University of Nairobi

School of Engineering

MAPPING THE FLOODING OF LAKE NAKURU NATIONAL PARK AND ITS EFFECTS ON RESIDENT WILDLIFE

BY

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DECLARATION

This Project is my original work and has not been presented for degree at any other University.

Signature ………………………………………… Date 16th **July 2020**

Hongo Peter Onyango

This project has been submitted for examination with my approval as University supervisor.

Signature ……………………………………… Date 19th **July 2020**

Prof. Galcano Canny Mulaku

Dedication

I dedicate this project to my wife Evelyne, and our sons Bradley Justin, Bramwel Blaise and Braiden Francis; and to my parents Lawrence and the late Margret Doris and the late step mother Consolata.

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My sincere gratitude starts with The Almighty and Most Merciful God who gave me the strength to start and finish this research project in good time. Without His blessings, this project would have been stagnated.

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Abstract

Lake Nakuru National Park (LNNP) covers an area of 188 km^2 and is fully enclosed with a comprehensive perimeter fence. The park is a home to 56 different species of mammals, 550 plant species, and 450 species of terrestrial birds as well as flamingos and other water birds. The park is flooded and the lake coverage increased from initial 31 km^2 in 2009 to 54 km^2 in 2018. This impacted negatively on the available space for wildlife. The park infrastructure including some park roads, main gate and the park headquarters were submerged in the floods. This would require a substantial amount of financial resources for rehabilitation. The floods reduced water salinity and this disturbed the water pH balance that helped growth of blue-green algae which formed the bulk of the flamingos' food. This made flamingos to migrate from Lake Nakuru to other places. Flamingos made the largest attractant to tourists in LNNP and their absence led to decline in tourist numbers impacting negatively to the national economy. The study provided data and information such as the current flood zones, change in land cover including acreages, flooded wildlife habitats, the infrastructure submerged in water, and the affected wildlife species and their new residents. These data and information could be used to mitigate future climate variability impacts on wildlife. The tools, equipment and data used included a computer, a laptop a Global Navigation Satellite System (GNSS), satellite images, topographical sheets, wildlife census blocks and wildlife statistical datasets.

The overall objective of this research project was to investigate the effects of flooding to wildlife and their habitats in Lake Nakuru National Park. GIS softwares such as ArcGIS 10.6, QGIS, and excel were used to carry out data analysis and development of thematic maps. The Exploratory Spatial Data Analysis (ESDA) that involved the use of a number of techniques to describe and visualize spatial distribution, discover patterns of spatial association, and also to identify hotspots were used. Some of the results included wildlife distribution maps before and after the floods, land cover change maps and wildlife displaced habitats among others.

Key words: Lake Nakuru National Park • Flooding effects to resident wildlife • wildlife displace habitats • Land cover change • Choropleth mapping technique

Table of Contents

List of Figures

List of Tables

List of Plates

Acronyms

ASAL	Arid and Semi-Arid Land
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CMS	Convention on the Conservation of Migratory Species of Wild Animals
EMCA	Environmental Management and Co-ordination Act
ENVI	Environment for Visualizing Images
ESDA	Exploratory Spatial Data Analysis
ESRI	Environmental Systems Research Institute
GBIF	Global Biodiversity Information Facility
GIS	Geographical Information Systems
GNSS	Global Navigation Satellite System
IBA	Important Bird Area
JICA	Japan International Cooperation Agency
KEMFRI	Kenya Marine and Fisheries Research Institute
KFS	Kenya Forest Service
Km	Kilometer
Km^2	Square Kilometers

KWS	Kenya Wildlife Service
LNNP	Lake Nakuru National Park
m.a.s.l	Meters Above Sea Level
NEMA	National Environment Management Authority
PA	Protected Area
RCMRD	Regional Centre for Mapping of Resources and Development
RMS	Root-Mean-Square
SD	Standard Deviation
SOP	Standard Operation Procedures
SDGs	Sustainable Development Goals
UNESCO	United Nations Educational, Scientific and Cultural Organization
UoN	University of the Nairobi
WHC	World Heritage Convention
WWF	World Wildlife Fund for Nature

1 INTRODUCTION

1.1 Background

Lake Nakuru National Park (LNNP) was established in 1961 and is a world-famous conservation area. Initially, it only encompassed Lake Nakuru and the adjacent mountainous vicinity, but was extended to include a large part of the surrounding savannahs. Lake Nakuru is one of the Rift Valley soda lakes at an elevation of 1,760 meters above sea level (m.a.s.l) and it lies between Bahati Escarpment in the east and the Mau Escarpment in the west as observed by (Montcoudiol, *et al*., 2019). Lake Nakuru National Park forms a perimeter buffer to protect the lake from intrusion by outsiders. Being the first park to be fenced all round in the country, LNNP became a closed island ecosystem as observed by (Shah, 2016).

Until recently the lake had an abundance of algae which attracted a vast number of flamingos that famously lined the shore. The lake Nakuru National Park watershed has plenty of vegetation and includes gazetted forests such as Mau, Eburu and Dundori forests. The Mau Forest consists of plantations and indigenous trees and is part of the Mau complex that covers an area of 650 km^2. Eburu Forest consists of indigenous tree species covering an area of 87.36 km^2 to the south of the lake while Dundori Forest in the eastern covers an area of 69.56 km^2 as observed by (Shah, 2016).

The climate, evolutionary history and geography have influenced progressions of characteristics and features that describe Lake Nakuru National Park as observed by (Mbote, *et al*., 2018). The United Nations Educational, Scientific and Cultural Organization (UNESCO) in 1990 and 2002 declared the park a Ramsar site and a World Heritage park respectively. The park supports a wide ecological diversity with flamingos and other water birds being the major attractions. The ecosystem provides for over 300 plant species; 50 different species of mammals; and a variety of terrestrial birds numbering more than 450 species as observed by (Shah, 2016). The park greenery cover comprises areas of marshland and grasslands with bushy woodland in the rocky cliffs. The park has the euphorbia forest dominated by *Euphorbia candelabrum* on the eastern side and acacia woodland immediately around the lake shore which is dominated by *Acacia* *xanthophlea* as observed by (Shah, 2016). There has been floods in LNNP since 2010 as observed by (Huho, *et al*., 2014).This has led to submerging in water of some important park infrastructures such as roads and buildings including the park headquarters affecting the normal park operations.

1.2 Problem Statement

Lake Nakuru National Park (LNNP) is a fully enclosed ecosystem by a comprehensive perimeter fence constructed to control wildlife movements and mitigate human wildlife conflicts. The park was experiencing flooding that has changed the land cover in the Lake Nakuru ecosystem. With floods submerging critical wildlife home ranges, leading to a congregation of wildlife into smaller areas. This led to increased trampling of wildlife species, spread of invasive plant species and the likelihood of wildlife breaking the perimeter fence to search for suitable habitats, introduction of some diseases such as anthrax that killed some buffalos as observed by (Edebe, *et al*., 2020). The water level in the park was so high that buildings including the park headquarters and some roads were submerged and rendered unusable as observed by (Penney, 2015). The floods reduced water salinity affecting the growth of the blue-green algae which was flamingos' main food source. The impact was that the flamingos that take the largest proportion of tourist attraction in the park flew to other parts of the continent in search of food hence reducing their population in LNNP.

There was a threat to the survival of the wildlife due to vegetation decline as the flood uprooted the shallow-rooted acacia trees which the herbivorous animals in the park feed on. This led to wildlife congregating in limited areas. Further, the Nakuru town had an increase in human population and urban development around the park as was observed by (Penney, 2015). This led to water pollution as run off from Nakuru town mixes with raw sewage from the municipal treatment works facility. The effect was that some wildlife such as water fowl and fish died affecting wildlife population in the park (Waithaka, *et al*., 2020). Largely, the main causes of the floods, from problem analysis, included poor flood management due to lack of reference to support decision making as well as inadequate skills in watershed management; lack of adequate skills in GIS and Remote Sensing; poor farming methods; lack of riverine vegetation; and deforestation in catchment areas as observed by (Penney, 2015).

1.3 Study Objectives

1.3.1 Overall Objective

The overall objective of the project was to investigate and document the effects of flooding to wildlife and their habitats in Lake Nakuru National Park.

1.3.2 Specific Objectives

The specific objectives were:

i. To generate geo-information that can support decision making regarding impacts of floods on LNNP.
ii. To generate land cover change maps
iii. To generate wildlife distribution maps
iv. To generate critical wildlife displaced habitats maps

1.4 Justification of the Study

Wildlife conservation was facing numerous and mounting challenges on private and communal lands in Africa, including in Kenya as observed by (Ogutu, *et al*., 2017). Wildlife conservation in Kenya was an important issue and was about conserving biodiversity and leaving a heritage for future generations. Conservation was not the preserve of a few elite Kenyans as may be presumed. It was up to Kenyans to see how to conserve their resources while at the same time being sensitive to other land users. Conservation was about assisting to mitigate flooding in wildlife protected areas. When flooding submerges park infrastructures, destroys wildlife habitats, and wildlife calving zones then it becomes a challenge to local livelihoods, the tourist industry and the nation's economy. When solutions to flooding in LNNP were not adequate, there was going to be displacement of wildlife; drastic change in land cover as water claims more land space; submerging of more infrastructures; altered water pH level resulting to death of some animals such as fish and reduced flamingo numbers as observed by (Waithaka, *et al*., 2020;

Kiprutto, *et al.*, 2012). This project was vital in that it would make available data and information for informed decision making in an effort to mitigate future flooding in LNNP. The data and information could be used to enhance flood mitigation measures by generating flood mitigation guidelines and flood preparedness awareness posters. The main beneficiary of this project included wildlife conservation organizations such as Kenya Wildlife service (KWS), Kenya Forest Service (KFS), the World Wildlife Fund for nature (WWF), the tourism sector, the Nakuru County Government and the community living near Lake Nakuru National Park.

1.5 Scope of the Study

The geographic extent of this project encompassed the entire Lake Nakuru National Park. The study determined to uncover flooding zones, displaced critical wildlife habitats and new homes to displaced wildlife. The study aimed at answering the following two research questions;

i. Have the floods submerged critical wildlife habitats?

ii. Have the floods caused wildlife displacement within the park?

1.6 Project Organization

This report has five chapters. Chapter one elaborates on the introduction of the project. It encompasses the back ground, objectives, project's justification and scope. Chapter two talks about the literature review. It involves a brief introduction, information on Lake Nakuru National Park, its existence and management; wildlife population in the park, physical environment and the previous studies. Chapter three is about research methodology. It includes an introduction, research design, procedures of data collection and data mobilization. Chapter four is on data analysis, results and discussion. It involves an introduction, land cover and wildlife data organization, analysis and generation of results such as land cover maps, land cover change, wildlife distribution maps, flood zones and affected wildlife habitats. It also entails standard deviation analysis and relationships between variables, discussion of results and challenges. Chapter five entails conclusions and recommendations. There is also references and appendices.

2 LITERATURE REVIEW

2.1 Introduction

Kenya made steps towards the execution of global biodiversity frameworks at regional and international levels as observed by (Shah, 2016). The government provided a good environment to conserve national biodiversity. Through the government's commitment to fulfilling the provisions of the biodiversity related resolutions, treaties and procedures. Kenya's conservation and creation of biodiversity regulations started during the colonial days as observed by (Shah, 2016). After independence, a lot of emphasis was placed on biodiversity security through devising of relevant policies, setting up national environment-based institutions such as Kenya Wildlife Service, and designation of Protected Areas (PA) such as Lake Nakuru National Park. The key national policies related to wildlife included the National Constitution of Kenya, the National Wildlife Conservation and Management Policy, the National Policy on Culture and Heritage and the National Wetlands Conservation and Management Policy. It also developed legal frameworks on biodiversity such as Wildlife Conservation and Management Act, Environmental Management and Co-ordination Act (EMCA), the National Museums and Heritage Act as observed by (Shah, 2016).

Wildlife in Kenya is managed by the Kenya Wildlife Service (KWS). Kenya Wildlife Service is a State Corporation established within the Ministry of Tourism and Wildlife. It was established in 1990 by an Act of Parliament, the Wildlife Conservation and Management Act CAP. 376 of 1989 now repealed and replaced by the Wildlife Conservation and Management Act, 2013, with the mandate to conserve and manage wildlife in Kenya and to enforce related laws and regulations. The service has an authority over national parks and also oversees other wildlife management areas such as national reserves, wildlife sanctuaries, conservancies and all wildlife management activities outside protected areas as indicated in (GoK, 2013b; GoK, 2012f; GoK, 2010; GoK, 1976a). Kenya Wildlife Service manages about 8% of Kenya's total land mass. The service also conducts wildlife research and outreach programs in conservation education.

2.2 Lake Nakuru National Park

Lake Nakuru is a locked drainage system within a water catchment area of 1800 km^2 and is fully contained within Lake Nakuru National Park. The Lake Nakuru National Park is an island on its own because it is totally fenced with a 74 km chain link and electric fence as reported by (Barua, 1995). Lake Nakuru has no visible water outlet. The mechanisms of the lake water balance includes rainfall over the lake, river inflows, disappearance of water from the lake surface and ground water inflows. Lake Nakuru is among the three listed UNESCO's World Heritage natural sites due to its matchlessness of the bird's life. The other two lakes include Lake Bogoria and Lake Elementaita. The three lakes are shallow and located within Africa's Great Rift Valley that crosses the productive Kenya's highlands as observed by (Penney, 2015). The three lakes are also characterised by stunning scenery that range from forests of acacia trees to animals grazing on the verdant plain or gathering at the shores of the lake to drink water in order to quench their thirstiness as observed by (Penney, 2015). Lake Nakuru went through many transformations. It was declared a National Park in 1957 with the objective to safeguard the flamingos and other water birds that used Lake Nakuru as their critical habitats as was observed by (Shah, 2016). It was designated a bird sanctuary in 1960, some land around the lake was added to the National Park in 1968, a Rhino sanctuary in 1987, a first Ramsar site in 1990, an Important Bird Area (IBA) in 1999 and branded a world-class National Park in 2005 as observed by (Shah, 2016; Raini, 2009).

Lake Nakuru National Park became an island of nature surrounded by a sea of humanity as observed by (Thampy, 2002). United Nations Educational, Scientific and Cultural Organization (UNESCO), when describing the three lakes region, said that with rapid population growth nearby, the area was under "considerable threat from surrounding pressures" as observed by (Penney, 2015). These threats to biodiversity included floods in protected areas, siltation from soil erosion, land degradation resulting from incompatible land use practices in areas adjacent to the park, habitat loss, global climate change, pollution emanating from town, poaching and overexploitation, invasive alien species and biosafety concerns (Mbote, *et al.*, 2018; Penney, 2015; Barua, 1995).

In 1961, the people living in Nakuru Town raised issues about a mosquito menace from Lake Nakuru and this was solved by introduction of Tilapia Graham (*Oreochromis alcalicus graham),* from Lake Magadi, to feed on the larvae of the mosquitos as reported by (Barua, 1995). The fish species effectively managed the mosquito's threats but the fish were attractants to many fish-eating birds that found new habitats at the lake. The birds included pelicans, cormorants and fish eagles. This also led to competition between flamingos and fish in picking blue green algae for food.

2.3 Wildlife Populations in the Park

The Lake Nakuru National Park had high numbers of buffalo, waterbuck, impala, and warthog as observed by (Edebe, *et al*., 2020; Young & Cynthia, 1997) as shown in Table 1. Some wildlife introduced to the park in 1977 included Rothschild's Giraffes, White rhinos, Black rhinos, Lions, Leopards and Hyenas as observed by (Young & Cynthia, 1997) and shown in Table 2.

Table 1: Herbivore populations

Wildlife/Year	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Impala	2271	2536	1888	1447	1756	1776	1718	1563	2053	1515
Buffalo	2995	2970	2702	3161	4673	3953	3510	3295	4144	2792
Waterbuck	246	207	195	161	205	224	194	135	180	187
Warthog	288	40	41	56	58	166	148	157	454	199

Table 2: Wildlife population introduced in the park in 1977

Species	**Details**	**Year**
Lion	30	1977
Leopard	24	1977
Cheetah	2	1977
Hyena	16	1977
Rothschild's Giraffe	150 (from western Kenya)	1977
Black Rhino	40 (from South Africa)	1977
White Rhino	24 (from South Africa)	1977

The other notable herbivore species found in LNNP includes hippo, eland, Thomson's gazelle, Grant's gazelle and Zebra. There were variety of vegetation species in the LNNP namely acacia woodland, open grassland bushland, marshland grassland, and cliff vegetation as observed by (Young & Cynthia, 1997)

2.4 Physical Environment

2.4.1 Geology

The geology of LNNP and its catchment area is made up of volcanic rocks of tertiary-quaternary age which has been affected by a series of faulting. The geology in the area is connected to activities linked with Rift Valley creation namely volcanic eruptions and faulting. The latest activity occurred in Menengai Crater and faulting that affected the recent tuff cones in Lake Elementaita as reported by (Barua, 1995). The rock units originated from the lava flows took a larger part and were essentially forming the bed of the area. The rock units were unnatural by faulting which happened parallel to the rift itself that runs in the north to south direction resulting into the formation of ridges and lowlands such as the ones in Lion Hill, Ronda, West Cliff and Mau Escarpment. The soils in the area comprise of porous and unconsolidated surface which are vulnerable to soil erosion as reported by (Barua, 1995).

2.4.2 Drainage

Lake Nakuru National Park lies at the lowest point of a basin that is fed by five rivers namely Njoro, Makalia, Nderit, Naishi and Larmudiak. Out of the five rivers, four rivers drain from the Mau Escarpment and only Makalia and Njoro Rivers are perennial and others disappear on the ground only to reoccur just before entering the lake as observed by (Montcoudiol, *et al*., 2019). No rivers emanating from Bahati Escarpment run into Lake Nakuru directly as observed by (Montcoudiol, *et al*., 2019). Lake Nakuru also collects water discharge from Baharini permanent springs and additional water springs from Lion Hill as observed by (Shah, 2016) The source of Baharini Springs can be traced to the Subukia region which is to the east of the lake as observed by (Shah, 2016). It can be concluded that rainfall in the Mau Forest and Aberdare Range influences a large proportion of the water level in the Lake Nakuru as shown in Table 3 and Figure 1.

Table 3: Seasonal characteristics of rivers that flow into Lake Nakuru

River/Channel	Seasonal Characteristics	Source
Njoro River	Perennial	Mau Escarpment
Makalia River	Seasonal	Mau Forest
Enderit River	Seasonal	Mau Escarpment
Naishi River	Seasonal	Mau Escarpment
Lamudiak River	Seasonal	Mau Escarpment
Baharini Springs	Perennial	Ground water, Lanet
Ngosur	Perennial	Bahari forest (subsurface)
Town sewage	Perennial	Nakuru town

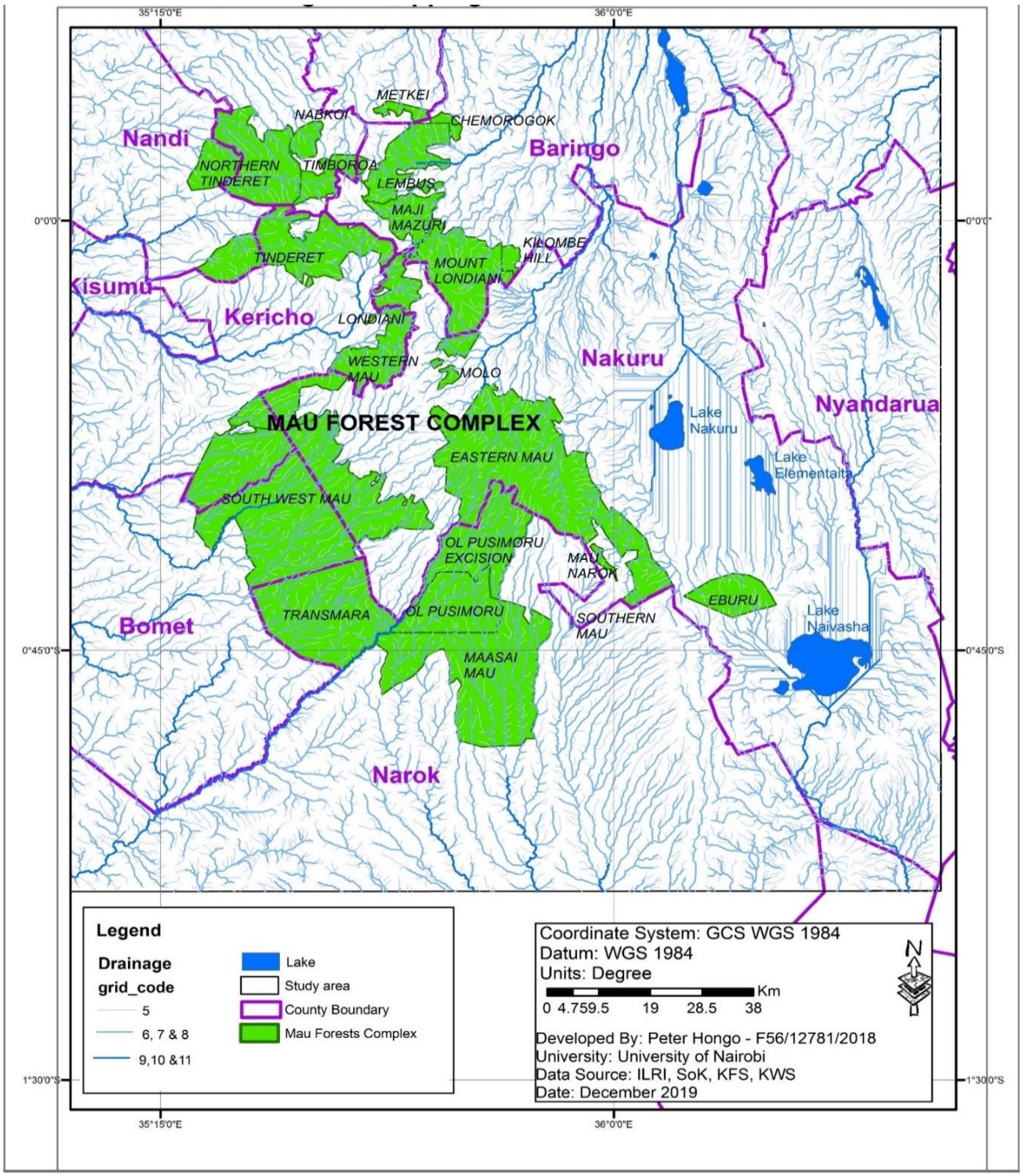


Figure 1: The Mau forest drainage in relation to Lake Nakuru. Source UoN (2019)

2.4.3 Climate

The Lake Nakuru National Park had annual averages for evaporation, radiation and temperature at 1800mm, 490 Langleys, and 17.0^{0}C respectively. The three factors had their crests centred between January and September with minima around April and August as reported by (Barua, 1995).

2.4.4 Floods

The rising water levels in Lake Nakuru National Park abridged available grazing pastures for herbivores as reported by (Barua, 1995) and this led to wildlife finding new habitats away from their usual wildlife dispersal areas making it hard for tourists to easily observe the wildlife. The park was popular and was receiving approximately 200,000 visitors yearly as observed by (Thampy, 2002; Barua, 1995). The floods affected both wildlife in terms of their habitats and tourism in terms of tourists' numbers and this threatened the local and national economy (Kiprutto, *et al*., 2012; Thampy, 2002). The floods expanded the shallow lake significantly from 31 km^2 in 2009 to 54 km^2 in 2013 and this upset the chemical stability that was behind the lake's ecosystem. The flood waters weakened the water alkaline level that supported the algae which flamingos fed on as observed by (Penney, 2015).

Floods also come with devastating impacts to both natural processes and community livelihoods. Water levels in Rift Valley lakes increased since 2012 and it was believed that the rise was due to the earth's tectonic movements or reforestation in the Mau forest complex. Researchers tried to explain the situation and attributed it to increased rainfall in catchment areas, lake siltation, underground geological shifts, pollution from Nakuru town and climatic factors as observed by the (Nation, 2020).

Flooding disturbed the environment and the organism that depended on it as shown in Plates 1, 2, 3 and 4. Apart from heavy metals which might include insufficient food, floods changed lake depth and water chemistry including the pH level of the lake (Tenai, 2015). Flamingos were populous in Lake Nakuru due to an abundance of their food and the shallowness of the lake that facilitated their grazing. Changes in water levels altered water salinity and nutrient concentration that reduced the growth of cyanobacteria. When flooding happens simultaneously in neighbouring salty lakes, flamingos would fly in vain in search of food as observed by (Tenai, 2015). Lake Nakuru area was classified as arid and semi-arid land (ASAL) and had low fragile soils that could easily be carried by flood water into the lake to facilitate a siltation process. Unpublished documents of Rift Valley lakes' levels in Kenya showed a rise in water levels in 1901 and 1963. Therefore the current flooding being witnessed could be attributed to a 50-year impact cyclic of climatic occurrence.

Plate 1: Part of Lake Nakuru National Park from Baboon Cliff in 2009 before flooding

Plate 2: Part of Lake Nakuru National Park from Baboon Cliff in 2014 with flooding water

Plate 3: Lake Nakuru National Park main gate in 2009 was operational

Plate 4: Lake Nakuru National Park main gate in 2014. The gate is flooded and therefore not operational

2.5 Previous Studies

One of the previous studies was about the aerial total count of buffaloes in Lake Nakuru National Park. The main objective of the count was to establish the estimate of buffalo population, their distribution and herd sizes to inform management cause of action including destocking. The aerial survey was done using a Bell 407 helicopter and 45 east to west transects as shown in Figure 2 and flight path information Table 4 to cover an area of 133 Km^2 of the LNNP but excluded the lake extent. Some of the data and information collected included the buffalo numbers, their Global Navigation Satellite System (GNSS) locations, and photographs of herds of more than 20 buffaloes as shown in Plate 5.

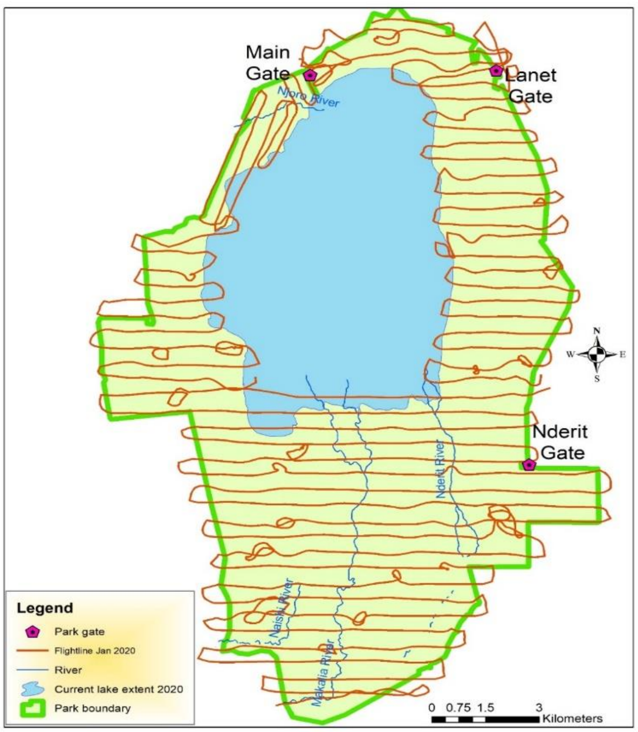


Figure 2: Flight paths used as transects during the aerial survey. Source KWS (2020).

A total of 6072 buffaloes were observed and the density was 45.65 animals per km^2. This confirmed that buffaloes were still the most abundant mammalian species in LNNP as observed by (Edebe, *et al.*, 2020). A total of 80 buffalo herds were encountered with 23 herds being above 100 individuals. The study found out the average herd size of buffaloes was 76 individuals.

Table 4: Flight parameters in buffalo count January 2020

Parameter	**value**
No. of flight lines	45
Flight line orientation	East - West
Mean length of flight line	8.84 Km
Mean Time/ flight line	4.93 Min
Total flight line distance	263 Km
Mean height above ground	57 m
Mean ground speed.	110 Km/hr

Source: KWS (2020)

Plate 5: A herd of buffaloes captured during aerial census (Source: KWS 2020)

The study found out that most of the large herds were concentrated on the southern and southern eastern part of the park near Rivers Naishi, Makalia and Nderit. The study concluded that at a density of 45.65, the buffalo numbers were very high in a park that was comprehensively fenced. The report recommended management intervention so that to reduce the buffalo population.

Another study was on a report on fish kills in Lake Nakuru. This study was carried out by Kenya Marine and Fisheries Research Institute (KEMFRI). The aim of the study was to assess and advise on possible causes of fish kills, impacts and mitigation measures to manage the fish population. The study was conducted by assessing the quality of water. One of the observations was that of the four fish species recorded in Lake Nakuru, Nile tilapia (*Oreochromis niloticus*), was the most affected and many of the dead fish were relatively larger sizes based on the size range found in the lake as observed by (Waithaka, *et al*., 2020).

Sarova Point where there was high concentration of fish kill was found to have the highest level of nitrates at a concentration of 67.6315 mgl-1, followed by the Hippo Point (near the sewage ponds) at 67.5565 mgl-1 (Waithaka, *et al*., 2020). This indicated the organic and inorganic discharge into the lake possibly originating from industrial or municipal waste as shown in Table 5.

Table 5: Nutrient levels at various lake points

	Nitrates (ug/L)	**Phosphate (ug/L)**	**Chlorophyll-a (ug/L)**
Hippo Pool	39.88	1.00	26.375
Nderit RM	36.29	0.81	25.975
Makalia RM	51.81	1.54	48.59
Hippo Point	67.56	0.65	77.35
Njoro RM	57.54	0.61	65.7475
Mid Lake	58.60	0.53	75.565
Sarova Point	67.63	0.62	84.49

Source: (Waithaka, et al., 2020)

The study concluded that there were high levels of nitrates (NO^3) that exceeded the recommended 45 mgl-1. This had led to the fish kills in Lake Nakuru.

Another study done was about eco-toxicological assessment of Rift Valley lakes in Kenya and the potential health impact on the lesser flamingo population. The specific objectives included to find out proven signs and post-mortem lesions on lesser flamingo during a die off; to detect the amount of fluoride in the water, soil sediments and lesser flamingo biological samples; and determine the presence and level of heavy metals in the same. The study found out that Rift Valley lakes were faced with pollution and soil sedimentation problems due to poor agricultural practices along the rivers which discharge to the lakes as observed by (Tenai, 2015). Some pesticides and fertilizers used by farmers contained fluorides and metals that were washed off to the rivers and finally drained to the lake, and when accumulated became toxic to the aquatic life. The study found out that all the study sites had fluoride concentration in water and soil sediments as observed by (Tenai, 2015). In conclusion, the study said that high fluoride concentration was detected in the lake water, sediments and the lesser flamingoes' tissues which could be an indication of contamination of the habitat which also affected the aquatic life. Lead concentration in Lake Nakuru waters and in the birds' tissues were also above the recommended levels. The study recommended more research to find out the actual cause of death of the lesser flamingoes.

Another study carried out in the area was the domestication and application of biodiversity related Multilateral Environmental Agreements (MEAs) in Kenya. The aim of the study was to evaluate the amalgamation of biodiversity MEAs in Kenya and also to determine the level of community awareness of biodiversity MEAs within the conservation areas. This study surveyed the domestication and execution of biodiversity MEAs considering the level of effectiveness at the national biodiversity policies and biodiversity management institutions in the country. The study also considered the level of MEA awareness among the local communities living around the MEA protected areas in Kenya. The results showed that Kenya has achieved the domestication and implementation of biodiversity MEAs to a certain extent as observed by (Shah, 2016). Frequency scores were used to demonstrate the difference between the MEA awareness and gender as shown in Table 6 which shows that for all the five biodiversity MEAs namely the CBD, CITES, CMS, Ramsar Convention and WHC, males were better aware about the conservation and operational sites being under MEAs than the females.

Table 6: MEA awareness and gender

MEAs	Awareness (%)	Gender	
		No. of males (%)	**No. of females (%)**
CBD	310 (77.9)	212 (68.4)	98 (31.6)
CITES	328 (84.8)	241 (73.5)	87 (26.5)
CMS	117(33.4)	107 (91.5)	10 (8.5)
Ramsar Convention	292 (51.7)	198 (67.8)	94 (32.2)
WHC	233(58.4)	188 (80.7)	45 (19.3)

Source: (Shah, 2016)

This study observed that biodiversity conservation was active in two MEAs only namely the CITES and the CMS as observed by (Shah, 2016). The study found out that CITES was active due to continuous awareness creation on anti-poaching by the KWS with support of NGOs and international campaigns. The CMS was active because the communities thought that biodiversity conservation was at a high level due to increased human-wildlife conflicts and the community thought that the wildlife population had increased. The study found out that the male respondents had better awareness of biodiversity MEAs than their female counterparts. The study concluded that the domestication and implementation of biodiversity-related MEAs in Kenya was insufficient. There was inadequate amalgamation of biodiversity MEAs in national biodiversity policies based on the overall integration level of 18-25% which indicated a weak integration level compared to other nations.

3 RESEARCH METHODOLOGY

3.1 Introduction

Different data were gathered and automated in a Geographical Information System (GIS) compatible format, which provided flexibility in mapping, data organization, data analysis, and data presentation. Topographical map sheet No. 119/3 was acquired from Survey of Kenya (SoK) and was important for basic data such as roads, rivers and park boundary, which were extracted by digitization from a georeferenced topographical sheet and overlaid to form part of the background data.

Wildlife data collected from KWS were statistical data. The project identified some errors that required data processing as in (GBIF, 2020). Wildlife data and wildlife census blocks were used in the project to indicate the distribution of wildlife before and after floods. The choropleth mapping technique was used to generate wildlife distribution maps for 2009 and 2018.

Remotely sensed data was used to detect and evaluate the land cover change which occurred within Lake Nakuru National Park between 2009 and 2018 as observed by (Kundu, *et al*., 2015). Five different habitat class categories were identified and used in the project. The five class categories included lake, forest, sewage pond, grassland and bare ground. The 2009 and 2018 satellite images covering the entire study area were acquired from the Regional Centre for Mapping of Resources for Development (RCMRD) and were used to generate a land cover change map for LNNP.

3.2 Research Design

The Research Design was developed to give direction to the project in terms of data to be collected, technique of data processing and the achievements. The indicators of the achievements included displaced wildlife habitats, land cover maps, wildlife distribution maps as shown in Figure 3.

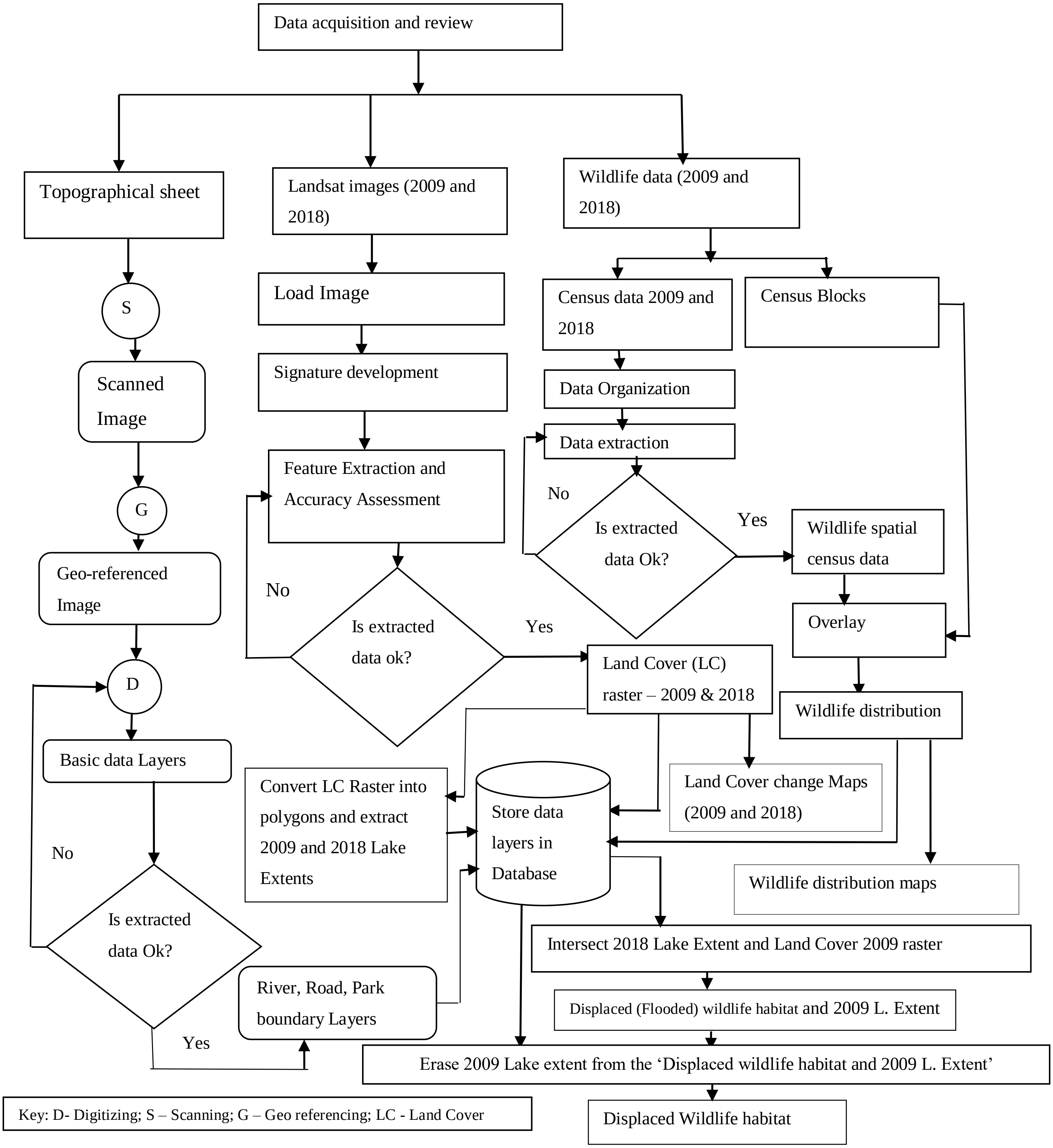


Figure 3: Flow diagram for generating wildlife displaced habitats

3.3 Study Area

The study area was Lake Nakuru National Park (LNNP), which covers an area of 188 km^2 and is found in the Great Rift Valley, 140km northwest of Nairobi, in Nakuru County (see Figure 4).

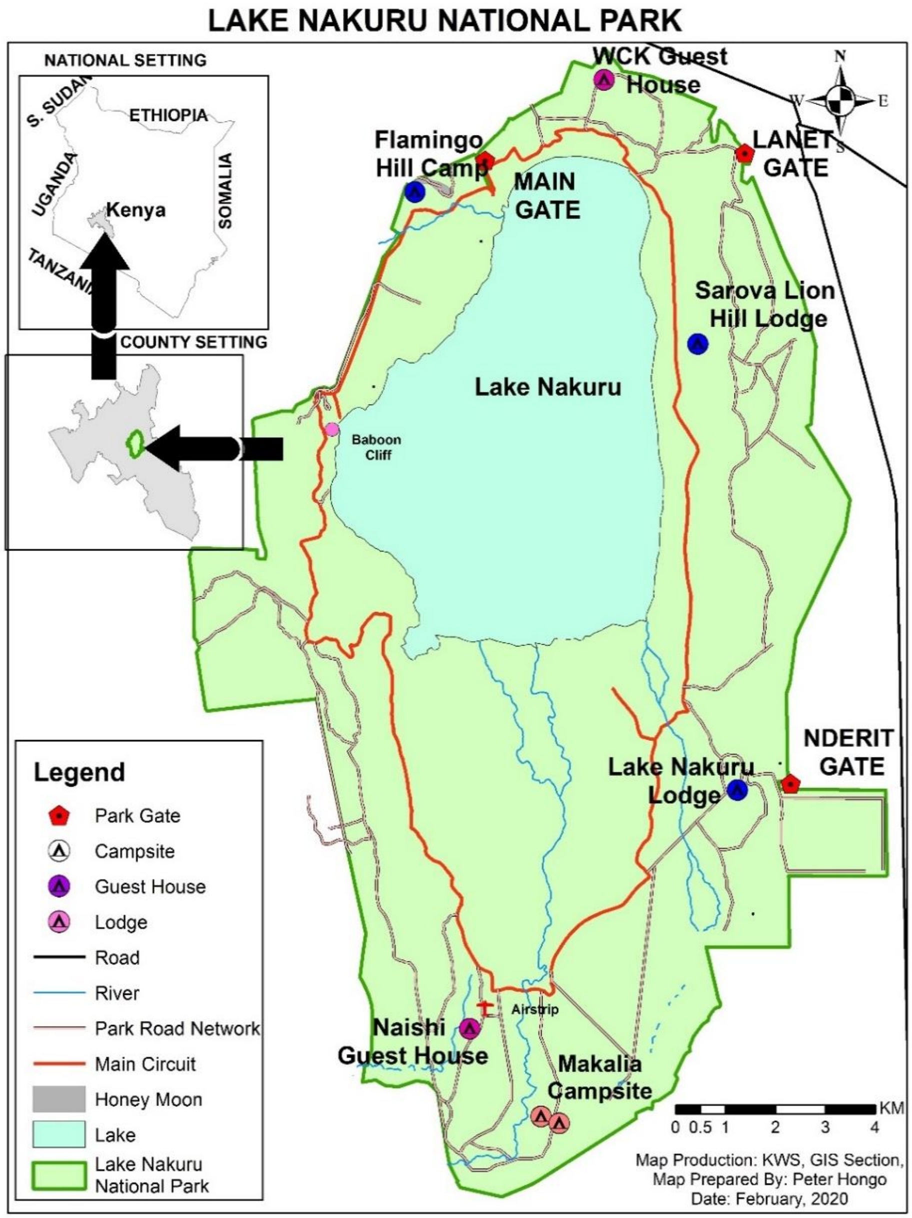


Figure 4: Lake Nakuru National Park. ***Source: KWS (2020)***

3.4 Data Collection Procedure

3.4.1 Data Request Procedure

Every organization that was identified by the project as ideal for data collection had their own data sharing protocol according to their respective Standard Operation Procedures (SOPs). The Regional Centre for Mapping of Resources for Development (RCMRD) required an official letter before data was shared, Kenya Wildlife Service (KWS) required the researcher to fill in a data request form before data was shared, and Survey of Kenya (SoK) required an official letter from an institution. The project took a lot of time acquiring the datasets.

3.4.2 Satellite Images

The 2009 and 2018 satellite images covering the entire study area were acquired from the Regional Centre for Mapping of Resources for Development (RCMRD) and were used to generate land cover change for LNNP. A letter was written using Kenya Wildlife Service's letterhead (Appendix 1) which was a required step before data was shared.

3.4.3 Wildlife Statistical Data and Census Blocks

The project collected wildlife census blocks, wildlife population data and reports from KWS. The acquisition of these datasets required filling of the data requisition form which was part of KWS's Standard Operation Procedures (SOP) for data sharing. The project followed the necessary procedure and was given the vital datasets (Appendix 2).

3.4.4 Topographical Map

Topographical sheet No. 119/3 was purchased from Surveys of Kenya (SoK) after a request was made through Kenya Wildlife Service where the author works. It was a procedure for a request to be made before the topographical sheet was purchased.

3.5 Data Organization

3.5.1 Land Cover

Land cover classification was vital in that it helped to group together a set of observational pixels regarding their common attributes for analysis purposes. The images were unzipped and black areas at the edges removed. For the images to be understood well, their properties were opened to find out information such as acquisition date, data type, sensor name, and cell size as shown in Tables 7 and 8.

Table 7: 2009 image

Item	Description
Acquisition Date	6/4/2009 7:37:04 am
Data Type	6 bands
Sensor Name	Landsat-5-TM
Cell size (xy)	30,30
Research Area	188 Km^2

Table 8: 2018 image

Item	Description
Acquisition Date	3/25/2018 7:48:28 am
Data Type	8 bands
Sensor Name	Landsat 8
Cell size (xy)	30,30
Research Area	188 Km^2

The ArcGIS 10.7.1 was launched and both images added. Both images were given the same coordinate system WGS84, UTM zone 37S. The study area was defined by using dissolve tool on the wildlife census blocks data to create one block and named it “StudyAreaentireBlock”. In order to work with a smaller image, the clipping tool was used to clip the images by selecting the entire image in the input raster and “StudyAreaentireBlock” in the output extent as shown in the Figures 5 and 6.

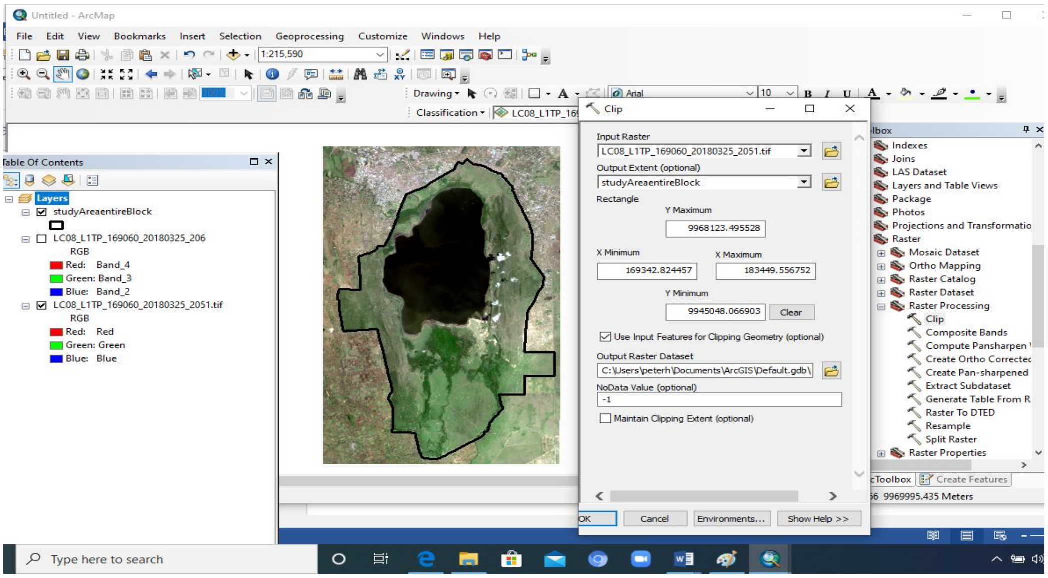


Figure 5: Clipping process

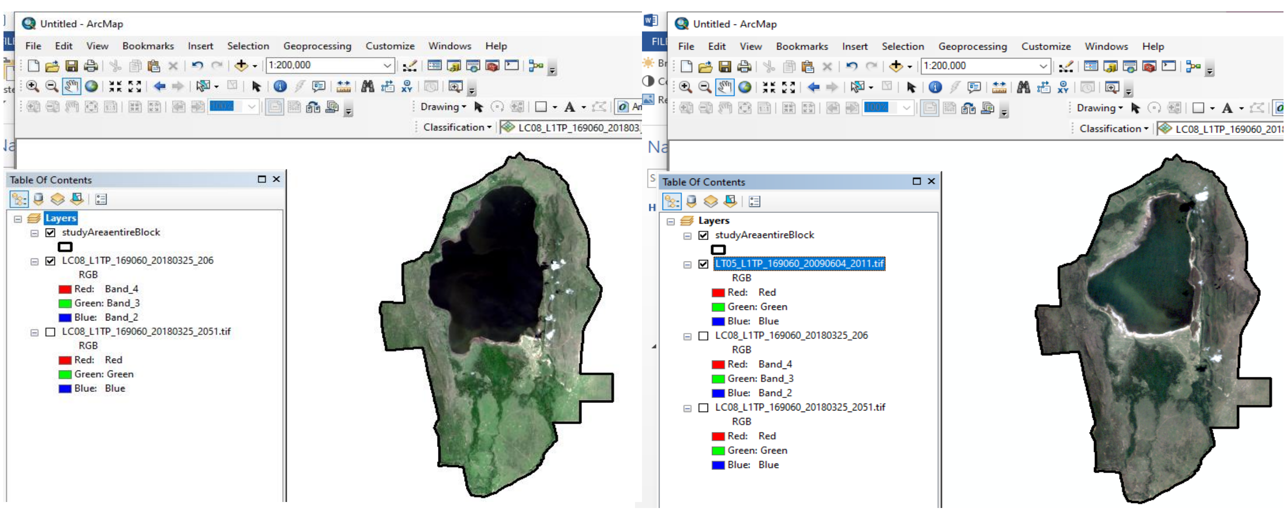


Figure 6: Clipped images 2018 (left) and 2009 on the (right)

In order to obtain consistent land cover datasets for Lake Nakuru National Park or Area of Interest (AoI) that had a combination of water body, forest, sewage ponds, grassland and bare ground, a per-pixel image classification approach was preferred. The images were classified based on guided clustering procedure as observed by (Yuan, *et al*., 2005). The false color bands combination and supervised classification were used when developing a signature file by generating training samples through the image classification toolbar. Homogeneous areas were identified for delineation. Once identified, between 6 to 8 polygons were digitized of similar spectral reflectance per category. For instance, the lake as a classification category, was attributed to sites that appeared dark blue, blue and grey at the edge. These sites were digitized, evaluated and label with class number identified in the classification (class name column). Evaluation was important to know whether the training pixels all fit the criteria and also how homogenous and how pure the training sites were. Later these labelled polygons were merged to form a class category as shown in Figure 7. A total of five different habitat class categories considered which included Lake (1), Forest (9), Sewage Pond (17), Grassland (23) and Bare Ground (31).

Training Sample Manager

ID	Class Name	Value	Color	Count
1	Class 1	1		2633
2	Class 2	2		246
3	Class 3	3		19
4	Class 4	4		10
5	Class 5	5		364
6	Class 6	6		19
7	Class 7	7		10
8	Class 8	8		9793
9	Class 9	9		97
10	Class 10	10		133
11	Class 11	11		265
12	Class 12	12		174
13	Class 13	13		146
14	Class 14	14		14
15	Class 15	15		19
16	Class 16	16		206
17	Class 17	17		2
18	Class 18	18		2
19	Class 19	19		1
20	Class 20	20		1
21	Class 21	21		1
22	Class 22	22		1
23	Class 23	23		45
24	Class 24	24		48
25	Class 25	25		22
26	Class 26	26		45
27	Class 27	27		41
28	Class 28	28		47
29	Class 29	29		19
30	Class 30	30		261
31	Class 31	31		1
32	Class 32	32		7
33	Class 33	33		2
34	Class 34	34		4
35	Class 35	35		3
36	Class 36	36		4

Training Sample Manager

ID	Class Name	Value	Color	Count
1	Class 1	1		13094
2	Class 9	9		1054
3	Class 17	17		8
4	Class 23	23		528
5	Class 31	31		21

Figure 7: Process of digitizing training sites (signature development)

An interactive supervised classification method was used to map the five class categories and was given a file name called Classification_2018 for image 2018. The interactive supervised classification executed maximum livelihood using sample set i.e. digitized training sites as shown in Figure 8.

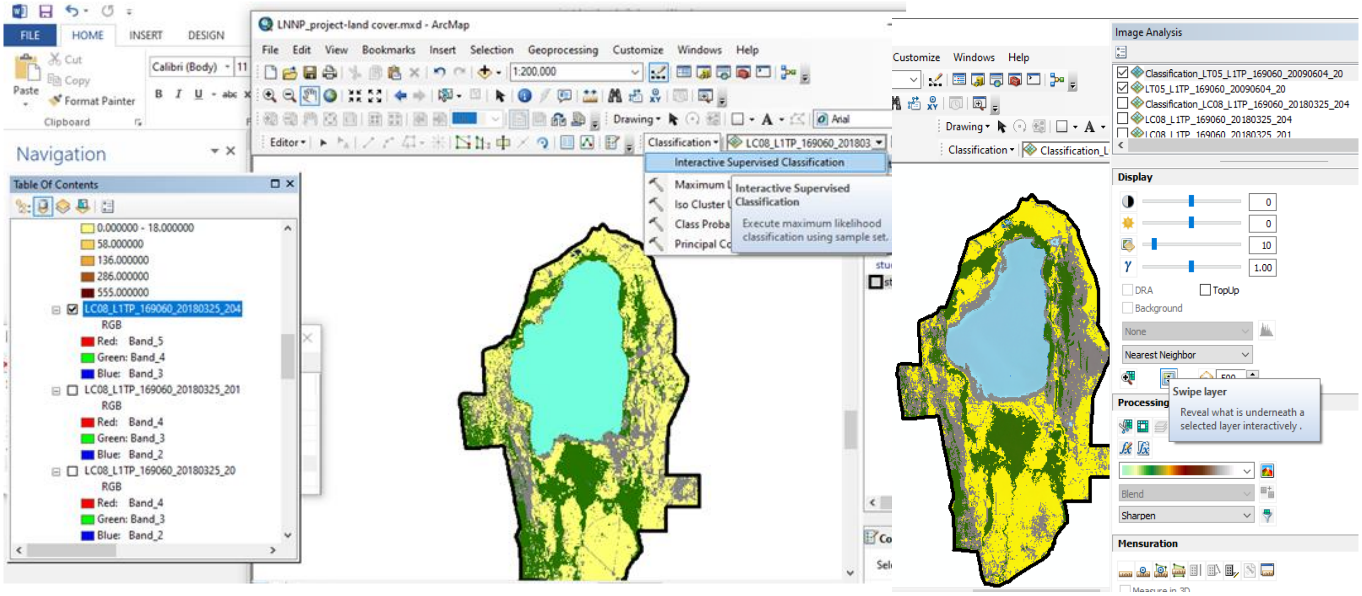


Figure 8: Interactive supervised classification for 2018 image (right), and 2009 (left)

3.5.2 Accuracy Assessment

The accuracy assessment was necessary before final compilation of land cover maps in order to enhance the quality of the land cover data layer generated. The first step was to generate a confusion matrix. The confusion matrix required field verifications. The COVID19 pandemic posed challenges to the project as it forced lockdown to Nairobi Metropolitan. This was cacophonous, prevented travelling from and back to Nairobi where the author lives and made it difficult to visit Lake Nakuru National Park for ground trothing. Procedural limitations such as scale of observation was also experienced when using remote sensing technique such that identification of objects at a large scale was not the same as the objects observed at small scale. The project countered these challenges by carrying out verification to 396 stratified random sampling points using indigenous knowledge to the area and google earth. QGIS's AcATaMa plugin was installed as shown in Figure 9 and used to automate confusion matrix and also overall accuracy.

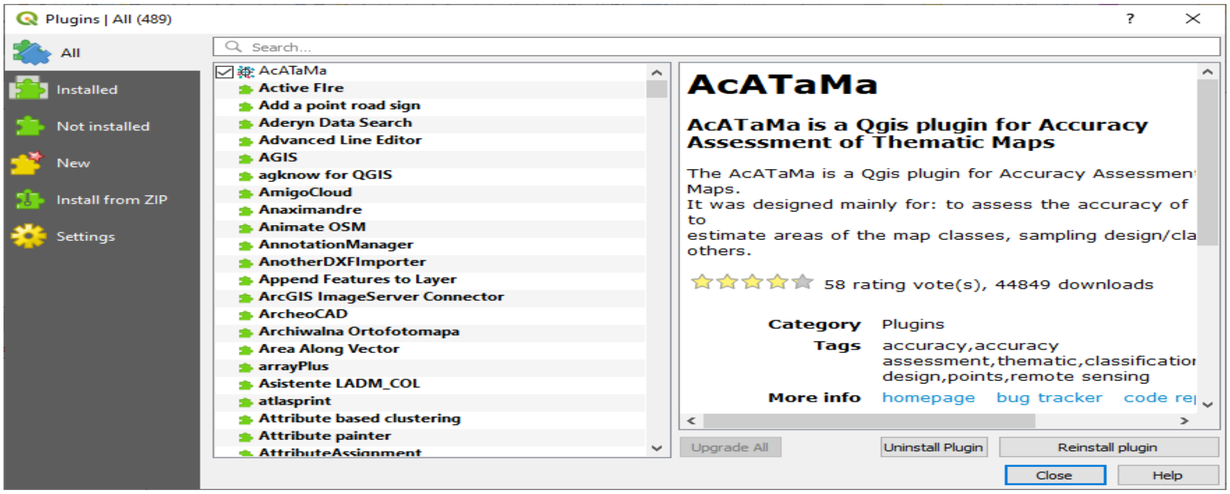


Figure 9: Installation of AcATaMa for accuracy assessment

QGIS 3.12 enabled with Grass was used for accuracy assessment of the land cover classification map by checking a confusion matrix calculated based on ground truth points. The data required for the assessment included google map, land cover classification for 2009 and 2018 and their original images (i.e. Classification_2018.tiff, Classification1_LT05_L1TP_169060_20090604_201_b.tiff, LT05_L1TP_169060_20090604_2011.tiff and LC08_L1TP_169060_20180325_2051.tiff). QGIS was launched and Classification_2018.tiff and LC08_L1TP_169060_20180325_2051.tiff added to canvas. AcATaMa was opened from plugin > Accuracy Assessment of Thematic Maps> AcATaMa as shown in Figure 10.

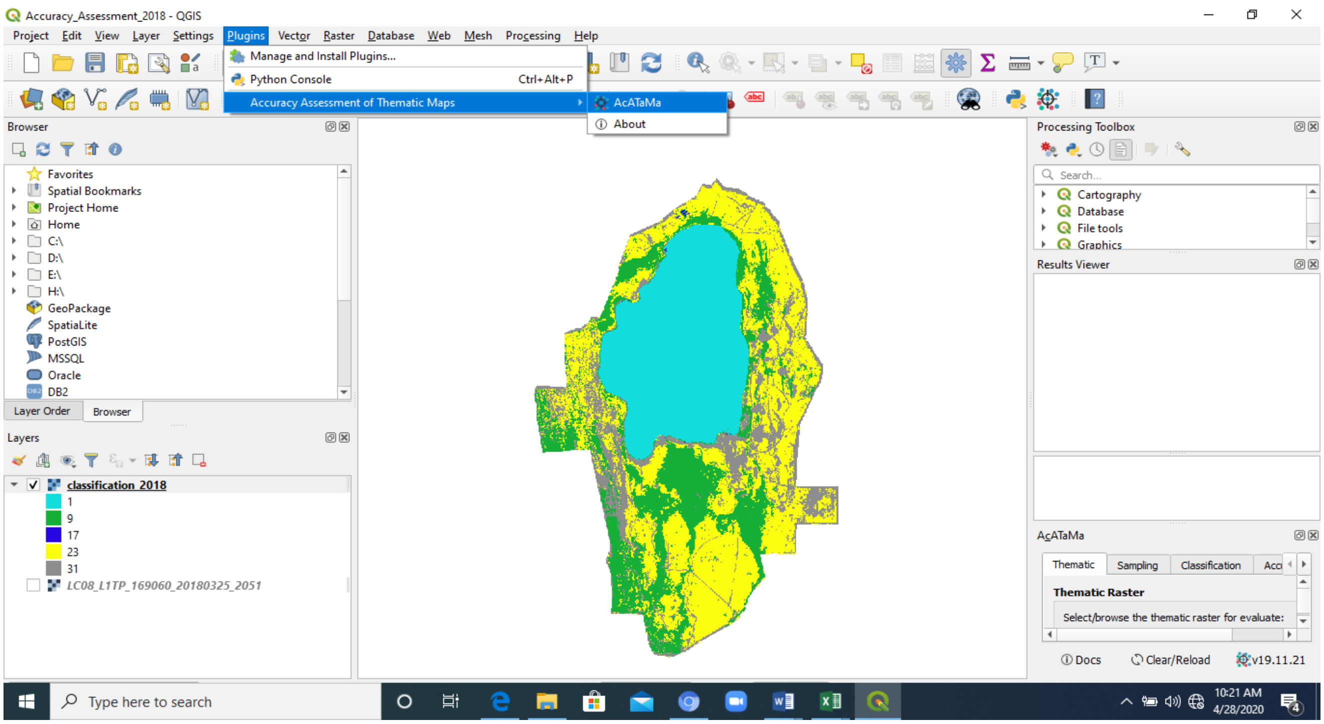


Figure 10: Classification_2018 and original image of 2018 added on the QGIS canvas

The process of accuracy assessment involved four steps namely Thematic, Sampling, Classification and Accuracy Assessment. The thematic was the first step in the accuracy assessment process to select the classification_2018 for evaluation. It is in this step that colors for the classication_2018.tif was changed using palette/unique values in order to avoid errors in the next step.

The second step was the sampling step where ground truth points were set. There were two sampling points namely Simple Random Sampling and the Stratified Random Sampling. In Simple Random Sampling, randomly distributed points could be made on the land cover classification map and the main parameters that must be included were number of samples (how many points to be created on the classification map) and minimum distance (minimum distance from point to point). The distance was based on the coordinate system of the classification map. The pixel of LC08_L1TP_169060_20180325_2051.tiff was 30m and therefore the distance had to be more than 30m. In Stratified Random Sampling, the number of samples was based on the size of class category of the classification map. Stratified Random Sampling was used in this project. 396 Stratified Random Sampling validation points were selected to assess classification by area-based proportion using overall standard error of 0.005. The number of samples was based on the size of class category of the classification map. For examples, Lake (waterbody) was large in size in Classification_2018.tif but Sewage Pond was smaller. Considering the proportion of the size of class category, the number of sample for each category were different. This method was used in this project to avoid insufficient number of samples per class category. The symbols for the class categories between QGIS layer and in the AcATaMa were also changed to correspond to one another in terms of pixel value and color as shown in Figure 11. The number of neighbors were set to be 8 and minimum neighbor with same class category was set to be 3. This meant that patches with less than 3 pixels were removed and if there were 3 pixels of the same class category within the surrounding of 8 pixels then the sample was distributed. In the button "Generate the sampling points" was then clicked and 396 sampling points were generated within the study area as shown in Figure 12.

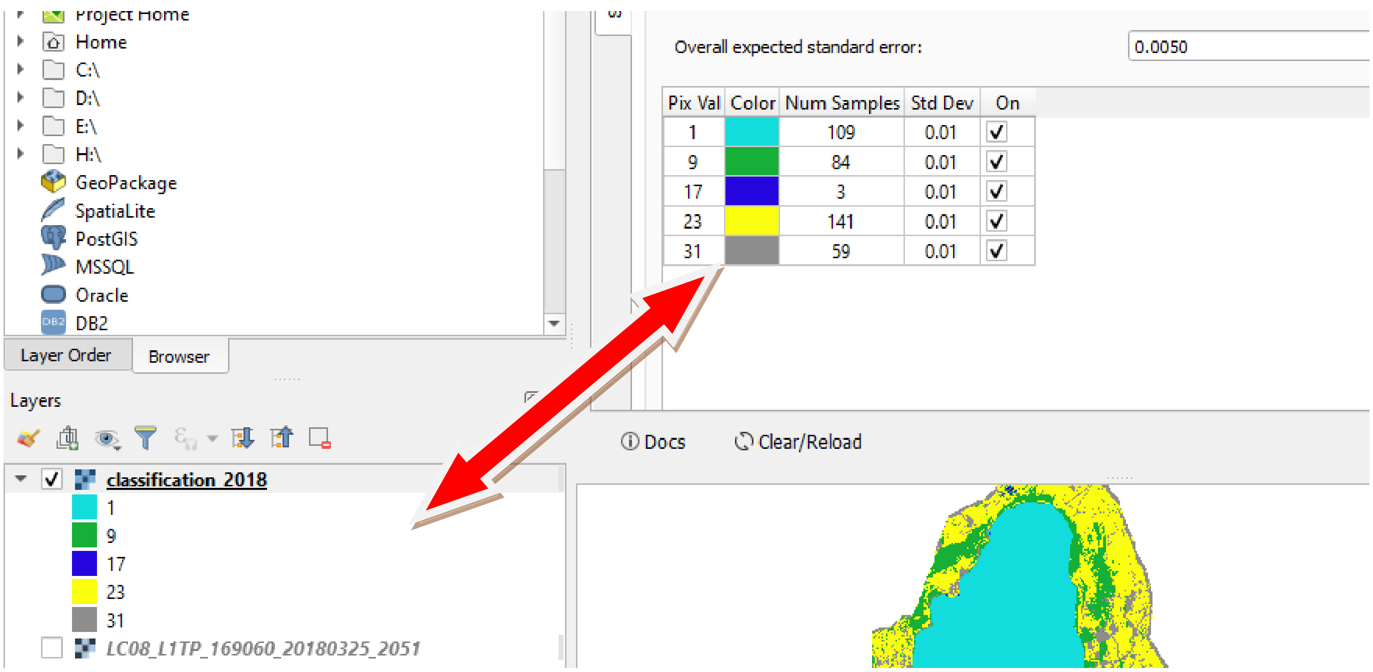


Figure 11: The Pix Val corresponds to the category of classification

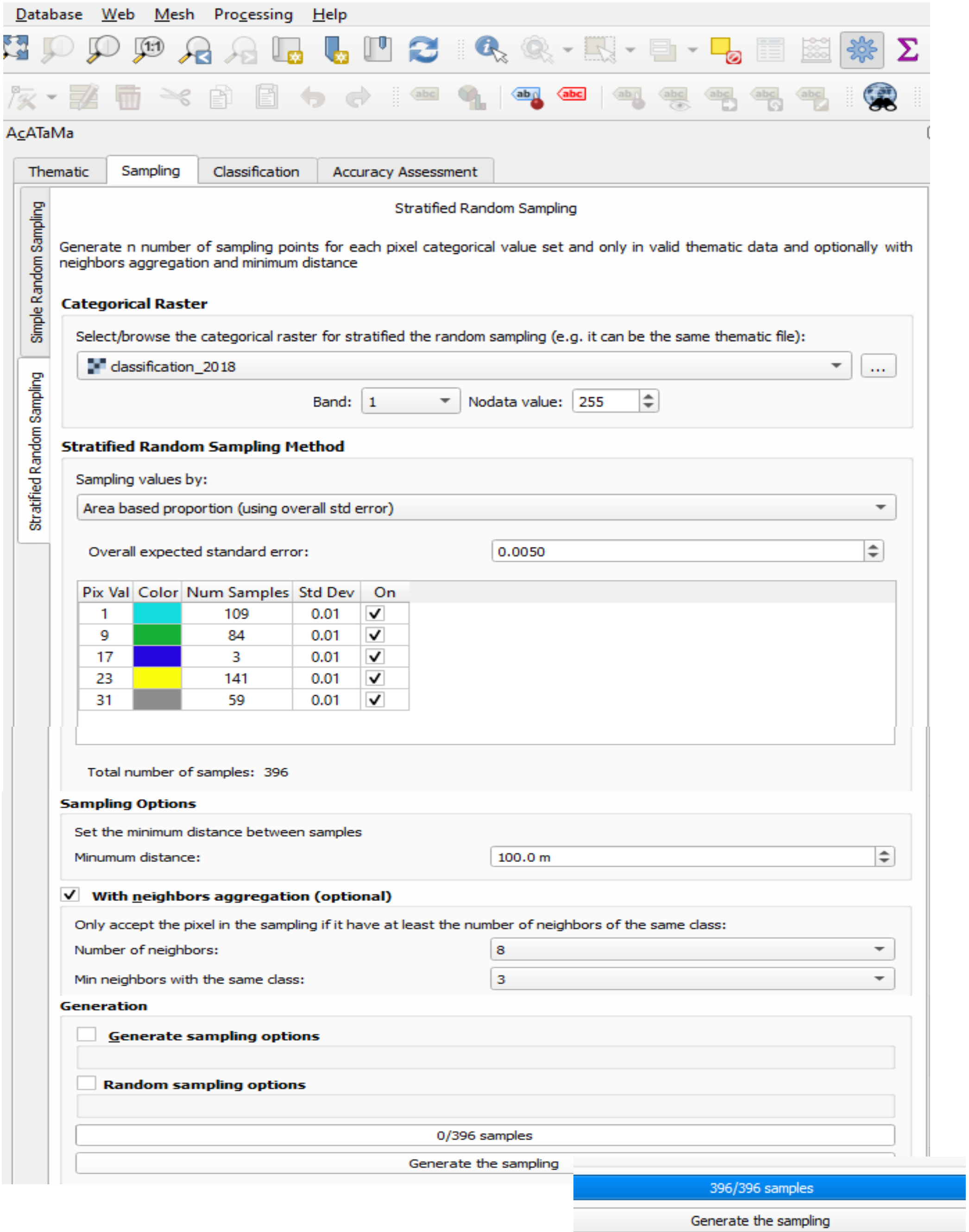


Figure 12: Stratified random sampling points generation process

The classification step was the third stage where the stratified random points were interpreted and manually created. All the 396 stratified random points were classified into different class categories of the classification map i.e. Classification_2018.tiff. The original image was duplicated in the same map view but assigned different band combination. One image was assigned true color combination (4, 3, and 2) while the other false color combination (5, 6, and 4 mainly because of water) as shown in Figure 13.

Figure 13: True color (left) and false color (right) of the original image for 2018

3.5.3 Interpreting the Stratified Random Sampling Point

The indigenous knowledge of the study area, Google satellite on Google Earth and a duplicated original image were crucial for interpretation of the sampling points. Google Image was added to QGIS by launching QGIS, clicking on the data source manager, opening XYZ tiles and double clicking google i.e. Launch QGIS 3.2.1> click Open Data Source Manager>Double click XYZ tiles>Double click Google as shown in Figure 14. The google image was used together with indigenous knowledge to the study area to understand the target sites during analysis. Google could be connected for the first time by right clicking the XYZ tiles>new connection then copy and pasting in the URL the following link

http://mt0.google.com/vt/lyrs=y&hl=en&x={x}&y={y}&z={z}&s=Ga.

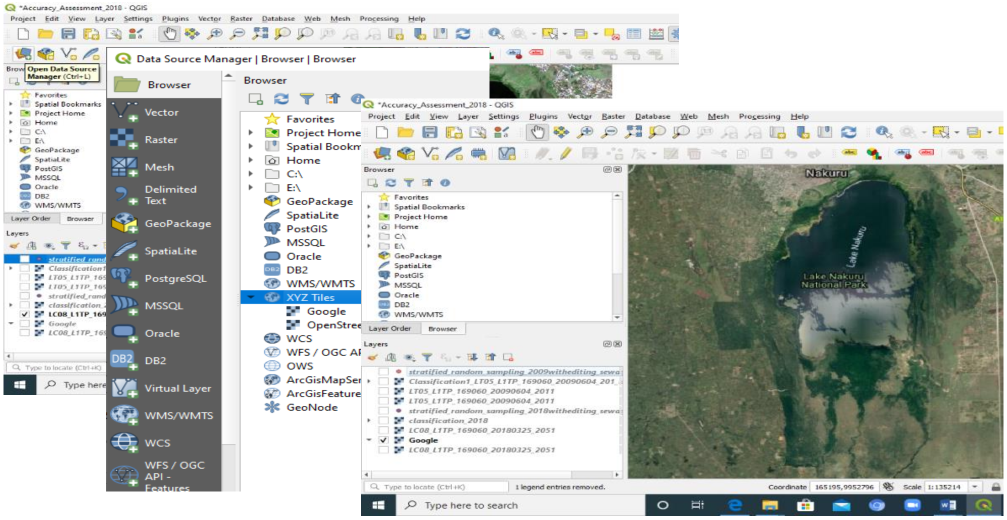


Figure 14: How google satellite image was added on QGIS

The stratified random sampling points generated from Classification_2018 image was selected for analysis, interpretation and classification as shown in Figure 15. This was followed by clicking Open the classification dialog to render views configuration column 2 by rows 2 as shown in Figure 16.

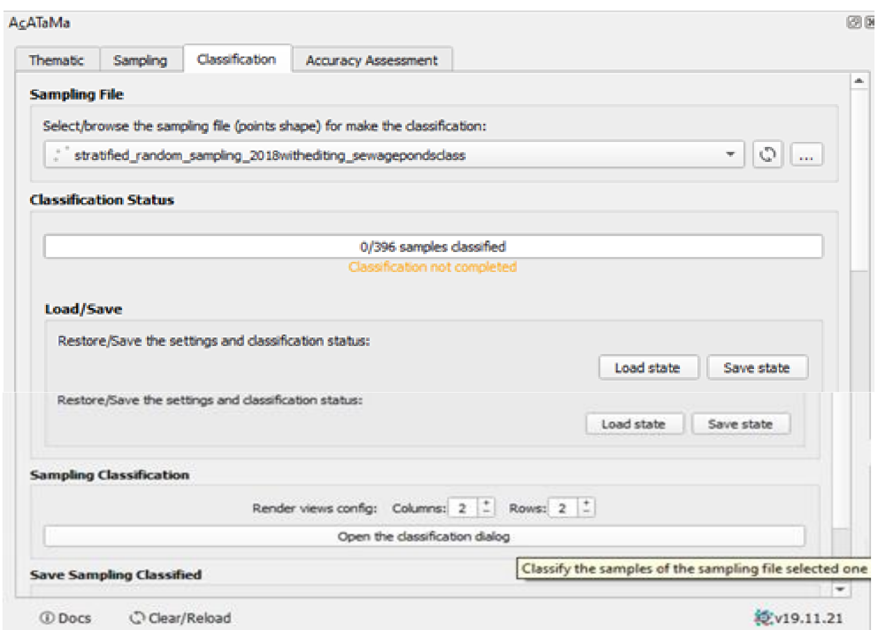


Figure 15: Selection of sampling point and opening classification dialog box

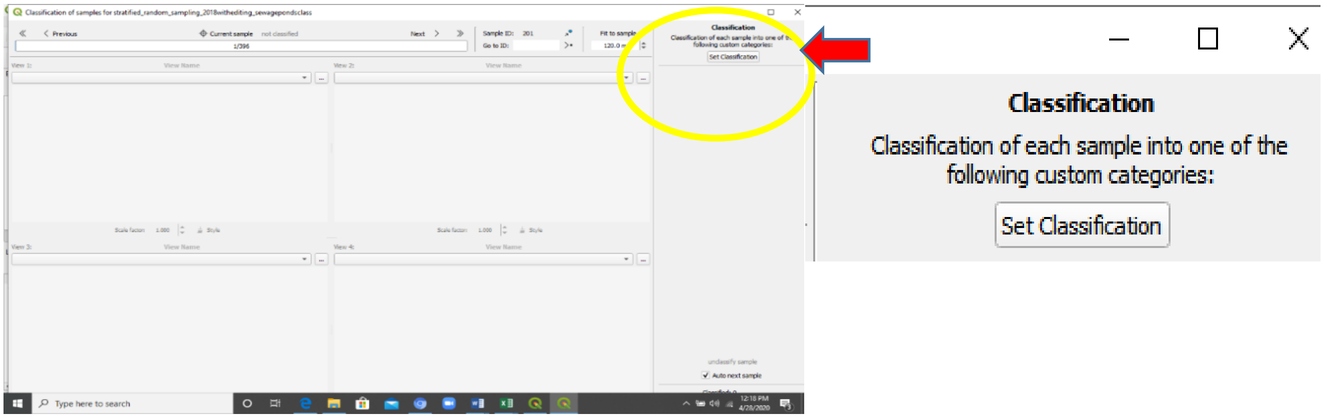


Figure 16: View configuration 2 by 2 window for the interpretation

Class categories for the interpretation were registered by clicking the “set classification”. The row under Thematic class column, in the window that showed up, was clicked and then a new window to select the same class as land cover classification appeared. The same name as in the landcover classification map and symbology was maintained interms of pixel values and color, then OK clicked as in Figure 17.

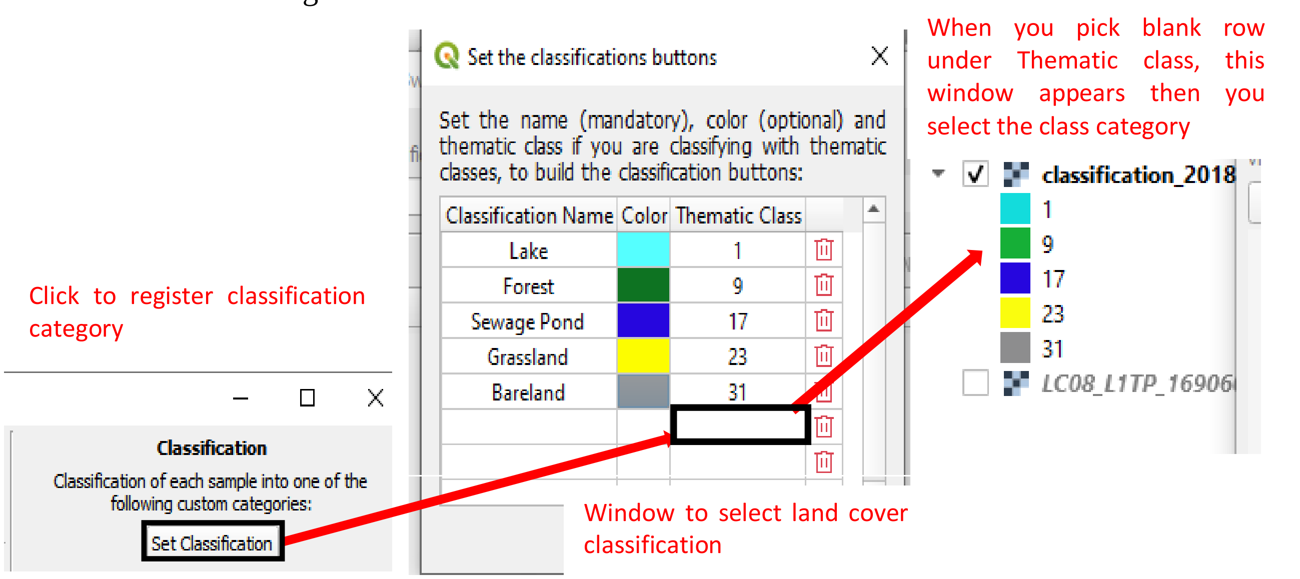


Figure 17: Category selection window for Interpretation class category

The original images (true color and false color) were selected from the drop-down menu and each added in a separate upper window in preparation to register images and to interpret the class of the individual stratified random sampling point. The Google image was also added to the lower left window as in Figure 18. The point marked with a red cross was interpreted and its class category selected from the class button at the right. When class category was clicked, the next sample point appeared automatically until the last sample point after which close was clicked as in Figure 19. Sample classified points was then saved by clicking save state and new classification point file generated (stratified_random_sampling_2009withediting_sewagepondsclass_acatama.yml)

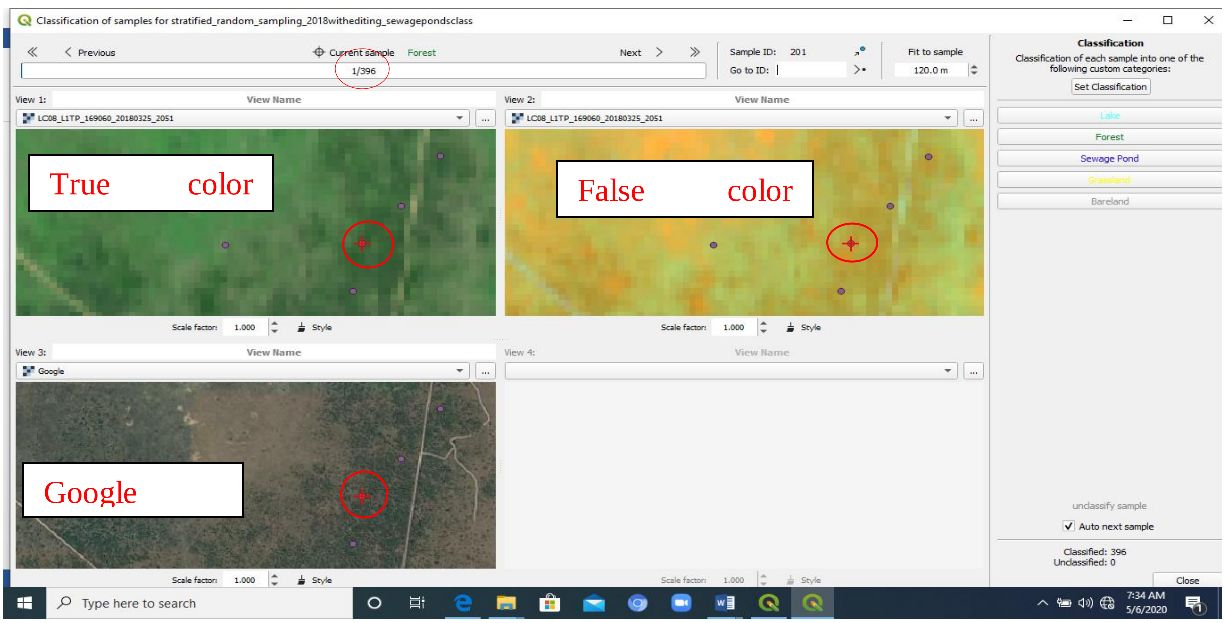


Figure 18: Interpretation window ready to interpret the first stratified random sampling point

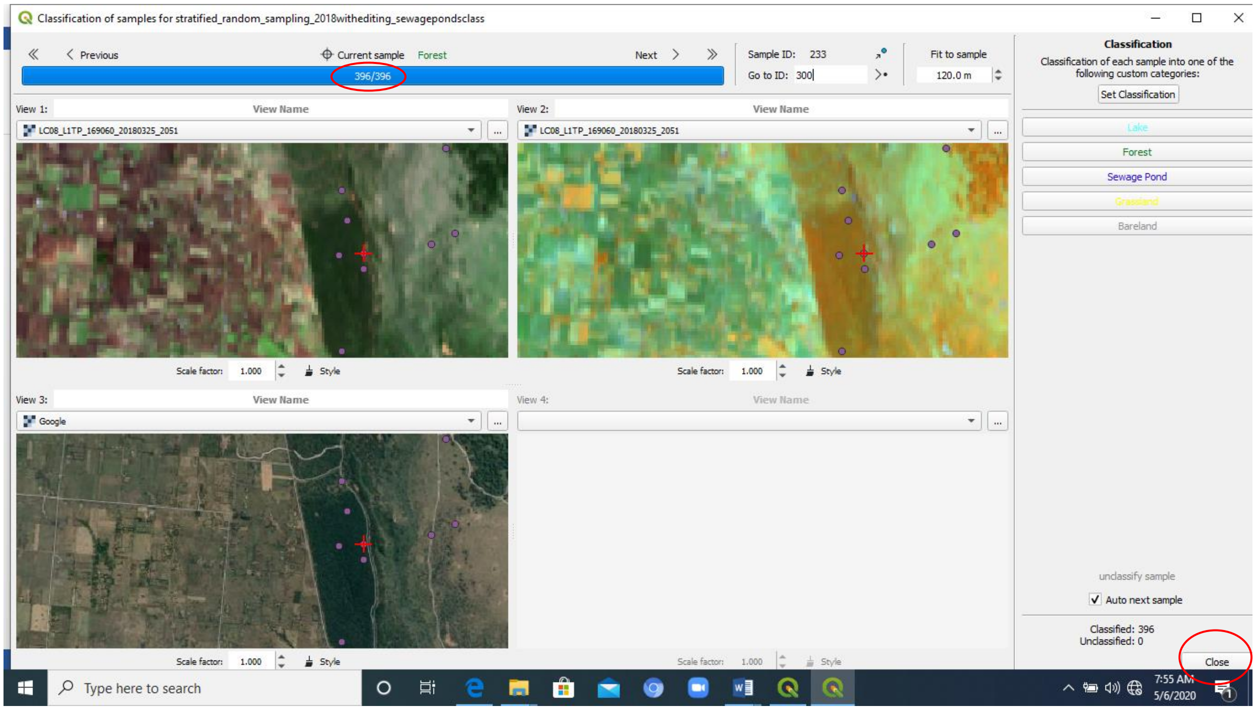


Figure 19: Interpretation window (the last random sampling point interpreted).

The last step was accuracy assessment step. It generated the confusion matrix based on ground truth data which was created from classification step. Stratified_random_sampling_2018withedited_sewagepondsclass was selected for 2018 classification. Then the project clicked "Open the accuracy assessment results" as in Figure 20.

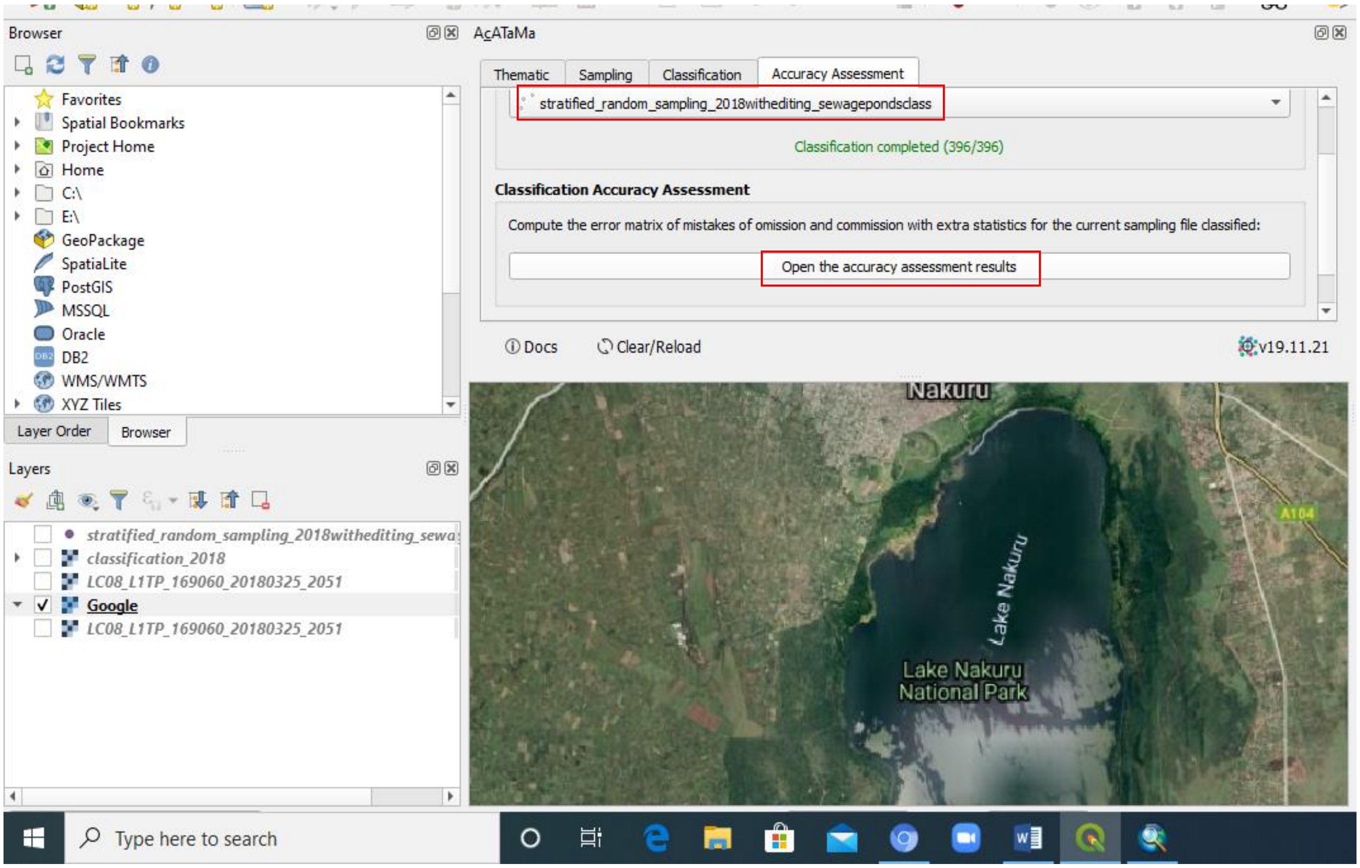


Figure 20: Accuracy assessment

The generated overall accuracy was verified by the standard procedure for assessing the accuracy of remotely sensed data known as the overall accuracy as used in ENVI and the kappa index as observed by (Kundu, *et al*., 2015). The project used ArcGIS 10.7.1 tools to integrate most of the spatial data. For instance intersect tool was used when integrating both the 2018 Lake extent and the 2009 Land cover raster to get 'Displaced (flooded) wildlife habitat and the Lake coverage'. This was in a raster format. The project then applied 'Raster to polygon' to change raster into vector data. This was followed by using erasing tool to expunge 2009 lake coverage from 'Displaced (flooded) wildlife habitat and the Lake coverage' to get the displaced wildlife habitat.

3.5.4 Wildlife Spatial Data

The wildlife data used in this project was collected by ground census method during the wet season between the months of April and May for both 2009 and 2018 (Appendix 3). The wildlife statistical data gathered from Kenya Wildlife Service lacked spatial data but the wildlife census blocks which were polygons had spatial reference. The wildlife data were checked and organized for quality by removing the duplicated records (GBIF, 2020) and made ready for storage in a provider node for sharing as explained by (Mwange, *et al*., 2017). Some disparities were noted in wildlife datasets and this were corrected by removing double entries of species names caused by wrong name spellings as in Figure 21. Wildlife population densities, mean, variance and standard deviation were calculated for 2009 and 2018 from wildlife census. ArcGIS 10.6 was used to calculate block acreages while wildlife density (wildlife numbers per block divided by the acreage of the individual block in km^2) was calculated using excel. The Excel Pivot tools were used to analyze and describe population sizes per block, densities, and standard deviation. The distribution data was presented in form of standard choropleth maps with equal intervals method and using five classes. The project was determined to understand whether there was wildlife displacement due to floods and also to identify the new blocks and habitats for the displaced wildlife within the park.

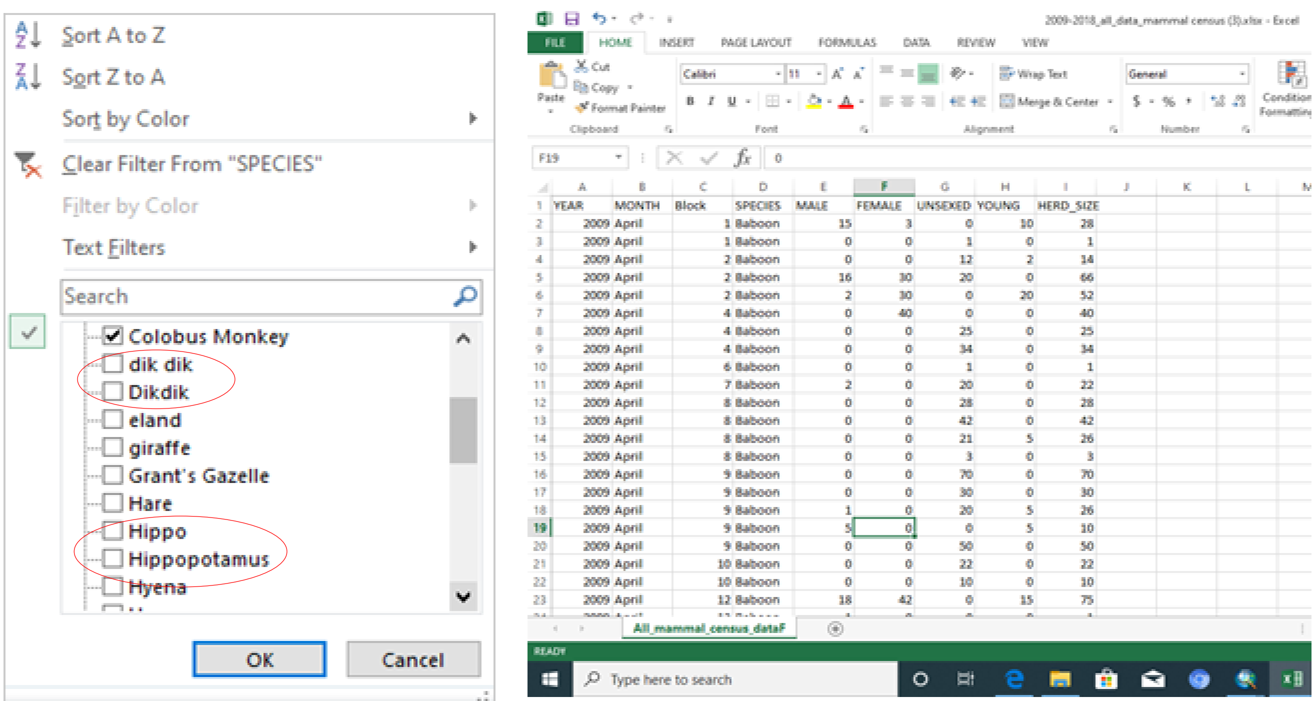


Figure 21: Data organization by cleaning and removing duplicated records

To bring the two datasets together, the project had to create a centroid data by converting wildlife census block data to point data using feature to point in ArcGIS environment. XY coordinate was then added to the centroid data. In order to spatial join the two datasets for analysis, the cleaned wildlife statistical data had to be enhanced with generated centroid point spatial data. Two columns were created in the cleaned statistical data and populated with XY coordinates from centroid point spatial data using Add XY Coordinates as in Figure 22. This was to facilitate one to many spatial join operation and intersect as match option in the ArcGIS environment. This process resulted in the production of spatial wildlife data shown in Figure 23.

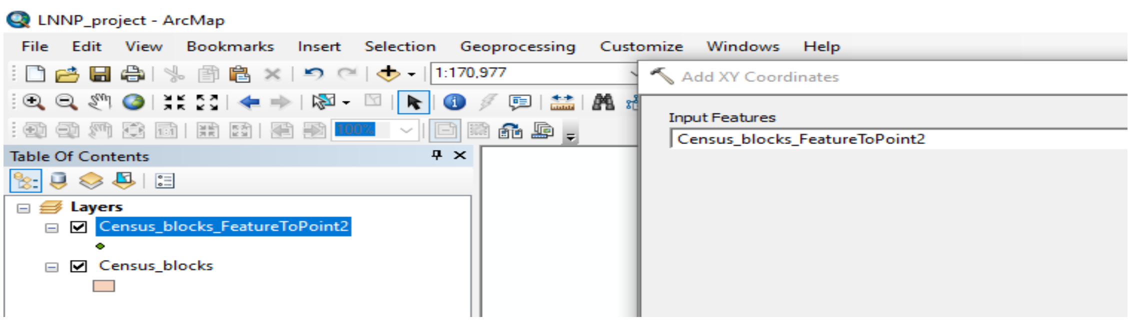


Figure 22: Adding XY coordinate to centroid points.

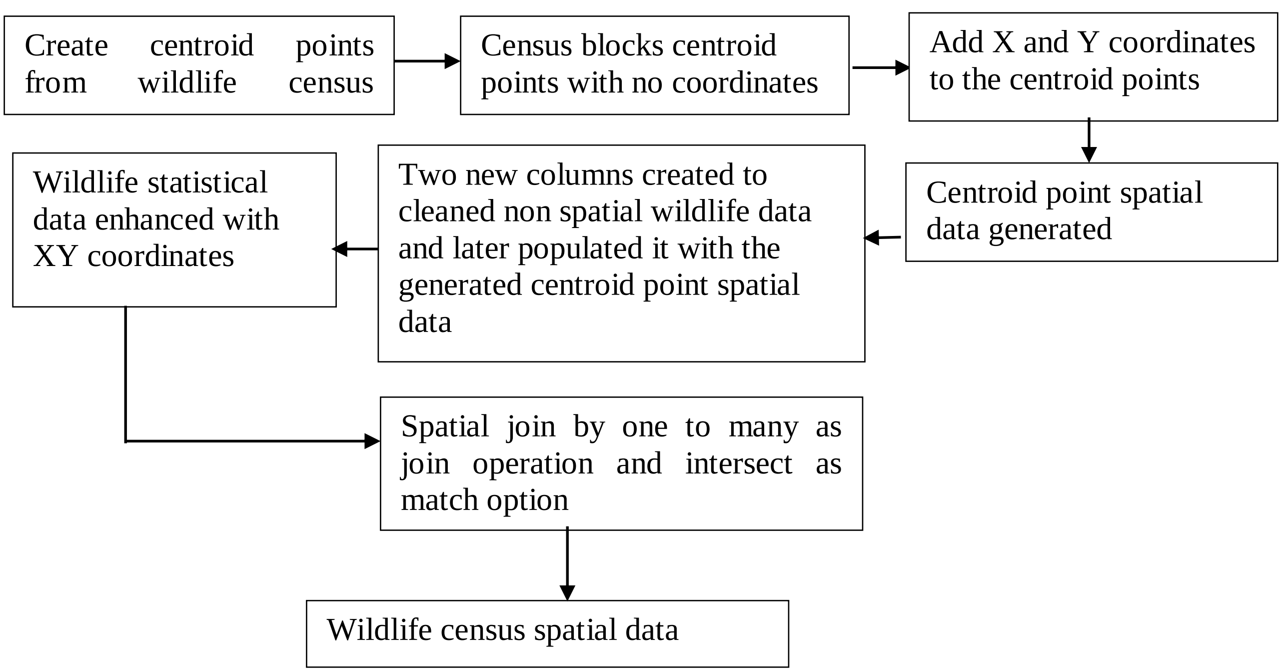


Figure 23: Process of organizing wildlife statistical data into wildlife spatial data

3.5.5 Topographical Map

Topographical sheet No. 119/3 was scanned to convert the hard copy into digital and then georeferenced to give topographical features their real position on the ground according to (Maguire, *et al.*, 2005). Basic data such as roads, rivers and park boundary were extracted by digitization from a georeferenced topographical sheet and overlaid to form part of the background data. The basic principle for geo-referencing was to add un-georeferenced raster data, as shown in Figure 24, into the GIS environment as the target data by identifying at least 4 ground control points of known x, y coordinates that linked locations on the raster with locations in the target data in map coordinates. The amalgamation of one control point on the raster and the matching control point on the target data formed a relationship.

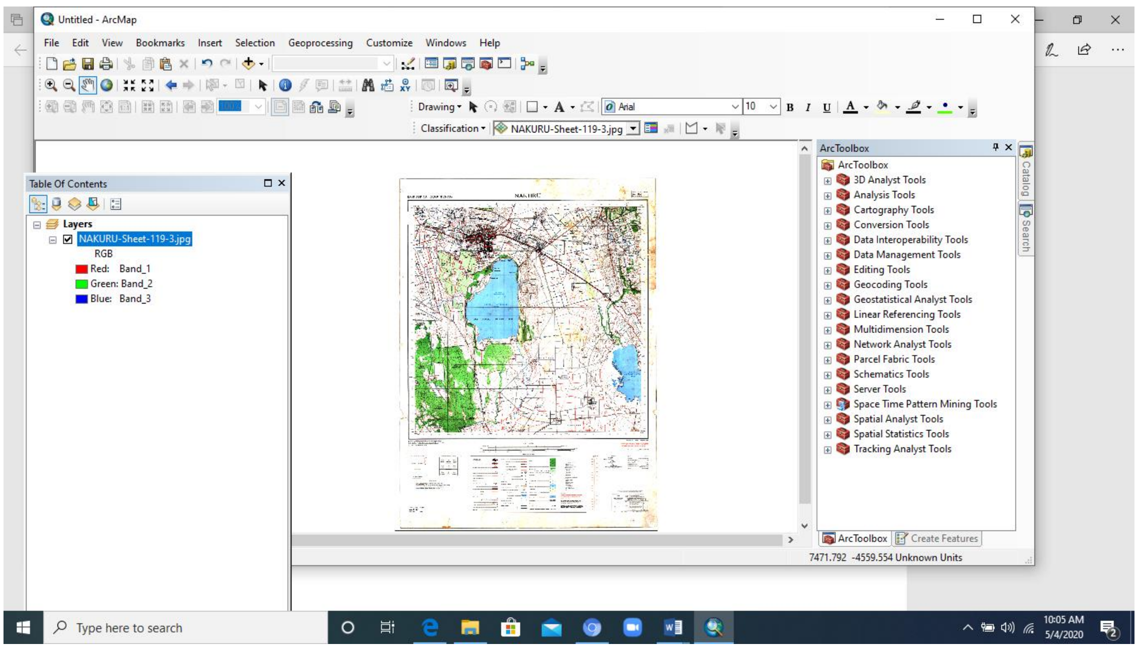


Figure 24: Un-georeferenced topographical sheet

The project made sure geo-referencing was active by selecting Georeferencing from the toolbars. The project also identified 4 links or control points (CP) with known coordinates and used for geo-referencing as shown in Figure 25. The control points were added in a clockwise direction. The project accepted 0.000055763 error against the standard 0.003 root-mean-square (RMS) error as shown Figure 26. Georeferencing raster data allowed the raster data to be integrated with other data in point and vector formats such as gates, rivers and wildlife census blocks. The raster data was aligned to existing spatial data such as a road junction that resided in the desired map coordinate system. The scanned topographic sheet was used to provide ancillary data which assisted in determining park boundary, roads and some rivers as well as image analysis and classification as observed by (Kundu, *et al*., 2015).

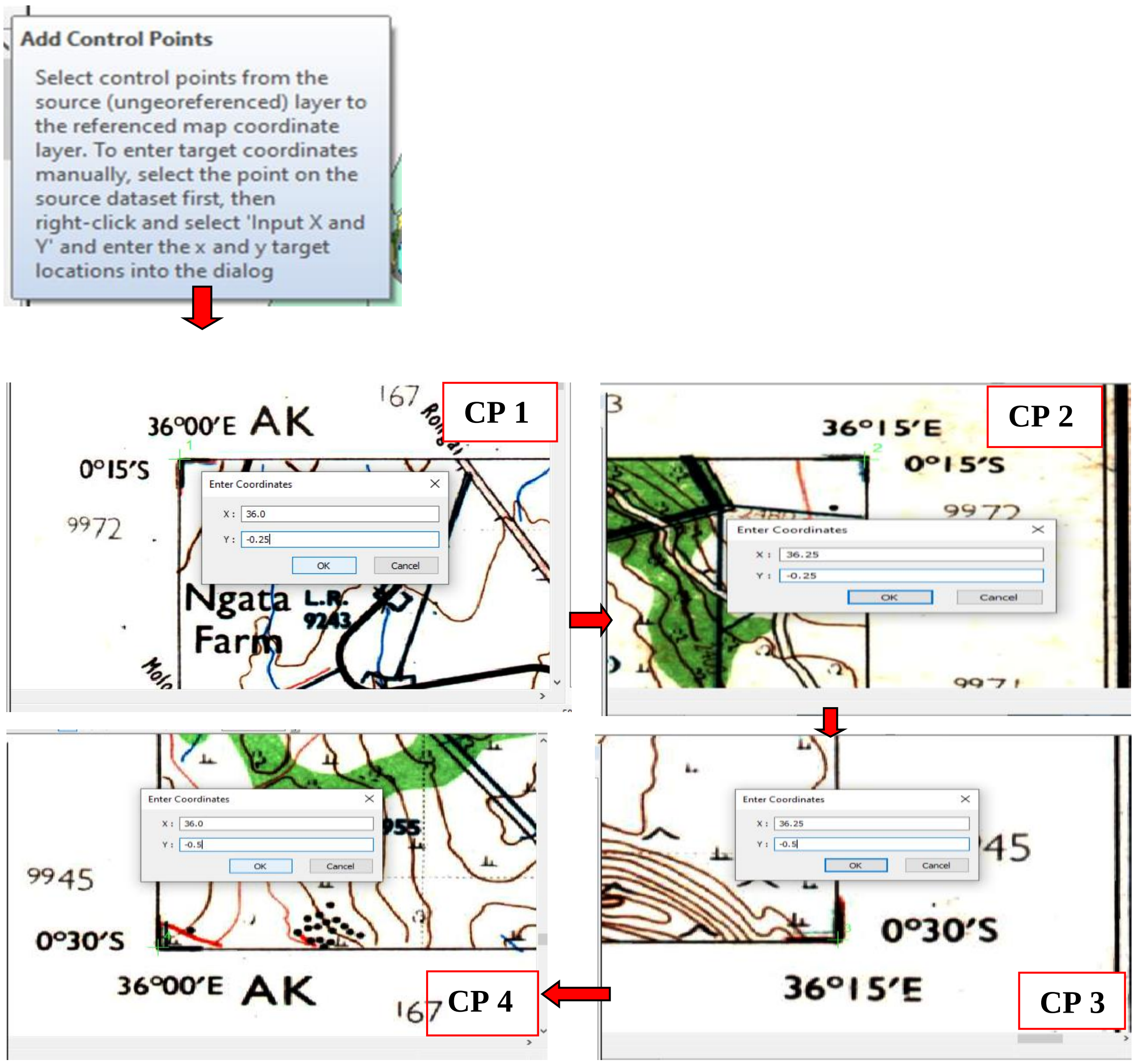
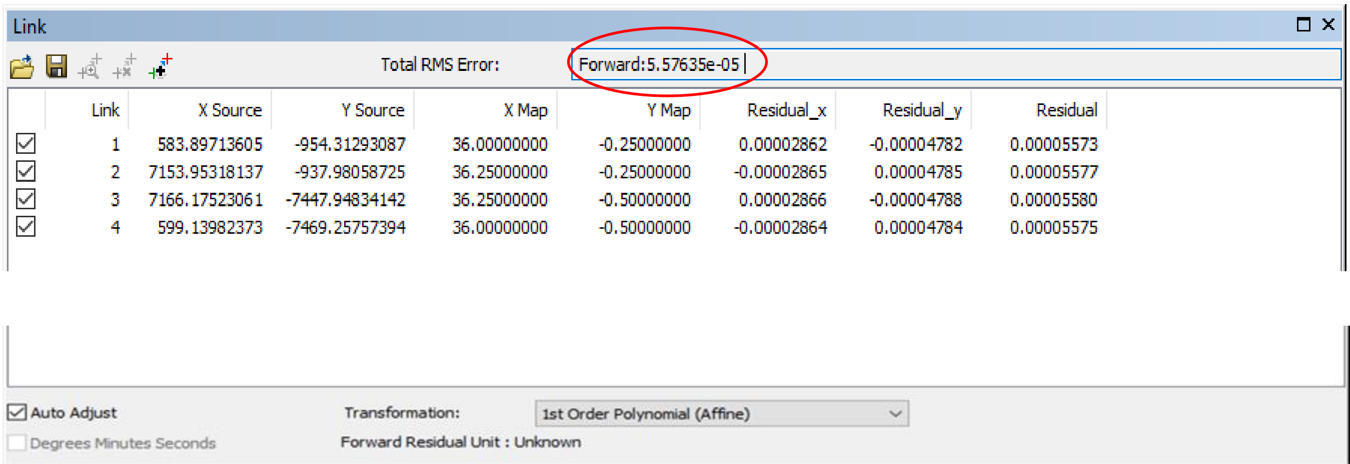


Figure 25: Process of geo-referencing using four control points in a clockwise direction



Link	X Source	Y Source	X Map	Y Map	Residual_x	Residual_y	Residual
1	583.89713605	-954.31293087	36.00000000	-0.25000000	0.00002862	-0.00004782	0.00005573
2	7153.95318137	-937.98058725	36.25000000	-0.25000000	-0.00002865	0.00004785	0.00005577
3	7166.17523061	-7447.94834142	36.25000000	-0.50000000	0.00002866	-0.00004788	0.00005580
4	599.13982373	-7469.25757394	36.00000000	-0.50000000	-0.00002864	0.00004784	0.00005575

Figure 26: RMS error

4 DATA ANALYSIS, RESULTS AND DISCUSSIONS

4.1 Introduction

In order to carry out good data analysis and achieve better results well, the project used exploratory spatial data analysis (ESDA) that involved the use of several techniques to visualize spatial distribution, discover patterns of spatial association, and to identify hotspots as recommended in (Maguire, *et al.*, 2005). Land cover, displaced wildlife habitats and wildlife distribution maps were generated.

4.2 Land Cover

The mapping of land cover change was necessary to graphically show the extent of the lake in 2009 and 2018 as well as the affected park infrastructures that included the main gate, park headquarter offices and the park road network. Land cover change mapping was instrumental to determine the affected wildlife habitats. Five different habitat categories namely Lake, Forest, Sewage Pond, Grassland, and Bare Ground were identified and ArcGIS 10.6 used for image classification. The main satellite images used included Landsat image for 2009 and Landsat image for 2018. The land cover layer was exposed to accuracy assessment according to QGIS's AcATaMa to enhance the quality of land cover data.

4.2.1 Land Cover Change

The project clipped the two images to the extent of the study area to maximize effort within the area of interest and also to enhance the speed of the computer as in Figure 27. From the two clipped images, it can be observed that the shape of the lake changed especially in the western and southern part. That change in shape was occasioned by increase in water volume causing floods that led to the displacement of some wildlife habitat and migration of some wildlife species to safer ground.

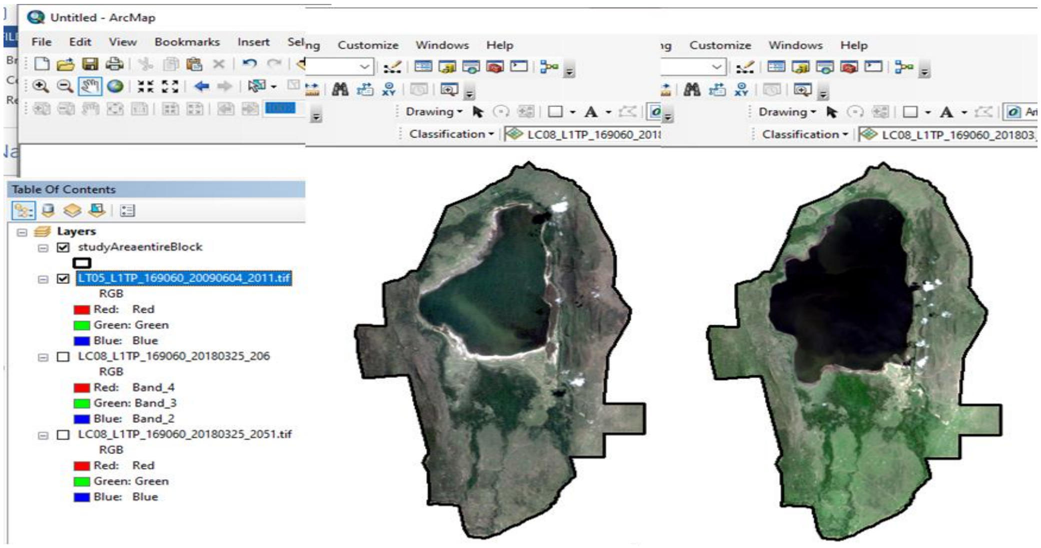


Figure 27: Clipped images 2009 (left) and 2018 (right)

To provide better pictorial land cover change, the project generated land cover layers for both 2009 and 2018 with same land cover class categories with the same symbology as in Figure 28. Five different class categories were used. The project depicted changes such as variations in shape of the lake, displacement of some class categories close to the lake and increase in forests cover in the western and southern part of the lake in 2018.

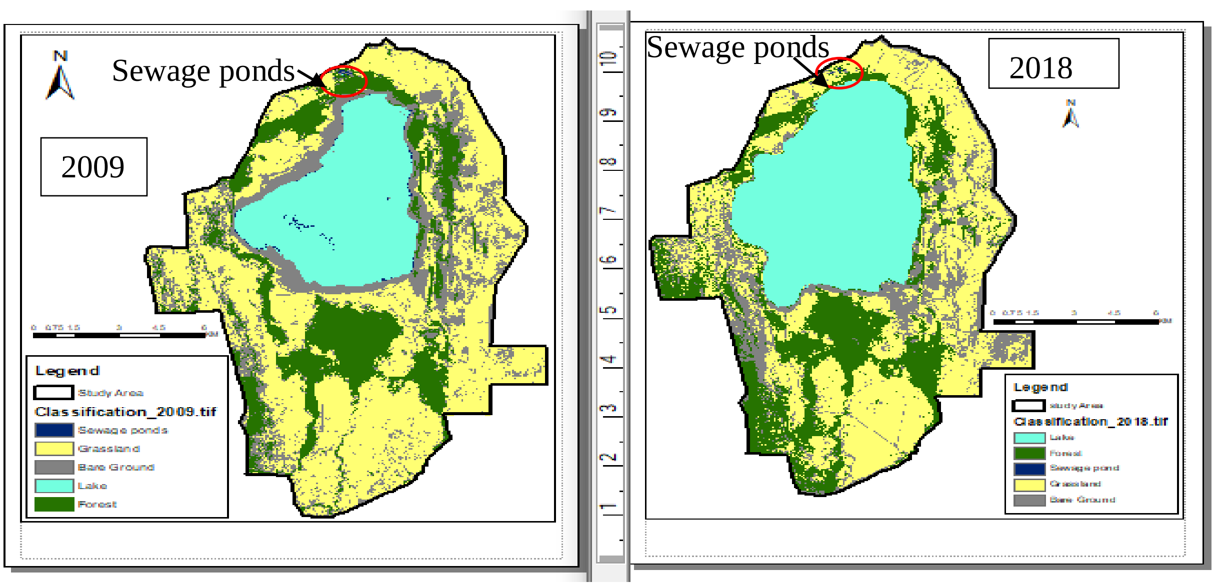


Figure 28: Land cover classification results for 2009 and 2018

4.2.2 Accuracy Assessments

QGIS's AcATaMa plug-in was used to generate error matrix. Error matrix was vital and commonly used way to present the accuracy of the classification results. The accuracy assessment was produced using 396 stratified random sampling points each on the land cover data for both 2009 and 2018 as shown in Figure 29.

Figure 29: Result (Stratified random points distributed on the 2018 classification map)

Overall accuracies, producer's and user's accuracies, and the Kappa statistic were then derived from the error matrices. The accuracy assessment results for 2009 and 2018 were shown in the Figures 30 and 31 respectively. The Kappa statistic combined the off diagonal features of the error matrices and denoted agreement obtained after eliminating the proportion of agreement that could be expected to happen by chance (Yuan, *et al*., 2005).

Kappa ($\hat{K}$)*. = observed accuracy – chance agreement/1-Chance agreement*

Figure 30 shows the error matrix for the 2009 land cover classification together with the overall accuracy. It illustrates that the calculated overall accuracy of land cover data for 2009 is 73.66% i.e. 0.73485*100% and the Kappa coefficient is 66.32%. The low Producers Accuracy registered especially in Forest and Bare ground at 56.90% and 58.0% respectively is attributed to transition between seasons within the Lake Nakuru National Park coverage.

The project applied ENVI technique as explained by (L3Harrisgeospatialsolution, 2020) to the confusion matrix in Figure 30 to counter check overall accuracy provided by AcATaMa,

Overall Accuracy (%) = (71+66+2+123+29)/396 * 100 = 291/396 * 100 = 73.49%

Kappa = 396(291) – ((71*73) + (66*116) + (2*2) + (123*155) + (29*50))/

$(396)^2$ – ((71*73) + (66*116) + (2*2) + (123*155) + (29*50))

= 115236-33358/115236-33358

= 81878/123458

Kappa = 0.663205 (indicating an agreement)

Classification accuracy assessment results

Thematic raster: Classification1_LT05_L1TP_169060_20090604_201_b.tif

Sampling file: stratified_random_sampling_2009withediting_sewagepondsclass.shp

Classification status: 396/396 samples classified

1) Error matrix (confusion matrix):

		Classified values								
		7 (Lake)	10 (Forest)	13 (Sewage pond)	19 (Grassland)	25 (Bareland)	Total	User accuracy	Total class area (m²)	Wi
Thematic raster classes	7	71	0	0	0	0	71	1.0	35217900.0	0.18095
	10	0	66	0	6	0	72	0.91667	35969400.0	0.18481
	13	2	0	2	0	0	4	0.5	500400.0	0.00257
	19	0	30	0	123	21	174	0.7069	85559400.0	0.4396
	25	0	20	0	26	29	75	0.38667	37384200.0	0.19208
	total	73	116	2	155	50	396		194631300.0	
	Producer accuracy	0.9726	0.56897	1.0	0.79355	0.58		0.73485		

2) Error matrix of estimated area proportion:

		Classified values					
		7 (Lake)	10 (Forest)	13 (Sewage pond)	19 (Grassland)	25 (Bareland)	Wi
Thematic raster classes	7	0.18095	-	-	-	-	0.18095
	10	-	0.16941	-	0.0154	-	0.18481
	13	0.00129	-	0.00129	-	-	0.00257
	19	-	0.07579	-	0.31075	0.05305	0.4396
	25	-	0.05122	-	0.06659	0.07427	0.19208
	total	0.18223	0.29642	0.00129	0.39274	0.12732	

3) Quadratic error matrix of estimated area proportion:

		Classified values				
		7 (Lake)	10 (Forest)	13 (Sewage pond)	19 (Grassland)	25 (Bareland)
Thematic raster classes	7	-	-	-	-	-
	10	-	4e-05	-	4e-05	-
	13	0.0	-	0.0	-	-
	19	-	0.00016	-	0.00023	0.00012
	25	-	0.0001	-	0.00011	0.00012
	total	0.00074	0.01714	0.00074	0.01952	0.01539

4) Accuracy matrices:

User's accuracy matrix of estimated area proportion:

		Classified values				
		7 (Lake)	10 (Forest)	13 (Sewage pond)	19 (Grassland)	25 (Bareland)
Thematic raster classes	7	1.0	-	-	-	-
	10	-	0.91667	-	0.08333	-
	13	0.5	-	0.5	-	-
	19	-	0.17241	-	0.7069	0.12069
	25	-	0.26667	-	0.34667	0.38667

Producer's accuracy matrix of estimated area proportion:

		Classified values				
		7 (Lake)	10 (Forest)	13 (Sewage pond)	19 (Grassland)	25 (Bareland)
Thematic raster classes	7	0.99295	-	-	-	-
	10	-	0.57151	-	0.03921	-
	13	0.00705	-	1.0	-	-
	19	-	0.25569	-	0.79124	0.41669
	25	-	0.1728	-	0.16955	0.58331

Overall Accuracy:
0.73666

5) Class area adjusted table:

	Area (m²)	Error	Lower limit	Upper limit
7 (Lake)	35468100.0	144453.03735	35184972.04679	35751227.95321
10 (Forest)	57692690.68966	3335122.1674	51155851.24155	64229530.13776
13 (Sewage pond)	250200.0	144453.03735	-32927.95321	533327.95321
19 (Grassland)	76438950.82759	3799580.99184	68991772.08358	83886129.57159
25 (Bareland)	24781358.48276	2994918.56327	18911318.09875	30651398.86677
total	194631300.0			

Figure 30: Classification accuracy results for 2009 image

Figure 31 shows the error matrix for the 2018 land cover classification together with the overall accuracy. It illustrates that the calculated overall accuracy of land cover data for 2018 is 74.91% i.e. 0.74909*100% and the Kappa coefficient is 66.29%. The low Producers Accuracy registered especially in Forest and Bareground at 52.29% and 68.75% respectively is attributed to the floods in Lake Nakuru National Park coverage.

The project applied ENVI technique as explained by (L3Harrisgeospatialsolution, 2020) to the confusion matrix in Figure 31 to counter check overall accuracy provided by AcATaMa,

Overall Accuracy (%) = (109+80+3+83+22)/396 * 100 = 297/396 * 100 = 75.0%

Kappa = 396(297) – ((109*111) + (84*153) + (3*3) + (141*97) + (59*32))/

$(396)^2$ – ((109*111) + (84*153) + (3*3) + (141*97) + (59*32))

= 117612-40525/156816-40525

Kappa = 0.662880 (indicating an agreement)

Classification accuracy assessment results

Thematic raster: classification_20181.tif

Sampling file: stratified_random_sampling_2018withediting_sewagepondsclass.shp

Classification status: 396/396 samples classified

1) Error matrix (confusion matrix):

		Classified values								
		1 (Lake)	9 (Forest)	17 (Sewage Pond)	23 (Grassland)	31 (Bareland)	Total	User accuracy	Total class area (m²)	Wi
Thematic raster classes	1	109	0	0	0	0	109	1.0	54103917.53805	0.27838
	9	0	80	0	3	1	84	0.95238	41559241.75165	0.21383
	17	0	0	3	0	0	3	1.0	78252.44091	0.0004
	23	0	49	0	83	9	141	0.58865	69777791.50763	0.35902
	31	2	24	0	11	22	59	0.37288	28834675.29649	0.14836
	total	111	153	3	97	32	396		194353878.53474	
	Producer accuracy	0.98198	0.52288	1.0	0.85567	0.6875		0.75		

2) Error matrix of estimated area proportion:

		Classified values					
		1 (Lake)	9 (Forest)	17 (Sewage Pond)	23 (Grassland)	31 (Bareland)	Wi
Thematic raster classes	1	0.27838	-	-	-	-	0.27838
	9	-	0.20365	-	0.00764	0.00255	0.21383
	17	-	-	0.0004	-	-	0.0004
	23	-	0.12477	-	0.21134	0.02292	0.35902
	31	0.00503	0.06035	-	0.02766	0.05532	0.14836
	total	0.28341	0.38877	0.0004	0.24664	0.08078	

3) Quadratic error matrix of estimated area proportion:

		Classified values				
		1 (Lake)	9 (Forest)	17 (Sewage Pond)	23 (Grassland)	31 (Bareland)
Thematic raster classes	1	-	-	-	-	-
	9	-	2e-05	-	2e-05	1e-05
	17	-	-	-	-	-
	23	-	0.00021	-	0.00022	6e-05
	31	1e-05	9e-05	-	6e-05	9e-05
	total	0.00353	0.01804	0.0	0.01731	0.01226

4) Accuracy matrices:

User's accuracy matrix of estimated area proportion:

		Classified values				
		1 (Lake)	9 (Forest)	17 (Sewage Pond)	23 (Grassland)	31 (Bareland)
Thematic raster classes	1	1.0	-	-	-	-
	9	-	0.95238	-	0.03571	0.0119
	17	-	-	1.0	-	-
	23	-	0.34752	-	0.58865	0.06383
	31	0.0339	0.40678	-	0.18644	0.37288

Producer's accuracy matrix of estimated area proportion:

		Classified values				
		1 (Lake)	9 (Forest)	17 (Sewage Pond)	23 (Grassland)	31 (Bareland)
Thematic raster classes	1	0.98225	-	-	-	-
	9	-	0.52383	-	0.03096	0.03151
	17	-	-	1.0	-	-
	23	-	0.32093	-	0.85689	0.28368
	31	0.01775	0.15524	-	0.11215	0.68481

Overall Accuracy:
0.74909

5) Class area adjusted table:

	Area (m²)	Error	Lower limit	Upper limit
1 (Lake)	55081364.15827	685174.95901	53738421.23861	56424307.07793
9 (Forest)	75558609.4261	3505547.08387	68687737.14171	82429481.71048
17 (Sewage Pond)	78252.44091	0.0	78252.44091	78252.44091
23 (Grassland)	47935085.22345	3363363.59568	41342892.57591	54527277.87098
31 (Bareland)	15700567.28601	2382248.98892	11031359.26773	20369775.3043
total	194353878.53474			

Figure 31: Classification accuracy results for 2018 image

4.2.3 Land Cover Maps

After the successful accuracy assessment, the land cover maps for 2009 and 2018 were developed to show the pictorial land cover change within lake Nakuru National Park as shown in Figures 32 and 33.

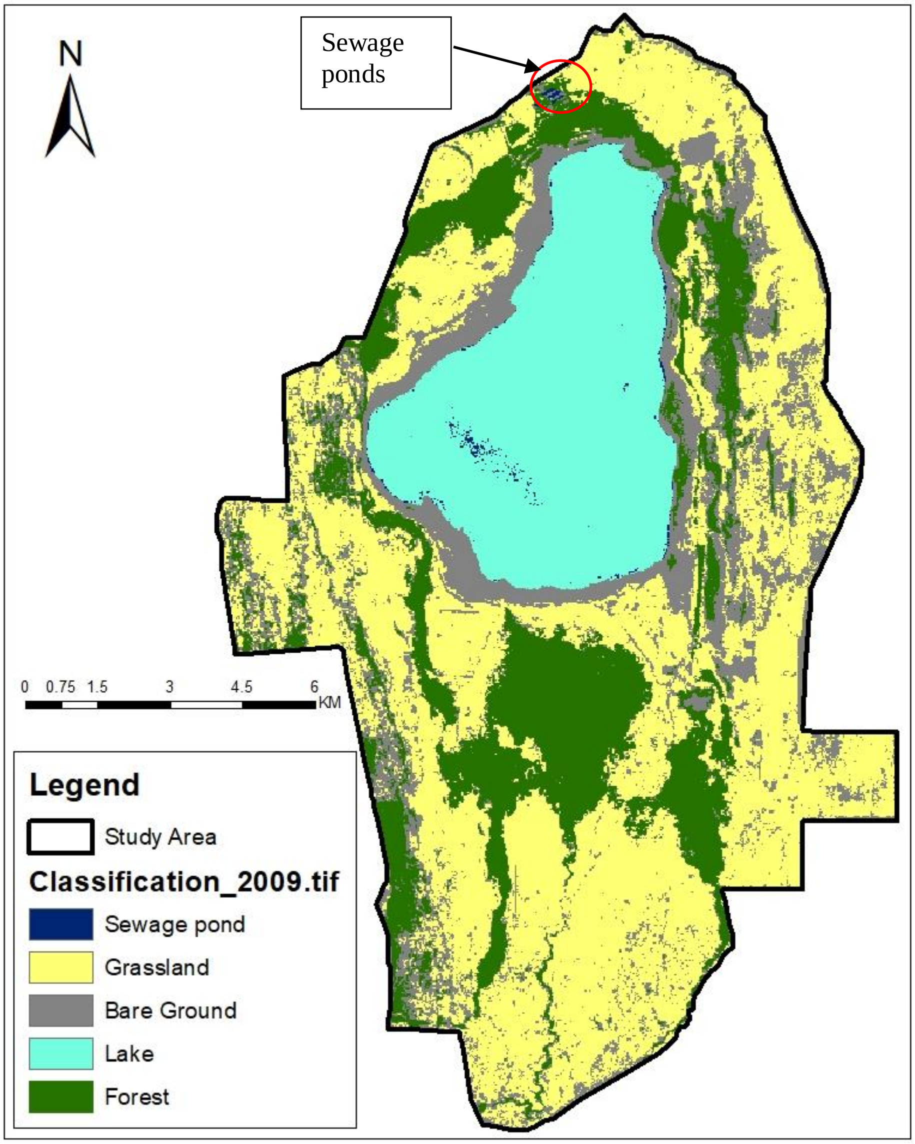


Figure 32: Classification map for 2009

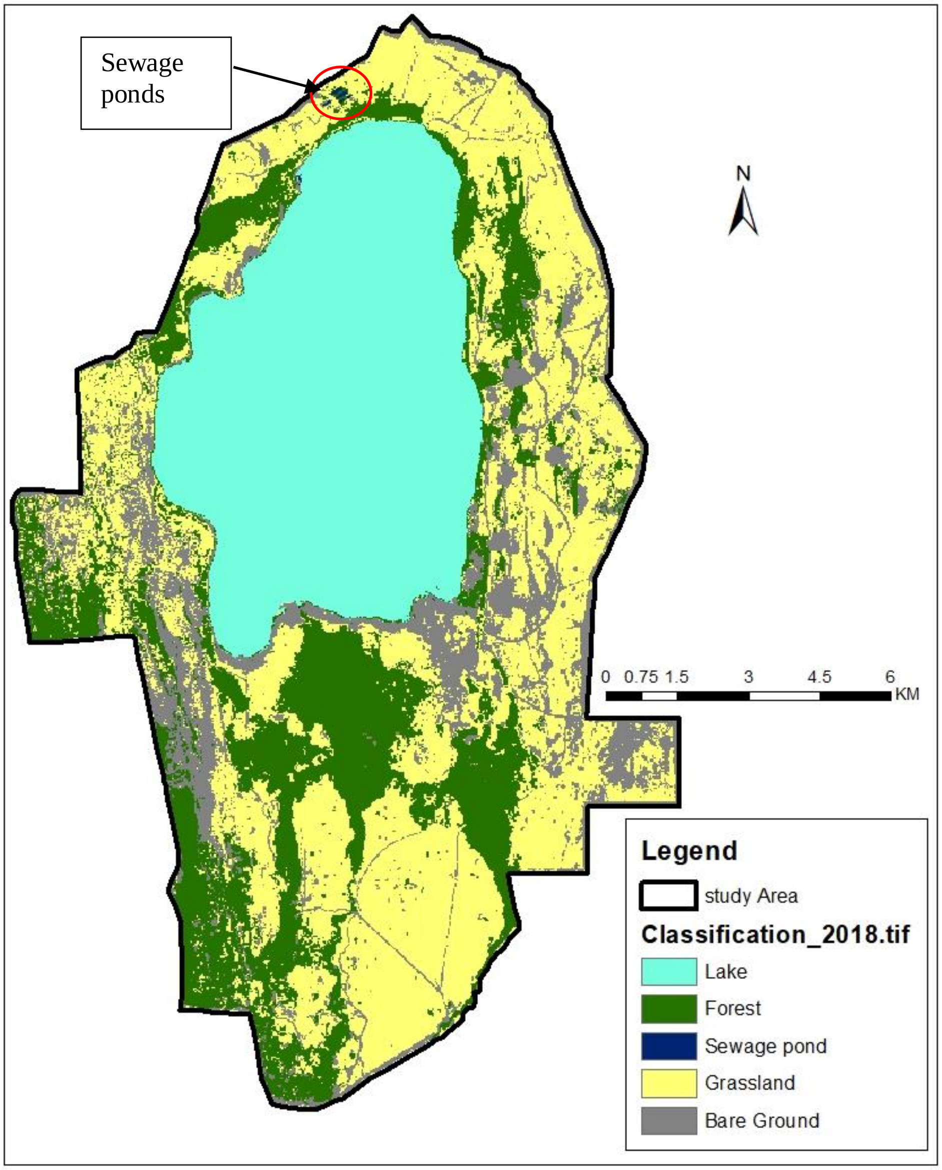


Figure 33: Classification map for 2018

4.2.4 Land Cover Changes

In order to show land cover statistical changes, a land cover change table was generated as shown in Table 9. The changes in land cover between 2009 and 2018 was evident as shown in Figure 34. The area covered by bare ground was 37,384,200 m^2 in 2009 and the figure reduced by 23% to 28,834,675 m^2 in 2018. The forest cover increased by 16% from 35,969,400m^2 to

41,559,242 m^2. The grassland abridged by 18% from 85,559,400 m^2 in 2009 to 69,777,792 m^2 in 2018. The lake coverage increased by 52% from 35,591,572 m^2 in 2009 to 54,103,917 m^2 in 2018. Sewage pond cover reduced from 126,728m^2 in 2009 to 78,252 m^2 in 2018. The increase in lake coverage was attributed to the floods within the LNNP. It seemed sections of the land covered by grassland and bare ground were converted into a lake body. The increase forest coverage was attributed to the availability of rainfall and a lot of water resulting into forest regeneration in parts of grassland, bare ground and sewage pond land cover class categories.

Table 9: Land cover change

Land cover category	**2009 (m^2)**	**2018 (m^2)**	**Change (m^2)**	**% Change**
Bare ground	37,384,200	28,834,675	-8,549,525	-23
Forest	35,969,400	41,559,242	5,589,842	16
Grassland	85,559,400	69,777,792	-15,781,608	-18
Lake	35,591,572	54,103,917	18,512,345	52
Sewage pond	126,728	78,252	-48,476	-38

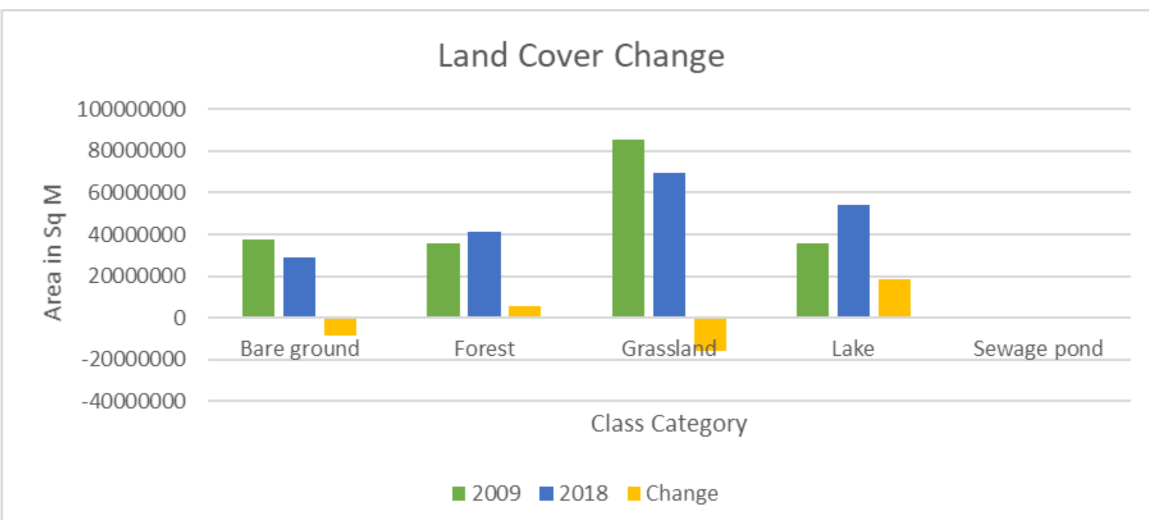


Figure 34: Land cover changes

4.3 Wildlife

4.3.1 Organized Datasets

The data was organized considering, census blocks, wildlife species and the immediate results were as showed in Figure 35 and Table 10. A total of 15 mammals which were part of the wildlife in Lake Nakuru National Park were mapped. They included black rhino, buffalo, eland, giraffe, Grant's gazelle, hippopotamus, hyena, impala, leopard, lion, Thomson's gazelle, waterbuck, white rhino, zebra and warthog. Simple percentages were calculated to support interpretation of population changes and trends.

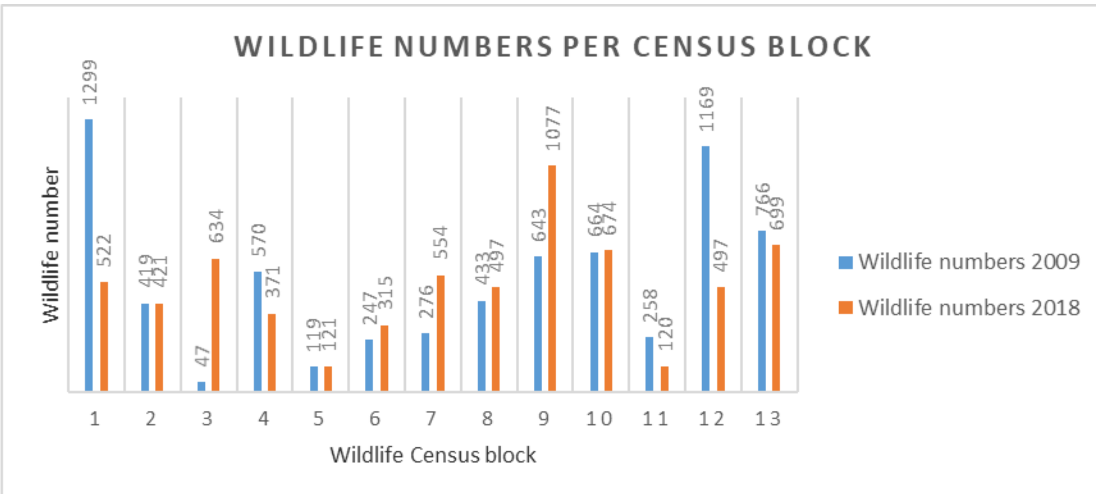


Figure 35: Wildlife numbers per census block

Figure 35 presents wildlife numbers per block. It clearly shows the difference in wildlife numbers in 2009 and 2018. In 2009, block 1 recorded the highest number of wildlife followed by block 12. In 2018 wildlife numbers observed were relatively low and out of 13 blocks, 7 blocks namely 2, 3, 5, 6, 7, 9, and 10 recorded more wildlife numbers compared to census in 2009 by 0.5%, 1248.9 %, 1.7%, 27.5%, 100.7%, 14.8%, 67.8%, and 1.5% respectively. This might mean that a good number of wildlife moved to block 3, 6, 7 and block 9 after floods. The blocks that were affected negatively by exodus of wildlife included blocks 1, 4, 11,12 and 13 by 59.8%, 34.9%, 53.5%, 57.4% and 8.4% respectively. This could imply that blocks 1, 4, 11, 12 and 13 experienced wildlife migration to other blocks due to floods. It could also mean that floods made the animals to shy away from coming out to the open during the wildlife count.

Table 10: Wildlife numbers per census block, densities and standard deviation

Block No	X1 (Wildlife 2009)	X2 (Wildlife 2018)	Block Area (KM^2)	Density 2009	Density 2018	X1-M1	X2-M2	$(X1-M1)^2$	$(X2-M2)^2$
1	1298	522	10.20512498	127.190995	51.15077	766.92	21.85	588166.29	477.42
2	419	421	8.462944055	49.50995744	49.74628	-112.08	-79.15	12561.93	6264.72
3	47	634	9.797976009	4.796909072	64.70724	-484.08	133.85	234333.45	17915.82
4	570	371	13.10051804	43.50972979	28.31949	38.92	-129.15	1514.77	16679.72
5	119	121	5.3239462	22.3518412	22.7275	-412.08	-379.15	169809.93	143754.7
6	247	315	12.12714112	20.36753737	25.97479	-284.08	-185.15	80701.45	34280.52
7	276	554	11.05739053	24.96068121	50.10224	-255.08	53.85	65065.81	2899.82
8	433	497	8.872726925	48.80123142	56.01435	-98.08	-3.15	9619.69	9.92
9	642	1077	12.41612662	51.70694691	86.74203	110.92	576.85	12303.25	332755.9
10	664	674	17.8187106	37.26420025	37.82541	132.92	173.85	17667.73	30223.82
11	258	120	12.364713	20.86583004	9.705037	-273.08	-380.15	74572.69	144514
12	1168	497	20.84021163	56.04549612	23.84813	636.92	-3.15	405667.09	9.92
13	763	699	7.342290011	103.9185321	95.20191	231.92	198.85	53786.89	39541.32
Total	6904	6502						1725770.92	769327.7
Mean	M1 = 531.08	M2 = 500.15	Variance					132751.61	59179.05
Standard Deviation								364.35	243.27

4.3.2 Wildlife Distribution Maps

A total of 6904 and 6502 of wildlife were counted in the survey area in 2009 and 2018 respectively as shown in Table 10. This was a reduction of 5.8%. In 2009, block 1 registered the highest wildlife counted at 1298 and block 3 registered the lowest wildlife numbers at 47. In 2018, block 9 recorded the highest wildlife counted at 1077. Block 11 registered the lowest wildlife at 120. The standard deviation for the distribution of wildlife across the blocks were 364.35 and 243.27 for 2009 and 2018 respectively. To explore the results further, the project developed a series of performance choropleth wildlife distribution maps that illustrated the wildlife density in census blocks that registered some changes and census blocks that did not change between 2009 and 2018. Choropleth maps provided an easy way to visualize and understand how wildlife spread across the wildlife census blocks in the study area. Choropleth maps were developed using ArcGIS 10.6 and following procedures as described by (ESRI, 2020). Wildlife population density was used to graphically show the continuous wildlife distribution in census blocks for 2009 and 2018. Density is a measurement of population per unit area and wildlife census blocks provided good geographic units. Density is a key ecological term that refers to the number of wildlife that were counted in a block per square kilometer. Bi-polar progressions were used with two opposite hues to show a change in value from highest through middle to lowest wildlife density blocks. An equal interval method was used with 5 classes. The colors ranged in order of density from red (lowest density) through brown, yellow and light green to green (highest density).

The wildlife distribution in the year 2009 (see Figure 36) showed that blocks 3, 5, 6, 7 and 11 had the lowest wildlife spread followed by blocks 2, 4, 8, 9 and 10. Block 12 had the middle wildlife spread and therefore wildlife spread was moderate while block 1 had highest wildlife spread followed by block 13. The wildlife distribution in the year 2018 (see Figure 37) showed that blocks 5, 6, 11 and 12 had the lowest wildlife concentration followed by blocks 4 and 10. Blocks 1, 2, 7 and 8 were in the middle with moderate wildlife concentration while blocks 9 and 13 had highest concentration followed by block 3 as the second block in wildlife spread. Blocks 4, 5, 6, and 10 were not affected in anyway by floods. These blocks retained their status of wildlife density after the floods. Wildlife density in block 1 deteriorated after the floods from highest wildlife spread block to middle block with moderate wildlife spread. Block 1 was most affected by floods. Blocks 2, 3, 7, 8 and 9 and 13 experienced an increase in wildlife concentration after the floods. The concentration of wildlife in block 7 moved two levels up from the lowest concentration level to the middle level. Blocks 8 and 13 improved by one level each with block 13 recording highest wildlife spread in 2018. Block 3 was the most enhanced block with wildlife concentration after floods from the lowest wildlife spread to the second highest wildlife spread block. Block 9 experienced an increase in wildlife density from the second level to the highest level with wildlife spread. Blocks 11 and 12 registered decline in wildlife concentration. The possible reason could be many mammals moved to block 3 after floods.

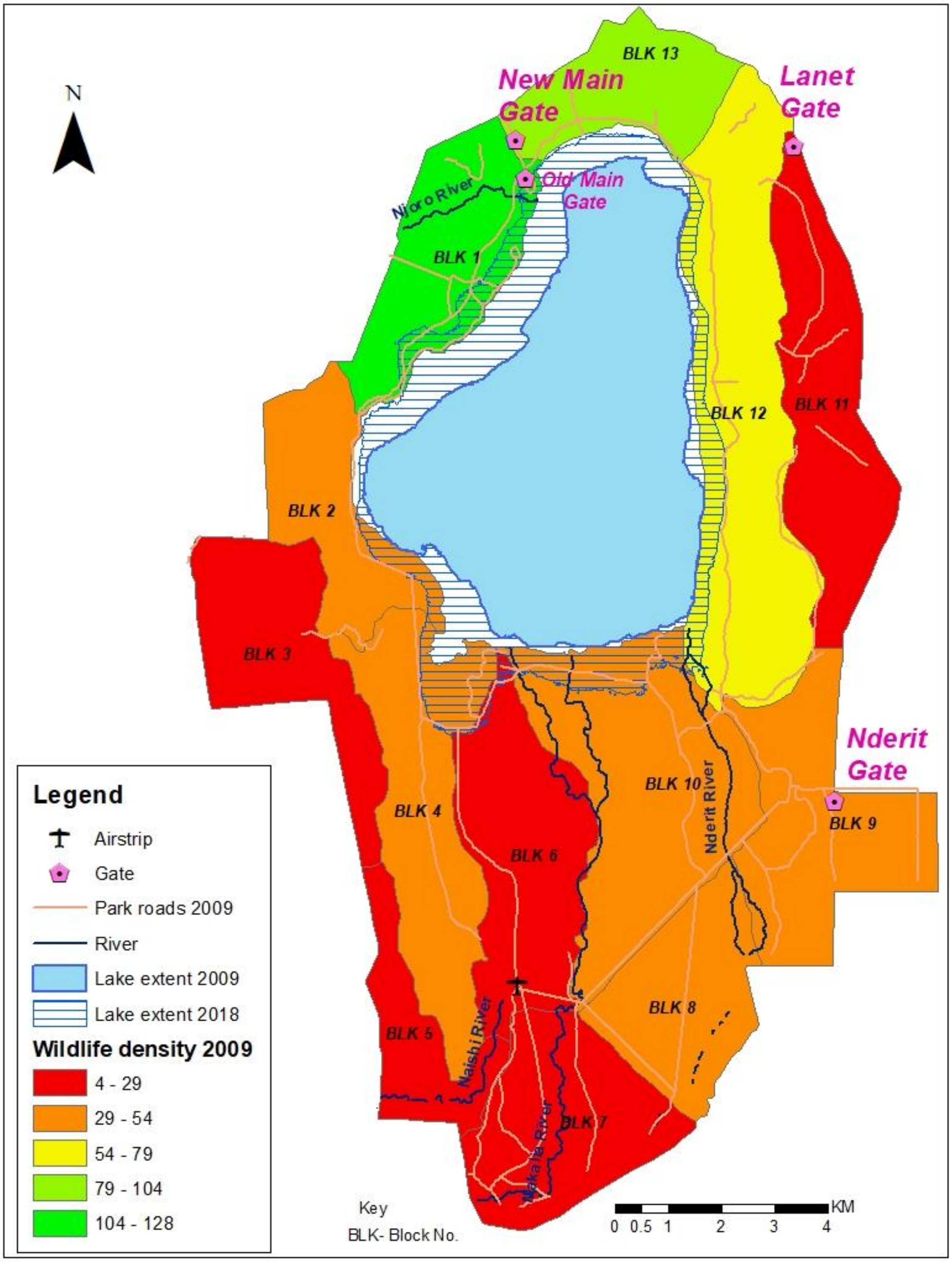


Figure 36: Choropleth wildlife density map for 2009

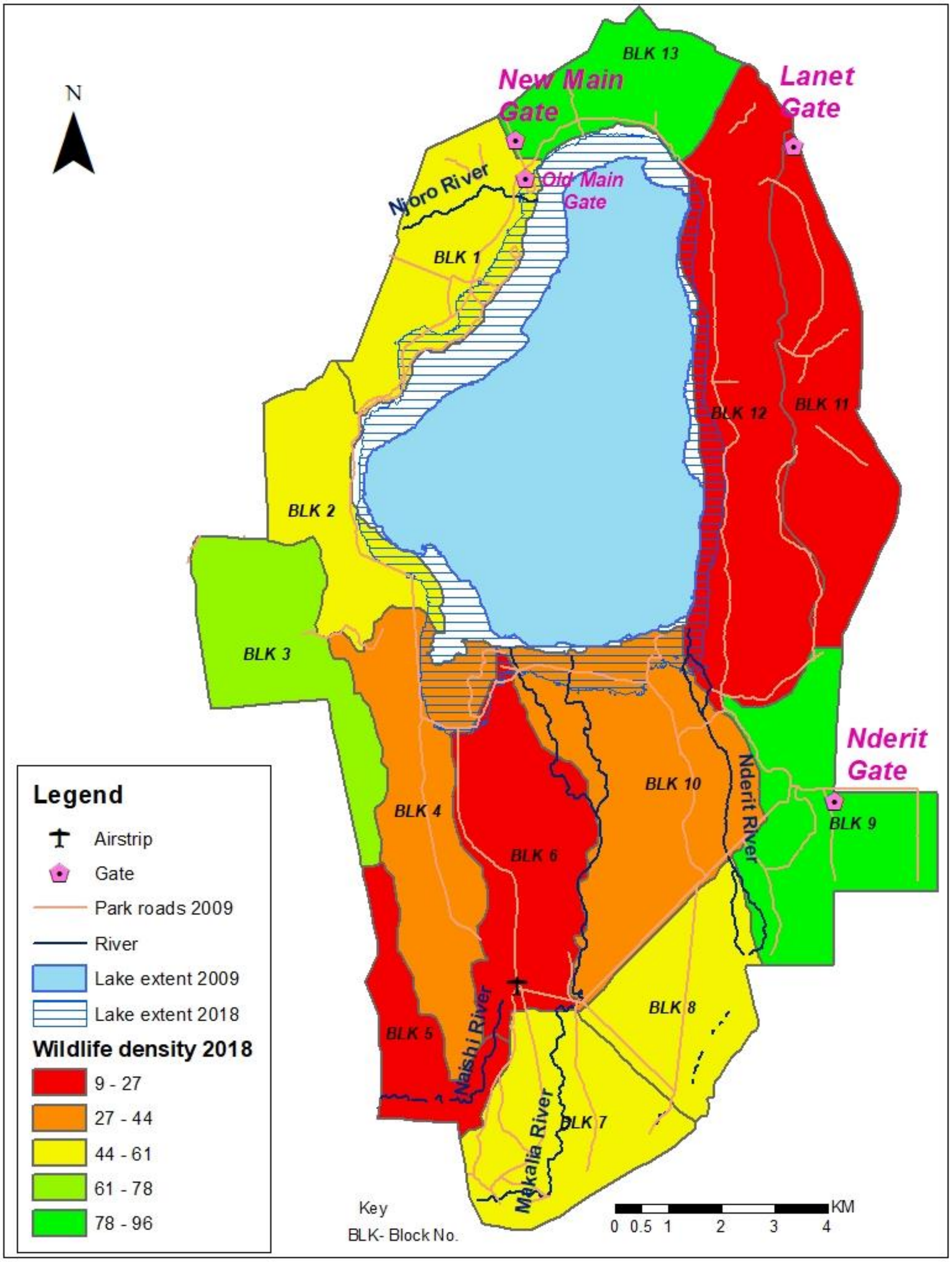


Figure 37: Choropleth wildlife density map for 2018

To analyze wildlife changes in 2009 and 2018, the project summarized wildlife species by numbers as shown in Table 11 and also graphically showed blocks that benefitted from the wildlife movement after floods as shown in Figure 38.

Table 11: Mammals numbers counted in April 2009 (before floods) and May 2018 (after floods)

Wildlife species	2009	2018	Grand Total
Black rhino	9	7	16
Buffalo	2422	2792	5214
Eland	20	62	82
Giraffe	57	92	149
Grant's Gazelle	224	188	412
Hippopotamus	2	0	2
Hyena	22	13	35
Impala	1688	1515	3203
Leopard	0	2	2
Lion	0	5	5
Thomson's Gazelle	620	313	933
Warthog	315	203	518
Waterbuck	232	187	419
White Rhino	11	15	26
Zebra	1282	1108	2390
Grand Total	6904	6502	13406

Table 11 shows that after 9 years the same season, the following mammals abridged their numbers by the percentages indicated in brackets black rhino (-22%), Grant's gazelle (-16%), hippo (100%), hyena (-41%), impala (-10%), Thomson's gazelle (-50%), warthog (-36%), zebra (-14%), white rhino (36%) and waterbuck (-19%).

Figure 38 graphically confirms the massive number of buffalo, impala, zebra and Thomson's gazelle in Lake Nakuru National park. Even though the number of buffalo increased after floods, the other species such as impala, zebra and Thomson's gazelle numbers reduced their numbers with floods.

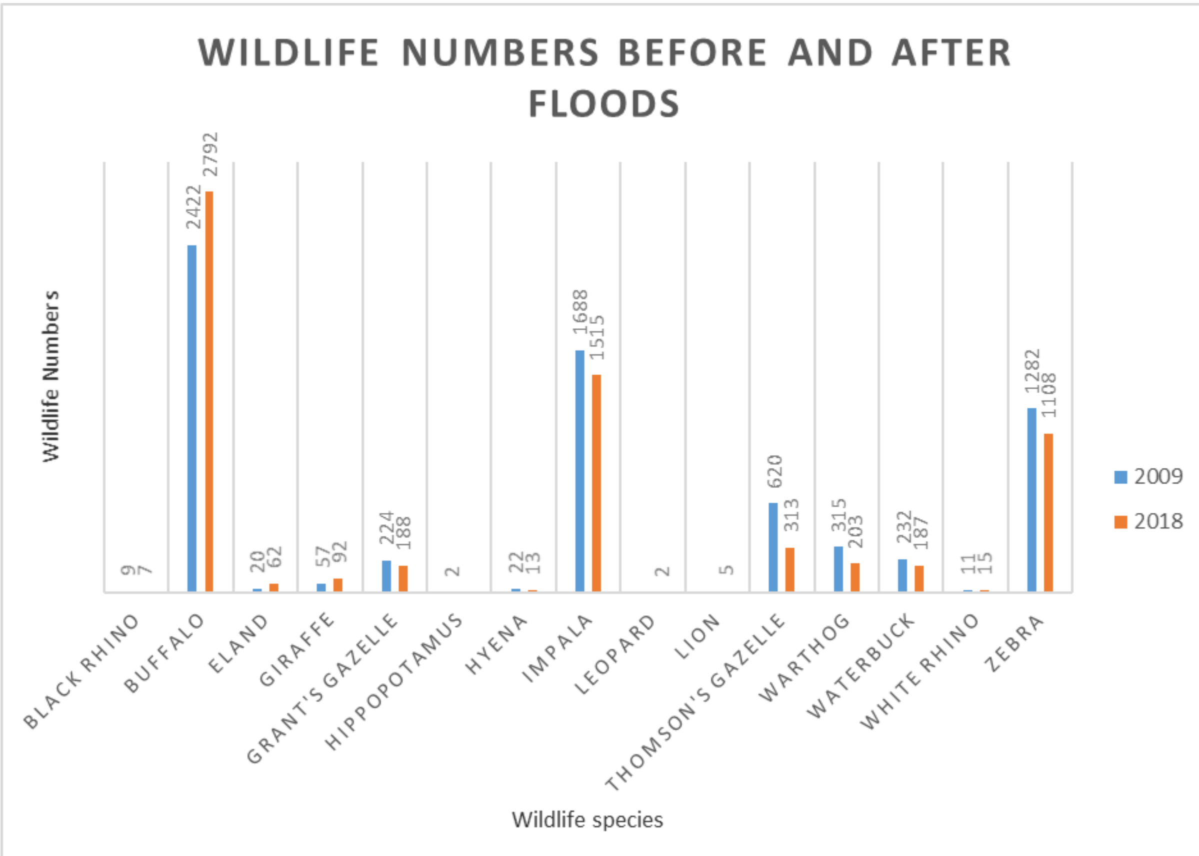


Figure 38: Graph of wildlife numbers before and after the floods

To analyze the wildlife species displaced from their original habitats by floods, the project developed wildlife species distribution maps. The project used ArcGIS's select by attribute query as described by (ESRI, 2020) to pick individual wildlife species for generation of mammal species distribution maps as shown in Figure 39a. To enhance clarity of the results that involved multiple layers, three distribution maps were generated using an exclusive type class interval as suggested by (Kothari, 2004) with equal interval method and 3 classes as shown in Figure 39 b.

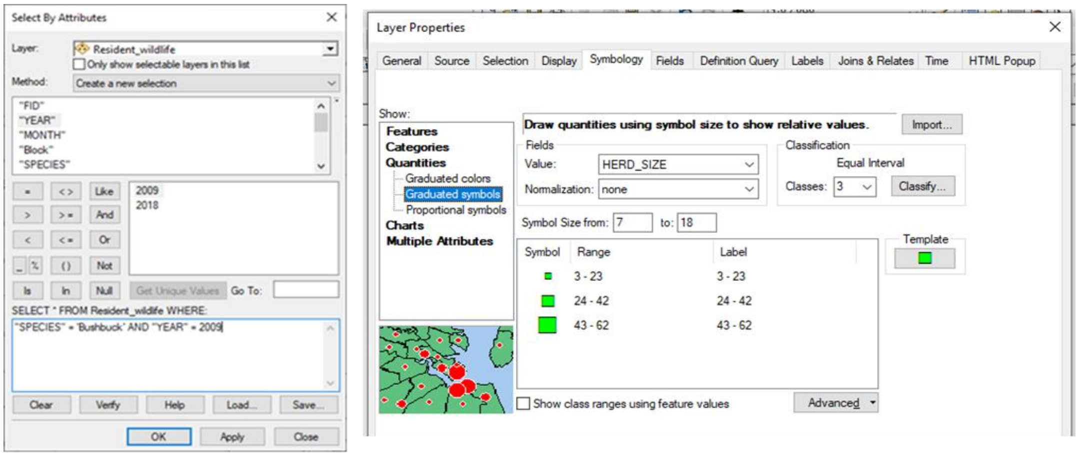


Figure 39: a) Analysis by querying the data; b) Analysis by symbology

The graduation symbols were used to differentiate the availability and abundance of mammal species in a block. Circle 2 multilayer, black, ESRI marker default was used as symbol to represent the wildlife numbers in 2009, while square 2 multilayer, black, ESRI marker default was used as symbol to represent the wildlife numbers in 2018. Dissimilar colors were used to differentiate wildlife species.

In the first map showed in Figure 40, the distribution of five mammals were integrated with the census blocks, lake extent before floods in 2009 and lake extent after floods in 2018. Big numbers of waterbuck were found in block 1 and 10 in 2018 compared to big numbers in block 12 and 13 in 2009. There were no floods in block 13 while section of block 12 was flooded. This meant that waterbuck moved and found blocks 1 and 10 as ideal for their habitation. A huge number of warthogs moved to block 9 after floods from their initial resident of blocks 1 and 7. Block 1 was flooded while block 7 was away from the lake but River Naishi passed through it. The warthog moved because there was possibility of floods in River Naishi. Blocks 1, 2, 7 and 13 recorded huge number of impala in 2018 compared to the same blocks in 2009. It seemed that impala species were favored by floods. White rhino moved from block 4 to block 10. Both block 4 and 10 were flooded. It seemed the floods affected the territory of white rhino in block 4.

Black rhino relocated from their initial residential blocks 1, 4 and 11 to new blocks 8 and 12. Block 12 was partly flooded and was a new block for black rhino. Block 8 had a seasonal river that might have had limited water during the floods period.

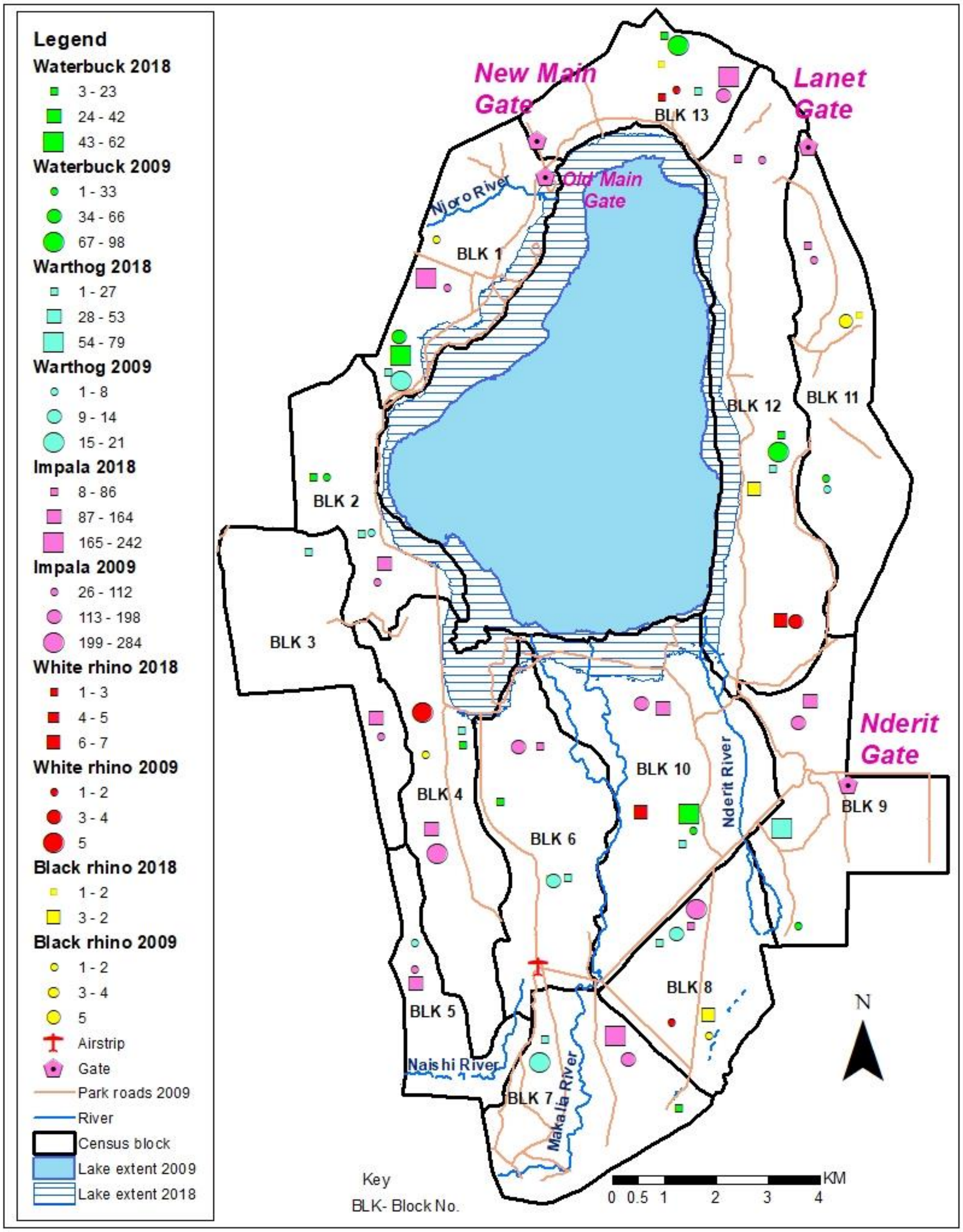


Figure 40: First wildlife distribution map

In the second map, in Figure 41, the distribution of seven mammals were integrated with the census blocks and the lake coverages. There was no hippopotamus observed after floods. This could be attributed to poor road network and researchers might have failed to comprehensively traverse the blocks 9 and 12. Big numbers of giraffe were found in blocks 2, 3 and 8 after floods compared to big numbers in blocks 6 and 9 before floods. Block 6 is attributed to Makalia River while block 9 is attributed to Nderit River. Both rivers might have registered some floods. It seemed giraffe moved to new blocks for survival. Grant's gazelle registered big numbers in blocks 8 and 9 after floods compared to their big numbers in block 1 before floods. It seemed most of the block 1's dispersal area was affected by floods. Eland were found in blocks that were further away from the lake and after floods their numbers increased in blocks furthest from the lake. It seemed eland was affected by floods. Blocks 2, 6, 9 and 13 registered increased number of zebra after floods compared to block 12 that had great numbers before floods. Buffalo registered increased numbers in blocks 3, 4, 8 and 9 after floods compared to big numbers in block 1 before floods. This could be attributed to reduction of dispersal area and disturbance of the buffalos' territory by floods. Thomson's gazelle registered huge numbers in block 9 after floods compared to huge numbers in blocks 4 and 12. This could be attributed to diminished Thomson's gazelle dispersal area.

In the third map, in Figure 42, the distribution of three mammals were integrated with the census blocks and the lake coverages. There were no leopard and lion registered before floods. Leopard was observed only in block 5 while lions were sighted in blocks 9 and 12. This could be because of the availability of food. There were huge number of impala in block 5 and also huge number of Grant's gazelle, eland, Thomson's gazelle and buffalo in block 9 and 12. Huge number of hyena were retained in block 1 while block 10 registered huge numbers of hyena after floods. This could be because of availability of food such as the huge number of waterbuck, Thomson's gazelle and zebra in both blocks.

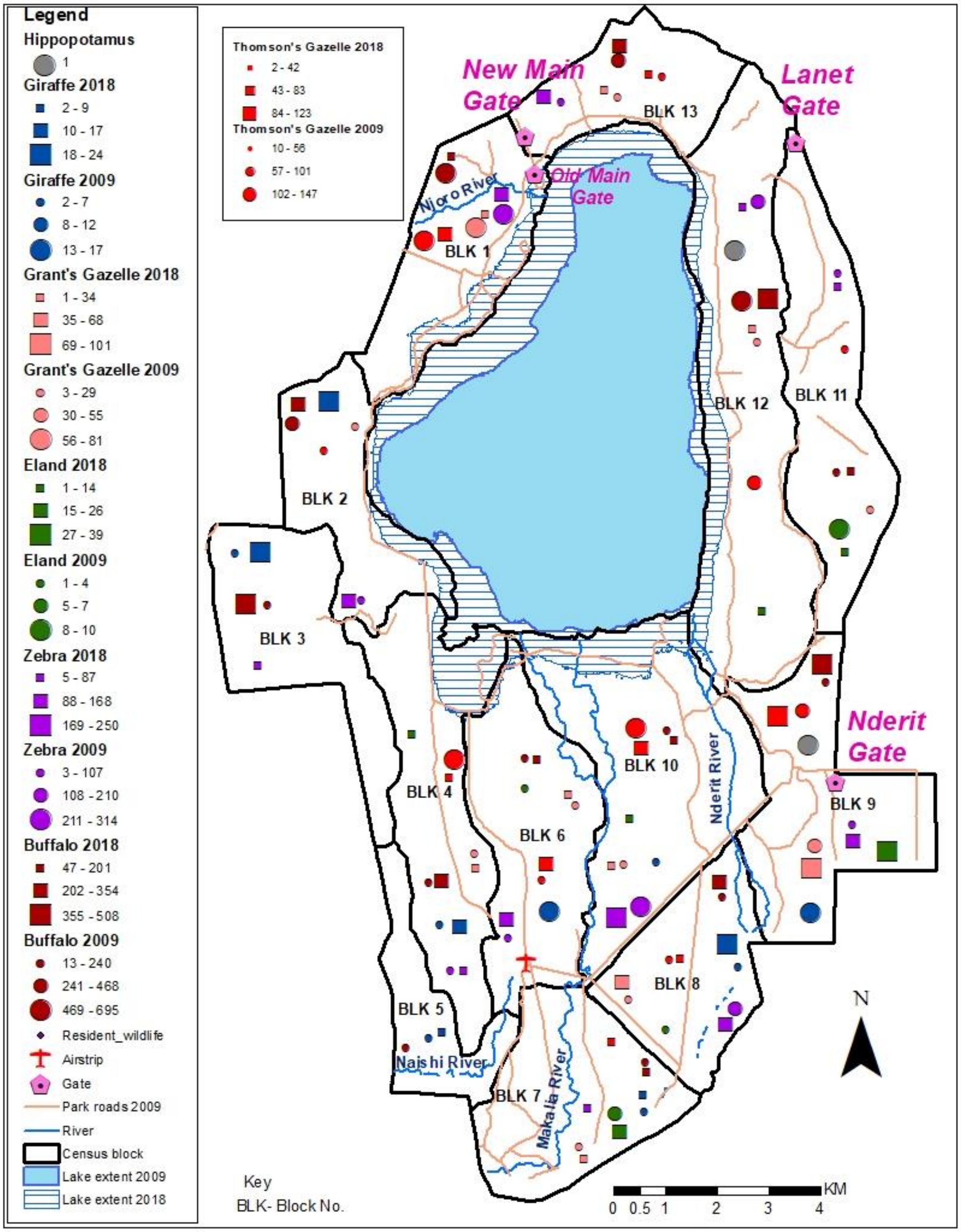


Figure 41: Second wildlife distribution map

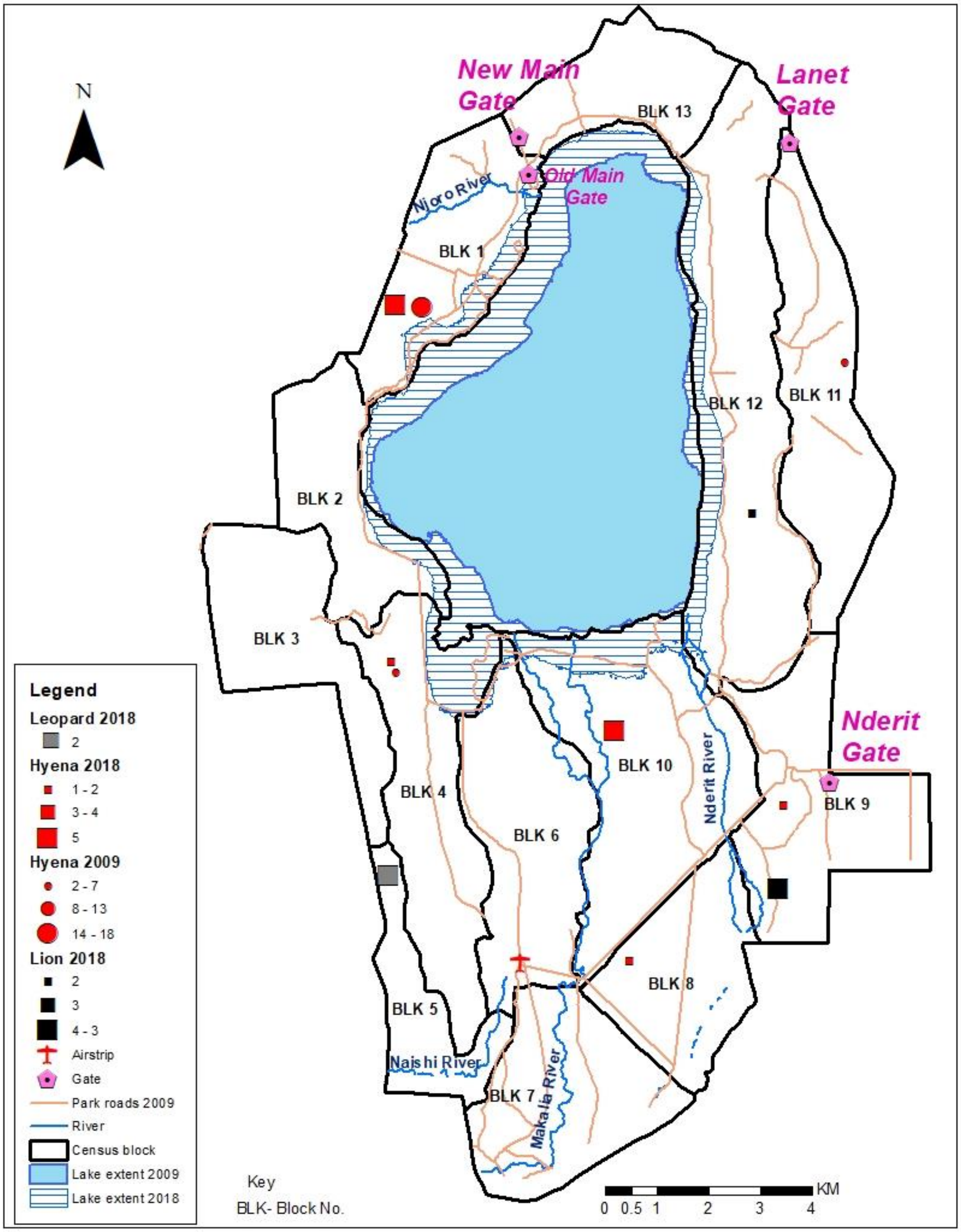


Figure 42: Third wildlife distribution map

4.4 **Flood Zones**

4.4.1 Flood Zone Map

The research found out that the total area of wildlife habitat flooded was 18 km^2. This is about 10% of the study area. Figure 43 shows the flood zone on the 2009 land cover layer.

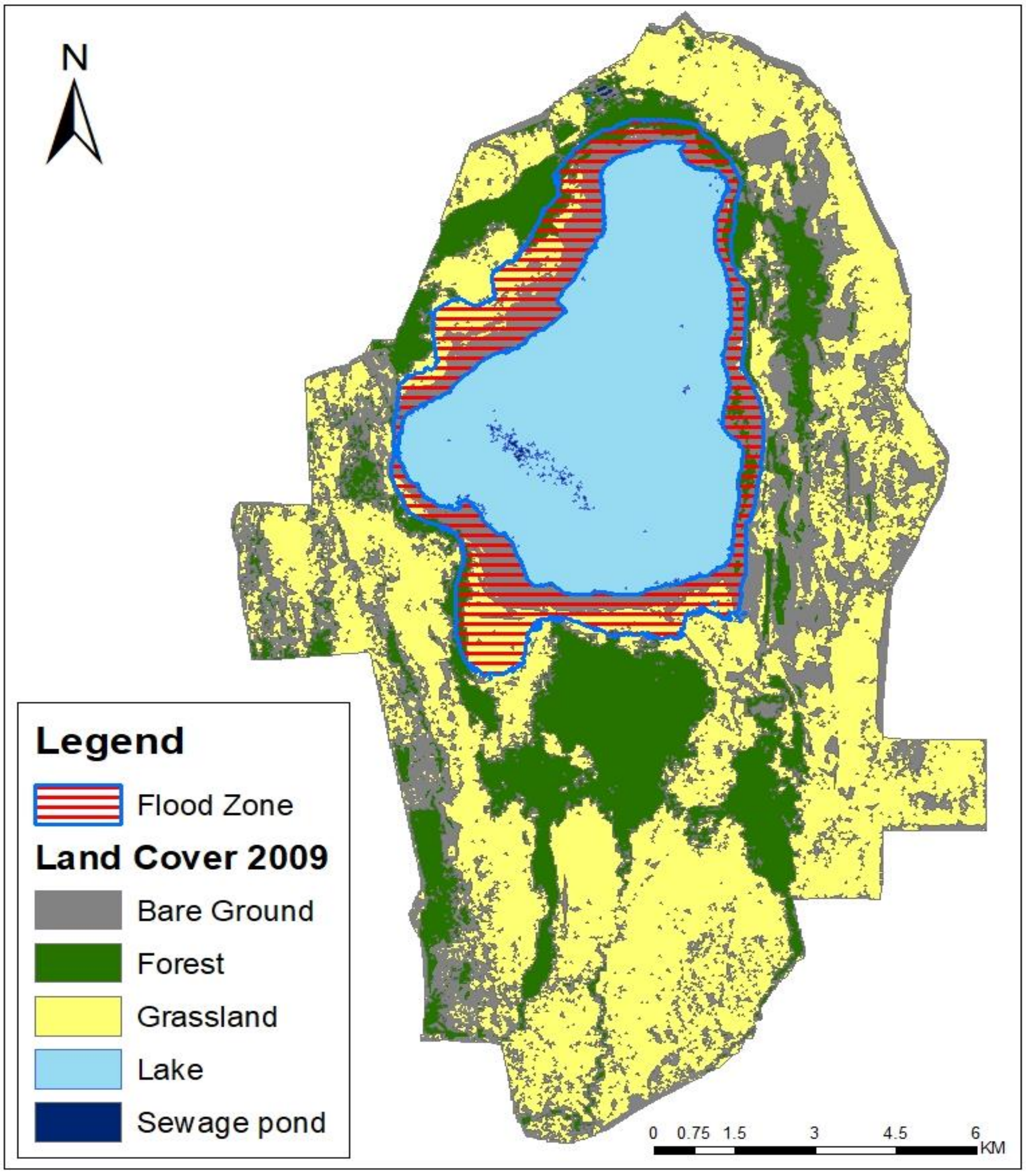


Figure 43: Flooded zone on the 2009 land cover layer

4.4.2 Affected Wildlife Habitats

The most affected wildlife habitat included Bare Ground, Grassland and Forest as shown in Table 12 and Figure 44. The research found out that Bare Ground was the most affected by floods as 27% of the total Bare Ground in the study area was flooded. This was equivalent to 53% of the wildlife displaced habitat. 7.6% of the Forest cover was flooded and this was 32% of the displaced habitat. 6.9% of Grassland was flooded which was equivalent to 15% of the flood zone.

Table 12: Acreages in square meters of the affected wildlife habitats after floods

Land cover	**Acreage (in m^2)**
Bare ground	9,815,361
Forest	2,728,974
Grassland	5,995,925
Total	18,540,260

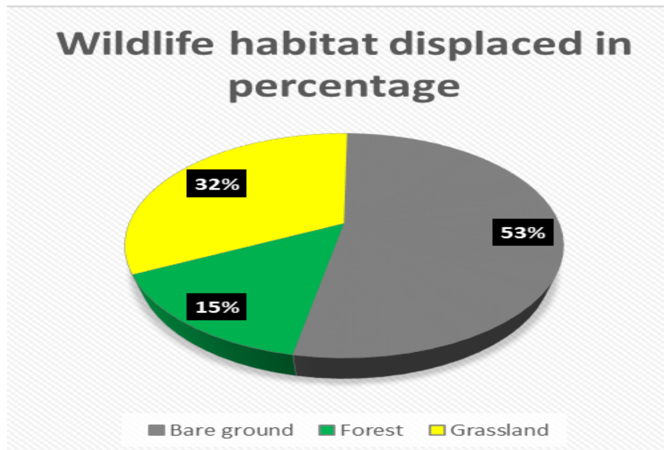


Figure 44: Displaced wildlife habitat in %

Other effects of floods in the study area included rendering some park roads impassable and therefore unable to be used by park managers and tourists. The park headquarters gate, offices and staff quarters near the main gate were also rendered useless as shown in Figure 45.

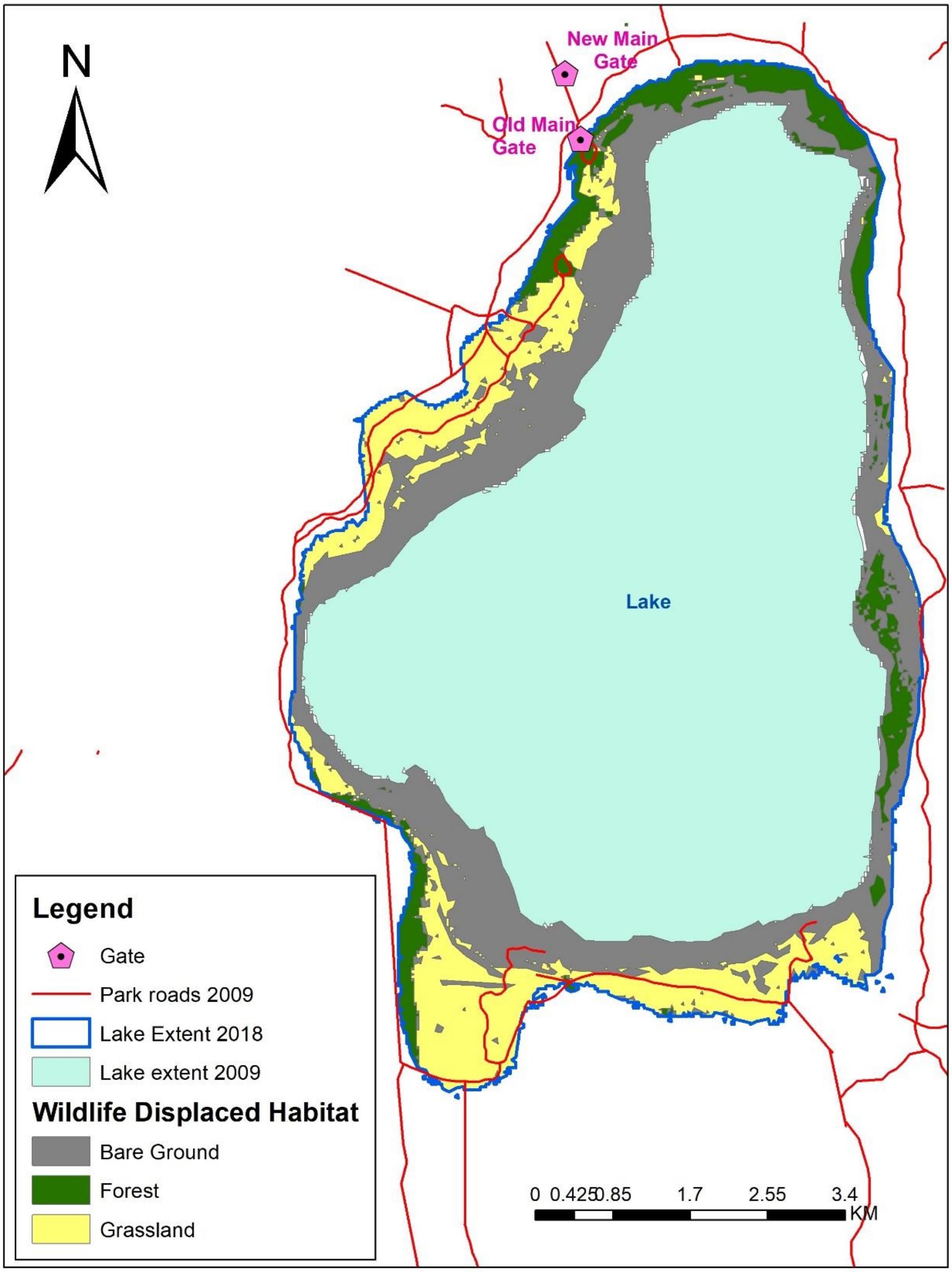


Figure 45: Effects of floods to wildlife habitats and park infrastructure

In order to show explicitly the wildlife habitat displaced by floods, the project generated wildlife displaced habitat thematic map as shown in Figure 46.

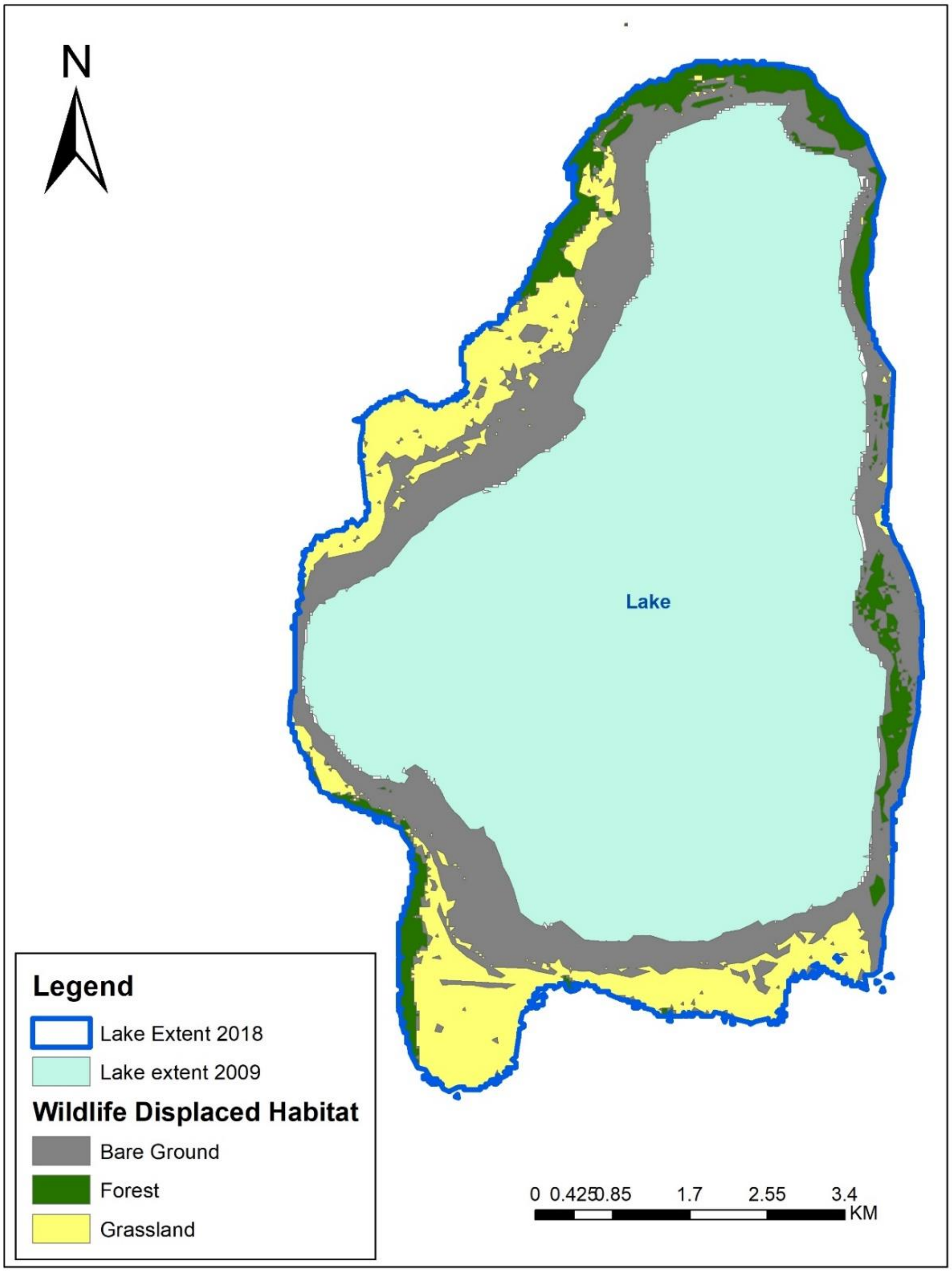


Figure 46: Displaced wildlife habitats

4.5 Standard Deviation Analysis and Relationship between Variables

The standard deviation, SD, is the degree of variation or dispersion of a set of values. The standard deviation was used to measure the spread of wildlife in the census blocks. A low standard deviation meant that the wildlife numbers were close to the average while high standard deviation meant that the wildlife numbers were spread out over a wide range. The standard deviation for the wildlife per census block were 364.35 and 243.27 for 2009 and 2018 respectively as shown in Table 10.

Blocks 3,5,6,7 and 11 had wildlife numbers below SD while blocks 1, 2, 4, 8, 9, 10, 12, and 13 had wildlife numbers above the SD in 2009. Blocks 5 and 11 had wildlife numbers below SD while the other blocks had wildlife numbers above the SD in 2018. Blocks 3, 6 and 7 enhanced with wildlife numbers after floods and the wildlife numbers were spread out over a wide range. From the land cover maps showed in Figures 32 and 33, block 3 experienced increase in forest coverage in 2018 through forest regeneration that could be the preferred food for the wildlife. Block 3 is not adjacent to the lake and the proximity of block 3 to the flooded area is approximately 1 km as applied in (Mijele, *et al*., 2013).

4.6 Discussion of Results

The study found out that there was change in shape of the lake especially in the western and southern part of the study area. The lake coverage increased from 35.591572 km^2 to 54.103917 km^2 which was 52% increase. That change in shape and coverage was occasioned by an increase in water volume causing floods that led to submerging of part of critical wildlife territories or habitats nearer to the lake. When wildlife habitats were affected, wildlife felt threatened and migrated to safer grounds. When parts of park roads, park headquarters and offices were submerged in water, the park operations became enormously difficult. This in the long run would negatively affect both the local and national economy, making it hard to implement one of the Government's Big 4 Agenda which is availability of food and also zero hunger which is the third in the list of Sustainable Development Goals (SDGs).

Out of the five class categories identified for land cover classification and land cover change maps, the Sewage Pond's class turned out to be too small to be seen obviously in the land cover map. The project realized the Sewage Ponds did not have much impact and such class categories with small acreages should had been left out. However about 373,672 m^2 of the lake was categorized as Sewage Ponds in 2009 as shown in Figure 32 but the acreage was subtracted from the Sewage Ponds calculated area and added back to the lake coverage for 2009. The project enhanced Sewage Pond visibility by adding text, arrow and a circle around their locations. The project learnt that accuracy assessment was very critical to enhance the quality of the land cover dataset and QGIS's AcATaMa was useful to achieve acceptable results. The AcATaMa's four steps were easy to follow and the results were commendable in terms of overall accuracy, considering 396 stratified random sampling points in an area of only 188 km^2. The overall accuracy of 73.67 % and 74.91%, as calculated by AcATaMa, for the land cover 2009 and 2018 respectively were good enough for use in this project. When ENVI technique was applied to the confusion matrix where columns represented true classes and rows classifier's predictions (the matrix is a square with all correct classifications along the upper-left to lower right diagonal), there was a small disparity in overall accuracy by - 0.18% and + 0.09% for 2009 and 2018 respectively.

The study found out that there was indeed land cover change largely favoring the lake and the total area of wildlife habitat flooded was 18.540260 km^2 as shown in Figure 43 which was 9.86% of the study area. There was an increase in lake coverage attributed to the floods within the study area. It seemed sections of the land covered by Grassland and Bare ground were converted into lake. The increase in forest coverage was attributed to the availability of rainfall resulting into forest regeneration in parts of Grassland, Bare Ground and Sewage Pond class categories. There was a small acreage missing due to conversion from a raster to vector of the wildlife habitats. This small acreage was about 0.027915 Km^2 added to Bare Ground. When the lake water claimed more space it meant that part of wildlife habitats were submerged in the water and in the process some wildlife migrated to newly found safer homes. The blocks that were affected negatively by an exodus of wildlife included blocks 1, 4, 11,12 and 13 by 59.8%, 34.9%, 53.5%, 57.4% and 8.4% respectively. Out of the 5 listed blocks, 4 blocks namely blocks 1,4,12, and 13 experienced floods and therefore it could be said that blocks 1, 4, 11, and 12 experienced wildlife migration to other blocks due to floods.

Parts of census blocks 1,2,4,6,10,12 and 13 were flooded. Some wildlife such as buffaloes, eland, giraffe and white rhino increased their numbers after the floods. Other wildlife such as black rhino, Grant's gazelle, hyena, impala, Thomson's gazelle, warthog, waterbuck, and zebra numbers declined with floods. There were big numbers of waterbuck found in block 1 and 10 in 2018 compared to big numbers in blocks 12 and 13 in 2009 and all the four blocks experienced some floods. The project established that waterbucks migrated to new home after the floods. Warthogs moved to block 9 from blocks 1 and 7 which was their original habitat. Warthogs moved because their habitats were submerged in water. Block 7 is away from the flooded zone but is crossed by river Makalia as shown in Figure 40. River Makalia might have flooded.

Blocks 1, 2,7,13 recorded huge numbers of impala in 2018 compared to the same blocks in 2009. It seemed that impala species adapted to the floods and behaved normally. White rhino moved from block 4 to block 10. Both block 4 and 10 were flooded. There was possibility that the floods affected the territory of white rhino in block 4 and this could be the reason for finding new home in block 10. Black rhino relocated from their initial residential blocks 1, 4 and 11 to new blocks 8 and 12. Block 12 was partly flooded and was a new home for black rhino. Block 8 had a seasonal river that might have limited water during the floods period. Generally rhino species were affected by floods and they moved to new habitats in new blocks.

There was no hippopotamus observed after floods. This could be attributed to poor road network and researchers might have failed to comprehensively traverse blocks 9 and 12 where the hippopotamus were observed in 2009. Big numbers of giraffe were found in blocks 6 and 9 before floods compared to big numbers in blocks 2, 3 and 8 after floods. Block 6 is crossed by Makalia River while block 9 is traversed by Nderit River. Both rivers might have registered some floods that made giraffes to migrate to new blocks. The migration of Grant's gazelle from block 1 to blocks 8 and 9 was due to the destruction of their dispersal area by floods. Eland were affected by floods because before floods they were found in blocks that were further away from the lake and after floods they migrated to the furthest blocks from the lake. When the fence line is not properly managed eland can easily move out of the island protected area. Buffalo registered increased numbers in blocks 3, 4, 8 and 9 after floods compared to big numbers in block 1 before floods. Blocks 12 and 13 registered almost similar numbers for both 2009 and 2018. Thomson's gazelle registered huge numbers in block 9 and 6 after floods in relation to big numbers in blocks 4 and 12 before floods. These migrations of wildlife from their original habitat to new homes could be attributed to diminished dispersal area and disturbance of their territories by floods as shown in Figure 40.

Leopards and lions were observed only in 2018. Leopards were observed in block 5 while lions were sighted in blocks 9 and 12. The reason why there were leopards and lions in these blocks could be because of availability of food. There were huge number of impala in block 5 and also huge number of Grant's gazelle, eland, Thomson's gazelle and buffalo in block 9 and 12 as shown in Figure 41. Huge number of hyenas remained in block 1 while block 10 registered huge numbers of hyenas after floods. This could be because of availability of food such huge number of waterbuck, Thomson's gazelle and zebra Figures 39, 40 and 41.

From the SD blocks 3, 5, 6, 7, and 11 registered wildlife numbers concentrated near the mean in 2009 and only two blocks 5 and 11 registered near the mean wildlife concentrations in 2018. Other blocks indicated wildlife numbers were well above SD. Block 3 was the most enhanced block with wildlife concentration in 2018. The wildlife numbers in block 3 was below the SD (364.35) in 2009 but the numbers improved from 47 to 634 which was above SD (243.27) in 2018. Block 1 was the most negatively affected considering the wildlife densities that declined from 127 in 2009 to 51 in 2018. The reason could be that many wildlife moved from blocks 1 to block 3 after floods due to forest regeneration. From the land cover maps, there were indications that block 3 experienced forest regeneration that could be the preferred food for the wildlife.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The project concluded that there have been floods in Lake Nakuru National Park that have caused land cover change and affected wildlife habitats. The floods covered an area of 18.54 km^2 which was about 10% of LNNP. The major wildlife habitats that were affected included Bare Ground, Grassland and Forest. This led to reduction of wildlife dispersal areas and hampered wildlife territories near the lake. Some wildlife such as rhinos, warthogs, giraffes, Grant's gazelles, elands, and Thomson's gazelles migrated from their original habitats in census blocks to new census blocks or new habitats. The floods also affected some park infrastructures making park operations difficult.

5.2 Recommendations

The study recommends that the data and information provided by this project be used to enhance formulation of flood mitigation measures through development of flood mitigation guidelines and flood preparedness awareness posters.

To mitigate further submerging of park infrastructures, the study recommends that the road network covered by floods be reclaimed by raising up these roads above the water level mark or come up with a design to suspend the affected roads above the current water level.

The study recommends further research to determine the source of Lake Nakuru National Park flood waters and also to determine whether Rivers Makalia and Nderit experienced some floods.

The study recommends further study on the effects of flooding on wildlife inside the Lake.

The study recommends that the Government of Kenya to find a way to make SDI work in Kenya to facilitate data sharing for research work and any other use.

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APPENDICES

Appendix 1: Letter for Image Data Request (RCMRD)

KENYA WILDLIFE SERVICE

ISO 9001:2008 Certified

Our Ref: KWS/BR&P/GIS/9104/2020-01

19th February, 2020

Regional Centre for Mapping of Resources for Development (RCMRD)
Kasarani Road, Off Thika Road
P.O Box 632-00618
Nairobi, Kenya

Dear Sir/Madam,

My name is Peter Hongo. I work for Kenya Wildlife Service (KWS) as a Senior GIS Officer and I am also a MSc in GIS student at the University of Nairobi currently working on my project thesis. As you may be aware, Lake Nakuru National Park (LNNP) is flooded and some of the critical wildlife habitat, infrastructures such as building and roads have been submerged. There is also possibility of displacement of wildlife. My thesis topic is "Mapping the flooding of Lake Nakuru National Park and its effects on Wildlife". One of the datasets I need to answer one of my research questions is the satellite images covering LNNP. The scope of my study is from 2009 to 2020.

I would like to request you to help me with the satellite images covering the park. I am interested in Landsat images for the month of February for the years 2009 to 2019 (ie it can be plus or minus one month). I already sent you the Lake Nakuru National Park boundary which is the extent of my study area.

Thank you,

Peter Hongo

P.O Box 40241-00100, Nairobi, Kenya. Tel: +254-20-2609233, +254-20-2609234
Wireless: +254-020-2379407-15. Mobile: +254-735 663 421, +254-726 610 508/9. Fax: +254-020-2661923
Email: kws@kws.go.ke Website:www.kws.go.ke

Appendix 2: Data Request Form (KWS)

KENYA WILDLIFE SERVICE

DATA REQUEST FORM (separate form to be filled for each data set requested)

DETAILS OF APPLICANT:

Name. ………**Peter Hongo**…………………………………………………………

Passport/ID/Huduma No……………**13600545**……………………………………………

Organization/Institution……………**Kenya Wildlife Service**………………

Affiliation In Kenya …..**University of Nairobi** ………………………………………………

Occupation……………**Snr GIS Technician at KWS/MSc in GIS Student at University of Nairobi**……….

Work Permit No……………………………………………………………………………………

Physical Address……..**Langata Road** ……………………………………………………………

Postal Address**....P. O. Box 40241 …Nairobi** ..Postal Code **00100** …………………………………

Tel:…………**0721296378**…………………………………………………

Email:……**peterh@kws.go.ke**……………………………………………

Date:…**19/02/2020**……………………………………………………………………………………

DETAILS OF DATA/INFORMATION REQUESTED:

Describe in sufficient details: (Lake NNP)

- Type of data: **Wildlife census data, Wildlife counting blocks**
- Data format: **Soft copy**
- Data coverage (location and period): **Lake Nakuru National Park (2009 to 2019)**

PURPOSE FOR WHICH DATA/INFORMATION IS TO BE USED:

(Attach Proposal, letter of introduction from affiliating institution. Applicable Research shall be charged as per Research Fee Schedule Annex 6)

For academic purposes

I confirm that I have requested the aforementioned data and information from Kenya Wildlife Service and that the information herein provided is true to the best of my knowledge

Name: **Peter Hongo**….. Sign ……[signature]……… Date ……19/02/2020……

FOR OFFICIAL USE ONLY

Application reference number ……………………………………………………………

Comments by Database officer ……………………………………………………………

I. Data availability (Attach data either hard or electronic copy)……………………………

II. Data classification………………………………………………………………………

……………………………………………………………………………………………

Name……Dr. Muteti……Sign……[signature]……Date……17/02/2020

Comments by Research authorizations officer……I have no objection to the use of data [illegible]……

Name……Dr. [illegible]……Sign……[signature]……Date……19.2.2020……

DATA/INFORMATION RELEASE APPROVAL

Relevant Head of Directorate/Division……………………………………………………………………

And/or

Director General……………………………………………………………………………………

Name ………………………….. .Sign.…………………………… Date ……………………………………………

Data/information can only be cleared for release by the Relevant Head of Directorate / Division or Director General where applicable

Appendix 3: Wildlife Data

YEAR	MONTH	Block	SPECIES	MALE	FEMALE	UNSEXED	YOUNG	HERD_SIZE
2009	April	1	Black rhino	1	0	0	0	1
2009	April	4	Black rhino	1	0	0	0	1
2009	April	4	Black rhino	0	1	0	0	1
2009	April	8	Black rhino	0	0	1	0	1
2009	April	11	Black rhino	0	0	0	1	1
2009	April	11	Black rhino	0	1	0	1	2
2009	April	11	Black rhino	0	1	0	1	2
2009	April	1	Buffalo	10	170	0	30	210
2009	April	1	Buffalo	2	0	0	0	2
2009	April	1	Buffalo	3	0	27	1	31
2009	April	1	Buffalo	0	0	0	2	2
2009	April	1	Buffalo	2	2	0	1	5
2009	April	1	Buffalo	20	150	0	30	200
2009	April	1	Buffalo	0	3	0	0	3
2009	April	1	Buffalo	10	33	0	10	53
2009	April	1	Buffalo	3	0	0	0	3
2009	April	1	Buffalo	0	2	0	3	5
2009	April	1	Buffalo	1	0	0	0	1
2009	April	1	Buffalo	0	0	20	3	23
2009	April	1	Buffalo	2	6	0	2	10
2009	April	1	Buffalo	2	0	0	0	2
2009	April	1	Buffalo	0	0	23	0	23
2009	April	1	Buffalo	4	0	0	0	4
2009	April	1	Buffalo	3	0	0	0	3
2009	April	1	Buffalo	2	0	0	0	2
2009	April	2	Buffalo	3	11	47	10	71
2009	April	2	Buffalo	23	144	0	37	204
2009	April	2	Buffalo	1	0	0	0	1
2009	April	2	Buffalo	2	0	0	0	2
2009	April	2	Buffalo	1	0	0	0	1
2009	April	3	Buffalo	5	0	0	0	5
2009	April	3	Buffalo	0	5	0	2	7
2009	April	3	Buffalo	2	3	0	2	7
2009	April	4	Buffalo	1	0	0	0	1
2009	April	4	Buffalo	2	0	0	0	2
2009	April	4	Buffalo	6	0	0	0	6
2009	April	4	Buffalo	4	0	0	0	4
2009	April	4	Buffalo	2	0	0	0	2

2009	April	4	Buffalo	2	0	0	0	2
2009	April	4	Buffalo	20	0	0	0	20
2009	April	4	Buffalo	2	0	0	0	2
2009	April	4	Buffalo	1	0	0	0	1
2009	April	4	Buffalo	3	0	0	0	3
2009	April	5	Buffalo	7	6	0	0	13
2009	April	6	Buffalo	0	0	2	0	2
2009	April	6	Buffalo	0	0	3	0	3
2009	April	6	Buffalo	0	0	4	0	4
2009	April	6	Buffalo	2	1	0	0	3
2009	April	6	Buffalo	2	0	0	0	2
2009	April	6	Buffalo	3	0	0	0	3
2009	April	6	Buffalo	0	0	2	0	2
2009	April	6	Buffalo	3	0	0	0	3
2009	April	6	Buffalo	3	0	0	0	3
2009	April	6	Buffalo	2	0	0	0	2
2009	April	6	Buffalo	4	0	0	0	4
2009	April	6	Buffalo	1	0	0	0	1
2009	April	6	Buffalo	1	0	0	0	1
2009	April	6	Buffalo	3	0	0	0	3
2009	April	6	Buffalo	2	0	0	0	2
2009	April	6	Buffalo	2	0	0	0	2
2009	April	6	Buffalo	2	0	0	0	2
2009	April	6	Buffalo	0	0	6	0	6
2009	April	7	Buffalo	65	2	0	0	67
2009	April	8	Buffalo	3	0	0	0	3
2009	April	8	Buffalo	7	0	0	0	7
2009	April	8	Buffalo	6	0	0	0	6
2009	April	8	Buffalo	2	0	0	0	2
2009	April	8	Buffalo	7	4	3	0	14
2009	April	8	Buffalo	3	0	0	0	3
2009	April	9	Buffalo	2	0	0	0	2
2009	April	9	Buffalo	10	0	0	0	10
2009	April	9	Buffalo	1	0	0	0	1
2009	April	9	Buffalo	1	0	0	0	1
2009	April	9	Buffalo	3	0	0	0	3
2009	April	9	Buffalo	2	0	0	0	2
2009	April	9	Buffalo	2	0	0	0	2
2009	April	9	Buffalo	6	0	0	0	6
2009	April	9	Buffalo	1	0	0	0	1
2009	April	9	Buffalo	7	0	0	5	12

2009	April	9	Buffalo	1	0	0	0	1
2009	April	9	Buffalo	6	0	0	0	6
2009	April	9	Buffalo	7	0	0	0	7
2009	April	9	Buffalo	2	0	0	0	2
2009	April	9	Buffalo	2	0	0	0	2
2009	April	9	Buffalo	2	1	0	0	3
2009	April	9	Buffalo	0	10	0	3	13
2009	April	9	Buffalo	7	18	0	6	31
2009	April	9	Buffalo	7	0	0	0	7
2009	April	9	Buffalo	3	11	0	3	17
2009	April	9	Buffalo	8	3	0	0	11
2009	April	9	Buffalo	2	0	0	0	2
2009	April	9	Buffalo	2	0	0	0	2
2009	April	9	Buffalo	7	0	0	0	7
2009	April	9	Buffalo	2	0	0	0	2
2009	April	9	Buffalo	3	0	0	0	3
2009	April	9	Buffalo	2	0	0	0	2
2009	April	9	Buffalo	2	0	0	0	2
2009	April	9	Buffalo	1	0	0	0	1
2009	April	9	Buffalo	2	0	0	0	2
2009	April	10	Buffalo	7	0	0	0	7
2009	April	10	Buffalo	0	5	0	0	5
2009	April	10	Buffalo	4	0	0	0	4
2009	April	10	Buffalo	0	0	8	0	8
2009	April	10	Buffalo	4	0	0	0	4
2009	April	10	Buffalo	0	0	1	0	1
2009	April	11	Buffalo	2	0	0	0	2
2009	April	11	Buffalo	16	54	0	10	80
2009	April	11	Buffalo	1	0	0	0	1
2009	April	11	Buffalo	1	2	0	1	4
2009	April	11	Buffalo	0	4	0	2	6
2009	April	11	Buffalo	4	0	0	0	4
2009	April	11	Buffalo	3	0	0	0	3
2009	April	11	Buffalo	4	0	0	0	4
2009	April	11	Buffalo	3	0	0	0	3
2009	April	11	Buffalo	3	0	0	0	3
2009	April	12	Buffalo	3	8	0	0	11
2009	April	12	Buffalo	0	0	9	1	10
2009	April	12	Buffalo	6	14	0	1	21
2009	April	12	Buffalo	0	0	31	2	33
2009	April	12	Buffalo	2	0	0	0	2

2009	April	12	Buffalo	12	3	0	0	15
2009	April	12	Buffalo	0	0	107	14	121
2009	April	12	Buffalo	0	0	30	0	30
2009	April	12	Buffalo	3	0	70	0	73
2009	April	12	Buffalo	0	0	23	0	23
2009	April	12	Buffalo	0	0	127	0	127
2009	April	12	Buffalo	0	0	180	0	180
2009	April	12	Buffalo	8	14	0	11	33
2009	April	12	Buffalo	0	14	0	1	15
2009	April	12	Buffalo	1	0	0	0	1
2009	April	13	Buffalo	0	0	127	40	167
2009	April	13	Buffalo	2	0	0	0	2
2009	April	13	Buffalo	3	8	0	3	14
2009	April	13	Buffalo	0	1	0	1	2
2009	April	13	Buffalo	2	0	0	0	2
2009	April	13	Buffalo	0	0	10	0	10
2009	April	13	Buffalo	5	0	0	0	5
2009	April	13	Buffalo	2	0	0	0	2
2009	April	13	Buffalo	4	3	0	0	7
2009	April	13	Buffalo	3	0	0	0	3
2009	April	13	Buffalo	3	0	0	0	3
2009	April	13	Buffalo	0	0	3	0	3
2009	April	13	Buffalo	0	0	3	0	3
2009	April	13	Buffalo	0	0	13	0	13
2009	April	13	Buffalo	2	1	0	0	3
2009	April	13	Buffalo	2	0	0	0	2
2009	April	13	Buffalo	0	2	0	0	2
2009	April	13	Buffalo	0	0	49	3	52
2009	April	13	Buffalo	5	0	0	0	5
2009	April	13	Buffalo	3	0	0	0	3
2009	April	13	Buffalo	12	0	0	0	12
2009	April	13	Buffalo	1	0	0	0	1
2009	April	13	Buffalo	4	0	0	0	4
2009	April	13	Buffalo	0	0	19	0	19
2009	April	6	Eland	0	3	0	0	3
2009	April	7	Eland	2	0	4	0	6
2009	April	8	Eland	1	0	0	0	1
2009	April	11	Eland	1	3	0	2	6
2009	April	11	Eland	0	3	0	0	3
2009	April	11	Eland	1	0	0	0	1
2009	April	3	Giraffe	0	1	0	1	2

2009	April	4	Giraffe	1	0	0	0	1
2009	April	4	Giraffe	1	0	1	0	2
2009	April	5	Giraffe	0	1	4	1	6
2009	April	6	Giraffe	2	0	0	0	2
2009	April	6	Giraffe	1	0	1	0	2
2009	April	6	Giraffe	1	0	0	0	1
2009	April	6	Giraffe	0	4	0	1	5
2009	April	6	Giraffe	1	2	0	1	4
2009	April	6	Giraffe	1	0	0	0	1
2009	April	6	Giraffe	0	0	2	0	2
2009	April	7	Giraffe	2	3	0	1	6
2009	April	8	Giraffe	1	1	0	0	2
2009	April	8	Giraffe	1	0	0	0	1
2009	April	8	Giraffe	1	0	0	0	1
2009	April	9	Giraffe	1	1	0	0	2
2009	April	9	Giraffe	1	0	2	0	3
2009	April	9	Giraffe	1	1	0	1	3
2009	April	9	Giraffe	1	1	0	0	2
2009	April	9	Giraffe	1	3	0	1	5
2009	April	10	Giraffe	0	0	1	3	4
2009	April	1	Grant's Gazelle	0	2	0	0	2
2009	April	1	Grant's Gazelle	0	0	2	0	2
2009	April	1	Grant's Gazelle	0	0	3	0	3
2009	April	1	Grant's Gazelle	0	0	43	0	43
2009	April	1	Grant's Gazelle	15	0	0	0	15
2009	April	1	Grant's Gazelle	0	0	2	0	2
2009	April	1	Grant's Gazelle	3	1	0	0	4
2009	April	1	Grant's Gazelle	1	0	0	0	1
2009	April	1	Grant's Gazelle	0	0	4	0	4
2009	April	1	Grant's Gazelle	1	0	3	0	4
2009	April	1	Grant's Gazelle	0	0	1	0	1
2009	April	2	Grant's Gazelle	4	9	0	0	13
2009	April	2	Grant's Gazelle	5	0	0	0	5
2009	April	2	Grant's Gazelle	1	0	0	0	1
2009	April	2	Grant's Gazelle	4	0	0	0	4
2009	April	4	Grant's Gazelle	1	3	0	0	4
2009	April	6	Grant's Gazelle	1	7	0	0	8
2009	April	7	Grant's Gazelle	3	0	0	0	3
2009	April	8	Grant's Gazelle	2	10	0	0	12
2009	April	8	Grant's Gazelle	0	0	3	0	3
2009	April	8	Grant's Gazelle	3	1	0	0	4

2009	April	8	Grant's Gazelle	1	1	0	0	2
2009	April	9	Grant's Gazelle	4	0	0	0	4
2009	April	9	Grant's Gazelle	1	8	0	2	11
2009	April	9	Grant's Gazelle	1	0	0	0	1
2009	April	9	Grant's Gazelle	1	12	0	1	14
2009	April	9	Grant's Gazelle	0	2	0	0	2
2009	April	9	Grant's Gazelle	1	4	0	0	5
2009	April	9	Grant's Gazelle	0	0	12	0	12
2009	April	9	Grant's Gazelle	0	0	2	0	2
2009	April	10	Grant's Gazelle	1	1	0	0	2
2009	April	10	Grant's Gazelle	1	2	0	0	3
2009	April	10	Grant's Gazelle	1	0	0	0	1
2009	April	10	Grant's Gazelle	0	0	1	0	1
2009	April	10	Grant's Gazelle	0	0	2	0	2
2009	April	11	Grant's Gazelle	2	1	0	0	3
2009	April	11	Grant's Gazelle	1	0	0	0	1
2009	April	11	Grant's Gazelle	2	0	0	0	2
2009	April	11	Grant's Gazelle	2	0	0	0	2
2009	April	12	Grant's Gazelle	0	3	0	0	3
2009	April	13	Grant's Gazelle	2	11	0	0	13
2009	April	9	Hippopotamus	1	0	0	0	1
2009	April	12	Hippopotamus	0	0	1	0	1
2009	April	1	Impala	17	0	0	0	17
2009	April	1	Impala	1	0	9	0	10
2009	April	1	Impala	5	0	0	0	5
2009	April	1	Impala	1	0	0	0	1
2009	April	1	Impala	0	5	0	0	5
2009	April	1	Impala	1	10	0	4	15
2009	April	1	Impala	0	0	2	0	2
2009	April	1	Impala	2	0	0	0	2
2009	April	1	Impala	1	15	0	2	18
2009	April	2	Impala	4	3	0	2	9
2009	April	2	Impala	2	13	0	2	17
2009	April	2	Impala	24	0	0	0	24
2009	April	2	Impala	1	0	0	0	1
2009	April	2	Impala	1	0	0	0	1
2009	April	2	Impala	8	0	0	0	8
2009	April	3	Impala	1	0	0	0	1
2009	April	3	Impala	1	0	0	0	1
2009	April	3	Impala	1	0	0	0	1
2009	April	3	Impala	1	19	0	3	23

2009	April	4	Impala	1	33	0	1	35
2009	April	4	Impala	2	0	0	0	2
2009	April	4	Impala	5	0	0	0	5
2009	April	4	Impala	1	5	0	0	6
2009	April	4	Impala	1	13	0	0	14
2009	April	4	Impala	1	27	0	2	30
2009	April	4	Impala	0	4	0	0	4
2009	April	4	Impala	0	2	0	0	2
2009	April	4	Impala	2	0	0	0	2
2009	April	4	Impala	10	0	0	0	10
2009	April	4	Impala	10	0	0	0	10
2009	April	4	Impala	1	0	36	0	37
2009	April	4	Impala	1	0	0	0	1
2009	April	4	Impala	16	0	0	0	16
2009	April	4	Impala	0	58	0	0	58
2009	April	4	Impala	1	18	0	0	19
2009	April	4	Impala	1	32	0	0	33
2009	April	5	Impala	10	82	0	6	98
2009	April	6	Impala	2	2	0	0	4
2009	April	6	Impala	2	2	0	0	4
2009	April	6	Impala	0	4	0	0	4
2009	April	6	Impala	6	0	0	0	6
2009	April	6	Impala	1	0	0	0	1
2009	April	6	Impala	1	39	0	0	40
2009	April	6	Impala	3	1	0	0	4
2009	April	6	Impala	4	0	0	0	4
2009	April	6	Impala	1	26	0	0	27
2009	April	6	Impala	0	0	44	0	44
2009	April	6	Impala	1	10	1	0	12
2009	April	7	Impala	36	136	0	1	173
2009	April	8	Impala	1	0	0	0	1
2009	April	8	Impala	3	0	0	0	3
2009	April	8	Impala	1	10	6	1	18
2009	April	8	Impala	1	27	0	0	28
2009	April	8	Impala	2	0	0	0	2
2009	April	8	Impala	1	6	0	0	7
2009	April	8	Impala	3	6	0	0	9
2009	April	8	Impala	7	26	0	3	36
2009	April	8	Impala	6	0	45	0	51
2009	April	8	Impala	1	7	0	3	11
2009	April	8	Impala	3	10	0	0	13

2009	April	8	Impala	1	0	12	0	13
2009	April	8	Impala	14	4	0	0	18
2009	April	8	Impala	6	1	0	0	7
2009	April	8	Impala	1	4	0	0	5
2009	April	9	Impala	3	0	0	0	3
2009	April	9	Impala	5	0	0	0	5
2009	April	9	Impala	0	5	0	0	5
2009	April	9	Impala	0	1	0	1	2
2009	April	9	Impala	1	0	0	0	1
2009	April	9	Impala	1	1	0	0	2
2009	April	9	Impala	4	4	0	0	8
2009	April	9	Impala	1	9	0	2	12
2009	April	9	Impala	1	0	0	0	1
2009	April	9	Impala	1	7	0	0	8
2009	April	9	Impala	1	5	0	0	6
2009	April	9	Impala	1	0	0	0	1
2009	April	9	Impala	1	0	0	0	1
2009	April	9	Impala	1	0	0	0	1
2009	April	9	Impala	1	24	0	2	27
2009	April	9	Impala	1	26	0	3	30
2009	April	9	Impala	4	0	0	0	4
2009	April	9	Impala	1	0	0	0	1
2009	April	9	Impala	1	7	0	0	8
2009	April	9	Impala	18	0	0	0	18
2009	April	9	Impala	1	20	0	1	22
2009	April	9	Impala	18	0	0	0	18
2009	April	10	Impala	2	0	0	0	2
2009	April	10	Impala	8	0	0	0	8
2009	April	10	Impala	6	0	0	0	6
2009	April	10	Impala	0	1	0	1	2
2009	April	10	Impala	0	1	0	0	1
2009	April	10	Impala	1	0	0	0	1
2009	April	10	Impala	8	0	0	0	8
2009	April	10	Impala	0	3	0	0	3
2009	April	10	Impala	8	4	0	0	12
2009	April	10	Impala	3	8	0	0	11
2009	April	10	Impala	1	12	0	0	13
2009	April	10	Impala	8	0	0	0	8
2009	April	10	Impala	1	0	0	0	1
2009	April	10	Impala	1	0	0	0	1
2009	April	10	Impala	0	1	0	0	1

2009	April	10	Impala	18	0	0	0	18
2009	April	10	Impala	2	30	0	4	36
2009	April	10	Impala	3	0	0	0	3
2009	April	10	Impala	1	20	0	2	23
2009	April	10	Impala	0	0	1	0	1
2009	April	11	Impala	5	0	0	0	5
2009	April	11	Impala	2	0	0	0	2
2009	April	11	Impala	3	0	0	0	3
2009	April	11	Impala	5	0	0	0	5
2009	April	11	Impala	1	0	0	0	1
2009	April	11	Impala	1	11	6	0	18
2009	April	11	Impala	3	0	0	0	3
2009	April	12	Impala	1	14	0	0	15
2009	April	12	Impala	0	2	0	0	2
2009	April	12	Impala	1	0	0	0	1
2009	April	12	Impala	2	18	0	0	20
2009	April	12	Impala	0	1	0	1	2
2009	April	12	Impala	2	20	0	0	22
2009	April	12	Impala	1	0	0	0	1
2009	April	12	Impala	1	6	0	0	7
2009	April	13	Impala	1	0	0	0	1
2009	April	13	Impala	0	3	0	0	3
2009	April	13	Impala	0	33	0	3	36
2009	April	13	Impala	10	0	0	0	10
2009	April	13	Impala	0	1	0	0	1
2009	April	13	Impala	1	12	0	0	13
2009	April	13	Impala	9	0	0	0	9
2009	April	13	Impala	1	0	0	0	1
2009	April	13	Impala	1	0	0	0	1
2009	April	13	Impala	1	0	0	0	1
2009	April	13	Impala	2	36	0	9	47
2009	April	13	Impala	1	0	0	0	1
2009	April	13	Impala	8	10	0	0	18
2009	April	13	Impala	0	3	0	0	3
2009	April	13	Impala	5	0	0	0	5
2009	April	1	Hyena	1	1	10	0	12
2009	April	1	Hyena	1	1	0	0	2
2009	April	1	Hyena	0	0	1	0	1
2009	April	1	Hyena	0	0	3	0	3
2009	April	4	Hyena	0	0	2	0	2
2009	April	11	Hyena	2	0	0	0	2

2009	April	1	Thomson's Gazelle	5	10	0	0	15
2009	April	1	Thomson's Gazelle	0	1	0	0	1
2009	April	1	Thomson's Gazelle	2	6	0	0	8
2009	April	1	Thomson's Gazelle	0	2	0	0	2
2009	April	1	Thomson's Gazelle	1	4	0	1	6
2009	April	1	Thomson's Gazelle	2	0	6	0	8
2009	April	1	Thomson's Gazelle	1	3	0	1	5
2009	April	1	Thomson's Gazelle	5	0	0	0	5
2009	April	1	Thomson's Gazelle	0	0	7	0	7
2009	April	1	Thomson's Gazelle	0	0	15	0	15
2009	April	1	Thomson's Gazelle	0	0	8	0	8
2009	April	1	Thomson's Gazelle	1	7	0	0	8
2009	April	1	Thomson's Gazelle	0	7	0	0	7
2009	April	1	Thomson's Gazelle	1	12	0	0	13
2009	April	1	Thomson's Gazelle	0	0	3	0	3
2009	April	1	Thomson's Gazelle	4	10	0	0	14
2009	April	1	Thomson's Gazelle	0	3	0	0	3
2009	April	1	Thomson's Gazelle	0	3	0	0	3
2009	April	1	Thomson's Gazelle	1	11	0	0	12
2009	April	1	Thomson's Gazelle	0	0	4	0	4
2009	April	2	Thomson's Gazelle	3	2	0	0	5
2009	April	2	Thomson's Gazelle	0	16	0	0	16
2009	April	2	Thomson's Gazelle	1	0	0	0	1
2009	April	4	Thomson's Gazelle	0	28	0	0	28
2009	April	4	Thomson's Gazelle	1	1	0	0	2
2009	April	4	Thomson's Gazelle	2	0	0	0	2
2009	April	4	Thomson's Gazelle	9	0	0	0	9
2009	April	4	Thomson's Gazelle	18	0	0	0	18
2009	April	4	Thomson's Gazelle	0	35	0	0	35
2009	April	4	Thomson's Gazelle	0	9	0	0	9
2009	April	4	Thomson's Gazelle	0	5	0	0	5
2009	April	4	Thomson's Gazelle	0	15	0	0	15
2009	April	4	Thomson's Gazelle	0	4	0	0	4
2009	April	6	Thomson's Gazelle	1	0	0	0	1
2009	April	6	Thomson's Gazelle	1	3	0	0	4
2009	April	6	Thomson's Gazelle	1	0	0	0	1
2009	April	6	Thomson's Gazelle	3	0	0	0	3
2009	April	6	Thomson's Gazelle	1	0	0	0	1
2009	April	8	Thomson's Gazelle	1	0	0	0	1
2009	April	8	Thomson's Gazelle	1	9	4	0	14
2009	April	8	Thomson's Gazelle	1	0	0	0	1

2009	April	9	Thomson's Gazelle	0	1	0	0	1
2009	April	9	Thomson's Gazelle	0	3	0	0	3
2009	April	9	Thomson's Gazelle	1	0	0	0	1
2009	April	9	Thomson's Gazelle	0	6	0	2	8
2009	April	9	Thomson's Gazelle	3	1	0	0	4
2009	April	9	Thomson's Gazelle	1	0	0	0	1
2009	April	9	Thomson's Gazelle	2	0	0	0	2
2009	April	9	Thomson's Gazelle	1	3	0	0	4
2009	April	9	Thomson's Gazelle	1	0	0	0	1
2009	April	9	Thomson's Gazelle	1	0	0	0	1
2009	April	9	Thomson's Gazelle	2	0	0	0	2
2009	April	9	Thomson's Gazelle	5	0	0	0	5
2009	April	9	Thomson's Gazelle	1	0	0	0	1
2009	April	9	Thomson's Gazelle	1	0	0	4	5
2009	April	9	Thomson's Gazelle	0	0	0	0	0
2009	April	9	Thomson's Gazelle	1	0	0	0	1
2009	April	9	Thomson's Gazelle	4	2	0	0	6
2009	April	9	Thomson's Gazelle	1	0	0	0	1
2009	April	9	Thomson's Gazelle	0	1	0	0	1
2009	April	9	Thomson's Gazelle	4	0	0	0	4
2009	April	9	Thomson's Gazelle	1	0	0	0	1
2009	April	9	Thomson's Gazelle	1	12	0	2	15
2009	April	10	Thomson's Gazelle	1	5	0	0	6
2009	April	10	Thomson's Gazelle	0	0	9	0	9
2009	April	10	Thomson's Gazelle	0	14	0	0	14
2009	April	10	Thomson's Gazelle	0	2	0	0	2
2009	April	10	Thomson's Gazelle	1	8	0	0	9
2009	April	10	Thomson's Gazelle	1	3	0	0	4
2009	April	10	Thomson's Gazelle	2	0	0	0	2
2009	April	10	Thomson's Gazelle	0	0	1	0	1
2009	April	10	Thomson's Gazelle	0	1	0	0	1
2009	April	10	Thomson's Gazelle	0	0	1	0	1
2009	April	10	Thomson's Gazelle	0	3	0	0	3
2009	April	10	Thomson's Gazelle	1	8	0	0	9
2009	April	10	Thomson's Gazelle	1	7	0	0	8
2009	April	10	Thomson's Gazelle	0	4	0	0	4
2009	April	10	Thomson's Gazelle	0	0	6	0	6
2009	April	10	Thomson's Gazelle	0	0	7	0	7
2009	April	10	Thomson's Gazelle	0	3	0	0	3
2009	April	10	Thomson's Gazelle	0	8	0	0	8
2009	April	10	Thomson's Gazelle	2	0	0	0	2

2009	April	10	Thomson's Gazelle	0	3	0	0	3
2009	April	10	Thomson's Gazelle	0	1	0	0	1
2009	April	10	Thomson's Gazelle	1	0	0	0	1
2009	April	11	Thomson's Gazelle	1	3	0	0	4
2009	April	11	Thomson's Gazelle	0	9	0	0	9
2009	April	11	Thomson's Gazelle	2	0	0	0	2
2009	April	12	Thomson's Gazelle	1	0	0	0	1
2009	April	12	Thomson's Gazelle	8	0	0	0	8
2009	April	12	Thomson's Gazelle	7	17	0	0	24
2009	April	12	Thomson's Gazelle	18	0	0	0	18
2009	April	12	Thomson's Gazelle	2	3	0	1	6
2009	April	12	Thomson's Gazelle	1	0	0	0	1
2009	April	12	Thomson's Gazelle	2	1	0	0	3
2009	April	12	Thomson's Gazelle	1	0	0	0	1
2009	April	12	Thomson's Gazelle	1	0	0	0	1
2009	April	13	Thomson's Gazelle	0	1	7	0	8
2009	April	13	Thomson's Gazelle	0	1	0	0	1
2009	April	13	Thomson's Gazelle	1	0	0	0	1
2009	April	13	Thomson's Gazelle	0	6	0	0	6
2009	April	13	Thomson's Gazelle	0	0	11	0	11
2009	April	13	Thomson's Gazelle	1	3	0	1	5
2009	April	13	Thomson's Gazelle	8	0	0	0	8
2009	April	13	Thomson's Gazelle	0	2	0	0	2
2009	April	13	Thomson's Gazelle	1	1	0	0	2
2009	April	13	Thomson's Gazelle	0	0	2	0	2
2009	April	13	Thomson's Gazelle	1	0	0	0	1
2009	April	13	Thomson's Gazelle	0	1	0	0	1
2009	April	1	Warthog	1	1	0	0	2
2009	April	1	Warthog	0	0	1	0	1
2009	April	1	Warthog	0	0	1	0	1
2009	April	1	Warthog	0	0	4	0	4
2009	April	1	Warthog	0	0	5	0	5
2009	April	1	Warthog	0	0	3	0	3
2009	April	1	Warthog	2	0	0	0	2
2009	April	2	Warthog	1	0	0	0	1
2009	April	4	Warthog	0	1	0	0	1
2009	April	4	Warthog	0	6	0	0	6
2009	April	4	Warthog	1	0	0	0	1
2009	April	4	Warthog	1	0	4	0	5
2009	April	4	Warthog	0	5	0	0	5
2009	April	4	Warthog	0	5	0	0	5

2009	April	4	Warthog	1	0	0	0	1
2009	April	4	Warthog	2	0	0	0	2
2009	April	4	Warthog	1	0	0	0	1
2009	April	4	Warthog	0	3	0	0	3
2009	April	5	Warthog	2	0	0	0	2
2009	April	6	Warthog	0	0	3	0	3
2009	April	6	Warthog	1	1	0	0	2
2009	April	6	Warthog	0	0	1	0	1
2009	April	6	Warthog	0	0	2	0	2
2009	April	7	Warthog	3	0	8	10	21
2009	April	8	Warthog	1	1	0	0	2
2009	April	8	Warthog	5	0	0	0	5
2009	April	8	Warthog	1	3	0	0	4
2009	April	9	Warthog	1	0	0	0	1
2009	April	9	Warthog	0	2	0	0	2
2009	April	9	Warthog	1	0	0	0	1
2009	April	9	Warthog	1	2	0	0	3
2009	April	9	Warthog	1	0	0	0	1
2009	April	9	Warthog	1	0	0	0	1
2009	April	9	Warthog	1	2	0	0	3
2009	April	9	Warthog	1	3	0	0	4
2009	April	9	Warthog	1	1	0	3	5
2009	April	9	Warthog	1	0	0	0	1
2009	April	9	Warthog	0	3	0	0	3
2009	April	9	Warthog	1	0	0	0	1
2009	April	9	Warthog	5	0	0	0	5
2009	April	9	Warthog	0	1	0	2	3
2009	April	9	Warthog	1	3	0	0	4
2009	April	9	Warthog	1	1	0	1	3
2009	April	9	Warthog	1	0	0	0	1
2009	April	9	Warthog	0	3	0	0	3
2009	April	9	Warthog	1	0	0	0	1
2009	April	9	Warthog	0	2	0	0	2
2009	April	9	Warthog	1	1	0	5	7
2009	April	9	Warthog	1	0	0	0	1
2009	April	10	Warthog	0	0	3	0	3
2009	April	10	Warthog	1	1	0	1	3
2009	April	10	Warthog	0	0	2	0	2
2009	April	10	Warthog	1	0	0	0	1
2009	April	10	Warthog	0	0	2	0	2
2009	April	10	Warthog	0	1	2	4	7

2009	April	10	Warthog	0	0	1	0	1
2009	April	10	Warthog	2	0	2	1	5
2009	April	10	Warthog	2	2	0	1	5
2009	April	10	Warthog	1	1	0	5	7
2009	April	10	Warthog	0	0	5	3	8
2009	April	10	Warthog	0	0	3	0	3
2009	April	10	Warthog	0	0	3	0	3
2009	April	10	Warthog	0	0	2	0	2
2009	April	10	Warthog	0	1	0	3	4
2009	April	10	Warthog	0	5	0	0	5
2009	April	10	Warthog	0	0	4	0	4
2009	April	10	Warthog	0	0	7	0	7
2009	April	10	Warthog	0	1	0	3	4
2009	April	10	Warthog	1	1	0	1	3
2009	April	10	Warthog	0	0	1	0	1
2009	April	10	Warthog	0	0	2	0	2
2009	April	10	Warthog	0	0	1	0	1
2009	April	11	Warthog	1	0	0	0	1
2009	April	12	Warthog	3	0	0	0	3
2009	April	12	Warthog	1	3	0	3	7
2009	April	12	Warthog	1	1	0	7	9
2009	April	12	Warthog	1	1	0	0	2
2009	April	12	Warthog	1	0	0	0	1
2009	April	12	Warthog	1	1	0	0	2
2009	April	12	Warthog	1	0	0	0	1
2009	April	12	Warthog	1	0	0	0	1
2009	April	12	Warthog	1	0	0	0	1
2009	April	12	Warthog	1	1	0	0	2
2009	April	13	Warthog	0	0	4	0	4
2009	April	13	Warthog	0	0	1	0	1
2009	April	13	Warthog	0	0	1	0	1
2009	April	13	Warthog	0	0	3	0	3
2009	April	13	Warthog	0	1	0	2	3
2009	April	13	Warthog	0	0	5	3	8
2009	April	13	Warthog	0	1	5	0	6
2009	April	13	Warthog	0	0	3	2	5
2009	April	13	Warthog	0	0	3	0	3
2009	April	13	Warthog	0	0	3	0	3
2009	April	13	Warthog	0	3	0	0	3
2009	April	13	Warthog	0	0	3	0	3
2009	April	13	Warthog	2	0	0	0	2

2009	April	13	Warthog	0	3	0	0	3
2009	April	13	Warthog	0	2	0	1	3
2009	April	13	Warthog	0	0	1	0	1
2009	April	13	Warthog	0	0	1	0	1
2009	April	13	Warthog	0	0	2	0	2
2009	April	1	Waterbuck	2	22	0	0	24
2009	April	1	Waterbuck	1	2	0	0	3
2009	April	1	Waterbuck	1	9	0	0	10
2009	April	1	Waterbuck	1	0	0	0	1
2009	April	1	Waterbuck	3	0	0	0	3
2009	April	1	Waterbuck	0	12	0	0	12
2009	April	1	Waterbuck	0	6	0	0	6
2009	April	1	Waterbuck	1	0	0	0	1
2009	April	1	Waterbuck	1	0	0	0	1
2009	April	1	Waterbuck	1	0	0	0	1
2009	April	2	Waterbuck	0	1	0	0	1
2009	April	2	Waterbuck	2	0	0	0	2
2009	April	9	Waterbuck	0	1	0	0	1
2009	April	10	Waterbuck	1	0	0	0	1
2009	April	11	Waterbuck	1	0	0	0	1
2009	April	12	Waterbuck	4	0	0	0	4
2009	April	12	Waterbuck	2	3	0	0	5
2009	April	12	Waterbuck	2	7	0	0	9
2009	April	12	Waterbuck	1	3	0	0	4
2009	April	12	Waterbuck	1	10	0	0	11
2009	April	12	Waterbuck	1	1	0	0	2
2009	April	12	Waterbuck	4	12	0	0	16
2009	April	12	Waterbuck	1	7	0	0	8
2009	April	12	Waterbuck	1	6	0	0	7
2009	April	12	Waterbuck	1	5	0	0	6
2009	April	12	Waterbuck	4	18	0	0	22
2009	April	12	Waterbuck	2	0	0	0	2
2009	April	12	Waterbuck	1	0	0	0	1
2009	April	13	Waterbuck	1	0	0	0	1
2009	April	13	Waterbuck	1	12	0	0	13
2009	April	13	Waterbuck	1	24	0	1	26
2009	April	13	Waterbuck	0	5	0	0	5
2009	April	13	Waterbuck	1	0	0	0	1
2009	April	13	Waterbuck	4	0	0	0	4
2009	April	13	Waterbuck	1	0	0	0	1
2009	April	13	Waterbuck	0	0	5	0	5

2009	April	13	Waterbuck	3	0	0	0	3
2009	April	13	Waterbuck	0	2	0	0	2
2009	April	13	Waterbuck	0	4	0	0	4
2009	April	13	Waterbuck	1	0	0	0	1
2009	April	13	Waterbuck	1	0	0	0	1
2009	April	4	White Rhino	2	0	0	0	2
2009	April	4	White Rhino	0	1	0	1	2
2009	April	4	White Rhino	1	0	0	0	1
2009	April	8	White Rhino	1	0	0	0	1
2009	April	12	White Rhino	1	0	0	0	1
2009	April	12	White Rhino	0	1	0	1	2
2009	April	13	White Rhino	0	0	1	0	1
2009	April	13	White Rhino	0	0	1	0	1
2009	April	1	Zebra	20	75	0	5	100
2009	April	1	Zebra	0	0	3	0	3
2009	April	1	Zebra	0	0	5	0	5
2009	April	1	Zebra	1	0	0	0	1
2009	April	1	Zebra	0	0	55	0	55
2009	April	1	Zebra	0	0	15	0	15
2009	April	1	Zebra	0	0	24	0	24
2009	April	1	Zebra	2	6	0	2	10
2009	April	1	Zebra	0	0	25	0	25
2009	April	1	Zebra	0	0	17	0	17
2009	April	1	Zebra	0	0	8	0	8
2009	April	1	Zebra	0	0	29	0	29
2009	April	1	Zebra	0	0	8	0	8
2009	April	1	Zebra	0	0	7	2	9
2009	April	1	Zebra	1	4	0	0	5
2009	April	2	Zebra	10	6	0	0	16
2009	April	2	Zebra	0	6	0	0	6
2009	April	2	Zebra	0	0	9	0	9
2009	April	4	Zebra	0	0	5	3	8
2009	April	4	Zebra	0	28	0	0	28
2009	April	4	Zebra	0	5	0	0	5
2009	April	4	Zebra	0	0	18	0	18
2009	April	4	Zebra	0	0	7	0	7
2009	April	4	Zebra	0	0	2	0	2
2009	April	4	Zebra	2	0	0	0	2
2009	April	6	Zebra	0	3	0	0	3
2009	April	8	Zebra	6	23	0	3	32
2009	April	8	Zebra	1	3	0	1	5

2009	April	8	Zebra	0	0	32	1	33
2009	April	8	Zebra	0	0	21	0	21
2009	April	8	Zebra	2	4	0	0	6
2009	April	8	Zebra	0	0	24	0	24
2009	April	9	Zebra	1	4	0	1	6
2009	April	9	Zebra	1	4	0	1	6
2009	April	9	Zebra	1	3	0	1	5
2009	April	9	Zebra	1	0	0	0	1
2009	April	9	Zebra	2	5	0	0	7
2009	April	9	Zebra	2	5	0	0	7
2009	April	9	Zebra	0	0	5	0	5
2009	April	9	Zebra	0	0	5	0	5
2009	April	9	Zebra	1	4	0	2	7
2009	April	9	Zebra	1	5	0	1	7
2009	April	9	Zebra	2	5	0	0	7
2009	April	9	Zebra	1	8	0	1	10
2009	April	9	Zebra	1	2	0	0	3
2009	April	9	Zebra	0	1	0	0	1
2009	April	9	Zebra	1	0	0	0	1
2009	April	9	Zebra	1	0	0	0	1
2009	April	9	Zebra	0	0	6	0	6
2009	April	9	Zebra	1	7	0	0	8
2009	April	9	Zebra	1	3	0	1	5
2009	April	9	Zebra	0	3	0	0	3
2009	April	9	Zebra	1	0	0	0	1
2009	April	9	Zebra	1	0	0	0	1
2009	April	10	Zebra	0	0	2	0	2
2009	April	10	Zebra	0	0	20	0	20
2009	April	10	Zebra	0	0	8	0	8
2009	April	10	Zebra	0	0	3	0	3
2009	April	10	Zebra	0	0	34	0	34
2009	April	10	Zebra	0	0	4	0	4
2009	April	10	Zebra	0	0	4	0	4
2009	April	10	Zebra	0	0	19	0	19
2009	April	10	Zebra	0	0	14	0	14
2009	April	10	Zebra	0	0	4	0	4
2009	April	10	Zebra	0	0	2	1	3
2009	April	10	Zebra	0	0	19	0	19
2009	April	10	Zebra	0	0	6	0	6
2009	April	10	Zebra	0	0	6	0	6
2009	April	10	Zebra	0	0	6	0	6

2009	April	10	Zebra	0	0	22	0	22
2009	April	10	Zebra	0	0	31	0	31
2009	April	10	Zebra	0	0	11	0	11
2009	April	10	Zebra	0	0	3	0	3
2009	April	10	Zebra	0	0	6	0	6
2009	April	10	Zebra	0	0	6	0	6
2009	April	10	Zebra	0	0	40	0	40
2009	April	10	Zebra	0	0	4	0	4
2009	April	11	Zebra	1	3	0	1	5
2009	April	11	Zebra	12	18	0	1	31
2009	April	11	Zebra	5	13	0	0	18
2009	April	11	Zebra	3	0	0	0	3
2009	April	11	Zebra	1	2	0	0	3
2009	April	11	Zebra	0	0	7	2	9
2009	April	12	Zebra	7	14	0	1	22
2009	April	12	Zebra	0	0	34	0	34
2009	April	12	Zebra	0	0	96	0	96
2009	April	12	Zebra	3	4	0	0	7
2009	April	12	Zebra	1	13	0	0	14
2009	April	12	Zebra	5	14	0	1	20
2009	April	12	Zebra	2	0	0	0	2
2009	April	12	Zebra	0	1	11	0	12
2009	April	13	Zebra	0	2	0	1	3
2009	April	13	Zebra	0	0	14	4	18
2009	April	13	Zebra	0	0	55	7	62
2009	April	13	Zebra	1	4	0	0	5
2009	April	13	Zebra	1	0	0	0	1
2009	November	13	Buffalo	2	0	0	0	2
2009	November	13	Buffalo	1	0	0	0	1
2009	November	13	Waterbuck	1	6	0	0	7
2009	November	13	Impala	0	1	0	0	1
2009	November	13	Hippopotamus	0	0	1	0	1
2009	November	13	Buffalo	1	0	0	0	1
2009	November	13	Black rhino	1	0	0	0	1
2009	November	13	Buffalo	1	0	0	0	1
2009	November	13	Buffalo	0	0	3	0	3
2009	November	13	Buffalo	0	0	34	3	37
2009	November	13	Buffalo	0	1	0	1	2
2009	November	13	Buffalo	0	0	203	7	210
2009	November	13	Buffalo	1	2	0	0	3
2009	November	13	Zebra	0	0	3	0	3

2009	November	13	Zebra	0	0	3	1	4
2009	November	13	Buffalo	0	0	15	0	15
2009	November	13	Buffalo	0	0	2	0	2
2009	November	13	Impala	1	0	0	0	1
2009	November	13	Zebra	0	0	4	0	4
2009	November	13	Impala	0	0	28	0	28
2009	November	13	Impala	0	0	19	0	19
2009	November	13	Warthog	1	0	0	0	1
2009	November	13	Grant's Gazelle	0	0	10	2	12
2009	November	13	Waterbuck	0	0	21	0	21
2009	November	13	Warthog	0	0	5	0	5
2009	November	13	Eland	2	3	0	3	8
2009	November	13	Zebra	0	0	8	0	8
2009	November	13	Waterbuck	1	0	27	0	28
2009	November	13	Thomson's Gazelle	1	0	0	0	1
2009	November	13	Waterbuck	3	0	7	0	10
2009	November	13	Impala	1	0	0	0	1
2009	November	13	Warthog	0	0	7	0	7
2009	November	13	Thomson's Gazelle	2	4	0	0	6
2009	November	13	Waterbuck	2	31	0	0	33
2009	November	13	Impala	1	0	0	0	1
2009	November	13	Zebra	0	0	18	2	20
2009	November	13	Warthog	1	0	0	0	1
2009	November	13	Waterbuck	0	3	0	0	3
2009	November	13	Zebra	0	0	106	0	106
2009	November	13	Buffalo	0	0	315	54	369
2009	November	13	Zebra	0	0	63	0	63
2009	November	13	Warthog	0	0	11	0	11
2009	November	13	Eland	2	7	0	0	9
2009	November	13	Buffalo	1	0	0	0	1
2009	November	13	Impala	0	0	8	0	8
2009	November	13	Thomson's Gazelle	0	0	6	0	6
2009	November	13	Buffalo	0	0	6	0	6
2009	November	13	Warthog	3	0	4	0	7
2009	November	13	Buffalo	0	0	2	0	2
2009	November	13	Impala	1	3	0	0	4
2009	November	13	Impala	1	1	0	1	3
2009	November	13	Buffalo	1	1	0	0	2
2009	November	13	Buffalo	0	0	7	3	10
2009	November	13	Impala	0	0	34	0	34
2009	November	13	Warthog	0	0	6	0	6

2009	November	13	Buffalo	0	0	2	0	2
2009	November	13	Warthog	0	0	2	0	2
2009	November	13	Warthog	0	1	3	0	4
2009	November	13	Buffalo	0	0	10	0	10
2009	November	13	Buffalo	0	0	51	0	51
2009	November	13	Warthog	0	0	8	0	8
2009	November	13	Buffalo	1	0	0	0	1
2009	November	13	Warthog	1	0	0	0	1
2009	November	13	Buffalo	1	0	0	0	1
2009	November	13	Waterbuck	1	3	0	0	4
2009	November	13	Buffalo	0	0	16	0	16
2009	November	13	Zebra	0	0	5	0	5
2009	November	13	Warthog	0	1	0	0	1
2009	November	13	Zebra	0	0	3	0	3
2009	November	13	Impala	1	0	0	0	1
2009	November	13	Warthog	2	3	0	2	7
2009	November	13	Impala	0	2	18	0	20
2009	November	13	Waterbuck	0	1	8	0	9
2009	November	13	Warthog	0	0	2	0	2
2009	November	13	Black rhino	0	1	0	1	2
2009	November	13	Warthog	0	0	2	0	2
2009	November	13	Impala	1	38	0	10	49
2009	November	13	Warthog	2	2	0	0	4
2009	November	13	Warthog	0	0	3	0	3
2009	November	13	Impala	1	0	0	0	1
2009	November	13	Warthog	1	0	0	0	1
2009	November	13	Waterbuck	1	0	0	0	1
2009	November	13	Buffalo	7	0	0	0	7
2009	November	13	Buffalo	2	0	0	0	2
2009	November	13	Hippopotamus	0	0	5	0	5
2009	November	13	Waterbuck	0	1	0	0	1
2009	November	13	Zebra	0	0	37	0	37
2009	November	13	Buffalo	0	0	2	0	2
2009	November	13	Waterbuck	0	0	2	0	2
2009	November	13	Buffalo	0	0	3	0	3
2009	November	13	Waterbuck	0	0	4	0	4
2009	November	13	Impala	1	1	0	0	2
2009	November	13	Impala	7	0	0	0	7
2009	November	13	Warthog	0	0	7	1	8
2009	November	13	Impala	1	0	42	3	46
2009	November	13	Thomson's Gazelle	1	0	0	0	1

2009	November	13	Waterbuck	1	0	0	0	1
2009	November	13	Buffalo	3	0	0	0	3
2009	November	13	Buffalo	1	0	0	0	1
2009	November	13	Waterbuck	0	0	4	0	4
2009	November	13	Zebra	0	2	0	0	2
2009	November	13	Warthog	0	2	0	0	2
2009	November	9	Buffalo	3	0	0	0	3
2009	November	9	Buffalo	4	0	0	0	4
2009	November	9	Waterbuck	1	0	0	0	1
2009	November	9	Impala	1	0	0	0	1
2009	November	9	Buffalo	5	0	8	0	13
2009	November	9	Buffalo	9	0	0	0	9
2009	November	9	Warthog	0	0	3	0	3
2009	November	9	Impala	5	0	0	0	5
2009	November	9	Thomson's Gazelle	0	0	2	0	2
2009	November	9	Impala	2	0	0	0	2
2009	November	9	Thomson's Gazelle	2	6	0	2	10
2009	November	9	Grant's Gazelle	1	7	2	1	11
2009	November	9	Buffalo	3	0	0	0	3
2009	November	9	Buffalo	4	4	0	1	9
2009	November	9	Impala	1	26	0	6	33
2009	November	9	Warthog	0	1	0	3	4
2009	November	9	Thomson's Gazelle	4	6	5	2	17
2009	November	9	Impala	1	0	0	0	1
2009	November	9	Thomson's Gazelle	3	8	10	4	25
2009	November	9	Buffalo	4	4	0	0	8
2009	November	9	Impala	1	32	0	10	43
2009	November	9	Buffalo	2	0	0	0	2
2009	November	9	Impala	2	0	0	0	2
2009	November	9	Warthog	1	0	0	0	1
2009	November	9	Thomson's Gazelle	6	12	20	10	48
2009	November	9	Zebra	2	22	4	3	31
2009	November	9	Buffalo	2	0	0	0	2
2009	November	9	Buffalo	12	6	24	4	46
2009	November	9	Warthog	1	3	0	0	4
2009	November	9	Thomson's Gazelle	0	0	20	2	22
2009	November	9	Buffalo	0	2	0	1	3
2009	November	9	Eland	5	12	0	0	17
2009	November	9	Warthog	0	1	0	4	5
2009	November	9	Impala	10	0	0	0	10
2009	November	9	Thomson's Gazelle	4	10	8	0	22

2009	November	9	Buffalo	0	12	0	0	12
2009	November	9	Eland	3	10	2	7	22
2009	November	9	Zebra	0	0	23	4	27
2009	November	9	Grant's Gazelle	0	0	10	0	10
2009	November	9	Impala	1	23	0	6	30
2009	November	9	Warthog	2	0	0	0	2
2009	November	9	Thomson's Gazelle	2	4	6	1	13
2009	November	9	Zebra	5	14	0	6	25
2009	November	9	Zebra	0	0	18	0	18
2009	November	9	Buffalo	1	0	0	0	1
2009	November	9	Zebra	5	11	0	2	18
2009	November	9	Thomson's Gazelle	0	0	10	0	10
2009	November	9	Buffalo	5	0	0	0	5
2009	November	9	Eland	1	0	0	0	1
2009	November	9	Thomson's Gazelle	0	0	7	0	7
2009	November	9	Buffalo	2	0	0	0	2
2009	November	9	Zebra	0	0	2	0	2
2009	November	9	Grant's Gazelle	2	8	4	0	14
2009	November	9	Zebra	0	4	16	1	21
2009	November	9	Impala	2	0	0	0	2
2009	November	9	Zebra	0	0	16	0	16
2009	November	9	Impala	1	10	0	0	11
2009	November	9	Buffalo	10	0	0	0	10
2009	November	9	Warthog	1	0	0	0	1
2009	November	9	Impala	1	40	0	12	53
2009	November	9	Buffalo	10	0	0	0	10
2009	November	9	Warthog	1	0	0	0	1
2009	November	9	Waterbuck	1	0	0	0	1
2009	November	9	Buffalo	9	0	0	0	9
2009	November	9	Giraffe	6	12	0	0	18
2009	November	9	Impala	17	0	0	0	17
2009	November	9	Impala	1	17	0	11	29
2009	November	9	Buffalo	12	0	22	0	34
2009	November	9	Warthog	0	0	8	0	8
2009	November	9	Grant's Gazelle	0	0	11	0	11
2009	November	9	Thomson's Gazelle	0	0	15	0	15
2009	November	9	Black rhino	0	1	0	1	2
2009	November	9	Warthog	0	0	6	0	6
2009	November	9	Buffalo	5	0	0	0	5
2009	November	9	Eland	1	0	0	0	1
2009	November	9	Zebra	0	0	37	0	37

2009	November	9	Zebra	2	13	0	0	15
2009	November	9	Impala	1	6	0	0	7
2009	November	9	Grant's Gazelle	4	6	2	2	14
2009	November	9	Impala	15	0	0	0	15
2009	November	9	Zebra	2	10	0	2	14
2009	November	9	Grant's Gazelle	1	5	0	0	6
2009	November	9	Impala	8	0	0	0	8
2009	November	9	Zebra	0	0	13	0	13
2009	November	9	Black rhino	1	0	0	0	1
2009	November	9	Buffalo	6	20	31	8	65
2009	November	9	White Rhino	1	1	0	1	3
2009	November	10	White Rhino	1	0	0	0	1
2009	November	10	Thomson's Gazelle	0	0	5	0	5
2009	November	10	Black rhino	1	0	0	0	1
2009	November	10	White Rhino	1	0	0	0	1
2009	November	10	Buffalo	2	0	0	0	2
2009	November	10	Warthog	0	0	2	0	2
2009	November	10	Buffalo	5	0	0	0	5
2009	November	10	Thomson's Gazelle	1	0	0	0	1
2009	November	10	Thomson's Gazelle	0	3	0	0	3
2009	November	10	Warthog	1	1	0	3	5
2009	November	10	Thomson's Gazelle	0	0	29	0	29
2009	November	10	Thomson's Gazelle	0	0	4	0	4
2009	November	10	Warthog	2	0	0	0	2
2009	November	10	Impala	1	0	0	0	1
2009	November	10	Buffalo	1	0	0	0	1
2009	November	10	Thomson's Gazelle	0	0	2	0	2
2009	November	10	Grant's Gazelle	2	6	0	0	8
2009	November	10	Warthog	0	0	1	1	2
2009	November	10	Thomson's Gazelle	1	25	0	0	26
2009	November	10	Impala	1	0	0	0	1
2009	November	10	Impala	1	0	0	0	1
2009	November	10	Thomson's Gazelle	0	0	37	2	39
2009	November	10	Buffalo	6	0	0	0	6
2009	November	10	Warthog	1	1	0	0	2
2009	November	10	Zebra	0	4	0	0	4
2009	November	10	Buffalo	7	0	0	0	7
2009	November	10	Buffalo	3	30	0	5	38
2009	November	10	White Rhino	0	1	0	1	2
2009	November	10	Thomson's Gazelle	0	0	5	0	5
2009	November	10	Warthog	1	2	0	1	4

2009	November	10	Buffalo	6	60	0	12	78
2009	November	10	Buffalo	0	2	0	1	3
2009	November	10	Buffalo	0	15	0	7	22
2009	November	10	Warthog	1	3	0	0	4
2009	November	10	White Rhino	1	1	0	1	3
2009	November	10	Black rhino	1	0	0	0	1
2009	November	10	Zebra	0	0	8	0	8
2009	November	10	Warthog	2	0	0	0	2
2009	November	10	Impala	1	28	0	4	33
2009	November	10	Thomson's Gazelle	2	3	0	0	5
2009	November	10	Impala	0	5	0	0	5
2009	November	10	Zebra	0	0	8	0	8
2009	November	10	Impala	1	2	0	0	3
2009	November	10	White Rhino	0	1	0	1	2
2009	November	10	Buffalo	0	40	0	14	54
2009	November	10	Impala	0	5	0	0	5
2009	November	10	Impala	1	38	0	6	45
2009	November	10	Grant's Gazelle	0	6	0	1	7
2009	November	10	Buffalo	0	73	0	7	80
2009	November	10	Warthog	1	2	0	0	3
2009	November	10	Black rhino	1	0	0	0	1
2009	November	10	Thomson's Gazelle	1	14	0	0	15
2009	November	10	Impala	4	0	0	0	4
2009	November	10	Impala	3	21	0	3	27
2009	November	10	Impala	16	0	0	0	16
2009	November	10	Buffalo	0	38	0	1	39
2009	November	10	Zebra	0	4	0	0	4
2009	November	10	Zebra	0	12	0	0	12
2009	November	10	Black rhino	0	1	0	0	1
2009	November	10	Buffalo	0	3	0	0	3
2009	November	10	Thomson's Gazelle	0	4	0	0	4
2009	November	10	Buffalo	4	0	0	0	4
2009	November	8	Eland	1	0	0	0	1
2009	November	8	Impala	1	0	0	0	1
2009	November	8	Impala	1	0	0	0	1
2009	November	8	Impala	20	0	0	0	20
2009	November	8	Zebra	0	0	10	2	12
2009	November	8	Impala	0	2	0	0	2
2009	November	8	Zebra	0	0	23	3	26
2009	November	8	Impala	1	0	0	0	1
2009	November	8	Buffalo	9	0	39	12	60

2009	November	8	Impala	5	0	0	0	5
2009	November	8	Zebra	1	2	0	2	5
2009	November	8	Impala	6	0	0	0	6
2009	November	8	Zebra	0	0	9	3	12
2009	November	8	Zebra	4	4	0	3	11
2009	November	8	Zebra	2	3	0	2	7
2009	November	8	Buffalo	12	24	17	7	60
2009	November	8	Zebra	4	0	0	0	4
2009	November	8	Buffalo	0	0	18	8	26
2009	November	8	Impala	1	0	0	0	1
2009	November	8	Grant's Gazelle	1	2	0	0	3
2009	November	8	Thomson's Gazelle	1	1	0	0	2
2009	November	8	Impala	8	0	0	0	8
2009	November	8	Zebra	0	0	16	3	19
2009	November	8	Buffalo	7	9	0	2	18
2009	November	8	Impala	12	0	0	0	12
2009	November	8	Impala	1	0	0	0	1
2009	November	8	Zebra	1	1	0	1	3
2009	November	8	Buffalo	5	0	0	0	5
2009	November	8	Impala	6	0	0	0	6
2009	November	8	Grant's Gazelle	1	17	0	0	18
2009	November	8	Impala	1	56	0	8	65
2009	November	8	Impala	1	0	0	0	1
2009	November	8	Impala	6	0	0	0	6
2009	November	8	Impala	1	32	0	2	35
2009	November	8	Warthog	1	0	0	0	1
2009	November	8	Impala	2	0	0	0	2
2009	November	8	Impala	16	0	0	0	16
2009	November	8	Buffalo	0	6	0	3	9
2009	November	8	Grant's Gazelle	1	0	0	0	1
2009	November	8	Waterbuck	1	0	0	0	1
2009	November	8	Impala	16	0	0	0	16
2009	November	8	Impala	1	50	0	22	73
2009	November	8	Zebra	0	0	15	1	16
2009	November	8	Zebra	1	0	5	1	7
2009	November	8	Impala	10	0	0	0	10
2009	November	8	Impala	1	60	0	11	72
2009	November	8	Impala	12	0	0	0	12
2009	November	8	Buffalo	0	8	1	0	9
2009	November	8	Buffalo	0	9	1	0	10
2009	November	8	Impala	4	0	0	0	4

2009	November	8	Thomson's Gazelle	0	2	0	1	3
2009	November	8	Impala	1	58	0	6	65
2009	November	8	Zebra	0	0	6	0	6
2009	November	8	Zebra	0	0	9	0	9
2009	November	8	Zebra	0	0	10	0	10
2009	November	8	Grant's Gazelle	0	12	0	0	12
2009	November	8	Impala	8	0	0	0	8
2009	November	8	Thomson's Gazelle	1	0	0	0	1
2009	November	8	Grant's Gazelle	0	0	9	1	10
2009	November	8	Thomson's Gazelle	0	0	8	0	8
2009	November	8	Warthog	0	0	4	0	4
2009	November	8	Impala	1	0	0	0	1
2009	November	8	Impala	2	0	0	0	2
2009	November	8	Grant's Gazelle	0	2	0	0	2
2009	November	8	Buffalo	1	0	0	0	1
2009	November	8	Grant's Gazelle	0	3	0	0	3
2009	November	8	Impala	1	25	0	4	30
2009	November	8	Zebra	0	0	10	0	10
2009	November	8	Buffalo	19	31	138	12	200
2009	November	8	Impala	1	64	0	17	82
2009	November	8	Impala	7	0	0	0	7
2009	November	8	Impala	1	3	0	0	4
2009	November	8	Warthog	0	0	3	1	4
2009	November	8	Leopard	0	1	0	0	1
2009	November	8	Waterbuck	0	1	0	1	2
2009	November	8	Impala	1	0	0	0	1
2009	November	8	Impala	1	46	0	13	60
2009	November	8	Zebra	0	0	4	0	4
2009	November	8	Impala	8	0	0	0	8
2009	November	8	Impala	10	0	0	0	10
2009	November	8	Eland	2	0	0	0	2
2009	November	8	Warthog	1	1	0	0	2
2009	November	8	Waterbuck	0	6	0	0	6
2009	November	8	Impala	1	7	0	2	10
2009	November	8	Impala	1	0	0	0	1
2009	November	8	Buffalo	0	0	60	9	69
2009	November	8	Grant's Gazelle	1	0	0	0	1
2009	November	8	Thomson's Gazelle	0	0	2	0	2
2009	November	8	Buffalo	1	0	0	0	1
2009	November	8	Zebra	0	0	2	0	2
2009	November	8	Impala	0	0	1	0	1

2009	November	8	White Rhino	1	0	0	0	1
2009	November	8	Zebra	2	3	0	0	5
2009	November	11	Buffalo	5	0	0	0	5
2009	November	11	Impala	1	0	0	0	1
2009	November	11	Zebra	0	0	2	0	2
2009	November	11	Waterbuck	1	1	0	0	2
2009	November	11	Impala	1	30	0	5	36
2009	November	11	Buffalo	6	0	0	0	6
2009	November	11	Zebra	1	8	0	4	13
2009	November	11	Hippopotamus	1	0	0	0	1
2009	November	11	Impala	2	0	0	0	2
2009	November	11	Buffalo	0	19	0	6	25
2009	November	11	Zebra	4	0	0	0	4
2009	November	11	Buffalo	0	28	0	14	42
2009	November	11	Waterbuck	1	0	0	0	1
2009	November	11	Impala	0	1	0	1	2
2009	November	11	Impala	1	30	0	7	38
2009	November	11	Grant's Gazelle	1	1	0	0	2
2009	November	11	Impala	10	0	0	0	10
2009	November	11	Zebra	0	0	0	7	7
2009	November	11	Warthog	1	0	0	0	1
2009	November	11	Zebra	0	0	14	0	14
2009	November	11	Impala	1	0	0	0	1
2009	November	11	Waterbuck	1	0	0	0	1
2009	November	11	Impala	1	30	0	5	36
2009	November	11	Grant's Gazelle	1	0	0	0	1
2009	November	11	Buffalo	3	0	0	0	3
2009	November	11	Buffalo	0	12	0	3	15
2009	November	11	Zebra	4	0	0	0	4
2009	November	11	Impala	1	32	0	8	41
2009	November	11	Buffalo	0	0	19	2	21
2009	November	11	Impala	2	0	0	0	2
2009	November	11	Eland	1	0	0	0	1
2009	November	11	Thomson's Gazelle	1	2	0	0	3
2009	November	11	Waterbuck	1	0	0	0	1
2009	November	11	Buffalo	2	0	0	0	2
2009	November	11	Zebra	0	0	8	0	8
2009	November	11	Zebra	4	11	0	0	15
2009	November	11	Zebra	1	3	0	2	6
2009	November	11	Zebra	0	0	17	0	17
2009	November	11	Buffalo	0	0	60	15	75

2009	November	11	Impala	1	0	0	0	1
2009	November	11	Impala	0	0	3	0	3
2009	November	12	Buffalo	0	0	12	5	17
2009	November	12	Warthog	1	1	0	0	2
2009	November	12	Buffalo	1	0	0	0	1
2009	November	12	Impala	1	0	0	0	1
2009	November	12	Buffalo	2	0	0	0	2
2009	November	12	Zebra	2	3	0	0	5
2009	November	12	Impala	1	9	0	0	10
2009	November	12	Warthog	1	0	0	0	1
2009	November	12	Impala	1	0	0	0	1
2009	November	12	Warthog	0	2	0	0	2
2009	November	12	Zebra	5	10	0	0	15
2009	November	12	Zebra	0	0	14	0	14
2009	November	12	Impala	0	3	0	0	3
2009	November	12	Waterbuck	1	0	0	0	1
2009	November	12	Buffalo	1	0	0	1	2
2009	November	12	Waterbuck	1	11	0	0	12
2009	November	12	Black rhino	0	0	1	0	1
2009	November	12	Waterbuck	0	4	0	0	4
2009	November	12	Buffalo	2	0	0	0	2
2009	November	12	Warthog	1	0	0	0	1
2009	November	12	Buffalo	2	0	0	0	2
2009	November	12	Waterbuck	1	0	0	0	1
2009	November	12	Buffalo	0	0	150	20	170
2009	November	12	Buffalo	2	0	0	0	2
2009	November	12	Waterbuck	1	0	0	0	1
2009	November	12	Buffalo	0	0	70	0	70
2009	November	12	Buffalo	0	0	20	0	20
2009	November	12	Waterbuck	0	4	0	0	4
2009	November	12	Warthog	0	2	0	0	2
2009	November	12	Waterbuck	4	17	0	5	26
2009	November	12	Buffalo	5	0	0	0	5
2009	November	12	Impala	1	16	0	2	19
2009	November	12	Buffalo	16	0	0	0	16
2009	November	12	Waterbuck	0	1	1	0	2
2009	November	12	Buffalo	16	0	0	0	16
2009	November	12	Warthog	1	2	0	2	5
2009	November	12	Thomson's Gazelle	1	0	0	0	1
2009	November	12	Zebra	0	2	0	0	2
2009	November	12	White Rhino	0	2	0	0	2

2009	November	12	Buffalo	5	0	0	0	5
2009	November	12	White Rhino	1	0	0	0	1
2009	November	12	Zebra	0	0	3	0	3
2009	November	12	Buffalo	1	0	0	0	1
2009	November	12	Impala	0	6	0	0	6
2009	November	12	Zebra	2	0	0	0	2
2009	November	12	Buffalo	1	4	0	1	6
2009	November	12	Zebra	0	0	10	0	10
2009	November	12	Zebra	5	10	8	0	23
2009	November	12	Grant's Gazelle	8	0	0	0	8
2009	November	12	Zebra	0	0	9	0	9
2009	November	12	Warthog	0	0	5	0	5
2009	November	12	Thomson's Gazelle	5	0	0	0	5
2009	November	7	Impala	1	37	0	12	50
2009	November	7	Buffalo	1	0	0	0	1
2009	November	7	Eland	1	0	0	0	1
2009	November	7	Impala	3	0	0	0	3
2009	November	7	Eland	3	9	0	4	16
2009	November	7	Waterbuck	1	0	0	0	1
2009	November	7	Impala	10	30	0	0	40
2009	November	7	Buffalo	50	10	0	0	60
2009	November	7	Zebra	5	3	2	0	10
2009	November	7	Eland	3	15	0	7	25
2009	November	7	Impala	3	0	0	0	3
2009	November	7	Buffalo	30	23	0	12	65
2009	November	7	Grant's Gazelle	7	3	0	0	10
2009	November	7	Impala	0	12	0	0	12
2009	November	7	Warthog	2	3	0	2	7
2009	November	7	Buffalo	15	15	0	8	38
2009	November	7	Impala	2	25	0	10	37
2009	November	7	Giraffe	0	2	0	2	4
2009	November	7	Warthog	0	0	3	0	3
2009	November	7	Impala	4	0	0	4	8
2009	November	7	Grant's Gazelle	3	0	0	2	5
2009	November	7	Zebra	0	0	5	1	6
2009	November	7	Buffalo	2	0	0	0	2
2009	November	7	Impala	2	0	0	0	2
2009	November	7	Buffalo	6	0	0	0	6
2009	November	7	Impala	3	30	0	10	43
2009	November	7	Impala	1	0	0	0	1
2009	November	7	Impala	2	40	0	5	47

2009	November	7	Buffalo	4	0	0	0	4
2009	November	7	Buffalo	10	3	0	0	13
2009	November	7	Zebra	0	0	5	2	7
2009	November	7	Impala	17	0	0	0	17
2009	November	7	Buffalo	12	4	0	4	20
2009	November	7	Zebra	0	2	0	1	3
2009	November	7	Buffalo	4	0	0	0	4
2009	November	7	Impala	2	30	0	5	37
2009	November	7	Impala	1	0	0	0	1
2009	November	7	Impala	0	7	0	0	7
2009	November	7	Zebra	0	0	11	4	15
2009	November	7	Waterbuck	3	12	0	0	15
2009	November	7	Impala	1	25	0	10	36
2009	November	7	Eland	1	0	0	0	1
2009	November	7	Buffalo	3	0	0	0	3
2009	November	7	Impala	1	0	0	0	1
2009	November	7	Zebra	0	0	1	0	1
2009	November	7	Buffalo	15	8	0	0	23
2009	November	7	Eland	1	0	0	0	1
2009	November	7	Impala	1	0	0	0	1
2009	November	7	Impala	1	0	0	0	1
2009	November	6	Thomson's Gazelle	3	0	0	0	3
2009	November	6	Impala	29	0	0	0	29
2009	November	6	Zebra	2	2	0	0	4
2009	November	6	Giraffe	1	0	0	0	1
2009	November	6	Grant's Gazelle	1	0	0	0	1
2009	November	6	Buffalo	8	9	0	3	20
2009	November	6	Buffalo	2	12	0	3	17
2009	November	6	Buffalo	2	0	0	0	2
2009	November	6	Impala	1	10	0	0	11
2009	November	6	Grant's Gazelle	0	3	0	0	3
2009	November	6	Buffalo	4	0	0	0	4
2009	November	6	Grant's Gazelle	4	6	0	0	10
2009	November	6	Impala	10	0	0	0	10
2009	November	6	Warthog	0	3	0	0	3
2009	November	6	Thomson's Gazelle	1	2	0	0	3
2009	November	6	Grant's Gazelle	0	1	0	1	2
2009	November	6	Zebra	7	0	0	0	7
2009	November	6	Impala	14	25	0	0	39
2009	November	6	Grant's Gazelle	4	14	0	0	18
2009	November	6	Thomson's Gazelle	1	12	0	0	13

2009	November	6	Buffalo	4	15	0	0	19
2009	November	6	Thomson's Gazelle	5	15	0	0	20
2009	November	6	Impala	2	12	0	0	14
2009	November	6	Giraffe	1	0	0	0	1
2009	November	6	Impala	1	27	0	6	34
2009	November	6	Impala	1	15	0	2	18
2009	November	6	Warthog	2	2	0	2	6
2009	November	6	Buffalo	3	0	0	0	3
2009	November	6	Lion	1	3	0	2	6
2009	November	6	Warthog	3	6	0	2	11
2009	November	6	Zebra	4	4	0	1	9
2009	November	6	Giraffe	1	0	0	0	1
2009	November	6	Waterbuck	1	0	0	0	1
2009	November	6	Impala	16	19	0	0	35
2009	November	6	Warthog	5	1	0	2	8
2009	November	5	Impala	25	10	0	0	35
2009	November	5	Impala	0	11	0	0	11
2009	November	5	Buffalo	3	0	0	0	3
2009	November	5	Buffalo	3	0	0	0	3
2009	November	5	Warthog	0	0	2	0	2
2009	November	5	Impala	10	0	0	0	10
2009	November	5	Impala	1	13	0	0	14
2009	November	5	Impala	1	0	0	0	1
2009	November	5	Impala	1	14	0	0	15
2009	November	5	Impala	1	0	0	0	1
2009	November	5	Waterbuck	0	1	0	0	1
2009	November	5	Impala	1	0	0	0	1
2009	November	5	Waterbuck	0	1	0	0	1
2009	November	5	Impala	1	6	0	2	9
2009	November	5	Lion	2	0	0	0	2
2009	November	5	Impala	1	0	0	0	1
2009	November	4	Buffalo	3	0	0	0	3
2009	November	4	Grant's Gazelle	1	5	0	0	6
2009	November	4	Thomson's Gazelle	2	8	0	0	10
2009	November	4	Grant's Gazelle	0	3	0	1	4
2009	November	4	Warthog	1	1	0	1	3
2009	November	4	Hyena	0	0	4	0	4
2009	November	4	Impala	1	0	0	0	1
2009	November	4	Thomson's Gazelle	3	7	0	1	11
2009	November	4	Thomson's Gazelle	0	2	0	0	2
2009	November	4	Grant's Gazelle	4	0	0	1	5

2009	November	4	Thomson's Gazelle	2	0	0	0	2
2009	November	4	Grant's Gazelle	1	1	0	0	2
2009	November	4	Thomson's Gazelle	6	0	0	0	6
2009	November	4	Impala	1	19	0	0	20
2009	November	4	White Rhino	1	0	0	0	1
2009	November	4	Thomson's Gazelle	2	7	0	0	9
2009	November	4	Warthog	1	0	0	6	7
2009	November	4	Impala	2	0	0	0	2
2009	November	4	Thomson's Gazelle	1	11	0	4	16
2009	November	4	Thomson's Gazelle	0	0	0	10	10
2009	November	4	Thomson's Gazelle	3	8	0	0	11
2009	November	4	Grant's Gazelle	1	3	0	0	4
2009	November	4	Impala	3	0	0	2	5
2009	November	4	Warthog	0	1	0	0	1
2009	November	4	Impala	2	0	0	0	2
2009	November	4	Zebra	0	0	4	0	4
2009	November	4	Impala	41	0	0	0	41
2009	November	4	Impala	1	20	0	0	21
2009	November	4	Giraffe	0	0	1	0	1
2009	November	4	Impala	2	0	0	0	2
2009	November	4	Black rhino	0	0	1	0	1
2009	November	4	Buffalo	3	0	0	0	3
2009	November	4	Impala	1	39	7	0	47
2009	November	4	Thomson's Gazelle	0	0	3	0	3
2009	November	4	Buffalo	8	0	0	0	8
2009	November	4	Impala	4	0	0	0	4
2009	November	3	Grant's Gazelle	1	0	0	1	2
2009	November	3	Buffalo	2	0	0	0	2
2009	November	3	Buffalo	5	2	0	0	7
2009	November	3	Impala	0	7	0	0	7
2009	November	3	Grant's Gazelle	1	15	0	0	16
2009	November	3	Warthog	2	0	0	0	2
2009	November	3	Waterbuck	2	0	0	0	2
2009	November	3	Grant's Gazelle	1	31	0	0	32
2009	November	3	Warthog	0	0	3	0	3
2009	November	3	Giraffe	5	3	0	1	9
2009	November	3	Grant's Gazelle	1	19	0	1	21
2009	November	3	Grant's Gazelle	1	0	0	0	1
2009	November	3	Buffalo	0	0	0	0	0
2009	November	3	Buffalo	0	0	0	0	0
2009	November	3	Grant's Gazelle	0	4	0	0	4

2009	November	3	Warthog	1	1	0	2	4
2009	November	3	Giraffe	12	3	0	0	15
2009	November	3	Impala	1	27	0	4	32
2009	November	3	Grant's Gazelle	2	0	0	0	2
2009	November	3	Warthog	1	0	0	0	1
2009	November	3	Giraffe	3	0	0	0	3
2009	November	3	Hyena	0	1	0	1	2
2009	November	3	Impala	2	2	0	0	4
2009	November	3	Giraffe	1	0	0	0	1
2009	November	3	Grant's Gazelle	1	2	0	0	3
2009	November	3	Grant's Gazelle	0	12	0	1	13
2009	November	3	Impala	1	2	0	0	3
2009	November	3	Impala	12	0	0	0	12
2009	November	3	Buffalo	7	0	0	0	7
2009	November	2	Hyena	0	0	2	0	2
2009	November	2	Eland	1	1	0	0	2
2009	November	2	Impala	1	15	0	0	16
2009	November	2	Impala	1	6	0	0	7
2009	November	2	Impala	20	0	0	0	20
2009	November	2	Waterbuck	2	0	0	0	2
2009	November	2	Warthog	0	0	2	0	2
2009	November	2	Impala	1	50	0	10	61
2009	November	2	Black rhino	1	0	0	0	1
2009	November	2	Buffalo	4	0	0	0	4
2009	November	2	Thomson's Gazelle	2	0	0	0	2
2009	November	2	Grant's Gazelle	0	3	0	0	3
2009	November	2	Buffalo	3	0	1	0	4
2009	November	2	Warthog	0	1	0	0	1
2009	November	2	Buffalo	5	0	0	0	5
2009	November	1	Buffalo	2	0	0	0	2
2009	November	1	Thomson's Gazelle	1	0	2	1	4
2009	November	1	Buffalo	0	0	0	0	0
2009	November	1	Warthog	0	1	0	3	4
2009	November	1	Buffalo	1	0	0	0	1
2009	November	1	Zebra	11	0	0	3	14
2009	November	1	Zebra	0	0	9	0	9
2009	November	1	Buffalo	15	0	0	0	15
2009	November	1	Impala	2	1	0	0	3
2009	November	1	Warthog	1	0	0	0	1
2009	November	1	Zebra	8	0	0	0	8
2009	November	1	Thomson's Gazelle	0	1	98	0	99

2009	November	1	Zebra	0	0	0	14	14
2009	November	1	Impala	2	0	0	0	2
2009	November	1	Thomson's Gazelle	0	0	21	0	21
2009	November	1	Buffalo	0	0	419	111	530
2009	November	1	Warthog	1	1	0	0	2
2009	November	1	Buffalo	0	0	54	0	54
2009	November	1	Warthog	1	0	0	0	1
2009	November	1	Buffalo	0	0	28	7	35
2009	November	1	Hippopotamus	0	0	1	0	1
2009	November	1	Thomson's Gazelle	1	21	0	1	23
2009	November	1	Grant's Gazelle	0	0	13	0	13
2009	November	1	Zebra	0	0	3	0	3
2009	November	1	Impala	2	22	0	0	24
2009	November	1	Zebra	0	0	11	0	11
2009	November	1	Waterbuck	0	4	0	0	4
2009	November	1	Buffalo	4	0	0	0	4
2009	November	1	Impala	1	5	0	0	6
2009	November	1	Thomson's Gazelle	1	2	0	0	3
2009	November	1	Impala	1	1	0	0	2
2009	November	1	Thomson's Gazelle	1	4	0	0	5
2009	November	1	Impala	1	8	0	0	9
2009	November	1	Buffalo	1	6	0	0	7
2009	November	1	Waterbuck	1	14	0	0	15
2009	November	1	Thomson's Gazelle	1	0	0	0	1
2009	November	1	Impala	1	0	16	0	17
2009	November	1	Buffalo	15	2	0	1	18
2009	November	1	Waterbuck	6	15	1	0	22
2009	November	1	Impala	7	16	0	0	23
2009	November	1	Zebra	1	11	0	0	12
2009	November	1	Impala	2	0	0	0	2
2009	November	1	Warthog	1	0	8	0	9
2009	November	1	Thomson's Gazelle	3	22	0	0	25
2009	November	1	White Rhino	0	12	0	2	14
2009	November	1	Thomson's Gazelle	1	53	0	0	54
2009	November	1	Hyena	0	0	7	1	8
2009	November	1	Impala	11	1	0	0	12
2009	November	1	Thomson's Gazelle	3	0	0	0	3
2009	November	1	Zebra	4	0	0	0	4
2009	November	1	Impala	30	118	10	11	169
2009	November	1	Thomson's Gazelle	1	9	0	0	10
2009	November	1	Zebra	0	2	19	0	21

2009	November	1	Buffalo	13	3	55	5	76
2009	November	12	Buffalo	0	0	70	22	92
2009	November	12	Zebra	0	0	56	0	56
2009	November	12	Black rhino	0	0	1	0	1
2009	November	4	Impala	1	23	0	0	24
2009	November	4	Grant's Gazelle	1	7	0	0	8
2009	November	4	Buffalo	3	7	0	1	11
2009	November	4	Giraffe	1	0	0	0	1
2009	November	4	Impala	1	18	0	0	19
2009	November	4	Giraffe	4	11	0	0	15
2009	November	4	Buffalo	1	0	0	0	1
2009	November	4	Warthog	1	2	0	2	5
2009	November	4	Giraffe	1	7	0	1	9
2009	November	4	Impala	24	0	0	0	24
2009	November	4	Giraffe	2	0	0	0	2
2009	November	4	Buffalo	0	0	0	6	6
2009	November	4	Impala	1	45	0	15	61
2018	May	1	Hyena	1	3	0	1	5
2018	May	1	Zebra	0	0	44	2	46
2018	May	1	Waterbuck	0	4	0	0	4
2018	May	1	Zebra	1	5	0	1	7
2018	May	1	Impala	0	15	0	0	15
2018	May	1	Impala	1	16	0	0	17
2018	May	1	Impala	1	9	0	1	11
2018	May	1	Warthog	1	0	0	0	1
2018	May	1	Impala	1	33	0	0	34
2018	May	1	Waterbuck	1	7	0	0	8
2018	May	1	Zebra	3	25	0	2	30
2018	May	1	Impala	20	0	0	0	20
2018	May	1	Warthog	2	0	0	0	2
2018	May	1	Warthog	1	0	0	0	1
2018	May	1	Impala	2	0	0	0	2
2018	May	1	Warthog	1	0	0	0	1
2018	May	1	Buffalo	2	0	0	0	2
2018	May	1	Impala	9	0	0	0	9
2018	May	1	Impala	11	0	0	0	11
2018	May	1	Thomson's Gazelle	1	1	0	1	3
2018	May	1	Impala	1	0	0	0	1
2018	May	1	Impala	2	2	2	0	6
2018	May	1	Impala	1	30	0	0	31
2018	May	1	Waterbuck	10	40	0	0	50

2018	May	1	Thomson's Gazelle	0	2	0	0	2
2018	May	1	Warthog	0	9	0	8	17
2018	May	1	Thomson's Gazelle	1	2	0	1	4
2018	May	1	Warthog	0	0	5	0	5
2018	May	1	Thomson's Gazelle	1	8	0	2	11
2018	May	1	Impala	1	35	0	6	42
2018	May	1	Impala	6	0	0	0	6
2018	May	1	Grant's Gazelle	0	3	0	0	3
2018	May	1	Thomson's Gazelle	0	25	0	0	25
2018	May	1	Zebra	0	5	0	1	6
2018	May	1	Thomson's Gazelle	1	8	0	0	9
2018	May	1	Buffalo	0	0	45	6	51
2018	May	1	Zebra	0	0	4	0	4
2018	May	1	Buffalo	0	0	20	0	20
2018	May	2	Impala	1	1	0	1	3
2018	May	2	Zebra	6	0	0	0	6
2018	May	2	Impala	1	20	0	0	21
2018	May	2	Impala	1	28	0	0	29
2018	May	2	Giraffe	0	3	0	1	4
2018	May	2	Impala	1	37	0	5	43
2018	May	2	Giraffe	1	4	1	2	8
2018	May	2	Warthog	0	0	1	0	1
2018	May	2	Zebra	0	0	70	5	75
2018	May	2	Giraffe	0	0	6	0	6
2018	May	2	Impala	0	0	1	0	1
2018	May	2	Zebra	0	0	4	0	4
2018	May	2	Buffalo	0	0	1	0	1
2018	May	2	Giraffe	0	0	1	0	1
2018	May	2	Waterbuck	0	0	3	0	3
2018	May	2	Warthog	0	0	1	0	1
2018	May	2	Warthog	0	0	1	0	1
2018	May	2	Buffalo	5	183	0	12	200
2018	May	2	Impala	0	0	1	0	1
2018	May	2	Impala	0	0	1	0	1
2018	May	2	Giraffe	0	0	4	0	4
2018	May	2	Warthog	0	0	3	0	3
2018	May	2	Zebra	0	0	4	0	4
2018	May	3	Impala	0	1	0	0	1
2018	May	3	Impala	3	0	0	0	3
2018	May	3	Zebra	3	3	0	0	6
2018	May	3	Impala	1	49	0	12	62

2018	May	3	Giraffe	3	6	4	1	14
2018	May	3	Impala	1	20	0	4	25
2018	May	3	Impala	1	0	0	0	1
2018	May	3	Buffalo	0	0	350	0	350
2018	May	3	Warthog	0	0	2	0	2
2018	May	3	Impala	1	0	0	0	1
2018	May	3	Buffalo	8	0	0	0	8
2018	May	3	Impala	1	0	0	0	1
2018	May	3	Giraffe	0	0	10	0	10
2018	May	3	Buffalo	30	80	20	20	150
2018	May	4	Waterbuck	1	2	0	0	3
2018	May	4	Hyena	0	1	0	0	1
2018	May	4	Buffalo	1	0	0	0	1
2018	May	4	Impala	1	0	0	0	1
2018	May	4	Buffalo	3	0	0	0	3
2018	May	4	Impala	1	1	0	1	3
2018	May	4	Buffalo	4	0	0	0	4
2018	May	4	Hyena	0	0	1	0	1
2018	May	4	Impala	1	0	0	0	1
2018	May	4	Warthog	0	0	4	0	4
2018	May	4	Grant's Gazelle	1	0	0	0	1
2018	May	4	Zebra	0	0	2	0	2
2018	May	4	Eland	1	0	0	0	1
2018	May	4	Buffalo	0	0	211	15	226
2018	May	4	Impala	24	0	0	0	24
2018	May	4	Giraffe	5	7	0	4	16
2018	May	4	Impala	13	0	0	0	13
2018	May	4	Zebra	2	0	0	0	2
2018	May	4	Impala	1	40	0	6	47
2018	May	4	Zebra	1	1	0	0	2
2018	May	4	Thomson's Gazelle	1	6	0	1	8
2018	May	4	Waterbuck	2	0	0	0	2
2018	May	4	Buffalo	5	0	0	0	5
2018	May	5	Impala	4	20	0	0	24
2018	May	5	Impala	1	11	0	0	12
2018	May	5	Impala	7	0	0	0	7
2018	May	5	Impala	0	13	0	0	13
2018	May	5	Impala	0	4	0	0	4
2018	May	5	Leopard	1	0	0	0	1
2018	May	5	Impala	0	4	0	0	4
2018	May	5	Impala	0	37	0	0	37

2018	May	5	Impala	0	9	0	8	17
2018	May	5	Giraffe	0	0	2	0	2
2018	May	6	Impala	1	0	0	0	1
2018	May	6	Buffalo	9	0	0	0	9
2018	May	6	Zebra	0	0	14	2	16
2018	May	6	Zebra	0	0	107	2	109
2018	May	6	Impala	13	0	0	0	13
2018	May	6	Zebra	0	0	13	0	13
2018	May	6	Buffalo	4	0	0	0	4
2018	May	6	Zebra	0	0	7	0	7
2018	May	6	Waterbuck	1	11	0	0	12
2018	May	6	Grant's Gazelle	2	0	0	1	3
2018	May	6	Impala	3	0	0	0	3
2018	May	6	Thomson's Gazelle	0	0	9	0	9
2018	May	6	Impala	4	0	0	0	4
2018	May	6	Grant's Gazelle	1	9	0	0	10
2018	May	6	Thomson's Gazelle	0	0	12	0	12
2018	May	6	Zebra	0	0	19	0	19
2018	May	6	Thomson's Gazelle	1	32	0	1	34
2018	May	6	Impala	1	0	0	0	1
2018	May	6	Black rhino	1	0	0	0	1
2018	May	6	Warthog	0	0	1	0	1
2018	May	6	Buffalo	0	0	34	0	34
2018	May	7	Impala	1	33	0	0	34
2018	May	7	Impala	1	0	0	0	1
2018	May	7	Impala	3	0	0	0	3
2018	May	7	Zebra	20	9	0	5	34
2018	May	7	Zebra	1	6	0	0	7
2018	May	7	Impala	1	14	0	0	15
2018	May	7	Buffalo	2	0	0	0	2
2018	May	7	Grant's Gazelle	2	0	0	0	2
2018	May	7	Buffalo	6	0	0	1	7
2018	May	7	Zebra	2	2	0	0	4
2018	May	7	Impala	1	19	0	0	20
2018	May	7	Impala	2	1	0	0	3
2018	May	7	Warthog	14	3	0	0	17
2018	May	7	Waterbuck	1	2	0	1	4
2018	May	7	Impala	23	0	0	0	23
2018	May	7	Warthog	1	0	0	0	1
2018	May	7	Eland	1	15	0	1	17
2018	May	7	Thomson's Gazelle	1	8	0	1	10

2018	May	7	Zebra	2	8	0	0	10
2018	May	7	Buffalo	13	120	0	30	163
2018	May	7	Impala	3	0	0	0	3
2018	May	7	Zebra	2	28	0	0	30
2018	May	7	Giraffe	0	0	3	0	3
2018	May	7	Impala	1	33	0	1	35
2018	May	7	Impala	1	8	0	0	9
2018	May	7	Impala	11	22	0	0	33
2018	May	7	Impala	5	35	0	0	40
2018	May	7	Impala	17	6	0	0	23
2018	May	7	Waterbuck	0	1	0	0	1
2018	May	8	Giraffe	0	5	3	3	11
2018	May	8	Zebra	1	2	0	0	3
2018	May	8	Impala	2	3	0	0	5
2018	May	8	Giraffe	0	0	11	0	11
2018	May	8	Black rhino	2	0	0	0	2
2018	May	8	Buffalo	7	10	67	12	96
2018	May	8	Grant's Gazelle	0	0	33	0	33
2018	May	8	Impala	0	8	0	0	8
2018	May	8	Thomson's Gazelle	0	0	1	0	1
2018	May	8	Giraffe	0	0	1	0	1
2018	May	8	Hyena	0	0	1	0	1
2018	May	8	Impala	1	26	0	0	27
2018	May	8	Giraffe	1	0	0	0	1
2018	May	8	Zebra	3	2	25	4	34
2018	May	8	Zebra	0	0	5	1	6
2018	May	8	Buffalo	0	0	110	0	110
2018	May	8	Impala	1	0	0	0	1
2018	May	8	Buffalo	1	0	0	0	1
2018	May	8	Impala	1	0	0	0	1
2018	May	8	Buffalo	2	1	0	0	3
2018	May	8	Warthog	0	0	6	3	9
2018	May	8	Grant's Gazelle	0	2	0	0	2
2018	May	8	Buffalo	16	0	0	0	16
2018	May	8	Zebra	0	0	5	0	5
2018	May	8	Buffalo	19	0	0	0	19
2018	May	8	Zebra	0	0	51	0	51
2018	May	8	Buffalo	11	0	0	0	11
2018	May	8	Warthog	0	2	0	6	8
2018	May	8	Impala	1	0	0	0	1
2018	May	8	Impala	0	8	0	0	8

2018	May	8	Zebra	0	0	10	0	10
2018	May	8	Thomson's Gazelle	1	0	0	0	1
2018	May	9	Zebra	0	0	4	0	4
2018	May	9	Impala	0	1	0	1	2
2018	May	9	Zebra	0	0	27	0	27
2018	May	9	Impala	1	25	0	0	26
2018	May	9	Thomson's Gazelle	1	1	0	0	2
2018	May	9	Grant's Gazelle	4	20	0	0	24
2018	May	9	Warthog	1	1	0	0	2
2018	May	9	Grant's Gazelle	2	9	0	0	11
2018	May	9	Zebra	0	0	78	0	78
2018	May	9	Impala	1	0	0	0	1
2018	May	9	Grant's Gazelle	3	13	0	0	16
2018	May	9	Warthog	0	0	3	0	3
2018	May	9	Buffalo	12	0	0	0	12
2018	May	9	Warthog	1	1	0	0	2
2018	May	9	Impala	4	0	0	0	4
2018	May	9	Warthog	1	0	0	0	1
2018	May	9	Hyena	0	0	1	0	1
2018	May	9	Warthog	0	0	3	0	3
2018	May	9	Warthog	0	0	4	0	4
2018	May	9	Thomson's Gazelle	1	3	0	0	4
2018	May	9	Thomson's Gazelle	0	0	6	0	6
2018	May	9	Impala	1	5	0	1	7
2018	May	9	Warthog	0	0	3	0	3
2018	May	9	Buffalo	0	0	75	0	75
2018	May	9	Zebra	3	4	0	0	7
2018	May	9	Thomson's Gazelle	1	25	0	0	26
2018	May	9	Warthog	0	0	9	1	10
2018	May	9	Impala	12	0	0	0	12
2018	May	9	Thomson's Gazelle	1	10	0	0	11
2018	May	9	Grant's Gazelle	6	25	0	0	31
2018	May	9	Thomson's Gazelle	1	20	0	4	25
2018	May	9	Eland	5	26	0	1	32
2018	May	9	Warthog	0	0	14	0	14
2018	May	9	Impala	42	0	0	0	42
2018	May	9	Warthog	3	8	0	5	16
2018	May	9	Zebra	0	0	1	0	1
2018	May	9	Thomson's Gazelle	6	30	0	0	36
2018	May	9	Buffalo	3	0	0	0	3
2018	May	9	Eland	0	0	5	0	5

2018	May	9	Thomson's Gazelle	1	3	0	0	4
2018	May	9	Thomson's Gazelle	9	0	0	0	9
2018	May	9	Impala	1	40	0	10	51
2018	May	9	Warthog	1	1	0	2	4
2018	May	9	Grant's Gazelle	0	7	0	0	7
2018	May	9	Impala	1	0	0	0	1
2018	May	9	Warthog	2	2	0	5	9
2018	May	9	Buffalo	0	0	220	0	220
2018	May	9	Zebra	2	3	0	0	5
2018	May	9	Zebra	1	0	0	0	1
2018	May	9	Grant's Gazelle	1	11	0	0	12
2018	May	9	Buffalo	0	0	127	0	127
2018	May	9	Zebra	2	5	0	0	7
2018	May	9	Warthog	1	1	0	6	8
2018	May	9	Impala	1	0	0	0	1
2018	May	9	Lion	0	3	0	0	3
2018	May	9	Impala	1	15	0	1	17
2018	May	9	Eland	2	0	0	0	2
2018	May	10	Impala	1	0	0	0	1
2018	May	10	Thomson's Gazelle	0	0	30	0	30
2018	May	10	Buffalo	4	0	0	0	4
2018	May	10	Zebra	2	2	0	2	6
2018	May	10	White Rhino	0	0	4	1	5
2018	May	10	Impala	45	0	0	0	45
2018	May	10	Thomson's Gazelle	0	0	1	0	1
2018	May	10	Warthog	0	0	3	0	3
2018	May	10	Impala	1	20	0	0	21
2018	May	10	Thomson's Gazelle	4	0	0	0	4
2018	May	10	Impala	1	0	3	0	4
2018	May	10	Zebra	0	0	25	0	25
2018	May	10	Buffalo	3	0	0	0	3
2018	May	10	Eland	1	1	0	0	2
2018	May	10	Buffalo	0	0	47	0	47
2018	May	10	Warthog	0	1	0	2	3
2018	May	10	Zebra	2	4	0	1	7
2018	May	10	Zebra	4	4	10	4	22
2018	May	10	Zebra	2	10	0	2	14
2018	May	10	Zebra	3	9	0	2	14
2018	May	10	Zebra	2	6	0	2	10
2018	May	10	Zebra	3	0	0	0	3
2018	May	10	Zebra	3	4	0	1	8

2018	May	10	Zebra	7	18	0	2	27
2018	May	10	Zebra	3	5	0	1	9
2018	May	10	Zebra	0	1	0	0	1
2018	May	10	Zebra	4	13	0	3	20
2018	May	10	Zebra	3	15	0	8	26
2018	May	10	Waterbuck	0	0	20	0	20
2018	May	10	Hyena	1	3	0	0	4
2018	May	10	Leopard	1	0	0	0	1
2018	May	10	Warthog	0	1	0	0	1
2018	May	10	Waterbuck	1	0	0	0	1
2018	May	10	Waterbuck	2	2	0	0	4
2018	May	10	Zebra	2	0	5	0	7
2018	May	10	Impala	1	15	0	1	17
2018	May	10	Warthog	1	0	0	0	1
2018	May	10	Zebra	1	9	0	0	10
2018	May	10	Impala	1	0	0	0	1
2018	May	10	Impala	1	9	0	0	10
2018	May	10	Waterbuck	0	21	0	0	21
2018	May	10	Warthog	1	0	2	0	3
2018	May	10	Warthog	5	0	5	0	10
2018	May	10	Buffalo	0	0	55	10	65
2018	May	10	Zebra	0	0	25	0	25
2018	May	10	Zebra	0	0	10	0	10
2018	May	10	Warthog	0	0	2	0	2
2018	May	10	Grant's Gazelle	1	1	0	1	3
2018	May	10	Thomson's Gazelle	1	6	0	0	7
2018	May	10	Impala	11	0	0	0	11
2018	May	10	Thomson's Gazelle	2	0	0	0	2
2018	May	10	Impala	1	15	0	1	17
2018	May	10	Warthog	0	1	0	0	1
2018	May	10	Waterbuck	1	3	0	0	4
2018	May	10	Impala	1	13	0	0	14
2018	May	10	Zebra	0	0	6	0	6
2018	May	10	Waterbuck	1	6	0	3	10
2018	May	10	Impala	1	15	0	3	19
2018	May	10	White Rhino	1	1	0	0	2
2018	May	11	Buffalo	2	0	0	0	2
2018	May	11	Buffalo	2	0	0	0	2
2018	May	11	Zebra	0	0	5	0	5
2018	May	11	Buffalo	8	0	0	0	8
2018	May	11	Impala	2	0	0	0	2

2018	May	11	Impala	1	20	0	0	21
2018	May	11	Impala	1	18	0	0	19
2018	May	11	Impala	11	0	0	0	11
2018	May	11	Impala	4	0	0	0	4
2018	May	11	Black rhino	1	0	0	0	1
2018	May	11	Eland	1	1	0	0	2
2018	May	11	Impala	1	0	0	0	1
2018	May	11	Buffalo	7	30	0	5	42
2018	May	12	Buffalo	1	0	0	0	1
2018	May	12	Black rhino	0	1	0	1	2
2018	May	12	Lion	2	0	0	0	2
2018	May	12	Waterbuck	1	0	0	0	1
2018	May	12	Buffalo	0	0	82	18	100
2018	May	12	Buffalo	2	0	0	0	2
2018	May	12	White Rhino	0	2	3	2	7
2018	May	12	Waterbuck	2	0	0	0	2
2018	May	12	Buffalo	0	0	85	0	85
2018	May	12	Zebra	0	0	10	0	10
2018	May	12	Grant's Gazelle	0	0	14	0	14
2018	May	12	Waterbuck	2	10	0	1	13
2018	May	12	Warthog	0	2	0	0	2
2018	May	12	Buffalo	2	0	0	0	2
2018	May	12	Buffalo	16	0	0	0	16
2018	May	12	Waterbuck	1	0	0	0	1
2018	May	12	Eland	1	0	0	0	1
2018	May	12	Buffalo	4	0	0	0	4
2018	May	12	Buffalo	2	0	0	0	2
2018	May	12	Buffalo	3	0	0	0	3
2018	May	12	Impala	1	6	0	1	8
2018	May	12	Buffalo	4	0	0	0	4
2018	May	12	Buffalo	0	0	210	0	210
2018	May	12	Buffalo	2	0	0	0	2
2018	May	12	Waterbuck	0	3	0	0	3
2018	May	13	Buffalo	0	0	6	0	6
2018	May	13	Waterbuck	0	8	0	0	8
2018	May	13	Impala	1	24	0	0	25
2018	May	13	Impala	0	1	0	0	1
2018	May	13	Zebra	0	0	8	0	8
2018	May	13	Impala	15	0	0	0	15
2018	May	13	Zebra	0	0	8	0	8
2018	May	13	Warthog	0	0	4	0	4

2018	May	13	Buffalo	5	0	0	0	5
2018	May	13	Waterbuck	0	2	0	0	2
2018	May	13	Zebra	0	0	98	2	100
2018	May	13	Impala	0	1	0	0	1
2018	May	13	Zebra	0	0	4	3	7
2018	May	13	Impala	0	18	0	0	18
2018	May	13	Zebra	0	0	25	2	27
2018	May	13	Impala	1	25	0	0	26
2018	May	13	Warthog	0	0	1	0	1
2018	May	13	Warthog	1	2	0	0	3
2018	May	13	Buffalo	2	0	0	0	2
2018	May	13	Warthog	0	0	5	0	5
2018	May	13	Buffalo	0	0	8	0	8
2018	May	13	Waterbuck	1	0	0	0	1
2018	May	13	Impala	1	1	0	0	2
2018	May	13	Impala	5	14	0	0	19
2018	May	13	Thomson's Gazelle	0	0	4	0	4
2018	May	13	Impala	2	3	0	1	6
2018	May	13	Impala	0	29	0	1	30
2018	May	13	Thomson's Gazelle	0	0	11	0	11
2018	May	13	Impala	3	1	0	0	4
2018	May	13	Black rhino	1	0	0	0	1
2018	May	13	Buffalo	0	0	150	0	150
2018	May	13	Grant's Gazelle	0	0	16	0	16
2018	May	13	Impala	1	0	0	0	1
2018	May	13	Warthog	0	0	5	0	5
2018	May	13	Impala	1	1	0	1	3
2018	May	13	Thomson's Gazelle	0	0	2	0	2
2018	May	13	White Rhino	0	0	1	0	1
2018	May	13	Buffalo	2	0	0	0	2
2018	May	13	Impala	0	5	0	0	5
2018	May	13	Impala	10	0	0	0	10
2018	May	13	Buffalo	0	0	82	0	82
2018	May	13	Waterbuck	3	0	0	0	3
2018	May	13	Impala	0	0	26	0	26
2018	May	13	Zebra	0	0	3	0	3
2018	May	13	Impala	2	0	0	0	2
2018	May	13	Waterbuck	4	0	0	0	4
2018	May	13	Warthog	1	0	0	0	1
2018	May	13	Zebra	0	0	8	0	8
2018	May	13	Impala	1	10	0	0	11

2018	May	13	Waterbuck	2	0	0	0	2
2018	May	13	Warthog	1	1	0	2	4