CONSUMPTIVE FOREST USE AND SPATIO-TEMPORAL ABUNDANCE OF WILDLIFE IN GEORGE MUKOYA AND MUDUVA NYANGANA COMMUNITY CONSERVANCY IN NORTHERN NAMIBIA

A THESIS SUBMITTED IN FULL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF
MASTER OF SCIENCE IN WILDLIFE MANAGEMENT AND TOURISM STUDIES

MIRIAM MAMBO LIYEKE

200909584

OCTOBER 2024

SUPERVISOR: DR. L.P. RUTINA
DEPARTMENT OF WILDLIFE MANAGEMENT AND TOURISM STUDIES
UNIVERSITY OF NAMIBIA

ABSTRACT

Forests are important to people because they provide socio-economic and ecological goods and services such as the use of poles for building materials and income through selling. Studies have shown that the degradation or loss of forests has a direct impact on wildlife. In rural areas of Namibia, some forests on communal land are managed by the local communities to provide socio-economic benefits. If not well managed and the use is not sustainable (inappropriate use), may undermine the long-term ecological value of forest resources including wildlife. The Khaudum north complex conservancies (George Mukoya and Muduva Nyangana) were established in 2005 and community forests were gazetted in 2010. In the year 2012, the government of Namibia through the Ministry of Environment Forestry and Tourism integrated the wildlife conservancies and community forests, with the aim of harmonising the two land uses. Since then there were no studies to assess the community forest use on wildlife species and their habitat thus the need to conduct this study.

This study used both quantitative and qualitative methods to collect data. Data on wildlife species abundance and distributions were collected from conservancies' event books and game counts. Interviews were used to gather community perceptions on the consequences of their livelihood strategies on wildlife. A sample size of 293 respondents was obtained from the two conservancies. To assess the change in wildlife species abundance, the regression analysis with yearly wildlife group size as a dependent variable was applied. The distance from nearby settlements, fire intensity, and vegetation cover change as continuous independent variables; and conservancy (George Mukoya and Muduva Nyangana), species category (carnivores and herbivores), land use (multiple use and wildlife exclusive zones) and season (dry and wet) as categorical variables. Satellite images were used to analyse vegetation cover change and accumulated fire intensity using change detection analysis and empirical Bayesian kriging interpolation. Average group size means, and standard errors were calculated and used to determine the associations

among variables. Contingency tables were used to analyse respondents' perceptions of the influences of livelihood strategies and major socio-economic activities on wildlife.

Generally, results showed a decrease in wildlife numbers in the study area between 2013 and 2017 (P <0.001). This was positively associated with vegetation change (P =0.032) and species category (P < 0.001), negatively by distance from settlement (P = 0.004) and land use (P < 0.001), but was not fire intensity (P = 0.714) and locality (conservancy) (P = 0.170). Carnivore density distribution was evenly spread in relation to distance from settlements, fire intensity, and vegetation change but was more in a wildlife-exclusive zone than the multiple-use zone. Herbivore distribution was denser in the wildlife-exclusive zone, more in areas where vegetation cover was high, and increased with increasing distance from settlements, but was not influenced by fire intensity. In both conservancies, the majority of respondents were either dependent on crop production (53%) or a combination of crop production and livestock (30%), with only 18% depending on other livelihood strategies. When asked what is the impact of their livelihood strategies on wildlife and its habitat, 75%, 17%, and 8% of the respondents said there no impact, impact, or no awareness, respectively. When the community was asked, what is the impact of the services they get from forestry on wildlife and its habitat, 73% of the respondents said there was no impact whereas 27% indicated that there was a significant impact. The study showed that the communities of George Mukoya and Muduva Nyangana are aware of the conservation issues in their areas and can manage wildlife successfully themselves.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIT OF ABBREVIATIONS AND/OR ACRONYMS

CBNRM	Community-Based Natural Resource Management
GDP	Gross Domestic Product
GMCF	George Mukoya Community Forest
IRDNC	Integrated Rural Development and Nature Conservation
KAZA TFCA	Kavango-Zambezi Transfrontier Conservation Area
MEFT	Ministry of Environment, Forestry and Tourism
MNCF	Muduva Nynaga Community Forest
NCRST	National Commission on Research, Science and Technology
NGO	None Governmental Organisation
NTFPs	Non-Timber Forest Products
OKACOM	The Permanent Okavango River Basin Water Commission
WEZ	Wildlife Exclusive Zone

ACKNOWLEDGEMENTS

First and foremost, I would like to thank the Almighty God in Jesus's name for making it possible to carry out this study through different constraints. I would like to acknowledge the support of all the people who have helped make this work a success. I give thanks for the inspiration and support to my supervisor Dr Lucas Pius Rutina, for his timeless efforts, commitment, support, and critical review on this thesis. He was always available whenever I needed his assistance. I would also like to acknowledge Mr Jim Kairu for assisting, encouraging and believing in me to register and pursue this research. I would like to appreciate the entire Wildlife Management Department for their assistance and motivation rendered to me. Special thanks to Mr Max Muyemburuko, Mr Laurence, and Mr Andrew Shashipapo for taking me through the conservancies during data collection. I would like to thank the community of George Mukoya and Muduva Nyangana for their cooperation, and kind assistance during data collection. Lastly, to my family for all their support, for constantly encouraging and motivating me to keep going forward, I say thank you very much and proudly present this product to you; the fruit of the sacrifices we have made!

DEDICATION

All Glory belongs to the Lord

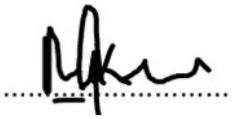
Dedicated to my dearly beloved mother Mrs Mary Chuma Liyeke, your support, motivation and mostly prayers moulded me into the woman I am today and I thank God for granting me the opportunity of having a wonderful woman as my mother. To my daughter Sarah Buitumelo may you grow well and follow into your mother's footsteps.

DECLRATIONS

I Miriam Mambo Liyeke, hereby declare that this study is my own work and is a true reflection of my research, and that this work, or any part therefore has not been submitted for a degree at any other institution.

No part of this thesis/dissertation may be reproduced, stored in any retrieval system, or transmitted in any form, or by means (e.g. electronic, mechanical, photocopying, recorded or otherwise) without the prior permission of the author, or The University of Namibia in that behalf.

I, Miriam Mambo Liyeke, grant The University the right to reproduce this thesis in a whole or a part, in any manner or format, which The University of Namibia may deem fit.

Miriam Mambo Liyeke		30/07/2023
Name of student	Signature	Date

CHAPTER 1: INTRODUCTION

1.1. Background of the study

The world's natural forests which support wildlife and human populations, are rapidly disappearing as a result of alteration, degradation and loss of forest cover with negative consequences on wildlife populations and their habitats (DeStefano, 2002). Over 400 million people in Africa are estimated to rely on forest products, either in the form of subsistence uses or as cash income resulting from a varied range of timber and non-timber forest products (Bore, 2014). In Sub-Saharan Africa, one-fifth of the rural population's daily needs are derived from forest products, this is due to more than 70 percent of the population depending on woodlands for its livelihood (World Bank Africa Region, 2017). In Africa, forests supply approximately 60 percent of all energy, and a large part of the Gross Domestic Product (GDP) of many countries is grounded on forest-related activities.

Many studies record that rural households use a wide range of forest products (Bore, 2014). Many forest products are treated as open-access resources, meaning that they are freely available including Non-Timber Forest Products (NTFPs). In rural areas of Sub-Saharan Africa, forest resources are among the most vital components of livelihoods and development opportunities (Arnold & Townson, 1998). Forest resource utilisation therefore is a precondition for livelihood of forested communities who do not have alternative sources of income (Bore, 2014). Management of forest for timber has assumed major importance while other forest outputs, mainly NTFPs have been largely ignored. Since many wildlife species depend on forests for survival, sound silviculture and forest

management could play an important role in maintaining and restoring wildlife habitats (Lindenmayer, 1995).

Wildlife plays an important ecological role in forest ecosystems and therefore forestry practices that do not consider wildlife may not be ecologically sustainable in the long-term conservation practice (Lindenmayer, 1995). This is because, forestry and wildlife are part of biodiversity that provides functional ecosystems that supply food, water and oxygen that is fundamental to the existence of people, animals and the environment. Human benefits are dependent on forests for regulating and supporting cultural and provisional services in many cases. However, the conversion of forests to crop lands and commercial logging has led to the decline in forest products globally (Tadesse & Teketay, 2017). Nonetheless, inclusion of wildlife management and conservation concerns in forest management will only occur if forest users derive economic benefits from wildlife (Melorose, Perroy & Careas, 2015). If economic benefits from wildlife are not valued by forest users, the conservation of wildlife may not be supported.

Conservancies generate sustainable income through wildlife-based land uses, which include both non-consumptive tourism (e.g. photographic) and consumptive tourism in the form of hunting and harvesting of other forest products. For instance, the Ministry of Environment, Forestry and Tourism (MEFT) (2021) revealed that wildlife in Namibia provides a wide range of benefits, such as attracting tourists and generating income from commercial activities such as trophy hunting, though some wildlife species can cause

conflicts with humans. Moreover, the meat from hunted game is a major benefit to conservancy communities, which are often situated in areas where there are no shops, and people have little, if any income (MEFT, 2021). In addition, conservancies in Namibia generated income from the harvesting of indigenous plant products. For instance, the volume of the indigenous plant harvest increased by three times from 2016 to 2017, and the devil's claw was one of the plants that was harvested, and grows in the Kalahari and its roots are dried for medicinal purposes (MEFT, 2021).

Furthermore, the conservancies use generated income to cover running costs, and invest in development projects and create employment opportunities for conservancy communities. Although, the growing overseas market led to unsustainable harvesting practices, which threaten indigenous plants and the long-term industry. In order to counteract this unsustainable practice, conservancies in Namibia have established monitoring systems and sustainable harvesting guidelines that also ensure that local harvesters receive fair prices (Chinsembu & Chinsembu, 2020).

In 2008, the Ministry of Environment, Forestry and Tourism awarded the Sikerete tourism concession to the Gciriku community, comprising of Muduva Nyangana Conservancy, George Mukoya Conservancy and Gciriku Traditional Authority (The Permanent Okavango River Basin Water Commission [OKACOM], 2008). Through this project, OKACOM is supporting the George Mukoya and Muduva Nyanagana conservancies with the construction of accommodation facilities for the Sikerete tourism concession tented

campsite. Currently, these conservancies main source of income is trophy hunting and harvesting of indigenous natural products such as thatching grass and devil's claw. Trophy hunting is carried out using the joint quota (determined by the local community, and then suggestions submitted to MEFT for consideration and approval), the community usually conducts a game count census to determine the population of wildlife within the conservancies, an activity facilitated by MEFT together with the conservancies. Revenue generated from hunting is then distributed among registered conservancy members through a benefit distribution plan (MEFT, 2021).

1.2. Statement of the problem

Wildlife offers tangible benefits to conservancies in the form of cash returns from tourism, employment creation, and in-kind benefits such as meat from the game (trophy animals). Even though these benefits do not generate the same level of financial satisfaction as trophy hunting, they have important livelihood support impacts. They cumulatively have a considerable economic impact (harvesting) at the household or individual level (Schick et al., 2018). However, anthropogenic activities likely to be brought by the integration of forest and conservancy management are expected to have a negative impact on biodiversity, mainly due to human-wildlife conflict. Thus, a need for this study that focuses on evaluating the influence of forest uses on wildlife in George Mukoya Conservancy (GMC) and Muduva Nyangana Conservancy (MNC). The two forest reserves were integrated into Muduva Nyangana (MN) and George Mukoya (GM) conservancies in 2008 and since then they have been part of the two conservancies with one management committee for each conservancy (OKACOM, 2008). Although conservancy communities rarely have control over high-value timber resources, they have

unfettered access to other forest resources that are critical for their livelihoods (Langat et al., 2016). Community members harvest timber for construction purposes, gather wild fruits to supplement their food, cut grass for thatching, gather fuelwood and use forests as animal pastures (Dalu et al., 2021; Natanael, 2019).

1.3. The overall objective

The overall objective of the study was to assess the perception of conservancy members on the influence of consumptive forest use on the abundance and distribution of large mammalian wildlife species in George Mukoya and Muduva Nyangana conservancies in the Kavango East Region, Namibia.

1.3.1. Specific objectives

1. . To assess changes in the abundance of large mammalian wildlife species (> 9kg) from 2013 to 2017.
2. To compare the spatial distribution of large wildlife between wildlife-exclusive zones and multiple-use areas.
3. To evaluate the perceptions of community members on the consequence of different consumptive forest uses and socio-economic activities on large mammalian wildlife species

1.3.2. Hypothesis

1. There are significant differences in the population sizes of large wildlife species populations from 2013 to 2017.

2. There are no significant differences in the spatial distribution of large wildlife between wildlife-exclusive zones and multiple-use areas
3. There is a significant difference between the consequence of different consumptive forest uses and socio-economic activities on large mammalian wildlife species and their habitats.

1.4. Significance of the study

To understand the current forest uses, their impacts on wildlife and habitat, and how forest uses can be changed for better in future for the survival of wildlife and habitats for the sustainable benefit of local communities. It is hoped that the study will improve community perception and attitudes towards wildlife. The study will also contribute knowledge needed in the development of policies and laws with regard to protection and utilisation of forest resources. In academia, the study can provide baseline data for future studies.

1.5. Limitation of the study

The study faced language communication challenges during interviews as the researcher could not speak the local language, thus an interpreter was engaged. The value of the results was depended on the willingness of the respondents to provide true answers to the questions asked, and thus the importance of the research to each respondent was explained prior to the interviews.

1.6. Delimitation of the study

This study only addresses how conservancy community perceptions and socio-economic activities such as farming and timber harvesting affect the conservation of wild animals and their habitats in George Mukoya and Muduva Nyangana community conservancies. It will not address technical issues of forest and wildlife management. Only people who have resided in George Mukoya and Muduva Nyangana conservancies for the past 10 years participated in the study. Visitors were not allowed to take part as they have acquired less knowledge of forest uses in the conservancies under study.

CAPTER 2: LITERATURE REVIEW

Forests are important to people because they provide socio-economic and ecological values (Dlamini & Geldenhuys, 2011). To better manage forest resources, global (Dlamini & Geldenhuys, 2011), regional (SADC) (Mbaiwa , 2004) and nationally, policies and laws (Watts, 2003) have been disseminated. Unless there is a management plan which is controlled, extractive use of forest resources may in the long run lead to the degradation and loss of forests (Shaanker et al., 2004). A study by Symes et al. (2015) has shown that the degradation of forests has a direct impact on wildlife. In Namibia, communities have been given the mandate to manage forests which are gazetted as community forests (Boudreaux, 2010). However, only those forest products which yield immediate benefits are perceived to be important by the community, thereby neglecting other resources whose intricate relationship is critical for a healthy forest and promises potential future benefits (Melorose et al., 2015). Several studies in forest management in Namibia have examined the available extractive resources such as devil's claw (medicinal product), timber, fruits/leaves and grass (Suich, 2010; Boudreaux, 2010).

Furthermore, forest products in general are currently threatened worldwide due to both habitat destruction and over-exploitation. Wildlife cannot be sustained without careful management of the natural vegetation and without assured water supplies. Clearly, a shift from unsustainable management practices of the land and natural resources may provide safety nets for wildlife and have important economic impacts on livelihood (Baker et al., 2020). However, there is a lack of information on how the use of forest-based products for short-term interests may affect the integrity of the forest and loss of potential future

benefits. Also lacking is information on the effects of different socio-economic activities and the perception of forest users on wildlife. This study wishes to fill these gaps by undertaking research in George Mukoya and Muduva Nyangana Community Conservancy Forests.

2.1. Changes in large mammalian wildlife species (> 9kg) abundance in community managed forests

Changes in mammal populations in community managed forests might differ in various regions around the world (Baker et al., 2020). Wildlife populations are in drastic and well-documented decline across the world. Kenya's long-term aerial count datasets show that there has been a 50% to 80% decline in the numbers of the vast majority of wildlife species since the mid-1970s (Ogutu et al., 2011). The drastic decline in wildlife has also been reported in protected areas such as conservancies (Western et al., 2006). Though, data for other East African regions are less complete, and the declines seem less apparent in Tanzania. For example (Tanzania Wildlife Research Institute, 2010) collated the 1980s to early 2000s aerial census data for large herbivore populations in eight large census zones in Tanzania, and of those that showed significant changes, most declined. Thomson's gazelle, Grant's gazelle, hartebeest, reedbuck, roan antelope, sable antelope, warthog and zebra declined in over 50% of the zones where they were surveyed, though elephant and giraffe generally fared well across the country. Around Tarangire, elephants were increasing, while wildebeest were declining (Stoner et al., 2007).

There are a number of possible causes of wildlife decline; these are habitat loss, introduced species including diseases, and overhunting by human or natural predators. In the case of East African wildlife, each of these factors has been shown to apply to some extent for individual species in individual sites. For example, in Serengeti and Ngorongoro, the temporary local extinction of wild dogs and a drastic decline in lion populations were both caused by an outbreak of canine distemper. In South Africa and other African countries, rhinoceros are perennially vulnerable to illegal hunting (Moneron, 2016). Some rhino subspecies are thought to be locally extinct in a number of sites, and others have been hunted to near complete or complete regional extinction across East Africa (Milliken et al., 2009).

Almost half of the land (43.87%) in Namibia is almost under conservation management, but there are still many occurrences of illegal hunting (MEFT, 2021). The situation was worse before independence in 1990, as wildlife populations in Namibia's communal areas were decreasing as a result of extensive poaching during a prolonged military occupation by South Africa (MET, 2020). In 1996, the Namibian government passed the Nature Conservation Act, which gives rights and ownership over wildlife and tourism to local communities that formed management bodies called conservancies (Nature Conservation Amendment Act, 1996). The Act allows communities to benefit from wildlife on communal land and by working with private sectors, None Governmental Organisations (NGOs) and the government to create a tourism market. Since then state protected areas have grown to include the entire coastline and adjacent desert areas, communal conservancies and community forests (The Ministry of Environment and Tourism [MET],

2018a). By 2007, 50 conservancies had been established and registered, and 31 are directly adjacent to larger national protected areas such as parks (MET, 2018a). Today people see wildlife as an economic asset to be managed. This is in contrast with the colonial era when wildlife was a state-controlled asset from which local communities were excluded and received no direct benefits. The positive change occurred when local communities began to be empowered, giving them ownership rights to manage and conserve wildlife in a sustainable manner and reaping economic benefits.

Significant wildlife recoveries started occurring when government and community managed conservancies invested in minimising poaching and ensuring sustainable wildlife utilisation (MET, 2018b). This was initially most evident in the north-west part of Namibia, where wildlife numbers were low due to drought and poaching in the early 1980s. It is estimated that there were only 250 elephants and 65 black rhinos in the north-west at that time, and populations of other large mammals were 60 to 90% of their sizes recorded in the 1970s (MET, 2018a)

In general terms, significant herbivore recoveries have occurred in the Zambezi Region over the past decade. These have been due largely to successful breeding, reduced poaching, wildlife introductions, and the drastic improvement of local attitudes toward wildlife conservation (Stoldt et al., 2020). The elephant sightings recorded in 2019 at Katima Mulilo town indicated a good recovery when compared with those observed in 2017 (MEFT, 2021; MET, 2018a). Elephant poaching declined in 2019 due to increased

efforts to combat wildlife crime, although ivory trafficking through the region remained a significant problem (Stoldt et al., 2020).

2.2. Distribution of large mammals between protected areas and communal area

In East Africa, an estimated 70% of wildlife populations are dispersed outside Protected Areas (PAs) on community land where pastoralism is practiced (Mureithi et al., 2019). Additionally, southern and eastern African PAs such as national parks and conservancies are the most unique for maintaining network connectivity. This finding complements and builds upon previous studies that report higher conservation effectiveness of southern African PAs. Moreover, compared to west and north Africa, southern Africa articulates a higher number of large mammals in the savannah biome due to the larger sizes of land area demarcated as PAs (Wegmann et al., 2014).

The study conducted in Kenya shows that there is a decline in Kenya's park animal populations (Mureithi et al., 2019). Only a diffident portion of the annual migratory range of large herbivores is observed in Kenya's parks. Most parks differentially cover dry season rather than wet season ranges of the dominant migratory species such as wildebeest and zebra that in many cases contribute to the reduction in parks' animal populations particularly during the dry season (Western et al., 2009). Onditi et al. (2021) and Western et al. (2009) revealed that big parks in Kenya are no longer protected from wildlife decline than small parks. The largest protected areas in Kenya have the steepest wildlife losses and these include Tsavo, Meru and Maasai Mara (Mojo et al., 2020). In sub-Saharan

Africa, agricultural expansion and poaching activities taking place in the parks contribute to a significant portion of the losses of forests and the reduction in herbivores (buffalos and zebras) (Lister, 2018). There are also other anthropogenic activities such as road network constructions in PAs that can lead to the out-migration of animals from PAs.

The engagement of local communities around parks in tourism establishments can strongly contribute to the wildlife increase (Bwalya Umar & Kapembwa, 2020). This is because parks associated with community and private conservation initiatives do better than parks with no outreach programs. Such evidence points to the need for new policies that combine national, private and community initiatives in order to sustain large free-ranging herbivore populations at an ecosystem and landscape scale.

In Namibia's Zambezi Region, elephant populations started growing in the 1990's and has continued to do so in the 2000's (Thouless et al., 2016). The explanation behind the relative stability of southern Africa's elephant population is attributed to the higher level of financial benefits that local communities and others are able to derive from the conservation of elephants. Whereas in Kenya, there was a high decline of 45% loss in the elephant population in the 1974−1976 period, a situation that led to a sport hunting ban in Kenya in 1973 (Holechek & Valdez, 2018). Conversely, Namibia, which has actively developed sport hunting over many decades, has had major increases in black and white rhinos, lions, elephants and several other wildlife species over the past 30 years

(Mcnamara & Claasen, 2015; Meyer et al., 2021). This was achieved mainly due to the re-investing of profits from sport hunting in anti-poaching and conservation efforts.

Potgieter (2019) revealed that, from the year 1993 to 2014, lion numbers in 11 unfenced national parks in Africa declined by 62 percent while lion numbers in the unfenced Kunene Region communal conservancies (which are not national parks) increased from approximately 25 in 1995 to an estimated 120-150 in 2017 (a 380-500 percent increase). The African Elephant Status Report in 2016 states that although elephant numbers in several southern African countries showed a decline, the Namibian population showed an increase (Thouless et al., 2016). The increase in the elephant population was particularly observed in the Kavango and Zambezi Regions where many conservancies have been established (Thouless et al., 2016). The increase in the elephant population may be a result of the in-migration of elephants from the neighbouring countries. Namibia is the only country in Africa where endangered black rhinos has been translocated from national parks into communal livestock farming areas leading to the establishment of communal conservancies. The number of rhinos in the country cannot be released for security reasons, but Namibia's communal conservancies host the only free-roaming population of black rhinos in the world.

2.3. Perceptions of local people on the effect of different consumptive forest uses, wildlife management, and socio-economic activities on large mammalian wildlife species.

Perception studies are used to assess the effectiveness of conservation programmes that guide consumptive forest uses for the social-economic benefit of local communities (Abukari & Mwalyosi, 2020). Wildlife conservation programmes can benefit from the analysis of local communities' awareness and perceptions of illegal consumptive forest uses (Bitanyi et al., 2012). This is because perceptions shape peoples' attitudes in the short run and behaviours in the end (Herbert et al., 2019). For illustration, when conservancy community members articulate an extensive awareness of illegal hunting practices, it indicates that some of the community members are involved in illegal wildlife use. Thus, the management and conservation of wildlife by local communities becomes a challenge. Consequently, a need for conservation management methods that establish positive attitudes and behaviours of local community members toward wildlife conservation, so that they are highly involved in legal than illegal forest use (Hasan & Csányi, 2023). Nevertheless, conservation strategies of large mammalian wildlife species should recognise both positive and negative perceptions of local communities to achieve increasing local support for and compliance with policies that protects wildlife and guide consumptive forest uses (Mubalama et al., 2020).

Wildlife management approaches are highly shaped by local communities' experiences with wildlife (Hasan & Csányi, 2023; Afriyie, Asare & Hejcmanová, 2021). This is because local people's knowledge can have a valid relevance in developing effective wildlife management strategies that can also contribute to the improvement of local

communities' socio-economic systems (Afriyie et al., 2021). For instance, Kariuki (2013) discovered that local communities' attitudes and perceptions are critical in the successful development of tourism businesses within or near PAs. Similarly, Herbert et al. (2019) uncovered that local communities' active involvement in wildlife management can have a positive impact on the management of wildlife, as community members will articulate a positive perception toward expected conservation benefits. If local community members are not involved in conservation management, they tend to have negative perceptions of tourism, as the benefits from natural resources are likely not to be fairly shared among stakeholders (Mutanga et al., 2015). Thus, some of the community members are likely to resort to illegal harvesting of forest products.

Conservation legislation can influence community members' perceptions, behaviuors and modes of interactions with wildlife (Weaver & Skyer, 2003). For instance, before the Namibian Nature Conservation Act was passed, most communities in or close to PAs resented wildlife as only the state benefited from their existence (Weaver & Skyer, 2003). In addition, wild animals competed with livestock for water and grazing land, while carnivores preyed on livestock and caused crop and infrastructure damages (communities were not compensated by the government for damages). After the Namibia Conservation Act was passed, community conservancies were established and conservancy members were eligible for benefits such as income, wildlife meat, and employment opportunities (Community Conservation Namibia, 2023). Cosequently, community members' mindset transforded as they started viewing wildlife as an asset than a liability.

The positive attitude of community members has resulted in a noticeable influence on the recovery of wildlife populations. In the early 1980s, during the previous two decades of heavy poaching and a major drought, wildlife populations in Namibia were low, with populations of species such as Oryx, Hartmann's zebra and springbok estimated at less than 1000 animals of each species (Gibson, 2001). Consequently, Namibia's fledgling Community-Based Natural Resource Management (CBNRM) Programme was introduced in the form of Community Game Guards through the None Governmental Organisation (NGO) Integrated Rural Development and Nature Conservation (IRDNC) (Naidoo et al., 2011). This community initiative, which eventually led to the conservancy programme, was highly successful in reducing poaching by enhancing community stewardship over its remnant wildlife resources.

Socio-economic activities are positively associated with consumptive forest uses and negatively associated with large mammalian wildlife species. This statement is in line with a study by Tudge et al. (2022) that revealed that large mammalian wildlife species tend to decline as the distance between forests (PAs) and human settlements declines. Consumptive forest uses and socio-economic activities in and around conservancies can lead to the depletion of large mammalian wildlife species such as forest elephants and large felids (Tudge et al., 2022; Weaver & Skyer, 2003). Poverty is one of the factors that contribute to the depletion of large mammalian wildlife species. This is because poverty is negatively associated with wildlife conservation. According to Bitanyi et al. (2012) and Afriyie, Asare and Hejcmanová (2021), when people do not have alternative sources of income or livelihoods, they get involved in illegal forest uses such as illegal wildlife

hunting, although they know the importance of the conservation of wildlife species. In addition, Bwalya Umar and Kapembwa (2020) discovered that the majority of people who lives nearby or in PAs are not involved in wildlife management, the few people involved is mainly for economic benefits.

Good governance and management practices of wildlife in PAs such as conservancies can articulate a positive impact on the livelihoods and local development of communities living in or near PAs (Abukari & Mwalyosi, 2020). This is based on Abukari and Mwalyosi (2020) study that assessed local communities' perceptions on the benefits of PAs in terms of local development and livelihoods. Contrary, the establishment of PAs to conserve wildlife can negatively affect local communities' livelihood and local development. For instance, Mubalama et al. (2020) revealed that, local communities in developing countries that priotise poverty reduction are frequently opposed to the establishment of PAs that limit agricultural development and exploitation of natural resources. This is mainly because, many people in developing countries highly rely on primary economic activities such as farmimg for their survival. This concurs with Afriyie, Asare and Hejcmanová (2021) who established that, the majority of local people in rural areas highly depend on hunting and collection of wildfruits for their livelihoods and rely on their knowledge to understand wildlife ecology.

2.4. Conceptual Framework

The diagram below depicts how wildlife could become extinct or decline in forests under community conservancies due to a loss of habitat occasioned by inappropriate and excessive use of forest resources, poor planning and negative attitudes.

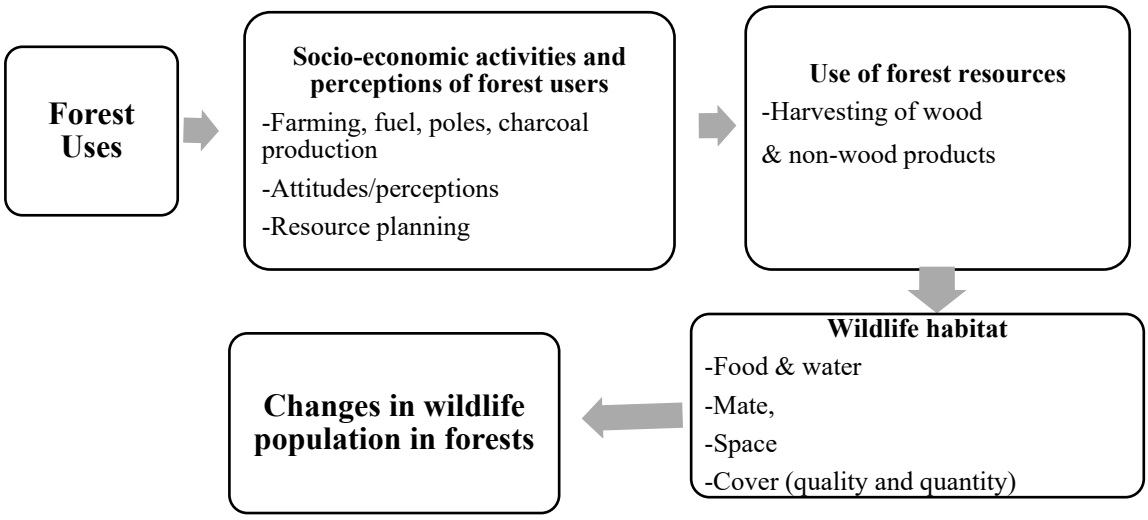


Figure 1: Conceptualization of the effects of forest use on wildlife (Author's own, 2019)

CHAPTER 3: RESEARCH METHODOLOGY

3.1. Study area

The study was carried out in George Mukoya and Muduva Nyangana Conservancies (Figure 3.1.1). Both conservancies are situated in the Kavango East Region, Ndiyona and Mukwe constituencies and within the Gciriku Traditional Area that is located approximately 130 kilo metres (km) east of Rundu along the Rundu/Divundu road. George Mukoya is located in the west of Muduva Nyangana conservancy. Both conservancies are bordering Khaudum National Park borders to the South, while the Southwest part of Muduva Nyangana shares a national border with Botswana. The conservancy area is divided into two zones, the farming zone covering ¾ of the total area and the wildlife exclusive zone in the South covering about ¼ of the conservancy. George Mukoya comprises of a land surface area of 48.830 km² (48, 830 ha (hectares) while Muduva Nyangana covers the area of 66000 km² (66, 000 ha).

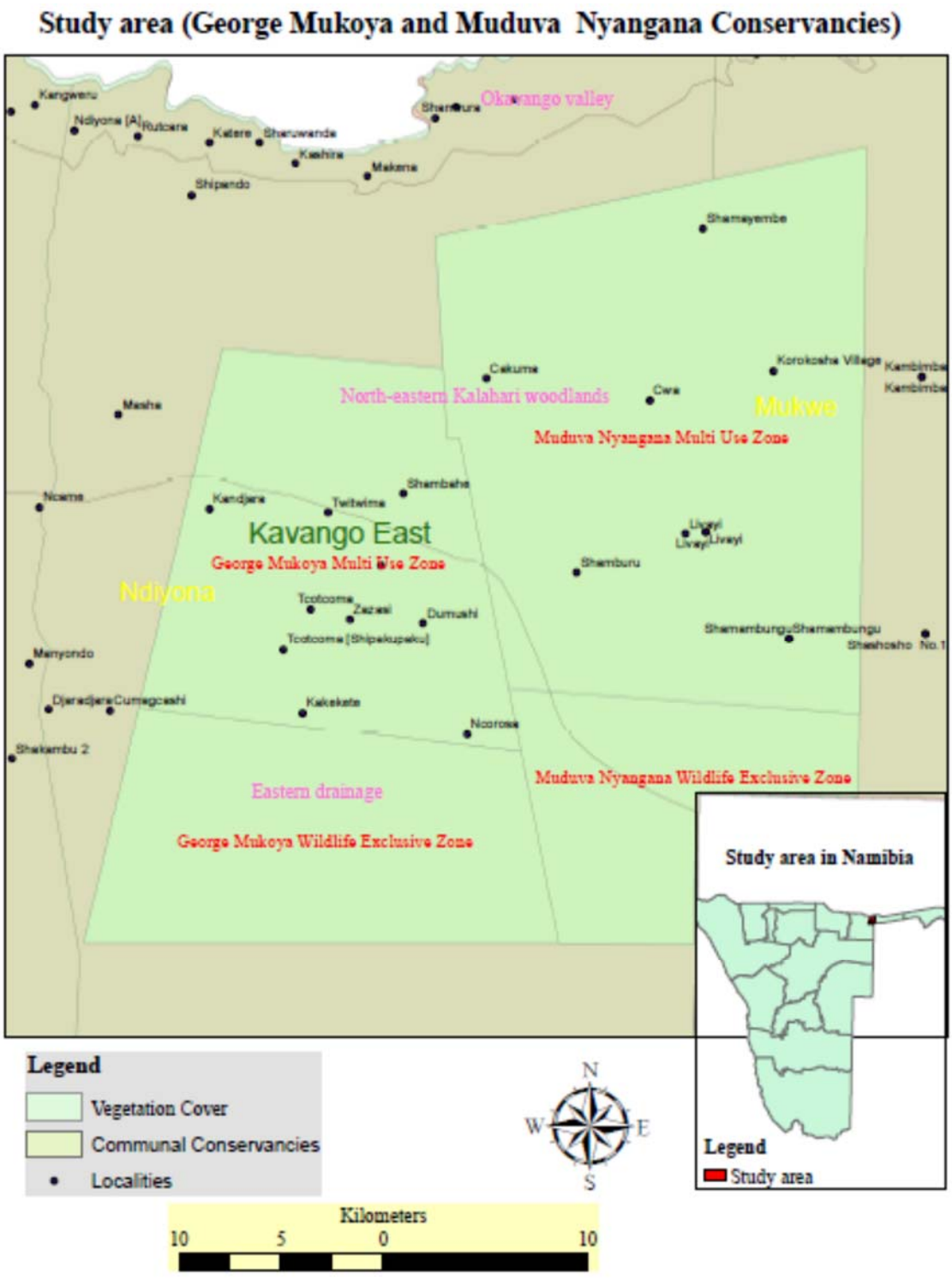


Figure 3.1.1. Study map

3.1.1. Human Population

The target population of the study consisted of 1231 registered residents of George Mukoya Conservancy (652 individuals in 134 households) and Muduva Nyangana Conservancy (579 individuals in 129 households).

3.1.2. Vegetation

Main vegetation types in GMC and MNC are "tree and shrub savanna'' according to the Atlas of Namibia with open forest savannas up to dense woodlands with the northern part of the area being classified as "woodlands of the Northern sand plain'', and the Southern area as ''eastern drainage vegetation'' (Mendelsohn et al. , 2002). These are characterised by *Baikiaea plurijuga*, *Burkea Africana*, *Guibourtia coleosperma*, *Terminalia sericea*, *Schiniophyton rautanenii*, *Combretum* species, *Grewia* species and *Pterocarpus angolensis*. Tall trees such as *Guibourtia coleosperma* (False mopane), *Burkea Africana* (Wild Syringa), Kiaat (Mukwe) and Mangetti trees dominate the deeper sand, while shrubby vegetation such as *Terminalia sericea* (Silver Terminalia), *Acacia erioloba* (Camelthorn), *Combretum hereroense*, *Acacia fleckii* and patches of grassland is found in the low-lying clayey sand (Mendelsohn et al., 2002).

Even though the soils make it hard for vegetation to grow, there are still many plants providing pastures for livestock, fuel wood, weaving and wooden craft, fruits and nuts, materials for building and traditional medicines (Mendelsohn et al., 2002). The area consists of a high variety of very important plant species (Non-Timber Forest Products

(NTFPs) that are being used traditionally for various purposes by the local population and for commercial purposes. Some of these forest resources (e.g. *Schinziophyton rautenenii, Strychnos cocoloides, Strychnos pungens*, Thatching grasses *Eragrostis* ssp.) have economic potentials that have not yet been used to the full extent due to difficult access, lack of infrastructure, lack of sustainable harvesting techniques and few marketing opportunities.

3.1.3. Wildlife Species

The area provides habitat for various games species, which are found in the wildlife exclusive zone, in the southern part of the community conservancies. The most prevalent game species include some of Namibia's flagship species such as the African elephant (*Loxondonta Africana*), eland (*Taurotragus oryx*), kudu (*Tragelaphus strepsciceros*), giraffe (Giraffa amelopardalis), oryx (*Oryx beisa*), roan (*Hippotragus equinus*), impala (*Aepyceros melampus*), blue wildebeest (Connochaetes), steenbok (*Raphicerus campestris*), warthog (*Phacocheorus africanus*), duiker (*Sylvicapra grimmia*), ostrich (*Struthio camelus*) (Sinclair et al., 2002, p. 142). Moreover, there are also hyenas, leopards (*Panthera leo*), lions, wild dogs and caracals (*Felis caracal*) (Stuart and Stuart, 2007), francolins (*Scleroptila levaillantoides*) and guinea fowls (*Numida meleagris*).

3.1.4. Climate

The climate in the Kavango region is characterised by mild winters and hot summers, with a rainy season lasting from November until March. The rainfall season is occasionally

punctuated by a break of no rain around December. MNC is located in the humid subtropical zone with an average annual temperature of 22.4 ºC (Degree Celsius). The mean maximum temperatures vary from 30 in winter to 40 ºC and above in summer. Average daily minimum temperatures vary between 11 and 18 ºC in summer and 0 and 10 ºC in winter. Incidents of frost are common during winter. The annual rainfall is around 500-600 mm (millimetres), but this has exhibited a general decline over the last decades.

3.1.5. Livelihood Strategies

People in GMC and MNC depend mostly on crop farming with common crops being mahangu/pearl millet, maize, sorghum, beans, peas, groundnuts and watermelons for their livelihood. Through yields, people are able to ensure food security and income generation from selling cereals. Crop fields are normally fenced with thorny bush but this method does not totally protect from animals such as elephants, monkeys and antelopes. This has created human-wildlife conflict in the past, which included the destruction of crops by elephants, monkeys and antelopes and killing of wildlife by the farmers affected by the destruction. Most people own livestock such as cattle and goats for meat and milk, which are sometimes sold for income. Cattle are supposed to be in corrals at night but are often left out to roam freely and interact with wild carnivores therefore exacerbating human-wildlife conflict. Grazing areas are around the villages in a distance of not more than 5 km. Other livelihood and income generating activities include cutting poles, collecting firewood, small business (shops, barbers, selling chickens), harvesting and selling thatching grass and devil's claw while some people do crafts and baskets.

3.2. Research-Design

This study used both quantitative and qualitative research designs. Quantitative approach was used to determine the forest and wildlife population changes over the years, census data (Namibia Statistics Agency [NSA], 2012) and Landsat imageries from year(s), 2000 to 2017 were downloaded from the website (https://glovis.usgs.gov/app?fullscreen=1#) of the United States Geological Survey (USGS) (2014). Census data and imageries were respectively applied to quantify percentage changes over 17 years since the establishment of the two community conservancies. Satellite images were from 2000 to 2017 because forest products were being used even before the conservancies were established, and such a length period ensured that adequate information in terms of forest dynamics was applied in the study. Qualitative approach was mainly based on personal interviews (conducted between February 2019 and January 2020) with community members of conservancies. Data on wildlife species abundance and distributions were collected from conservancies' event book and game counts.

3.2.1. Study sample

To obtain a statistically representative sample at a 95% confidence level, Smith (2013) and Fluid Surveys (2014) formulae were used. Using the two formulae a total of 293 respondents were interviewed, distributed as follows, 155 from MNC and 138 from GMC. The respondents were systematically sampled (Southworth, 2015) to easily achieve good coverage of the study areas. Sampling started by selecting between 1 and 4 and every 4^{th} (sampling interval=652/138= 4.2) dwelling units for George Mukoya and (sampling

interval =579/155= 3.7) for Muduva Nyangana. The priority was to interview the head of households first, and then any member of a household, either male or female who is aged 18 years and above had a chance of being interviewed.

3.2.2. Procedure

The data collection instrument used in this study was an interview question guide (please see Appendices, page 71 for reference on questions asked). The main purpose of using in-depth personal interviews was to draw upon respondents' attitudes, feelings, beliefs, experiences and reactions. Interviews, using a question guide with both close-ended and open-ended questions were performed in both conservancies' villages to determine the effects of respondents' socio-economic activities on wildlife. Open-ended interviews were only used where there were needs for the respondents to explain in detail. Responses from Open-ended questions were grouped into thematic areas and coded using Likert scales.

3.2.3. Data analysis

This study used both quantitative and qualitative methods to collect data. Data on wildlife species abundance and distributions were collected from conservancies' event books and game counts. Qualitative and quantitative data were analysed and translated to graphs using SPSS software. Interviews were used to assess community perceptions on the impact of their livelihood strategies on wildlife. A sample size of 293 respondents was obtained from the two conservancies. To assess the change in wildlife species abundance, multiple regression analysis with group size as dependent variable; year, distance from nearby settlement, fire intensity and vegetation cover change as continuous independent

variables. Conservancy (George Mukoya and Muduva Nyangana), species category (carnivores and herbivores), land use (multiple use and wildlife exclusive zones) and season (dry and wet) were applied as categorical variables. Satellite images were used to analyse vegetation cover change and accumulated fire intensity using change detection analysis and empirical Bayesian kriging interpolation. Average group size means and standard errors were calculated and used to determine the associations among variables. To assess respondents' perceptions on the impacts of the livelihoods strategies and major socio-economic activities contingency tables were used.

3. 3. Research ethics

The researcher obtained permission from community forest management committees to conduct the surveys. The researcher obtained the ethical clearance certificate from the University of Namibia (UNAM) Katima Mulilo Campus and the research permit from the National Commission on Research, Science and Technology (NCRST) (please see appendices). The researcher explained the study to the potential respondents before asking for their consent to participate in the study. The respondents were assured that the study will not cause any harm to them as a result of their participation in the research. To ensure confidentiality and privacy, the prospective respondents were assured that their personal identity would not be revealed and code names would be used for future reference if need be. Additionally, respondents were informed that they had the right to accept or refuse to complete the survey questionnaire or to answer a specific question(s) if they feel such question(s) would intrude their right to privacy or simply if they were not interested to answer such question(s) without offering any explanation.

CHAPTER 4: RESULTS

4.1. Population trends of large mammalian wildlife species

4.1.1. Carnivores

Table 4.1.1 reveal that, most carnivore species group sizes remained constant in the study area. Land use, year, season and conservancy did not influence (at 0.05 significance level or 95% confidence interval) the group sizes of the following carnivore species, caracals, cheetahs, spotted hyenas, leopards, lions and wild dogs. However, pangolin group sizes significantly decreased, particularly in wildlife exclusive zone of Muduva Nyangana Conservancy. This indicates that, a decrease in pangolin group sizes was associated with land use and conservancy variables.

Table 4.1.1. Carnivores group sizes distribution in relation to year, season, land use and conservancy

Dependent variable	BETA	T	P-VALUE	Direction	Independent Variable
Caracal group sizes distribution	-0.141	0.669	0.511 ns	⟷	Year
	0.009	0.04	0.969 ns	⟷	Season
	-0.432	-1.61	0.124 ns	⟷	Land use
	-0.51	-1.987	0.062	⟷	Conservancy
Cheetah group sizes distribution	0	3.048	0.56 ns	⟷	Year
	-0.372	-1.313	0.281 ns	⟷	Season
	-0.417	-1.462	0.240 ns	⟷	Land use
	-0.51	2.31	0.104 ns	⟷	Conservancy
Spotted hyena group sizes distribution	0.009	0.053	0.958 ns	⟷	Year
	0.116	0.565	0.576 ns	⟷	Season
	0.007	0.042	0.966 ns	⟷	Land use
	0.074	0.367	0.716 ns	⟷	Conservancy
Leopard group sizes distribution	0.05	0.205	0.840 ns	⟷	Year
	-0.317	-1.234	0.235 ns	⟷	Season
	-0.41	-0.167	0.869 ns	⟷	Land use
	-0.309	-1.198	0.248 ns	⟷	Conservancy

Lion group sizes distribution	-0.413	-1.332	0.220 ns	⟷	Year
	-0.227	-0.719	0.493 ns	⟷	Season
Pangolin group sizes distribution	0.153	0.952	0.348 ns	⟷	Year
	-0.023	-0.142	0.888 ns	⟷	Season
	-0.383	-2.309	0.028**	↘	Land use
	-0.366	-2.154	0.039**	↘	Conservancy
Wild dog group sizes distribution	0.157	-0.716	0.482 ns	⟷	Year
	0.056	0.2	0.843 ns	⟷	Season
	0.54	0.253	0.803 ns	⟷	Land use
	0.293	1.055	0.304 ns	⟷	Conservancy

4.1.2 Herbivores

Contrary to the status of carnivores, the status of herbivores was species specific (as per Table 4.1.2 below). Twelve (12) herbivore species and one (1) primate species (vervet monkey) were included in this study. The primate species, vervet monkey group size did not change from 2013 to 2017 due to year, season, land use and conservancy variables. The group size of seven (7) out of twelve (12) herbivore species did not change (at 0.05 significance level) from 2013 to 2017 due to differences in year, season, land use and conservancy. These species include elephant, giraffe, oryx, roan antelope, springbok, warthog and wildebeest. However, duiker group sizes showed a significant difference between conservancies, duiker group sizes in George Mukoya Conservancy were significantly larger than in Muduva Nyangana Conservancy.

Table 4.1.2. Herbivores group sizes distribution in in relation to year, season, land use and conservancy

Dependent variable	BETA	T	P-VALUE	Direction	Independent Variable
Duiker group sizes distribution	-1.37	-0.936	0.356 ns		Year
	0.286	1.853	0.073 ns		Season
	0.071	0.496	0.623 ns		Land use
	-0.427	-2.782	0.009**		Conservancy
Eland group sizes distribution	-0.06	-0.375	0.715 ns		Year
	0.837	5.079	<0.000 ***		Season
	-0.056	-0.324	0.752 ns		Land use
	0.207	1.243	0.240 ns		Conservancy
Elephant group sizes distribution	-0.333	-1.572	0.140 ns		Year
	0.539	2.054	0.061 ns		Season
	0.124	0.604	0.556 ns		Land use
	-0.133	-0.51	0.619 ns		Conservancy
Giraffe group sizes distribution	-0.328	-1.579	0.132 ns		Year
	0.259	1.096	0.287 ns		Season
	-0.124	-0.598	0.557 ns		Land use
	0.379	1.571	1.34 ns		Conservancy
Impala group sizes distribution	-0.336	-2.018	0.054 ns		Year
	-0.021	-0.105	0.917 ns		Season
	0.124	0.752	0.459 ns		Land use
	-0.515	-2.602	0.015**		Conservancy
Kudu group sizes distribution	-0.378	-2.863	0.009**		Year
	0.352	2.538	0.018**		Season
	-0.053	-0.412	0.684 ns		Land use
	-0.58	-4.098	0.000 ***		Conservancy
Oryx group sizes distribution	-0.31	-1.404	0.180 ns		Year
	0.268	1.074	0.299 ns		Season
	-0.027	-0.125	0.902 ns		Land use
	0.368	1.465	0.162 ns		Conservancy
Roan antelope group sizes distribution	-0.368	-1.755	0.097 ns		Year
	0.142	0.641	0.530 ns		Season
	-0.047	-0.226	0.824 ns		Land use
Springbok group sizes distribution	0.094	0.221	0.846 ns		Year
	0.731	1.678	0.235 ns		Season
	-0.57	-0.361	0.753 ns		Land use
Steenbok group sizes distribution	-0.205	-1.361	0.187 ns		Year
	0.272	1.724	0.098 ns		Season
	0.13	0.917	0.369 ns		Land use
	-0.59	-3.579	0.002**		Conservancy
	-0.32	-1.355	0.199 ns		Year

Vevert Monkey group sizes distribution	-0.382	-1.391	0.187 ns	⟺	Season
	-0.133	-0.559	0.586 ns	⟺	Land use
	0.084	0.305	0.765 ns	⟺	Conservancy
Warthog group sizes distribution	-0.315	-1.751	0.094 ns	⟺	Year
	0.283	1.435	0.165 ns	⟺	Season
	0.294	1.688	0.106 ns	⟺	Land use
	-0.107	-0.556	0.584 ns	⟺	Conservancy
Wildebeest group sizes distribution	-2.855	-2.887	0.212 ns	⟺	Year
	2.138	2.121	0.281 ns	⟺	Season
	0.147	0.577	0.667 ns	⟺	Land use

4.2 Land cover change, fire intensity and wildlife abundance

4.2.1. Land cover changes from 2000 to 2017

The four variables used in this study were highly correlated (Table 4.2.1). Land cover change remained stable moving away from the settlement and was low in wildlife-exclusive zone than in multiple use area, but changed with increasing fire intensity. Fire intensity increased with distance from settlement. Table 4.2.1 indicates that, there are significant relationships between land-cover change, distance from settlement, land use and cumulative fire intensity. Land cover change declines as the distance from settlements increases and as land use becomes wildlife-exclusive zone. Occurrence of wildfire results into drastic change of land cover to bare soil.

Table 4.2.1. Land cover changes from 2000 to 2017

		Distance from Settlement	**Land use**	**Cumulative Fire intensity**
Land use zone	Pearson Correlation	.583		
	Sig. (2-tailed)	.000*		

Cumulative fire intensity	Pearson Correlation	.234	.027	
	Sig. (2-tailed)	.000*	.007*	
Land cover change	Pearson Correlation	-.024	-.139	.082
	Sig. (2-tailed)	.016*	.000*	.000*
. Correlation is significant at the 0.05 level (2-tailed).				

Figure 2 below provides the vegetation change, cumulative fire intensity, and wildlife distribution. Generally, land cover mainly remained unchanged from 2000 to 2017 for both conservancies and land use (Figure 2.a). However, only 5% of the land cover changed from open woodland to closed woodland. In Muduva Nyangana conservancy, 92% of land cover remained unchanged, with only 8% increase in the multiple-use zone. In George Mukoya conservancy, 94% of land cover remained unchanged, with 3% increase in each land use zone.

Generally, there was a significant association between land cover change and wildlife abundance ($\chi^2 = 42.87$, $P < 0.001$), and in George Mukoya conservancy ($\chi^2 = 6.94$, $P = 0.008$), but not in Muduva Nyangana (($\chi^2 = 0.61$, $P = 0.44$). Herbivore group sizes were larger in changed areas than unchanged areas (Figure 4.2.1.c). However, group sizes of carnivore were similar in changed and unchanged areas (Figure 4.2.1.c). Overall, a higher abundance of wildlife was found in areas where land cover did not occur ($\chi^2 = 10.52$, $P = 0.001$) and as such land cover change was not included in further analysis.

There was association between fire intensity and land use change in the whole complex ((χ^2 = 116.28, P < 0.001), and in the conservancies (χ^2 = 204.27, P < 0.001 for George Mukoya; χ^2 = 34.04, P < 0.001 for Muduva Nyangana). In George Mukoya, 48% and 32% of the wildlife exclusive zone experienced low and high fire intensities, respectively, while 51% and 34% of the multiple use zones experienced low and medium fire intensity, respectively (Figure 2b). In Muduva Nyangana, 43% and 35% of the wildlife exclusive zone experienced low and medium fire intensities, respectively, while 52% and 29% of the multiple use zones experienced low and medium fire intensity, respectively (Figure 2b). However, the observed distribution of fire intensity did not significantly (at 0.05 significance level) influence group sizes of carnivores and herbivores (Figure 4.2.1.b), and as such fire intensity was excluded from further analysis.

Generally, wildlife species were more abundant in wildlife-exclusive zone than the multiple-use zone (χ^2 = 8.52, P = 0.014; Figure 2c), with group sizes larger in wildlife-exclusive zone than multiple use zone (Figure 4.2.1.d). Carnivores were more abundant in Muduva Nyangana (Figure 2e) and herbivores evenly distributed between the conservancies (Figure 2d). Both carnivores and herbivore group sizes were far away from settlements (χ2 = 388.58, P < 0.001; Figure 4.2.1.a).

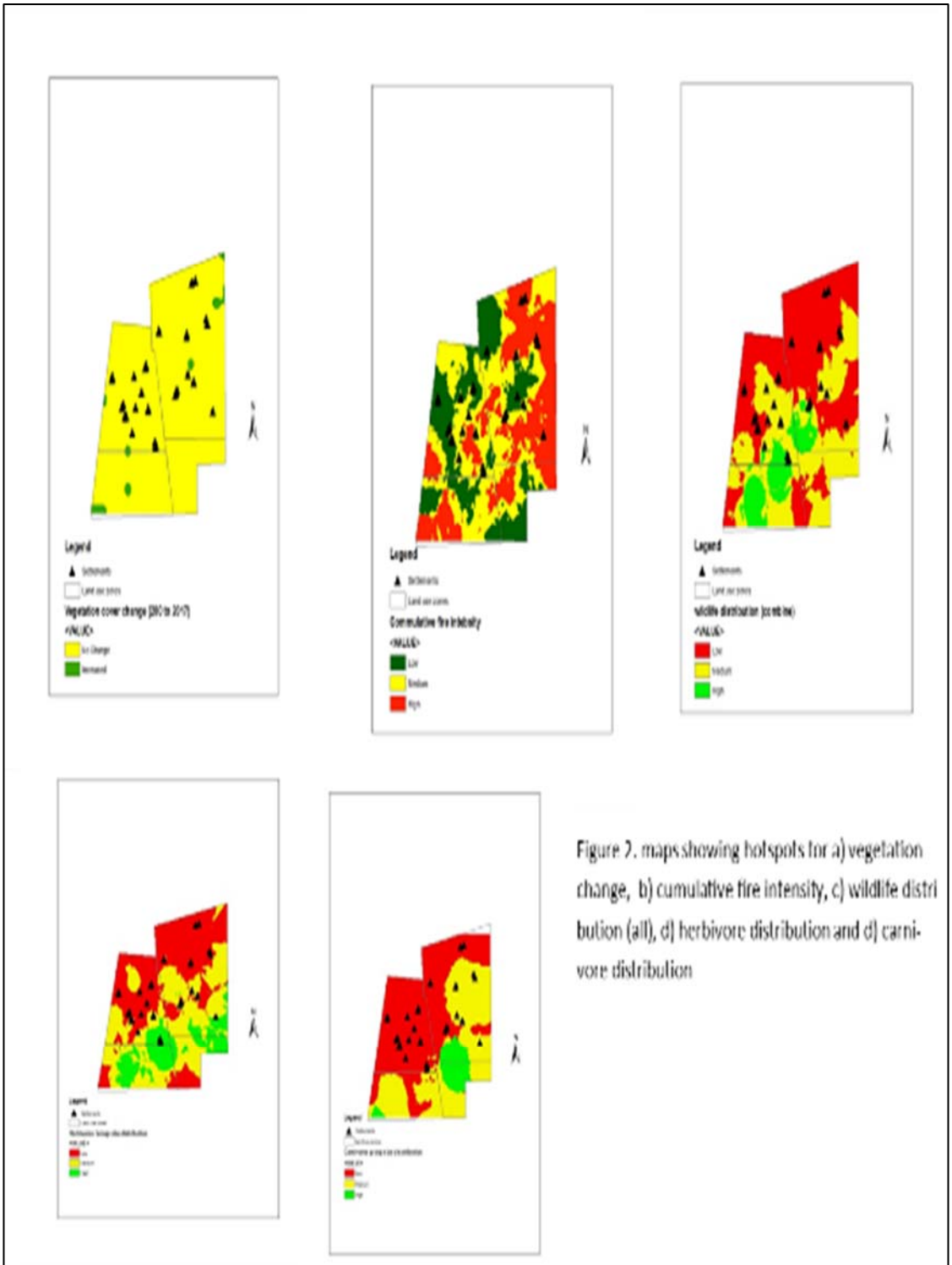


Figure 7. maps showing hotspots for a) vegetation change, b) cumulative fire intensity, c) wildlife distribution (all), d) herbivore distribution and d) carnivore distribution

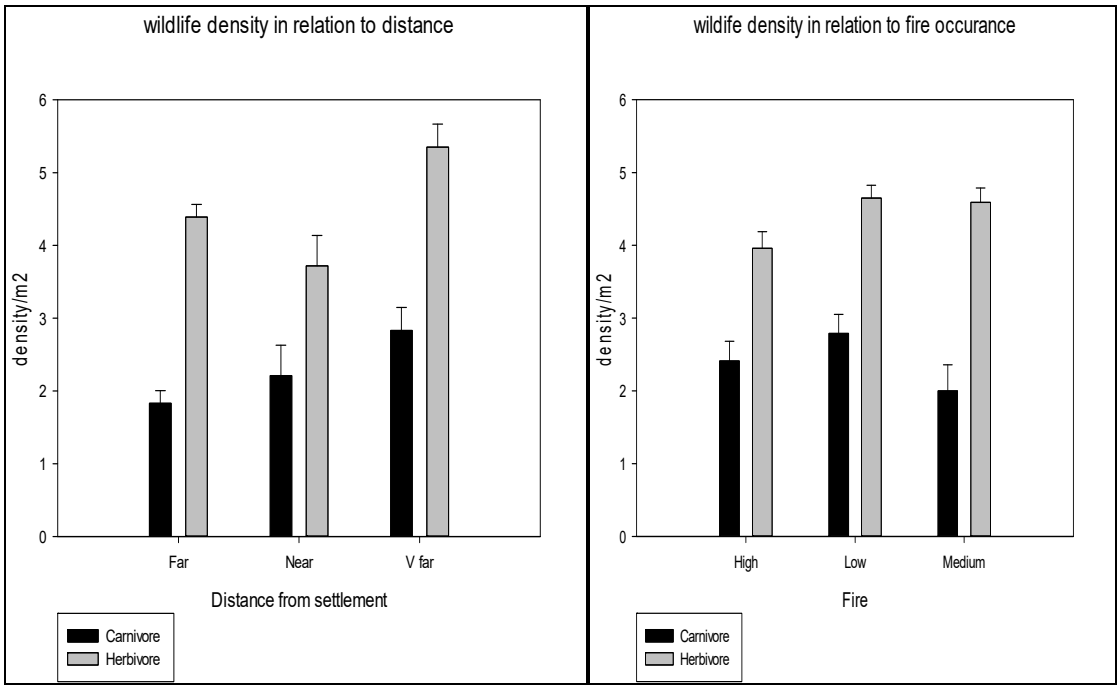


Figure 4.2.1.a. Wildlife distance from settlements - ***Figure 4.2.1.b. Fire intensity and wildlife distribution***

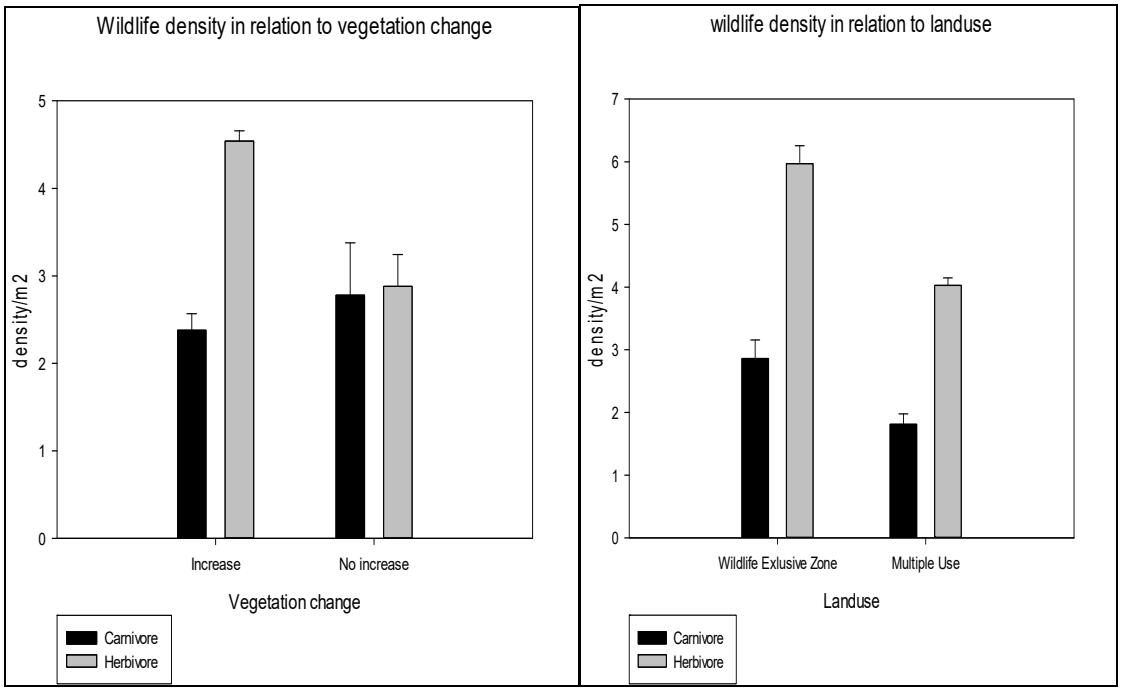


Figure 4.2.1.c. Wildlife and vegetation change - ***Figure 4.2.1.d. Wildlife distribution per land use***

4.2.2. Average group sizes of carnivores in relation to distance from settlement, fire intensity, vegetation change and land use zones

Considering selected species of carnivores, spotted hyenas (Figure 4b), wild dogs (Figure 4c) and leopards (Figure 4d) were more abundant in the wildlife-exclusive zone than in the multiple-use zone, while caracal was more abundant in multiple-use zone (χ^2 test, $P < 0.001$ for all tests; Figure 4a). Moreover, Figure 4.2.2.b reveal that, all leopards were far or very far from human settlements in both GMC and MNC. Spotted hyenas (Figure 4.2.2.1) and caracals (Figure 4.2.2.4) group sizes did not differ between land use zones and conservancies. Leopard group sizes were larger in the wildlife-exclusive zone than in the multiple-use zone in both conservancies (Figure 4.2.2.2), while wild dog group sizes were larger in the wildlife-exclusive zone than in the multiple-use zone in Muduva Nyangana, but did not differ between land use zones in George Mukoya (Figure 4.2.2.3).

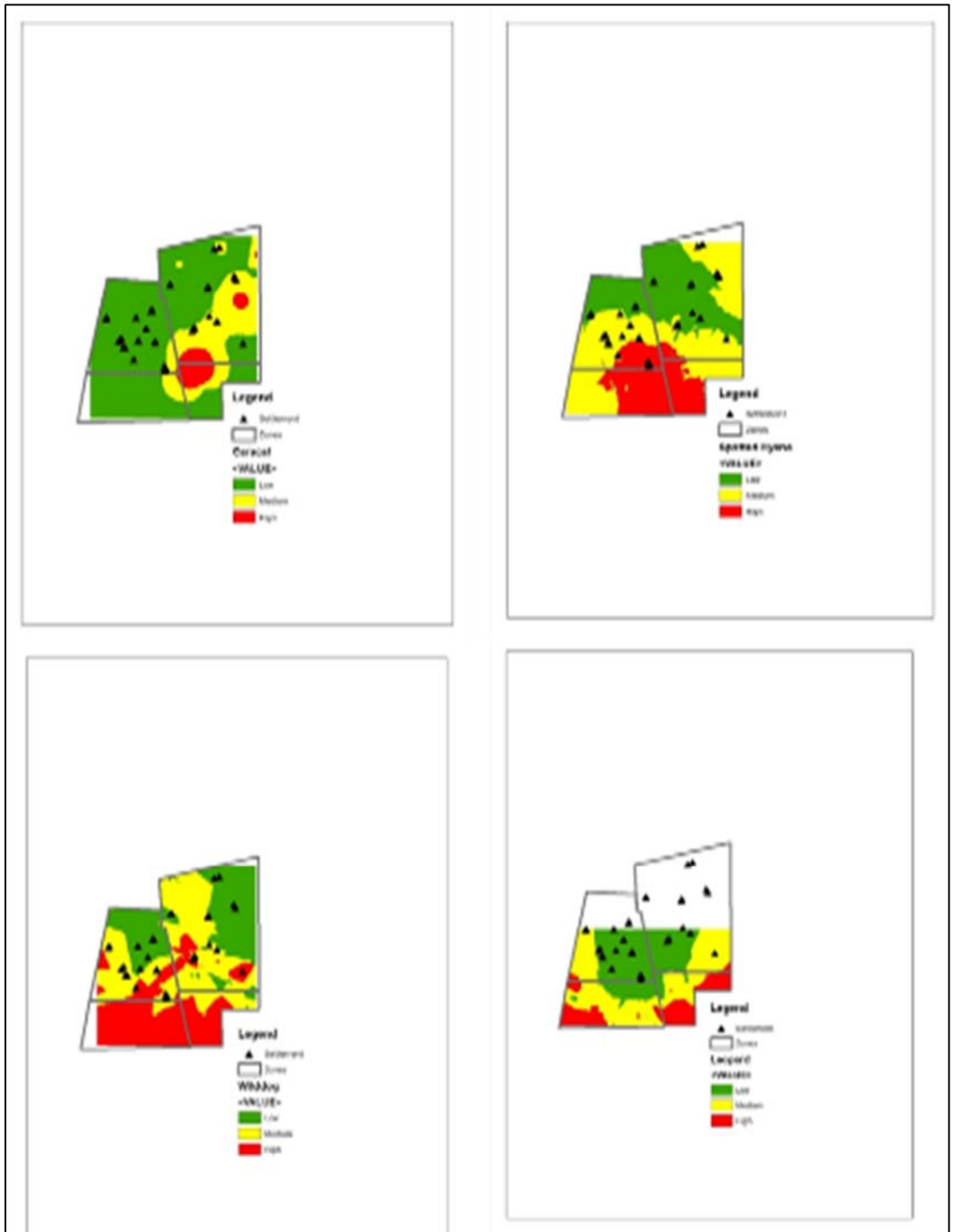
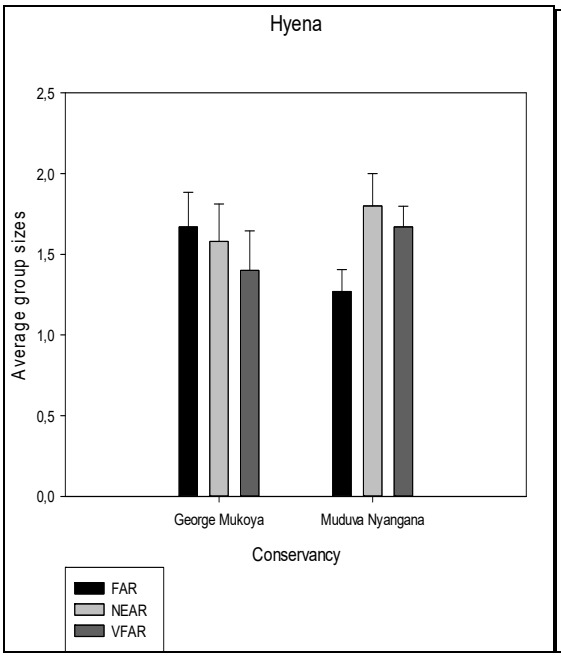


Figure 4. Carnivore distributions in the study area a) caracal b) spotted hyena c) wilddog d) leopard



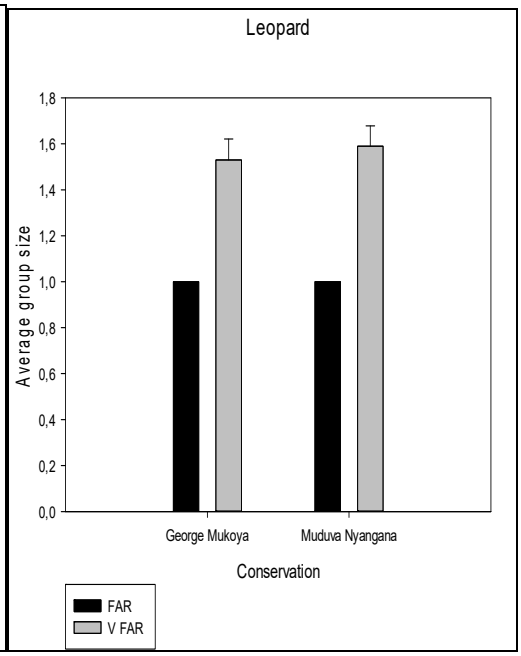
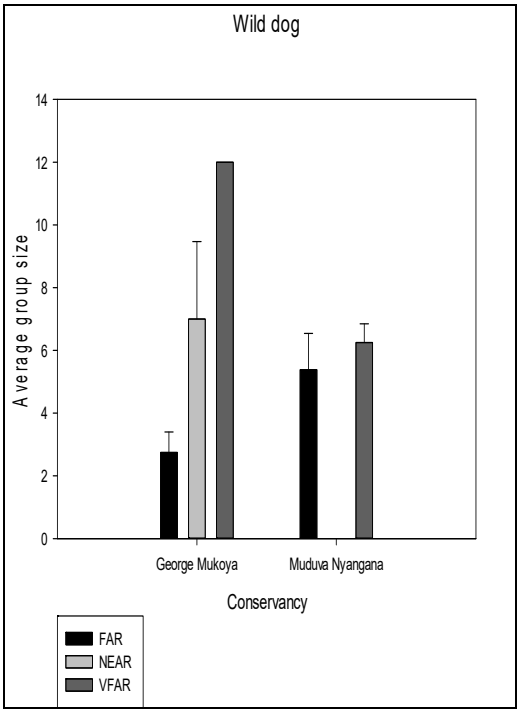


Figure 4.2.2.a. Distance of from settlements: Wild dogs - Figure 4.2.2.b. Distance of from settlements: Caracal



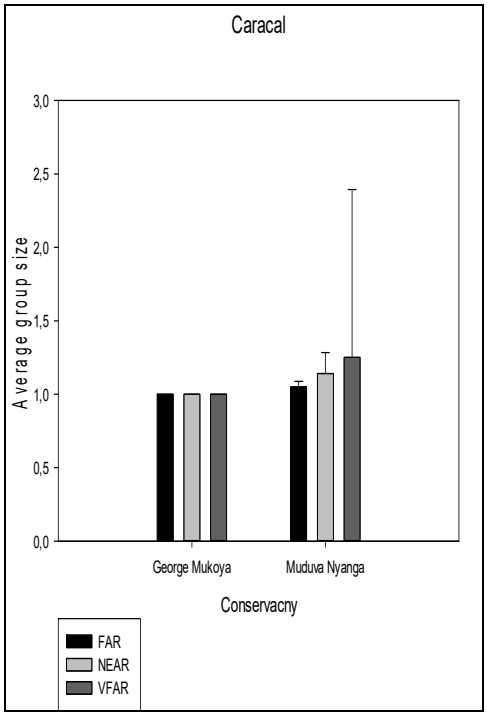
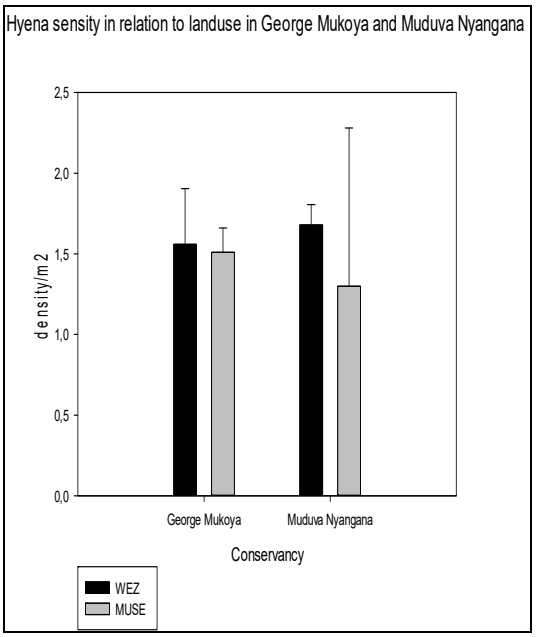


Figure 4.2.2.c. Distance of from settlements: Wild dogs - Figure 4.2.2.d. Distance of from settlements: Caracal



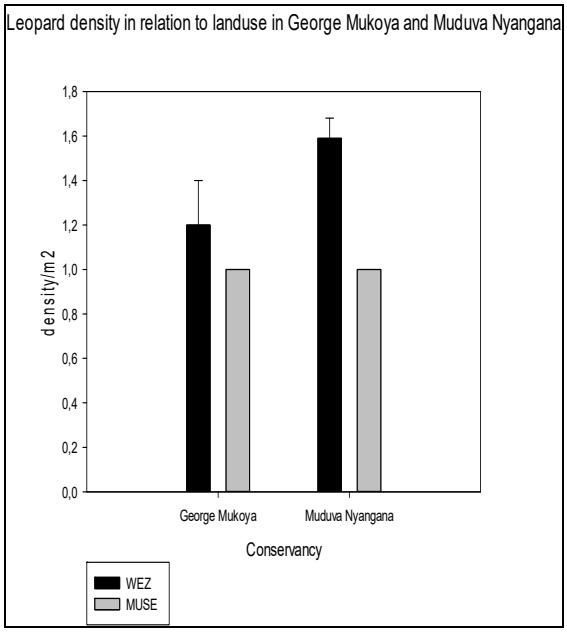
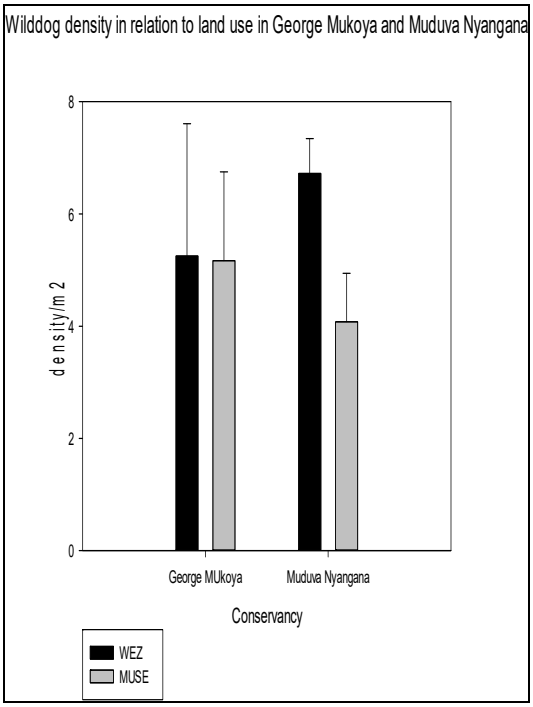


Figure 4.2.2.1. Land use and Hyena distribution

Figure 4.2.2.2. Land use and Leopard distribution



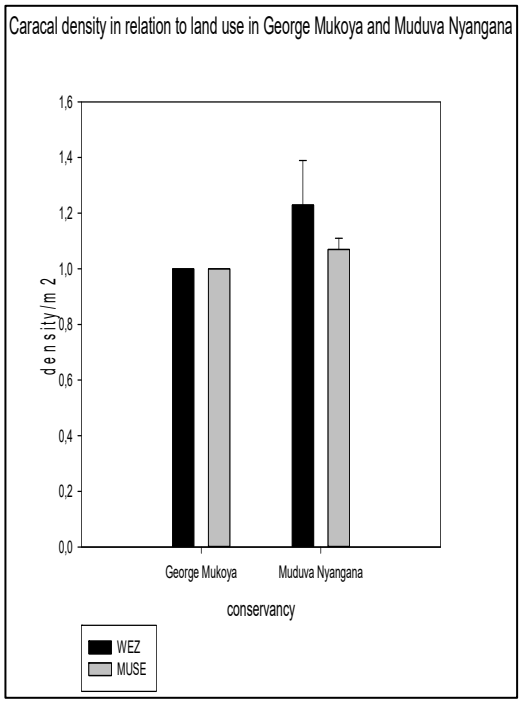


Figure 4.2.2.3 Land use and Wild dog distribution

Figure 4.2.2.4. Land use and Caracal distribution

4.2.3 Average group sizes of herbivores in relation to distance from settlement, fire intensity, vegetation change and land use zones

Most herbivore species were evenly distributed in both land use apart from roan antelope and pangolin (Figure 7). Herbivore group sizes were not influenced by distance from settlement (Figure 4.2.3.1-3), but by land use zone (Figure 4.2.3.4/5). However, Figure 4.2.3.1 indicate that, most of the elephants were far/very far from human settlements in MNC than in GMC. Figure 4.2.3.2 reveal that, all roan antelope were far from human settlements in GMC, while Figure 4.2.3.3 indicate that warthogs were more close to the communities in GMC than in MNC. Figure 4.2.3.4 and 4.2.3.5 uncover that, apart from impala and steenbok, which had group sizes with a close even distributed between land use zones, other herbivores had group sizes larger in wildlife exclusive zone than in multiple-use zone.

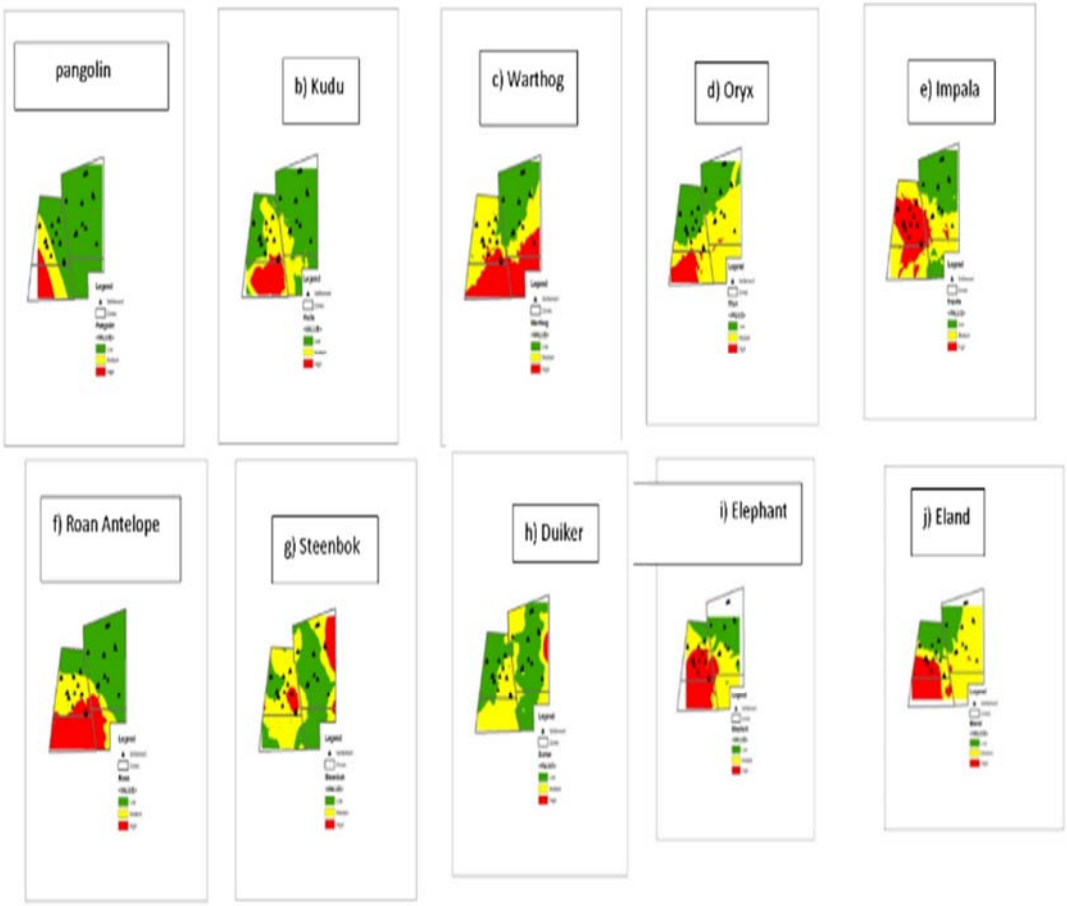


Figure 7: Herbivore Distribution in the study area a) pangolin b) kudu c) warthog d) Oryx e) impala f) roan antelope g) steenbok h) Duiker i) elephant j) eland

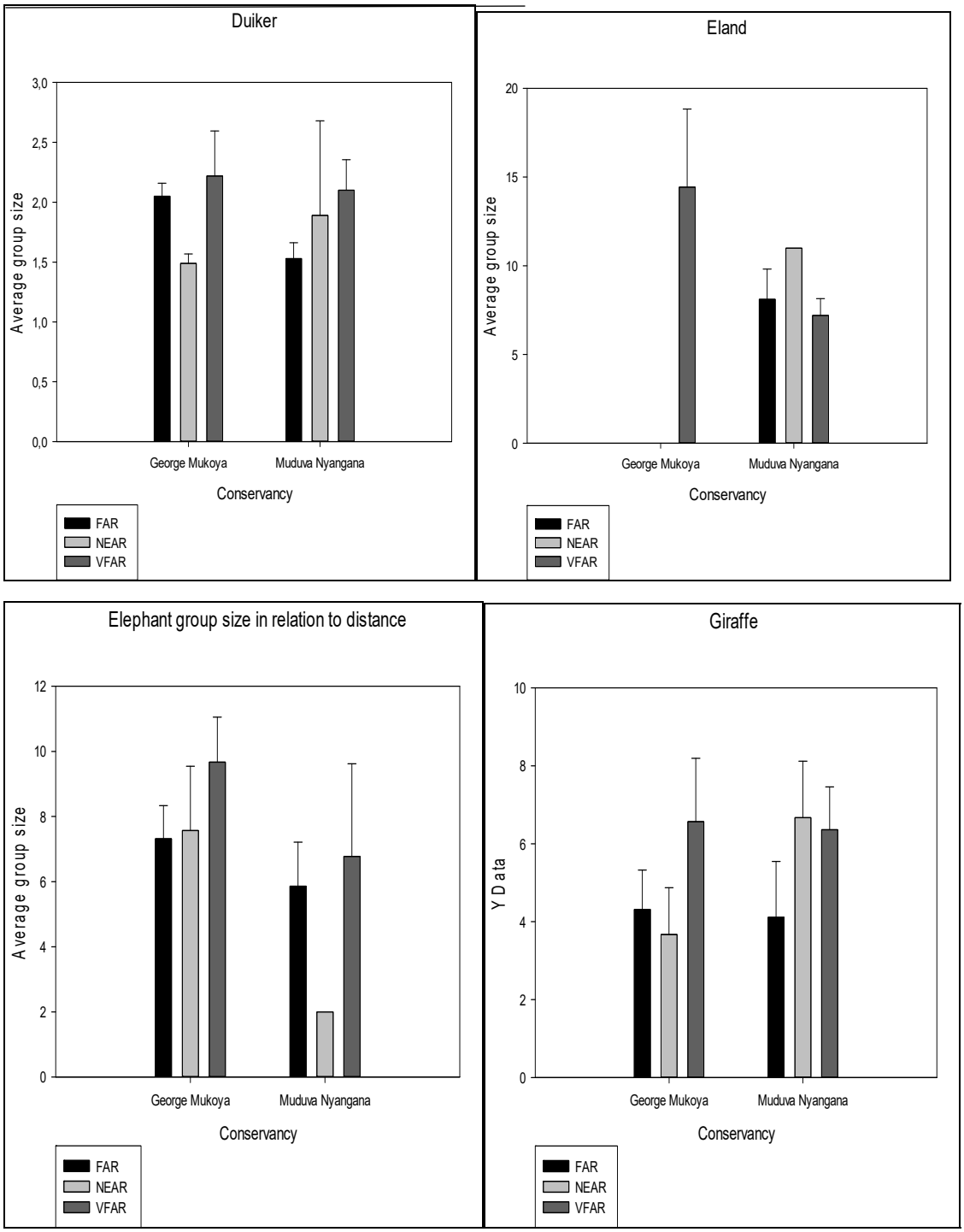


Figure 4.2.3.1. Herbivores (duiker, eland, elephant and giraffe) distribution and distance from settlements

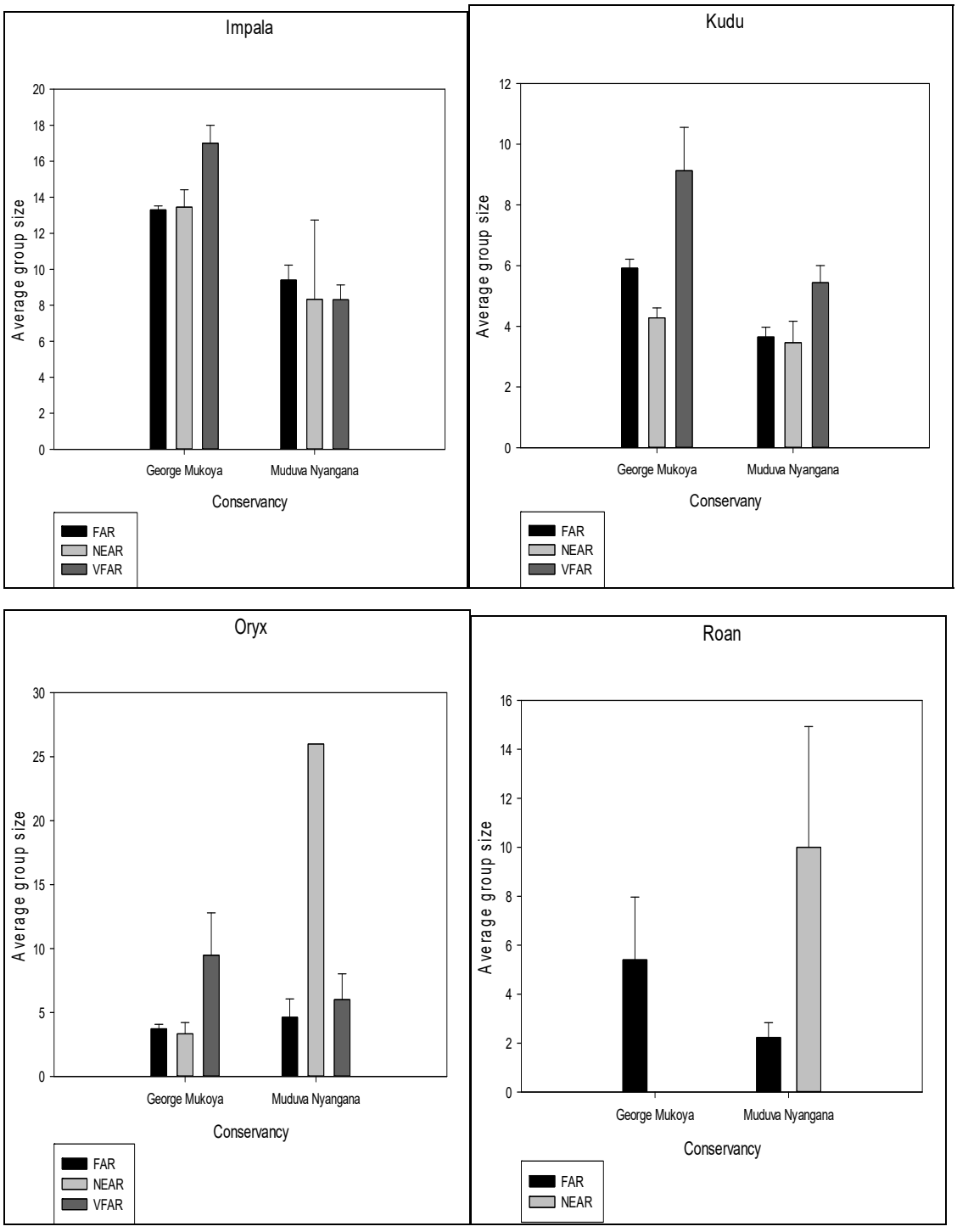


Figure 4.2.3.2. Herbivores (impala, kudu, oryx and roan) distribution and distance from settlements

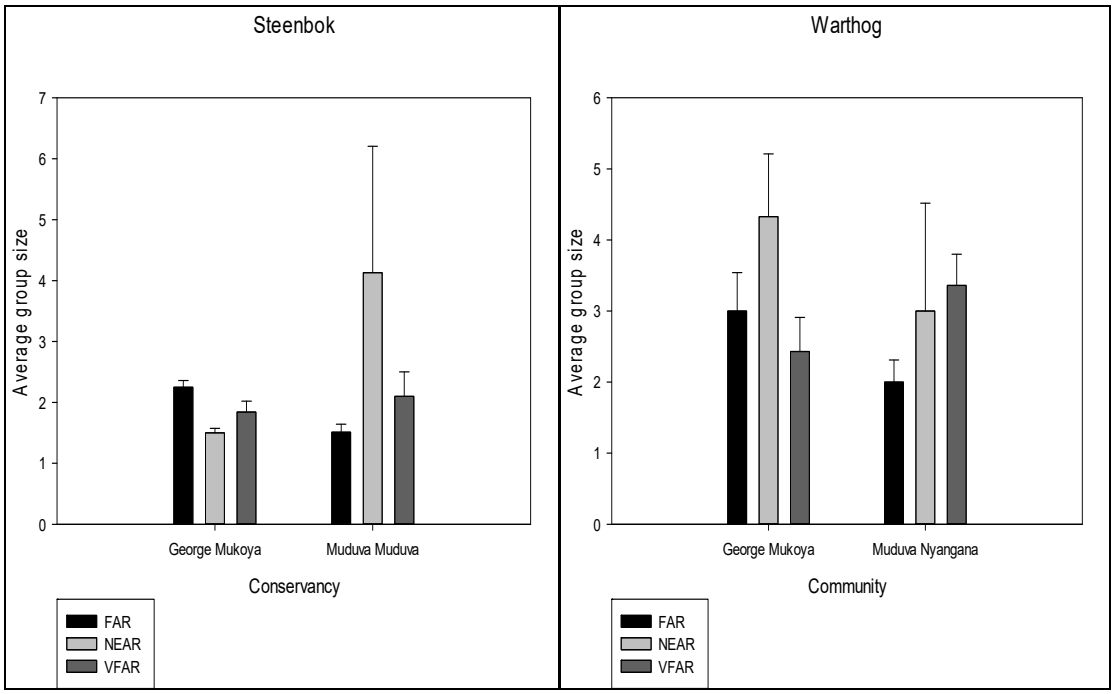
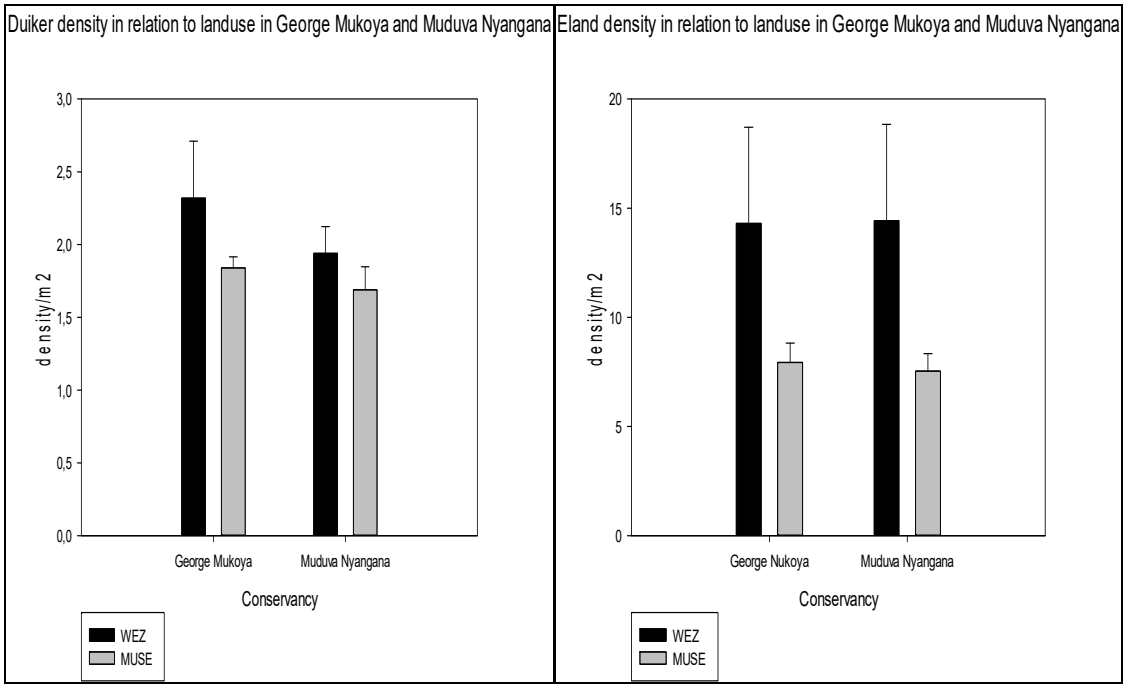


Figure 4.2.3.3. Herbivores (steenbok and warthog) distribution and distance from settlements



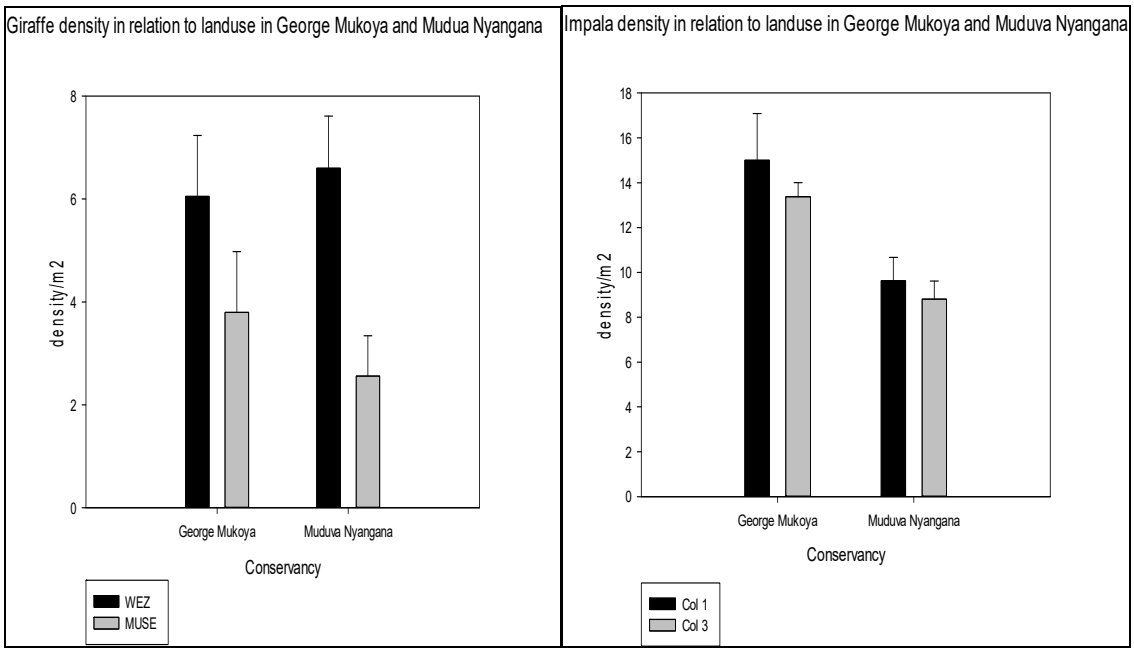
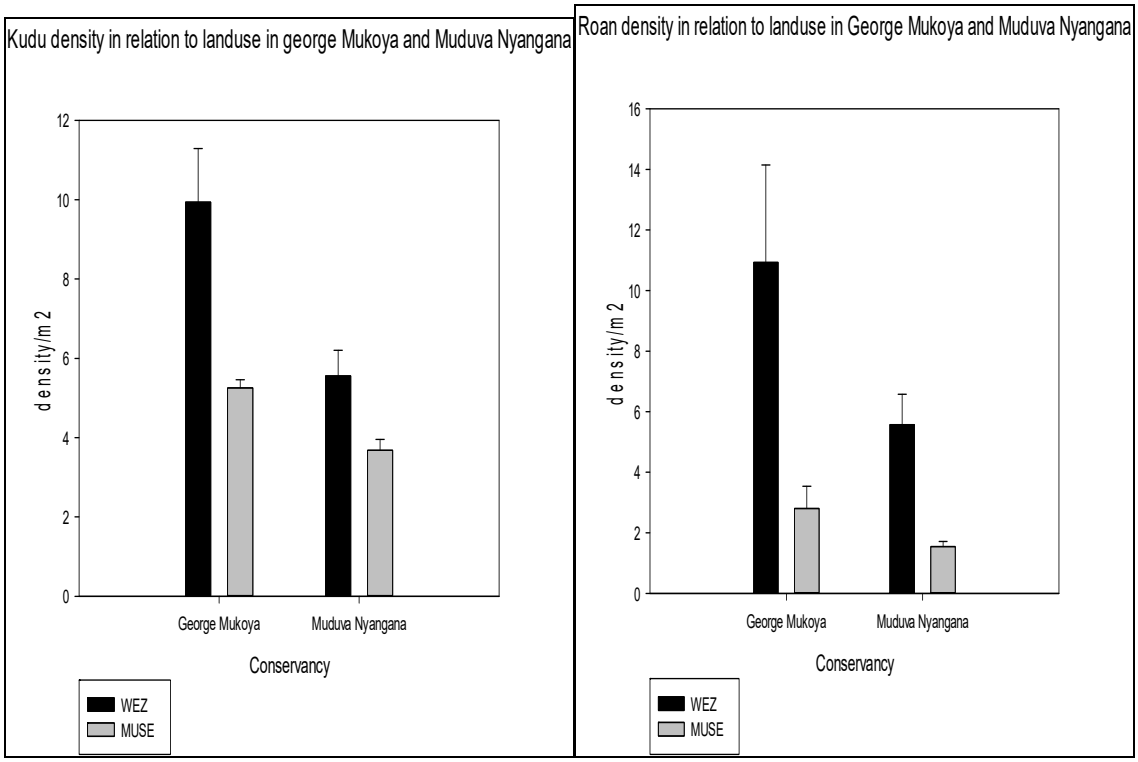


Figure 4.2.3.4. Land use and Herbivores (duiker, eland, giraffe and impala) distribution



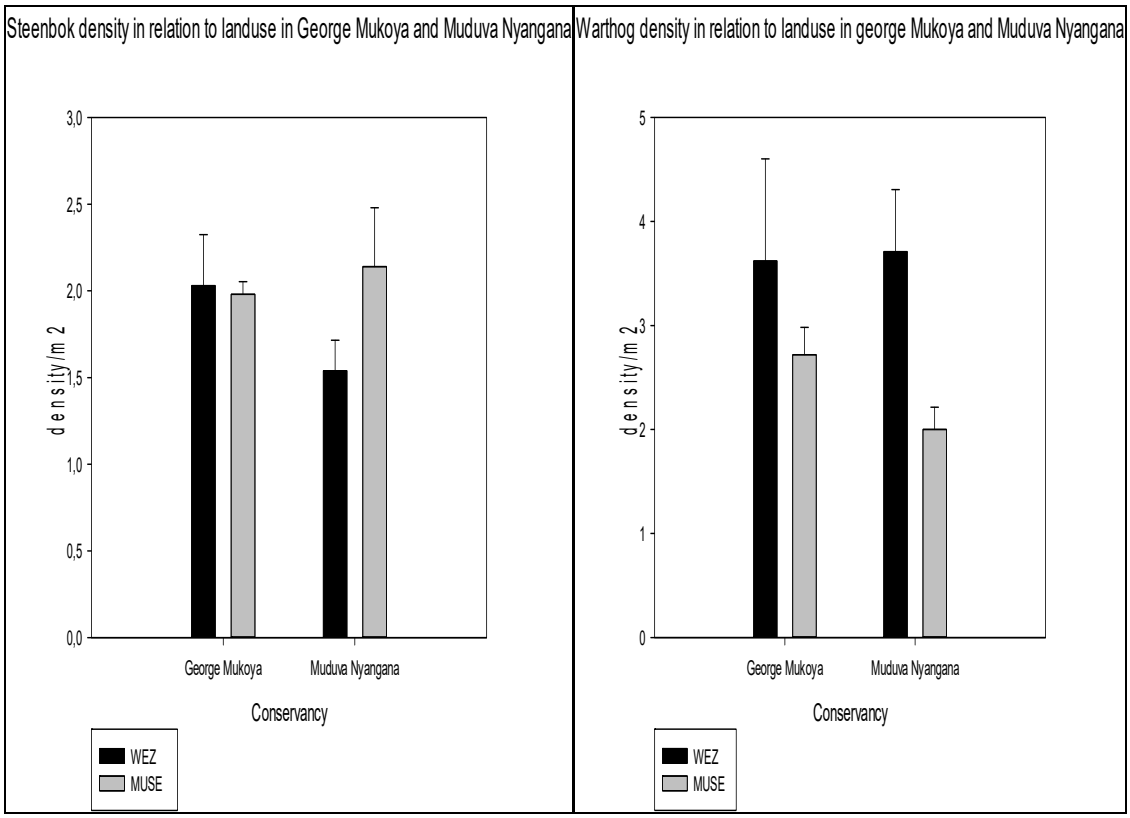


Figure 4.2.3.5. Land use and Herbivores (kudu, roan, steenbok and warthog) distribution

4.3 Perceptions of local people on the effect of different consumptive forest uses, wildlife management and socio-economic activities on large mammalian wildlife species

Table 4.3.1 below, provides the proportion of farmers who in the last 12 months reported that; they cleared land, experienced the presence of wildlife near their households, and their occupation had an impact on wildlife and forestry in George Mukoya and Muduva Nyangana Conservancies. Moreover, Table 4.3.1 indicates that there is a significant association between farmer type (occupation) and their household clearing land. The significant differences are reported in both George Mukoya Conservancy (GMC) and Muduva Nyangana Conservancy (MNC) as 87.2%, 100% of crop-only farmers cleared

land in the past 12 months, compared to 0 and 39.4% of crop and livestock farmers in GMC and MNC respectively. There is no significant differences when it comes to experiencing wildlife mammals nearby households between crop-only and crop and livestock farmers, as all crop farmers experienced wildlife near their households in both GMC and MNC. In addition, 56.6% and 97% of crop and livestock farmers experienced the presence of wildlife nearby their households in GMC and MNC respectively. All crop and livestock farmers reported that, their occupation have no impact on wildlife and forestry.

Table 4.3.1. Proportion of farmers who reported that their household cleared land or cut trees, experienced the presence of wildlife near their households, their occupation impact wildlife and forestry in the past 12 months in George Mukoya and Muduva Nyangana Conservancies

Variable	**Conservancy**	**Crop farmers**		**Crop and livestock farmers**	
		Yes	No	Yes	No
% of farmers who cleared land or cut trees	George Mukoya	87.2% (n=75)	12.8% (n=11))	(0)	100% (n=53)
	Muduva Nyangana	100% (n=68)	0	39.4% (n=13)	60.6% (n=20)
% of farmers who reported the presence of wildlife near their households	George Mukoya	100% (n=86)	0	56.6%(n=30)	43.3% (n=23)
	Muduva Nyangana	100%(n=68)	0	97%(n=32)	3% (n=1)
% of farmers	George Mukoya	31.4%(n=27)	68.6%(n=59)	0	100%(n=53)

who reported the impact of their occupancy on wildlife and forestry	Muduva Nyangana	32.4%(n=22)	67.6%(n=46)	0	100%(n=33)

Table 4.3.2 reveals a significant association between farming type and the importance of community forest (George Mukoya Conservancy, χ^2 (25) = 211.948 p <. 001) and Muduva Nyangana Conservancy, χ^2 (20) =280.826, p < .001). In George Mukoya Conservancy 94.2%(n=81) and in Muduva Nyangana Conservancy 36.8%(n=15) of crop production farmers listed harvesting and use of building material as the importance of community forest. They reported that the community forest is important because it offers them building materials to fence off their crop fields and for household use (Table 4.3.2 and 4.3.3/4).

Table 4.3.2. List of importance of community forest in George Mukoya and Muduva Nyangana Conservancies

	Crop farming		Crop and livestock farming	
	GMC	MNC	GMC	MNC
Building Materials	94.2%(n=81)	36.8%(n=1)	11.3%(n=6)	9.1%(n=3)
Timber	5.8%(5)	26.5%(n=18)	22.6%(n=12)	0
Agriculture	0	19.1%(n=13)	20.9%(n=11)	9.1%(n=3)
NTFP	0	17.6%(n=12)	22.6%(n=12)	18.2%(n=6)
Ecotourism	0	0	22.6%(n=12)	63.6%(n=21)
Total	100%	100%	100%	100%

Table 4.3.3 indicate that, there is a significant association between occupation and forest use benefit (George Mukoya Conservancy, χ^2 (25) = 211.948p <. 001 and Muduva Nyangana Conservancy, χ^2 (20) =280.826, p < .001). In George Mukoya Conservancy

29.1 %(n=25) and in Muduva Nyangana Conservancy 66.2 %(n=45) farmers engaged in crop production only listed timber as the benefit derived from the community forest. In Muduva Nyangana 100%(n=33) crop and livestock farmers listed thatch grass as the most derived benefit from the community forest (Table 4.3.4). In George Mukoya Conservancy, crop farmers listed timber and in MNC crop and livestock farmers listed thatch grass as the most used forest product benefit.

Table 4.3.3. Benefits derived from George Mukoya community forest

Farming type	Timber	thatch	Poles	droppers	Bush meat	firewood	water	Herbal plants
Crop production	29.1% (n=25)	27.9 % (n=24)	31.4%(n=27)	11.6%(n=10)	0	0	0	0
Crop & livestock	7.5%(n=4)	0	11.3% (n=6)	9.4% (n=5)	34.0 % (n=10)	13.2% (n=7)	9.4%(n=5)	15.1 % (n=8)
Total	36.6%	27.9 %	42.7%	21.0%	34.0 %	13.2%	9.4%	15.1 %

Table 4.3.4: Benefits derived from Muduva Nyangana community forest

Farming type	Timber	Thatch	Total
Crop production	66.2% (n=45)	33.8% (n=23)	100%
Crop & livestock	0	100% (n=33)	100%
Total	66.2%		Xx

Forest use benefits and impact on wildlife

There was a significant association between occupation and the importance of community forest (George Mukoya Conservancy, χ^2 (4) =52.414 p < .001 and Muduva Nyangana Conservancy, χ^2 (4) =96.949, p < .001). In George Mukoya Conservancy 78.6% (n=55)

crop farmers who listed timber as benefit derived from community forest, reported that timber harvesting has negative effects on the survival of wildlife (Table 4.3.5). All the crop and livestock farmers reported that their benefits do not have negative effects on the survival of wildlife.

Table 4.3.5 Benefits derived from the community forest and proportion of crop production farmers who believe these benefits have an impact on wildlife

Forest product/use	George Mukoya		Muduva Nyangana	
	Yes	No	yes	No
Timber	78.6% (n=55)	21.4% (n=15)	0	0
Thatch	48.9% (n=23)	51.1% (n=24)	0	100% (n=37)
Poles	0	100% (n=27)	0	0
Droppers	0	100% (n=10)	0	100% (n=6)
Bush meat	0	0	0	100% (n=5)
Fire wood	0	0	0	100% (n=18)
Water	0	0	0	100% (n=7)

CHAPTER 5: DISCUSSION

Study results revealed a significant decline in the abundance of pangolin (carnivore) group sizes, particularly in Muduva Nyangana Conservancy due to land use dynamics. When it comes to herbivores, the group size of five out of twelve herbivore species populations experienced changes due to differences of year, season, land use and conservancy. These species include elands (decreased during dry seasons), impalas, steenbok and duikers (were less in MNC than in GMC), Kudu (declined as years increased, and increased in wet seasons, and were few in MNC compared to GMC). All other carnivores and herbivores wildlife species remained stable between 2013 and 2017 in GMC and MNC. Thus supporting the hypothesis of this study, that no significant changes in abundance of most wildlife species occurs between 2013 and 2017 in GMC and MNC.

5.1. Changes in large mammalian wildlife species

5.1.1: Carnivore

Most carnivores' populations were stable and did not differ between land use in both George Mukoya Conservancy and Muduva Nyangana Conservancy. These include the African elephants, the spotted hyenas (*crocuta*) and cheetahs (*Acinonyx jubatus*) and the caracals. Based on game count records from the nature conservancy office, the spotted hyenas seemed to be the relatively most stable followed by cheetahs and lastly the caracals. The spotted hyenas seemed to be the relatively most abundant followed by the

lions and lastly the cheetahs. The population sizes were stable mainly due to the increased conservation efforts because of mechanisms imposed such as anti-poaching strategies as per the Namibian Conservation Act (Community Conservation Namibia, 2023). In addition, the Namibia Conservation Act afforded local communities the opportunity to access forest resources legally; they were eligible for benefits such as such as income, wildlife meat, and employment opportunities. Factors that have lead to the decline/stable than an increase in wildlife abundance in GMC and MNC are linked to elements that have been exposed as per the below studies.

Current estimates of African lion populations range from 23 000 to 39 000 (International Union for Conservation of Nature [IUCN], 2020). Although lions live on unprotected and protected lands, they are gradually being restricted to large, fenced, protected areas to avoid more occurrences of conflicts between human and wildlife (IUCN, 2020). There is strong doubt lion populations can be sustained outside of national parks with or without hunting bans, unless major economic incentives are provided to local landholders (Holechek & Valdez, 2018). Anthropogenic mortality is often the biggest threat to leopards outside of protected areas, and similar results have been reported for other large carnivores (Holechek & Valdez, 2018). Local ethnic communities have a strong motivation to eliminate lions because they prey on both livestock and people. Roughly, a 50% decline has occurred in African lion populations since 1993 (Holechek & Valdez, 2018). This is because of increased retaliatory killing of lions than small carnivores such as leopards, as lions cause more livestock damages (Athreya et al., 2020). Similarly, Mekonen (2020) established that, anthropogenic mortality is often the biggest threat to

leopards outside of protected areas, and similar results have been reported for other large carnivores.

The greatest overall threat to wildlife is the loss of habitat. Draught is accelerating shrinkage in forest areas, continent-wide, 65% of biodiversity, including wildlife habitat has been lost since 1970 in Africa (World Wildlife Fund [WWF], 2023). In eastern Africa the growth of human settlements and cultivation is removing land from use by wildlife and is constraining access to migration routes and wet season dispersal areas around national parks (Meyer et al., 2021). Droughts, especially if frequent and intense, are always accompanied by reduced wildlife access to water and vegetation. All these affect the survival and reproduction of wildlife, and eventually its population status (Kapuka & Hlásny, 2021). Generally, in African savannah, wildlife populations grow in wet season and decline in dry season. Rainfall, in particular droughts, plays a major role in influencing large herbivore population dynamics in semiarid savanna ecosystems with high rainfall variability (Sankaran, 2019). A study in Zimbabwe found that populations of some large herbivore species declined following the 1992 drought in Gonarezhou National Park and subsequently increased after the drought.

Since the rise of human populations, wildland mammals have declined by 85%, as animal habitats have been cleared for the expansion of agriculture production, as the rise in agriculture activities is in many cases is at the expense of wild mammals (Ritchie & Roser, 2020). Although, farming has reduced direct pressure on the wildlife population, as

farming has reduced illegal hunting as people focus on raising livestock for meat and milk (Food and Agriculture Organisation [FAO], 2017a). Similarly, crop and livestock farming in GMC and MNC plays a role in terms of producing food and less reliance on wild meat. Negatively, agricultural land for cultivating means the loss of wildlife habitats. As the human population increases the need for land for settlement increases, resulting in humans encroaching into wildlife habitats.

5.1.2 Herbivore

Two important factors contribute to the alteration of the quantity and quality of wildlife and their habitats. The first is the impact of human activities and the second is the impact caused by seasonal modification, climate change and other unpredictable natural hazards (Kapuka & Hlásny, 2021). People in rural areas of Africa, hunts animals such as buffalos and antelopes for wild meat consumption (FAO, 2017b). Although, people consume wild meat, local community members can still develop negative attitudes towards the conservation of large mammal species that cause property and crop destructions, consequently leading to food insecurity.

Similar to the current study results, that indicated that elephant population sizes were stable between 2013 and 2017. A study by Bennitt et al. (2019) revealed that, in Okavango Delta (Botswana) populations of the African elephant and Cape buffalos remained stable than medium-bodied herbivores (e.g. deer) populations that declined by 73% and 90% respectively. Contrary, studies by Thouless et al. (2016), Mcnamara and Claasen (2015)

revealed that, in Namibia elephants, rhinos, lion, and several other wildlife species populations have been increasing since in the 1990s. The reasons behind the relative stability of southern Africa's elephant population, relative to other parts of Africa, are varied but hypothesized in some places to include the higher level of financial benefits that local communities and others are able to derive from the sustainable use of elephants (Meyer et al., 2021).

Extreme weather events can hinder the ability to protect threatened and endangered species and habitats. Climate change affects savannah, grassland and steppes in a way that reduces the productivity of vegetation and composition of grassland species. The end result is the collapse of wildlife species representing great losses to the ecosystem (Kapuka & Hlásny, 2021). Global warming has caused a gradual reduction in annual rainfall across Africa over the past 50 years. This reduction could reduce the distribution and availability of both food and surface water for animal species. Rainfall is the main climate factor governing herbivore population dynamics across Africa. African wildlife resources are therefore likely to be subjected to climate warming due to rising temperatures and extreme events such as droughts and floods (Kapuka & Hlásny, 2021). Thus, global warming has potential to directly affect wildlife resources through shifts in arrival and duration of rainy seasons and droughts on wildlife species, reduction in species distribution ranges, alteration in abundance, and diversity of mammals, changes in calving and population growth rates, and changes in juvenile survival of most ungulates.

The current study results show that carnivores were more stable than herbivores in both conservancies (GMC and MNC). Protected areas are maintaining the abundance of wildlife mammals within the boundaries (Henson et al., 2016). On average monitored populations within protected areas are stable, though, the recent poaching crisis in Africa shows that animal populations can be rapidly reduced. However, due to conservation efforts, communities are likely to be less resentful and more tolerant of wildlife and the damage they cause. This is mainly because local communities are highly involved in wildlife conservation planning and management, and/or the costs of living with wildlife are offset by benefits from conservation.

5.2. Distribution of large mammals in wildlife exclusive zone and multiple use areas

The study findings show that land cover types (vegetation, waterbodies, settlement areas and bare soil) did not significantly change from 2000 to 2017 for both conservancies (Figure 2a). When it comes to land use, In Muduva Nyangana there was 8% increase in the area size designated for multiple-use zone and in George Mukoya, there was a 3% increase in area size in both wildlife-exclusive zone and multiple-use zone. This is probably due to the expansion of human settlement and the need to clear land for agricultural purposes such as crop production and livestock grazing.

Most wildlife was found to be abundant in areas where vegetation land cover did not change, although carnivore animal group sizes remained similar in areas changed and

unchanged areas. On the other hand, herbivore animal group sizes were higher in changed areas than in unchanged areas. This could be attributed to herbivores being attracted to multiple-use zones to consume grass and crops under production. Moreover, herbivores are able to coexist with livestock in multiple-use areas that are less associated with poaching activities. However, larger herbivore group sizes were observed in the wildlife-exclusive zone than in the multiple-use zone. Nevertheless, on average study results show that there were no significant changes in wildlife populations between wildlife-exclusive and multiple-use zones. Fire intensity did not affect the distribution and abundance of wildlife, as carnivores and herbivore group sizes are generally observed to be larger in the wildlife-exclusive zone than in the multiple-use zone. This is because the wildlife-exclusive zone get a lot of inflow of wild animals from the neighbouring Khaudum National Park. However, the conservancy wildlife-exclusive zone use to experience the outflow of wild animals during the dry season when the vegetation becomes dry, and there are higher chances of the occurrence of wildfires.

Both carnivore and herbivore group sizes were far away from settlements. This is probably because the wildlife-exclusive zone excludes human activities such as harvesting of timber and non-timber forest products, crop and livestock farming. Hence, results from this study indicate that the roan antelope and pangolins were not evenly distributed. Roan antelope, pangolin and wild dogs are categorised as rare and endangered species (IUCN, 2021; WWF, 2023b). Wild dogs prefer dense vegetation and that explains why they are more abundant in the wildlife-exclusive zone. However, in George Mukoya, wild dog group sizes did not vary. Leopards were more abundant in the wildlife-exclusive zone in

both conservancies; this is attributed to their shy and solitary nature. The availability of prey also plays a role since most of the herbivore group sizes were mainly distributed in the wildlife-exclusive zone. However, data from event book recorded by game guards indicated that caracals were reported to be preying on domesticated birds like chicken hence their high abundance in the multiple-use zone.

The group sizes of carnivores were similar in changed and unchanged areas. The little change observed in multiple-use areas could be a result of land clearing to expand settlement, and agriculture purposes such as crop production and livestock grazing. However, this change did not have significant effects on large mammalian wildlife species. The increase in agriculture and settlements have become a severe threat to the ecological sustainability of wildlife habitat, resulting in habitat fragmentation and human encroachment of wildlife habitats, as well as extreme pressure and competition for resources (Ntukey et al., 2022). Habitat change can be a result of land cover changes that significantly affect the distribution of wildlife and ecological systems (Billah et al., 2021).

5.3. Perceptions of local people on the effect of different consumptive forest uses, wildlife management and socio-economic activities on large mammalian wildlife species

Wildlife mammals are most likely to be seen by crop farmers due to crop raiding by wild animals, thus all respondents who are only farming with crops have all seen or

encountered wildlife mammals near their household or crop fields. Similarly, Ntukey et al. (2022) exposed that, crop farmers are more likely to experience encounters with wildlife through crop raiding.

In both conservancies, respondents reported that their occupation does not have a significant effect on the forest and wildlife. This is because the conservancies are divided into zones, the wildlife-exclusive zone and the multiple-use zone designated for settlement, cultivation and livestock rearing. However, the majority of crop farmers (Table 4.3.1) indicated that they cleared land for farming purposes in the past 12 months, which has a negative effect on forests and wildlife, particularly when farming areas are expanded. Nonetheless, the negative impacts on forests and wildlife are further reduced by applying restrictions on forest uses. For instance, the use of forest resources such as poles and droppers for building kraals and courtyards is harvested in line with the community forest management plan. The Ministry and Environment, Forestry and Tourism than the local communities provides prescribed methods that guide the burning of fields in the conservancies.

However, wildlife mammals have a significate impact on the local communities. Community members have suffered due wild animals invading their crop fields and loss of animal from carnivores who prey on livestock. Similarly, a study by (Crouthers, 2021) states that local people are more likely to suffer from economic loss of crop damage and livestock due to the increasing number of wildlife in the community. According to a study

done by (Mekonen, 2020) baboons, red duiker, warthog, bush pig, wildebeest, Zebra and elephants are frequent crop raiders. Mekonen (2020) further stated that carnivores usually attack domestic livestock when faced with a declining number of herbivores in the wild due to prolonged droughts and habitat degradation.

The main observed pressure leading to the impact of humans on the forest ecosystem is in line with overexploitation of forest products, overstocking and overgrazing. This results in human-wildlife conflicts. This was due to the local communities' involvement in crop farming and livestock production as their main means of livelihood. A number of cases, where livestock and wildlife co-exist, research has concluded that there is little impact of livestock on wildlife (Pietikäinen, 2006). For instance, Gordon (2018) found that livestock could outcompete wildlife in shared niche or forage resources.

Some respondents also reported the lack of proper management activities as an important factor affecting biodiversity. Their opinions were consistent across all of the investigated sites. The reason for this could be the lack of awareness of conservation activities among the local population. Another reason could also be the former technical forest policy, in which people were always separated from the forests and were not considered to be a crucial part of forest management.

This study found that in both conservancies crop production farmers mostly use forests products such as trees and grass as building materials and timber for subsistence and commercial use. Study respondents further stated that timber harvesting has an impact on the survival of wildlife. Though, overharvesting of timber can result in deforestation another major cause of human wildlife conflict caused by cutting of trees, mainly during the expansion of farmland. Moreover, local community forest uses also includes, firewood collection, timber harvesting and livestock grazing and fire-set for the purpose of charcoal production. Overgrazing was also another major cause of human wildlife conflict (Mekonen, 2020). This occurred where crop production and livestock farming were the main livelihood activities. Lack of regulations and laws governing forest uses, can contribute to biodiversity loss, as local community overexploit forests through firewood collection, and selling of forest products such as grass to escape poverty (Jalilova & Vacik, 2012). Similarly, respondents during interviews in GMC and MNC also mentioned firewood collection (as their main source of energy for cooking and heating) as one of the factors that contribute to biodiversity loss in their areas. Moreover, uncontrolled livestock grazing can also contribute to the loss of biodiversity (Jalilova & Vacik, 2012).

The regeneration of forest species is mostly affected by grazing, especially during the wet season when the ground is waterlogged. Nonetheless, very few respondents in GMC and MNC viewed uncontrolled grazing as a factor affecting biodiversity loss; livestock grazing in forests is a common practice. The locals appear to have little knowledge of the effects uncontrolled grazing has on forest species or they could simply be ignorant (Jalilova & Vacik, 2012).

CHAPTER 6: CONCLUSION AND RECOMMENDATION

6.1. Conclusion

The establishment of community-managed forests in Namibia is a clear indication that the community of George Mukoya and Muduva Nyangana conservancies recognise the value of biodiversity/natural resources. The purpose of this study was to analyse the perceptions of community members on the effects of consumptive forest uses on large mammalian wildlife in George Mukoya and Muduva Nyangana conservancies. The study results indicates that there are fewer effect of forest use-on wildlife mammalian species. George Mukoya and Muduva Nyangana conservancies have ensured the protection, conservation and successful use of natural resources, particularly trees and grasses as building materials and timber for subsistence and commercial benefits. Despite recorded cases and reports of human-wildlife conflicts, the study found that humans are living in harmony with wildlife and the abundance and distribution of large mammal species did not vary between the two conservancies. The majority of wildlife mammals are located in wildlife-exclusive zones of GMC and MNC.

6.2. Recommendation

Even though results indicate that there are fewer effects of consumptive forest use on wildlife, and that communities are utilising the natural resources in a sustainable manner, an effective mitigation approach to threats and conflicts facing natural resources is needed.

In order to ensure that the success and sustainability of the two community conservancies, George Mukoya and Muduva Nyangana improve and continue, there is a need to improve and strengthen conservation awareness of the members of the two communities, surrounding communities and the entire country as a whole. There is a need to introduce renewable (solar) energy and intensive crop farming practices, so that less amount of land is cleared for cultivation and household (cooking and heating) purposes, and the need for farmland expansion becomes obsolete. New conservation laws and regulations are needed, so that local community members can be allowed to domesticate wild animals, an approach that can lead to an increase in the distribution of wildlife mammals in multiple-use zones of the two conservancies. Although, in order to achieve success in domesticating wildlife, proper resource animal inventory and monitoring system should be in place. Stakeholders and line ministries to provide the community with technical, financial support, provision of tools and equipment for wild animal husbandry, firefighting, uniforms, and vehicles for easy access. Encourage the community to adhere to conservation laws because it is not only about benefits but also for the future generation.

REFERENCES

Abukari, H., & Mwalyosi, B.R. (2020). Local communities' perceptions about the impact of protected areas on livelihoods and community development. *Global Ecology and Conservation, 22*, e00909. https://doi.org/10.1016/j.gecco.2020.e00909

Afriyie, J. O., Asare, M. O., & Hejcmanová, P. (2021). Exploring the knowledge and perceptions of local communities on illegal hunting: Long-term trends in a west African protected area. *Forests*, *12*(11), 1–18. https://doi.org/10.3390/f12111454

Arnold, M., & Townson, I. (1998). Assessing the potential of forest product activities to contribute to rural incomes in Africa. *Natural Resource Perspectives, 37*. https://www.researchgate.net/publication/42764889_Assessing_the_Potential_of_Forest_Product_Activities_to_Contribute_to_Rural_Incomes_in_Africa/link/0c96052a08f09a9933000000/download

Athreya, V., Isvaran, K., Odden, M., Linnell, J. D. C., Kshettry, A., Krishnaswamy, J., & Karanth, U. K. (2020). The impact of leopards (Panthera pardus) on livestock losses and human injuries in a human-use landscape in Maharashtra , India. *PeerJ*. https://doi.org/10.7717/peerj.8405

Baker, O. E., Zon, R., & Sparhawk, W. N. (2020). The world's forests. *Geographical Review, 14* (1). https://doi.org/10.2307/208372

Bennitt, E., Hubel, T. Y., Bartlam-Brooks, H. L. A., & Wilson, A. M. (2019). Possible causes of divergent population trends in sympatric African herbivores. *PLoS ONE*, *14*(3), 1–19. https://doi.org/10.1371/journal.pone.0213720

Billah, M. M., Rahman, M. M., Abedin, J., & Akter, H. (2021). Land cover change and its impact on human–elephant conflict: a case from Fashiakhali forest reserve in Bangladesh. *SN Applied Sciences*, *3*(6). https://doi.org/10.1007/s42452-021-04625-1

Bitanyi, S., Nesje, M., Kusiluka, L. J. M., Chenyambuga, S. W., & Kaltenborn, B. P. (2012). Awareness and perceptions of local people about wildlife hunting in western Serengeti communities. *Tropical Conservation Science*, *5*(2), 208–224. https://doi.org/10.1177/194008291200500209

Bore, N. C. (2014). *A struggle between livelihoods and forest conservation: A case of Mau forest in Kenya* [Master's thesis, University of Nairobi]. http://erepository.uonbi.ac.ke/bitstream/handle/11295/75933/Bore_A%20struggle%20between%20livelihoods%20and%20forest%20conservation%3A%20%20A%20case%20of%20Mau%20forest%20in%20Kenya%20.pdf?sequence=1&isAllowed=y

Boudreaux, K. (2010). *Community conservation in Namibia: Devolution as a tool for the legal empowerment of the poor*. http://the-eis.com/elibrary/sites/default/files/downloads/literature/Community%20Conservation%20in%20Namibia_Devolution%20as%20a%20tool%20for%20the%20legal%20empowerment%20of%20the%20poor.pdf

Bwalya Umar, B., & Kapembwa, J. (2020). Economic benefits, local participation, and conservation ethic in a game management area: Evidence from Mambwe, Zambia. *Tropical Conservation Science*, *13*, 16. https://doi.org/10.1177/1940082920971754

Chinsembu, W. W., & Chinsembu, K. C. (2020). "Poisoned chalice": Law on access to biological and genetic resources and associated traditional knowledge in Namibia. *Resources*, *9*(7), 1-34. https://doi.org/10.3390/RESOURCES9070083

Community Conservation Namibia (CCN). (2023, July 30). Benefits to Conservancies and Members. *CCN*. https://communityconservationnamibia.com/support-to-conservation/livelihoods/benefits-to-conservancies-and-membersCrouthers, R. (2021). *Human Wildlife Interactions and people' s perceptions towards wildlife, conservation and protected area management systems across communities living within or adjacent to Srepok and Phnom Prich Wildlife Sanctuaries*.

Dalu, M. T. B., Gunter, A. W., Makatu, M., Dowo, G. M., Dondofema, F., & Dalu, T. (2021). Contribution of natural forest products to rural livelihoods at mavunde and sambandou villages, vhembe biosphere reserve, South Africa. *Sustainability (Switzerland)*, *13*(8), 1–11. https://doi.org/10.3390/su13084252

DeStefano, S. (2002). Regional and national issues for forest wildlife research and management. *Forest Science*, *48*(2), 181–189.

Dlamini, C. S., & Geldenhuys, C. J. (2011). Towards a theoretical framework for the management of non-timber forest products (NTFPs) in Swaziland : A review. *Journal of Geography*, *4*(15), 715–730. https://doi.org/10.5897/JGRP11.097

Food and Agriculture Organisation (FAO). (2017). *Brief outlook on forestry, wildlife and protected*. https://www.fao.org/3/i7686e/i7686e.pdf

FAO. (2017). *The impact of disasters and crises on agriculture and food Security*.

Fluid Surveys. (2014). Calculating the Right Survey Sample Size. Retrieved June 17, 2014, from http://fluidsurveys.com/university/calculating-right-survey-sample-size/

Gibson, M.A. (2001). Immigration adaptation and patterns of acculturation. *Human Development, 44*, 19-23. https://www.researchgate.net/profile/Margaret-Gibson-3/publication/232545440_Immigrant_Adaptation_and_Patterns_of_Acculturation/links/57e4294f08ae06097a0bf645/Immigrant-Adaptation-and-Patterns-of-Acculturation.pdf

Gordon, I. J. (2018). Review: Livestock production increasingly influences wildlife across the globe. *Animal*, *12*(s2), S372–S382. https://doi.org/10.1017/S1751731118001349

Hasan, S. M., & Csányi, S. (2023). Attitude index of local communities toward wildlife and their management methods in Malaysia. *Diversity*, *15*(2). https://doi.org/10.3390/d15020202

Henson, D. W., Malpas, R. C., & D'Udine, F. A. C. (2016). *Wildlife law enforcement in Sub-Saharan African protected areas : a review of best practices*. https://doi.org/10.2305/iucn.ch.2015.ssc-op.58.en

Herbert, N., Muchapondwa, E., Jagers, S.C., Linell, A., & Sjöstedt, M. (2019). *Factors influencing people's perceptions towards conservation of transboundary wildlife resources: The case of the great Limpopo trans-frontier conservation area*. www.efdinitiative.orgorcontactinfo@efdinitiative.org.

Holechek, J., & Valdez, R. (2018). Wildlife conservation on the rangelands of eastern and southern Africa: Past, present, and future. *Rangeland Ecology and Management*, *71*(2), 245–258. https://doi.org/10.1016/j.rama.2017.10.005

International Union for Conservation of Nature. (2021). *2019 Report of the species survival commission and the global species and key biodiversity area programme*. https://portals.iucn.org/library/sites/library/files/documents/Species%20no.60.pdf

IUCN. (2020). The state of protected and conserved areas in Eastern and Southern Africa. In *The state of protected and conserved areas in Eastern and Southern Africa* (Issue 1). https://doi.org/10.2305/iucn.ch.2020.15.en

Jalilova, G., & Vacik, H. (2012). Local people's perceptions of forest biodiversity in the walnut fruit forests of Kyrgyzstan. *International Journal of Biodiversity Science, Ecosystem Services and Management*, *8*(3), 204–216. https://doi.org/10.1080/21513732.2012.696557

Kapuka, A., & Hlásny, T. (2021). Climate change impacts on ecosystems and adaptation options in nine countries in southern Africa: What do we know? *Ecosphere*, *12*(12), 20. https://doi.org/10.1002/ecs2.3860

Kariuki, P.N. (2013). *Local residents' attitudes and perceptions towards tourism development: A study of Lake Nakuru national park and its environs, Kenya* [Master's thesis, Moi University]. https://aquadocs.org/bitstream/handle/1834/6851/ktf0228.pdf?sequence=1&isAllowed=y

Langat, D. K., Maranga, E. K., Aboud, A. A., & Cheboiwo, J. K. (2016). Role of Forest Resources to Local Livelihoods: The Case of East Mau Forest Ecosystem, Kenya. *International Journal of Forestry Research*, *2016*, 10. https://doi.org/10.1155/2016/4537354

Lindenmayer, D. B. (1995). Forest disturbance, forest wildlife conservation and the conservative basis for forest management in the mountain ash forests of Victoria-Comment. *Forest Ecology and Management*, *74*(1–3), 223–231. https://doi.org/10.1016/0378-1127(94)03524-Z

Lister, D. G. (2018). *Wildlife Crime and Monitoring: Applications for ranger-collected data* [Masters thesis, University of York].

Mcnamara, T., & Claasen, C. (2015). *Trophy hunting in Namibia: Controversial but sustainable? A case study of "Hunters Namibia Safaris" business model renewal and environment changes: insights of Chinese textile industry View project* (Issue December). https://doi.org/10.13140/RG.2.1.1195.9769

Mendelsohn J.M., Jarvis, A.M., Roberts, C.S., & Robertson, T. (2002) Atlas of Namibia. Windhoek, Namibia: Research and Information Services of Namibia

Mekonen, S. (2020). Coexistence between human and wildlife: The nature, causes and mitigations of human wildlife conflict around Bale Mountains National Park, Southeast Ethiopia. *BMC Ecology*, *20*(1), 1–9. https://doi.org/10.1186/s12898-020-00319-1

Melorose, J., Perroy, R., & Careas, S. (2015). *Are animals and forests forever? Perceptions of wildlife at Cantanhez Forest National Park, Guinea-Bissau Republic*.https://www.researchgate.net/publication/314153253_Are_Animals_and_

Forests_Forever_Perceptions_of_Wildlife_at_Cantanhez_Forest_National_Park_Guinea-Bissau_Republic/link/5ea82e44299bf1dcb09ec5cb/download

Meyer, M., Klingelhoeffer, E., Naidoo, R., Wingate, V., & Börner, J. (2021). Tourism opportunities drive woodland and wildlife conservation outcomes of community-based conservation in Namibia ' s Zambezi region. *Ecological Economics*, *180*(October 2020), 106–863. https://doi.org/10.1016/j.ecolecon.2020.106863

Milliken, T., Emslie, R. H., & Talukdar, B. (2009). *African and Asian rhinoceroses-status, conservation and trade a report from the IUCN Species Survival Commission (IUCN/SSC) African and Asian Rhino Specialist Groups and TRAFFIC to the CITES Secretariat pursuant to Resolution Conf. 9.14 (Rev. CoP14) and Decision 14.89*. *230*(December 2007), 1–18. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=28f6d541595d92bb24b45f0a3b4e031a7b2b40b1

Mojo, D., Oduor, A. M. O., Fu, C., Bai, Y., Long, H., Wang, G., & Zhang, L. (2020). Effects of protected areas on welfare of local households: The case of Maasai Mara National Reserve in Kenya. *People and Nature*, *2*(3), 856–867. https://doi.org/10.1002/pan3.10123

Moneron, S. L. (2016). *Analysis of rhino poaching incidences and management strategies in South Africa* [Master's thesis, University of KwaZulu-Natal]. https://ukzn-dspace.ukzn.ac.za/bitstream/handle/10413/16331/Moneron_Sade_Leigh_2016.pdf?sequence=1&isAllowed=y

Mbaiwa , L. (2004). The Southern African Development Community (SADC) Protocol on Forestry - Can it stop the mounting threats to the region's forests? *Unasylva*.

Mubalama, L. K., Igunzi, F. A., & Buhendwa, G. M. (2020). Local community perceptions towards biodiversity conservation within protected areas : Implications for policy making and management in Itombwe Nature Reserve, Eastern DR Congo. *IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT), 14*(4), 26–48. https://doi.org/10.9790/2402-1404022648

Mureithi, S.M., Verdoodt, A., Njoka, J.T., Olesarioyo, J.S., & Van Ranst, E. (2019). Community-based conservation: an emerging land use at the livestock-wildlife interface in northern kenya. *IntechOpen*. http://dx.doi.org/10.5772/intechopen.73854

Mutanga, C. N., Vengesayi, S., Gandiwa, E., & Muboko, N. (2015). Community perceptions of wildlife conservation and tourism: A case study of communities adjacent to four protected areas in Zimbabwe. *Tropical Conservation Science*, *8*(2), 564–582. https://doi.org/10.1177/194008291500800218

Naidoo, R., Weaver, L. C., Longcamp, M. D., & Du Plessis, P. (2011). Namibia's community-based natural resource management programme: An unrecognized payments for ecosystem services scheme Source : *Environmental Conservation*, *38*(4).

Namibia Statistics Agency (NSA). (2012). *Namibia 2011 population and housing census main report*. https://cms.my.na/assets/documents/p19dmn58guram30ttun89rdrp1.pdf

Natanael, M. N. (2019). *Assessment of community dependency on forest resources and their roles in Sustainable Forest Management : A case of Kavango West region in Namibia* (Issue November).

Nature Conservation Amendment Act, No. 5 of 1996 (1996). https://www.npc.gov.na/wp-content/uploads/2022/06/Nature-Conservation-Amendment-Act-5-of-1996.pdf

Ntukey, L. T., Munishi, L. K., Kohi, E., & Treydte, A. C. (2022). Land Use/Cover Change Reduces Elephant Habitat Suitability in the Wami Mbiki–Saadani Wildlife Corridor, Tanzania. *Land*, *11*(2), 20. https://doi.org/10.3390/land11020307

Ogutu, O.J., Owen-Smith, N., Piepho, H.P., & Said, M.Y. (2011). Continuing wildlife population declines and range contraction in the Mara Region of Kenya during 1977-2009. *Journal of Zoology*. doi:10.1111/j.1469-7998.2011.00818.x

Onditi, K. O., Li, X., Song, W., & Li, Q. (2021). The management effectiveness of protected areas in Kenya. *Biodiversity and Conservation*, *30*(13), 3813–3836. https://doi.org/10.1007/s10531-021-02276-7

Pietikäinen, V. (2006). *Measures to prevent overstocking and overgrazing in woodlands* (Issue 840106).

Potgieter, G. (2019, May 29). *Community conservation in Namibia requires balance and understanding (commentary)*. Mongabay. https://news.mongabay.com/2019/05/community-conservation-in-namibia-requires-

balance-and-understanding-commentary/

Ritchie, H., & Roser, M. (2020). *Energy—Our world in data*. https://www.scirp.org/(S(czeh2tfqw2orz553k1w0r45))/reference/referencespapers.aspx?referenceid=2943205

Sankaran, M. (2019). Droughts and the ecological future of tropical savanna vegetation. *Journal of Ecology*, *107*(4), 1531–1549. https://doi.org/10.1111/1365-2745.13195

Schick, A., Sandig, C., Krause, A., Hobson, P. R., Porembski, S., & Ibisch, P. L. (2018). People-Centered and Ecosystem-Based Knowledge Co-Production to Promote Proactive Biodiversity Conservation and Sustainable Development in Namibia. *Environmental Management*, *62*(5), 858–876. https://doi.org/10.1007/s00267-018-1093-7

Tanzania Wildlife Research Institute. (2010). *Aerial census serengeti ecosystem*. https://serengetidata.weebly.com/uploads/1/1/8/5/118542972/serengetiecosystem_censusreport_2010.pdf

Sinclair I., Hockey P., & Tarboton W. (2002). *Birds of Southern Africa (3rd Edition fully revised and updated)*. South Africa: Struik Nature.

Shaanker, R., Ganeshaiah, K., Rao, M., & Aravind, N. (2004). Ecological Consequences of Forest Use: From Genes to Ecosystem - A Case Study in the Biligiri Rangaswamy Temple Wildlife Sanctuary, South India. *Conservation and Society*.

Smith, S. (2013). Determining Sample Size: How to Ensure You Get the Correct Sample Size. Retrieved from https://www.qualtrics.com/blog/determining-sample-size/

Stoldt, M., Göttert, T., Mann, C., & Zeller, U. (2020). *Transfrontier Conservation Areas and Human-Wildlife Conflict : The Case of the Namibian Component of the*

Kavango-Zambezi (KAZA) TFCA. https://doi.org/10.1038/s41598-020-64537-9

Stoner, C., Caro, T., Mduma, S., Mlingwa, C., Sabuni, G., Borner, M., & Schelten, C. (2007). Changes in large herbivore populations across large areas of Tanzania. *African Journal of Ecology*, *45*(2), 202–215. https://doi.org/10.1111/j.1365-2028.2006.00705.x

Stuart, C. and Stuart T. (2007). Field guide to mammals of Southern Africa (4th edition). South Africa: Struik Nature.

Suich, H. (2010). The livelihood impacts of the Namibian community based natural resource management programme: A meta-synthesis. *Environmental Conservation*, *37*(1), 45–53. https://doi.org/10.1017/S0376892910000202

Symes, W. S., Edwards, D. P., Miettinen, J., Rheindt, F. E., & Carrasco, L. R. (2015). underestimated. *Nature Communications*, *9*(2018). https://doi.org/10.1038/s41467-018-06579-2

Tadesse, S. A., & Teketay, D. (2017). Perceptions and attitudes of local people towards participatory forest management in Tarmaber District of North Shewa Administrative Zone, Ethiopia: the case of Wof-Washa Forests. *Ecological Processes*, *6*(1), 16. https://doi.org/10.1186/s13717-017-0084-6

The Ministry of Environment, Forestry and Tourism (MEFT). (2021). *The state of community conservation in Namibia: annual report 2019*. https://conservationnamibia.com/other/meft-nacso-state-of-community-conservation-2019.pdf

The Ministry of Environment and Tourism (MET). (2020). *The state of community conservation in Namibia: 20 year anniversary edition – 2018 annual report*.

https://www.nacso.org.na/sites/default/files/State%20of%20Community%20Conservation%20book%202018%20web.pdf

The Ministry of Environment and Tourism (MET). (2018). *Revised national policy on human wildlife conclict managenet: 2018 to 2027*. https://www.meft.gov.na/files/files/HWC%20revise%20Policy.pdf

The Ministry of Environment and Tourism (MET). (2018). *The state of community conservation in Namibia: annual report 2017*. http://the-eis.com/elibrary/sites/default/files/downloads/literature/The%20state%20of%20community%20conservation%20Annual%20Report%20for%202017.pdf

The Permanent Okavango River Basin Water Commission (OKACOM) (2008). *Okavango river basic community engagement on joint venture models for the Sikerete tourism concession*. https://www.okacom.org/sites/default/files/publications/Sikerete%20Tourism%20Campsite%20FINAL%20ENG.pdf

Thouless, C. R., Dublin, H. T., Blanc, J. J., Skinner, D. P., Daniel, T. E., Taylor, R. D., Maisels, F., & Frederick, H. L., & Bouché, P. (2016). *African elephant status report: An update from the African elephant database*, 60. https://portals.iucn.org/library/sites/library/files/documents/SSC-OP-060_A.pdf

Tudge, S. J., Brittain, S., Kentatchime, F., Kamogne Tagne, C. T., & Rowcliffe, J. M. (2022). The impacts of human activity on mammals in a community forest near the Dja Biosphere Reserve in Cameroon. *Oryx*, *56*(6), 947–955. https://doi.org/10.1017/S0030605321000806

United States Geological Survey (USGS). (2014, July 30). Landsat missions: Landsat 5. *USGS Earth Explorer*. Available at: https://www.usgs.gov/core-science-systems/nli/landsat/landsat-5?qtscience_support_page_related_con=0#qt-science_support_page_related_con

Watts, S. (2003). The effects of communal land resource management on forest conservation in northern and north-eastern Namibia. *Development Southern Africa*. https://doi.org/10.1080/0376835032000108167

Weaver, L., & Skyer, P. (2003). Conservancies: Integrating wildlife land-use options into the livelihood, development, and conservation strategies of Namibian communities. *Options*, 1–40.

Wegmann, M., Santini, L., Leutner, B., Safi, K., Rocchini, D., Bevanda, M., Latifi, H., Dech, S., & Rondinini, C. (2014). Role of African protected areas in maintaining connectivity for large mammals. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *369*(1643). https://doi.org/10.1098/rstb.2013.0193

Western, D., Russell, S., & Cuthil, I. (2009). The status of wildlife in protected areas compared to non-protected areas of Kenya. *PLoS ONE*, *4*(7), 1-6. https://doi.org/10.1371/journal.pone.0006140

World Bank Africa Region. (2017, Feb 24). Forests in Sub-Saharan Africa: challenges & opportunities. *Profor*. https://www.profor.info/knowledge/forests-sub-saharan-africa-challenges-opportunities

World Wildlife Fund (WWF). (2023, July 31). A warning sign: where biodiversity loss is happening around the world. *WWF*. https://www.worldwildlife.org/magazine/issues/summer-2021/articles/a-warning-sign-where-biodiversity-loss-is-happening-around-the-world

WWF. (2023, July 31). WWF's work to protect wild dogs in Namibia. *WWF* https://www.worldwildlife.org/pages/wwf-s-work-to-protect-wild-dogs-in-namibia

APPENDICES

Appendix 1: UNAM ethical clearance certificate

UNAM
UNIVERSITY OF NAMIBIA

ETHICAL CLEARANCE CERTIFICATE

Ethical Clearance Reference Number: KMC0006 **Date: 15/02/2023**

This Ethical Clearance Certificate is issued by the University of Namibia Ethics Committee (REC) in accordance with the University of Namibia's Research Ethics Policy and Guidelines. Ethical approval is given in respect of undertakings contained in the Research Project outlined below. This Certificate is issued on the recommendations of the ethical evaluation done by the ethics committee.

Title of Project: THE EFFECTS OF CONSUMPTIVE FOREST USES ON LARGE MAMMALIAN WILDLIFE SPECIES ABUNDANCE IN GEORGE MUKOYA AND MUDUVA NYANGANA COMMUNITY FORESTS, KAVANGO EAST REGION, NAMIBIA

Principal researchers: Miriam Mambo Liyeke

Staff Number/ Student number: 200909584

Remarks: This ethical clearance is granted with no preconditions.

Centre for Research Services

Take note of the following:

1. Any significant changes in the conditions or undertakings outlined in the approved Proposal must be communicated to the ethics committee. An application to make amendments may be necessary.
2. Any breaches of ethical undertakings or practices that have an impact on ethical conduct of the research must be reported to the ethics committee
3. The Principal Researcher must report issues of ethical compliance to the ethics committee (through the Chairperson) at the end of the Project or as may be requested by the ethics committee
4. The ethics committee retains the right to:

i) Withdraw or amend this Ethical Clearance if any unethical practices (as outlined in the Research Ethics Policy) have been detected or suspected,

ii) Request for an ethical compliance report at any point during the course of the research.

The ethics committee wishes you the best in your research.

Dr David Nkengbeza

(Chairperson Decentralized Ethics Committee)

Prof. Davis Mumbengegwi (Head, Multidisciplinary Research)

Appendix 2: NCRST research permission letter

NCRST
NATIONAL COMMISSION ON RESEARCH SCIENCE & TECHNOLOGY

AUTHORIZATION OF RESEARCH PROJECTS

Authorization is hereby granted in terms of Section 21 of the RST Act No. 23 of 2004, to:

Name: Miriam Mambo Liyeke

Address: P.O. Box 285, Rundu,
Namibia

Coworkers: N/A

Certificate Number (if applicable): RCIV00022018 **Authorization No:** 202201010

Type of Research:
Non- Commercial research and the use of resources be limited to what is in the proposal.

Title of Research Authorized:
The effets of consumptive forest uses on large mammalian wildlife species abundance in George Mukoya and Muduva Nyangana Conservancy/Community Forests, Kavango East Region, Namibia.

Locality:
George Mukoya and Muduva Nyangana conservancies, in Ndiyona constituency, Kavango East Region, Namibia

Duration: 19 October 2022 - 31 October 2023

Research / Sample Collection Conditions:
Refer to research conditions on the next page.

Yours sincerely,

National Commission on Research Science & Technology
17 OCT 2022
P/Bag 13253
Windhoek, Namibia

Ms. Albertina Nguvare
Acting Chief Executive Officer

Head Office:
A Cnr Louis Raymond & Grant Webster Street Olympia Windhoek
P Private Bag 13253, Windhoek
T +264 61 431 7000
F +264 61 216 531
W www.ncrst.na
E info@ncrst.na
Ncrst @NCRST_Namibia @ncrst.na

Innovation Hub:
A Cnr Louis Raymond & Grant Webster Street Olympia Windhoek
T +264 61 431 7070
F +264 61 215 758

RESEARCH/SAMPLE COLLECTION CONDITIONS

1. You must report to the Park Chief warden and / or Regional Office of the Ministry of Environment and Tourism prior to arrival in fieldwork area, and must present your permit.
2. This permit does NOT entitle the holder to free entry to the protected areas or state land outside protected areas.
3. For Field work in National Parks you have to make arrangement with park management in advance prior to arrival in fieldwork area.
4. Voucher specimens should be deposited with National Museum of Namibia.
5. If you would like to export samples of specimens you must loan them from the National Museum of Namibia.
6. To conduct research work in the rhinos and elephants range all persons listed on the permit must be in possession of a police clearance certificate.
7. The permission of the land owner is required to work/collect on private lands.
8. The permission of the concession holder is required to work/collect in concession areas.
9. The permission of the communal authority is required to work/collect in communal areas.
10. No commercial filming will be permitted without prior approval by the Ministry of Environment and Tourism under this permit.
11. Duplicates of publications and / or final report should be made available to the Ministry of Environment and Tourism and also the final report.
12. The specimens and their derivatives may be used for the purposes of this study only and may not be patented, commercialised, donated or sold to a third party without the written consent of the Ministry of Environment and Tourism.
13. All results (raw materials) or technology derived directly or indirectly from this research must be made available free of charge without reservations to the Ministry of Environment and Tourism.
14. A report on the work conducted under this permit must be submitted to the Ministry of Environment and Tourism not later than one month after the expiry of this permit as well as to regional office in whose area research was conducted.
15. Applications for renewal of this permit must reach this office at least three months prior to the expiry of this permit.
16. Habitat destructive collecting methods must not to be used.
17. Veterinary restriction may apply in the case of movement of samples and it is the applicants' responsibility to obtain such permits.
18. Foreign (or destination) wildlife import, and veterinary import permits may be required.
19. CITES import permit from the country of the destination is required for the application of export permit for CITES –listed species.
20. All field teams must be in possession of the permit and permit copy must accompany the transport of specimens.
21. You are subject to all conditions listed on the entry permit to any of the protected areas, unless specifically exempted.
22. Failure to adhere to the conditions will lead to cancellation of the research permit.
23. It is your responsibility to make the necessary contacts and arrangements as specified above.

Appendix 3: Interview question guide

Data collection: Household interview question guide

The information you will provided will be treated confidentially and it will be used purely for academic research purposes only. Please indicate the correct answer with a tick (√) symbol.

Section A

Date of Interview…….. Questionnaire Number…….

1. Respondent's information

a. Gender: Male Female

b. Age: <18 18-35 >35

c. Name of your village: ……

d. How many members live in your household?.....

e. Education: No formal education Primary secondary Tertiary

f. Distance from the community forest: 0-5 km 6-10 km >10 km

2. Socio-economic characteristic

1. Occupation

i. Farmer (specify)……..

ii. Business (type)……..

iii. Employed: Yes No

iv. Others (specify)……

2. (a) Do you think your occupation has an impact on the forest and wildlife?

Yes No

(b) Please explain your answer in 2(a)

_____
_

_____
_____
_____
_____

3. Do you own land in which your household lives? Yes No

4. Is your land within the boundaries of the community forest or close to the forest boundaries? Yes No

5. (a) Has your household cleared land or cut trees in the past 12 months?

Yes No

(b) If the answer to 5 (a) is Yes, did the clearance lead to land deterioration? Yes No

6. (a) Are there any wild animals present or near your household? Yes No

(b) If the answer to 6(a) is No, what could be the reason(s)?

_____
_

_____
_

3. Forest user's knowledge, perception and attitudes

1. List the importance of a community forest?

_____
_

_____
_

2. (a) Are you aware of instances where people have encroached into the wildlife zone of the community forest?

Yes No

(b) If the answer for 2(a) is yes, what do you think could be reason?

i. Boundaries not known

ii. Poor soil fertility outside the community forest

iii. Land scarcity

iv. Others, Please specify

_____
_____
_____
_____
_____

3. What happens to the persons who are found by authorities to have encroached into wildlife zone?

i. Arrested

ii. Nothing

iii. Others specify

_____
_____
_____

4. In your opinion, who owns the MNCF and GMCF?

i. The Government

ii. The traditional authority

iii. Others. Please specify

_____

5. (a) Have you witnessed instances where the ownership of the forest land is being disputed?

Yes No

(b) If the answer to 5(a) is yes, please identify the parties involved in the dispute of the forest land.

_____
_

_____
_

6. (a) Is the existence of wildlife important to you and your community? Yes No

(b) if the answer to 6 (a) is yes, please explain why?

_____
_

_____
_

_____
_

7. What would you say is the contribution of wildlife to forests?

_____
_

_____
_

8. What do you think should be done to improve the conservation and management of wildlife in community forests?

_____
_

_____
_

4. Forest resource utilization and challenges

1 (a) what are the benefits that you derive from the forest?

i. Timber

ii. Bush meat

iii. Building materials

iv. Firewood

v. Grazing

vi. Herbal plants

vii. Charcoal burning

viii. Water

ix. Others, Please specify

_____

(b) How often do you harvest these forest products?

_____
_

_____
_

(c) Are the benefits for household use only? Yes No

Please explain your answer.

_____
_____
_____
_____

(d) Do you think these benefits have an impact on the survival of wildlife? Yes No

Please explain the answer you have selected

_____
_

_____
_

2. (a) List five plants that are mostly used in your village?

_____
_____
_____
_____

(b) In your opinion, has the abundance of the five plants listed in 2(a) changed over time?

Yes No

(c) Is there any plant which was common in the area but is now absent or rarely seen?

Yes No

_____

_____
_

The end

Thank you for your time

NB: for each and every community forest, there is staffs from the Ministry of Environment and Tourism (MET) and Ministry of Agriculture, Water and Forestry (MAWF) assigned to monitor the activities and facilitate meetings.

Appendix 4: Field pictures


NO ENTRY
EXCLUSIVE
HUNTING AREA