflicts with the park authorities as they sneaked their animals and grazed them inside the park at night (Mbatia 2015).

The other common species group in the area were carnivores, mainly the lions, jackals and hyenas that were usually photographed during the night. This could be attributed to the fact that they may be following the ungulates to try to catch prey (Lesilau et al. 2021). Lions mainly came out at night when it was quieter to avoid encounters with human beings which could be their main threat in the area. This has been supported by Agha et al. (2018) in their review of the use of camera traps across Africa.

The presence of lions in the community area increases the chance of threat to human life. Residents in the Mara and Tsavo felt threatened by the presence of carnivores in the community area (Ogutu 2018). Lions could be seen using the same dirt roads as humans and sometimes within very short time intervals which means that there is a possibility of encountering them in the dark thus a threat to humans in the area. There is also the potential risk of predation as a result of failed hunting for wild prey. The lions could opt for easier prey i.e., livestock. Lesilau et al. (2021) recorded similar findings which confirm that lions tend to move over larger areas and further into communities during the wet seasons resulting in predation.

Hyenas are generally nocturnal and were frequently captured by the camera traps during the night. Our findings correspond with those of Kolowski et al. (2007) on the same species in the Mara region of Kenya. Since they are opportunistic feeders, they probably hang around homesteads and feed off of leftovers which eventually results in livestock predation (Kolowski et al. 2006). They have an impeccable ability to crawl and dig through fences to get access to livestock inside the bomas (Ogara et al. 2017). This doubles the chances for livestock predation which is already worsened by the presence of lions in the Naretunaoi Conservancy.

5. Conclusion

Our study provides evidence of wildlife crossings from the park into the community area, which confirms that there are constant human-wildlife interactions in the areas that border the Nairobi National Park to the South. These results are important for the park managers, community members and other stakeholders as they capture the species that stray into community areas therefore providing a basis for the invention of mitigation measures that are species-specific.

Based on our study we suggest that more camera traps should be installed in different locations to cover a wider range of species and their movement. The cameras should also be used over long periods of time and during different seasons to ensure consistency in the species seen which will enable wildlife managers to predict potential conflicts and improve on the mitigation methods for specific species captured by the camera traps.

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