IMPACTS OF THE SOUTHERN BYPASS ROAD CONSTRUCTION THROUGH NGONG FOREST ON THE AFRICAN CROWNED EAGLE, NAIROBI COUNTY

BY

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DECLARATION

This research dissertation project is my original work and has not been submitted for any degree course in any other university.

Signed: _____ Date:

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N36/ 3187/ 2010

This research project has been submitted for examination with my approval as a university supervisor.

DR. MOHAMED DEKOW _____ Date:

_____

DEDICATION

To my friends and family.

ACKNOWLEDGEMENT

To the various parties whose contribution made the completion of this study possible.

First, my sincere gratitude goes to my project supervisor, Dr. Mohamed Dekow for his tireless efforts, dedication and sacrifice which have made the completion of this project possible.

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LIST OF ABBREVIATIONS

CPF - Central Placed Foragers

FAO - Food and Agriculture Organization

IUCN – International Union for Conservation of Nature

UNDP – United Nations Development Programme

UNEP - United Nations Environment Programme

ABSTRACT

Forests have numerous economic, social and ecological values. In Kenya most of the forests form vital water catchments for rivers among other ecological services as well as providing a habitat for numerous species of animals. Ngong Forest is an urban forest in Nairobi County that has a wide variety of flora species and serves as a habitat to various animals including birds such as the African Crowned Eagle.

This research project aimed at finding out the challenges facing the African Crowned Eagle in Ngong forest as a result of the clearance of sections of the forest to pave way for the construction of the Southern bypass road, which resulted in habitat fragmentation.

The study focused on determining how the birds' population has been affected as well as the impacts on its breeding grounds and changes in its dietary characteristics.

The findings of this study indicate that there are a number of negative impacts that have resulted from the construction of the road through the forest.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Problem

According to Norman Meyers in a study for Friends of Earth, 142,000 Km^2 were cleared in 1989 and a further 200,000 Km^2 severely degraded. He noted that forest loss has increased since 1979 by 90%, Brazil, Indonesia and Zaire (DRC) which had the highest percentage of natural tropical forests, accounted for half of that. (FAO 2003)

Regionally, deforestation has also been on the rise. In the Central Africa region, rates of forest loss have surged ahead of this dismaying global average increase (WRI 1992: 285). Africa is losing more than 4 million hectares (9.9 million acres) of forest every year, twice the world's average deforestation rate according to a statement by the United Nations Environment Programme (UNEP). Four million hectares is roughly the size of Switzerland or slightly bigger than the U.S. state of Maryland. Of worth to note is that natural forests in East Africa total 134 million hectares.

Forests are principally degraded or cleared for agriculture, fuel wood while the main cause of degradation is uncontrolled logging which can be attributed to rising levels of urbanization globally.

Any land-use change within a forest can potentially result in fragmentation. Habitat fragmentation is usually defined as a landscape-scale process involving both habitat loss and the breaking apart of habitat. The extent of the impact will depend on the type of change, the degree of fragmentation, and the species involved. In the early days of settlement, much of

the forested landscape was fragmented by land clearing for timber and agriculture. In the more recent decades, some of the most serious fragmentation has been caused by urban sprawl. Urban sprawl refers to new development that consumes land at a rate faster than that at which the population is growing. It uses more land per person combined with the fact that the population itself is steadily increasing in cities and towns. It promotes dependency on the use of cars, because it is characterized by low-density development that separates where people live from where they shop, work and recreate. It also separates them from access to green space and natural areas in their communities because typically natural areas are not incorporated into the design of these developments.

Roads and rights-of-way are a major contributor to habitat fragmentation because they divide large landscapes into smaller patches and convert interior habitat into edge habitat. As additional road construction and timber harvest activities increase habitat fragmentation across large areas, the populations of some species may become isolated, increasing the risk of local extirpations or extinctions (Noss and Cooperrider 1994).

Some of the primary adverse impacts of roads and highways on wildlife and wildlife habitats include: Direct loss of habitat; Reduction of effective useable habitat near roads for small mammals such as Duikers, Deers and Dik Diks; Direct mortality as a result of game animal/ vehicle collisions; and increased noise and visual disturbance for small mammals such as duikers and Bush Bucks..

The construction of the Ngong Road-bypass intersection through Ngong Forest, now underway, has seen the Kenya Forest Service sacrifice more forest land to create space for this new development. Sadly, the four slip roads that form a clover leaf intersection will see the forest lose thousands of trees. What was once one continuous ecosystem was split into

five separate forest sections to give way for the development of the bypass (Ngong Forest Sanctuary).

Forest fragmentation can have negative and often irreversible effects on local environments, especially when associated with human development. These negative impacts include reduction of total habitable area; Edge habitation: When a habitat is fragmented, the amount of edge-habitat increases at the expense of interior habitat. Species dependent on interior habitat suffer, while edge-dependent species, including invasive species and predators, thrive. Woodland-dependent bird species, even though they are found in nearby woodland areas, often avoid small fragments; Vulnerability during movement among patches; Isolation of a population; Vulnerability to external competition and predation; Inhibits with flow of genetic materials throughout the landscape as it interferes with breeding and more importantly, interbreeding.

Ngong Forest is the only indigenous forest that is located within Nairobi county, it is rich in biodiversity as it is home to over 175 bird species, over 35 mammals and numerous insects, reptiles, amphibians and fish. One of the important bird species that inhabits the forest, which serves as an indicator of ecosystem health, is the African Crested Eagle.

The African Crowned Eagle *Stephanoaetus coronatus* is Africa's most powerful raptor. Although not the largest bird of prey, it is considered one of the "Big Three" eagle species in Africa along with the mighty Martial Eagle and the beautiful black Verreaux's Eagle**. (**Bill De Guilio). The Crowned Eagle is found only on the continent of Africa. In East Africa, the Crowned Eagle's range extends from central Ethiopia, to Uganda, forested parts of Kenya and Tanzania to as far south as eastern South Africa, with a southern distribution limit around

Knysna. In western and central Africa, the Crowned Eagle's range extends through much of the (once) vast African rainforest. They may be found from Senegal, The Gambia, Sierra Leone and Cameroon, where they inhabit the Guinean forests, to the Democratic Republic of the Congo, where they live in the Congolian forests, and down south to as far Angola. Despite its large distribution there, the Crowned Eagle is now rare in many parts of West Africa.

Current estimates place the number of African Crowned Eagles at about 10,000 individuals. In 2012 they were listed as Near Threatened by the IUCN (International Union for Conservation of Nature). With widespread deforestation occurring across Africa the amount of suitable habitat for the Crowned Eagle is shrinking and placing a strain on the species. However in South Africa, organizations such as African Raptors and Birdlife international have listed the bird as threatened.

The Crowned Eagle inhabits mainly dense woodlands, including those deep within rainforest, but will sometimes also be found in relict patches, wooded escarpments, riparian strips of Acacia, heavily wooded hillsides, and rocky outcrops throughout its range (Kemp, A. C. 1994)

Typical of most raptors that breed in Africa, the Crowned Eagle is non-migratory and is largely sedentary. This species usually inhabits a fixed territory throughout the year its adult life. There is evidence that the birds move about to some degree when circumstances require (Oatley, T.B., Oschadleus, H.D., Navarro, R.A. and Underhill, L.G. 1998). Their diet consists primarily of mammals, especially monkeys, hyraxes and small antelopes, as well as some birds and large monitor lizards. Mates may hunt cooperatively, and share their prey.

The Crowned Eagle is fairly common in suitable habitat, though at the population level, its numbers have shown a decline in sync with deforestation. Declines appear to be widespread and may be increasing due to the often fevered pace of clear-cutting. This species main habitat is rich, high-canopy forest, which is a major target of timber companies, agriculturists, palm oil and bio-fuel plantations and miners as well as slash and burn farmers. Biologists in Africa now suspect that the Crowned Eagles adaptability to small, fragmented tracts of woodland has been exaggerated in the past. (Thomsett, S. 2010)

1.2 Statement of the problem

Ngong forest, one of the few indigenous urban forests found within the Nairobi County provides valuable environment services and ecosystem services and also serves as a carbon sink for Nairobi County. The clearance of hectares of forest cover to pave way for the construction of Southern Bypass road has resulted in habitat fragmentation. The forest has been divided into five sections and this had an impact on biodiversity in the forest. The forest serves as a home to one of the few raptors species in the forest, the nearly threatened African Crowned Eagle. The eagle is a non-migratory bird that is accustomed to inhabiting areas with minimal disturbance.

1.3Research Questions

This study on the African Crowned Eagle seeks to find answers to the following questions:

a) How did the habitat fragmentation of the forest affect the populations of the African Crowned Eagle in Ngong forest?

b) Has the fragmentation of Ngong forest affected the African Crested Eagle's breeding grounds?

c) What is the impact of clearing sections of the forest on the prey of the the African Crowned Eagle?

1.4 Research Objectives

The study was guided by the following specific research objectives:

a) To determine the population dynamics of the African Crowned Eagle in relation to forest fragmentation.

b) To establish whether the African Crowned Eagle's breeding grounds have been disturbed.

c) To determine if the African Crowned Eagle's prey has reduced as a result of the construction of the Southern bypass road.

1.5Research Premises

The study is based on the following hypotheses:

a) The construction of the Southern bypass road through Ngong forest has lead to reduced numbers of the African Crowned Eagle bird species.

b) Clearing of sections of Ngong forest and splitting it into smaller sections to pave way for the construction of the Southern bypass road has reduced prey of the African Crowned Eagle in the forest.

c) Clearing sections of Ngong forest has disturbed the African Crowned Eagle's breeding ground.

1.6 Justification

The African Crowned Eagle, that is endemic to Africa, is one of Africa's most powerful raptors as earlier mentioned, whose populations have been decreasing over the years. The bird is currently listed as 'nearly threatened' by the IUCN although its numbers have been declining steadily over the past 15years. In South Africa its status has recently been regarded as 'endangered'. The Crowned Eagle is said to have the lowest reproductive rate of all African raptors, and this puts it at a higher risk of becoming endangered.

The Crowned Eagle acts as indicator of ecosystem health, it status within an ecosystem acts as a reflection of the general state and well being of an ecosystem in relation to other plants and animals. In Kenya, the bird has attracted attention from bird watching societies due to its reducing population. Both local and international such as Nature Kenya and Birdlife international; ornithologists; and photographers who exclusively take photographs of the African Crowned Eagle either for documentaries so as to facilitate its conservation.

1.7 Significance

This study highlights the issues facing the African Crowned Eagle. The impacts that constructing the Southern Bypass through Ngong Forest has had on the African Crowned Eagle species in the forest will be brought to light. The information can then be used to create awareness of the impacts that the construction project has had on bird species in the forest

and in turn, strategies formulated to remedy any negative impacts. The findings of the project can also be used as a reference point in future construction projects that may be undertaken in a forest and its possible impacts on biodiversity in general. The African Crowned Eagle is also an important indicator of ecosystem health and highlighting the challenges facing it will reveal the general status of the ecosystem.

The findings of the study would provide an insight to the institutions undertaking similar research, the findings would also be used to sensitize concerned parties such as Ngong Forest Sanctuary, International Union for Conservation of Nature (IUCN), East African Wildlife Society and also National Environment Management Authority (NEMA) to review the existing policies on undertaking infrastructural developments in ecological sensitive such as indigenous forests.

1.8 Scope of the study

Spatially, the study area covers Ngong forest, including the Ngong Forest Sanctuary. The study focused on the African Crowned Eagle bird and its population dynamics in the forest; the challenges facing the bird species such as habitat fragmentation; changes in its population; and possible impacts on prey of the bird species as a result of loss in large tracts of forest cover and therein forest fragmentation. The study also advances recommendations and proposals regarding clearing forests and fragmentation of forests for infrastructural development purposes. The variables considered in the study included population dynamics of the African Crowned Eagle in Ngong forest in relation to the construction of the Southern bypass road as well as impacts on breeding grounds and changes in dietary characteristics.

1.9 Operational terms

Habitat: The place or environment where a plant or animal naturally or normally lives and grows

Fragmentation: The process of detaching or breaking apart off from a whole into smaller whole sections

Breeding ground: A place that offers a particular set of circumstances suitable for and favourable for producing offspring by hatching.

Clearing: Felling of tree stands over a large area in a forest.

Deforestation: Permanent destruction of forests in order to make the land available for other uses.

Raptor: A bird of prey such as an eagle, vulture or hawk

1.10 Limitations

Access to some organizations was barred by the lack of correspondence and feedback and therefore data collected was limited, also some collecting data from the relevant organization and government institutions was very limited due to the lack of and inadequate relevant information and that is up to date; Insecurity was also a major limitation because the Ngong Kenya Forest Station are located within the forest which has wild animals also there is no convenient means of transportation within the forest; Inadequate time to interview the relevant persons in some institutions was also a limitation; and inadequate finances created a constraint as some organizations required a fee to be paid in order to access information.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter contains an evaluative report of information found in the literature related to impacts of habitat fragmentation on the African Crowned eagle. It provides a theoretical base for the research and determines the nature of research. An analysis of this literature will help identify a gap in areas not researched and those with limited information. This will in turn help formulate a conceptual framework. It contains an analysis of published and unpublished works.

2.2 Population dynamics of the African Crowned Eagle

The conservation of raptors is a high priority for many conservation organizations around the world. This is mainly due to the fact that birds, particularly diurnal raptors, are sensitive to ecological changes and habitat disturbance (Thiollay 1985). Brown (1976) has stated that 'all threats to eagles are due to humans', as they have few natural enemies. Dowsett (1985) supported this by commenting that the major threats to tropical forest birds are 'human-induced'.

MacLean (1993) found that the distribution of African Crowned Eagles is now discontinuous due to the fragmented nature of their habitat. He also reported that 65% of original habitat in sub-Saharan Africa has been lost with the rate of deforestation in tropical areas continuing to increase. It is therefore important to conduct a habitat analysis of the African Crowned Eagle in order to understand the habitat requirements of this species. Furthermore, by studying

breeding success, we can gain a better knowledge of what threats there are to these birds and how humans can assist the long-term survival of this species. By investigating the roles of exotic plantations, the future of these birds in Southern Africa can be assessed as commercial forestry of exotic plantations is a large-scale industry. Supporting this, Barnes (2000) suggested that the planting of exotic plantations in place of indigenous forests in South Africa is leading to a decline in the African Crowned Eagle.

The conservation of forest raptor species has come under increasing scrutiny due to the large-scale effects of deforestation and habitat fragmentation. The Solitary Crowned Eagle (*Harpyhaliaetus coronatus*) is an endangered forest eagle in South America, fairly closely related to the African Crowned Eagle. Its current IUCN status is "Endangered" and the severity of its threats "strongly suggest a significant and continuing decline in numbers" (BirdLife International 2008). BirdLife International (2008) suggests that the main threats to the Crowned Solitary Eagle are habitat destruction and hunting whereas Bellocq et al. (2002) observed that naturally low population numbers combined with habitat fragmentation are the main threats.

Rain forests in Africa are becoming more fragmented, with reports suggesting that only the protection of large areas of forest will conserve many species of African Birds (Beier et al. 2002). Such environmental stresses have meant that mortality factors have become more important in species conservation. One factor is raptor mortality from power line electrocution, where such losses should be compensated by healthy populations (Bevanger 1998). It has been noted that birds with large and broad wings, as for instance forest eagles,

can be susceptible to both electrocution and collisions (Bevanger 1998). However, there are many other threats to African raptors; transformation of habitat into agriculture and invasive alien vegetation which have been cited as two main factors that have reduced the Black Harrier (*Circus maurus*) to only 50% of its core breeding habitat in South Africa (Curtis et al. 2004).

Supporting this, Steyn (1982) has reported that in Southern Africa, birds of prey are most threatened due to the "technological advancement of the region", which is heavily linked to habitat destruction. Steyn (1982) agreed with Brown (1970) who discussed people's negative attitude towards large eagles, as South African farmers tend to blame large eagles such as the Martial Eagle (Polemaetus bellicosus) for domestic stock losses. However, both Brown (1970) and Steyn (1982) agreed that the eagle is often not to blame for such losses and that this could be an example of prejudice. In support of this Machange et al. (2005) found that eagles were found in significantly higher densities in areas supporting indigenous game than in areas supporting domestic stock.

2.3 Disturbance of breeding ground of the African Crowned Eagle

The nests of the African Crowned Eagle can be enormous and are often situated in tall trees, near rivers and streams in the first fork of the tree (Brown et al. 1982, Malan and Shultz 2002). Despite this, African Crowned Eagle nests are among the most difficult to find of all eagle nests, as they are usually in thick forest (Brown 1966). The eagles prefer the tree to be clear of low-level branches as these often assist nest predators in reaching the nest (Malan and Shultz 2002). Therefore, most nesting sites are found in emergent trees with the main

fork above the surrounding canopy for easy access and protection from non-flying nest predators (Shultz and Thomsett 2007). The nests are near the centre of their ranges and so they are termed 'central placed foragers' (CPF) (Orians and Pearson 1978). In addition Shultz and Noë (2002) found that the majority of African Crowned Eagle foraging takes place within the centre of their home ranges, this was identified through the use of radio tracking. Nests are re-used as long as there is a pair present in the area and the nest is not excessively disturbed, as findings from Brown et al.

(1982) and Steyn (1982) suggest that nests can be older than fifty years.

Breeding success can potentially be influenced by many natural factors, such as prey availability, habitat availability and quality, and climate, and additionally by many anthropogenic factors, such as afforestation which potentially enhances success (Allan et al 1997). Exotic timber plantations are very common in Mpumalanga, South Africa and their effects on nesting bird species has been studied (Allan et al 1997, Malan and Robinson 2001). The use of exotic tree species in forestry plantations, may enhance breeding success of birds by providing suitable trees for nesting (Malan and Robinson 2001) but may reduce success via a reduction in biodiversity in large timber monocultures (Johns 1993). Habitat selection may be linked to breeding success due to the type of prey found in certain habitats. For example Brown (1982) stated that monkeys were only a minor dietary component outside of forests. Boshoff et al. (1994) carried out a dietary comparison across two biomes within South Africa, and reported that although hyraxes (Procaviidae) and antelope (Bovidae) were among the dominant prey types in both, hyraxes were more common prey in savannahs whereas antelope were the most common prey in forests.

2.4 Dietary characteristics of the African Crowned Eagle

There have been many studies of the diet of African Crowned Eagles (Brown 1976, Daneel 1979, Jarvis et al. 1980, Tarboton and Allan 1984, Skorupa 1989, Struhsaker and Leakey 1990, Boshoff 1994, Shultz 2002, Shultz and Thomsett 2007) but a common dietary composition or preference has not been identified. Some studies found a predominance of primates (mainly the family Cercopithecidae) in the diet (Skorupa 1989), others a predominance of small antelopes (Bovidae) (Brown 1972), or rock hyraxes (Procaviidae) (Jarvis et al. 1980). In addition, Boshoff et al. (1994) reported that both rock hyraxes and antelope formed a large component of Crowned Eagle diet. McGraw et al. (2006) found a preference for small Duikers and carnivores despite the majority of prey being primates. Skorupa (1989) commented that by the early 20th century, naturalists were classifying the African Crowned Eagle as a "monkey specialist", but Brown (1982) had previously stated that monkeys were a minor dietary component outside of rainforests. In the Taï National Park (Ivory Coast), the African Crowned Eagle has been identified as the most prevalent and important predator of mammals (Shultz 2002). Although mammals constitute the majority of their prey, African Crowned Eagles also feed on birds and reptiles, albeit as a much smaller proportion of their diet (Jarvis et al. 1980, Struhsaker and Leakey 1990, Boshoff et al. 1994, Shultz 2002). Studies on predation rates by the African Crowned Eagle (Brown 1976, Shultz 2002) estimate it removed 4 - 9% prey biomass per year. Observations by Brown (1976) included a female African Crowned Eagle consuming 1.1kg of Sunni antelope (*Neotragus moschatus*) in one meal. However, regardless of the geographical location, these three prey types (antelope, primates and hyraxes) comprise the vast majority of the diet of the African Crowned Eagle. Brown (1966) found that an African Crowned Eagle pair in Kenya were

"exclusively mammal-eaters", but acknowledged that other African Crowned Eagles in other areas did prey on birds and reptiles. In addition African Crowned Eagles have been known to prey on domestic animals, rodents and small carnivores such as mongoose.

2.5 Gap identification

Much has been studied on the conservation ecology of then African Crowned Eagle but not much has been done to determine how urbanization affects raptor biodiversity, such as the African Crowned Eagle and their populations. Development and growth of cities and towns coupled with industrial and infrastructural development and its impacts on raptors in Africa especially in urban areas has not been critically assessed.

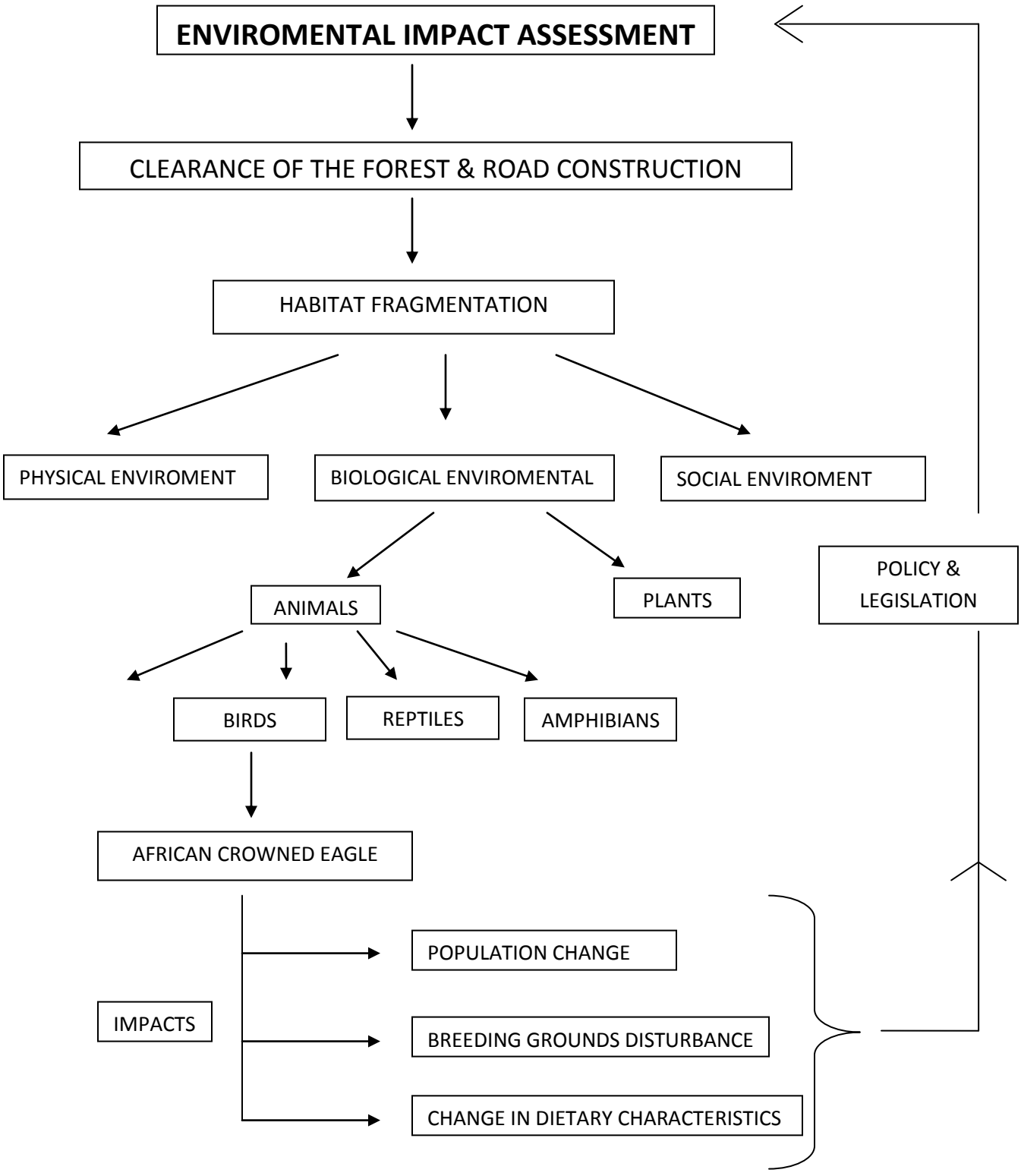
Also, results of empirical studies of habitat fragmentation are often difficult to interpret because first, many researchers measure fragmentation at the patch scale, not the landscape scale. In addition, most researchers measure fragmentation in ways that do not distinguish between habitat loss and habitat fragmentation i.e., the breaking apart of habitat after controlling for habitat loss. More studies of the independent effects of habitat loss and fragmentation per se are needed to clearly determine the factors that lead to positive versus negative effects of fragmentation.

2.6 Conceptual framework

The conceptual framework of this study is based on one independent variable; habitat fragmentation. Changes in population; disturbance of breeding grounds; and changes in

dietary characteristics are dependent on habitat fragmentation. Each of these factors arises from the change in habitat as a result of clearing sections of the forest for road construction and development. Policies and legislations facilitated infrastructural development in the forest and the Environmental Impact Assessment (EIA) was carried out by the government.

Figure 2.1: Conceptual framework of Impacts of Habitat fragmentation of the African Crowned Eagle.



CHAPTER THREE

AREA OF STUDY

3.1 Introduction

This chapter discusses background information of Ngong Forest reserve and sanctuary. It highlights the physical, ecological and socio-economic set up of the study area. It focused on how each of these aspects relates to the African Crowned Eagle bird species in the forest. Information on the area of study was collected from Kenya meteorological department (2008) and Kenya forestry master plan (1994).

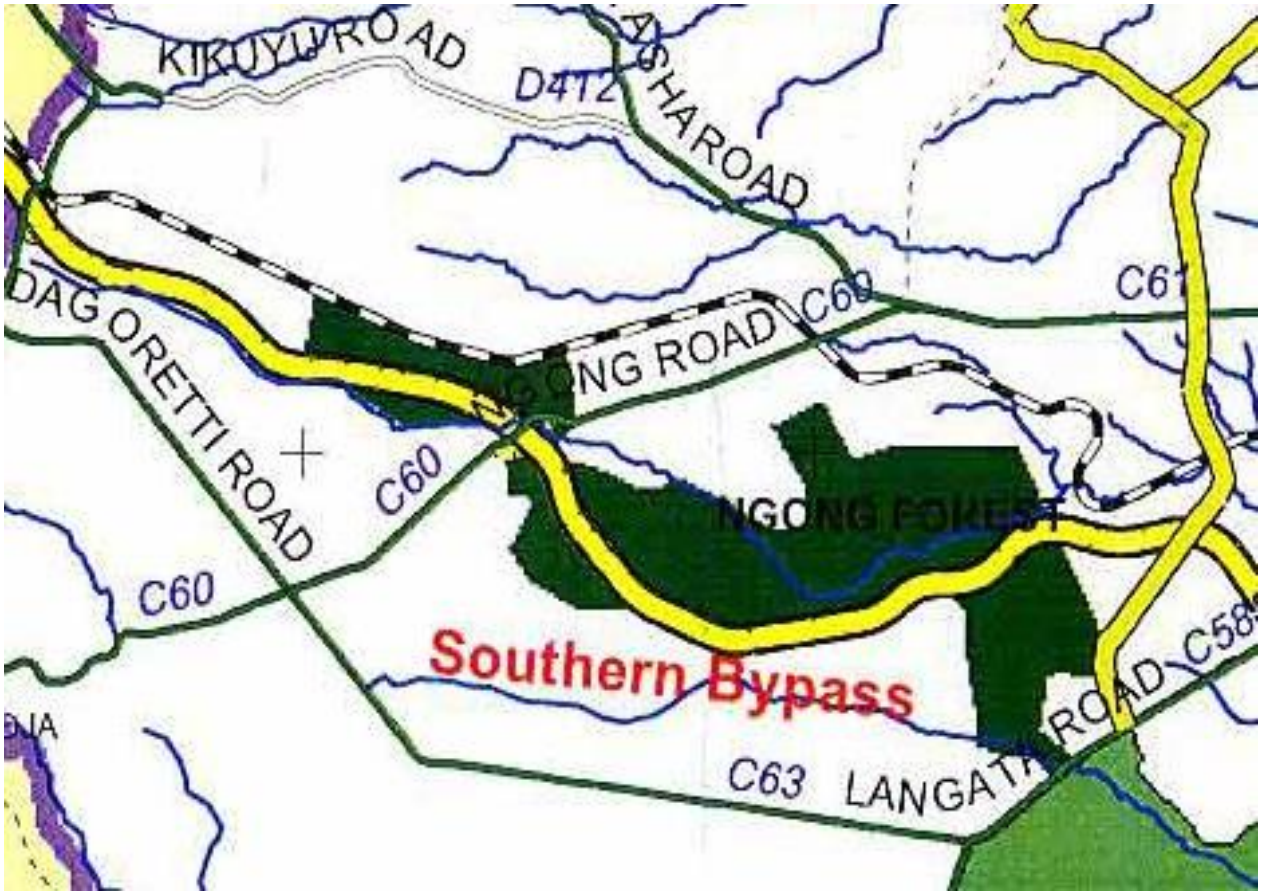
3.2 Physical Aspects

3.2.1 Location and extent

The forest reserve and sanctuary is located 6Km to the west of Nairobi Central Business District. It lies approximately 2^0 8^0 South and 36^0 50^0 East. The forest reserve and sanctuary is bordered to the East, Langata road to the west and Ngong Road to the South. The reserve and sanctuary is in Nairobi province. Ngong forest Reserve and Sanctuary occupies an area of approximately 1329.25Ha.

The forest reserve has been reduced as a result of urban developments such as new housing estates in Langata and the Southern by-pass road. These developments have led to reduction of indigenous tree species coverage that serve as a breeding ground for the African Crowned Eagle such as the Silver Oak tree species, hence less tree biomass.

Figure 2.1 Study area (Ngong forest) and surrounding areas



Source: Sanctuary trust, 2012

3.2.2 Geology and Soils

Ngong forest reserve and sanctuary is underlain by a succession of lava and pyroclastics of Canizoic age. Overlaying a foundation of Precambrian Schist and Gneiss of the Mozambique Belt. Crystalline rocks are rarely exposed but occasionally fragments are found in agglomerates derived from the former Ngong volcano. These formations are covered by deep soils and gravel of Quaternary age. The mass of lava thins out appreciably in the easterly direction along the length of Mutu-ini River, with the easterly limits marked by erosion scarps forming the terminal walls of more resistant lava sheets underlying geological layer beneath Ngong Forest in upper Athi series, which is porous and permeable, allowing for

percolation. This makes it favourable as a watershed for discharge into rivers and recharge aquifers.

The Mutu-ini river has clay soils making it swampy with good grass cover and light forests. In some places, it has deposits of shallow soils associated with rocky outcrops along its course. On weathering, much of the lava and tuff changes into pale brown reddish ferruginous and ferricite (also reffered to as murram). The material is frequently hard and of sufficient thickness to allow quarrying. The soils around Mutu-ini river are shallow, yellow brown to yellow red, friable clay overlaying laterite horizon. They have low humus overlaying friable clays passing downwards into massive laterite (ferricite) representing soils with slight impeded drainage.

These soils support the growth of numerous flora, ranging from the herbaceous undergrowths, shrubs and grasses to the trees, especially indigenous trees which provide breeding grounds for the African Crowned Eagle. This flora creates a suitable habitat for the numerous birds, reptiles, amphibians and mammals in the forest.

3.2.3 Topography

Ngong forest reserve and sanctuary is gently undulating with the highest point being to the West at an altitude of 1980m, falling to 1820m at Mutu-ini River Bridge on Ngong Road. Mutu-ini river which is a relatively small seasonal stream, originates from Riu swamp to the Northwest of Dagoretti Forest.

The gently undulating landscape ensures that the area is well drained and makes it suitable for growth of various tree species that provide breeding ground for the African crowned

Eagle and , shrubs and woody herbs and grasses that provide browsers such as Dik diks and Duikers, which the African Crowned Eagle preys on, with food.

3.2.4 Climate

The major water source in the reserve and sanctuary is Mutu-ini river, which is a seasonal river. This water body is however polluted by meat processing industries in Dagoretti. The Jockey Club dam has been constructed to serve the Ngong Racecourse. The Riu swamp in the north -eastern part of the forest ensures that the animals in the forest have a constant supply of water to animals in the forest throughout the year, even during the dry season.

3.2.4. 1 Hydrology and Rainfall

The major water source in the reserve and sanctuary is Mutu-ini river, which is a seasonal river. This water body is however polluted by meat processing industries in Dagoretti, this means that the animals in the forest consume contaminated water which may lead to negative impacts on their health and may result in premature deaths of various animals as well increased death of animals. The Jockey Club dam has been constructed to serve the Ngong Racecourse. The Riu swamp in the north -eastern part of the forest ensures that the animals in the forest have a constant supply of water to animals in the forest throughout the year, even during the dry season.

The forest reserve and sanctuary experience rainfall during the double maxima regime with the long rains falling between mid- March to the end of May and the short rains from October to November. There are two dry seasons, the short dry season and the long dry season during which there is usually a water shortage. The area falls under the climatic zone with mean annual rainfall from 1000-1200mm. This adequate rainfall supports the growth of

the numerous species of flora found in the which serves as a habitat to the African Crowned Eagle forest as well as ensuring that the animals in the forest have adequate supply of water for about six months in a year. The rainfall also helps to maintain the riversand streams in the forest such as the Mutuini river which provides water for animals in the forest including browsers such aas Duikers and Dik diks, primates such as Vervet monkeys which the African Crowned Eagle feeds on. The adequate amount of rainfall also helps to maintain the forest canopy

3.2.4.2 Temperature

The maximum temperatures are experienced between December and March. High temperatures lead to reduction in the level of water in the dam and river within the reserve and sanctuary due to high levels of evaporation. Maximum temperatures experienced in this area range from 21.4^0 during the month of August to 25.6^0 in March while maximum daily temperatures range between 11.6^0 to 15.0^0. Relative humidity ranges from a daily maximum of 88% in May to a daily minimum of 36% in the month of April. Daily evaporation ranges from a minimum of 89mm in July to a maximum of 191mm in March. These moderate temperatures make the forest a suitable habitat to various animal species as well as ensuring the growth of flora providing food for browsers such as Duikers and Dik diks.

3.3 Ecological Aspect

3.3.1 Landscape classification

There are three distinct landscape classifications evident in the forest reserve and sanctuary. Each of these landscapes creates a habitat for the various animals in the forests. The forest landscape influences the distribution of birds and other wild animals that live on trees such as birds including the African Crowned Eagle and such as primates (monkeys); the bush-land and open grasslands provide a habitat for browsers such as Duikers, Dik diks and Sunni antelopes as well as reptiles; the riverine vegetation provides a habitat for amphibians such as toads and frogs.

3.3.1.1 Forest landscape

The trees cover about 1204.8 hectares and are the main feature at an altitude of 1800m-1980m. According to the Kenya Forest Service, 80% of the sanctuary is indigenous forest with trees such as *Doryopteris concolor, Pleopeltis macrocarpa, Croton megalocarpus, Drypetes gerrardii, Juniperus procera* and 20% is composed primarily of Eucalyptus (Blue Gum species) plantations.

3.3.1.2 Bushland: Thickets and shrubs

Valleys, gorges and slopes are dominated by bush land. The area is also covered by open grasslands interspersed with Eucalyptus tree species. It lies between 1800-1820m. Such flora include*: Dovyalis caffra ,Dovyalis macrocalyx , Dombeya burhessiae, Hibiscus calyphyllus*

3.3.1.3 Riverine vegetation

This landscape is found along Mutu-ini river in the reserve and is characterized by marshes, bog and swamps.

3.3.1.4 Grasslands

Grasslands are generally found on the Black Cotton soils and Grey soils. They are either on the flat plains (open) or on undulating plains (wooded dominant species in the grasslands). Grass species include D.*macroblepharis*, *cynodon dactylon* and H.*schimperi*. Grasslands provide food and a habitat for browsers such as Duikers and Bush backs which the African Crowned Eagle preys on.

3.3.2 Fauna

The forest reserve and sanctuary is abundant in animal and bird species it has over 175 bird species, including the African Crowned Eagle over 35 mammals and numerous insects, reptiles, amphibians and fish.

Bird species include; Grebes, Cormorants, Darters, Herons, Ibises, Storks, Ducks, Geese and Hamerkops among others.

Reptiles include; snakes, lizards, tortoises, toads and frogs

The mammals found in the forest include among others: Bush Buck, Dik Dik, Duiker, Sunni antelope, Leopard, Hyaena (spotted), Baboon, Vervet Monkey, Aardvark, Porcupine, Squirrel,Tree Hyrax. Majority of these mammals form the staple diet of the African Crowned Eagle.

3.4 Socio-economic Aspect

3.4.1 Special interest sites

The picnic site is situated between the nature trail and Mutu-ini river. It offers a scenic recreation and relaxation area. Several nature trails within the sanctuary also provide for bird watching, horse-back riding and also host Charity walks for corporate organizations.

3.4.2 Education sites

With support from UNDP and Ford Foundation, the sanctuary has developed a 1.8Km nature trail; The Winnie Duku Nature Trail, after a student of Malezi School who passed away in the forest while planting trees. The trail is currently in use and since its launch, pupils and students from Primary, secondary and University institutions have visited.

With the help of the European Union's Community Development Trust Fund, the Tourism Trust Fund and Safaricom Foundation, the sanctuary has constructed an education center; The Imre Loefler Education Centre to be used by school children, corporate's meetings, and community education on conservation. The center serves also serve as a resource center for disseminating information through screening of educative conservation based movies to schools, tertiary colleges, universities, the local community, visitors and Nairobi residents at large. Planning is also underway to make the site available for hire for conferences, weddings, etc.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 Introduction

The research design and methodology adopted is the focus of discussion in this chapter. It is a guideline for solving a problem with specific components such as tasks, methods, phases, techniques and tools. It can be qualitative (such as information on the breeding grounds and dietary characteristics of the African Crowned eagle) or quantitative (such as information on population dynamics of the African Crowned eagle). Methodologies encompass procedures followed, analyzed and interpretation of the data gathered. It sets the framework through which relevant data will be collected and analyzed to achieve the set research objectives and goals as per the requirements of the study. It discusses the research design, the nature and sources of data and data collection, the analysis and presentation.

4.2 Research Design

Research design can be defined as the arrangement of conditions for collecting and analysis data in a manner that aims to combine relevance of the research purpose with the economy procedure. (Marczyk et al. 2010). Both qualitative and quantitative approaches were used in carrying the study, this is because populations numbers of the bird species will be required and as well information the birds' dietary and breeding characteristics Exploratory method of research will be used, because of the flexibility of its design, which allows different aspects of the problem to be considered. Also this method of sampling is appropriate when there is no pre-planned design for analysis, unstructured instruments for collection of data and no fixed decision about operational procedures will be employed.

4.3 Sampling

The sampling method employed for this particular study was systematic sampling method to select various relevant institutions to conduct interviews with for the study. Also this method of sampling is appropriate when there is no pre-planned design for analysis, unstructured instruments for collection of data and no fixed decision about operational procedures will be employed.

The following institutions relevant to the study were purposively selected. They include:

a) **African raptors**

This is an organization that is a database and platform for exchanging information about raptor biology and raptor conservation issues, run by renowned ornithologist across the continent.

b) **International Union for Conservation of Nature (IUCN)**

This is world's authority on biodiversity conservation, nature-based solutions and related environmental governance. Also mandated with formulating the Red List Data; the world's most comprehensive inventory of the global conservation status of biological species.

c) **Nature Kenya**

Their mandate includes enhancing knowledge of Kenya's biodiversity; promote conservation of key species, sites, and habitats; encourage community participation in conservation through promotion of sustainable benefits; advocate policies favorable to biodiversity conservation; and enhancing knowledge of Kenya's biodiversity. They also conduct regular bird counts all over the country.

d) Kenya Forest Service

Their mandate is to conserve, develop and sustainably manage forestry resources. Forests such as Ngong forest are protected areas that serve as a home to numerous species of biodiversity. Ngong forest serves as home to over 175 bird species.

e) Ngong Road Forest Sanctuary Trust

Their mandate is to protect in perpetuity the forest's natural environment through wise conservation management and to create a self-sustaining and multi-functional reserve. The trust's overall goal is to protect in perpetuity the forest's natural environment and resources including all animals within the sanctuary through wise conservation management and to create a self-sustaining and multi-functional reserve.

f) Nairobi National Museum

They are an up-to date database on all plants and animal, and have information of populations and conversation status of all flora and fauna. They are charged with carrying out regular bird counts among other species of animals so as to monitor the status of various species of animals.

4.4 Nature and sources of data

4.4.1 Nature of data

The study is designed to determine the impacts of habitat fragmentation on the African Crowned Eagle in Ngong forest reserve and sanctuary. In particular, changes in population size of the bird species, impacts on its breeding grounds and changes in the birds' dietary characteristics. In order to achieve the objectives of the study, secondary and primary data was used.

Data on the population dynamics was collected through bird counts, taking photographs and records from the inventory of African Crowned Eagle in the forest. Data on the impacts on the breeding grounds and dietary characteristics was collected through interviews with the key subjects and secondary sources of data such as books and journals so as to provide for background information.

4.4.2 Secondary sources of data

Secondary sources of data included information from library sources, government agencies, maps and physical development plans, information from relevant and reliable websites online concerning effects of forest fragmentation on avifauna species and relevant data from journals, encyclopedias and other published materials.

Instruments of secondary data collection used were books, existing reports, topographical sheets, satellite imagery and encyclopedias.

4.4.3 Primary sources of data

Primary data sources included observation, taking photographs, bird counting exercises and key informant interviews. Instruments of primary data collection used include:

a) Observation

Observations of the extent of forest clearance were made and of the African Crowned Eagle in its natural habitat and the location of its nest.

b) Photography

Photographs were used to capture the actual situation in the forest as it is. Photographs of the extent of forest clearance and destruction as well as the birds nesting ground were collected through this medium.

c) Bird counting exercise

This involved visiting the forest and sanctuary on several occasions aided by the forest rangers and wardens to count the number of African Crowned eagle birds in the forest

d) Scheduled Interviews

This involved verbal interaction between the researcher and the respondents. This included local and international NGOs to relevant government agencies. Key informant interviews will be used because the data needed for the study can be accessed from various organization and institutions and the interviews will be conducted with forest officers from Ngong Forest station and Ngong forest sanctuary, International Union for Conservation (IUCN), African Raptors and The National Museums of Kenya. Information about the bird's population,

habitat and breeding grounds and its currents status in the forest will be collected through these interviews.

4.5 Methods of Data Analysis and Presentation

Data was collected through observation, bird counting exercises, taking photographs and scheduled interviews.

Field data on the populations of the birds was quantitative and was analyzed using Microsoft Excel 2007 presented in a tabular form and a line graph on Microsoft Word.

Data collected on impacts on breeding grounds and dietary characteristics ecosystems was qualitative and was analyzed through Content-analysis techniques.

Photographs were used as evidence to support the findings.

CHAPTER FIVE

DATA ANALYSIS AND DISCUSSION OF RESULTS

5.1 Introduction

This chapter presents the analysis of data collected from a research conducted in Ngong Forest. The main purpose of the study was to gain insight on the impacts of road construction through Ngong forest and it's impacts on the African Crowned Eagle. The study aimed at assessing how the populations of the African Crowned Eagle have been affected; how the bird's breeding grounds have been affected and how the bird's prey has been affected.

5.2 Population Dynamics

This was the first objective of the study and its aim was to find out how the road construction of the southern bypass road has affected the population of the African Crowned Eagle in Ngong forest.

The records of the population of the African Crowned Eagle acquired from Ngong Forest Sanctuary reveal that the numbers of the birds have been fluctuating over the years. The population of the birds in the forest is low and this is attributed to the tendency of these birds to be territorial over large tracts of forest cover.

Data collected on population dynamics of the African Crowned Eagle is presented in the table below.

Table 5.1 Population of the African Crowned Eagle in Ngong Forest

YEAR	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
No. Of BIRDS	6	5	4	6	5	3	3	2	2	2

Figure 5.1: Population of the African Crowned Eagle between 2005- 2014

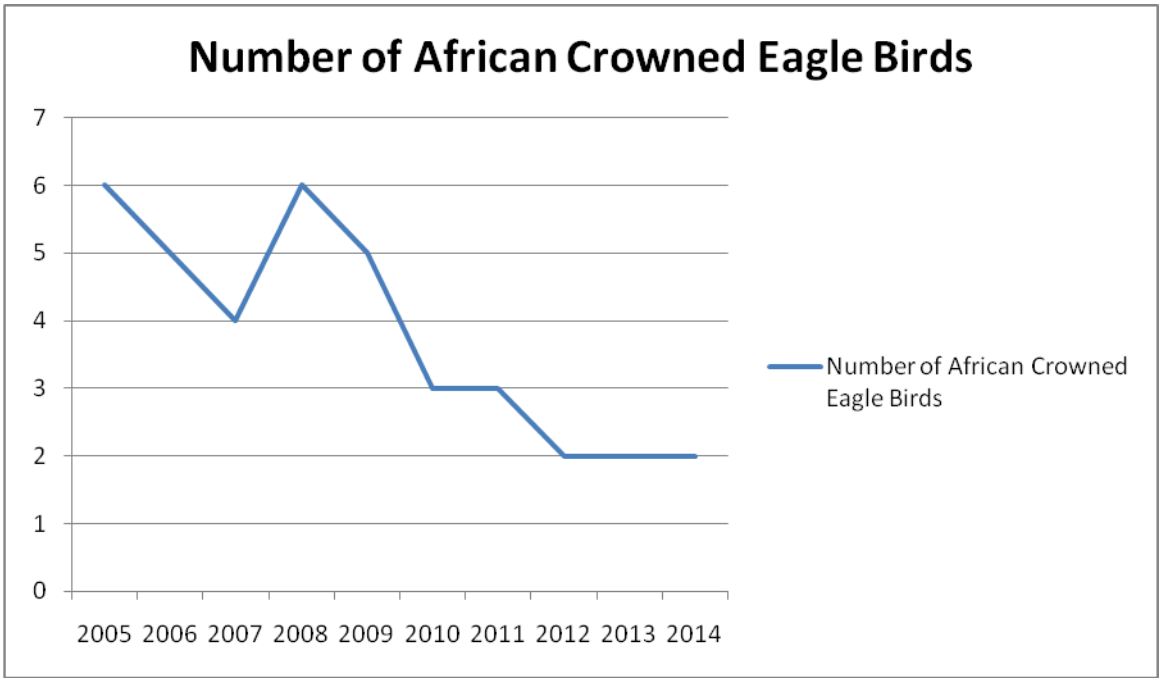


Figure 5.1 above is a line graph that shows the changes and trend in population of the African Crowned Eagle over a span of 10 years. The numbers of the birds fluctuated between 2005 and 2009 however the population of the birds rapidly declined from 2009 when clearance of the forest for road construction started. Findings from the bird counts conducted also indicate that there are only two African Crowned Eagles left in the forest.

An interview conducted at the sanctuary with the chief warden in Ngong Forest Sanctuary revealed that the population of the birds fluctuated fairly constantly have been reducing over the years for unknown reason but stated that the birds reduced continuously after clearance of the forest started late in 2009 and most of it being done in 2010. He stated that the birds had not always inhabited the forest. The first two pairs in the sanctuary were spotted in 1999. The second pair of birds took habitat of the forest in 2003.

The increase in their numbers was due to breeding but their offspring move from their parent's nest when they are no longer juvenile resulting in the fluctuation in numbers. In 2010 one of the pairs left the forest and hasn't been spotted since. This is worrying because the birds are sedentary (non-migratory).

The Crowned Eagle has one of the longest breeding cycles (up to 500 days) among raptors meaning they will only breed once every other year. The records from the sanctuary show that after a juvenile left in 2011, no other chick has been spotted since.

It is not clear why there have been no offspring over the past five years. It is suspected that the pair of birds has not mated due to environmental and physiological changes that can be attributed to the recent changes in its surrounding habitat. This shows that the birds breeding patterns may have been interfered with.

The bird's average lifespan is about 30 years while some have been known to live up to 50 years and there have been no deaths of the birds reported within the forest.

5.3 Disturbance of breeding ground

This is the second objective of the study and the aim is to establish how the road construction has disturbed the breeding grounds of the birds

Findings from the study show that the African Crowned Eagles require forests with large trees.

They do not have a preference to a particular tree species, they however prefer tall indigenous trees, about 30metres in height. The pair have perched their nest on a tall Croton tree. It is however important to note that there are few trees in forest that tower over 30 metres. The tree is close to the bypass road; approximately 1.5kms from the bypass road; the section that connects Langata road to Ngong road. During the forest clearance a number of these trees were removed reducing the number of trees available for perching. It is suspected that once the road is complete and under full use, the noise from motor vehicles will be heard from inside the sanctuary. According to the head of the sanctuary the main diet of the African Crowned Eagle are the Sunni antelopes, Dik diks and Duikers. The population of these browsers has declined since the road construction started because noise from the heavy earth moving machinery. This means that meat is not regularly available as compared to before the road construction started. This has therefore affected the breeding patterns of the bird and in turn it's populations as well.

It has been noted however that the birds have a preference for indigenous tree species such as the Croton and Silver oak. The second pair of birds and one of the juvenile birds (although temporarily before fleeing), had built their nest on a Silver oak tree. The Silver Oak is an indigenous hardwood tree that is mainly used in sculpting that is used to create high value sculptors. Its numbers in the forest has been significantly reduced as a result of forest clearance to pave way for the construction of the Southern bypass road. The section of the bypass between the Ngong road intersection and Kibera contained between 75-80% of the Silver oak trees in the forest (Sanctuary Trust, 2012). The total number of hectares that were

cleared felled for the road construction was over 100 hectares. According to the Sanctuary Trust, 90% of the Croton trees in that section were cleared. This has resulted in this tree species numbers in the forest being placed at risk. According to the head of the sanctuary, this particular section used to contain 35% of the Croton trees in the forest and quite a number of them were felled during the clearance.

Plate 5.1: ree stands

Plate 5.3 shows Silver Oak trees unexposed adjacent to the Southern Bypass road and Ngong road. The tree stands are vulnerable to illegal logging which may contribute to loss of more trees further decreasing their population in the forest.

Plate 5.2 African Crowned Eagle nest (Left) **Plate 5.3: African Crowned Eagle nest (Upclose) (Right)**

Plate 5.1 and plate 5.2 show the African Crowned Eagle nest that is built on a Croton tree in the sanctuary. This particular Croton tree towers over 25 metres. The nest is fairly large as compared to those of other raptors as it is more than 3 meters in width.

Research also showed that the reason the birds have a preference for the sanctuary section of the forest is due to its higher concentration of indigenous trees as compared to other sections which the birds find favourable to nest in. The other four sections of the forest have a higher percentage of exotic species of trees such as Eucalyptus which most wild animals do not find favourable to live in. They also lack a variety of biodiversity of undergrowths such as bushes and shrubs for animals such as browsers to feed on.

5.4 Changes in dietary characteristics

Findings from the study show that the birds prefer to feed on Red Duikers, Bush Bucks, Dik Diks, Vervet Monkeys, Sykes Monkeys and occasionally Olive Baboons.

The African Crowned Eagle prefers to hunt larger prey, such as the Red Duikers which weigh on average 30kgs, due to their high dietary demands. It has been noted that The Bush Backs, Duikers and Dik Diks are less sighted. The wardens have noticed during their patrols that the Duikers and Bush backs have reduced in number in the sanctuary. Duikers and Bushbacks are particularly sensitive to noise disturbances and with the construction ongoing, it is suspected that the noise generated from the road works could have caused them to flee to less noisier and less disturbed areas.

Also the numbers of Duikers and Sunni Antelopes is expected to continue reducing because the forest has not been fenced and they may crushed and injured as they attempt to cross the road to try to get to other sections of the forest. They tend to move around a lot within the entire forest.

Plate 5.4: Southern bypass road that has divided the forest into (unfenced) sections

Plate 5.4 shows two sections of the forest that have been split by the Southern bypass road (the section that connects Langata road to Ngong road). Both section are unfenced which increases the chances of animals in the forest such as Sunni antelopes, Duikers and Dik diks being knocked or ran over by motor vehicles as they attempt to cross from one section of the forest to another.

It has been noted that the birds have been hunting more Monkeys and occasionally young Olive Baboons. Preying on Baboons causes a threat to the birds. In 2012 the birds nest was destroyed by a group of mature Olive baboons after the bird made a meal of one of their young. This resulted in the bird having to flee temporarily for a few months. It is not known where the birds sought refuge as they were not sighted elsewhere by those who attempted to identify their location. The birds have since returned and constructed their nest again on the same tree.

Some of the birds prey taxa consisting of the Sykes Monkeys and Vervet Monkeys seem unaffected by the clearance of trees in the forest. Their numbers have been noted to have been increasing.They appear to have adapted well to areas where extensive plantations of exotic trees have been planted for timber, such as the Eucalyptus tree plantations.

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

6.0 Introduction

This chapter provides for the closing of this research project by summarizing the finding of the study on the African Crowned Eagle in Ngong Forest.

6.1 Summary of findings

Given that the forest is in an urban setting and the total forest cover that was cleared was over 100 hectares, negative impacts were inevitable. The findings of the study show that the African has been affected by the clearances of trees and there in habitat fragmentation section of the forest. The numbers of the African Crowned Eagle have been shown to be decreasing since the clearance of tracts of forest cover started in 2009. The population of the birds in the forest was not high initially but the any decrease in numbers causes concern. The birds' breeding ground, that is, the choice of trees that they choose to nest in has not been affected given that the position of the current pair of birds' nest was not located along the section cleared for road construction. However it is important to take note of the fact that the indigenous trees species which the current pair of birds chose to nest in (Croton tree species) and the Silver Oak tree species which the other pair of birds nested in has reduced significantly within the forest. Although the birds are not known to have any biological affiliation to these two particular tree species, they do have a preference for indigenous trees. The continued reduction of indigenous trees from logging will cause a major threat to the

sustainability of the trees in the forest given that their numbers have already reduced drastically especially the Silver oak species.

The dietary taxa of the African Crowned Eagle have not been largely affected by the habitat fragmentation that has resulted from the clearance of forest. The species of monkeys that the bird preys on; Vervet Monkeys and Sykes Monkeys have been increasing in the forest and although the Red Duikers and Bushbacks have been noted to have reduced, the numbers still remain sufficient enough to support the pair of birds in the forest. However if their numbers continue to decrease steadily over the next couple of years, changes might be noted in the dietary characteristics of the bird because the Duikers, Dik diks and Bushbacks are what the birds prefer to feed on. It is suspected that if the birds are unable to prey on these species of animals, they may flee from the forest.

6.3 Conclusion

In order to ensure the sustainable existence of the African Crowned Eagle in the forest, efforts towards trying to conserve and protect the bird must be undertaken. If not undertaken to protect the natural environment of the bird, its existence in the forest may be jeopardized. To prevent such negative impacts resulting in the future, large infrastructural developments should be avoided in natural areas such as forests such as Ngong forest that serve as a home to a variety of numerous animal species and one of Africa's most powerful birds of prey, the African Eagle. If it is necessary to undertake infrastructural developments in areas such as forests, Environmental Impact Assessments should be carried out critically so as to ensure that no species of animals of plant will be adversely affected. Long term impacts of such

projects should be assessed critically so as to avoid disrupting ecosystems, reduction or loss of biodiversity among other negative environmental impacts.

The population of the African Crowned Eagles in the country needs to be determined so as to determine its status on a national level. This will be in line with the new Wildlife Conservation Act 2013, section 4. This will help in enforcing conversation and management of the species, the review of the national list of wildlife ecosystems and habitats that are threatened or endangered and threatened are in need of protection every five years will also help to monitor the status of the bird regularly as well as other flora and fauna that may become endangered, threatened or in need of protection

6.4 Recommendations

e) Restrict development of construction projects such as the Southern bypass road on natural conservation areas such as forests

f) Environmental Impact Assessment conducted prior to undertaking large construction projects in natural areas should take into all biodiversity within a conservation area and the severity of its potential impacts.

g) Fencing on the individual five section of the forest should be undertaken so as to limit incidences of animals such as Duikers, Bush-back and Antelopes being run over and being injured or being killed as they attempt to cross the 60m width road reserve between forest sections.

h) Collaboration with environmental planners should be considered to facilitate development of 10m buffer zone in areas not covered by the forest to limit noise pollution affecting the animals in the forest.

i) Increase forest patrols by rangers and forest guards to reduce the incidences of felling of indigenous tree species such as the Silver Oak that have significantly reduced in the number of tree stands in the forest.

j) Together with legal bodies such as the Law Society of Kenya, the forest department and sanctuary trust should impose heavy penalties on those found trees in the forest specially indigenous tree species.

k) Close monitoring of the African Crowned Eagle should be undertaking to ensure that any changes in the birds' immediate environment are noted to avoid irreversible impacts that could result loss of this species in the forest.

l) Create public awareness of the status of the African Crowned Eagle to enhance conservation measures undertaken.

m) National Museums of Kenya should conduct a regular inventory of the bird so as to monitor the birds status as well as have an up to date database.

6.5 Areas of further study

1. Impacts of habitat fragmentation as a result of construction the southern bypass on biodiversity in Ngong forest and sanctuary.

2. Impacts of construction of the southern bypass on sustainable forest conservation in Ngong Forest Reserve and Sanctuary.

3. Impacts of development activities taking place adjacent to the forest reserve and sanctuary on forest conservation.

4. Viability of extending the land entrusted to the sanctuary through a new lease agreement with the Ministry of Environment, Water and Natural Resources and the Ministry of Finance.

5. Impacts on biodiversity in other natural areas that the Southern bypass road has traversed such as Dagoretti Forest, Ondiri Swamp, Thogoto Forest and Alliance High school forest.

6. The edge effects that have resulted on biodiversity in Ngong Forest as a result of habitat fragmentation

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APPENDICES

APPENDIX I

KEY INFORMANT INTERVIEWS

Kenya Forest Service: Ngong Forest Station and Ngong Forest Sanctuary

Name:

……

Position:

……

Office:

……

Date: …….

1. What is the total hectarage of the forest?

2. How many hectares of trees were cleared in the forest?

3. How many African crowned Eagle bids are in the forest?

4. Have you noticed any changes in the numbers (population) of the African Crowned Eagle in the forest? If yes, explain.

5. Have you noticed any changes in the feeding characteristics of the African crowned Eagle? If yes, explain

6. Was the bird's breeding ground affected? If yes, explain.

7. What species of tree do the birds prefer to nests on?

8. Are you facing any challenges in efforts towards protecting and conserving the African Crowned Eagle in the forest?

APPENDIX II

International Union for Conservation (IUCN) and Nairobi National Meuseums

Name:

……

Position:

……

Office:

……

Date: …….

1.What is the current status of the African crowned Eagle?

2 .What is the status of the bird in Ngong forest?

3. Have any bird counts been carried out in the forest since the clearance started in 2009?

4. Have there been reported cases of reducing numbers of the bird in the forest?

5. Are you taking any measures to conserve the status of the bird in the forest? If yes, please state and explain.

6. What measures have been undertaken to ensure that the bird is protected?

APPENDIX III

African Raptors and Nature Kenya

Name:

……

Position:

……

Office:

……

Date: …….

1.How often do you carry out bird counts in Ngong forest?

2.Have you noticed any changes in the population of the African Crowned Eagle in Ngong Forest?

3.What does the preferred dietary taxa of the African Crowned Eagle consist of? Please elaborate.

4. Have any of the animals that the birds feed on been affected by the clearance of sections of the forest and road construction?

5. Was the birds' breeding ground affected in any way during the clearance of the forest? If yes, explain.

6. Were any of these changes (if any) expected due to the clearance of sections of forest and habitat fragmentation?

7. Were there any measure taken to mitigate these negative impacts (if any)?

8. Were you consulted during the Environmental Impacts Assesment (EIA) of the Southern bypass road?

9. Do you think the EIA was carried out was adequate and transparent?

10. Do you the road construction project should have been carried given the impacts (if any) that have resulted?

11. Any other remarks?

APPENDIX IV

FORD FOUNDATION

Name:

……

Position:

……

Date: …….

1. What type of investment has the organization made in the organization?

2. Does the organization provide funding for the conservation?

3. What is the role of the organization in the conservation efforts of the Ngong Forest sanctuary?

4. Is the African Crowned Eagle a primary concern of the organization's conservation efforts?

5. Do you face any challenges in trying to work with the Kenya Forest Service. If yes, explain

6. Are you taking any measures to protect and conserve the African Crowned Eagle in the forest?