Vulture Abundance, Distribution and Species Diversity along a Gradient of Anthropogenic Effects in Nairobi National Park and its Environs, Kenya.

Final report by:

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Acknowledgments

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Summary

Vultures face a critical threat in Kenya. My study on vulture abundance, distribution and species diversity in Nairobi National Park (NNP) and Olerai Community Wildlife Conservancy (OCWC) revealed that only the White-backed Vulture breeds in these areas. Significantly, the high number of nests found in NNP highlights its essential role as a breeding ground for these endangered birds. A notable finding was the difference in nesting patterns between the two sites. In NNP, vultures exhibited flexibility, with nests distributed across various habitats. In contrast, in OCWC, nests were primarily located in riparian zones, indicating potential habitat constraints. This study also assessed local community awareness and attitudes towards vulture conservation. Encouragingly, awareness of vultures' population decline is widespread among the local community, with strong support for public education and awareness creation to advocate against wildlife poisoning. Equally, there is strong support for public education initiatives among the community as a way to raise awareness on the plight of vulture conservation. However, opinions are divided on enforcing strict penalties for poisoning. Based on these findings, I recommend a two-pronged approach to bolster vulture conservation efforts: first, prioritize education and awareness campaigns on best herding practices to mitigate human wildlife conflicts; second, promote non-lethal methods for retaliating livestock predation to reduce vulture deaths from wildlife poisoning.

Introduction

Across Africa, vultures have been faced with devastating population declines for over three decades. Several species of birds have experienced considerable population decline as land use change intensifies (Sinclair et al., 2002). Human population growth has been a major contributing factor to substantial decline of Kenya's wildlife population (Ogada et al., 2022). Old World vultures are not spared either. As scavengers, they are peculiarly sensitive to anthropogenic stress, and their changing status has direct impacts on the ecosystem services they provide (Ogada et al., 2022). With the exception of Palm-nut Vulture (*Gypohierax angolensis*), these charismatic birds feed mostly on carcasses of large mammals (Mundy et al., 1992, Bowden & Botha, 2018). Their ecology makes them extremely vulnerable to some threats, specifically toxic substances (Houston 1996) picked from the carcasses they forage on.

Kenya is a home range to eight vulture species. Four of these (i) the White-backed Vulture (*Gyps africanus*), (ii). Rüppell's Vulture (*Gyps rueppelli*), (iii). White-headed Vulture (*Trigonoceps occipitalis*), and (iv). Hooded Vulture (*Necrosyrtes monachus*), are categorized as critically endangered on the International Union for Conservation of Nature (IUCN) Red List (HBW and BirdLife International 2024). Threats to vultures across Africa include habitat loss through land degradation and change in land use, resulting in declining breeding sites and food supply (Virani *et al.* 2011), collision/ electrocution on energy infrastructure, wildlife poisoning (Ogada et al., 2016), and unsustainable harvesting for human consumption or traditional medicines (Saidu & Buij 2013). According to Ogada & Keesing (2010), intentional or accidental wildlife poisoning as a retaliation approach to livestock predation is the leading driver to vultures' population decline around wildlife conservation areas in Kenya. When a predator such as a lion, hyena, or leopard attacks and kills cattle, herders retaliate by lacing a carcass with poison targeting the involved predator. Ogada et al., (2016) conducted an analysis of 7,819 vulture deaths recorded across 26 countries in Africa, indicating that 61% were

due to either intentional or unintentional poisoning. Vultures, which are not the primary targets, are particularly vulnerable to these poisoning incidents, because they rapidly congregate in large numbers at a carcass (Ogada & Keesing 2010).

Ecologically, vultures provide critical ecosystem services that directly benefit the environment and people living nearby. This is because they not only clean up the land, but also eliminate the need for treatment and incineration of thousands of tons of animal remains and carrion every year (Grilli et al., 2019). This free cleaning service saves millions of dollars in waste management and avoids the potential emission of hundreds of thousands of tons of CO_2 per year, benefiting the environment and society as a whole (Grilli et al., 2019). Vultures' scavenging lifestyle also play a significant role in regulating the spread of zoonotic diseases. Unfortunately, vultures have been perceived as lowly scavengers by the public, leading to undercutting the conservation efforts they receive (Nyirenda et al., 2024). Yet, their foraging behaviour that gives them a very negative public image is, in fact, what makes them so important to the ecosystem.

There is rapid population growth and industrialization in Kenya. Nairobi City and its environs are at the epicentre of rapid infrastructural development as part of the country's vision 2030 development agenda. Situated adjacent to a major urban area, Nairobi National Park (NNP) is particularly facing high pressure of encroachment and habitat loss due to the rapid land use changes that occur around the park's borders. As keystone species in cleaning up the environment, vultures' ecological role is significant in reducing spill-over of zoonotic diseases between NNP and its surroundings. This study focused on supplementing other studies on vulture conservation by providing baseline data on the vulture abundance and species diversity within NNP and adjacent dispersal areas, while also assessing the attitude of the local community with respect to vulture conservation.

Study objectives

i. To establish baseline data of vulture abundance and species diversity in Nairobi National Park and the adjacent habitats.

ii. To engage communities around Nairobi National Park by creating vulture conservation awareness through public education, highlighting the importance of vultures in the ecosystem and the negative impacts of wildlife poisoning.

iii. To investigate community perception and attitude towards vulture conservation.

iv. To develop a distribution map of vulture breeding sites within Nairobi National Park to guide informed decision-making for management of the park's habitats by Kenya Wildlife Service (KWS) into the future.

Methods

Study Area

Nairobi National Park was gazetted as a protected area in 1947 on the borderlands between pastoral grazing lands and highland farming areas. The Park encompasses 117 km^2 at an altitude of 1600-1800m above sea level and located at latitude -1.355576, longitude 36.802186. The park is within the City of Nairobi boundaries, separated from human settlement in the north, east and west by an electric wire fence. Nairobi National Park is left open at its southern boundary which is marked by the Mbagathi River. The Park has a subtropical highland climate with December to March being the warmest season (mean maximum temperature being 24 °C) and June/July being the coolest season with temperatures dropping to about 9 °C at night (NOAA, n.d.). Rainfall decreases from over 800 mm in the northern part of NNP to under 500 mm in the extreme south-east of the plains. Vegetation within NNP consists mostly of open grasslands with scattered low *Vachellia drepanolobium* trees, open bushland with *Vachellia robusta*, wooded river margins and upland forest on the elevated terrain on the western side of the park. Soils are predominantly grey or reddish clays prone to water logging. The Park provides habitat to diverse animals such as black rhino, lion, zebra, eland, and giraffe (Nkedianye, 2004), among others.

Olerai Community Wildlife Conservancy is among the Athi-Kapiti wildlife conservancies associations that forms the Athi-Kapiti ecosystem. The Athi-Kapiti ecosystem's dispersal areas enables seasonal movement of wildlife from Nairobi National

Park to diverse ecosystems up to Amboseli, Ol Donyo Sabuk, Tsavo and Serengeti national parks. The 8 km^2 conservancy is located in the landscape to the south of Nairobi National Park at an altitude of about 1,500-2,200 metres above sea level and at latitude -1.625535, longitude 36.753788, within Kajiado County. Its vegetation is largely grassland and riverine woodland dominated by *Vachellia xanthophloea* trees. The migration corridors of Athi-Kapiti plains, Kitengela, and Ngong have undergone massive anthropogenic activities ranging from settlements to pastoralism, and agriculture. This has led to rising human-wildlife conflicts that have often contributed to the destruction of property and even loss of life for both humans and wildlife (Kutatoi & Waweru, 2017).

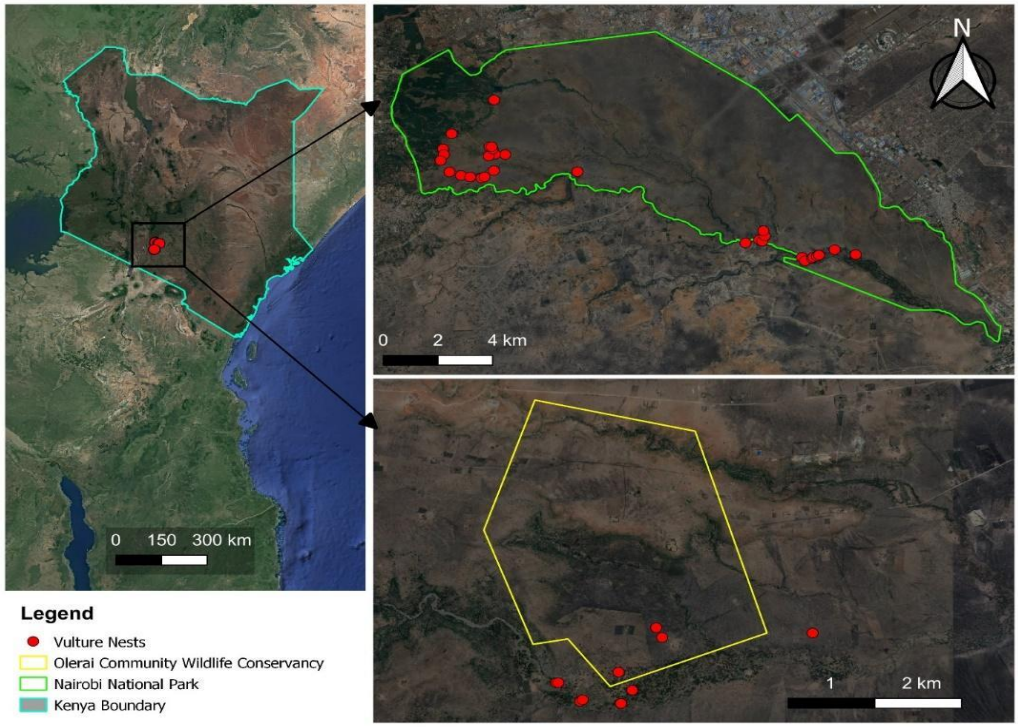

Figure 1: Map showing documented White-backed Vulture nests (indicated by the red dots) in the two surveyed study areas: Top right – Nairobi National Park; Bottom right – Olerai Community Wildlife Conservancy.

Data Collection and Analysis

Vulture species and nest surveys

Old World vultures are generally long ranging birds, except for breeding individuals that tend to remain closer to their nesting sites (Thompson et al., 2020; Zvidzai et al., 2022). Our survey focused on vulture nesting activity during the breeding season (May-September 2023), employing a combination of vehicle transects for efficient large-area coverage and on-foot surveys to access areas like rivers and gorges inaccessible by vehicle. Trained observers equipped with binoculars (Nikon 10*40), and a spotting scope (Fujinon 60 S super scope) documented all sighted vultures, identifying them to species level (guided by Stevenson & Fanshawe 2020), and recording their behavior.

The study specifically targeted active vulture nests to assess breeding populations. The survey period coincided with the breeding season of White-backed Vultures (the most common species in the region, Leepile et al., 2020). This strategic timing (May-September) encompassed the typical start of breeding season (March-April) and peak egg-laying (May) for White-backed Vultures (Piper, 2005; Mundy, 1982). To ensure accuracy, only nests with a confirmed sighting of a vulture were classified as active. We recorded data on each active nest, including its precise location using a handheld GPS (Garmin MAP 65s). Details about the nest tree were also documented, such as the tree species, approximate distance from the transect/road, side of the road where sighted, and approximate height of the tree. The general habitat type of the nest location was noted as well.

Vulture abundance within each study area was estimated by multiplying the number of active nests by two, assuming each nest represents a breeding pair. Finally, we employed QGIS software (QGIS 3.34 LTR) to create a map visualizing the spatial distribution of vulture nests across the study areas. This methodology provided a systematic and objective approach to assess vulture populations and their distribution patterns within the surveyed study areas.

Public education and community perception on vulture conservation

The project aimed to raise awareness among local communities, and to understand the community perception and attitude on the significance of vulture conservation. The community engagement and awareness creation was conducted in the month of December 2023, involving pastoralist communities within wildlife dispersal areas of Kajiado County. The selection of villages was informed by locations that reported highest incidents of human-wildlife conflict (Appendix 3) and reported incidents of suspected wildlife poisoning arising from livestock predation. For the success of community meetings, stakeholders from Kenya Wildlife Service, local administrators, and community leaders were engaged during planning and meeting presentations. The meetings were facilitated through talks, banner presentations, and lessons sharing approach.

Data on community perception and attitude about vultures and their conservation was collected through semi-structured questionnaires following Manqele et al., (2023). Questionnaires were administered one month later after awareness creation, within the villages where awareness were conducted. Consent to participate in the interview was sought from the meeting participants verbally, before administering the questionnaires. The purpose of the questionnaires was explained to the participants: that it was meant to understand the community's perception and attitude towards vultures and their conservation. A simple random sampling was used targeting people who were seen to be able to provide information on perception and attitude based on the local field assistants' judgement. Participants composed of only the willing community members above 18 years old. During the interviews, questions were translated to Maasai language to by a local field assistant, to those participants who had informal level of education so as to ensure clarity of the questions. Both data collation and descriptive analysis were done using Microsoft Excel©.

Results

Vulture species and nest surveys

We recorded two species of vultures occurring in the NNP and OCWC: Ruppell's Vulture (*Gyps rueppellii*) and White-backed Vulture (*Gyps africanus*). Ruppell's Vultures were often spotted roosting on top of tall *Vachellia xanthophloea* tree within the two study areas during early in the morning in OCWC (n = 4) and in the afternoon hours in NNP (n = 10). In NNP, Ruppell's vulture (n = 24) ware also sighted together with White-backed Vultures (n = 40) at a small water pool (See Appendix 1: Picture-1).

A total of 42 nests (84 breeding individuals) were documented within NNP while 18 nests (36 breeding individuals) were documented in OCWC (Figure 2). Within NNP, nests were distributed across different habitats from the bushland with scattered *Vachellia robusta* trees (n = 24) to the riverine woodland of *Vachellia xanthophloea* (n = 17). One nest was also documented on a blue gum tree (*Eucalyptus globulus)* (see Appendix 1: Picture-2). Subsequent visits to the documented nests in NNP recorded 8 confirmed juveniles, including one juvenile which was fully fledged, indicating flight attempt. In OCWC, all the nests were confined within the riverine habitat of *Vachellia xanthophloea* trees (n = 18).

Notably, at the onset of nest survey within OCWC, we encountered the occurrence of honeybees *Apis mellifera,* attaching their nests underneath six nests of White-backed Vultures (*Gyps africanus*) (see Appendix 1: Picture-4). This is the first documentation of such an association that I have been able to find so far. In NNP, I also encountered a White-backed Vulture and a Martial Eagle (*Polemaetus bellicosus*) sharing a nesting tree (see Appendix 1: Picture-3).

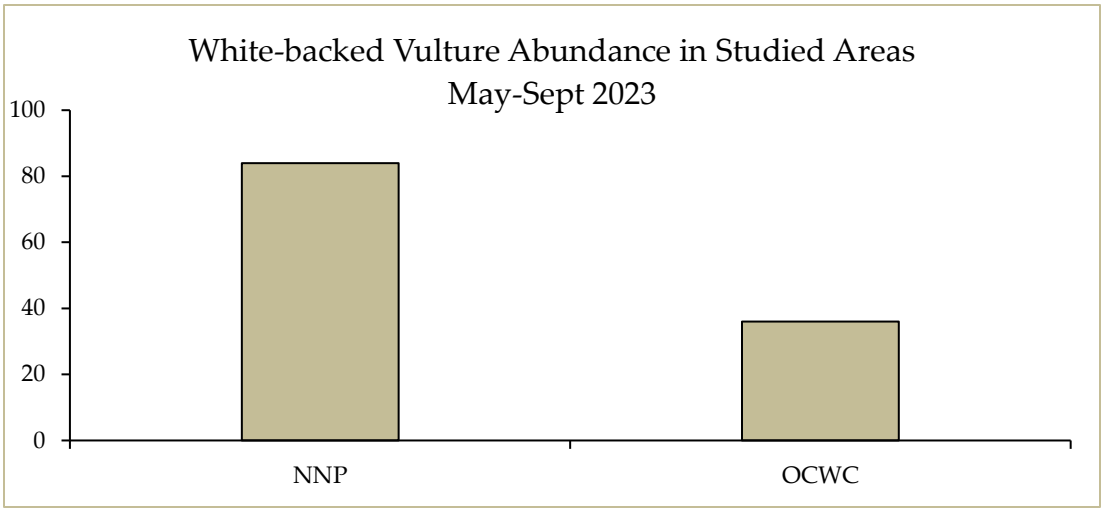

Figure 2: Breeding pairs of White-backed Vultures documented within Nairobi National Park (NNP) and Olerai Community Wildlife Conservancy (OCWC) surveyed between May – September 2023

Public education and community perception on vulture conservation

Vulture conservation awareness was undertaken within human-wildlife conflict prone dispersal areas in 8 villages: Emparua, Looselia, Olng'ania, Lasari, Indupa, Upper Olngulului, Kilonito, and Duka Moja within Kilonito, Ildamat and Elangata Uwas locations. Overall, 799 local community members were reached with messages creating awareness on the negative impacts of wildlife poisoning on vultures and the environment. We interviewed 271 participants who were willing to participate in the interviews, and 250 of the questionnaire forms had sufficient data to be processed for analysis. The demographics of participants included in the analysis of perception and attitude towards vulture conservation is outlined in Table 1 below.

Table 1: Summary of demographic, composition, and socioeconomic attributes of the study participants

Demographics	Composition	Number of respondents	Percentage
Gender	Male	160	64%
	Female	90	36%
Age bracket	Below 20	6	2%
	20-30	93	37%
	31-40	48	19%
	41-50	50	20%
	51 and above	53	21%
Level of education	Informal	73	29%
	Primary	93	37%
	Secondary	62	25%
	Tertiary	22	9%
Occupation	Employed	36	14%
	Self employed	65	26%
	Unemployed	149	60%
Land use activity	Livestock Keeping	153	61%
	Crop farming & livestock keeping	62	25%
	Crop farming	26	10%
	Others	8	3%

Ninety-seven percent of respondents (n = 243) agreed that vulture populations have declined. The remaining 3% (n = 7) indicated either that vulture populations are increasing or that they were unsure, with half of this group not being local residents by birth. Wildlife poisoning and vulture hunting for cultural beliefs were frequently cited as the main factors to have contributed to the decline of vultures. Wildlife poisoning was the most reported method of retaliation against livestock predation, cited by 58% (n = 110) of respondents. However, 30% (n = 57) of respondents indicated that scaring the predator away was also used as a retaliatory approach.

Following an awareness campaign (Appendix 2: Picture 5-8), 92% (n = 229) of respondents recognized vultures as important birds. Among them, 96% (n = 232) attributed this importance to vultures' role in clearing carcasses. Participants also noted

other benefits of vultures, such as helping herders locate livestock predation sites in grazing fields (1%; n = 2), reducing the spread of zoonotic diseases (1%; n = 3), and creating source of opportunities for local communities through vulture conservation programs/projects (1%; n = 2). To reduce vulture mortality from wildlife poisoning due to human-wildlife conflicts, 95% (n = 237) of respondents agreed that raising awareness can help mitigate this threat. Additionally, 99.2% (n = 247) believe that a swift response to human-wildlife conflict incidents by the Kenya Wildlife Service, and compensation for all losses caused by wildlife (99.6%; n = 249), would further reduce wildlife poisoning and overall save vulture populations. However, most respondents (55%) disagreed with harsh penalties for culprits of wildlife poisoning as an approach towards mitigating vulture mortality through wildlife poisoning.

Discussion

Vulture abundance and distribution

Among the eight vulture species occurring in Kenya, our survey recorded White-backed Vulture as the only vulture species breeding in the two study areas. Shema (2019) had reported 21 nests in OCWC, and 37 nests in NNP. This survey notes a decreased number of nests in OCWC (n = 18; 18 breeding pairs) and increase in nests recorded in NNP (n = 42; 42 breeding pairs). The high number of nests recorded within NNP seems to confirm the observation that this critically endangered species persists mostly within well protected areas like national parks (Thiollay 2006; Bamford et al., 2009; Moleón et al., 2020). However, observed variation in nest numbers, particularly in NNP where nests are widely distributed, can also be attributed to undetected nests due to difficulty of sighting nests on tall trees (Bamford et al., 2009; Dhakal et al., 2022) during the survey.

Unlike in OCWC where vulture nests are confined along the riparian habitat just like other findings elsewhere (see Monadjem 2001; Monadjem 2005), in NNP, vulture nests are distributed widely across three different habitats (open bushland, riparian woodland, and one occurring in the forest habitat), indicating that lack of riparian vegetation does not necessarily stop White-backed Vultures from nesting (Tarboton and

Allan 1984). For instance, one pair of White-backed Vulture had a successful breeding on a Eucalyptus tree within NNP. Monadjem & Garcelon (2005) attribute such secondary selection of woodland habitats for nesting to the change in land use over time that has led to loss of critical breeding habitats outside protected areas. This contributes to the influx of breeding White-backed Vultures in the national parks such as the case of Hlane National Park in Swaziland. As a result, the surplus birds likely entered an already saturated preferred breeding habitat along riparian vegetation (Monadjem & Garcelon 2005) and may have been forced to choose alternative habitats (open bushlands and forest habitats) for nesting. Such is likely to be the case also with the White-backed Vulture's roosting colony in the forest habitat within NNP.

Vulture species diversity

While Shema (2019) reported a pair of Lappet-faced Vulture (*Torgos occipitalis*) breeding inside NNP, and occurrence of Palm-nut Vulture in NNP, these species were not recorded in the park during our survey. Nonetheless, only two species of vultures were recorded both in NNP and OCWC. Whereas White-backed Vulture breed in the two surveyed areas, Ruppell's Vultures are cliff nesters, and could probably be visiting from the Kwenia cliffs (Shema 2019) for foraging and cooling themselves in water pools. The disappearance of Lappet-faced Vulture pair from the NNP is potentially attributed to wildlife poisoning that might have occurred within their foraging areas, somewhere away from the park (S. Thomsett pers. comm.).

Vulture nests and honeybees

Record of honeybee combs attached under White-backed Vulture nests is the first sighting of this kind of occurrence associated with vulture nests that I could find. Bees have been observed under the nests of other raptors; this could be potentially a beneficial association for vultures by offering protection from baboons attacking chicks in the nest (S. Thomsett pers. comm.). However, bees have been reported to attack and cause disturbance to raptors in the nest (J. Oduori, pers. comm.). In Namibia, Bridgeford & Kolberg (2013) reported several encounters of honeybees found around the eyes of

Lappet-faced Vulture chicks. The chicks, were often found with partially or completely closed eyes and some were later found dead on the ground under the nest. Larger chicks were found with their heads under the wings, a sign of escaping from the stubborn bees that were seen flying around the nest and the chick, looking for moisture (Bridgeford & Kolberg 2013).

Human perception towards Vulture Conservation

Results of our interviews indicate that 97% of respondents acknowledge that vulture populations have declined, suggesting widespread recognition of the existing problem. This is similar to the finding of interviews conducted around Comoé National Park, Côte d'Ivoire (Asso et al., 2024). A small minority (3%) who had the contrary opinion were not local residents by birth. This may suggest that local experience and familiarity with the ecosystem play crucial roles in traditional knowledge towards understanding vulture population trends and support for conservation of vultures.

Wildlife poisoning emerged as the most prevalent method of retaliation against livestock predation, reported by 58% of respondents. This is in line with sentiments of Ogada et al., (2011) that deliberate poisoning of carnivores by humans is likely the most widespread cause of vulture poisoning. However, 30% of respondents mentioned scaring predators away using various approaches such as guard dogs, as a potential non-lethal method of managing human-wildlife conflict. This split in response to livestock predation is similar to the results from Maasai pastoralists reported by Didarali et al., (2022).

The effectiveness of an awareness campaign is evident, as 92% of respondents came to recognize the importance of vultures, with majority (96%) of them specifically valuing vultures' role in clearing carcasses. Similar outcomes were reported by interviews conducted in Pokhara Valley, Nepal (Dhakal et al., 2022). Additional benefits noted by respondents include helping herders locate livestock predation sites (also reported by Didarali et al., 2022), reducing zoonotic disease spread, and creating community opportunities through conservation programs. This acknowledgment of vultures' ecological role is critical for garnering public support for vulture conservation.

To address the threat of wildlife poisoning, 95% of respondents agreed that raising awareness could mitigate this issue, indicating strong support for public education and awareness creation initiatives. Moreover, 99.2% say that timely responses to human-wildlife conflict incidents by the Kenya Wildlife Service, along with compensation for losses caused by wildlife (99.6%), would help reduce wildlife poisoning and thereby protect vulture populations. While there is support for reducing vulture mortality, 55% of respondents disagreed with imposing harsh penalties on those responsible for wildlife poisoning. This may reflect concerns about fairness in law enforcement in relation to human-wildlife conflicts.

Conclusion

The survey of vultures in Nairobi National Park and its environs identified the White-backed Vulture as the sole breeding species in the two study areas. The distribution of White-backed Vulture nests within various habitats in Nairobi National Park (NNP) suggests a preference for well-protected areas by this species. The findings underscore the importance of protected areas like national parks for the persistence of these critically endangered birds. Positive local perception towards a species is indispensably fundamental to its successful conservation. By people understanding the significance of vulture in the ecosystem, they are likely to reduce activities that threaten vultures. The findings on human perception towards vulture conservation suggest that a combination of awareness, timely response to human wildlife conflict incidents by KWS, and compensation for livestock predation could form an effective strategy for vulture conservation by reducing wildlife poisoning.

Recommendations

i. The observed association of honeybees with vulture nests introduces area of potential study. I recommend further monitoring of nests documented at Olerai Community Wildlife Conservancy to understand if this occurrence is seasonal, and to unpack the balance between potential protective benefits and negative impacts on vulture chicks in the nest.

ii. Increase community involvement in vulture conservation through education outreach and awareness creation while advocating against wildlife poisoning to reduce retaliatory poisoning.

iii. Continued survey of vulture breeding sites within protected and unprotected areas is recommended to enable earlier detection of potential threats for a timely response towards mitigation.

Appendices

Appendix 1: Pictures from field vulture surveys

Picture 2: White-backed and Ruppell's Vultures at a water pool in NNP

Picture 1: White-backed Vulture nesting on blue gum tree in the upland forest in NNP

Picture 4: Honeybees comb attached under the White-backed Vulture's nest in OCWC

Picture 3: Martial Eagle (orange rectangle) and White-backed Vulture (blue rectangle) nesting on the same tree (Vachellia robusta).

Appendix 2: Pictures from community awareness village meetings

Picture 5: Community awareness meeting held with village members at Indupa village (-1.859582, 36.618605) on 18/12/2023.

Picture 6: Community awareness meeting held with Kilonito village leaders at Kilonito village (-1.788507, 36.611155) on 13/12/2023.

Picture 7: Community awareness meeting held with youth football team at Kilonito village (-1.786840, 36.612083) on 13/12/2023.

Picture 8: Community awareness meeting held with community members at Kilonito village (-1.786840, 36.612083) on 13/12/2023. T-shirts branded with Rufford logo were awarded to active participants.

Appendix 3: Analysis of human wildlife conflict data that guided selection of location for community awareness on the plight of vulture conservation.

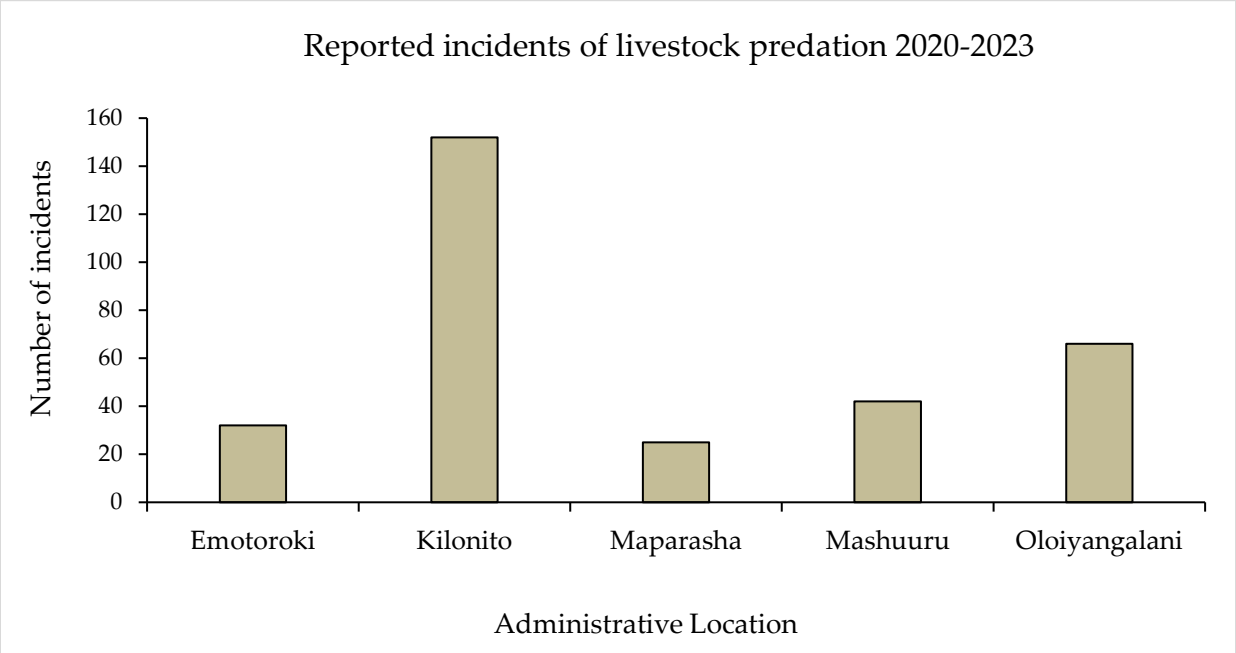

Figure 3: Reported incidents of wildlife predation reported from different administrative locations within wildlife dispersal areas in Kajiado County with respect to Nairobi National Park. Data source: ©Nature Kenya (EANHS) – Human wildlife conflict consolidated database 2020-2023.

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