

Impacts of Tourist Accommodation Facilities on Migratory Wildlife Species within Serengeti National Park, Northern Tanzania

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Abstract

Tourist accommodation facilities play an important role in facilitating tourism activities in many protected areas. Despite their significance, these facilities have several negative impacts on migratory wildlife species, particularly in Serengeti National Park (SNP). This study aimed to assess the effects of tourist accommodation on migratory wildlife species in the SNP, Northern Tanzania. Various methods were used for data collection, including field visits with Global Positioning System (GPS) technology to gather location points of tourist facilities in hotspot areas. Additionally, desktop research was conducted to compile visitor influx statistics from the park's visitor database, and the movement and duration of stay of GPS-collared migratory animals, such as wildebeests and zebras, were analyzed. The findings revealed that 64% of the tourist accommodation facilities were situated in Seronera Valley, which hosted 84% of all tourists visiting the SNP. Furthermore, migratory wildlife species (zebras and wildebeests) spent less time in areas with a high concentration of tourist accommodations in Seronera Valley compared to Ndutu/South and Kogatende/Mara in the north. To address these issues, it is recommended to reduce or control the number of tourist accommodation facilities from the core of SNP to its periphery, develop and adopt eco-friendly practices within these facilities, and effectively utilize existing policies and regulations to promote harmonious coexistence between migratory wildlife species and tourist accommodations in the SNP.

Keywords: *Accommodation facilities, migratory species, Serengeti National Park, time spent, tourism hotspots*

1.0 INTRODUCTION

Constructed tourist accommodation facilities support tourism in natural areas (Bulatović, 2017). These constructed accommodation facilities in attractive natural resources and landscapes are intended to draw in tourists **Error! Reference source not found.** as well as enhancing tourists experience and satisfaction of the area (Bulatović, 2017). Despite of their importance, they are associated with several negative impacts on

migratory wildlife species. The study by **Error! Reference source not found.**, support this as it found that tourism estates comprised of hotels, resorts and camp grounds had potential adverse impacts on the environment on which tourism depends. Again, lodges/ hotels were the top most contributors to the negative impacts on the environment because of their high capacity to utilise resources such as water, energy, and production of waste (Karis et al., 2013). Prior studies have highlighted numerous important effects of tourist accommodation facilities such as habitat alteration, animal habituation, the transmission of zoonotic diseases, inadequate solid waste management, depletion of grazing lands and water supplies, loss of vegetation cover, soil erosion, the introduction of non-native species, and the risk of wildlife extinction (Erdogan and Tosun, 2009; Rimaze et al., 2020).

It was further revealed that lodges/ hotels have potential disruption to wild species and their habitats, which might be caused by human proximity and their associated activities **Error! Reference source not found.** These facts are also supported by Rimaze et al. (2020) through their study on mammals' diversity and abundance and their interactions with different accommodation facilities in Kwakuchinja Wildlife Corridor adjacent to Tarangire National Park. Vividly, the results of the study by Rimaze et al. (2020) signified the negative impact of lodges/ hotels on wildlife as they attract animals towards their vicinities. Although, SNP has been extensively researched in relation to protected areas in Tanzania, there is limited information on the effects of tourist accommodation facilities on migratory wildlife species within this renowned conservation estate. Thus, this study aimed to evaluate the effects of tourist accommodation facilities on migratory wildlife species in SNP, northern Tanzania. This paper hypothesised that, time spent by migratory species performing their behavioural activities within the tourist hotspots within the SNP tourist's hotspots would decrease as the number of tourist accommodation facilities increased.

2.0 MATERIALS AND METHODS

2.1 The Study Area

Serengeti National Park is situated in northwest Tanzania, spanning from Longitude 34° to 36° E and Latitude 1° 15' to 3° 30' S (Figure 1). It was established in 1959 (Kaltenborn et al., 2011). The park holds both World Heritage Site (WHS) and Man and Biosphere Reserve (MAB) designations due to its exceptional globally significant biological resources **Error! Reference source not found.** Covering an area of

14,763 square kilometers (Díez Gutiérrez et al., 2017; Scoon, 2018), it features diverse habitats, including grasslands, riverine forests, swamps, and woodlands, all rich in wildlife diversity **Error! Reference source not found.**

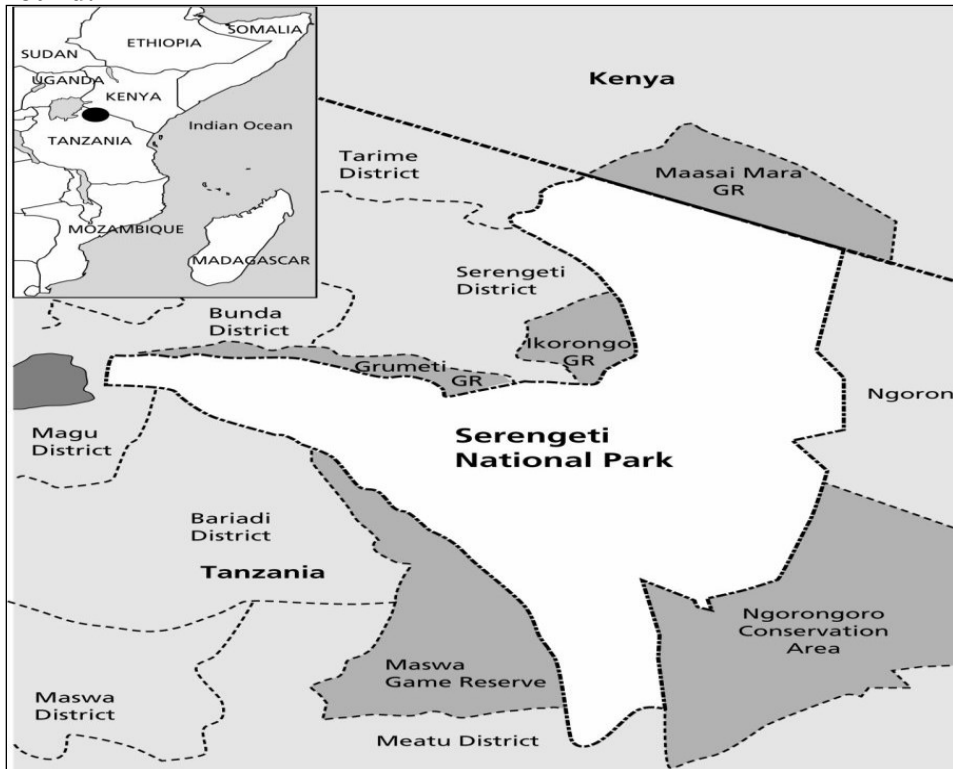


Figure 1: Serengeti National Park and adjacent protected areas
 Source: Kaltendorfer et al., 2011)

The climatic conditions in the Serengeti are diverse, affecting precipitation patterns. Rainfall varies from a minimum of 500 mm per year in the southeastern part of the park influenced by the rain shadow of the Ngorongoro Highlands, to a maximum of 1,100 mm per year in the northeast and 900 mm per year in the northwest (Belsky, 1984). SENAPA experiences bimodal rainfall, with shorter rains occurring in October, November, and December, and longer rains from March to May. The distinctiveness of SNP is linked to the presence of migratory wildlife species, particularly the wildebeest (*Connochaetes taurinus*) and zebra (*Equus buchelli*), with populations estimated at approximately 1.5 million and 0.5 million individuals, respectively (Joly et al., 2019; UNESCO, 2020). This annual event begins in the southern part of SNP and moves northward through SNP before continuing to the neighbouring Masai

Mara National Reserve (MMNR) in Kenya (UNESCO, 2020). The short grass plains in southern SNP, adjacent to the Ngorongoro Conservation Area (NCA), provide optimal calving conditions due to their nutrient-rich pastures during the wet season. In contrast, northern SNP and MMNR serve as refuges during the dry period (Msoffe et al., 2019; UNESCO, 2020). Serengeti National Park was specifically chosen for the study because of its high tourist numbers, ample accommodation facilities, and the presence of migratory ungulates that are not found in other parks.

2.2 Data collection methods

2.2.1 Research design

Research design is the conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement and analysis of data (Kothari, 2004; Gara and Mhache, 2021). This research was based on a multiple research method for data collection and analysis keeping in minds the prevailing COVID-19 pandemic limitations. Moreover, it also relied on correlation and other statistical tests to deduce the required conclusion. This framework was considered as it rendered the researcher with flexibility in obtaining the required data and subsequently their analysis while also reducing the health risks following the emergence of the COVID-19 pandemic.

2.2.2 Sampling

To meet the study objectives, both purposive and random sampling methods were used. As noted by Saunders et al. (2016) and Etikan and Bala (2017), purposive or judgmental sampling depends on the researcher's discretion to select the most relevant cases that facilitate answering of research questions and meeting the study objectives. The specific study areas namely Ndutu, Seronera Valley and Mara/Kogatende were purposeful chosen due to their importances for migratory species including calving grounds, all year-round tourism spots, dry season refuge as well as the Mara River crossing, all of which have a high concentration of tourist accommodation facilities.

Furthermore, to evaluate the number of tourist accommodation facilities and the migratory species in the areas, three blocks of equal size (484.124703 km²) were designated, one in each hotspot. All facilities and migratory animals within these blocks were included as samples for the study. Serengeti National Park has a total of 273 accommodation facilities, comprising 12 hotels/ lodges, 73 seasonal campsites, 15 special campsites, and 6 public campsites. These were sampled to examine the

impact of tourist accommodation on migratory wildlife species in hotspot areas. Consequently, the three selected study sites were analyzed for the duration of migratory species' presence, measured in the number of days spent in the hotspot areas. Ultimately, the temporal patterns of these animals were evaluated in relation to tourist numbers and accommodation facilities to assess their impact on migratory wildlife species, and a correlation was tested.

2.2.3 Data collection methods and materials

In this study both primary and secondary data was collected. A Global Positioning System (GPS) Garmin Montera™ was used to collect primary data during field visits carried out in March and April 2020 to determine the tourist accommodation facilities located within SNP. On the other hand, secondary data on visitors' number and recorded movements of the GPS collared migratory species comprised of two-years data (2018/2019 and 2019/2020) obtained from the existing SNP visitor's database and Serengeti Biodiversity Project. Although the researcher aimed to employ various data collection methods, the onset of the COVID-19 pandemic restricted the use of face-to-face data collection techniques, leading to a reliance on field and desktop research methods. This was particularly relevant since the study concentrated on the duration spent by migratory wildlife species in tourist hotspot areas. The data within a hotspot area were obtained from a total of 87 collared individuals comprising of two migratory animal species (wildebeests *Connochaetes taurinus* and zebras *Equus buchellii*).

2.3 Data analysis

The organization and storage of the collected visitor statistics from the sampled facilities were managed using MS Excel. Additionally, the Statistical Package for the Social Sciences (IBM SPSS, Version 26) was used to analyze the quantitative data, with the goal of determining whether there were statistically significant temporal variations in animal movements within hotspots, influenced by tourist accommodation facilities and the influx of visitors over specific periods. Furthermore, the mapping of collected GPS coordinates for tourist accommodation sites and the movements of collared animals in the tourist hotspot areas was carried out using ArcMap software (Version 10.3). Ultimately, to evaluate the statistical relationships between the number of accommodation facilities/tourists and the time spent by 87 collared animals in the hotspots, as well as the temporal variations across the three tourist hotspot areas, correlation analysis and ANOVA tests were conducted.

3.0 RESULTS

3.1 Number of Tourist Accommodation Facilities, Density and Category

Out of the 273 accommodation facilities in the Serengeti National Park, 106 are located within the three sampled tourist hotspots; Ndutu/South, Seronera Valley/Central, and Kogatende/Mara (Figure 2).

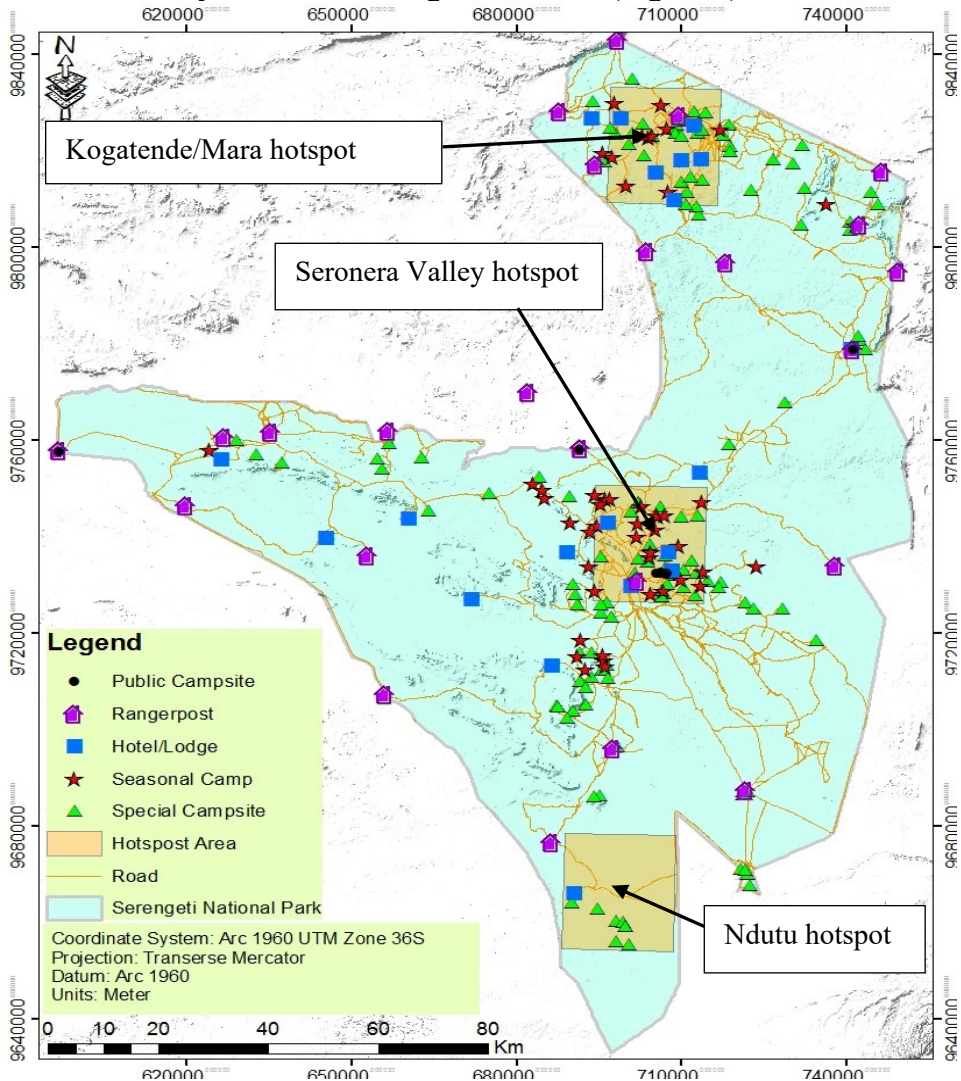


Figure 2: A map illustrating the spatial distribution of tourist accommodation facilities across the three tourist hotspots

The results show that Seronera hotspot has the highest number of tourist accommodation facilities compared to the other hotspots. Specifically,

Seronera has 68 (64.2%) facilities, while Ndutu has 6 (5.7%) and Kogatende/Mara has 32 (30.2%), indicating a greater density of facilities in Seronera. The analysis of facility density across the three equal blocks of 484 km² in these hotspot areas revealed that Seronera Valley is significantly developed, with a facility density of 0.1405 facilities per km². While Ndutu/South tourist hotspot expressed a low facility density with a value of 0.0124 facilities per km², Kogatende/Mara hotspot fall in the medium facility density category with a value of 0.0661 facilities per km². Regarding the composition of tourist accommodation facilities, the results identified four categories: Hotels/Lodges 12 (11.3%); Seasonal Camps 73 (68.9%); Special Campsites 15 (14.2%); and Public Campsites 6 (5.7%). Despite the variation in facility types, their effects on the time spent by migratory wildlife species during the periods of 2018/2019 and 2019/2020 were statistically insignificant, with p-values of P=0.177 and P=0.691, respectively.

3.2 Number of Tourists Staying in Accommodation Facilities in the Hotspot Areas

The number of tourists staying at the sampled facilities increased during the two years (2018/2019 and 2019/2020), despite the impact of the COVID-19 pandemic. This rise can be attributed to the fact that the pandemic began at the start of the low tourism season, when most tourists had already visited the park. The results found a total of 194,223 comprising of 87,656 and 106,567 tourists residing from the accommodation facilities for 2018/2019 and 2019/2020 years respectively. Further, the results indicated uneven distribution of tourists within the hotspots. According to the results Seronera Valley received 163,170 (84%) tourists compared to Ndutu 2,858 (1.5%), and Kogatende/Mara 28,195 (14.5%) tourists.

The results also found uneven distribution of tourists in various categories of tourist accommodation facilities within SNP. For the two years period used by the study Seasonal campsites attracted 86,658 (44.62%) of tourists visiting Serengeti. Other categories with the number of tourists attracted include public campsites 57,475 (29.59%), Hotels/Lodges 33,870 (17.44%), and Special campsites 16,220 (8.35%).

3.3 Time spent by migratory species within hotspot areas

3.3.1 Abundance and distribution of migratory species within hotspot areas

Data on the movements of 87 GPS-collared wildebeest and zebra individuals were collected and analyzed to assess the duration of stay of these migratory species in tourist hotspot areas. Of the total, 63 wildebeests (72.4%) and 24 zebras (27.6%) were tracked. The analysis revealed that the encounters of these individuals within hotspot areas were as follows: 29 (33.3%) in Ndutu, 35 (40.2%) in Seronera Valley, and 23 (26.4%) in Kogatende/Mara.

3.3.2 Duration of migrants stay in the tourist hotspot areas

The results from 87 collared individuals indicated that the mean duration of animals' stay in the tourist hotspot areas varied. On average, migratory animals spent between 12 and 6 days in these areas during the years 2018/2019 and 2019/2020, respectively. Specifically, the mean duration of stay for migratory animals in each hotspot area was as follows: Ndutu/South had averages of 29.52 and 59.04 days; Seronera Valley/Central had 9.285 and 2.228 days; and Kogatende/Mara maintained an average of 15.869 and 15.04 days. While other hotspots showed different averages, Kogatende/Mara consistently had a mean stay of about 15 days. Notably, 2018/2019 mean duration of stay of migrants in Ndutu/South was half the number of days spent in 2019/2020. The same trend was experienced in Seronera Valley/Central where the migrants mean duration of stay for 2019/2020 was 25% of the 2018/2019 mean. Despite the variations in the time spent in hotspot areas, there was no statistically significant difference between the different types of accommodation facilities and the time spent by migratory animals in these areas during 2018/2019 and 2019/2020, with values of $X^2=45.508$, $df=42$, $p=0.328$ and $X^2=21.176$, $df=30$, $p=0.882$, respectively. Furthermore, the results indicated no evidence of a relationship between the duration of animal stays and the number of tourists, with $X^2=218.629$, $df=189$, $p=0.069$ and $X^2=230.798$, $df=216$, $p=0.232$ for 2018/2019 and 2019/2020, respectively. These findings suggest that neither the type of accommodation facility nor the number of visitors to these facilities significantly affects wildlife behavior. This could be attributed to the fact that many tourists' accommodation facilities in Serengeti are tented camps which their construction is relatively less destructive to the surrounding environment hence making it tolerable.

3.3.2.1 Time spent Vs Number of tourists

A Correlation Analysis was conducted to explore the relationship between the time spent by migratory wildlife species and the number of tourists residing in accommodation facilities. The results showed a weak negative

correlation between the duration of animal stays in hotspot areas (in days) and the number of tourists in these facilities for the years 2018/2019 and 2019/2020. This is reflected in Pearson Correlation (r) values of -0.125 and -0.095 when comparing the animals' duration of stay for 2018/2019 with the number of tourists for 2019/2020, and vice versa. The weak negative correlation persisted in the comparisons of animal duration of stay for 2019/2020 against the respective groups, as well as the correlation between the number of tourists in 2018/2019 and other groups. However, the significance levels for all correlated groups were above the alpha threshold of 0.05, ranging from 0.247 to 0.382, indicating no significant differences in the time spent by migratory animal species in the hotspot areas. In contrast, the Chi-Squared Test (X^2) revealed that the time spent by migratory animals significantly differed based on the number of tourist accommodation facilities within the hotspots, with results showing $X^2=114.758$, $df=68$, $P<0.0001$.

3.3.2.2 Testing the Significance of Migratory Animals' Time Spent in Hotspots Using ANOVA

Given that the correlation analysis indicated no significant differences in the time spent by migratory species in the hotspots, an ANOVA statistical test was conducted to explore this further. The ANOVA results revealed variations in the duration of migratory species in the hotspots across the years, with mean durations ranging from 2 days in 2019/2020 for Seronera Valley/Central to 59 days in 2019/2020 for Ndotu/South hotspot. The variances for 2019/2020 displayed a similar trend, with a minimum of 18.7 days in Seronera Valley and a maximum of 2241.7 days in Ndotu/South. Overall, the Analysis of Variance (ANOVA) strongly indicated a significant difference in the time spent by migratory animal species within the hotspots, with a p-value of $P = 8.04 \times 10^{-16}$.

4.0 DISCUSSION

4.1 The Number of Tourist Accommodation Facilities and Tourists in Hotspot Areas

The study found that SNP has a total of 273 tourist accommodation facilities, including hotels/lodges, seasonal campsites, special campsites, and public campsites. While the selection, allocation, and development of these facilities adhere to the guidelines set forth by SNP GMP, TANAPA DALP, and the Tourism Investment Manual documents (Tanzania National Parks, 1995; TANAPA, 2014, 2019), the majority are situated within Seronera Valley compared to the Ndotu/South and Kogatende/Mara hotspots. The current findings show that there are 12

(11.3%) Hotels/Lodges, 73 (68.9%) Seasonal Camps, 15 (14.2%) Special Campsites, and 6 (5.7%) Public Campsites, which are crucial for accommodating tourists visiting SENAPA. Additionally, these facilities had the capacity to host a total of 87,654 and 106,567 tourists during the 2018/2019 and 2019/2020 financial years, respectively. Despite the onset of the COVID-19 pandemic, which could have affected tourist numbers, the results indicated an increase in the total number of visitors. This was mainly due to the fact that the pandemic heightened at the beginning of low tourism season. However, the manifestation of the effects of the pandemic were largely observed in 2020/2021 following the imposition of stringent measures to curb the pandemic worldwide (Kideghesho et al., 2021; World Travel Organization (UNWTO), 2021). As a result of pandemic established control measures the number of tourists' arrivals in Serengeti declined from 6,000 to 24 a day in April 2021 (Kideghesho et al., 2021).

4.2 The Time Spent by Migratory Wildlife Species in Relation to Accommodation Facilities and Tourists

The impact of tourist accommodation facilities on wildlife is well-documented (Rimaze et al., 2020). This study found that, due to the high number of tourist accommodation facilities, migratory species spent less time in Seronera Valley in the central Serengeti compared to Ndutu/South and Kogatende/Mara. Additionally, the presence of migratory animals has influenced the establishment of tourist accommodation facilities in these hotspots (UNESCO, 2020). The park's reputation, bolstered by the migration of 1.5 million wildebeests, zebras, and gazelles, attracts a significant number of tourists globally (UNESCO, 2020), leading to increased demand for the development of accommodation facilities. Furthermore, factors such as ease of access, supporting infrastructure (e.g., information centers), and water availability also contribute to the growing number of tourist accommodation facilities in hotspot areas. Due to an ease of access, 66% of tourist accommodations in Kruger National Park South Africa were located in the Marula South (Ferreira and Harmse, 2014). Similarly, Mogende and Moswete (2018), reported the disturbance to migratory animals due to the development of tourist facilities along waterfronts of the Chobe River in Chobe National Park in Botswana and the Okavango Delta. Furthermore, this finding reinforces the hypothesis that a higher number of tourist accommodation facilities and an increase in tourist numbers lead to a reduction in the time spent by migratory wildlife species in tourist hotspot areas. In contrast, this research is consistent with findings from other studies, such as as Larsen

et al. (2020) and Díez-Gutiérrez et al. (2017), which indicate that migratory species tend to avoid tourist accommodation facilities due to associated disturbances, and that the Seronera area has a higher concentration of these facilities compared to other regions. This situation, combined with increased tourism activities, may compromise the Seronera Valley's status as a year-round water source for migratory and other animals, significantly affecting grazing and water availability for herbivores. This aligns with Kihwele et al. (2020), who argue that the surface, spatial, and temporal distribution of water is crucial for wildlife and for understanding the composition of large herbivore assemblages in savannah ecosystems.

Tourist accommodation facilities are strategically positioned in the Ndutu/South, Seronera Valley/Central, and Kogatende/Mara hotspots to align with the movements of migrating ungulates traveling from the southern regions to the Maasai Mara National Reserve in Kenya and back. According to Msoffe et al. (2019) and UNESCO (2020), areas in the southern Serengeti, including Ndutu in both the Serengeti and Ngorongoro Conservation Area, serve as crucial nursing grounds for lactating wildebeests and their calves. The presence of short grass plains provides a safe environment against predators while offering nutritious grazing for both the mothers and their young (Msoffe et al., 2019; Larsen et al., 2020). The calving season, which occurs between January and March each year, draws tourists to the southern Serengeti to witness this remarkable event. Due to the increased demand for accommodation during this period, many operators of seasonal camps relocate their facilities to the southern Serengeti to cater to tourists until the migration northward begins. The movement of the migrants toward the north is prompted by the depletion of resources, such as pasture and water, in the plains (Harris et al., 2009).

Conversely, various types of pollution, including dust, human-made noise, light, and fuel emissions, disrupt the natural behaviors of animals (Ndibalema et al., 2008; Kight and Swaddle, 2011; Francis and Barber, 2013; Harding et al., 2019) and could be the major reason for migratory animals less time expenditure in Seronera Valley. Some of the quantified anthropogenic effects to animals include reduced reproduction, survival, abundance, diversity, and altered interactions between species (Shannon et al., 2016; Larsen et al., 2020). Moreover, habitat fragmentation resulted from animal movements obstruction within SENAPA especially in Seronera Valley, may be due to the development tourist accommodation

facilities. Within this context, Rimaze et al. (2020) explain the adverse effects of tourism developments (accommodation facilities) to smooth dispersal of animals in protected areas. Cited example includes Reindeers preference to areas with low human presence over developed areas leading to habitat fragmentation in the Polar Regions (Gundersen et al., 2019). According to the study results, neither the type of facility nor does the number of visitors to the accommodation facilities impacted wildlife behaviour signalling that the number and locations of the developments could be the major culprit of the disturbance. This was elaborated by Gundersen et al. (2019, p. 26), who noted that "decreased habitat use, a loss of foraging resources, and alterations to traditional migration routes (such as fewer crossings, delays in crossings, or the complete cessation of crossings)" were consequences of the development of visitor infrastructure in areas critical for reindeer". Furthermore, the findings revealed that the disruption of migratory animals' behaviour was due to the overall number and location of the facilities. The study by Skarin & Ahman (2014), found that human activities and infrastructure development interfered with the seasonal migratory patterns of reindeer in Arctic and subarctic regions. Other previous studies example Vistnes and Nellemann, (2008); Nellemann et al. (2010); Skarin and Ahman (2014) and Gundersen et al. (2019) provide evidence for migratory animal's avoidance of anthropogenic developments.

Additionally, the variation in avoidance distance is influenced by the type of human activity and infrastructure, as well as the sex of the animal. According to Skarin & Ahman (2014), reindeer avoidance distances ranged from 8 to 12 km in areas with tourist resorts featuring hiking and snowmobile trails, but this distance could decrease to about 4 km around the resort after disturbances, particularly for males, while females still tended to avoid these areas. Similarly, the avoidance distance for reindeer concerning infrastructure varies with the level of disturbance, ranging from 0.5 to 25 km. Beyond a certain threshold, if alternative habitats are available, the animals may abandon the area (Nellemann et al., 2010). Although this study did not focus on the avoidance distance of migratory wildebeests and zebras from accommodation facilities, it was noted that reindeer maintained a distance of 3.5 km from developments, irrespective of their prior use of the area (Skarin & Ahman, 2014). However, based on past experiences and perceived benefits, animals may exhibit increased tolerance to disturbances (Skarin & Ahman, 2014). Therefore, tourist accommodation facilities development and disturbance may result into the loss of traditional migratory routes within Serengeti National Park.

Elsewhere, the loss of important migration corridors due to infrastructure development has happened in reindeer strongholds (Gundersen et al., 2019). The shorter duration of stay for migrants in the Seronera Valley, a key year-round tourism hotspot, signals a need for intervention. While the study found no statistically significant impact of visitor numbers on the time migratory wildlife species spent in these tourist areas, the trend of reduced time spent in some hotspots serves as a warning for park management. Due to excessive tourist accommodation facilities development within Seronera Valley wildebeest and zebra are forced to abandon their traditional migration routes. The findings corroborate Skarin & Ahman (2014) findings, prompt reduction or completely removal of facilities reindeers return to their original ranges despite the doubling number of tourists.

5.0 CONCLUSIONS AND RECOMMENDATIONS

This study concludes that the time migratory animals spend varies across different years and tourist hotspot areas. Specifically, migratory species tend to spend less time in areas with a high concentration of tourist accommodation facilities, with Seronera Valley showing shorter durations compared to Ndutu/South and Kogatende/Mara in the north. This is attributed to the abundance of such facilities. Consequently, the impacts linked to tourism and accommodations—such as obstruction of migratory routes, pollution, and ecological disturbances—are significant factors disrupting the movement patterns of migratory animals within the Serengeti. These issues highlight the need for effective mitigation strategies.

To address these challenges, the study recommends reducing or regulating the number of tourist accommodations from the park's core to its edges, implementing eco-friendly practices within these facilities, effectively enforcing existing policies and regulations, and conducting studies on current migratory animal movement patterns. These recommendations aim to prevent development along migratory routes while fostering a harmonious coexistence between migratory wildlife species and tourist accommodations in Serengeti National Park.

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