

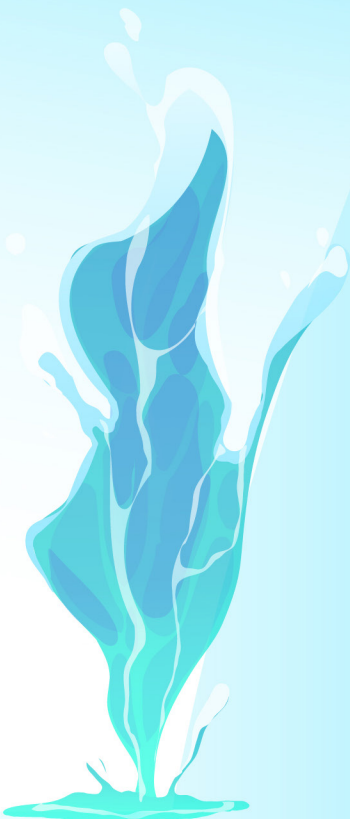
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Influence of Selected Environmental Parameters, Cattle and Human Encroachment on Landscape Occupancy by the Common Eland in Eland Sanctuary Park, Zimbabwe

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ABSTRACT

Savanna herbivores' landscape utilization is influenced by resource requirements and environmental and anthropogenic factors. The study explored the influence of vegetation cover, elevation and slope, cattle encroachment and human activities on common eland landscape utilisation in the Eland Sanctuary Park, Zimbabwe. Presence-only data for the common eland was recorded between January 2022 and December 2022. Ground surveys were carried out once a week, and data on sightings was recorded using a Global Positioning System (GPS) handset. GPS coordinates for human activities and cattle sighted during the survey in the study area were also recorded. Home range sizes for the common eland were calculated using a vector geometry processing tool. Results of the study showed that number of common eland records was higher in the wet season compared to the dry season. However, there was no significant difference in common eland utilization of montane grassland, miombo, *Uapaca kirkiana*, and mixed vegetation habitat in dry and wet season (p-value = 0.701). Wet season cattle and eland grazing areas overlapped. The study recommends the use of satellite-enabled collars to monitor near-real-time movement patterns of the common eland in the area.

INTRODUCTION

Savanna herbivores' landscape utilisation is influenced by resource requirements, environmental and anthropogenic factors. Savanna herbivores' body size also determines habitat selection for their daily survival (Burkepile *et al.*, 2013). The common eland (*Tragelaphus oryx*), for example, is one of the largest African savanna antelope that selects its habitat based on its resource requirements and safety. It utilises different habitats and complex landscapes in search of forage, water, shed and safe areas to rest. The common eland is more of a browser than a grazer and it prefer areas with shrubs and bushes that provide forage (Parrini *et al.*, 2019). The species is selective and consume certain fruits, large bulbs, and tuberous roots. It utilises water when available but can go for long periods as long as it feeds on a sufficient amount of succulent, moisture-rich food (Furstenburg, 2012). The species is nomadic, migratory and have no fixed home ranges and thus it moves to areas when good quality feed becomes available (Hillman, 2008; Ruckstuhl & Neuhaus, 2000). On game ranches the common eland generally roam the entire area utilising different habitats irrespective of the ranch size (Furstenburg, 2012). However the common eland can be easily tamed to a certain area whenever its preferred forage is in abundance (Mahakata & Chikara, 2024)

In southern Africa, for example in Lesotho, Swaziland, Botswana, Mozambique, Namibia and Zimbabwe, the common eland is widely distributed in free range and under fenced areas (Patel *et al.*, 2019, Simonova & Rystsova, 2019). The species prefer semi-arid areas that have shrub-like bushes, and often inhabit grasslands,

woodlands, sub-desert, bush, and mountain tops with altitudes upto about 4600 m (Pappas, 2002). Selection of its home ranges and landscape occupancy is influenced by both environmental related variables and by human related activities.

In arid and semi-arid regions, the common eland landscape utilisation is also dependent on the existence of refuge habitats (Smith *et al.*, 2007) as well as topographic factors like terrain (Ogotu *et al.*, 2014). Terrain provide foci for animal landscape occupancy and represents the important predictor of the common eland landscape and habitat utilisation in a protected area (Fabricius & Mentis 1990). However, Seidel & Boyce (2015) reports that there are several environmental parameters that determine landscape selection in general for wild animals. Hence selective landscape use by the common eland results from the species' distribution being constrained by both abiotic and biotic environmental parameters that are spatially variable such as topography and vegetation cover (Bailey *et al.*, 1996).

Several factors relating to species interactions and anthropogenic activities also play an important role in determining distribution of the common eland and other antelopes in tropical savanna (Jha & Isvaran, 2022). However, in the Eland Sanctuary Park, Zimbabwe, factors driving landscape utilisation by the common eland remain unexplored in a scientific detail except on forage availability (Mahakata & Chikara, 2024). Behavioural understanding of habitat selection is key for monitoring the common eland landscape utilisation.

More often protected area managers do not have well

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informed knowledge on the dynamics of common eland movement, habitat use and selection. There are efforts to improve the numbers of the species in Eland Sanctuary Park which, over the years, its population has been constantly declining while human and cattle presence in the sanctuary continue to increase. It is vital to understand how habitat cover, slope, elevation and cattle and human encroachment are influencing seasonal habitat selection by the common eland in the study area for effective monitoring. Therefore the specific objectives of this study are;

- (i) To determine seasonal home range and variation in sightings of the common eland,
- (ii) To relate the common eland landscape occupancy to elevation, vegetation cover, cattle and human movement and,
- (iii) To determine habitat use by the common eland in Eland Sanctuary Park, Zimbabwe.

Understanding the influence of these parameters is vital for formulating long-term conservation strategies of the common eland in Eland Sanctuary Park. In this study, the assumption was common eland habitat occupancy is influenced by slope, vegetation cover and type and cattle and human movements. Therefore there is a significant difference on seasonal landscape occupancy and habitat use by the common eland in the study area.

MATERIALS AND METHODS

Location and Size of Study Area

The Eland Sanctuary Park is only 18km² and is located on the northern side of Chimanimani Town in the eastern highlands region of Chimanimani District, Manicaland Province, Zimbabwe. The protected area is partially fenced and has two recently established public roads that pass through the area. Various land use practices are found adjacent the park namely timber plantation on the north, urban settlements to the south while to the west, indigenous forest farms exist. To the eastern side, there are communal settlements. Climate of the area is generally considered humid to temperate with average temperature across the eastern Chimanimani area of 23–25°C during summer (November–April) while 17–19°C in winter season (May–August). Mean average temperature is 22°C. Rainfall amount ranges between 1200 and 2000 mm per year.

The study area is characterised by mountainous and undulating terrain with peaks of altitudes up to 1,979m above sea level at the Porkpie point. Four major vegetation types are recognised in the study area and these are montane grassland, miombo, uapaca and mixed riverine woodlands. Dominant tree species include *Uapaca kirkiana*, *Brachystegia spiciformis*, *Julbernardia globiflora* and protea species which covers a large part of the study area. Common grass species include *Hyperbania* spp with *Loudetia simplex* and *Themeda trianda* which dominates the montane grasslands. The grasslands are mostly sour-veld, and they provide very low nutrient values for grazers. Wildlife in the study area is not abundant, but include the

common eland, bushbuck and common duiker.

Data Collection

The study considered only primary data that was collected through field surveys by the research team consisting of one ecologist and two assistance. Primary data on common eland sightings was collected over a period of one year i.e. January, 2022 to December, 2022 during field work conducted once a week. Due to size of the area (18km²), equal efforts across the area were done. In this study, only two seasons were considered, i.e. dry and wet season so as to understand common eland landscape utilisation in relation to environmental variables. Wet season covered January–April and November–December while dry season covered from May–October. The seasons were defined based on rainfall patterns of the area. Presently only data were collected from visual sightings only. A hand-held Global Positioning System (GPS) device (Garmin Etrex-10) was used to mark points where common elands were sighted as well as human and cattle encroachment sightings in the Eland Sanctuary Park. At each point where the common eland and cattle was sighted, vegetation type and cover and elevation were recorded. Data on human encroachment and related activities was also recorded, capturing type of activities and GPS points in a datasheet.

Data Analysis

Comparison on common eland sightings for dry and wet season in different habitats were calculated using a parametric paired-t-test at $p = 0.05$. It was used to determine whether the common eland sightings between wet and dry season in different vegetation types differ significantly. GPS points from ground surveys were downloaded and imported into the computer for mapping seasonal home ranges of common eland and cattle and human encroachment sighted in the study area. GPS points were first overlaid on a vector map of the study area. Home ranges were then calculated separately for dry and wet season in QGIS Software version 3.28.2 using a vector geometry processing tool where minimum bounding geometry algorithm creates geometries to enclose the features from the input layers.

Google Earth Engine- an online software- processing tool was used in processing elevation, landcover and slope maps of the study area. Elevation map for the Eland Sanctuary Park was used as a reference map during resampling for all the layers to have the same size, and coordinate system. This was so to model the common eland distribution in relation to slope, elevation and landcover.

RESULTS

Seasonal Variation in the Common Eland Sightings and Habitat utilisation in the Eland Sanctuary Park

Common eland were sighted twenty-six times in wet season while twenty-three times in dry season. The

species utilised different habitats with predominantly montane grassland in wet season while woodland areas in dry season. However, there was no significant difference

on number of sightings across different vegetation types utilised at 0.05 (Figure 1).

Seasonal Home Range Variation of the Common

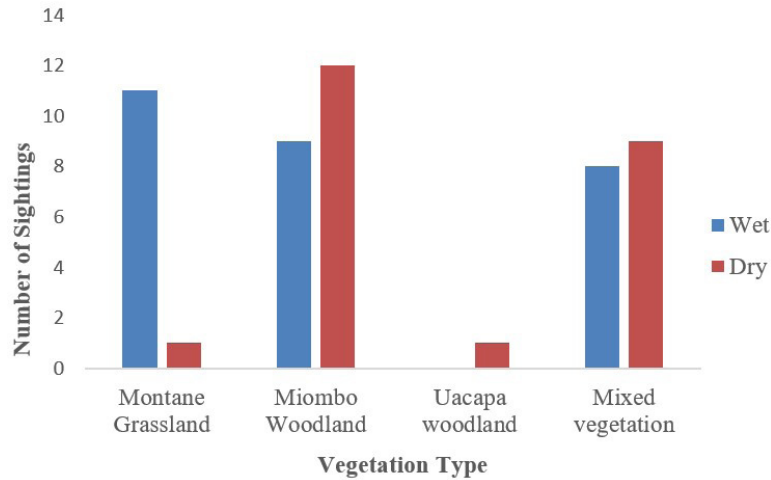


Figure 1: Number of common eland sightings in different vegetation habitats between wet and dry season in Eland Sanctuary. Paired-t-test for mean difference on utilisation of different vegetation types between wet and dry season showed no significant difference (T-value = 0.42 and p-value = 0.701).

Eland in Relation to Cattle and Human Activities in the Eland Sanctuary

The dry season home range of the common eland in the study area was dominantly on the north-western side of the park while wet season home ranges stretches from

north-western to eastern central part of the park (Figure 2). Equally the wet season home range of the common eland overlap with wet season cattle encroachment sightings.

Eland sightings were higher in open grassland and in

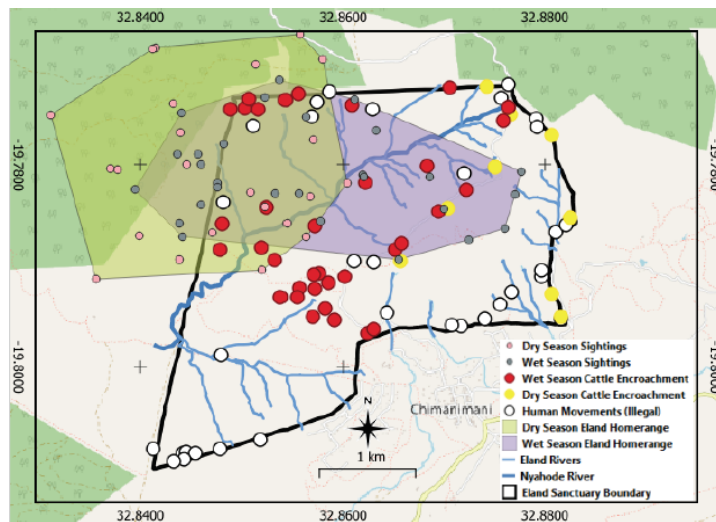


Figure 2: Dry and wet season home range of the common eland in relation to cattle encroachment and human activities in the Eland Sanctuary

sparse woodlands compared to thick woodland areas. Eland preferred middle to higher areas compared to lower altitude areas while also avoiding steep slopes. Low eland sightings were recorded in areas where human movements were high compared to cattle encroachment. Wet season cattle encroachment areas were overlapping with areas utilised by the common eland during same period. However, analysis of data from field observations shows no overlap in dry season home range for the common eland and cattle.

Influence of Elevation, Vegetation Cover and Slope on Common Eland Landscape Occupancy in Eland Sanctuary Park

Common eland sightings utilised altitude between 1600-1900m above sea level (Figure 4).

Selected habitat types by the common eland vary with season but preferred areas with cover ranging between 0.2 and 0.5 based on Soil Adjusted Vegetation Index (SAVI) (Figure 4).

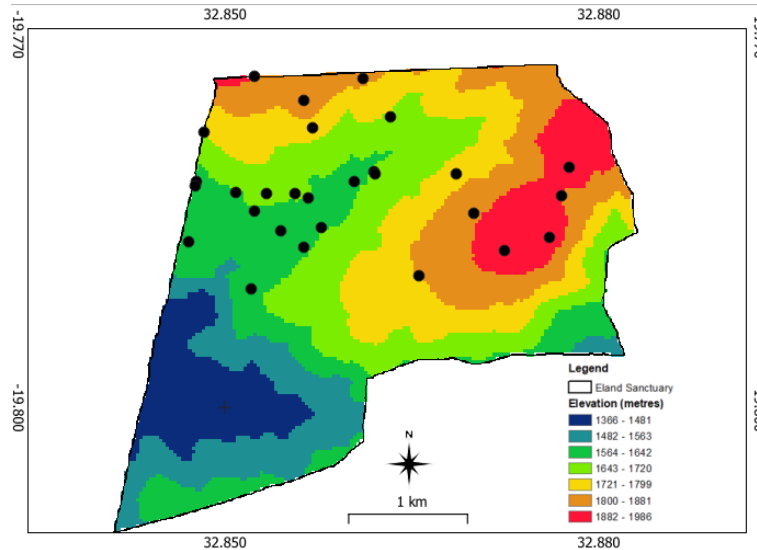


Figure 3: Location of common eland sightings in relation to elevation in Eland Sanctuary

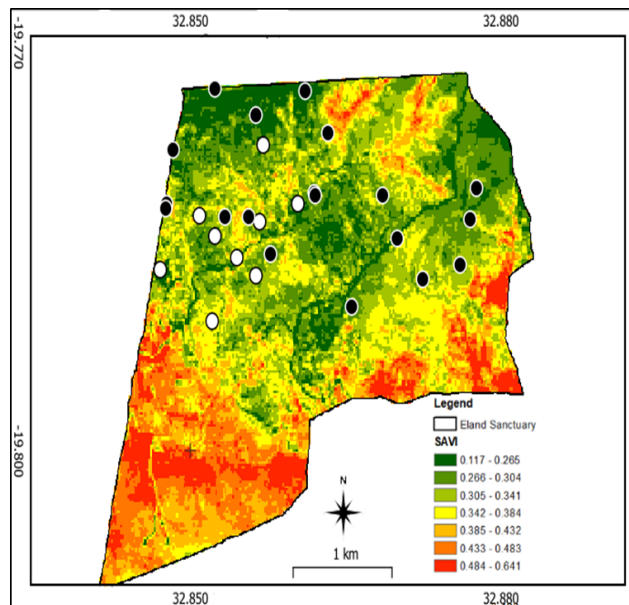


Figure 4: Map showing vegetation cover index in relation to seasonal (dry-white; black-wet) habitat selection by the common eland of the Eland Sanctuary Park

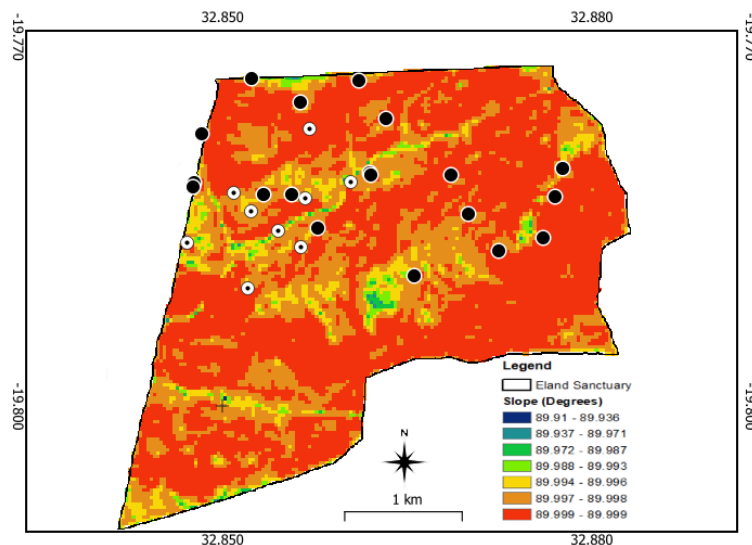


Figure 5: Map showing seasonal (Wet-black dots; dry-white dots) slope selection by the common eland in the Eland Sanctuary Park

Terrain selection by the common eland ranged between 89.937-89.998degrees, which are gentle to relatively slope areas, while avoiding very steep slopes above 89.999 degrees (Figure 5).

DISCUSSION

The study reports that the common eland landscape occupancy in the study area is influenced by both environmental factors (Slope elevation and cover) and human encroachment related parameters. Environmental factors and human interfaces are complex and heterogeneous which affect the common eland habitat occupancy. The parameters are decisive in the seasonal landscape occupancy by the common eland in the study area. The landscape occupancy by the common eland and human activities is a top-down process which echoes the costs of avoiding human dominated landscapes and very steep slopes in the study area.

Seasonal Variation in Common Eland Home Range and Habitat Selection

The common eland showed a characteristic of non-territorial and it utilises different landscapes in both wet and dry season in the study area. The species home range straddles the north western boundary in all seasons. Observations of the common eland in different parts of the park indicates the species' ability to occupy different landscapes if not restricted by barriers like fence. According to Hillman (2008) and Marshal et al (2020) the common eland can move several kilometres in a free range area, while in restricted ranges, they generally roam the entire area.

In wet season, the species were mostly sighted in montane grassland areas while in dry season it utilised habitats dominated by woodlands on the western and central part of the study area, an indication of seasonal home range shifts. The observation supports ideas by Mduma *et al.*, (1999) and D'Ammando *et al.*, (2014) who reports the common eland mostly browse during dry season and is also adapted to grazing during the rainy season when grasses are more common and nutritious. According to Watson & Owen-Smith (2001), as the common eland quickly adjusts to the surroundings in relation to season, they also change their feeding habits, food requirements and habitats.

Effects of Habitat Type, Slope and Elevation on Common Eland Landscape Occupancy

The animals were sighted in montane grasslands, miombo woodlands, low laying riverine and in open bushlands except in thick woodlands dominated by *Uapaca kirkiana* and along the drainage lines. The species utilised elevation between 1564-1986meters above sea level while avoiding very steep slopes. However, no sightings were recorded in low areas of altitude below 1366m. According to Marshal (2020) the common eland is able to move up and down steep slopes and ragged terrains while Melton (1987) highlighted that it is highly adaptable and can be found across a range of altitudes, including upper slopes of plateaus.

Effects of Human Activity and Cattle Encroachment on Common Eland Landscape Occupancy

Areas with high human activities were avoided by the species and this can be attributed to its shyness. From this study, it is possible that high human activities in the southern and eastern parts of the study area forced the common eland to move to the north-western side where human activities are low. According to Averbeck *et al.*, (2009) savannah areas affected by human activities are often characterised by shifts in landscape structuring, with a predominance of few habitat types and this typically is accompanied by pronounced changes in the communities of ungulates. Matandiko (2016) also reports of decline in ungulate densities in areas proximity to protected area edges where indicators of human access is high. While the common eland avoided areas of high human activities in the south, there is an overlap of habitat utilisation with cattle in wet season in the study area. Only in dry season sightings of the common eland were higher on the north western part of the park while cattle were confined to the eastern boundary of the Eland Sanctuary Park. During this period, dry season, the grass species of the Eland Sanctuary Park becomes unpalatable (Mahakata & Chikara, 2024) hence drives the common eland and cattle to other sites where there is palatable forage. It is likely in dry season cattle move out of the park to communal area where they will utilise harvested crops left in the field.

CONCLUSION

The common eland landscape occupancy is influenced by terrain, elevation, vegetation type and cover as well as human encroachment in Eland Sanctuary Park. However, the influence of cattle encroachment is not obvious and cannot be used as an influencer to determine the common eland landscape utilisation. The common eland displayed a characteristic of highly nomadic and appear to utilise different habitats in the central to northwest part of the study area across seasons. Basing on the preliminary findings of the study, use of satellite enabled collars are recommended to monitor near-real time movement patterns of eland that will inform law enforcement. It is important that wildlife monitors take into consideration the importance of slope, human activities, elevation and vegetation cover and type when monitoring the species landscape utilisation in the study area.

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