ANTHROPOGENIC INFLUENCES ON THE ECOLOGICAL INTEGRITY OF THE WILDLIFE HABITAT ALONG KISERIAN-KITENGELA-ISINYA WILDLIFE MIGRATORY CORRIDOR IN KAJIADO COUNTY, KENYA

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A Thesis Submitted in Partial Fulfilment of the Requirements for the Award of the Degree of Master of Science in Environment and Natural Resource Management in the Department of Environment and Natural Resources Management, School of Science and Technology of Africa Nazarene University

June 2022

DECLARATION

I declare that this document and the research it describes are my original work and that they have not been presented in any other university for academic work.

………………………… ……………………………..

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15S03EMEV001

This research was conducted under our supervision and is submitted with our approval as university supervisors.

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DEDICATION

I dedicate this thesis to my father Stephen N. Gichuru and my mother Rhodes K. Gichuru for their financial and emotional support during the course of my studies, May God richly bless them.

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I thank God for providing me with His grace and strength, which enabled me to accomplish this work. I appreciate my two supervisors Dr. M. N. Mutinda and Dr. M.O. Esilaba for their valuable guidance, motivation, advise and the time they took to guide me through the research and writing of this thesis, may God richly bless them. An honourable mention goes to my family, especially my Dad and Mum, for their understanding, emotional and financial support which enabled me complete this work, and without their help this would have been impossible.

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ABSTRACT

Human encroachment into protected areas normally has negative impacts to the natural resources and also the wildlife habitats in the area. The Kiserian-Kitengela-Isinya wildlife corridor was formed to allow for free movement of wildlife from the Nairobi National Park (NNP) to the Athi-Kapiti plains and the areas around Kitengela and north of Kajiado County. The corridor was once able to sustain and ensure unhindered movement of the animals while providing cover. Currently human encroachment and activities have affected the ecological integrity of this corridor and in turn the welfare of the wildlife, this study therefore aimed at quantifying the anthropogenic activities and their impact on the ecological integrity of the wildlife habitat. The objectives of this research were to; (i) assess the ecological integrity of the wildlife habitat, (ii) quantify ecological integrity of the wildlife habitat using ecological techniques, (iii) determine the extent of the anthropogenic influences within the wildlife corridor, and (iv) determine the influence of the anthropogenic activities on the ecological integrity of the wildlife corridor. A mixed method research design involving socio-ecological and ecological techniques was used. A stratified random sample of 381 household heads was selected proportionally from the three strata (Kiserian, Kitengela and Isinya). A structured questionnaire, Focus Group Discussion guide were used to collect socio-ecological data from the participants. Ecological data protocols were used to collect data on the ecological attributes. The household survey data was analysed using descriptive and inferential statistics in SPSS version 26 software at 95 % level of significance. Ground cover, Shannon and Wiener diversity index and plant attributes were used to analyse ecological data. The level of ecological integrity of the wildlife habitat was found to be low (M=3.0, SD=.45) on a scale of 0 to 10. The impact of anthropogenic activities was found to be high (M=7.74, SD=.65) and statistically significantly influenced (β=-.263, t=-5.30, p<.001) the ecological integrity of the wildlife habitat negatively. The findings imply that the corridor as a wildlife habitat is not useful and cannot be used for the purpose of wildlife management.

DEFINITION OF TERMS

Adaptation: responses that reduce the vulnerability of people and ecosystems to climatic changes. Adjustments in response to actual or expected climate change or its effects ('anticipatory' or 'proactive' adaptation is adaptation that takes place before the impacts of climate change are observed).

Biodiversity: the variability (and relative abundance) of life, and encompasses diversity at all scales and levels of organization from genetic through populations, species, ecosystems (communities) and landscapes in a particular area. Biodiversity includes diversity within species, between species, and between ecosystems.

Connectivity: the degree to which a landscape either facilitates or impedes the movement of species among resource patches.

Corridors: linear landscape features that serve as linkages between historically connected areas of natural habitat, and which facilitate movements (connectivity) between important habitats.

Dispersal: the spread in the distribution of animal populations; refers to the tendency, among large mammals, to range widely in the wet season, and to concentrate in narrower core areas during the dry season.

Drivers: natural or human-induced factors that change ecosystems. There are indirect and direct drivers. Indirect drivers affect ecosystems by influencing the direct drivers. Habitat change and over-exploitation, for instance, are direct drivers. These influence ecosystem processes explicitly. Examples of important indirect drivers are changes in human population, economic activity, and technology, as well as socio-political and cultural factors. Important direct drivers include habitat change, climate change, invasive species, over-exploitation, and pollution.

Ecosystem: a natural unit of living things (animals, plants, and micro-organisms) and their physical environment, or a dynamic complex of plant, animal, and microorganism communities and their non-living environment, interacting as a functional unit. An ecosystem is a collection of plants, animals, and micro-organisms interacting with one another and with their surroundings.

Habitat: the particular environment or place where an organism or species tends to live; a more locally circumscribed portion of the total environment, or any place or type of place where an organism or community of organisms can normally live and thrive.

Land degradation: the decline or loss of a landscape's biological or economic productivity; drylands are especially fragile, and prone to degradation, resulting in desertification.

Land use: the social and economic activities and arrangements for which a landscape is used and managed.

Resilience: the amount of change a system can withstand without changing its state.

Species: one of the basic units of biological classification; the lowest taxonomic rank. A species is defined as a group of organisms which are capable of mating or interbreeding and producing fertile offspring.

Species diversity: measures of diversity within an ecological community that incorporates species richness (number of species in a community) and evenness of species' abundance. Species includes all fauna and flora above the ground and in the soil. (Liniger & Mekdaschi Studer, 2019).

Species richness: the number of species within a given sample, community, or area.

LIST OF ABBREVIATIONS AND ACRONYMS

EPZ:	Export Processing Zone
FAO:	Food and Agricultural Organization of the United Nations
FGD:	Focus Group Discussion
KWS:	Kenya Wildlife Service
SID:	Society for International Development
NNP:	Nairobi National Park

CHAPTER ONE

INTRODUCTION

1.1 Introduction

A mixed method research design was used for this study. The research aimed at quantifying the ecological and sociological factors that have affected the Kiserian-Kitengela-Isinya wildlife corridor that was created to allow movement of wildlife from the Nairobi National Park (NNP) to the Athi-Kapiti plains and the area north of Kajiado County, while providing the animals with nourishment and cover. The research design involved a mixed method research design that involved the collection of social and ecological data within the corridor.

1.2 Background to the Study

Encroachment is a term used to describe the advancement of structures, roads, railroads, improved paths, utilities, and other development, into natural areas including floodplains, rivers, wetlands, lakes and ponds, and the buffer around these areas. The term encroachment also encompasses the placement of fill, the removal of vegetation, or alteration of topography into such natural areas. These encroachments can cause impacts to the functions and values of the affected natural ecosystems, such as a decline in water quality, loss of habitat (both aquatic and terrestrial), disruption of equilibrium (or naturally stable) conditions, loss of flood attenuation, or reduction of ecological processes (Okello et al., 2011).

A habitat is an ecological or environmental area that is inhabited by a particular species or animal, plant, or other types of organisms. It refers to the zone in which the organism lives and where it can find food, shelter, protection and mate for reproduction. It is the natural environment in which an organism lives, or the physical environment that surrounds a species population. It is made up of physical factors such soil, moisture, range of temperature, and light intensity as well as biotic factors such as the availability of food and the presence or absence of predators (Western et al., 2009).

Wildlife migratory corridor, also known as a habitat corridor (or habitat connectivity), is an area of habitat connecting wildlife populations separated by human activities and structures, that is, roads, development, and urbanization. It can also be described as a set route that migratory animals adhere to when they migrate from one area to another or a habitat pathway an animal uses to relocate from one place to another. Hence, allowing the exchange of individuals between populations, that may help prevent the negative effects of inbreeding and reduced genetic diversity through genetic drift (Gichohi, 2000)

According to Gichohi (2003), Nairobi National Park has been part of a much larger system comprising the Kitengela, the Athi and Kapiti Plain to its south. The system, much smaller than it was at the turn of the century, it is thought to have once contained the second largest migrating population after the Mara-Serengeti. The Athi-Kapiti Plains comprise approximately 2,200 km^2 of open rolling land. Nairobi National Park the only protected part of the system is a mere 114 km^2. The park serves as a dry season concentration area for the significant wildlife migrants that make up over 50% of the total biomass of the park. The Park is fenced on three sides, and only the southern boundary marked by the river Mbagathi is open and allows the continuing movement of wildlife to the wet season feeding areas in the south. The Kitengela to the south measures 390 km^2 and is used seasonally but also has a resident population of many of the herbivores represented in the park.

During the pre-revolutionary era, the colonists arrived in the area where the park is located in the late 19th century. At this time, the Athi plains east and south of what is today Nairobi had plentiful of wildlife. Nomadic Maasai lived and herded their cattle among the wildlife. The Kikuyu people farmed the forested highlands above Nairobi. As Nairobi grew, it had 14,000 residents by 1910, conflicts between humans and animals increased. During this era, residents of the city carried guns at night to protect against lions. People complained that giraffes and zebras walked on and ruined their flower beds. Animals were gradually confined to the expansive plains to the west and south of Nairobi, and the colonial government set this area aside as a game reserve.

The conservationist Mervyn Cowie born in Nairobi returned to Kenya after a nine-year absence in 1932, he was alarmed to see that some game animals on the Athi plains had dwindled. Expanding farms and livestock had taken the game's place. He later recalled this place as a paradise that was quickly disappearing. Hunting was not permitted in reserve, but nearly every other activity, including cattle grazing, dumping, and even bombing by the Royal Air Force was allowed. Cowie started a campaign for the establishment of a national park system in Kenya. The government formed a committee to examine the matter.

Nairobi National Park was officially opened in 1946 and the first national park established in Kenya. Maasai pastoralists were removed from their lands when the park was created. Mervyn Cowie was named the first director of the Nairobi National Park when it was first created and held this position until 1966.

The Athi-Kapiti Plains have been the traditional home to the Kaputiei Maasai pastoralists, whose main livelihood is livestock production, keeping cattle, sheep, and goat in the vast plains. When Nairobi National Park was established in 1946, the Kitengela plains were declared but never formally gazetted as a wildlife conservation area.

In the mid-sixties, land privation began for areas previously held as communal lands. The change in land policy from communal to group ranches was seen as a compromise between the government's preference for individual tenure and the production requirements of the semi-arid zones. These two forms of tenure which provided for large land holdings allowed for the great mobility needed by wildlife and livestock in the East African savannahs as well as their coexistence. However, the system failed to operate as expected and the Maasai owners began to push for sub-division. As a result, the Kitengela group ranch measuring 18,292 ha (45,200 acres) with 214 registered members was subdivided in 1988 to individual landholdings (Kristjanson et al., 2002).

The process of land privatization and sub-division followed in the entire Kajiado County as the Maasai landowners passed on plots to several inheritors, and increased land sales mostly to non- Maasai community interested in agriculture. The land sales, alongside rapid increase in human population, has resulted in land uses such as expansion of urban centers, such as, Kitengela and Athi River and industries such as, the Export Processing Zones: EPZs, large scale irrigated horticultural schemes, quarrying and expansion of permanent settlements with fencing, which have restricted the movement and seasonal dispersal of wildlife between Nairobi National Park and the Athi-Kapiti Plains. Consequences of these changes in land use patterns include; declining ecological, economic and social integrity of rangelands due to landscape fragmentation of landscape, declining rangeland productivity, diminishing migratory wildlife corridor, wildlife population diversity and cultural and economic diversification due to immigration (Gichohi et al., 1996).

Since the 1980s, vital wildlife areas of the Athi-Kapiti Plains have progressively been partitioned and fenced off, reducing their access to wildlife. Gichohi (1996) reported that the area experienced a substantial decline of wild herbivore populations, by approximately 50% over the few years mainly attributed to increasing human and livestock populations, changing land use, declining access to essential resources and poaching. The reduction in wild herbivore numbers coupled with changes in distribution and land use patterns have significant ecological impacts on the Nairobi National Park and the entire ecosystem as is currently being demonstrated.

The wildlife occupy the private land of the Maasai pastoralists creating human-wildlife conflict through competition for water and pasture with livestock, transmission of infectious diseases to livestock, and livestock predation by the large carnivores. The Nairobi National Park is amongst the most visited parks in Kenya accounting for 23% of parks visitors and thus generating very high revenues from wildlife tourism (World Resources Institute, 2007). The absence of a revenue-sharing mechanism with the land owners in Athi-Kapiti Plains which is critical as a dispersal zone for wildlife that attracts tourists to the park means that landowners have very little or no incentives for having wildlife on their private lands. Consequently, the lack of direct monetary benefits from the wildlife coupled with the increase in human-wildlife conflicts in Athi-Kapiti Plains over the years made the Maasai household intolerant to and excluded wildlife on their land through fencing and direct killing of predators. Without any intervention to address the challenges of land use change with negative implications on the wildlife migratory corridor and dispersal area, the future of Nairobi National Park and the viability of wildlife in the Athi-Kapiti Ecosystem are in jeopardy (KWS, 1992).

In April 2000, the Maasai community with the help of Kenya Wildlife Service and Friends of Nairobi National Park [FONNAP] established a program that generates conservation benefits through co-existence with wild life (Matiko, 2014). The Wildlife Lease Conservation (WCL) Program was initiated to ensure that wildlife could move freely between the Nairobi National Park and Kitengela-Athi-Kaputiei Plains(AKP). This Payment for Ecosystem Services (PES) program was managed by The Wildlife Foundation (TWF), a locally incorporated Non-Governmental Organization (NGO). In 2008, the TWF was awarded a grant by the Global Environment Facility (GEF) through the World Bank in the category of a Medium-sized Project (MSP) to pilot the expansion of the WCL as a demonstration project for effective conservation of wildlife on private lands outside protected areas.

The program provided monetary compensation to land owners in the Kitengela area who had agreed to keep their fallow land unfenced; un cultivated, with no building on it, or not sell the designated land; and were to actively manage their land for wildlife protection and sustainable livestock grazing. For all this the pastoralists (land owners) were to be compensated by being paid Ksh. 725 (about US$ 10.36) per hectare per year, the program payments to participating households averaged Ksh 28,000 (US$ 400) to Ksh 56,000 (US$ 800) annually (Gichohi 2003).

The lease programme grew and by July, 2003, a total of 115 members and 3,500 hectares were incorporated into the programme, providing an access or corridor, a habitat connecting the Nairobi National Park and the Kitengela-Athi-Kaputei wildlife dispersal area. This ecosystem termed in this study as the Kiserian-Kitengela-Isinya wildlife corridor is basis of the ecological evaluation to ascertain its integrity as a wildlife habitat and an access habitat to the plains in Kaputei and Kiserian.

1.3 Statement of the Problem

The increase in human population and subdivisions of large parcels of land (group and commercial ranches) to pave way for development and human settlement has affected the migration of wildlife from the Nairobi National Park to the Athi-Kapiti plains during the wet season. This led to the formation of the Kiserian-Kitengela-Isinya wildlife migratory corridor to provide connectivity and an access route for wildlife dispersal from the Nairobi National park during the rains to the Athi-Kapiti plains and the Kiserian-Kitengela-Isinya areas back again to the park during the dry season.

Currently, this corridor has been encroached by human activities, which include: human settlements, grazing animals, crop farming, fencing and quarrying. These activities have affected the ecological integrity of the area making the area not to be suitable as a wildlife habitat and path for migrating wild animals. The interaction between the wild animals and humans in the corridor often lead to conflicts. Studies related to this corridor are old and don't provide the current condition of the area and their effects on the integrity of the ecological resources. This study, therefore, aimed at quantifying the human influences on the ecological integrity of the wildlife habitat along the corridor and to suggest ways and means of solving the issue.

1.4 Purpose of the Study

The purpose of the study was to assess the anthropogenic influences affecting the ecological integrity of the wildlife habitat along the Kiserian-Kitengela-Isinya wildlife corridor in Kajiado County, Kenya.

1.5 Objectives of the Study

The objectives of this study were:

(i) To assess the current ecological integrity of the wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor in Kajiado Kenya using socioecological techniques.

(ii) To quantify the level of ecological integrity of the wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor using ecological techniques

(iii) To quantify the anthropogenic activities influencing the ecological integrity of the wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor in Kajiado County.

(iv) To assess the influence of anthropogenic activities on the ecological integrity of the wildlife habitat along the Kiserian-Kitengela-Isinya wildlife corridor in Kajiado County.

1.6 Research Questions

The research question for the proposed study were:

(i) What is the ecological integrity of the wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor in Kajiado County using socio-ecological techniques?

(ii) What is the current level of the ecological integrity of wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor using ecological techniques?

(iii) What are the levels of anthropogenic activities performed within the wildlife habitat along the Kiserian-Kitengela-Isinya wildlife corridor in Kajiado County?

(iv) How do the anthropogenic activities influence the ecological integrity of the wildlife habitat along Kiserian-Kitengela-Isinya wildlife corridor in Kajiado County?

1.7 Significance of the Study

In Kenyan National parks, wildlife numbers have drastically declined due to park land encroachment and land use changes patterns over the past three decades (Nyamasyo et al., 2014). The changes in land use have affected wildlife habitats around the national park by converting them into farmlands and human settlements. The Kiserian-Isinya corridor used by wildlife to migrate during the wet season and back to the park during the dry period, since, the park has more water resources, is in a critical condition. The corridor is being destroyed through an increase in agricultural land, human settlement along the corridor due to increased population, unplanned land use strategies, unmanaged resource extraction, increased bush meat trade and construction of infrastructure. All this can be summed up in one word, human encroachment. When this occurs, species find themselves in areas too small to support them, making it difficult for the wildlife to find food and mate.

If appropriate actions are not taken to reduce human encroachment, the wildlife habitat along the corridor will continue to decrease and eventually the wildlife will no longer be able to migrate and allow an exchange of individuals between populations. This will help prevent negative effects of inbreeding and reduce genetic diversity that often occur within isolated populations especially the NNP. Hence, protected areas, like the NNP, will become isolated; a situation likely to have severe implications for economic development including the sustainability of the tourism industry.

Conservation of the wildlife corridor is important since it is the base for tourism at the national and county level, an important revenue earner and source of employment. In recent times, the income generated from tourism activities in Kenya has continued to be a good source of national revenue with wildlife-based safaris and photography ranking among the leading industries, contributing about 13.7% of the gross domestic product and generating more than 10% of national formal sector employment. For example, in 2011, wildlife-based safaris contributed about US$ 1.16 billion to national revenue (GOK, 2012).

1.8 Scope of the Study

Threats to the dispersal areas beyond the park boundaries have significant implications on the environmental and economic sustainability of many parks in East Africa (Gichohi 2000). This study was focusing on Kiserian-Isinya migratory corridor, its habitat and human encroachment along the corridor. We will be investigating how human encroachment has affected the habitat along the corridor and what happens to NNP because of habitat loss.

1.9 Assumptions of the Study

According to MerriamWebster (2017), an assumption of the study is a factor a statement which has been taken for granted without much attention being given to it. They are also factors beyond the researchers ability to influence. The assumptions of this study was that the respondents would be truthfully to the researcher since we assured them that their identity would remain anonymous. The respondents would answer the questions based on their experiences and knowledge but not a discussion with spouse to give the best answers. The researcher also assumed that the respondents had general knowledge on wildlife habitat, human encroachment, and migratory corridors and were residents of Kiserian-Isinya migratory corridor. The study also assumed that the changes that have occurred within the wildlife corridors were caused by factors related to anthropogenic influences occurring over the years.

1.10 Delimitation of the Study

The study focused on the wildlife habitat located within the Kiserian-Kitengela-Isinya wildlife corridor in Kajiado County. The study used both ecological and ecological techniques to assess the level of anthropogenic activities and the ecological integrity of the wildlife habitat. Ecological attributes assessed included plant diversity, ground cover, plant species composition and plant physical attributes (such as cut stumps, height, stem diameter at breast height [DBH], and plant vigour)

1.11 Limitations of the Study

These were the potential constraints of the study which the researcher had no control over. Language barrier was a big limitation since the researcher was not able to communicate with the respondents who were not able to communicate in English or Swahili. To address this, the researcher, required a translator during the visit to the respondents, hence, enabling the researcher and the respondent to communicate throughout the interview. The researcher also had no control over the climatic conditions or weather the weather would be suitable for the research, the geographical terrain and access to some of these areas, that is, whether it would favour the research or not. The researcher was required to visit and assess the area before hand to learn more about the weather, the terrain and find alternatives or ways to work around any obstacles. The reception given to the researcher by the respondents, was also a potential constraint as some would be willing to participate while others would be hostile. The researcher would require assistance from an authority figure, like the chief or an elder, while visiting the homes along the corridor to make the respondents at ease and willing to answer any questions asked. Finally, finances were a big constraint since the researcher would not be able to cover all the cost needed to conduct the research. To address this, the researcher used the help provided by willing friends especially during data collection so as to minimise the cost of the research.

1.12 Theoretical Framework

As time has progressed and land development accelerated, scientists were compelled to turn from the traditional study of undisturbed land to study the effects of fragmentation on ecosystems. Until the 1960s the primary foci of ecological and wildlife research were on large tracts of undisturbed land. There were many reasons for this trend; early ecologists followed the teachings of George Perkins Marsh (1864) and Aldo Leopold (1941) who held people as separate from nature and viewed natural systems as balanced only if they were undisturbed by humans. Another reasons is that most endangered animals and plants are typically found in undisturbed areas because they do not fare well coexisting with people (Noss, 1991).

Much of the theoretical basis of fragmentation studies comes from the seminal work, the Theory of Island Biogeography (MacArthur and Wilson, 1967). Island biogeography has two basic principles. First, the closer an island is to the mainland, the higher the probability that species from the mainland will migrate to the island and provide a source for populating or repopulating the island. Second, the probability of species extinction on an island is a function of island size. In essence island biogeography states that large patches with high connectivity and proximity to a larger source foster a healthy ecosystem in structure and function. This model has since been viewed as analogous to mainland fragmented forest environments that are basically islands in sea of developed land. Using the theory of island biogeography as a new framework, smaller forested remnant patches have become a major focus for research and many theories have been born.

Several conceptual frameworks for incorporating the heterogeneity of the landscape and its effects on ecological process were developed based largely on island biogeography theory. One of these was the metapopulation model developed by Richard Levins in 1970. The metapopulation model focuses on a set of subpopulations across landscapes that are in reproductive contact with each other through dispersal. Thus if one subpopulation goes extinct, it may eventually be recolonized by a nearby subpopulation, provided there is continued opportunity for movement between both areas. This model brings to light the importance of connectivity of habitats. If a metapopulation is to persist in nature, the subpopulations must be connected (movement through the matrix from one to another must be possible and not too energetically expensive). If movement is too costly from an energetic standpoint, as when the terrain is too difficult to navigate and/ or resources are absent along the way, then the population become reproductively isolated from each other and the metapopulation dynamic ceases to exist. Should catastrophe befall the isolated populations, then extinction is imminent. This theory is of great importance when evaluating the dynamics of animal movements along fragment habitats in suburban and exurban landscapes. If the fragments are resource rich and the individuals of the population are free to traverse the developed suburban or exurban matrix then the metapopulation dynamic could remain in quasi-equilibrium indefinitely.

1.12 Conceptual Framework

The conceptual framework that informed this study had the dependent variable as the ecological integrity of the wildlife habitat, this variable is indicated by the ground cover which provides habitat for wild animals, vegetation biomass which provides the wild ungulates with food and plant diversity which provides the ecological services (watershed and carbon sequestration) from the area.

The ecological integrity of the wildlife habitat can be directly affected by anthropogenic influences, which include two independent variables encroachment into the corridor and human activities within the corridors. The indicators for these independent variables include: human settlements within the corridor, human and animal populations, human activities such as grazing, farming and quarrying and infrastructure.

These relationships can be affected by factors that are not part of this study. Two intervening factors climate change and land use policies, have been identified as possible factors that can affect the relationship directly or indirectly.

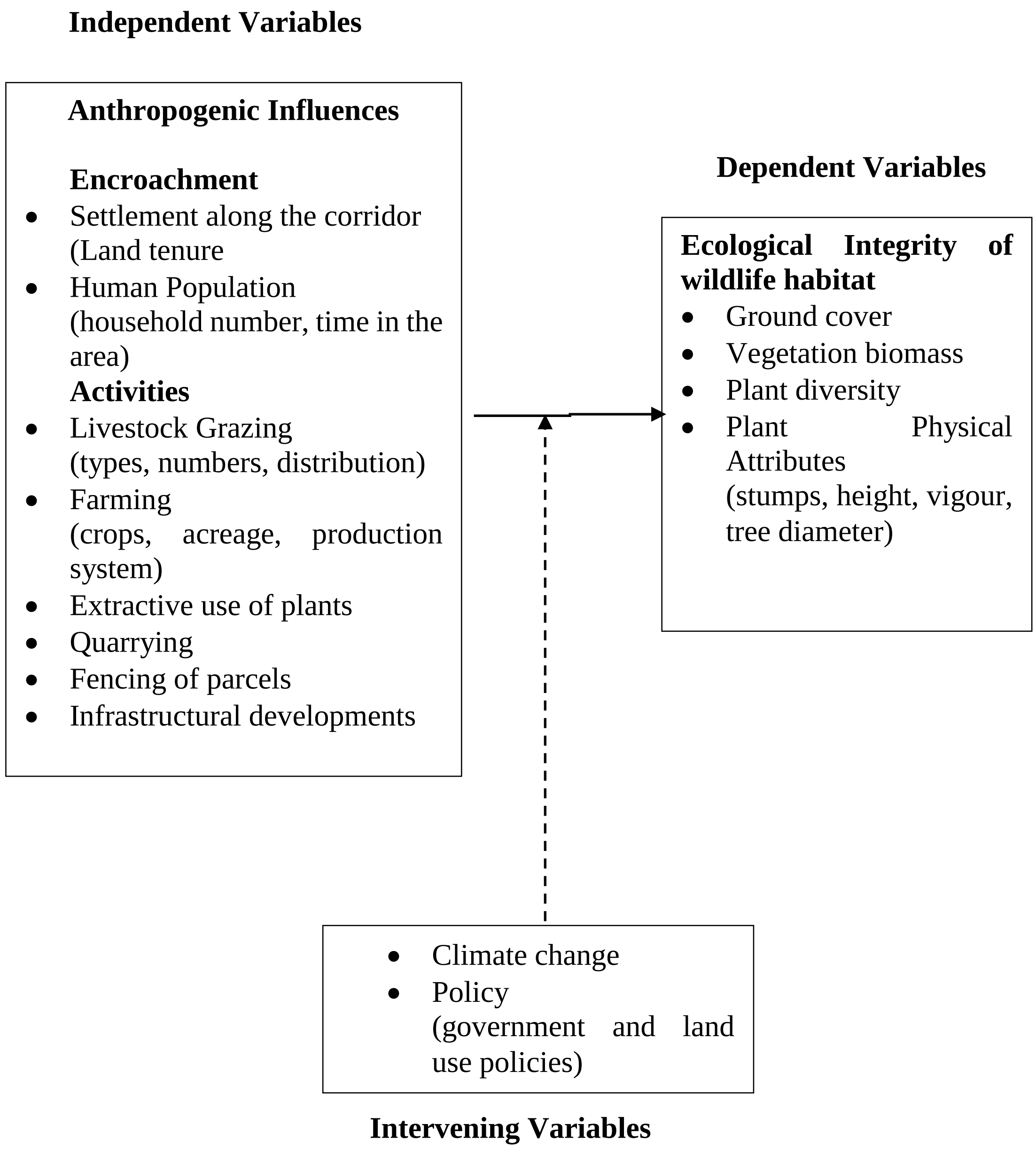


Figure 1.1 Conceptual Framework showing anthropogenic influences on the ecological integrity of wildlife corridor

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter deals with the review of literature related to the study. The study reviews aspects of anthropological influences within and outside the study area, and also reviews aspects related ecological integrity of wildlife habitats.

2.2 Human Populations

Human populations, livestock and wildlife have interacted in East African savannahs for millennia. In recent times, human population growth, agricultural expansion, deforestation, and hunting have had profound cumulative impacts on the environment, natural habitats and wildlife populations (Bourne and Blenche 1999). In Kenya, the human population has doubled over the past 20 years, generating pressure for the conversion of extensive natural grasslands to croplands. At the landscape level livestock number and species have fluctuated widely without a clear trend following changes in primary productivity (Kristjanson et al. 2002), but wildlife population has declined by 45% mostly because of the habitat loss and unauthorised hunting (Norton-Griffiths 1998). Such is the case with Kiserian-Isinya wildlife corridor. It connects NNP with Athi-Kapiti plains and the animals use it to migrate from the park in search of food, water and new mates. Human encroachment along the corridor has resulted to habitat loss along the corridor, hence, reducing the corridor size and the wildlife populations.

2.3 Wildlife Habitat and Protected Areas

2.3.1 Definitions

Wildlife habitat is an ecological or environmental area that is inhabited by a particular species or animal, plant, or other type of organism. It refers to the zone in which the organism live and where it can find food, shelter, protection and mate for reproduction. It is the natural environment in which an organism live, or the physical environment that surrounds a species population. It is made up of physical factors such soil, moisture, range of temperature, and light intensity as well as biotic factors such as the availability of food and the presence or absence of predators (Western, Russell, & Cuthil, 2009).

Wildlife habitats in Kenya are created to protect critical ecosystems and species in the form of Protected Areas (PAs), which can be either government managed under strict rules and regulations or without strict rules and regulations (Onditi et al., 2021). The International Union for Conservation of Nature (IUCN) defines a protected area or conservation area as a "clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values." (Dudley, 2008). They include: national parks, wilderness areas, community conserved areas, and nature reserves. Protected areas are a mainstay of biodiversity conservation, while also contributing to people's livelihoods, particularly at the local level. Protected areas are at the core of efforts towards conserving nature and the services it provides us – food, clean water supply, medicines and protection from the impacts of natural disasters. Protected areas are a mainstay of biodiversity conservation, while also contributing to people's livelihoods, particularly at the local level. Protected areas are at the core of efforts towards conserving nature and the services it provides us – food, clean water supply, medicines and protection from the impacts of natural disasters. Their role in helping mitigate and adapt to climate change is also increasingly recognized; it has been estimated that the global network of protected areas stores at least 15% of terrestrial carbon (Worboys & Trzyna, 2015).

Buffer zones at the boundaries of PAs have increasingly been incorporated into management plans in an attempt to serve the multiple purposes of protecting resources within the park core; providing resource benefits to local people who often must bear the burden of the PA; and desires for PAs to reduce poverty (Wells and Brandon, 1992; Naughton-Treves et al., 2005; Dudley, 2008)

2.3.1 Wildlife Habitat Loss

The loss of habitat through the conversion of land from its natural state to a developed landscape represents the single greatest impact of increase in human encroachment on wildlife habitat. All animal species require certain habitat features to survive. Development typically eliminates or significantly changes many important habitat features found in a natural area, thus reducing or eliminating the habitat value of that area. For example, a diverse wildlife population depends upon the natural diversity of native plants found in most undeveloped areas, that is, during migration, wildlife depend upon the wildlife habitat along the corridor to provide whatever needs the wildlife will require as they transition/ move from one habitat to the other. These needs will include; food, water, shelter, and mating grounds. Human encroachment often changes the vegetative community, composition, cover and biodiversity of the corridor making it more difficult for the wildlife to survive during migration. Those species able to survive in human encroachment settings may thrive, but the rest are forced to continue staying in the protected areas or perish while trying to migrate from protect areas to other ecosystems. In this case, from NNP to Athi-Kapiti Plains (Mc Euen, 2003).

Habitat fragmentation and loss constitute the greatest of all threats to biodiversity (Hanski, 1998). Fragmentation or loss of habitats reduces spaces available to wildlife, and often disrupts wildlife dispersal and migration patterns, leading to changes in the composition of plant communities and the disruption of vital ecological processes. Habitat connectivity helps reduce the adverse impacts of fragmentation. For the continued survival of species, it is necessary to maintain existing wildlife dispersal areas and migration routes/corridors, and to restore previous such areas that have been interfered with or lost (Maitima *et al.*, 2009).

2.3.3 Wildlife Migratory Corridor

Wildlife migratory corridor, also known as a habitat corridor, is an area of habitat connecting wildlife populations separated by human activities and structures, that is, roads, development, and urbanization. It can also be described as a set route that migratory animals adhere to when they migrate from one area to another or a habitat pathway an animal uses to relocate from one place to another. Hence, allowing the exchange of individuals between populations, that may help prevent the negative effects of inbreeding and reduced genetic diversity through genetic drift (Gichohi, 2000).

Habitat loss and fragmentation is the greatest threat to biodiversity and a major cause of species extinctions (MEMR 2012). The loss or fragmentation of wildlife habitats reduces the area for wildlife use, and disrupts dispersion and migration patterns. Habitat connectivity or corridors is a way to reduce the adverse impacts of fragmented wildlife areas (MEMR 2012). Corridors are linear landscape features that serve as linkages between historically connected habitats thus facilitating movement between them. The identification and maintenance of existing dispersal and migration corridors and restoration of those already lost or interfered with by human activities is necessary for the existence and future survival of wildlife. Corridors increase the effective area available and are important conduits for reducing interbreeding and improving genetic viability and overexploitation by predators. Wildlife corridors therefore allow movements of species between otherwise isolated areas. They are landscape patterns that promote connectivity for species and communities and are important for the maintenance of ecological processes in environments modified by human impacts (MEMR 2012).

2.3.4 Importance of Migratory Corridors

Migratory corridors are important as they ensure the survival of the protected areas since they aid in the migration of wildlife. Kiserian-Isinya corridor connects NNP to the Athi-Kapiti plains. The wildlife migrate to the Athi-Kapiti plains during the wet season in search of food, water and mating while during the dry season, they migrate back to the NNP because, during the dry season, the park has more food and water. The corridor and its habitat plays a very important role (Bennett, 2003).

Corridors reduce the chances of inbreeding and of over exploitation by predators. The theoretical basis for habitat corridors is grounded in the theory of metapopulation extinction (Richard Levins, 1969; Hanski & Gilpin, 1991; Hanski, 1998); in the theory of island biogeography (McArthur and Wilson, 1967), and in Leopold's law of dispersion put forward in the early 1930s. In biodiversity conservation, connectivity is essential in all landscapes for attaining metapopulation stability and sustainability (Hanski, 1998).

Corridors link historically connected natural habitats, by facilitating movement between areas that may now be isolated (McEuen, 1993). Connectivity is the degree to which a landscape facilitates or impedes movement between resource patches (Taylor et al., 1993, in Bennett, 2003). Wildlife corridors are the prime means of securing habitat connectivity, serving as important conduits that preserve access to the larger habitat, while reducing inbreeding and improving genetic viability. Connectivity also enhances the security of wildlife populations through providing avenues for predation avoidance, while ensuring that essential ecological processes can continue (McEuen, 1993; Bennett, 2003).

Arguments against corridors suggest, among other things, that they might act as avenues for spreading diseases, fires, and predation, while at the same time incurring high management costs (Simberloff et al., 1992). And yet, despite these criticisms, corridors are widely seen as the best option for protecting and conserving wildlife and wildlife habitats (McEuen, 1993). The use of corridors in wildlife conservation and management has proved especially effective in preserving biodiversity in fragmented habitats (Bennett, 2003). Corridors are also important for the maintenance of ecological processes in environments that have been modified by human impacts (Bennett, 2003).

The planning and design of wildlife corridors is of great importance in determining whether or not the corridors will succeed. Several criteria must be taken into account. These include an understanding, in the case of each corridor, of the ecological needs and movement patterns of species that are expected to use that corridor. The ecological needs of species (food and water requirements, shelter, breeding behaviour, predation, and so on) and their movement patterns (dispersal, migration, or home range) will determine what form a particular corridor should take, in terms of habitat cover, and length and breadth, among other considerations (Beier & Loe, 1992; McEuen; 1993; Harrison, 1992; Lindenmayer & Nix, 1992; Bennett, 2003). Provision for management strategies that include monitoring of human activities within wildlife corridors is another important consideration (Bennett, 2003).

2.3.5 Threats to Wildlife Corridors

Threats to the dispersal areas beyond the park boundaries have significant implications for the environmental and economic sustainability of many parks in East Africa (Gichohi, 2000). The loss of the migratory corridor from its habitat loss caused by fencing and conversion to croplands might affect the viability of the corridor itself and the parks reducing the flow of benefits provided by them and affecting human well-being since, there is increase in the human-wildlife conflict.

Increase in human population in Kenya is rapidly causing encroachment into wildlife habitats (Okello *et al*., 2011) leading to the decrease of wildlife space and wildlife corridor blockage. If protected areas have no wildlife corridors, genetic drift that results to inbreeding may occur, thus leading to instability of wildlife population, loss of ecological integrity, increase in human-wildlife conflict and some animal extinction locally (Newmark, 1993; Campbell *et al*., 2000). Such conflicts create animosity towards wildlife and may eventually lead to retaliatory killings (Sindiga, 1995; Okello, 2005). Negative effect of human encroachment on wildlife habitat is increasing especially along the corridors. This has led to habitat loss along the corridor and eventually shrinking of the corridor making it less viable for the animals to migrate through, hence, the wildlife will intern encroach into the human homesteads in search of food, water and space to move through.

Increase in human population around the national parks and the migratory corridors has resulted to encroachment in areas inhabited by wildlife, hence, fragmentation and conversion of land, that is; settlement land, agricultural land, construction of infrastructure and other associated land use types that are incompatible.

In Kenya, Western (1995) observes that the people who live in these areas (around national parks and migratory corridors) depend more on natural resources and find it difficult to tolerate wild animals in their lands when they consider them a threat to their lives and livelihoods. The main wildlife problems in the Kenyan rangelands are crop damage, competition for water and grazing, livestock predation, increased risk of some livestock diseases, various inconveniences such as when protecting crops, and human fatalities (KWS, 1992; Northon-Griffiths, 1996; Campbell *et al*., 2000; Muruthi, 2005).

Human-wildlife conflict is fast becoming a critical threat to the survival of many globally endangered species. Human-wildlife conflicts can have adverse impacts on wildlife and humans alike. Recently, there have been deplorable reports in the local and international press of human-wildlife conflicts around wildlife protected areas in Kenya (Farhana, 2013).

2.4 Human Encroachment

Human encroachment is a term used to describe the advancement of structures, roads, railroads, improved paths, utilities, and other development, into natural areas including floodplains, rivers, wetlands, lakes and ponds, and the buffer around these areas. The term encroachment also encompasses the placement of fill, the removal of vegetation, or alteration of topography into such natural areas. These encroachments cause impacts to the functions and values of those natural areas, such as a decline in water quality, loss of habitat (both aquatic and terrestrial), disruption of equilibrium (or naturally stable) conditions, loss of flood attenuation, or reduction of ecological processes (Okello *et al.*, 2011).

2.4.1 Human Population Increase

The current population of Kajiado County is 687,312 which has increased from 406,054 in 1999. Population has always increased in each census. Kajiado County has a combination of a child rich and a transitional population structure. Overall, 42% of the population is aged between 0-14 with Kajiado Central (50%), Kajiado West (48%) and Kajiado South (49%) constituencies having the highest proportion of children. The county also has a high proportion of the working age (15-64) population especially in Kajiado North (66%) and Kajiado East (60%) constituencies. This may be explained by the growth of Ngong and Ongata Rongai Wards in Kajiado North as well as Kitengela Ward in Kajiado East that have attracted high numbers of migrants from rural areas and provided residency for people working in the city of Nairobi and its environs.

2.4.2 Threats from Human Population Increase

Rapid human population growth and its ramifying effects on the rangeland ecosystems. Kenya’s human population grew nearly five-fold from 8.1 million in 1960 to 44.4 million in 2013. The annual average human population growth rate in 2013 was estimated at 2.9 % (World Bank, 2014). The pastoral regions are also experiencing a significant population increase, a trend forecasted to continue in the coming years (Pricope et al., 2013). Associated with the rising population pressures are browning trends in vegetation condition in the pastoral regions, signalling progressive habitat degradation or loss. Habitat degradation, fragmentation and loss are attributed to land-use and cover changes associated with unregulated expansion of agriculture along rainfall gradients and settlements, land-use intensification, over-stocking and overgrazing, unsustainable range management, unregulated wood harvesting for firewood and the charcoal trade, and unregulated spread of urban centres and infrastructural development.

This is exactly what is happening along Kiserian-Isinya corridor. Human encroachment has resulted to habitat degradation and habitat loss along the corridor. Humans encroach wildlife habitats to fit their own needs like, more agricultural and settlement land, urban centres, industries, more grazing land for their livestock and other selfish needs.
continues to shrink and with time, it cannot accommodate the migration of wildlife from protected areas like the NNP to the Athi-Kapiti plains.

2.5 Plant Diversity

Biodiversity is the full variety of plants, animals, and microorganisms found on Earth, it is a source of many benefits crucial to human well-being. It provides the underlying conditions necessary for the delivery of ecosystem services (MA, 2003).

Biodiversity is the term that is given to describe the variety of life on earth and the natural patterns it forms. It is the result of evolution, natural processes, and human influence (Secretariat, 2000). Biodiversity involves diversity of genes within a species, of species within ecosystems, and of ecosystems in the biosphere (Frequently, 2005). Biodiversity is not determined by only one factor, but rather many factors that differ spatially and temporally (Climate, 2005).

Although many humans may not realize how important biodiversity is to them, it is clear that without it humans would not be able to exist. Each day humans use 40,000 species, most of which go totally unnoticed (Eldredge, 2000). Even though only a minority of humans realize it, biodiversity provides humans with food, water, oxygen, energy, detoxification of waste, stabilization of earth's climate, medicine, opportunities for recreation and tourism, and many more things (Secretariat, 2000). Simply put, there would be no population of humans without biodiversity.

2.5.1 Loss of Plant Diversity

Kenya's wildlife resources account for about 70% of the gross tourism earnings, 25% of the gross domestic product (GDP), and more than 10% of overall formal sector employment in 2011 (Government of Kenya, 2011). The African continent has been at the forefront in retaining and conserving a considerable concentration and diversity of wildlife when compared to Australia and America. However, over the last three decades, the populations of wildlife have plummeted substantially inside and outside protected areas (Western, Russell, & Cuthil, 2009). To be specific, East Africa was unmatched in sustaining relatively intact wildlife, but this has changed over time.

Kenya is ranked second highest among African countries, in bird and mammal species richness with an estimate of 394 mammals, 1100 birds, 201 reptiles (100 lizards, 100 snakes, and 1 crocodile), 100 amphibians, and 950 (250 freshwaters and 700 marine) fish species. However, over the last 30 years, her wildlife numbers have shrunk by between 35% and 50% (Grunblatt, Said & Wargute, 1996) and, by 2006, the number of threatened species in Kenya included 33 species of mammals (IUCN, 2008). This decline in wildlife numbers globally, regionally, and locally has more been attributed to land use changes, human encroachment into wildlife habitats, recurrent droughts, poaching, and other anthropogenic activities (Loibooki *et al*., 2002).

Land use changes influence fundamental aspects of the earth's functioning as well as have a direct impact on world biodiversity (Sala *et al*., 2000; Lambin, *et al*., 2001). In East Africa, changes in land use have transformed wildlife land cover to livestock grazing lands, mining grounds, agricultural lands, human settlements, and urban centres at the detriment of wildlife habitat (Maitima *et al*., 2009).

2.6 Summary of Literature Review

Wildlife migratory corridors are important for wildlife animals when it comes to migration to other ecosystems in search of food, water and mates during the wet season. In this case, wildlife from NNP require Kiserian-Isinya migratory corridor to move to the Athi-Kapiti plains during the wet season and back to the park during the dry season. Wildlife habitat along the corridor is important as it provides food, water, shelter for the wildlife during the migrating period. Unfortunately, human encroachment along the corridor has resulted greatly to the loss of habitat along the corridor. This is because of human activities such as; settlement, agriculture, fencing, grazing, quarrying, increased urban centres and industries. These activities have resulted to increase in human-wildlife conflict due to reduced space for the wildlife, migration of wildlife has been restricted especially by fencing, and natural resources for the wildlife have greatly reduced hence the wildlife wander into homesteads in search of food and water. Wildlife habitat along the corridor is important for the wildlife during migration and ensure the corridor stays intact. On the other hand, loss of habitat along Kiserian-Isinya migratory corridor has resulted to shrinking of the corridor and loss of wildlife to human-wildlife conflict as the wildlife try to migrate through the settlement. If this trend is allowed to continue, in a few years the corridor will disappear completely due to destruction of the wildlife habitat, no more migration of wildlife to and from NNP, and there is a great chance that NNP will be a zoo.

2.7 Research Gap

Human encroachment along the corridor has led to habitat destruction along the corridor. Habitat has been destroyed directly by many human activities, most of which involve the clearing of land for agriculture, grazing, mining, logging for charcoal burning and urbanization. Habitat destruction will cause the corridor to shrink and it is just a matter of time until the corridor completely disappears and is replaced by settlement, agricultural land, urban areas and more of human encroachment. In this study, the researcher would provide solutions that would aid in the conservation and protection of the corridor and show the agency of managing the corridor.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This section expounds on the methods which this research employed to achieve the sample population and to enable data collection and analysis. The chapter therefore, encompasses research design, research site, target population, sampling procedures and sample size, description of research instruments, pilot testing of instruments, validity, and reliability of data collection instruments, data collection procedures, data analysis techniques, legal and ethical considerations.

3.2 Research Design

A research design is an overal strategy that was chosen to incorporate the different components of the research in a logic and coherent way to ensure the research problem was addressed and research questions in reporting the research judgment. This study adopted a mixed method type of research design, which combined various research methods that include: a social survey for the homesteads along the corridor and ecological measurements using Shannon and Wiener Diversity Index to account for the biodiversity. These components of the research design were used to assess the effects of human encroachment and activities on the ecological integrity of the wildlife habitat along Kiserian-Isinya corridor.

3.3 Research Site

The study area was restricted to Kiserian-Kitengela-Isinya migratory corridor, that is, a migratory corridor which occupies the area south of the Nairobi National Park (NNP) and extends into the Athi-Kapiti plains and north of Kajiado County (see map, Figure 3.1). In Kajiado County the area extends and connects two towns Kiserian to the west and Isinya to the east along the highway from Nairobi to the Namanga border. The Athi-Kapiti plains consist of gently undulating slopes, which become rolling and hilly towards the Ngong hills. The altitude ranges from 1580 to 2460 meters above sea level. The hills are the catchment areas for Athi River, which is fed by Mbagathi and Kiserian tributaries.

The Kiserian-Kitengela-Isinya corridor has a road that connects the two towns of Kitengela and Isinya and currently is being tarmacked opening up the area for settlement and development, further enhancing human influences in the area affecting the wildlife habitat and wildlife migrations within the corridor, which is the target of this study; how these human encroachment and activities influence the wildlife habitat and animal migrations within the corridor.

In 2016, the corridor was made up of the following conservancies as shown in Figure 3.1: Olooloitikoshi, Kitengela game conservation area, Naretunoi, Olerai, Kisaju, Kipeto, Kaputei North, Silole, Olochoro Onyare and Ildamat in Kajiado County and the following in Machakos County: Game ranching, Machakos ranching, Kapiti estate, Astra ranch, Lisa Ranch and Kasanga ranch.

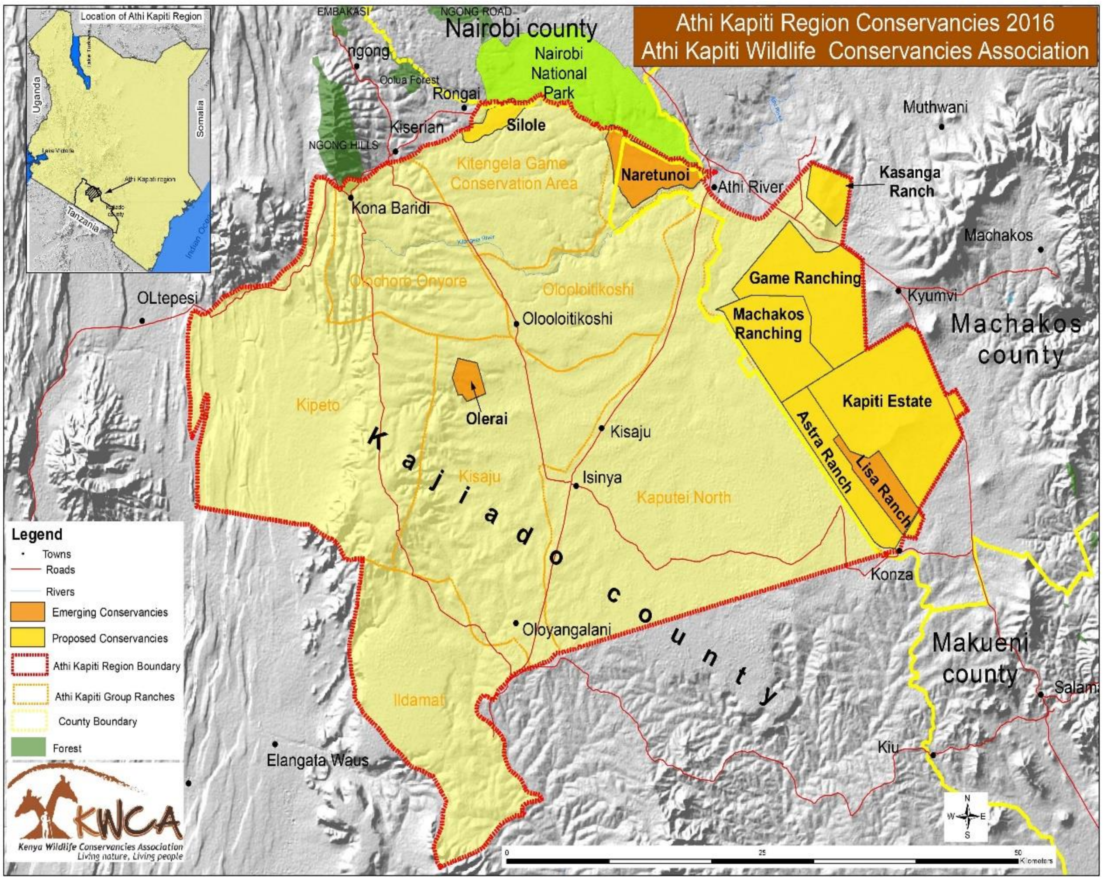
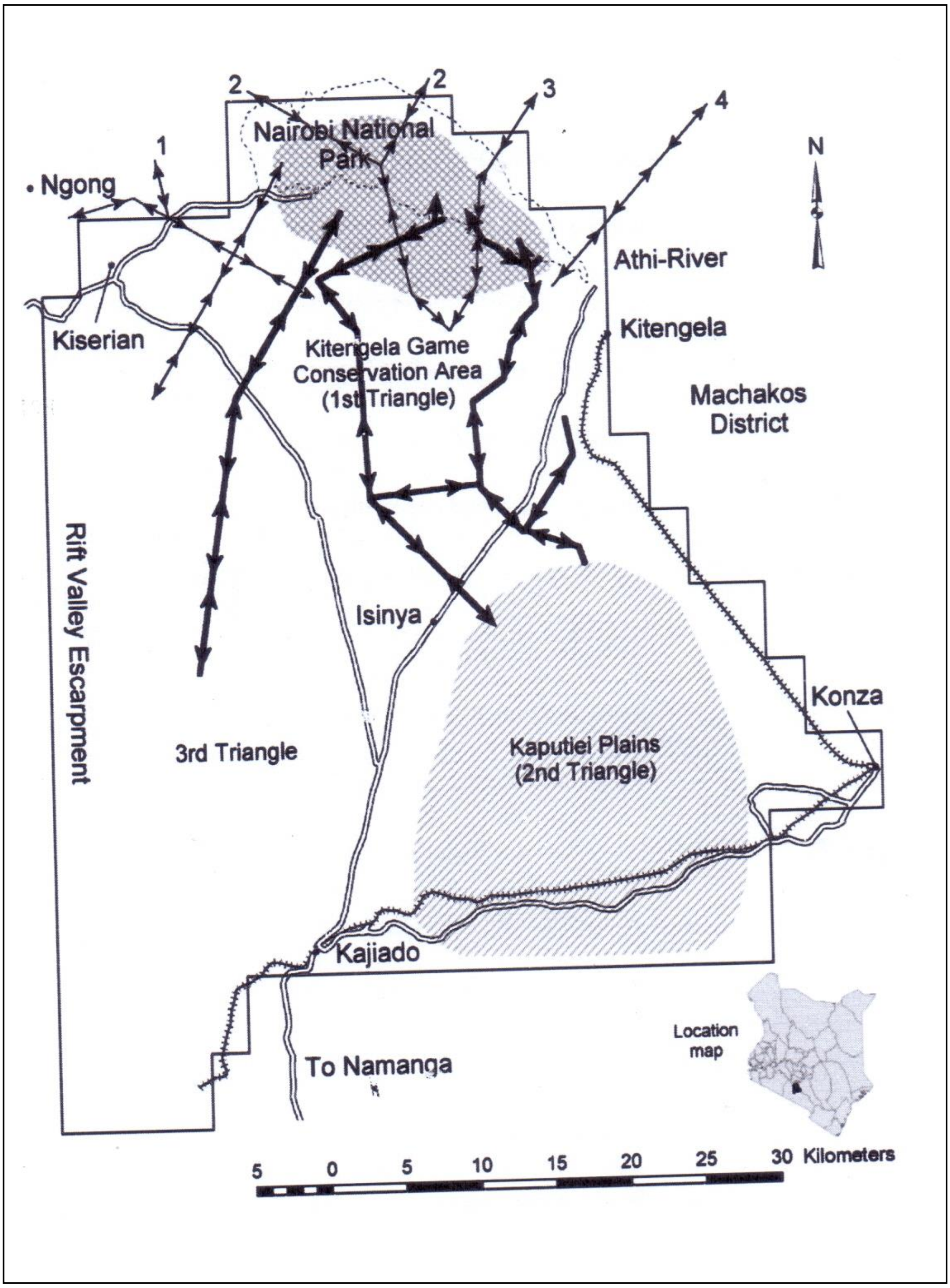


Figure 3.1: Kiserian-Kitengela-Isinya Wildlife Corridor (source Kenya Wildlife Conservancies Associations)

The Kiserian-Kitengela-Isinya wildlife corridor has been described by Reid et al. (2008) as the Athi-Kaputiei ecosystem, which extends from Kiserian to Kitengela and then extends southwards to Kaputiei plains below Isinya town and above Kajiado, the area forms the pastoral part of the ecosystem. The area is divided into three triangles, the first lies next to the Nairobi National Park (NNP) forming the Kitengela conservation area, the second triangle is the area below Isinya forming the Kaputiei plains and the third is below the Kiserian-Isinya Road (towards the Rift Valley escarpment (Figure 3.2), these three stratum are referred to in this thesis as the Kiserian-Kitengela-Isinya wildlife corridor. The Kiserian area (triangle 3), Kitengela area (triangle 1) and Isinya area (triangle 2).



Source:

Figure 3.2: Map showing the extent of the wildlife corridor (area around Kiserian, area around Kitengela and the area below Isinya).

3.4 Target Population

The target population for this study was taken as the people who have settled in the corridor and the pastoralists inhabiting the area. These included farmers, pastoralists and agro-pastoralists found living within the corridor. The population was estimated using the 2009 Kenya population census as 211,435 (KNBS, 2010). The population included 45,780 from Isinya, 30,098 and Kiserian 13,557 locations. The households in the study area were estimated at 54,583 found in three locations as follows: Isinya 27,127, Kitengela 18,892, and Kiserian 7,209.

3.5 Study Sample

Sample size refers to the number of participants or observations included in a study. This number is usually represented by n. The size of a sample influences two statistical properties: (i) the precision of our estimates and (ii) the power of the study to draw conclusions (IW & H, 2008).

3.5.1 Study Sample Size

The study sample size was the portion of the population which was used in the research investigations. The sample size required was calculated using the formula described by Krejcie and Morgan (1970), Kathuri, and Pals (1993) based on 54,583 households in the study area:

$$n = \frac{\chi^2 * N * P(1-P)}{(ME^2 * (N-1)) + (\chi^2 * P(1-P))}$$

Where:

n = The required sample size, given by the following:

χ^2 = The table value of chi square for one degree of freedom relative to the desired level of confidence, which was 0.95. [The chi-square value used was 3.841].

N = The population within the study area [54,583]

P = The population proportion [assumed to be 0.50], as this magnitude yields the maximum possible sample size required.

ME = desired margin of error (expressed as a proportion). This is the degree of accuracy as reflected by the amount of error that can be tolerated in the fluctuation of a sample proportion about the population **P**. The value of d was taken as 0.05, which is equal to plus or minus 1.96σp. $\boldsymbol{ME^2}$= [0.05^2 =0.0025]

Based on the number of households in the area (54,583) and the above formula the required sample size was estimated to be 381 household heads. Proportional allocation was used to allocate the samples within the four localities.

Having determined the total sample size based on the target population, the number of respondents to be interviewed in each of the three strata (Isinya, Kiserian, Kitengela) were selected proportionately to avoid bias in strata that have more people than the smaller ones. This was done using the proportion to size method defined as follows (Kothari, 2004):

$$i = \frac{N_1}{N_2}(n)$$

Where:

i = Proportion of the sample in particular stratum

N_1 = the total number of respondents in a particular stratum

N_2 = the total number of respondents (54,583)

n_i = the total sample size calculated based on the target respondents (381).

Therefore, the number of respondents from each selected stratum *X* were determined as follows:

$$\text{Stratum } X = \frac{\text{No. of people in the stratum}}{\text{Total target population households}} \times 381 = X_i$$

The total sample size of respondents selected from the strata ($X_{i,}$ $X_{ii.....}X_n$) therefore, it was $\sum X_i^n$ respondents distributed proportionately as follows:

Table 3.1: Proportional Distribution of the Sample to the three Strata in the Study Area

Sub-location	Proportional allocation	Respondents
Stratum 1 Isinya	381 (8178/54,583) = 57.0	57
Stratum 2 Kiserian	381 (22,635/54,583) = 157.99	158
Stratum 3 Kitengela	381 (23,770/54,583) = 165.92	166
Total		**381**

3.5.2 Sampling Procedure

According to Cohen (1997*)*, sampling is defined as the process by which a small number of objects, individuals or in other cases, an event, are selected and analysed to determine an outcome of something about the entire population from which will they will be chosen. A sample is a small percentage of the targeted population selected using some systematic form which is dependent on the desired accuracy of the estimate. The study area was divided into three strata, that is, Kiserian, Kitengela and Isinya. Each stratum was sampled independently. Selection of households in each stratum was by random sampling within each stratum.

The selection of a focus group was also a simple random sampling but the chief was involved in selection of the group members to ensure that the members selected were knowledgeable on Kiserian-Isinya migratory corridor, wildlife habitat and effects of human encroachment on the corridor.

3.6 Data Collection Measures

This was a socio-ecological type of study, which employed both social and ecological measurements.

3.6.1 Data Collection Instruments

The social data was collected using a structured questionnaire and Focus Group Discussion interview schedule (Appendix A and B). The structured questionnaire was used to collect data from the households and the Focus Group Discussion (FGD) interview schedule was used to collect data from three FGDs, one in each stratum (Kiserian, Kitengela and Isinya).

Data collection protocols were used to collect plant cover and plant physical properties from random located sampling points in the three stratum (Kiserian, Kitengela and Isinya). The ecological data was used to calculate ecological indices that were used in quantifying the ecological integrity of the wildlife habitat located within the Kiserian-Kitengela-Isinya wildlife corridor.

3.6.2 Pilot Testing of Research Testing

Pilot testing is defined as observing and testing tools before using them for the intended research to ensure practicability, reliability and validity. Piloting will be done to ascertain the credibility of the tools by testing the clarity of language, the time is taken to respond, the procedure of administering, length and layout of tools. All the questionnaires will be answered to know the kind of answers to expect, ensure the language is simple and no technical jargons especially those questions to be distributed to households. The cameras, videos or other machines to be used in remote sensing will require being double-checked to ensure they work perfectly. The availability of the respondents for the research and interviews will also need to ensure that the research is well conducted.

3.6.3 Instrument Reliability

Reliability is the degree to which the particular measuring procedure gives similar results over some repeated trials. To establish the reliability of the instruments, the researcher used test re-test technique. Test re-test involves administering the same instrument twice to the same group of subjects to establish whether the same results can be obtained with a repeated measure of the same concept. In this study, reliability will be established by administering the instrument to the total respondents in the pilot study.

3.6.4 Instrument Validity

Validity is defined as quality attributed as a proposition or the measure of the degree to which they confirm to establish knowledge. Validity is also the accuracy and meaningfulness which inferences are based on the results of research. That is, however the degree to which results can be obtained from the data which actually represents the phenomena under study. This study therefore established the validity of the instruments in used data collection by ensuring that the measurements and results are genuine by discussing with experts and the supervisors.

3.6.5 Data Collection Procedure

The researcher got an introductory letter from Africa Nazarene University. This letter assisted the researcher to get permission from the National Commission of Science, Technology and Innovation (NACOSTI) to conduct the study. After receiving the permit, the researcher proceeded to the Kajiado County Director of Education and asked for permission to do the study in the County. Upon receiving all the documents, the researcher then proceeded to Kiserian, Isinya, Kitengela and Ngong constituencies where the Chiefs gave the researcher permission to conduct research in the households. The chief provided an escort for the researcher to locate the households and introduce him to the people.

The study area (Kiserian- Kitengela-Isinya corridor) was divided into three strata as shown in the map (the Kiserian stratum zone 3), Kitengela stratum (zone 2) and Isinya stratum (zone 4) as shown in Figure 6.1 (Appendix D). Then each stratum was sampled individually in two stages first for the social data and then the ecological data.

Social data collection procedure involved selecting the households to be sampled in each of the stratum. A sampling frame involving the accessible households identified in Chief's offices was prepared and the households were numbered and selected at random using a table of random numbers. The enumerators were then trained to use the questionnaire and were then distribute to the selected households to collect data.

The ecological data was collected using the point sampling technique (Bonham, 1989; Mitchell & Hughes, 1995). Random placed transects were located in each transect. Random sampling points were selected on the transect using measure random distances selected using a table of random numbers. At each sampling point the plant species were identified and recorded and cover was estimated. Plants along the transect were measured their diameter at breast height [(DBH] (Nicholas & Thompson, 2000), other physical attributes of the plants were collected these included: height, stumps, and vigour.

3.7 Data Analysis

Saunders, Lewis and Thornhill (2009) defined data analysis as the process of converting data to meaningful information. Data collected is compared against each other to get more relevance on the matter. Editing, coding, and tabulation was carried out. The data were analysed using qualitative and quantitative techniques. Qualitative method involved content analysis and evaluation of text materials. Quantitative data was analysed through the use of descriptive and inferential statistics and presented diagrammatically in form of tables, charts, and percentages (Baily, 2004).

The Shannon and Weiner index (*H’*) was calculated and used to compare plant diversity. The formula for calculating the Shannon and Wiener index was:

$$H' = \sum_{i-1}^{s} [(pi) * (\ln pi)]$$

where *H’* is the species diversity index,

s is the number of species (species richness),

and *pi* is the proportion of individuals of each species belonging to the *i*th species of the total number of individuals. Divide number of individuals of species *i* by total number of samples.

3.8 Legal and Ethical Consideration

Privacy and ethical consideration were prioritized while conducting the research. This was meant to avoid embarrassment and ridicule that could have led to failure in achieving the study objectives. Throughout the study period, the researcher observed ethical procedures by ensuring that respondents' dignity was respected.

Table 3.2: Summary of Data Analysis and Statistical Tools Used

Objectives		Variables	Method of Data Analysis
(i)	To assess the current ecological integrity of the wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor in Kajiado Kenya using socio-ecological techniques	Ecological integrity (Cover, species composition, Plant diversity, plant physical attributes)	Descriptive statistics
(ii)	To quantify the ecological integrity of the wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor in Kajiado County using ecological techniques	Ecological integrity (Cover, species composition, plant diversity, plant physical attributes)	Shannon-Wiener diversity index, Cover, Abundance, species richness
(iii)	To quantify the anthropogenic activities influencing the ecological integrity of the wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor in Kajiado County.	Anthropogenic activities (settlements, grazing, crop production, fencing, infrastructure, industries)	Descriptive Statistics. ANOVA, Chi-square
(iv)	To assess the influence of anthropogenic activities on the ecological integrity of the wildlife habitat along the Kiserian-Kitengela-Isinya wildlife corridor in Kajiado County.	Independent: Ecological integrity Dependent: Anthropogenic activities	Descriptive statistics, Regression analysis,

CHAPTER FOUR

DATA ANALYSIS AND FINDINGS

4.1 Introduction

This chapter presents an analysis of the results of this study based on formulated objectives and study questions as presented in Chapter One. The chapter is divided into the following sections: sociodemographic characteristics, ecological integrity of the wildlife habitat, anthropogenic influences within the wildlife corridor, influence of anthropogenic activities on the ecological integrity of the wildlife habitat.

4.2 Sociodemographic Characteristics of the Households

The section deals with the description of the demographic characteristics of the respondents. The characteristics described include: age, gender, education level and marital status and occupation of the respondents.

4.2.1 Age of the Household Head

The respondent household heads were asked to state the year they were born as indicated on their identity card and their ages were later on calculated. The age of the respondent, frequency distribution, percentages and descriptive statistics were then calculated and the results are shown in Table 4.1.

Table 4.1: Age Categories of the Respondents

Age categories	Frequency	Percent
Below 20 years	36	9.4
21-30 years	66	17.3
31-40 years	60	15.7
41-50 years	70	18.4
51-60 years	81	21.3
61-70 years	56	14.7
above 71 years	12	3.1
Total	**381**	**100.0**

Mean 43.9±.83, median 45, mode 19, Std. dev 16.30, minimum 18, maximum 80

The mean age for the participants was found to be (M=43.9. SD 16.3) years, with a minimum age of 18 and a maximum age of 80.

4.2.2 Gender of the Household Heads

The Household heads gender was noted and the information was analysed and its frequency distribution of the data by gender is shown in Table 4.2.

Table 4.2 Gender of the Respondents

Gender	Frequency	Percent
Male	262	68.8
Female	119	31.2
Total	**381**	**100.0**

The majority (68.8 %) of the respondents were male, while 31.2 % were female.

4.2.3: Education Level of the Household Heads

The household heads were asked to state their highest formal academic level they had attained, then the responses were grouped into three categories as follows: no formal education, primary (class 1 to 8), secondary (form 1 to 4), tertiary (college diploma, and degree) levels. The frequency distribution and percentages of the level of education attained by respondents is shown in Table 4.3.

Table 4.3 Level of Formal Education Attained by the Respondents

Level of formal education	Frequency	Percent
Illiterate (No formal schooling)	87	22.8
Primary (class 1-8)	149	39.1
Secondary(form 1-4)	73	19.2
Certificate	37	9.7
Diploma	21	5.5
Degree	14	3.7
Total	**381**	**100.0**

Analysed data in Table 4.3, shows that only (18.9 %) of the respondents had attained the certificate level and above, while 22.8 % were illiterate and 39.1 % had attained the primary level and 19.2 % the secondary level.

4.2.4 Marital Status of the Respondents

The respondents were asked to state their marital status and the data was analysed and presented in Table 4.4.

Table 4.4: Marital Status of the Respondents

Marital Status	Frequency	Percent
Married	299	78.5
Single	46	12.1
Widow	36	9.4
Total	**381**	**100.0**

The majority (78.5 %) of the respondents were married, while 12.1 % of them were single, and 9.4 % were widowed.

4.2.5 Household Livelihood Sources and Number

The household heads were asked to state the number and type of livelihood sources they relied on. The data was analysed and presented in a multiple response Table 4.5

Table 4.5: Main Livelihood Sources for the Households (Multiple Response Table)

Livelihood	Frequency	Percent
Livestock	303	79.6
Crop cultivation	98	25.7
Business	56	14.7
Formal employment	14	3.6
Casual labourer	10	2.6

The majority (79.6 %) of the respondents relied on livestock keeping for their livelihood, while 25.7 % relied on crop cultivation. The number of number of livelihood sources undertaken by the households are presented in Table 4.6.

Table 4.6: Number of Livelihoods Undertaken by the Households

Number	Frequency	Percent
1.00	71	18.6
2.00	275	72.2
3.00	22	5.8
4.00	13	3.4
Total	**381**	**100.0**

Mean 1.9± .02, Median 2, Mode 2, Std. dev .614, Minimum 1, Maximum 4.

The majority (72.2 %) of the households had at least two sources of livelihood, while 18.6 % had one source.

4.2.6 Number of Years Lived in the Area

The household heads were asked to state the number of years they had lived in the area and the data was analysed and the descriptive statistics and frequency distributions are presented in Table 4.7.

Table 4.7 Number of years lived in the area

Years	Frequency	Percent
Below 10 years	45	11.9
11-20 years	74	19.5
21-30 years	99	25.9
31-40 years	75	19.7
41-50 years	36	9.5
51-60 years	33	8.6
above61 years	19	5.0
Total	**381**	**100.0**

Mean 30± .79, Median 28, Mode 20, Std. Dev 16.35, Minimum 1, Maximum 78.

The average number of years the household heads had lived in the Kiserian-Kitengela-Isinya wildlife corridor was (M=30, SD=16.3) years.

4.3 Ecological Integrity of the Wildlife Habitat within the Kiserian-Kitengela-Isinya Corridor

The first objective of this research was to assess the current ecological integrity of the wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor in Kajiado County. Two techniques were used to determine the integrity of the wildlife habitat, socio-ecological technique based on the perceptions of the participants and ecological techniques using actual measurements of ecological attributes. This was done in order to achieve triangulation of the measurements.

4.3.1 Socio-ecological Measurement of the Wildlife Habitat

The integrity of the wildlife habitat was assessed using a socio-ecological index that was a combination of ecological items that were assessed by the participants on a scale of 0 to 10, 0 being extremely low and 10 being extremely high for the attribute being measured. The ecological attributes used for the assessment included: plant diversity (using species composition), plant cover, plant biomass, tree physical attributes (height, stumps, size of the plants, erosion features). The negative impact ratings of the attributes were converted to positive by getting the difference from 10, so as to quantify the magnitude of the impact on integrity. For example, a rating of 7 on the increase in bare areas will reduce the integrity of the ecological resources giving a lower integrity figure of 3 very low, this is realized by considering the impact of the bare areas is negative, so the difference comes to 3 which is the contribution bare areas give to the integrity of the ecological resources. This will be the opposite for the positively rated items. The rating of these ecological attributes and the descriptive statistics of the ratings both negative (7) and positive are given in Table 4.8.

Table 4.8: Socio-ecological Rating of the Ecological Integrity of the Wildlife Habitat

	Rating by Residents	
Items forming the Ecological Attributes	**Impact (Mean)**	**Integrity Mean**
Plant diversity (decrease number of different grass species)	(7.5)	2.4
Increase in woody plants	(5.6)	4.3
Ground cover (increase of bare areas)	(6.7)	3.2
Plant cover (increase in loss of grass covering the ground)	(7.9)	2.09
Plant biomass (decrease in amount of grass)	(8.7)	1.26
Plant biomass (decrease amount of woody plants/bushes)	(5.7)	4.2
Plant condition (grazing condition) being poor	(5.9)	4.0
Surface erosion (increase in stones, rock, soil loss, gullies)	(7.4)	2.5
Tree physical attributes		
Tree height (decrease)	(5.6)	4.3
Number of cut stumps (increase in number of cut stumps)	(6.7)	3.2
Wounded trees (increase in debarking, overused)	(7.9)	2.0
Size of the plants (decrease in vigour of plants)	(8.7)	1.2
increase in dead plants (grass and woody plants)	(5.7)	4.2

The rating of the different ecological attributes in terms of their impact and integrity are shown in Table 4.8. The integrity scores were then added together to form the index of ecological integrity of the wildlife habitat. The descriptive statistics for the index is shown in Table 4.9.

Table 4.9: Descriptive Statistics for the Index of Ecological Integrity of the Kiserian-Kitengela-Isinya Wildlife Habitat

Category	Description / Level	Frequency	Percent
1-2	Extremely low	4	1.0
2.1-3	Very low	185	48.6
3.1-4	Low	187	49.1
4.1-5	Medium	5	1.3
Total		**381**	**100.0**

Mean 3.04±02, Median 3.07, Mode 2.85, Std. Dev .45, Minimum 1.77, Maximum 4.3

The index for the ecological integrity of the wildlife habitat was found to be (M=3.04, SD=.45) on a scale of 0 to 10., based on this categorization the level of the index of ecological integrity of the wildlife habitat can be described to be low, meaning as a wildlife habitat the corridor was not useful.

The index of ecological integrity was for the equality of the categories using the Chi-square test and the results of the test are summarized in Table 4.10.

Table 4.10: Chi-square Test for the Equality of Categories of the Ecological Integrity of the Wildlife Habitat

Category	Observed N	Expected N	Residual	Statistics
1-2	4	95.3	-91.2	χ^2=345.87
2.01-3	185	95.3	89.8	*df*=3
3.01-4	187	95.3	91.8	*p*=.001
4.01-5	5	95.3	-90.2	
Total	**381**			

The chi-square test (Table 4.10) indicates that the majority of the participants rated the index of ecological integrity to be low (score of 3.01-4), which had the highest residual value. The chi-square test returned a statistically significant value (χ^2 345.87, *df* 3, *p*<

.001) meaning that the differences within the categories were true differences and did not occur by chance.

4.4 Ecological Integrity of Wildlife Habitat Using Ecological Measurements

The second objective of this study was to quantify the level of ecological integrity of the wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor in Kajiado County. The ecological integrity of the wildlife habitat was assessed using ecological measurements. The attributes that were measured included: Ground Cover, plant diversity, species composition, plant physical attributes (plant height, DBH, stumps, debarking). The measurements were done within the three strata (Kiserian, Kitengela and Isinya). In each stratum, line transects were stretched and random sampling points were located on the transect for measuring the ecological attributes.

4.4.1 Plant Species Composition within the Kiserian-Kitengela-Isinya Wildlife Corridor

Plant species composition within the Kiserian-Kitengela-Isinya wildlife habitat was determined using relative abundance and the results are shown in Table 4.11 for grass species and 4.12 for tree species. The results indicate that there were 28 grass species and the grass species within the habitat and *Cyperus rotundus* was the most abundant species (6.93%) and *Seteria verticillata* was found to be the least abundant species.

The plant species composition for each stratum (Kiserian, Kitengela and Isinya) were determined and the results are contained in Appendix D, in six different Tables (Table 6.3, Table 6.4, Table 6.5, Table 6.6, Table 6.7, Table 6.8).

Table 4.11: Grass Species Composition within the Kiserian-Kitengela-Isinya Wildlife Corridor

Grass Species	Number Counted	Relative Abundance
Cyperus rotundus	58	6.93
Aristida keniensis	52	6.21
Harpchne schimperii	50	5.97
Cymbopogon pospichilii	48	5.73
Aristida adoensis	48	5.73
Themeda triandra	47	5.62
Digiteria macroblephora	44	5.26
Eragrostis superba	44	5.26
Cynadon plectostachyus	43	5.14
Enteropogon macrostachyus	38	4.54
Bothriochloa insculpta	38	4.54
Chrysopogon plumulosus	36	4.30
Pennisetum mezianum	34	4.06
Chloris gayana	31	3.70
Cenchrus ciliaris	30	3.58
Heteropogon contortus	30	3.58
Hyparrhenia hirta	30	3.58
Chloris roxburghiana	24	2.87
Chloris pycnothrix	22	2.63
Digiteria milanjiana	16	1.91
Dactyloctenium aegrypticum	16	1.91
Tragus barteronianus	12	1.43
Panicun maximum	10	1.19
Sporobolus fimbriatus	10	1.19
Brachiaria brizantha	8	0.96
Pennisetum purpureum	6	0.72
Cymbopogon sp	6	0.72
Seteria verticillata	6	0.72
28	**837**	**100.00**

Table 4.12: Composition of Woody Plant Species within the Kiserian-Kitengela-Isinya Wildlife Corridor

	Three stratum in Corridor	
Tree species	**Number counted**	**Relative abundance**
Acacia drepanalobium	122	10.74
Ipomea kituensis	88	7.75
Acacia xanthophloea	66	5.81
Croton dichogamous	56	4.93
Euphorbia triucalli	51	4.49
Tarchonanthus camphoratus	48	4.23
Sanseviera robusta	46	4.05
Solonum incanum	44	3.87
Acacia tortilis	43	3.79
Euclea divinorum	39	3.43
Aloe secundiflora	38	3.35
Balanites aegyptiaca	36	3.17
Carissa edulis	35	3.08
Cambretum molle	33	2.90
Acacia seyal	32	2.82
Acacia mellifera	32	2.82
Indigifera erector	32	2.82
Commiphora swynnertonii	24	2.11
Sericocomopsis hildebrandtii	24	2.11
Acokanthera schimperi	22	1.94
Commiphora africana	18	1.58
Maytenus senegalensis	18	1.58
Acacia nilotica	16	1.41
Boscia angustifolia	16	1.41
Aspillia mossambicensis	16	1.41
Grewia villosa	15	1.32
Osyris lanceolata	14	1.23
Psidia punctulata	14	1.23
Prunus africana	12	1.06
Withania somnifera	12	1.06
Achyranthes aspera	12	1.06
Salvadora persica	10	0.88
Lippia javanica	9	0.79
Albizia amara	9	0.79
Acacia gerrardii	8	0.70
Grewia similis	8	0.70
Grewia bicolor	6	0.53
Omocarpum trachycarpum	3	0.26
Clerodendram mycoides	3	0.26
Vernonia brachycalyx	2	0.18
Aloe sp	2	0.18
Zizypus mucronata	1	0.09
Urtica massaica	1	0.09
43	**1136**	**100.00**

4.4.2 Plant Species Diversity

Plant species diversity was determined using the Shannon-Wiener index (*H'*) for the three stratum (Kiserian, Kitengela and Isinya). The calculated Shannon-Wiener index (*H'*) ranges between the values of 1 and 3. The value, categories and the interpreted are shown in Table 4. 13.

Table 4.13: Shannon-Wiener Index Interpretation

No.	Index Values	Index Category	Interpretation
1	Below 1	Very Low diversity	Degraded land (Very Poor condition)
2	1-1.5	Low diversity	Undergoing degradation (Poor Condition)
3	1.6-2	Medium diversity	Moderate degradation (Medium)
4	2-2.5	High diversity	Slight degradation (Good Condition)
5	2.6-3	Very High diversity	No degradation (Excellent Condition)

The plant species diversity (*H'*) for the three stratum are shown in Appendix E, Tables (Table 6.9, Table 6.10, and Table 6.11), while the summary is shown in Table 4.14.

Table 4.14: Plant Species Diversity for the Three Stratum within the Kiserian-Kitengela-Isinya wildlife Corridor

Stratum	Number of species	Plant Diversity	Description	Interpretation
Kiserian	72	-1.013	Low	Slightly degraded
Kitengela	61	-0.848	Very Low	Degraded
Isinya	38	-0.812	Very Low	Degraded

The plant diversity (Table4.14) for Kiserian stratum was found to be (*H'*= -1.013) with a total of 72 plant species, while for Kitengela was (H'= -0.848 with a species composition of 61. The plant diversity for Isinya was (H'=-0.812) with 38 plant species. The index was above average, indicating that the area was slightly affected.

4.4.3 Ground Cover of the Wildlife Habitat within the Kiserian-Kitengela-Isinya Corridor

The ground cover for the three stratum was determined using the point method and the results for percent vegetation cover and bare areas is shown in Table 4.15, 4.16 and 4.17.

Table 4.15: Ground Cover for Wildlife Habitat within Kiserian Stratum

Grass Species	Number Counted	Percent cover	Percent species composition
Cyperus rotundus	28	7	15.30
Cymbopogon pospichilii	18	4.5	9.84
Bothriochloa insculpta	18	4.5	9.84
Aristida adoensis	15	3.75	8.20
Enteropogon macrostachyus	14	3.5	7.65
Aristida keniensis	12	3	6.56
Themeda triandra	11	2.75	6.01
Harpchne schimperii	11	2.75	6.01
Eragrostis superba	6	1.5	3.28
Cenchrus ciliaris	5	1.25	2.73
Hyparrhenia hirta	4	1	2.19
Digiteria macroblephora	4	1	2.19
Dactyloctenium aegrypticum	4	1	2.19
Chloris roxburghiana	4	1	2.19
Heteropogon contortus	2	0.5	1.09
Chloris pycnothrix	2	0.5	1.09
Tragus barteronianus	4	1	2.19
Sporobolus fimbriatus	3	0.75	1.64
Digiteria milanjiana	3	0.75	1.64
Cymbopogon sp	3	0.75	1.64
Seteria verticillata	4	1	2.19
Panicun maximum	4	1	2.19
Brachiaria brizantha	4	1	2.19
Grass species	183	45.75	
Bare Area	175	43.75	
Litter/Mulch	42	10.5	
	400	100	

The results for Kiserian Stratum (Table 4.15), show that the plant cover was (45,75 %), while the bare areas were (43.75 %), and the dead plant materials (litter /mulch) was 10.5 %.

Table 4.16: Ground Cover for Wildlife Habitat Within Kitengela Stratum

Plant Species	**Number Counted**	**Percent Cover**	**Percent Species Composition**
Themeda triandra	9	2.25	10.84
Eragrostis superba	8	2.00	9.64
Digiteria macroblephora	8	2.00	9.64
Cymbopogon pospichilii	8	2.00	9.64
Aristida keniensis	7	1.75	8.43
Harpchne schimperii	6	1.50	7.23
Aristida adoensis	3	0.75	3.61
Cyperus rotundus	2	0.50	2.41
Cynadon plectostachyus	2	0.50	2.41
Pennisetum mezianum	1	0.25	1.20
Heteropogon contortus	1	0.25	1.20
Enteropogon macrostachyus	1	0.25	1.20
Chrysopogon plumulosus	1	0.25	1.20
Chloris gayana	1	0.25	1.20
Cenchrus ciliaris	1	0.25	1.20
Hyparrhenia hirta	4	1.00	4.82
Bothriochloa insculpta	3	0.75	3.61
Digiteria milanjiana	3	0.75	3.61
Chloris roxburghiana	4	1.00	4.82
Panicun maximum	2	0.50	2.41
Chloris pycnothrix	2	0.50	2.41
Tragus barteronianus	2	0.50	2.41
Brachiaria brizantha	1	0.25	1.20
Sporobolus fimbriatus	1	0.25	1.20
Pennisetum purpureum	1	0.25	1.20
Seteria verticillata	1	0.25	1.20
Grass species	83	20.75	
Litter /Mulch	52	13.00	
Bare areas	266	66.50	
	400	**100.00**	

The ground cover for Kitengela stratum is shown in Table 4.16. The plant cover was 20.75 %, while the bare areas covered 66.5 % and decomposing plant material made up the rest 13 %.

Table 4.17: Ground Cover for Wildlife Habitat within Isinya Stratum

Plant Species	Number Counted	Percent Cover	Percent Species Composition
Harpchne schimperii	13	3.25	8.07
Aristida keniensis	13	3.25	8.07
Digiteria macroblephora	12	3.00	7.45
Eragrostis superba	10	2.50	6.21
Chloris gayana	10	2.50	6.21
Aristida adoensis	10	2.50	6.21
Chrysopogon plumulosus	9	2.25	5.59
Themeda triandra	8	2.00	4.97
Pennisetum mezianum	8	2.00	4.97
Hyparrhenia hirta	8	2.00	4.97
Heteropogon contortus	8	2.00	4.97
Cyperus rotundus	8	2.00	4.97
Cynadon plectostachyus	8	2.00	4.97
Chloris pycnothrix	6	1.50	3.73
Cenchrus ciliaris	5	1.25	3.11
Enteropogon macrostachyus	4	1.00	2.48
Digiteria milanjiana	4	1.00	2.48
Chloris roxburghiana	4	1.00	2.48
Bothriochloa insculpta	3	0.75	1.86
Pennisetum purpureum	2	0.50	1.24
Panicun maximum	2	0.50	1.24
Cymbopogon pospichilii	2	0.50	1.24
Tragus barteronianus	1	0.25	0.62
Sporobolus fimbriatus	1	0.25	0.62
Dactyloctenium aegrypticum	1	0.25	0.62
Brachiaria brizantha	1	0.25	0.62
Vegetation cover	161	40.25	
Bare Areas	210	52.50	
Litter/Mulch	29	7.25	
28	**400**	**100.00**	

The results of ground cover for the Isinya stratum are shown in Table 4.17. the plant cover was 40.25 %, while the bare areas were 52.50 % and the plant litter was 7.25 %. The plant species composition was mainly composed of annuals and biennial grass species of low grazing value *Harpchne schimperii* (8.07 %) and *Aristida keniensis* (8.07 %).

4.4.4 Tree Physical Attributes within the Wildlife Habitat

Woody plants (tree) attributes measured included: stem (trunk or bole) diameter measured at adult breast height of 1.37 m (4.5 ft.) above ground (referred to as DBH), tree height, cut tree stumps, and debarking or branch cutting. The attributes were measured on random selected plants along laid down transects.

DBH and Woody Plant Heights in the three Stratum

The DBH and plants heights were measured in centimeters and the means are shown in Figure 4.1.

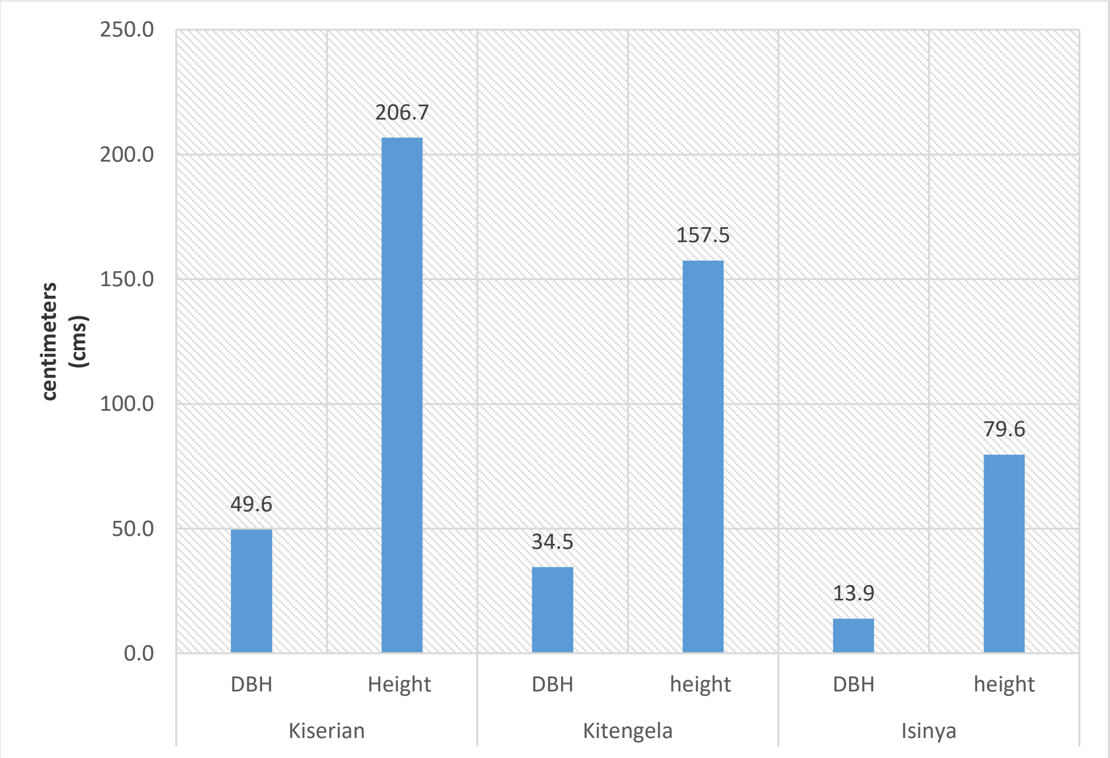


Figure 4.1: Means of DBH and tree heights within the three Stratum (Kiserian, Kitengela and Isinya).

The DBH was highest in Kiserian Stratum (M=49.6 cms) and lowest for Isinya stratum (M=13.9 cms) and Kitengela was in middle (M=34.5). Woody plants heights were (M=206.7 cms) for Kiserian, Kitengela (M=157.5cms) and Isinya (79.6 cms).

Number of Disturbed Trees

Cut Tree Stumps

The number of tree stumps were counted on four different transects in each of the three stratum, this signified dead plant species. The number of stumps were the added together and a mean calculated, and the results are given in Table 4.18. This variable is an indicator of the extractive loss caused to the vegetation.

Table 4.18: Descriptive Statistics of Woody Plants Cut Stumps within the Wildlife Habitat

	Transects					
Stratum	**A**	**B**	**C**	**D**	**Total**	**Mean**
Kiserian	5	5	3	1	14	3.5
Kitengela	11	22	12	27	90	22.5
Isinya	33	13	36	29	111	27.75

The extractive loss of the trees (Table 4.18) shows that the loss was highest in Isinya (M=27.75), followed by Kitengela (M=22.5) and finally Kiserian (M=3.5).

Debarked, Cut Branches and Root Removal

The trees that were wounded in any manner (debarked, cut branches, and root removal) were counted and the means calculated for each of the stratum, and the results are shown in Table 4.19.

Table 4.19: Number of Debarked Woody Species in the Three Stratum of the Wildlife Habitat

	Transects					
Stratum	**A**	**B**	**C**	**D**	**Total**	**Mean**
Kiserian	24	1	16	18	59	14.75
Kitengela	12	44	23	29	108	27
Isinya	19	36	49	51	155	38.75

The number of wounded woody plants was highest in Isinya stratum (M=38.75), followed by Kitengela (27) and finally Isinya (M=14.75).

4.4.5 Index of Ecological Integrity of the Wildlife Habitat

The ecological integrity of the wildlife habitat was quantified based the measured ecological attributes, which were combined to form an index of ecological integrity. The measured attributes, which were measured in the three stratum, included the following: (i) species richness in the three strata, denoted by the number of species in the community, (ii) plant species diversity (*H'*) using the five categories shown in Table 4.13, (iii) ground cover, denoted by plant species cover and litter, and (iv) woody plants attributes, the higher the attribute value, denotes a negative contribution to the integrity of the habitat. These attributes were measured as shown in section 4.4 of this thesis. The four attributes were added together to form the of Ecological Integrity Index (EII) for each stratum in the Kiserian-Kitengela-Isinya wildlife corridor (Table 4.20).

Table 4.20: Ecological Integrity Index for the Wildlife Habitat within Kiserian-Kitengela-Isinya Wildlife Corridor

Ecological Attributes	Stratum			Total
	Kiserian	Kitengela	Isinya	
Species richness				
Grass species	477/28=17	249/28=8.8	161/28=5.7	10.5
Woody species	519/43=12	340/43=7.9	274/43=6.3	8.7
Species diversity (H')	2	1	1	1.3
Grass and litter cover	56.5	47.5	33.75	45.91
Plant attributes				
DBH	49.6	34.5	13.9	43.61
Plant height	206.7	157.5	79.6	147.9
Cut stumps	(3.5)	(22.5)	(27.75)	(17.91)
Branch, bark, root removed	(14.75)	(27.0)	(38.75)	(26.8)
Total	**325.55**	**207.7**	**73.75**	**213.21**

The ecological integrity Index determined using ecological measurements for the wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor was found to be low with a value of (213). The Kiserian stratum had the highest (325) ecological integrity value, followed by Kitengela (207) and finally Isinya stratum (73).

4.4.6: Assessment of the Ecological Integrity of Representative Sites within the Kiserian-Kitengela-Isinya Wildlife Corridor

The section presents an evaluation of different sites within the wildlife corridor using the Ecological integrity index.

Comparison of a Good and Poor Site

The Figure 4.2 is a photo of a site in the Kitengela stratum showing a contrast between two sites, A site with high integrity on the left and a site with low integrity on the right of the fence. The left site has high ground cover, high plant diversity and low extractive aspects compared to the right site with low ground cover, low plant diversity (level 1) and exhibits a lot of extractive features.

Figure 4.2: A comparison of two sites in Kitengela stratum.

Sites Depicting Very Low Ecological Integrity

The Figure 4.3, Figure 4.4 and Figure 4.5, show different sites within the wildlife corridor that were a clear depiction of very low ecological integrity.

Figure 4.3: Very low integrity and ground cover with signs of soil loss

Figure 4.4: Loss of top soil and a stone mantle, ground covered by annual grass

Figure 4.5: gullies formed after loss of plant cover

Sites Depicting Low Integrity

Figure 4.6, and Figure 4.7 depict low ecological integrity.

Figure 4.6: some soil covers the mantle with most of the plants being overused

Figure 4.7: low integrity, low height and DBH of woody plant species, low cover

Figure 4.7b: low cover, overused area and depicting low diversity

Figure 4.8: A lot of bare areas, low plant cover and soil loss

Figure 4.9: Overuse of the perennial grass species, a lot of forbs and bare areas

Medium Integrity sites

Figure 4.10: perennial grasses still visible, increase in bare areas

Figure 4.11: Soil covered with perennial grass cover, over browse of woody plants

Good Integrity Sites

Figure 4.12: Good perennial grass cover, high plant diversity

Figure 4.13: Tall perennial grass species, good ground cover

Figure 4.14: Good perennial grass cover and less bare areas

Excellent / High Integrity Sites

Figure 4.15: High plant species diversity, good plant cover

Figure 4.16: Tall perennial grass cover, high plant species diversity

Figure 4.17: good ground cover, high species diversity

Figure 417b: Impalla grazing

4.5 Anthropogenic Influences within the Wildlife Habitat in the Kiserian-Kitengela-Isinya Wildlife Corridor

The third objective of this study was to quantify the anthropogenic activities influencing the ecological integrity of the wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor in Kajiado County. This objective was accomplished by observing and taking photos of the different anthropogenic activities within the corridor, secondary data and rating the perceptions of the participants.

4.5.1 Observations of Anthropogenic Influences within the Wildlife Corridor

The following activities were observed to occur within the wildlife corridor and they had negative influences to the integrity of the Kiserian-Kitengela-Isinya wildlife habitat. They included fencing of individual parcels, urban centers, industries and mining blocking the access of the area for animals and affecting the ecological integrity of the wildlife habitat.

Fencing of individual parcels of land within the corridor (Figure 4.17 and Figure 4.18) were observed. These were identified by the respondents as some of the activities affecting the wildlife habitat and the movement of the animals within the Kiserian-Kitengela-Isinya wildlife corridor.

Source: Photograph taken by the researcher

Figure 4.17: Wildlife proof fencing within the corridor

Source: Photograph taken by the researcher

Figure 4.18: Fencing and crop growing within the corridor

Increase in infrastructural developments such as roads (Figure 4.19), railway lines (SGR Figure 4.21 and 4.22) blocking access to the wildlife habitat and causing Human-Wildlife conflicts (Figure 4.20).

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Source: Photograph taken by the researcher

Figure 4.19: An access road made within the corridor by tourists

Source: Photograph taken by the researcher

Figure 4.20: Livestock killed by predators

Source: Photograph taken by the researcher

Figure 4.21: Standard Gauge Railway Line (SGR) cutting across the Wildlife Corridor

Source: Photograph taken by the researcher

Figure 4.22: Urban centre (Athi River) town and the SGR cutting across the Corridor

Human encroachment in form of industries (Figure 4.23 and 4.24) within the Kiserian-Kitengela-Isinya wildlife Corridor has resulted to habitat degradation and habitat loss along the corridor.

Source: Photograph taken by the researcher

Figure 4.23: Cement factory

Source: Photograph taken by the researcher

Figure 4.24: Electricity Company

The extractive activities such as mining of stones (Figure 4.25), sand, and soil within the corridor causes vegetation loss and this reduces the quality of the habitat for animals.

Source: Photograph taken by the researcher

Figure 4.25: A stone quarry located inside the Kiserian-Kitengela-Isinya wildlife corridor

4.5.2 Assessment of the Anthropogenic Influences on the Wildlife Habitat within the Kiserian-Kitengela-Isinya Corridor by the Participants

An index of anthropogenic influences on the wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor was developed by having the participants rating the different human activities that have a bearing on the ecological integrity of the wildlife habitat. The participants were asked to rate the activities on a 10-point scale ranging from 0 to 10, 0 indicating no influence and 10 indicating high influence. The attributes that were rated for this index, included: pressure from increased population indicated by the number of people within households, blockage of corridor due to settlement, extent of extractive use within the corridor by number of quarries, extent of plant loss due to grazing animal (overgrazing), livestock numbers, extent of crop farming, fencing of parcels, cutting of trees and increase in urban and rural centers. The scores were analysed and their descriptive statistics are presented in Table 4.21.

Table 4.21: Descriptive Statistics of the Ranking of Anthropogenic Items by Participants

		Rating of the items by Participants	
No	**Anthropogenic Activities Items/ indicators**	**Mean**	**SD**
1	pressure from increased population (number of people in household)	8.9	1.18
2	Blockage of corridor due to settlement (increase in number of settlement, houses or *manyattas*)	7.5	1.19
3	Extent of mineral extraction (number of quarries)	7.4	1.21
4	Extent of plant loss due to grazing animals (increase in number of animals per grazing area)	7.7	1.19
5	Extent of plant loss due extractive use (cutting of trees)	7.9	1.25
6	Increase in individual parcels and fencing of parcels	8.2	.715
7	Increase in bare areas (bareness)	8.7	.715
8	Extent of crop farming	7.1	1.20
9	Increase in urban and rural centers	8.0	1.23
10	Infrastructure (roads, installations, factories)	9.1	1.11

The household rating of the different indicators depicting anthropogenic influences within the wildlife habitat is shown in Table 4.21. The scores were then added together to form the index of anthropogenic activities within the Kiserian-Kitengela-Isinya wildlife habitat, whose descriptive statistics are shown in Table 4.22.

Table 4.22: Descriptive Statistics for the Index of Anthropogenic Influences

Categories	Frequency	Percent
6-7	52	13.6
7.01-8	211	55.4
8.01-9	104	27.3
9.01-10	14	3.7
Total	**381**	**100.0**

Mean 7.74±.03, Mean 7.77, Median 7.78, Std. Dev .65, Minimum 6.4, Maximum 9.3

The index of Anthropogenic influences within the Kiserian-Kitengela-Isinya wildlife corridor was found to be (M=7.74, SD=.65). The data was grouped into four categories and the chi-square test was performed to determine the equality of the categories and the results are shown in Table 4.23.

Table 4.23: Chi-square Test for the Equality of Categories for the Index of Anthropogenic influences within the Kiserian-Kitengela-Isinya Wildlife Corridor

Category	Observed N	Expected N	Residual	Statistics
6-7	52	95.3	-43.2	χ^2 =230.41
7.01-8	211	95.3	115.8	df=3
8.01-9	104	95.3	8.8	p=.001
9.01-10	14	95.3	-81.2	
Total	381			

Mean 7.74±.03, Median 7.77, Mode 7.78, Std. Dev .650, Min 6.44, Max 9.33

The chi-square test indicates that the majority of the participants' rating of the anthropogenic influences was in the high level category (score of 7.01-8), which had the highest residual value. The chi-square test returned a statistically significant value (χ^2 230.41, *df* 3, p <.001) meaning that the differences within the categories were true differences and did not occur by chance.

4.6 Influence of Anthropogenic Activities on the Ecological Integrity of Wildlife Habitat within the Kiserian-Kitengela-Isinya Wildlife Corridor

The fourth objective of this study was to assess the influence of anthropogenic activities on the ecological integrity of the wildlife habitat along the Kiserian-Kitengela-Isinya wildlife corridor in Kajiado County. this objective was accomplished through the use of bivariate linear regression analysis. The index of anthropogenic activities (section 4.5) was the independent variable and the ecological integrity of the wildlife habitat (section 4.4) was the dependent variable. The results of the regression model are shown in Table 4.24.

Table 4.24: Regression Model Summary for Anthropogenic Influences and the Ecological Integrity of the Wildlife Habitat

R	R Square	Adjusted R Square	Std. Error of the Estimate
.263[a]	.069	.167	.434

The regression model indicates an adjusted R^2 value of 0.167, meaning that the independent variable, anthropogenic influences explained approximately 16.7 % of the variation in the dependent variable ecological integrity of the wildlife habitat. The *F* test for the fit of the regression model is shown in the ANOVA Table 4.25.

Table 4.25: ANOVA Table for the Regression Testing the Fit of the Model

	Sum of Squares	df	Mean Square	*F*	*p*
Regression	5.326	1	5.326	28.173	.001
Residual	71.650	379	.189		
Total	76.976	380			

The fit of the overall regression model was found to be significant (*F* (1,379) =28.17, *p* <. 001). The regression coefficients of the model showing the *beta,* and *t* statistics are shown in Table 4.26.

Table 4.26: Regression Coefficients for Anthropogenic Influences and the Ecological Integrity of Wildlife Habitat

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics
	B	Std. Error	Beta	t	p.	VIF
(Constant)	5.550	.267		20.82	.001	
Anthropogenic	.182	.034	-.263	5.30	.001	1.000

The regression analysis (Table 4.26) shows that the anthropogenic influences Statistically significantly influenced (*β*=-.263, *t*=-5.30, *p*<.001) negatively the ecological integrity of the wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor. This indicates that as the anthropogenic influences increased the ecological integrity of wildlife habitat decreased.

CHAPTER FIVE

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the study, discussion of the results, conclusions of the study and the recommendations made.

5.2 Summary of the Study

This study aimed at assessing the influence of the anthropogenic activities on the ecological integrity of wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor in Kajiado County. The study triangulated socio-ecological and ecological methods in assessing the ecological integrity of the wildlife habitat. Personal observations, primary data using questionnaires and ecological measurements and secondary data were used in the analysis. The study then utilized descriptive and inferential statistics to analyse the data. The results indicated that anthropogenic activities within the wildlife corridor had increased substantially and were rated (M=7.74, SD=.65), on a scale of 0 to 10. The anthropogenic activities were found to have had significant negative influences on the ecological integrity of the wildlife habitat within the corridor.

5.3 Discussion

The findings for this study are discussed in this section based on the specific objectives of the study as stated in section 1.4 of this thesis.

5.3.1 Household Characteristics

Said *et al.* (2016) in his study suggested that the community has continuously been exposed to increased education coupled with government policies directed at reducing human encroachment. The result is that majority of the younger population are finding settlement in these areas less than favourable. They seek out education and employment in areas that are far from the settlements and traditional farms.

5.3.2 Ecological Integrity of the Wildlife Habitat within the Kiserian-Kitengela-Isinya Wildlife Corridor

The level of the ecological integrity of the wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor was found to be low having been affected by the anthropogenic activities within the area. This situation affects the wildlife home ranges, which extends to the community land and the corridor where lions attack livestock (Lesilau et al., 2021).

The species diversity using the Shannon-Wiener index (*H'*) was found to be lower than the one recorded by Gebreyohannes (2013) in the same area. The figures in 2013 ranged between 1.436, the lowest to 1.707, the highest. The figures from this study were lower and ranged between 0.808 to 1.2. The grass species identified by Kamau et al. (2020) as useful (*Cynodon plectostachyus*, *Chloris gayana*, *Pennisetum clandestinum, Cymbopogon citratus*, and *Themeda triandra)* for the rehabilitation of rangelands and control of soil erosion control and were found to be of low abundance in the data of this study. Ndung'u (2016) working in Kajiado found a declining trend in the quality and availability of indigenous grass species and identified the cause to be drought, overgrazing and increased human disturbances, especially in the removal of plant roots for medicinal purposes (Nankaya et al., 2020). Household density and cultivation intensity were negatively correlated with grass cover and were greatest on small-scale farms and lowest in a dedicated PA (Mworia et al., 2008).

5.3.3 Extent of Anthropogenic Influences within the Kiserian-Kitengela-Isinya Wildlife Corridor

The anthropogenic influences within the wildlife corridor were found to be high and they influenced the ecological integrity of the wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor negatively. This situation agrees with what other authors have found in this area. Imbahale et al. (2008) observed a distinct variation in the biomass within the NNP and the study area due to increased land subdivision, which had an impact in the movement of migratory wild ungulates. Boone et al. (2006) observed increased intensification of livestock production from extensive group ranches to subdivided plots, and changing livelihoods. Kiboro and Kiboro (2016) found increased human activity within the corridor, especially the Kitengela area, where activities such as fencing and land subdivision, flower farming, human settlement, mining and quarrying and sale of land were on the increase. Megaze et al. (2017) identified Human-Wildlife Conflicts (H-WC) as another factor causing negative influences within the surrounding protected areas (PAs). To this list of human activities impacting on the integrity of the wildlife corridor Hyman (2011) included an oil pipeline within the Park and corridor. The extent of land use changes and land tenure types has increased human activities in the corridor (Mbane et al., 2019). The increase in the percent of built up environment is a major human activity that was identified to exist in the corridor (Mwendwa et al., 2017), this has also enhanced Human-Wildlife Conflicts and negative attitudes towards wildlife in the area (Megaze et al., 2017; Rushkya, 2019).

The behaviour of animals within the corridor, has also changed to take considerations of the human activities in the corridor (Barrett et al., 2019). The animals take advantage of new resources and opportunities associated with anthropogenic disturbance in the area.

5.3.4 Influence of Anthropogenic Activities on the Ecological Integrity of the Kiserian-Kitengela-Isinya Wildlife Corridor

The anthropogenic activities within the wildlife habitat statistically significantly influenced the ecological integrity of Kiserian-Kitengela-Isinya wildlife corridor negatively. The increase in anthropogenic activities reduced the level of the ecological integrity of the wildlife habitat. These findings are in line with Mworia et al. (2008) who concluded that cultivation and household density were key anthropogenic activities that destroyed wildlife habitats. Huntsinger & Sayre (2017) concluded that there were many factors that controlled the quality and productivity of rangeland vegetation, which were biotic in nature. A study by Shema (2019) in the area same area spanning the corridor concluded that there were largescale developments currently in progress which included wind energy facilities, a Standard Gauge Railway, cement factories, and a major expressway. Ambani & Mulaku (2021) study estimated this loss as SGR effect on NNP. He concluded that the SGR-I had encroached on Nairobi National Park occupying an area of 87.29 Hectares and the proposed SGR-IIA, which was to cut across the park caving out an area of 42 Hectares. Moreover, approximately 500.61 Hectares of vegetation cover was to be lost to construction and operation of the SGR affecting wildlife migration routes negatively. Reid et al. (2008) documented the historical fragmentation of the Athi-Kaputei ecosystem which currently constitutes the Kiserian-Kitengela-Isinya wildlife corridor and identified fencing, roads, land demarcation, population growth and industrial activities as the factors causing this fragmentation.

5.4 Conclusions

The following conclusions were made from this study:

(i) The ecological integrity of the wildlife habitat within the Kiserian-Kitengela-Isinya wildlife corridor was found to be compromised to an extent that the wildlife species utilization and migration within the corridor is affected and in most cases is non-existent.

(ii) The assessment of the ecological integrity using socioecological and ecological measurements are comparable, it is therefore possible to triangulate the information from the two assessments.

(iii) The anthropogenic influences within the Kiserian-Kitengela-Isinya wildlife corridor were found to be very high and increasing in extent.

(iv) The anthropogenic activities within the Kiserian-Kitengela-Isinya wildlife corridor were found to negatively influence the ecological integrity of the wildlife habitat to an extent that the wildlife species have diminished and in some places are non-existent

5.5 Recommendations

From the findings of this study, it is recommended that;

The community in the vicinity of the corridor need to benefit from the money accrued from wildlife management so as they can maintain the wildlife corridor. The concept Payment for Environmental Services (PES), where the people conserving the resources are paid a fee from the proceeds arising from the resource use. The payment could be direct payment in form of cash or through Corporate Social Responsibility (CSR), such as providing social amenities to the community.

The national and county government land use policy of the area needs to be reviewed to make it compatible with wildlife management by either fencing the corridor or encouraging the community to have activities that take in to consideration the wildlife species, initiatives such as the conservation land lease program.

5.6 Recommendation for Further Research

(i) Assessment of the knowledge dissemination in the community with regard to effects of human encroachment

(ii) Effect of collective action in addressing the challenges of human encroachment into wildlife habitats

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APPENDICES

Appendix A: Household Questionnaire

Household information

1. Respondent's name: ....
2. Sex: i) Male ( ) ii) Female ( )
3. Age...... Marital Status i) Married ( ) ii) Single ( ) iii) Divorced ( ) iv) Widow ( )
4. Education level: i) None ( )ii) Primary ( ) iii) Secondary ( ) iv) Tertiary ( )
5. Main Source of livelihood: i) Livestock ( ) ii) Crop cultivation ( ) iii) Business ( ) iv) Formal Employment ( ) v) Others ....
6. How long have you lived in this area? ______________
7. Did you inherit the land or purchased the land? ______________________
   (i) Inheritance ( ) (ii) Purchase ( )
8. Have you experienced any wildlife attacks? i) Yes ( ) ii) No ( )
9. If yes, what animal attacked?
10. How many times have you been attacked by wildlife?
11. What are the current estimates of wildlife numbers by species (use Table)
12. What are the trends of wildlife numbers by species over the last 10 years? Have the numbers increased or decreased?

Wildlife species	**Current numbers in the area**	**Trends (increased or decreased)**
Buffalo		
Zebra		
Kongoni		
Gazelles		
Giraffe		
Wildebeest		
Ostrich		
Lions		
Hyenas		
Cheetah		
Leopard		

13. Grazing conditions: has vegetation increased or decreased over the last 10 years

Plant species	**Increased in amount**	**Decreased in amount**
Grasss		
Chloris gayana		
Eragrostis superba		
Themeda triandra		
Bothriochloa insculpta		
Sehima nervosum		
Cynadon dactylon		
Panicum coloratum		
Cenchrus ciiaris		

Bush species		
Acacia tortilis		
Acacia drepanalobium		
Acacia seyal		
Acacia xanthoploea		
Trees		
Areas that are bare (without plant cover)		
Eroded areas		

Ecological integrity of the wildlife corridor

Rate the following attributes that are related to the integrity of the wildlife corridor on a scale of 0 to 10 (0= No influence or impact to10=extremely high impact to the integrity)

Attribute	Rating (0 to 10)
Plant diversity (decrease number of different grass species)	
Increase in woody plants	
Ground cover (increase of bare areas)	
Plant cover (increase in loss of grass covering the ground)	
Plant biomass (decrease in amount of grass)	
Plant biomass (decrease amount of woody plants/bushes)	
Plant condition (grazing condition) being poor	
Surface erosion (increase in stones, rock, soil loss, gullies)	
Tree physical attributes	
Tree height (decrease)	
Number of cut stumps (increase in number of cut stumps)	
Wounded trees (increase in debarking, overused)	
Size of the plants (decrease in vigour of plants)	
---increase in dead plants (grass and woody plants)	

Human encroachment

14. Number of your units (houses, manaytta) you own ………………
15. Size of your farm …………………
16. Number of household members ……………… Male ………. Females …………
17. Number of homesteads in the area ………………. Count …………….
18. Have the homesteads increased over the last 10 years (Yes/ No)

19. Are the homesteads fenced (Yes/No)
20. Describe the type of fencing

21. Livestock numbers

Animal species	**Numbers**	**Trend**	**Where marketed**
Cattle Female			
Cattle Male c			
Goats			
Sheep			
Poultry			

22. Crops grown:

Crop	**Acreage**	**Average production**	**Where marketed**
Rainfed crops			
Maize			
Beans			
sorghum			
Irrigated crops			
vegetables			
flowers			
Green house			
Flowers			
Vegetables			

Anthropogenic Influences on the wildlife habitat

Rate the following human activities that are practised in the corridor that would impact on the integrity of the wildlife habitat. The scale to use is 0 to 10, where 0 is no impact or influence and 10 is extremely high influence.

Activities	**Rating on a scale 0-10**
Pressure from increased human population in the area	
Increase in settlements (manyatta and houses)	
Increase in extractive use (quarries)	
Increase in extractive use (cutting of trees and bushes)	
Loss of plant species through grazing	
Increase in bare areas due to human influences	
Opening areas for cropping	
Increase in livestock numbers	
Blockage of passage for wild animals	
Increase in fencing	
Increase in fencing	
Increase in infrastructure	

Household activities

23. Do you use firewood for the home (Yes/ No)
24. State the amount of firewood used per day ………………..
25. Do you use charcoal (Yes/ No)
26. Do you burn charcoal (Yes/ No)
27. State number of bags per month ………………
28. Do you use grass to thatch (roof) your house (Yes/ No)

Quarries

29. Number of quarries in the area ………………
30. Size of the quarries ………………..

Industries and shopping centres

31. Have the number of industries increased?
32. Have the number of shopping centres increased?
33. Does this increase affect the number of wildlife (Yes/ No)
34. How ……………………………………………………….

Wildlife Perceptions

35. Do you think these changes have affected wildlife populations (Yes/ No)
36. How ……………………………………………………….

Appendix B: FGD Questions

QUESTION GUIDE FOR FOCUS GROUP DISCUSSIONS INTERVIEWS ALONG KISERIAN-KITENGELA-ISINYA CORRIDOR

Questions that will guide the focus group discussions include:

1. What is your opinion on human encroachment along the corridor? (settlement, crop cultivation, infrastructure)
   i) Has it increased (Reason)
   ii) Remained the same (Reason)
   iii) Has it decreased (Reason)
2. How has human encroachment influenced your co-existence with the wildlife?
3. How are the trends in human-wildlife conflict along the corridor?
   i) Has it increased (Reason)
   ii) Remained the same (Reason)
   iv) Has it decreased (Reason)
4. What type of human-wildlife conflict have you experienced?
5. What causes the conflict?
6. What is normally your reaction when attacked by a wild animal? (Kill, Call KWS, Police, Scare them away)
7. What is your opinion on KWS on mitigation of human-wildlife conflict?
8. What do you think should be done to reduce human-wildlife conflict along Kiserian-Isinya corridor?

Appendix C: Protocols Used During Ecological Data Collection

Table 6.1: Plant Species Checklist

No.	species	%occurrence	family	Occurrence in strata		
				Kiserian	Kitengela	Isinya

Table 6.2: Ground Cover (Point Sampling)

Species	Number Of Hits In The plots	Percent Cover	Percentage Vegetation Cover

Appendix D: Map of Study Area

Source: Map hill

Figure 6.1 Map of Nairobi and its Surrounding Areas

Appendix E: Field Data and Results on Plant Species Composition

Table 6.3: Grass Species Composition in Kiserian Stratum

	Kiserian	
Grass Species	**Number Counted**	**Relative Abundance**
Themeda triandra	21	4.92
Chloris roxburghiana	14	3.28
Chloris pycnothrix	12	2.81
Digiteria milanjiana	6	1.41
Digiteria macroblephora	14	3.28
Aristida keniensis	22	5.15
Cenchrus ciliaris	15	3.51
Eragrostis superba	16	3.75
Chrysopogon plumulosus	17	3.98
Cynadon plectostachyus	23	5.39
Panicun maximum	4	0.94
Enteropogon macrostachyus	24	5.62
Sporobolus fimbriatus	7	1.64
Bothriochloa insculpta	28	6.56
Pennisetum mezianum	16	3.75
Heteropogon contortus	12	2.81
Cymbopogon pospichilii	28	6.56
Hyparrhenia hirta	14	3.28
Brachiaria brizantha	4	0.94
Dactyloctenium aegrypticum	14	3.28
Chloris gayana	11	2.58
Pennisetum purpureum	2	0.47
Cymbopogon sp	6	1.41
Aristida adoensis	25	5.85
Seteria verticillata	5	1.17
Tragus barteronianus	8	1.87
Cyperus rotundus	38	8.90
Harpchne schimperii	21	4.92
28	**427**	**100.00**

Table 6.4: Grass Species Composition within Kitengela Stratum

	Kitengela	
grass species	Number Counted	Relative Abundance
Themeda triandra	18	7.23
Chloris roxburghiana	6	2.41
Chloris pycnothrix	4	1.61
Digiteria milanjiana	6	2.41
Digiteria macroblephora	18	7.23
Aristida keniensis	17	6.83
Cenchrus ciliaris	10	4.02
Eragrostis superba	18	7.23
Chrysopogon plumulosus	10	4.02
Cynadon plectostachyus	12	4.82
Panicun maximum	4	1.61
Enteropogon macrostachyus	10	4.02
Sporobolus fimbriatus	2	0.80
Bothriochloa insculpta	7	2.81
Pennisetum mezianum	10	4.02
Heteropogon contortus	10	4.02
Cymbopogon pospichilii	18	7.23
Hyparrhenia hirta	8	3.21
Brachiaria brizantha	3	1.20
Dactyloctenium aegrypticum	1	0.40
Chloris gayana	10	4.02
Pennisetum purpureum	2	0.80
Cymbopogon sp	0	0.00
Aristida adoensis	13	5.22
Seteria verticillata	1	0.40
Tragus barteronianus	3	1.20
Cyperus rotundus	12	4.82
Harpchne schimperii	16	6.43
28	249	100.00

Table 6.5: Grass Species Composition for Isinya Stratum

	Isinya	
Grass Species	**Number Counted**	**Relative Abundance**
Themeda triandra	8	4.97
Chloris roxburghiana	4	2.48
Chloris pycnothrix	6	3.73
Digiteria milanjiana	4	2.48
Digiteria macroblephora	12	7.45
Aristida keniensis	13	8.07
Cenchrus ciliaris	5	3.11
Eragrostis superba	10	6.21
Chrysopogon plumulosus	9	5.59
Cynadon plectostachyus	8	4.97
Panicun maximum	2	1.24
Enteropogon macrostachyus	4	2.48
Sporobolus fimbriatus	1	0.62
Bothriochloa insculpta	3	1.86
Pennisetum mezianum	8	4.97
Heteropogon contortus	8	4.97
Cymbopogon pospichilii	2	1.24
Hyparrhenia hirta	8	4.97
Brachiaria brizantha	1	0.62
Dactyloctenium aegrypticum	1	0.62
Chloris gayana	10	6.21
Pennisetum purpureum	2	1.24
Cymbopogon sp	0	0.00
Aristida adoensis	10	6.21
Seteria verticillata	0	0.00
Tragus barteronianus	1	0.62
Cyperus rotundus	8	4.97
Harpchne schimperii	13	8.07
28	**161**	**100.00**

Table 6.6: Tree Species Composition for Kiserian Stratum

Tree species	**Kiserian**	
	Number counted	**Relative abundance**
Acacia nilotica	10	1.93
Acacia seyal	11	2.12
Acacia drepanalobium	52	10.02
Acacia xanthophloea	33	6.36
Acacia tortilis	23	4.43
Acacia gerrardii	3	0.58
Acacia mellifera	12	2.31
Prunus africana	4	0.77
Osyris lanceolata	6	1.16
Acokanthera schimperi	20	3.85
Carissa edulis	15	2.89
Psidia punctulata	8	1.54
Commiphora africana	9	1.73
Commiphora swynnertonii	14	2.70
Maytenus senegalensis	8	1.54
Tarchonanthus camphoratus	18	3.47
Vernonia brachycalyx	2	0.39
Cambretum molle	16	3.08
Euclea divinorum	16	3.08
Euphorbia triucalli	27	5.20
Croton dichogamous	36	6.94
Omocarpum trachycarpum	1	0.19
Grewia bicolor	3	0.58
Grewia similis	3	0.58
Zizypus mucronata	1	0.19
Salvadora persica	7	1.35
Urtica massaica	1	0.19
Clerodendram mycoides	3	0.58
Withania somnifera	2	0.39
Grewia villosa	5	0.96
Boscia angustifolia	6	1.16
Sericocomopsis hildebrandtii	14	2.70
Ipomea kituensis	38	7.32
Lippia javanica	5	0.96
Balanites aegyptiaca	16	3.08
Aspillia mossambicensis	8	1.54
Indigifera erector	24	4.62
Achyranthes aspera	2	0.39
Albizia amara	2	0.39

Solonum incanum	15	2.89
Aloe secundiflora	8	1.54
Sanseviera robusta	12	2.31
Aloe sp	0	0.00
43	519	100.00

Table 6.7: Tree Species Composition for Kitengela Stratum

	Kitengela	
Tree Species	**Number counted**	**Relative abundance**
Acacia nilotica	3	0.88
Acacia seyal	11	3.24
Acacia drepanalobium	49	14.41
Acacia xanthophloea	22	6.47
Acacia tortilis	13	3.82
Acacia gerrardii	3	0.88
Acacia mellifera	6	1.76
Prunus africana	4	1.18
Osyris lanceolata	4	1.18
Acokanthera schimperi	6	1.76
Carissa edulis	12	3.53
Psidia punctulata	3	0.88
Commiphora africana	6	1.76
Commiphora swynnertonii	5	1.47
Maytenus senegalensis	7	2.06
Tarchonanthus camphoratus	15	4.41
Vernonia brachycalyx	0	0.00
Cambretum molle	9	2.65
Euclea divinorum	13	3.82
Euphorbia triucalli	13	3.82
Croton dichogamous	10	2.94
Omocarpum trachycarpum	1	0.29
Grewia bicolor	2	0.59
Grewia similis	3	0.88
Zizypus mucronata	0	0.00
Salvadora persica	2	0.59
Urtica massaica	0	0.00
Clerodendram mycoides	0	0.00
Withania somnifera	5	1.47
Grewia villosa	5	1.47
Boscia angustifolia	6	1.76

Sericocomopsis hildebrandtii	4	1.18
Ipomea kituensis	23	6.76
Lippia javanica	2	0.59
Balanites aegyptiaca	10	2.94
Aspillia mossambicensis	5	1.47
Indigifera erector	7	2.06
Achyranthes aspera	7	2.06
Albizia amara	2	0.59
Solonum incanum	13	3.82
Aloe secundiflora	15	4.41
Sanseviera robusta	14	4.12
Aloe sp	0	0.00
43	340	100.00

Table 6.8: Tree Species Composition for Isinya Stratum

	Isinya	
Tree species	Number counted	Relative abundance
Acacia nilotica	3	1.09
Acacia seyal	10	3.65
Acacia drepanalobium	21	7.66
Acacia xanthophloea	11	4.01
Acacia tortilis	7	2.55
Acacia gerrardii	2	0.73
Acacia mellifera	4	1.46
Prunus africana	4	1.46
Osyris lanceolata	4	1.46
Acokanthera schimperi	6	2.19
Carissa edulis	8	2.92
Psidia punctulata	3	1.09
Commiphora africana	3	1.09
Commiphora swynnertonii	5	1.82
Maytenus senegalensis	3	1.09
Tarchonanthus camphoratus	15	5.47
Vernonia brachycalyx	0	0.00
Cambretum molle	8	2.92
Euclea divinorum	10	3.65
Euphorbia triucalli	11	4.01
Croton dichogamous	10	3.65
Omocarpum trachycarpum	1	0.36
Grewia bicolor	1	0.36

Grewia similis	2	0.73
Zizypus mucronata	0	0.00
Salvadora persica	1	0.36
Urtica massaica	0	0.00
Clerodendram mycoides	0	0.00
Withania somnifera	5	1.82
Grewia villosa	5	1.82
Boscia angustifolia	4	1.46
Sericocomopsis hildebrandtii	6	2.19
Ipomea kituensis	27	9.85
Lippia javanica	2	0.73
Balanites aegyptiaca	10	3.65
Aspillia mossambicensis	*3*	1.09
Indigifera erector	1	0.36
Achyranthes aspera	0	0.00
Albizia amara	5	1.82
Solonum incanum	16	5.84
Aloe secundiflora	15	5.47
Sanseviera robusta	20	7.30
Aloe sp	2	0.73
43	274	100.00

Appendix F: Field Data and Results for Plant Species Diversity

Table 6.9: Plant Species Diversity for Kiserian Stratum

Plant species	Number Counted	*pi*	*logpi*	*Loge*pi*
Themeda triandra	5	0.013	-1.903	-0.024
Chloris roxburghiana	4	0.010	-2.000	-0.020
Chloris pycnothrix	2	0.005	-2.301	-0.012
Digiteria milanjiana	3	0.008	-2.125	-0.016
Digiteria macroblephora	7	0.018	-1.757	-0.031
Aristida keniensis	11	0.028	-1.561	-0.043
Cenchrus ciliaris	8	0.020	-1.699	-0.034
Eragrostis superba	3	0.008	-2.125	-0.016
Chrysopogon plumulosus	3	0.008	-2.125	-0.016
Cynadon plectostachyus	1	0.003	-2.602	-0.007
Panicun maximum	1	0.003	-2.602	-0.007
Enteropogon macrostachyus	2	0.005	-2.301	-0.012
Sporobolus fimbriatus	1	0.003	-2.602	-0.007
Bothriochloa insculpta	3	0.008	-2.125	-0.016
Pennisetum mezianum	3	0.008	-2.125	-0.016
Heteropogon contortus	1	0.003	-2.602	-0.007
Cymbopogon pospichilii	3	0.008	-2.125	-0.016
Hyparrhenia hirta	1	0.003	-2.602	-0.007
Brachiaria brizantha	1	0.003	-2.602	-0.007
Dactyloctenium aegrypticum	2	0.005	-2.301	-0.012
Chloris gayana	2	0.005	-2.301	-0.012
Pennisetum purpureum	1	0.003	-2.602	-0.007
Cymbopogon sp	1	0.003	-2.602	-0.007
Aristida adoensis	2	0.005	-2.301	-0.012
Seteria verticillata	3	0.008	-2.125	-0.016
Tragus barteronianus	3	0.008	-2.125	-0.016
Cyperus rotundus	4	0.010	-2.000	-0.020
Harpchne schimperii	2	0.005	-2.301	-0.012
Acacia nilotica	2	0.005	-2.301	-0.012
Acacia seyal	3	0.008	-2.125	-0.016
Acacia drepanalobium	3	0.008	-2.125	-0.016
Acacia xanthophloea	1	0.003	-2.602	-0.007
Acacia tortilis	2	0.005	-2.301	-0.012
Acacia gerrardii	2	0.005	-2.301	-0.012
Acacia mellifera	1	0.003	-2.602	-0.007
Prunus africana	1	0.003	-2.602	-0.007
Osyris lanceolata	2	0.005	-2.301	-0.012

Acokanthera schimperi	1	0.003	-2.602	-0.007
Carissa edulis	2	0.005	-2.301	-0.012
Psidia punctulata	2	0.005	-2.301	-0.012
Commiphora africana	1	0.003	-2.602	-0.007
Commiphora swynnertonii	2	0.005	-2.301	-0.012
Maytenus senegalensis	2	0.005	-2.301	-0.012
Tarchonanthus camphoratus	3	0.008	-2.125	-0.016
Vernonia brachycalyx	1	0.003	-2.602	-0.007
Cambretum molle	2	0.005	-2.301	-0.012
Euclea divinorum	2	0.005	-2.301	-0.012
Euphorbia triucalli	3	0.008	-2.125	-0.016
Croton dichogamous	3	0.008	-2.125	-0.016
Omocarpum trachycarpum	1	0.003	-2.602	-0.007
Grewia bicolor	1	0.003	-2.602	-0.007
Grewia similis	1	0.003	-2.602	-0.007
Zizypus mucronata	1	0.003	-2.602	-0.007
Salvadora persica	4	0.010	-2.000	-0.020
Urtica massaica	1	0.003	-2.602	-0.007
Clerodendram mycoides	3	0.008	-2.125	-0.016
Withania somnifera	2	0.005	-2.301	-0.012
Grewia villosa	2	0.005	-2.301	-0.012
Boscia angustifolia	3	0.008	-2.125	-0.016
Sericocomopsis hildebrandtii	1	0.003	-2.602	-0.007
Ipomea kituensis	3	0.008	-2.125	-0.016
Lippia javanica	1	0.003	-2.602	-0.007
Balanites aegyptiaca	6	0.015	-1.824	-0.027
Aspillia mossambicensis	2	0.005	-2.301	-0.012
Indigifera erector	1	0.003	-2.602	-0.007
Achyranthes aspera	1	0.003	-2.602	-0.007
Albizia amara	2	0.005	-2.301	-0.012
Solonum incanum	2	0.005	-2.301	-0.012
Aloe secundiflora	1	0.003	-2.602	-0.007
Sanseviera robusta	1	0.003	-2.602	-0.007
bare areas	236	0.590	-0.229	-0.135
72	400	1.000	0.000	-1.013

Table 6.10: Plant Species Diversity for Kitengela Stratum

Plant Species	Number Counted	*pi*	*log(pi)*	*Loge*pi*
Themeda triandra	2	0.005	-2.301	-0.012
Chloris roxburghiana	3	0.008	-2.125	-0.016
Chloris pycnothrix	1	0.003	-2.602	-0.007
Digiteria milanjiana	2	0.005	-2.301	-0.012
Digiteria macroblephora	2	0.005	-2.301	-0.012
Aristida keniensis	3	0.008	-2.125	-0.016
Cenchrus ciliaris	3	0.008	-2.125	-0.016
Eragrostis superba	2	0.005	-2.301	-0.012
Chrysopogon plumulosus	4	0.010	-2.000	-0.020
Cynadon plectostachyus	3	0.008	-2.125	-0.016
Enteropogon macrostachyus	4	0.010	-2.000	-0.020
Sporobolus fimbriatus	2	0.005	-2.301	-0.012
Bothriochloa insculpta	2	0.005	-2.301	-0.012
Pennisetum mezianum	2	0.005	-2.301	-0.012
Heteropogon contortus	2	0.005	-2.301	-0.012
Cymbopogon pospichilii	3	0.008	-2.125	-0.016
Hyparrhenia hirta	1	0.003	-2.602	-0.007
Brachiaria brizantha	1	0.003	-2.602	-0.007
Dactyloctenium aegrypticum	1	0.003	-2.602	-0.007
Aristida adoensis	4	0.010	-2.000	-0.020
Seteria verticillata	1	0.003	-2.602	-0.007
Tragus barteronianus	3	0.008	-2.125	-0.016
Cyperus rotundus	2	0.005	-2.301	-0.012
Harpchne schimperii	3	0.008	-2.125	-0.016
Acacia nilotica	3	0.008	-2.125	-0.016
Acacia seyal	2	0.005	-2.301	-0.012
Acacia drepanalobium	4	0.010	-2.000	-0.020
Acacia xanthophloea	1	0.003	-2.602	-0.007
Acacia tortilis	1	0.003	-2.602	-0.007
Acacia mellifera	2	0.005	-2.301	-0.012
Prunus africana	1	0.003	-2.602	-0.007
Carissa edulis	6	0.015	-1.824	-0.027
Psidia punctulata	3	0.008	-2.125	-0.016
Commiphora africana	2	0.005	-2.301	-0.012
Commiphora swynnertonii	3	0.008	-2.125	-0.016
Maytenus senegalensis	3	0.008	-2.125	-0.016
Tarchonanthus camphoratus	3	0.008	-2.125	-0.016
Cambretum molle	1	0.003	-2.602	-0.007

Euclea divinorum	3	0.008	-2.125	-0.016
Euphorbia triucalli	3	0.008	-2.125	-0.016
Croton dichogamous	3	0.008	-2.125	-0.016
Omocarpum trachycarpum	1	0.003	-2.602	-0.007
Grewia bicolor	2	0.005	-2.301	-0.012
Grewia similis	1	0.003	-2.602	-0.007
Salvadora persica	2	0.005	-2.301	-0.012
Grewia villosa	2	0.005	-2.301	-0.012
Boscia angustifolia	1	0.003	-2.602	-0.007
Sericocomopsis hildebrandtii	4	0.010	-2.000	-0.020
Ipomea kituensis	3	0.008	-2.125	-0.016
Lippia javanica	2	0.005	-2.301	-0.012
Balanites aegyptiaca	1	0.003	-2.602	-0.007
Aspillia mossambicensis	*2*	0.005	-2.301	-0.012
Indigifera erector	2	0.005	-2.301	-0.012
Achyranthes aspera	2	0.005	-2.301	-0.012
Albizia amara	2	0.005	-2.301	-0.012
Solonum incanum	3	0.008	-2.125	-0.016
Aloe secundiflora	1	0.003	-2.602	-0.007
Sanseviera robusta	2	0.005	-2.301	-0.012
Bare Areas	267	0.668	-0.176	-0.117
61	400	1.000		-0.848

Table 6.11: Plant Species Diversity for Isinya Stratum

Plant Species	**Number Counted**	***pi***	***logpi***	***loge*pi***
Themeda triandra	4	0.010	-2.000	-0.020
Chloris roxburghiana	4	0.010	-2.000	-0.020
Chloris pycnothrix	6	0.015	-1.824	-0.027
Digiteria milanjiana	4	0.010	-2.000	-0.020
Digiteria macroblephora	7	0.018	-1.757	-0.031
Aristida keniensis	6	0.015	-1.824	-0.027
Cenchrus ciliaris	5	0.013	-1.903	-0.024
Eragrostis superba	5	0.013	-1.903	-0.024
Chrysopogon plumulosus	6	0.015	-1.824	-0.027
Cynadon plectostachyus	8	0.020	-1.699	-0.034
Enteropogon macrostachyus	4	0.010	-2.000	-0.020
Sporobolus fimbriatus	1	0.003	-2.602	-0.007
Bothriochloa insculpta	3	0.008	-2.125	-0.016
Pennisetum mezianum	8	0.020	-1.699	-0.034
Heteropogon contortus	8	0.020	-1.699	-0.034

Brachiaria brizantha	1	0.003	-2.602	-0.007
Dactyloctenium aegrypticum	1	0.003	-2.602	-0.007
Acacia xanthophloea	8	0.020	-1.699	-0.034
Acacia tortilis	7	0.018	-1.757	-0.031
Acacia mellifera	4	0.010	-2.000	-0.020
Prunus africana	4	0.010	-2.000	-0.020
Carissa edulis	8	0.020	-1.699	-0.034
Commiphora africana	3	0.008	-2.125	-0.016
Commiphora swynnertonii	5	0.013	-1.903	-0.024
Maytenus senegalensis	3	0.008	-2.125	-0.016
Tarchonanthus camphoratus	9	0.023	-1.648	-0.037
Cambretum molle	8	0.020	-1.699	-0.034
Croton dichogamous	5	0.013	-1.903	-0.024
Grewia bicolor	1	0.003	-2.602	-0.007
Grewia similis	2	0.005	-2.301	-0.012
Salvadora persica	1	0.003	-2.602	-0.007
Grewia villosa	5	0.013	-1.903	-0.024
Sericocomopsis hildebrandtii	6	0.015	-1.824	-0.027
Lippia javanica	2	0.005	-2.301	-0.012
Balanites aegyptiaca	5	0.013	-1.903	-0.024
Indigifera erector	1	0.003	-2.602	-0.007
Solonum incanum	6	0.015	-1.824	-0.027
bare	226	0.565	-0.248	-0.140
38	400	1.000	-74.731	-0.812