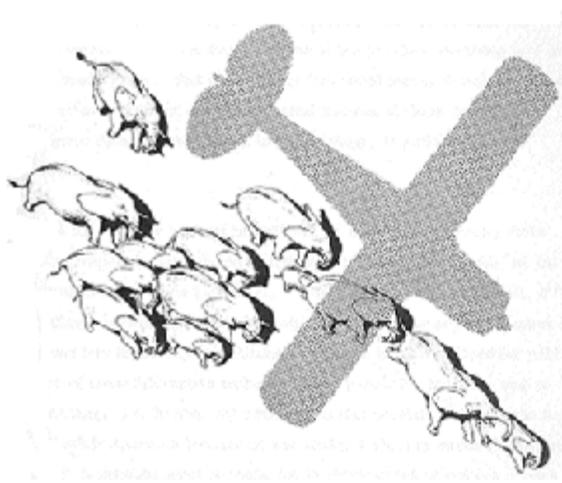


AERIAL TOTAL COUNT

AMBOSELI - WEST KILIMANJARO AND MAGADI-NATRON CROSS BORDER LANDSCAPE

WET SEASON, MARCH 2010



Conducted by

**KENYA WILDLIFE SERVICE AND TANZANIA
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DIVISION**



WILDLIFE DIVISION

EXECUTIVE SUMMARY

The Amboseli-West Kilimanjaro/Magadi – Natron cross- border landscape, as referred to in this report, comprises various ecologically important areas in Kenya and Tanzania. On the Kenyan side it includes Amboseli National Park and the surrounding group ranches, the southern part of Kajiado district from Namanga to Magadi and Nguruman. On the Tanzanian side, the ecosystem covers Natron and West Kilimanjaro areas. Although this broad cross-border landscape is a very significant area for wildlife conservation, it has seldom been considered in its entirety as a conservation unit. Consequently past aerial censuses and other studies have been confined to smaller areas (e.g. Amboseli National Park and West Kilimanjaro), leading to a partial understanding of wildlife interrelations in the area. In addition, there has been no recent census to determine wildlife and domestic animal numbers and their distribution in the whole region. This census report therefore forms an initial attempt of covering the Amboseli- West Kilimanjaro landscape as a unit. Further, this census provides important means to evaluate the impact of the recent 2008/2009 prolonged drought, on both wildlife and livestock in the landscape. The drought led to substantial mortalities among some of the species, particularly the grazers (wildebeest, zebra, buffalo and cattle).

A total aerial count of wildlife species, livestock and human activities in Amboseli-Namanga and Magadi areas in Kenya, and West Kilimanjaro and Natron areas in Tanzania was conducted from 1st to 6th March, 2010. This was a joint cross-border exercise between Kenya Wildlife Service (KWS) and Tanzania Wildlife Research Institute (TAWIRI), with additional support from African Wildlife Foundation (AWF), Amboseli Trust for Elephants (ATE) and other stakeholders. The census covered 24,108 km² area including 8,797 km² of the Amboseli ecosystem and 5,513 km² of the Namanga-Magadi areas in south-western Kenya together with 3,014 km² of the West Kilimanjaro and 7,047 km² of the Natron areas in North Tanzania.

During the survey, 25 wild mammalian and 2 avian species were counted. It is recognized that by the very nature of aerial total counts, numbers counted are quite likely to be underestimates. Therefore, adhering to the FSO tallies, Zebra with a population of approximately 13,740 individuals was the most numerous wild species in the entire survey area followed by Grant's gazelle (8,362), common wildebeest (7,240), Maasai giraffe (4,164), Eland (1,992), Maasai ostrich (1,461), African elephant (1,420), Impala (1,317), Thomson's gazelle (933) and Coke's hartebeest (441). Livestock species recorded included sheep and goats (230,048), cattle (100,433), donkey (2,258) and camel (762). There were four main elephant cluster areas in: Chyulu; Amboseli-West Kilimanjaro area, east of Lake Natron and Magadi-Nguruman area. In the Amboseli area, the elephant population has been relatively stable, with 1,087 individuals counted in the year 2000; 1,090 in 2002 and 967 in 2007 compared

to the current population of 1,266. There was a dramatic decline in the number of large herbivore species between the years 2007 and 2010: wildebeest declined by about 83% from 18,538 to 3,098; zebra declined by about 71% from 15,328 to 4,432; and buffalo declined by about 61% from 588 to 231 in the Amboseli area. Livestock similarly declined in the Amboseli area with data from comparable blocks in 2007 and 2010 censuses showing a reduction of 56% and 62% in cattle and shoat estimates. These declines can be attributed to the severe drought that occurred between 2007 and 2009.

Wildlife was widely distributed in the entire survey area. This can be explained by the fact that the land use has largely remained pastoral, allowing relative coexistence between livestock and wildlife. While pastoralism was the main form of land use in the survey area, the presence of crop cultivation in key wildlife habitats such as the wetlands is of concern to the future of the area for wildlife conservation.

Crop cultivation and other forms of development in the area threaten to block wildlife movement routes. For instance, wildlife movements into and out of Kimana Sanctuary in the Amboseli region and in the Kitenden area between Kenya and Tanzania is disrupted. Proliferation of charcoal burning poses serious concerns, as most mature trees which are key browse forage and nesting sites are targeted; this was notable in the Mailua, Meto, Osilalei, Elangata Wuas and Kaputiei areas and in Kimana Group Ranch.

This survey underlies the need for a landscape approach in conservation planning in the Amboseli- West Kilimanjaro/Magadi- Natron cross- border ecological area. While Amboseli National Park remains a crucial wildlife refuge, the associated wildlife disperses into the adjacent areas, especially the slopes of Chyulu hills and Natron areas. We recommend that future wildlife studies/surveys should focus in assisting wildlife managers to better understand the large-scale wildlife movement dynamics in this landscape. This survey shows the key cross border wildlife dispersal areas and highlights gaps in our understanding of the interactions among the migratory species (elephants, wildebeest and zebra), that use Magadi, Natron, West Kilimanjaro and Amboseli areas. The survey further identifies some human activities which are possible threat to wildlife conservation within the survey area. Addressing these specific threats will be important for maintaining the future viability of the landscape as a wildlife dispersal area.

Acronyms

ATE	Amboseli Trust for Elephants
AWF	African Wildlife Foundation
CRCA	Central Rift Conservation Area
ECA	Eastern Conservation Area
FSO	Front Seat Observer
GCA	Game Controlled Area
GIS	Geographic Information Systems
GPS	Global Positioning System
KWS	Kenya Wildlife Service
NP	National Park
RSO	Rear Seat Observer
SCA	Southern Conservation Area
SRF	Systematic Reconnaissance Flight
TANAPA	Tanzania National Parks
TC	Total Count
TCA	Tsavo Conservation Area
CIMU	Conservation Information and Monitoring Unit
TWCM	Tanzania Wildlife Conservation Monitoring
TAWIRI	Tanzania Wildlife Research Institute
SARDEP	Semi & Arid Development Programme
SNV	Netherlands Development Organization
WD	Wildlife Division

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INTRODUCTION

The Amboseli-Kilimanjaro/ Magadi –Natron cross-border landscape, as referred to in this report, comprises various protected and non-protected areas of grasslands, bushed and wooded grasslands in Kenya and Tanzania. It also comprises two ecologically linked cross-boarder ecosystems: The Amboseli- West Kilimanjaro ecosystem to the east, and the Magadi-Natron ecosystem to the west. They are roughly divided by a geological complex of basement hills and step-faults that make up the eastern wall of the Kenya-Tanzania portion of the East African Rift Valley. The Amboseli-West Kilimanjaro ecosystem in Kenya includes Amboseli National Park and the surrounding group ranches that define the Ilkisongo ecozone portion of Kajiado district from the Kajiado-Namanga road east to the Chyulu Hills. In Tanzania, it encompasses the West Kilimanjaro area as far south as Mount Meru Forest Reserve. The Magadi-Natron ecosystem, as the name implies, comprises the regions around Lake Magadi and Nguruman in Kenya and those east and southeast of Lake Natron in Tanzania.

The Amboseli-Kilimanjaro/ Magadi –Natron landscape has been well studied over the past 40 years. The northern part of the survey area is extensively studied (Western 1973; Western & Van Praet 1973; Lindsay 1994; Kikoti 2009). Most of these studies have, however, focused on smaller portions of the linked ecosystems, mainly confined within national administrative boundaries in the two countries. Consequently, the wider picture of the Amboseli-Kilimanjaro/ Magadi –Natron cross-border ecological area in terms of wildlife population monitoring has not been adequately captured. With increasing knowledge of animal movements within this landscape and observations of fluctuating animal numbers within each country, it has become necessary to have a broader survey that studies the whole ecosystem as a unit.

There have been a number of aerial surveys conducted in different parts of these linked ecosystem, with spatial, temporal and design differences. These differences are attributed to differences in the objectives of the surveys between individual researchers in the area and differences in the survey methodologies used between the two countries. The present survey is the first one covering the larger portion of the Amboseli-Kilimanjaro/ Magadi –Natron cross-border ecological area and used a common methodology of total count. A similar survey was done in 2002 but it only covered a smaller portion of the ecosystem i.e. Amboseli and West Kilimanjaro areas. Other surveys conducted within the Amboseli- West Kilimanjaro ecosystem include counts done in Amboseli in 2000, 2002 and 2007 and those done in West Kilimanjaro in 1997, 2001, 2002 and 2009. The counts done in West Kilimanjaro were done using systematic reconnaissance flight (SRF) except the 2002 count which was a total count but only covered elephant and buffalo while those done in Amboseli were all total aerial counts . Details concerning previous counts are provided in Table 1.

The purpose of this survey, therefore, was to gather comprehensive wet season information on abundance and distribution of various wildlife species, water and human activities in the Amboseli-Kilimanjaro/ Magadi -Natron cross-border ecological area following the major drought of 2007, 2008 and 2009. The survey specific objectives were to:

1. Determine the abundance and distribution of wildlife species in the ecosystem
2. Use the abundance data to derive trends in wildlife numbers over time in the ecosystem
3. Determine the extent and spread of human activities in the ecosystem
4. Identify threats to wildlife conservation in the ecosystem

Table 1: Aerial surveys conducted in Amboseli and West Kilimanjaro areas, 1997 – 2010

Year	Month	Season	Survey Technique	Name of area surveyed	Area (km ²)	Source
1997	June	Wet	SRF	West Kilimanjaro	2,537	TWCM (1998)
2000	January	Wet	TC	Amboseli	4035	KWS (2000)
2001	May	Wet	SRF	West kilimanjaro	2,537	CIMU (2002)
2002	August	Dry	TC	West Kilimanjaro	6,909	TAWIRI (2003)
2002	August	Dry	TC	Amboseli	5736	KWS (2002)
2007	May	Wet	TC	Amboseli	5542	KWS (2007)
2009	March	Dry	SRF	West Kilimanjaro	2,558	TAWIRI (2009)
2010	March	Wet	TC	Amboseli, West Kilimanjaro, Namanga-Magadi, Natron	24108	This report

MATERIAL AND METHODS

Study Area

Amboseli-West Kilimanjaro/Magadi- Natron Landscape covers portions of Southern Kenya and Northern Tanzania between 1° 37' S and 3° 13' South and 35° 49' and 38° 00' East (Figure 1). This ecosystem comprises Amboseli and Namanga-Magadi areas in southern Kenya, and West Kilimanjaro and Natron in northern Tanzania. The survey covered approximately 24,000 km² and extended from the foot of Chyulu hills to the east, Arusha National Park to the south, Lake Natron to the west and Lake Magadi to the North. Mt. Kilimanjaro lies to the south eastern boundary of the survey area. For purposes of this census, the survey area has been divided into four broad areas namely: Namanga-Magadi area (also labeled as Magadi on Maps and Tables), Amboseli area, Natron area and West Kilimanjaro area.

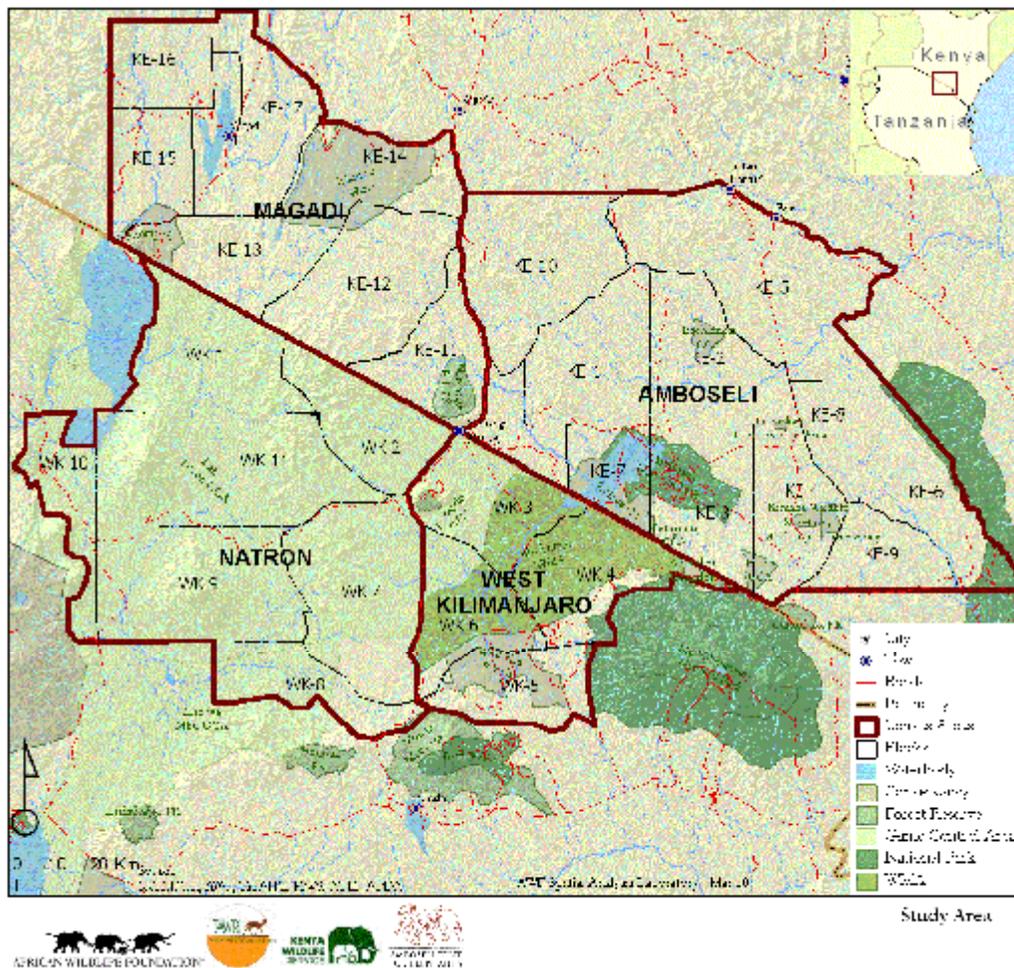


Figure 1 Map of the survey area showing the counting blocks and the four broader census areas

Amboseli Area

Amboseli area covers an area of 8797 km² and consists of Amboseli National Park and the surrounding five group ranches namely; Kimana/Tikondo, Olgulului/Olararashi, Selengei, Mbirikani and Kuku. It also includes the former 48 individual ranches located on the lower slopes of Kilimanjaro along the international border, westwards from Loitokitok, that are now under crop production, mainly rain fed agriculture.

The area consists of basement plains, saline plains with fresh water swamps and the volcanic slopes of the Kilimanjaro. The vegetation reflects the mainly semi-arid environment. According to Pratt and Gwynne (1977), Quaternary volcanic soils on the northeastern Kilimanjaro slope dominate around the southeast area, encouraging rain-fed agriculture; basement rock soils cover most of the rest of Ilkisongo, making only pastoralism possible.

The Amboseli area lies in ecological zone VI on agro-climatic zone map and is generally arid to semi- arid savanna environment, with low agricultural potential (Croze et al, 2006). The area is characterized by spatial and temporal variation in the hydrology. Surface water is only found in the few permanent rivers. Streams and the existing water resources are predominantly as a result of the influence of Mt. Kilimanjaro water which flows under gravity and emerge from underground in form of springs. These springs together with rainfall, feeds the rivers, streams and swamps in the area.

There is scarcity of water in the area surrounding the Park, particularly in Olgulului/Olorarashi group ranch during the dry season. The group ranch depends mostly on a series of boreholes and dams, and the 90 km Amboseli water pipeline, to water livestock and for domestic use.

The dominant vegetation types are open grasslands towards the north and northeast to the Chyulu Hills; Acacia dominated bushland to the south until the forest belt of Kilimanjaro. Throughout these main types, there are patches of swamp and swamp-edge grassland and Acacia woodland following a roughly northwest-southeast line along the park's long axis, with wooded and bush grassland found variously wherever there is seasonal accumulation of water. There have indeed been changes in *Acacia xanthophloea* and *A. tortilis* woodland along the swamps and just to the southeast of the National Park, but such changes – though visually striking – must be seen in the context of the long- term, non-equilibrium behavior of arid ecosystems that are by nature highly variable, unpredictable and surprisingly resilient (Croze et al, in press).

Namanga-Magadi Area

The Namanga-Magadi area (5513 km²) comprises of Mailua, Meto, Torosei, Mbuko, Elangata wuas, Olkiramatian, Lorngosua and Shompole ranches. For most parts, the topography of Mailua Group Ranch area is a combination of gently undulating plains and outstanding hilly landscape and the rift valley. The soil is “black clayey”

(grumosolic soils) and consist of a range of “black cotton” soils including the calcareous and non calcareous variants.

Uaso Ngiro is the only permanent river; however there are several seasonal rivers like the Namanga and Esokota rivers which originate from Namanga and Meto hills. The other main seasonal river is the Ol Kejuado that originates from Ilemelepo hills to the north west of Ibisil town and drains into river Kiboko. Minor seasonal rivers are Nosikitok, Nendanai and Ngatataek. Namanaga (Ol donyo Orok) hill is a formidable water catchment. The other important water resources in the area are boreholes and artificial water dams that are either publicly or privately owned. These artificial water sources are the principle sources of water for humans and livestock in much of the group ranches.

The diverse physical features have led to spatial and temporal variation in distinct habitat types. The dominant tree species include a variety of Acacias, *Commiphora* and *Balanites glabra*. The major grasses include *Chloris roxburgiana*, *Pennisetum stramenium*, *Pennisetum mezianum*, *Digitaria sp*, *Cynodon dactylon* and *Eragrostis sp*.

The rainfall is low, bimodal and highly variable, ranging between 400 - 600 mm. These low rainfall has rendered the area to be of marginal agricultural potential and therefore, most of the area is under pastoralism by Maasai people (Kioko 2008). Limited irrigation and rain fed agriculture is practiced in a few areas, mostly along MailiTisa-Namanga road, along the main rivers and Uaso Ngiro. Quarrying of building stones is practiced mainly along the Kajiado-Namanga road while sand harvesting occasionally occurs in the dry river beds.

West Kilimanjaro Area

The West Kilimanjaro area (3014 km²) is within the Longido District of Arusha. The northern extent of the area is the Tanzania-Kenya border from Namanga southeastward to Irkaswa. The eastern border is defined by the boundary of Kilimanjaro National Park extending southward to near the community of Sanya Juu. The southern extent of this study area extends west from Sanya Juu to the northeast corner of Arusha National Park, continuing along the northern park border to the Arusha-Nairobi Road that also defines the western extent of the area.

The area is a complex mosaic of diverse natural communities, extensive grazing lands, and large agricultural fields at lower elevations on Mt. Kilimanjaro. There are traditional, agro-pastoral Maasai communities that graze cattle and other livestock and raise subsistence crops. In addition, there are five other medium-sized agricultural communities in the region. There are several protected areas in the study region, including Kilimanjaro NP (755 km²) on the eastern boundary, Arusha NP (137 km²) to the south, and Amboseli NP (390 km²) in southern Kenya, 20 km north of the Tanzania-Kenya border. Additionally, there are two private conservation areas, West Kilimanjaro Ranch (303 km²), Endarakwai Ranch (44 km²); as well as , Longido Game Controlled Area (GCA)(1,700 km²), and Ngasurai Open Area (544 km²) that provide important habitats for wildlife.

Although the area varies in elevation (1,230 to 1,600 m), the predominant ecological zone is semi-arid savannah (Pratt et al. 1966) interspersed with woodlands. There are extensive agricultural fields along the lower, western flank of Mt. Kilimanjaro and lowland forests within the boundary of Kilimanjaro NP. Distribution of rainfall is unpredictable, especially at lower elevations, and highly variable from year to year. Rainfall amounts average 341 mm/yr in semi-arid lower elevations (Moss 2001) and 890 mm/yr in agricultural areas at lower elevations on Mt. Kilimanjaro (Rey and Das 1996), also at Mt. Meru and Monduli areas in the southern portion of the survey area.

Natron Area

The Natron area (7,047 km²) is to the west of the West Kilimanjaro area with its northern extent defined by the Tanzania-Kenya border, extending from the border town of Namanga on the east and continuing northwest along the border to the northern terminus of Lake Natron. The western extent is along the east side of Lake Natron continuing south along the eastern border of Ngorongoro Conservation Area. The southern boundary extends from the southeast corner of Ngorongoro Conservation Area eastward to the northwest corner of Arusha National Park.

The area is a mosaic of diverse natural communities and extensive grazing lands. There is a unique Maasai grazing area extending westward from the Kiserian-Mriata Ridge (on the eastern side of the study region) extending westward encompassing the grasslands adjacent to Gelai (2,942 m) and Ketumbeine (2,858 m) mountains. This area is characterized by well-drained savannah grasslands and woodlands where Maasai graze their cattle during the dry season and no permanent human settlements are allowed.

Within this study region, traditional Maasai communities graze their livestock and practice subsistence agriculture. The entire region is included within the Natron GCA and the northern portion of the Monduli GCA where wildlife is managed primarily for hunting. The predominant ecological zone is semi-arid savannah interspersed with open acacia woodlands (*Acacia sp* and *Commiphora sp*), especially on the western side of the Kiserian-Mriata Ridge. Distribution of rainfall is unpredictable and highly variable from year to year, but rainfall is typically less than 350 mm/yr.

Census technique

The count was conducted between 1st and 6th, March 2010 using the Aerial Total Count -technique (Norton-Griffiths 1978). The study area was divided into 28 blocks; 17 in Kenya and 11 Tanzania. Each block was systematically searched by air-craft flying either North South or East West directions along transects of 1-2 km width depending on visibility and terrain. In the mountainous areas, such as those in blocks KE- 12, WK 2 WK 4, WK 5 WK9 and WK 11, irregular transects were undertaken (Figure 2). Seven aircrafts consisting of two 2-two seater and five- four

seater planes were used in the census. The crew of the aircrafts consisted of a pilot, Front Seat Observer (FSO) and Rear Seat Observer (RSOs) (Appendix 5 & 6).

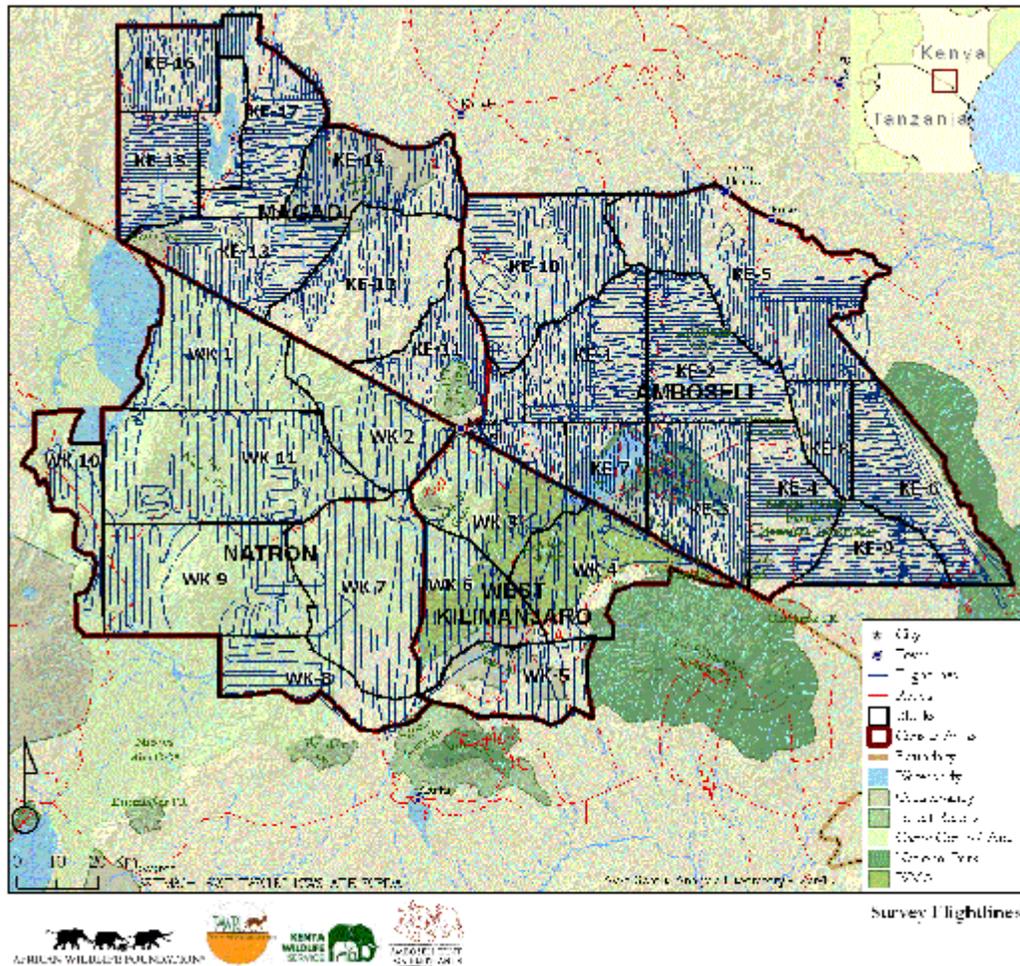


Figure 2 Map of survey flight lines in the study area

The aircraft crew systematically searched for and made observations and recording of parameters of interest within the flight transects. For each observation a waypoint was marked on a hand held Global Positioning System (GPS) and the observation recorded on a data sheet. Tape recorders were also used to aid in data capture and data transcribed into the datasheet after every survey session. The data recorded included wildlife and livestock number and species as well as human activities and water points. Large herds of more than 10 individuals were photographed and tallied later to verify the counted individuals. At the end of count session the GPS flight paths and waypoints were down loaded using DNR-Garmin /MapSource software. Flight path and way point data were processed using ArcGIS 9.2 program. The observation data sheets were cleaned and entered into Microsoft Excel 2003/2007 for further analysis. Data validation was undertaken to check and remove double counting.

Data analysis

The observation data were calculated across the count blocks and the entire survey area. GIS based distribution and density maps were generated to depict the spatial extent and distributions of various wildlife and livestock species. Analysis of trends for select wildlife species and areas was undertaken.

RESULTS

Here we present the numbers of animals recorded adhering faithfully to the summations of the FSO tally sheets. We recognize that by the very nature of aerial total counts, the numbers are quite likely to be underestimates (Krebs 1989). There were a total of 25 mammalian and two avian species recorded during the count (Table 2). Common Zebra (*Equus burchelli*) was the most abundant wild species followed by Grant's gazelle (*Gazella granti*) and common wildebeest (*Connochaetes taurinus*). Other included Maasai giraffe (*Giraffa camelopardalis*), eland, ostrich (*Struthio camelus*), elephant (*Loxontoda africana*), impala (*Aepyceros melampus*), Thomson's gazelle (*Gazella thomsonii*), Coke's hartebeest (*Alcelaphus buselaphus*) and buffalo (*Syncerus caffer*).

Table 2: Summary of Wildlife species numbers counted in various areas of the surveyed area

	Area (Size) Species	MAGADI (5513 Km ²)	AMBOSELI (8797Km ²)	W/KILI (3014 Km ²)	NATRON (7047km ²)	Total
1	Common Zebra	3846	6029	686	3179	13740
2	Grant gazelle	3465	3905	87	905	8362
3	Common Wildebeest	1604	3410	132	2094	7240
4	Maasai Giraffe	780	2283	263	838	4164
5	Cape Eland	247	1621	0	124	1992
6	Maasai Ostrich	335	876	61	189	1461
7	African Elephant	48	1292	61	19	1420
8	Elephant Carcass	0	41	11	2	54
9	Impala	463	753	23	78	1317
10	Thomson gazelle	44	331	213	345	933
11	Kongoni/ Hartebeest	0	377	39	25	441
12	Cape Buffalo	62	235	0	37	334
13	Baboon	134	76	22	0	232
14	Fringe-eared Oryx	24	168	4	0	196
15	Bushbuck	193	0	0	1	194
16	Gerenuk	5	73	11	28	117
17	Hippopotamus	0	49	0	0	49
18	Warthog	7	29	0	10	46
19	Common Waterbuck	2	18	2	14	36
20	Dik dik	3	0	4	6	13
21	Grey Crowned crane	0	13	0	0	13
22	Duiker	0	0	0	9	9
24	Spotted Hyena	0	0	4	1	5
25	Lesser Kudu	0	10	4	6	20
26	Lion	0	3	0	0	3
27	Cheetah	0	2	0	0	2
	Total	11262	21594	1627	7910	42393

Wildlife Numbers and Distribution

Common Zebra

There were 13740 zebras recorded in the entire survey area (Table 2), that were widely distributed in the entire survey area, with exception of block KE - 12 in Namanga and WK-5 in West Kilimanjaro ranch (Figure 3). Among the four survey areas Magadi had the highest density (0.70/km²), followed by Amboseli (0.68/km²), Natron (0.45/km²) and West Kilimanjaro (0.23/km²) (appendix 3).

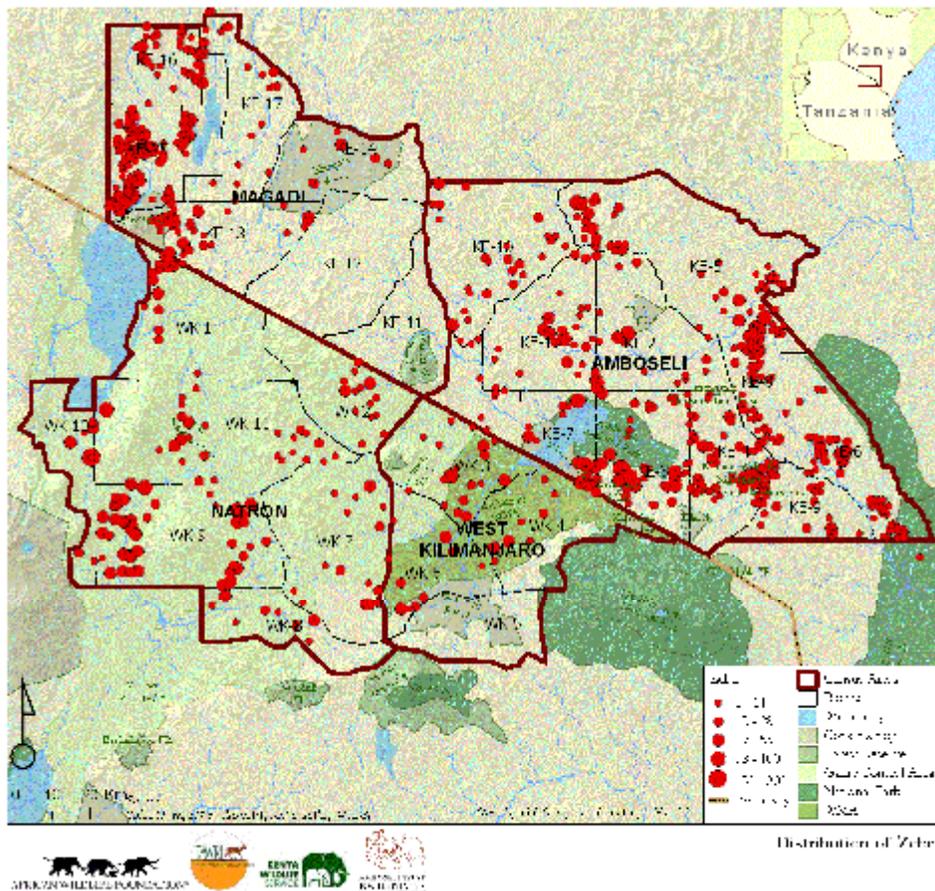


Figure 3 Distribution of common zebra in the study area

Grant's gazelle

Grant's gazelle, with a population of 8,362 was the second most abundant species in the surveyed area. The Amboseli and Namanga-Magadi areas had the majority of Grant's gazelles (3,905 and 3465 respectively). Natron area had 905 individuals while, 87 individuals were found in the West Kilimanjaro area. This species was ubiquitously distributed (figure 4) with the highest density recorded in the Namanga-Magadi area (0.63/km²) and the lowest in West Kilimanjaro (0.029/km²) (appendix 3).

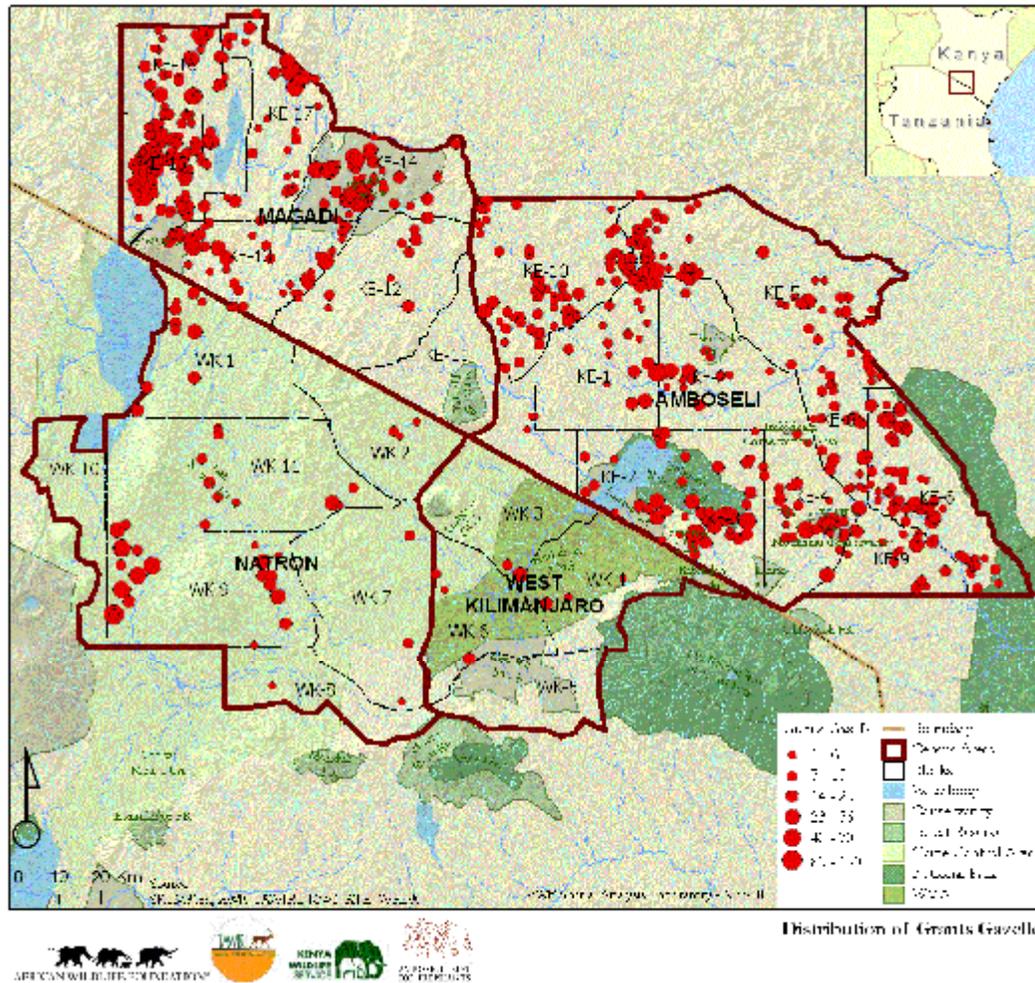


Figure 4 Distribution of Grant's gazelle in the study area

Common Wildebeest

Wildebeest was the third most abundant wildlife species recorded in the surveyed area with a total number of 7240 individuals. Most of the wildebeest were in the Amboseli, Lake Natron and Lake Magadi areas and were remarkably absent in blocks KE-12 (Meto-Longoswa) WK2 (Longido area) and WK- 5 (West Kilimanjaro ranch) (Figure 5). In Namanga-Magadi area, they were mostly confined in block KE-15 (Shompole Group Ranch). In West Kilimanjaro area, wildebeest were in blocks WK3 and KE 7 (Ketendeni-Enduimet), near the borders of Kenya and Tanzania, while in Natron region they were found in blocks WK 9 south of Gelai mountains. The highest density was recorded in the Amboseli region (0.39/km²), followed by Natron 0.30/km²). In the Namanga-Magadi area, wildebeest had a density of 0.29/km² while in the West Kilimanjaro their density was 0.04/km² (Appendix 3).

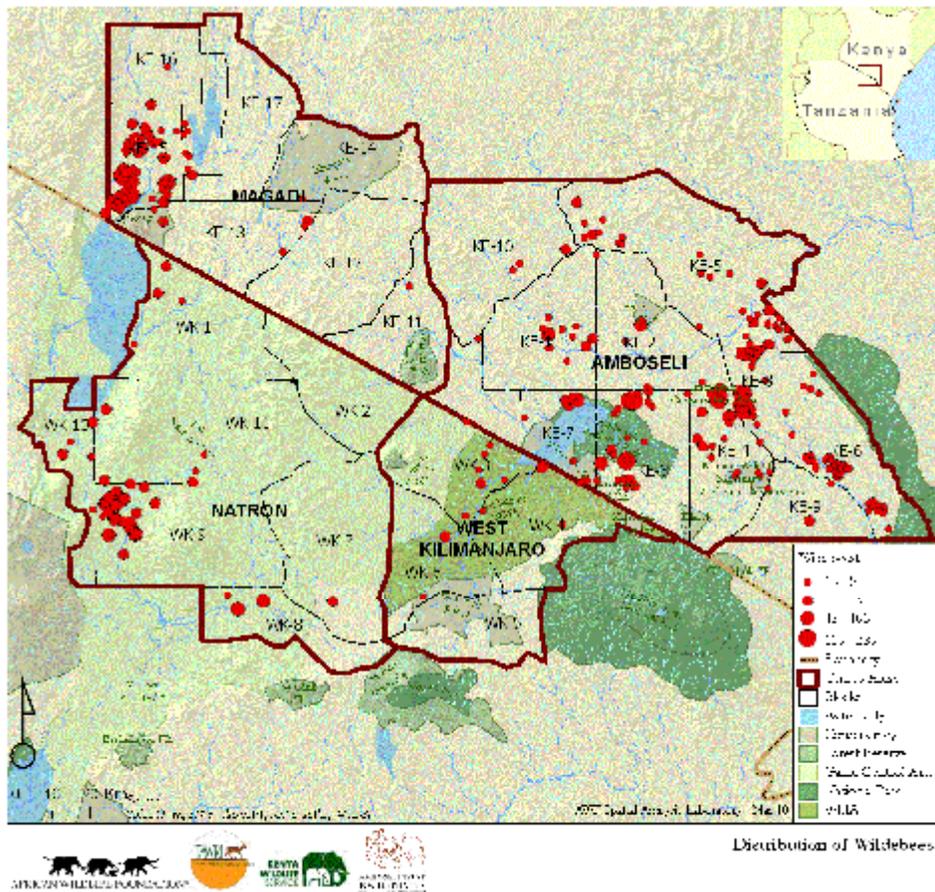


Figure 5 Distribution of wildebeest in the study area

Maasai Giraffe

Giraffes were widely distributed in the entire ecosystem. They occurred in all the surveyed blocks except WK-5 in West Kilimanjaro region (Figure 6). The highest number recorded was in Amboseli (2,283) followed by Natron (838), Magadi (780) and were least in West Kilimanjaro (263) (Table 2). However, there were variations in densities between areas, such that Amboseli had 0.26/km², Magadi 0.14 /km², Natron 0.12/km² and West Kilimanjaro 0.09/km² (Appendix 3).

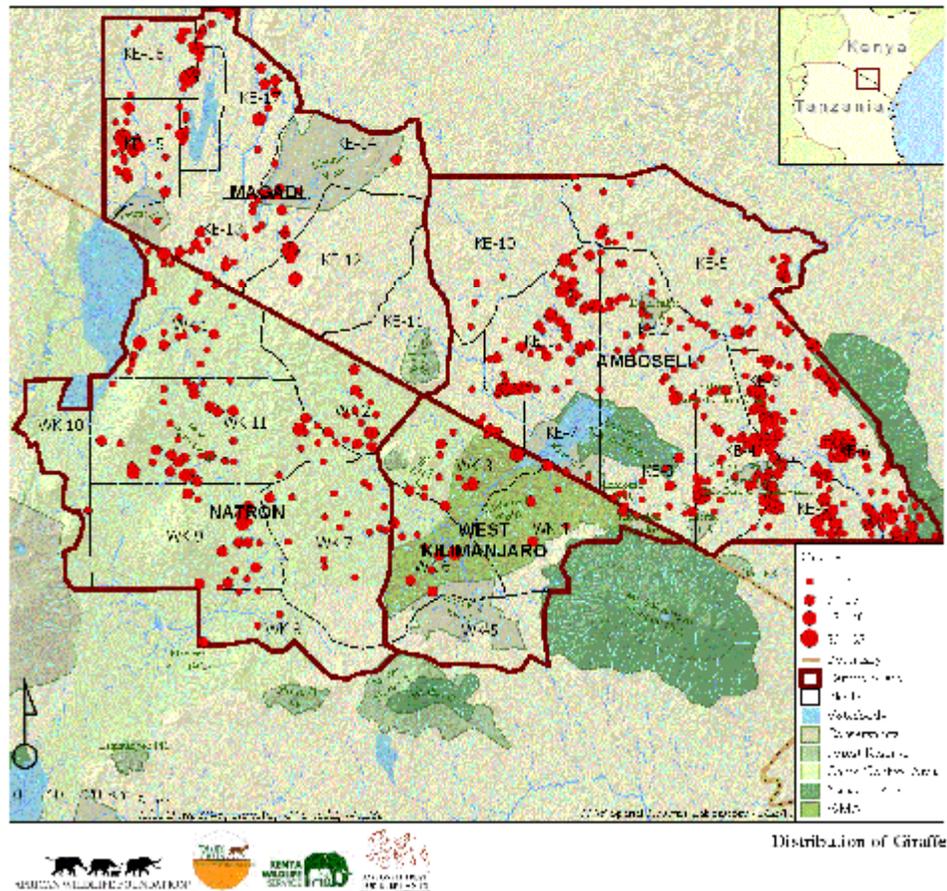


Figure 6 Distribution of Maasai Giraffe in the study area

Eland

Population of eland recorded in the study area was 1992 individuals. These were widely distributed in the survey area with the exception of west Kilimanjaro where there were no Elands recorded (figure 7). Elands were mainly concentrated to the east and north east outside Amboseli National Park. The highest density was recorded in the Amboseli area (0.18/km²) followed by Magadi (0.05/km²) and Natron (0.02/ km²) (Appendix 3).

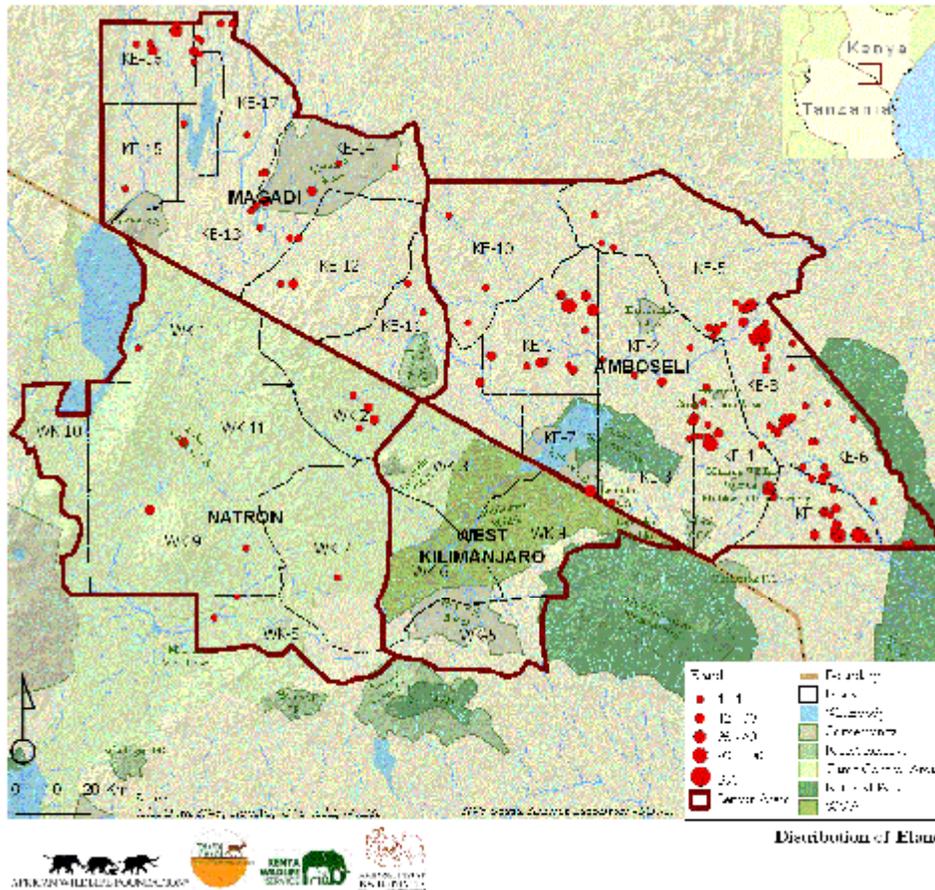


Figure 7 Distribution of Eland in the study area

Maasai Ostrich

One thousand four hundred and sixty one (1461) Ostriches were recorded during the census, and they were sighted in 25 out of the 27 blocks (Figure 8). Most of the Ostriches were recorded in the Amboseli area and showed a density of 0.10/km²; Namanga-Magadi area with density 0.06/km², while both West Kilimanjaro and Natron had similar density of 0.02/km² (appendix 3).

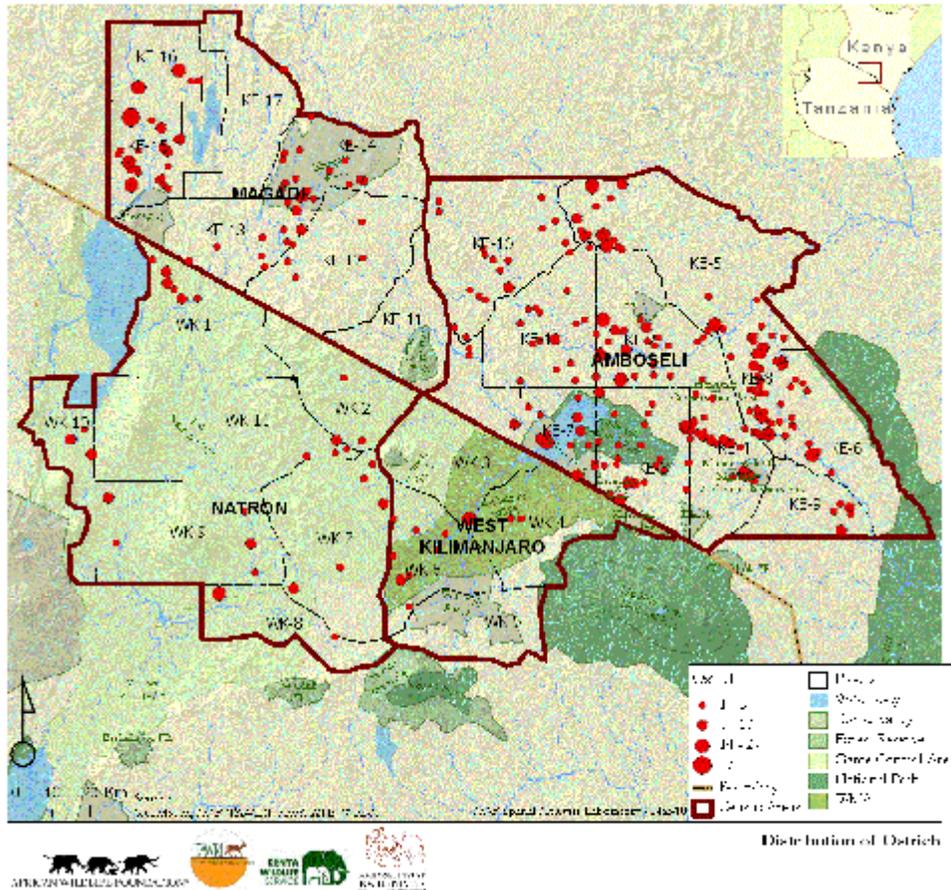


Figure 8 Distribution of Ostrich in the study area

African Elephant

Elephants were the 7th most abundant species in the ecosystem with a total of 1,420 individuals. However, elephants were confined within the Amboseli region (1292 individuals), while West Kilimanjaro, Namanga-Magadi and Natron areas recorded 61, 48 and 19 individuals respectively (Table 2). Similarly, the species density was high in Amboseli (0.15/km²), followed by West Kilimanjaro (0.02/km²); Magadi (0.01/km²) and Natron had the least (0.002/km²) (Appendix 3). The species was sparsely distributed across the ecosystem though more concentration was recorded in Amboseli (block KE-3) (Figure 9).

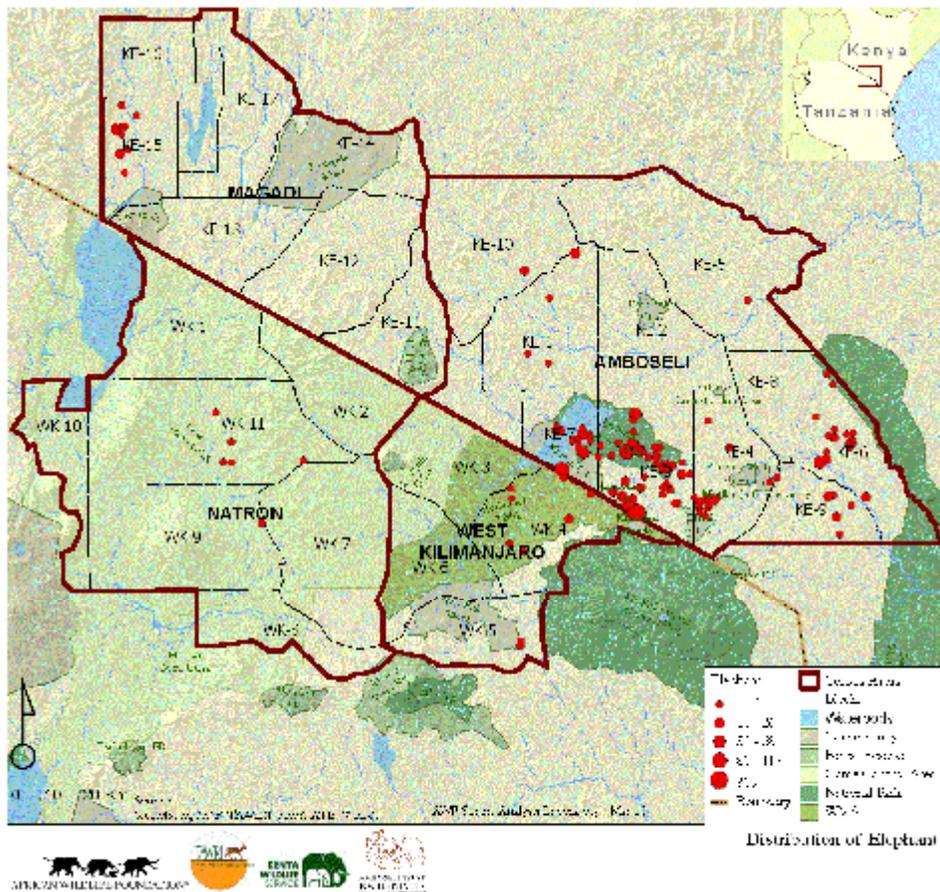


Figure 9 Distribution of African Elephant in the study area

African Elephant Carcasses

Fifty four elephant carcasses were recorded in the entire ecosystem. Most of these carcasses were in the Amboseli (41) while West Kilimanjaro areas and Natron areas recorded 11 and 2 respectively (Table 2). The carcasses were found in all the census areas except in Namanga-Magadi area. Most of the carcasses were clustered around water sources (swamps and river), across the Amboseli and West Kilimanjaro areas (Figure 10).

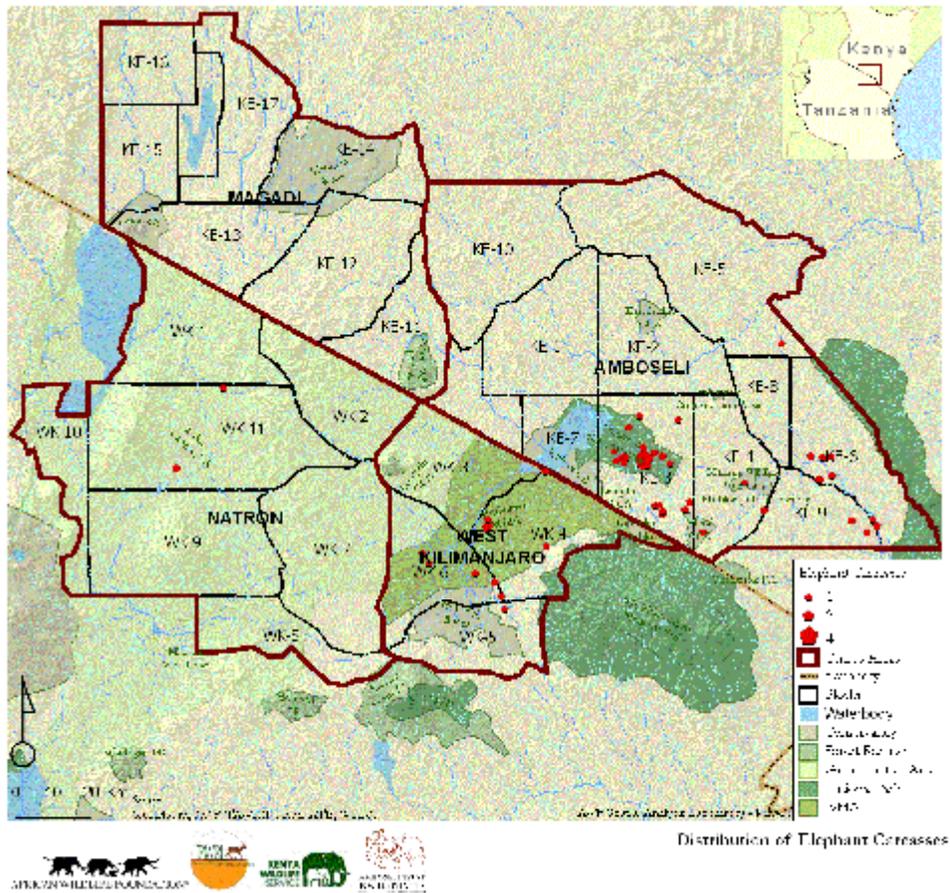


Figure 10 Distribution of African Elephant carcasses in the study area

Impala

The population of Impala in the study area was 1317 individuals (Table 2). Amboseli recorded the highest density (0.09/ km²) while Namanga-Magadi had a density of 0.08/km² (Appendix 3). Impala density was comparatively lower in the West Kilimanjaro and Natron areas, each with 0.01/km². The species was widely distributed in the area north of Kilimanjaro (Figure 10). A cluster of high Impala population was observed to the east of Amboseli, Namanga and Lake Magadi Figure 11).

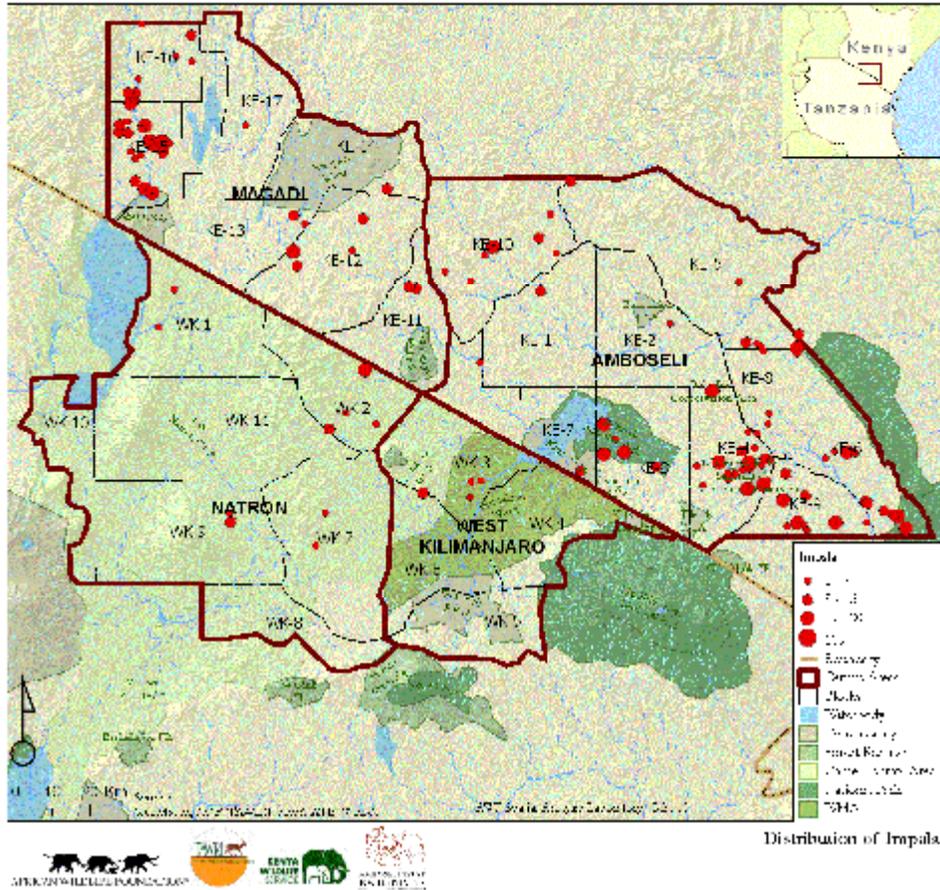


Figure 11 Distribution of Impala in the study area

Thomson's Gazelle

Thomson's gazelles were widely distributed in the census area where 933 individuals were counted (Table 2 and Figure 12) . Most individuals were recorded in the West Kilimanjaro and Natron area. In West Kilimanjaro area, the density was the highest (0.07/km²) followed by 0.04/km² in Natron region (appendix 3). In the Amboseli region the density was 0.03/km², while Namanga-Magadi region had the lowest density of 0.01/ km²) (appendix 3).

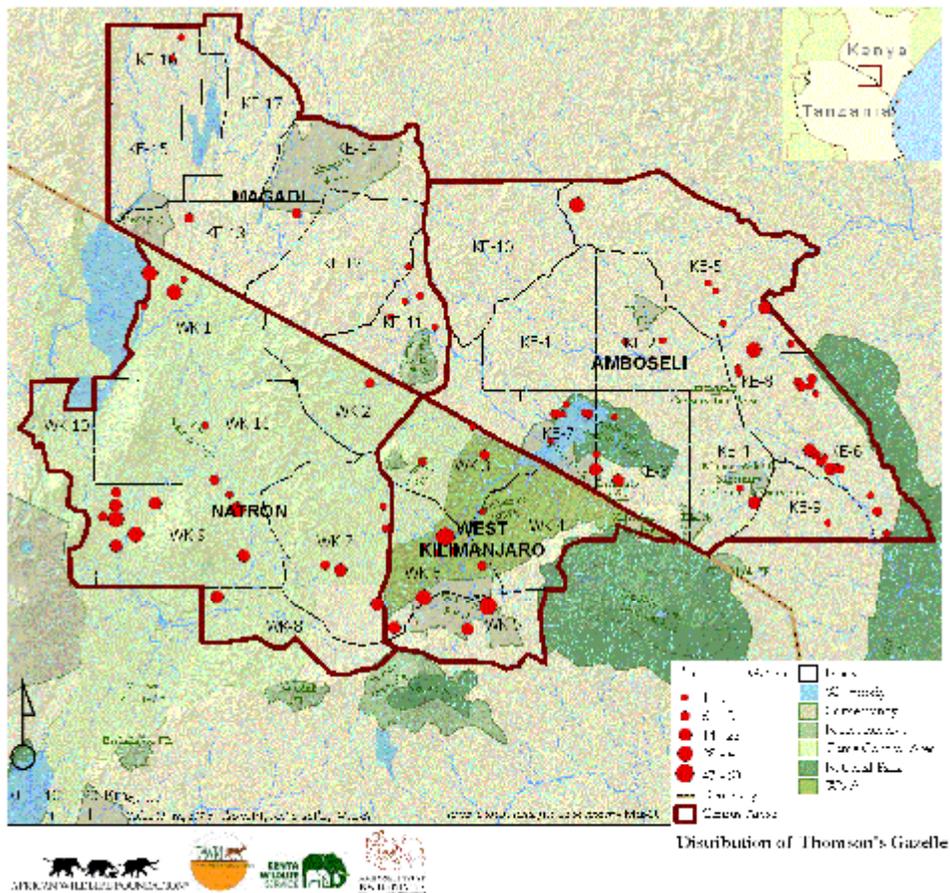


Figure 12 Distribution of Thomson's Gazelle in the study area

Coke's Hartebeest (Kongoni)

Four hundred and forty one individuals were recorded in the surveyed area and were distributed in all blocks with the exception of blocks in the Namanga-Magadi area (Figure 13). Amboseli had exceptionally high number of Kongoni (377) compared to West Kilimanjaro (39), Natron (25). Similarly, the density was higher in Amboseli (0.04/km²) compared to 0.01/km² and 0.004/km² for West Kilimanjaro and Natron areas respectively (appendix 3). Block (KE-6) in the Amboseli area had the highest concentration of the species in the entire census zone.

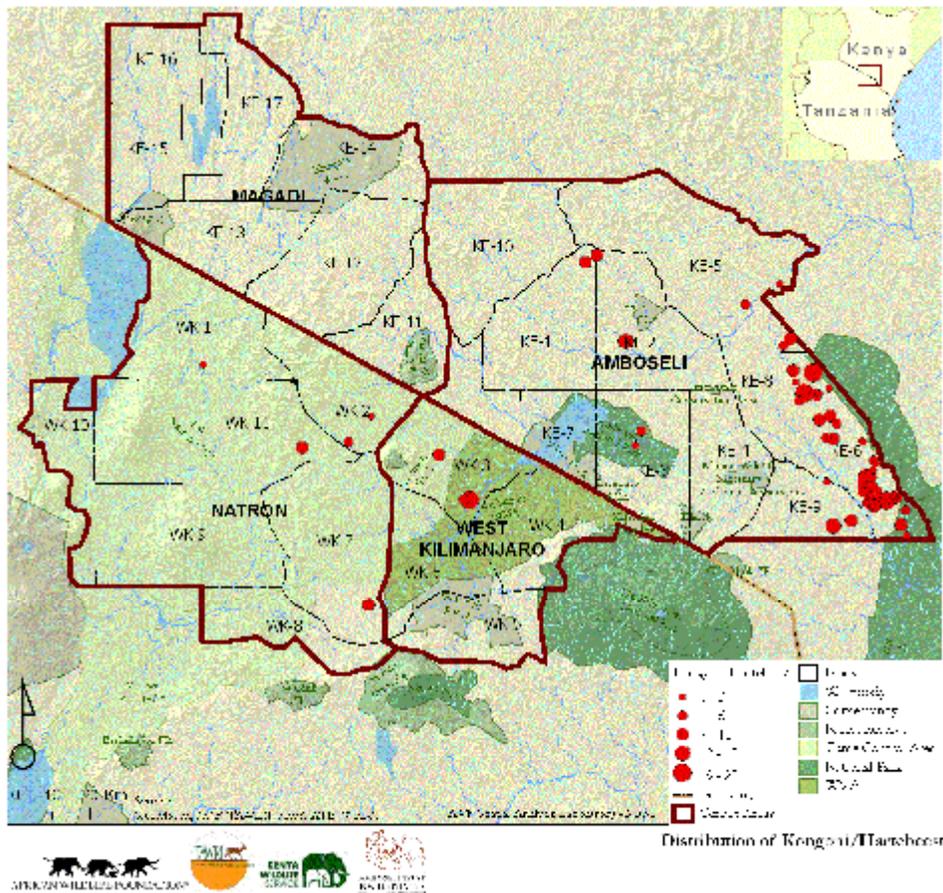


Figure 13 Distribution of Coke's Hartebeest (Kongoni)

African Buffalo

There were 334 buffaloes recorded during the census and their density was highest in Amboseli (0.03/km²) followed by Namanga-Magadi (0.01/km²) and Natron (0.01/km²) (Appendix 3). The buffalo distribution was restricted to areas in and around Amboseli National Park, in Lake Natron area (east of WK 11 (Gelai)), and Namanga-Magadi Area (blocks KE-13 and KE-15 (Shompole area)) (Figure 14).

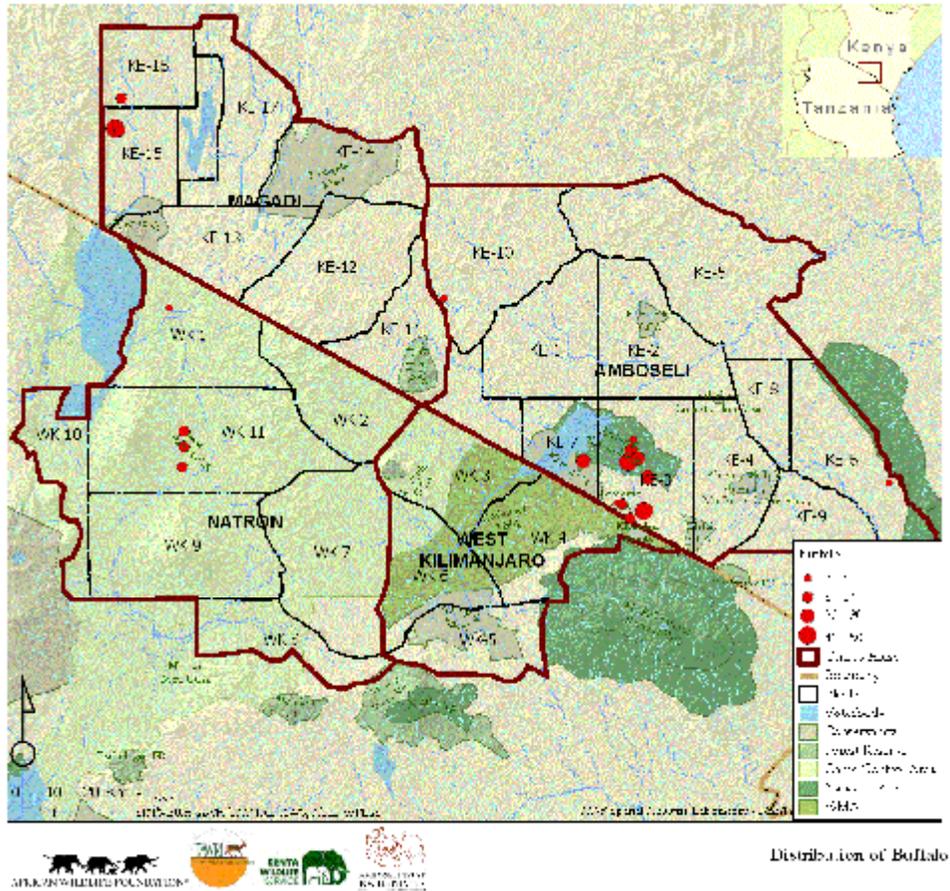


Figure 14 Distribution of African buffalo in the study area

Fringe-Eared Oryx

A total of 196 individuals were recorded in the survey area. The species was sparsely distributed in the study area and were found only in 9 out of the 27 blocks surveyed (Figure 15). The key areas where Oryx were recorded included Block KE-10 (Mashuru-Maparasha area), Block KE-3 (Amboseli National Park), Block KE-4 (Kimana area), Block KE-8 (Merueshi area) and the Namanga-Magadi area (blocks KE 13, 14, 15 and 16). Oryx were also recorded in blocks WK-1 and WK-11 with the Lake Natron area.

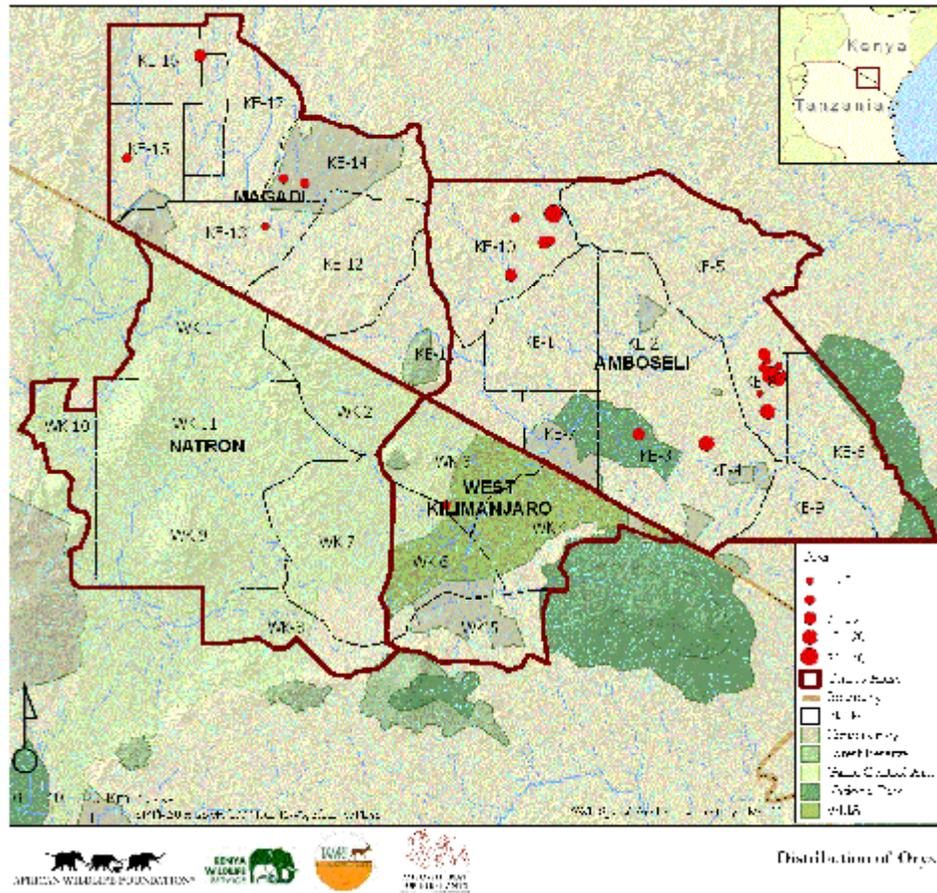


Figure 15 Distribution of Fringe Eared Oryx in the study area

Lesser Kudu

There were 20 lesser Kudu recorded in the survey area and were confined into six blocks in Amboseli (KE-5, KE-1 and interface of KE-4 and KE-5), Natron area (WK-2 and WK-7) and West Kilimanjaro Area in block WK-3 (Figure 16).

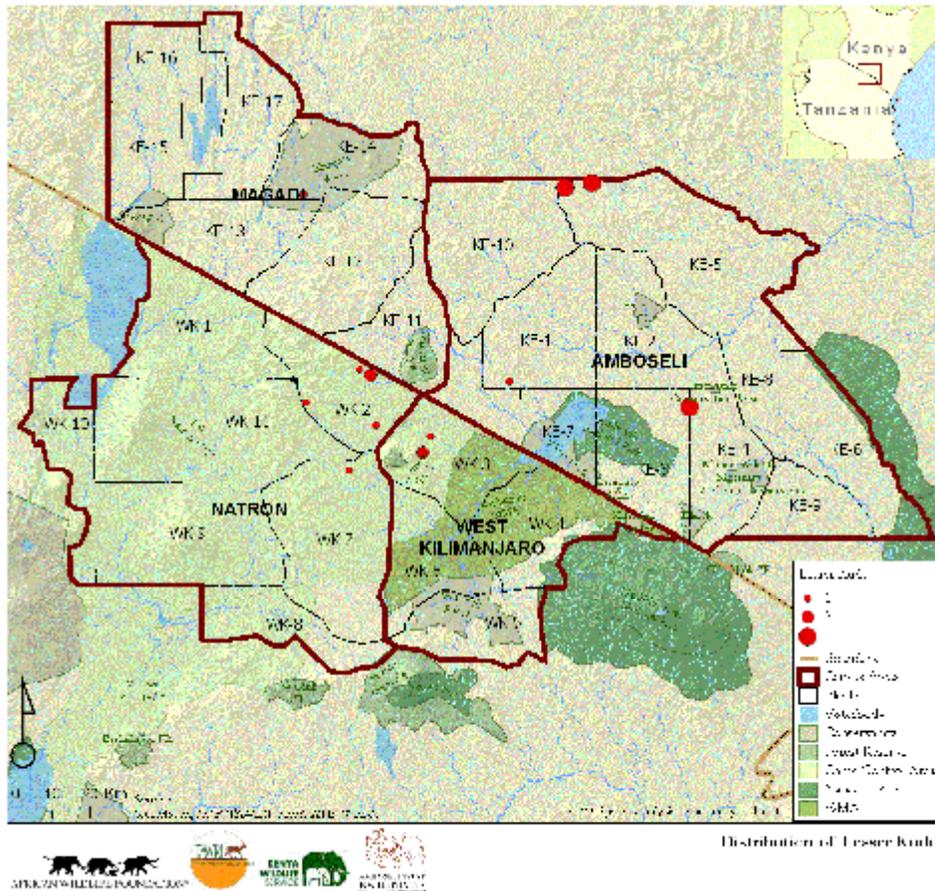


Figure 16 Distribution of Lesser Kudu in the study area

Gerenuk

Gerenuks were among the sparsely distributed species in the area with Natron area (interface of blocks WK-3, WK-7 and WK-11) having the highest concentration of the species (Figure 17). 117 individuals were counted in the survey area whereby the species was most abundant in Amboseli area with 73 individuals followed by Natron with 28 individuals. West Kilimanjaro and Magadi had low abundance of 11 and 5 individuals respectively.

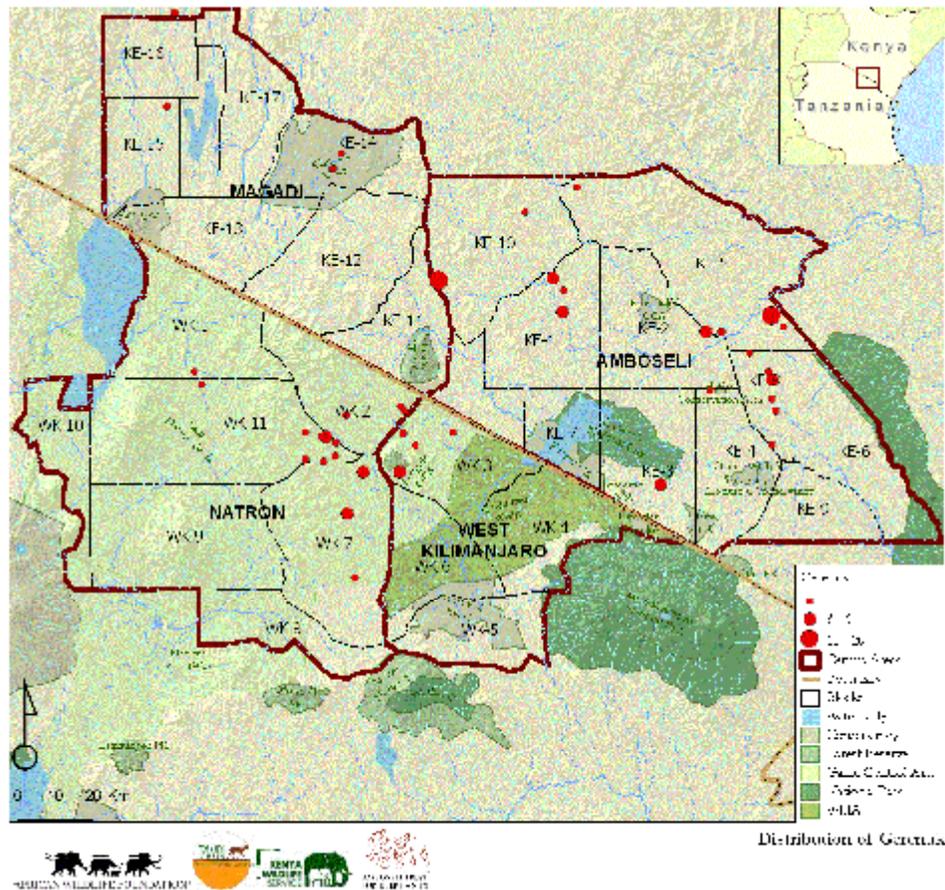


Figure 17 Distribution of Gerenuk in the study area

Warthog

Forty six warthogs were recorded during the census. The species was widely distributed in the surveyed area with the exception of West-Kilimanjaro Area. However, warthogs were recorded at low densities in the surveyed areas (Figure 18, Appendix 3).

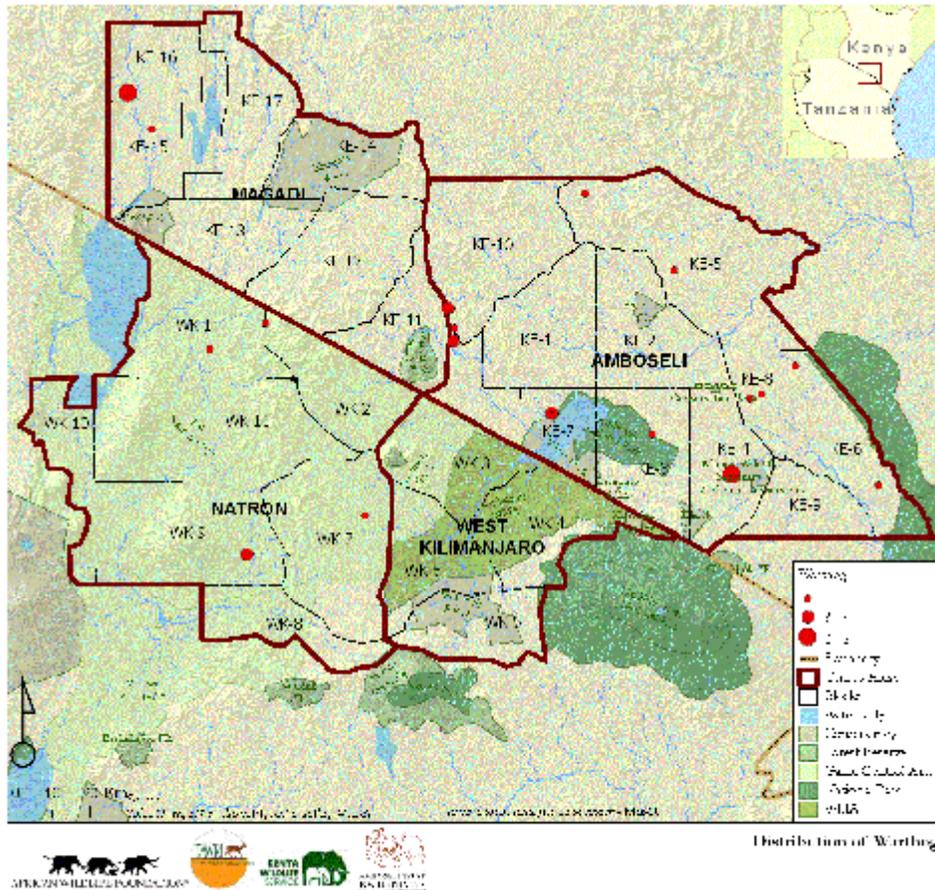


Figure 18 Distribution of Warthog in the study area

Common Waterbuck

Thirty six waterbucks were counted in during the census and these were recorded in Amboseli (KE-3, 4, 5, and 9), Lake Natron (WK-4, 7 and interface of WK-8 and 9) and Magadi area(block KE-15, Figure 19).

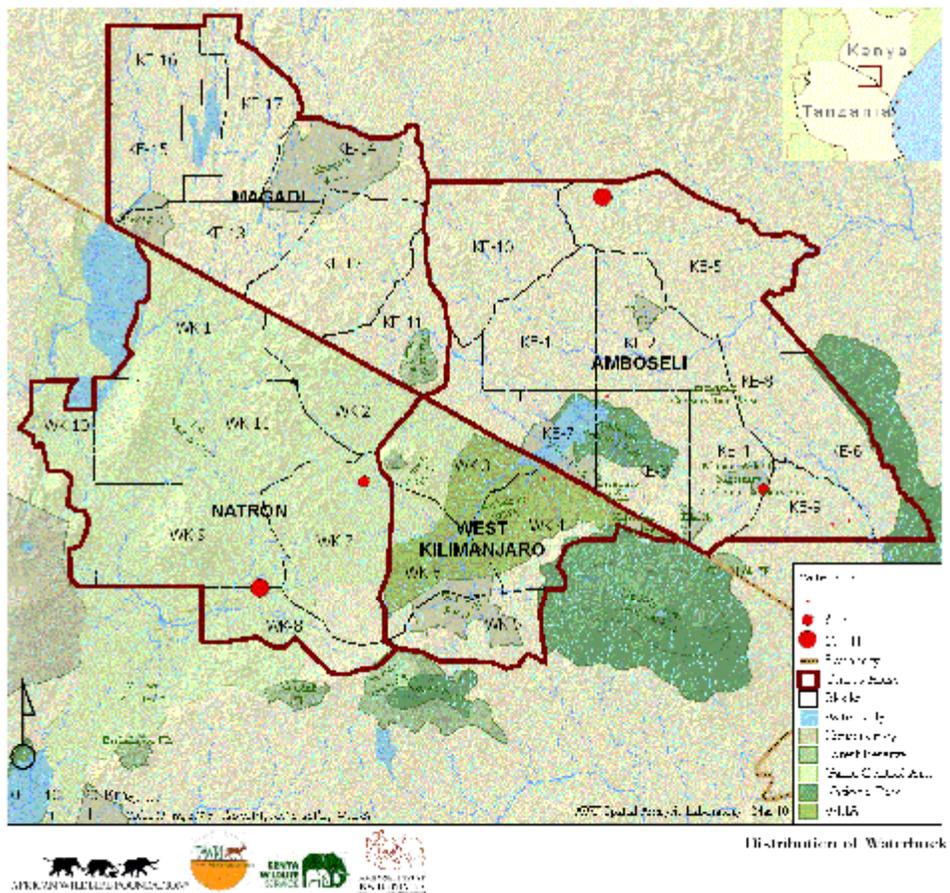


Figure 19 Distribution of Waterbuck in the study area

Other species

Other wildlife species recorded during the census included: Baboon (232), Bushbuck (194), Dikdik (13), Hyena (5), Duiker (9), Grey Crowned cranes (13), Cheetah (2), Hippopotamus (49) and Lions (3). Their distribution is summarized in Figure 20. The results from this survey are likely to be an under count for these species as some of them have poor detectability from the air, while others are active during night (e.g. Lion) and some are live in a confined environment (e.g. hippopotamus). Species in this category require other appropriate census techniques.

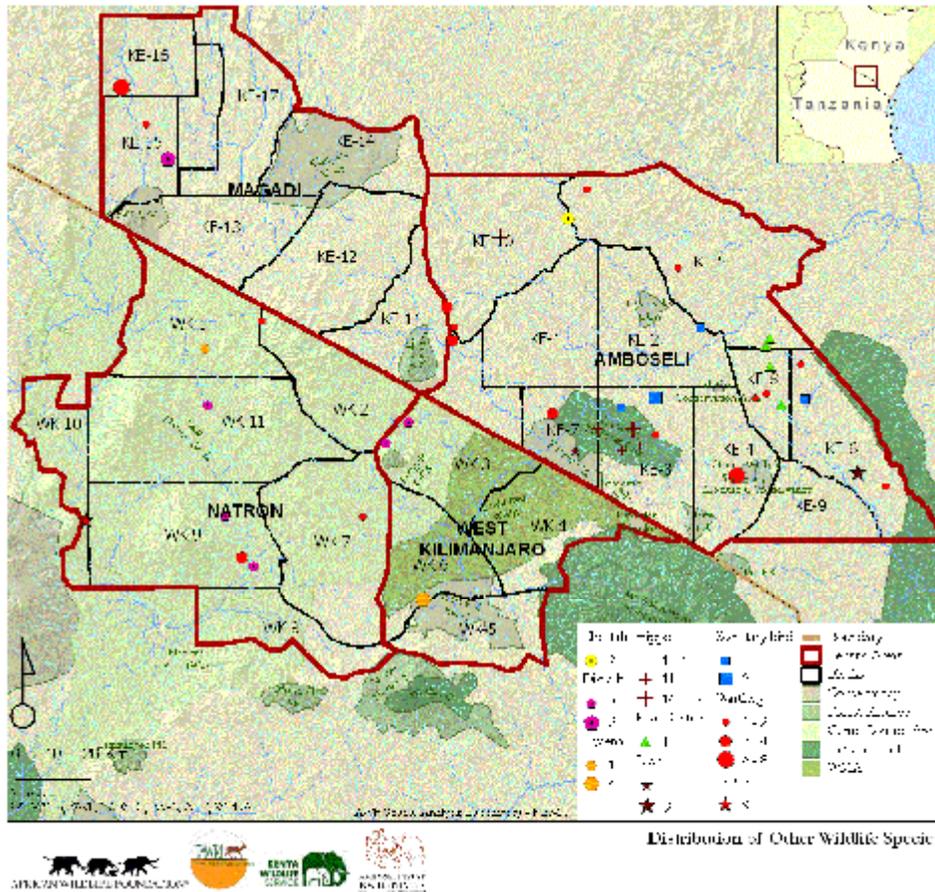


Figure 20 Distribution of other wildlife species recorded in the study area

Human activities

Human activities recorded in this survey included livestock (sheep, goats, cattle and camels), human settlements, cultivation fields, charcoal production, mining activities and artificial water provisions. Human settlements included structures such as schools, churches, shopping centers and homesteads (Table 3).

Table 3: Human activities recorded in the study area

	LIVESTOCK	Magadi	Amboseli	West Kilimanjaro	Natron	Total
1	Sheep and Goats	69969	101321	15503	43255	230048
2	Camel	167	565	30	0	762
3	Bee hives	0	0	0	34	34
4	Cattle	15734	48389	13422	22888	100433
5	Donkey	749	617	225	667	2258
	Cattle dip	0	1	2	5	8
	Cultivation					
7	Agriculture/cultivation locations	66	206	20	16	308
	Settlements					
9	Boma-abandoned	15	18	62	223	318
10	Hut with mabati roof	183	1479	10	6	1678
11	Maasai boma-Occupied	2277	3080	245	1139	6741
12	Market place	16	32	0	0	48
13	School	29	59	0	0	88
14	Tourist camp	2	9	0	0	11

Water resources

15	Water hole (Dam)	155	148	35	143	481
16	Water hole (Pump)	24	11	0	37	72

Habitat destruction

17	Charcoal kiln	777	1601	18	13	2409
18	Poachers camp	0	0	1	0	1

Mining

19	Mining hole	1	105	0	0	106
20	Mining camp	0	7	0	1	8

Cultivation

Most of the farming activities recorded in the survey area was confined in permanent wetlands and along seasonal rivers (Table 3). In West Kilimanjaro, cultivation occurred in WK-6; these are areas along the lower slopes of west Kilimanjaro, south and east of west Kilimanjaro ranch, and the slopes of Northern Mount Meru and Tinga Tinga and Ngereiyani villages. In the Natron area cultivation occurred in WK-2, the northern part of Enkare Naibor. There was also farming in WK-11 and WK-7, the north-east slopes of Mt. Gelai and Kiserian village. In Amboseli area; KE-4 was cultivated on slopes of Mt. Kilimanjaro, in Kimana and Namelok Swamp and along river Kikaranko in Esambu and and Ilchalai. Block KE-9 was cultivated in Olorika, Elangata and Ikisanjani area. There was limited crop farming in block KE-6 on the slopes of Chyulu hills in Lemasusu area. Cultivation occurred in Namelok, Kimana and Loitoktok areas. Other areas with major cultivation activities were in block KE-11, KE-5 (along the Nol-turesh water pipeline) and in Block KE-5 Emali-Sultan area.

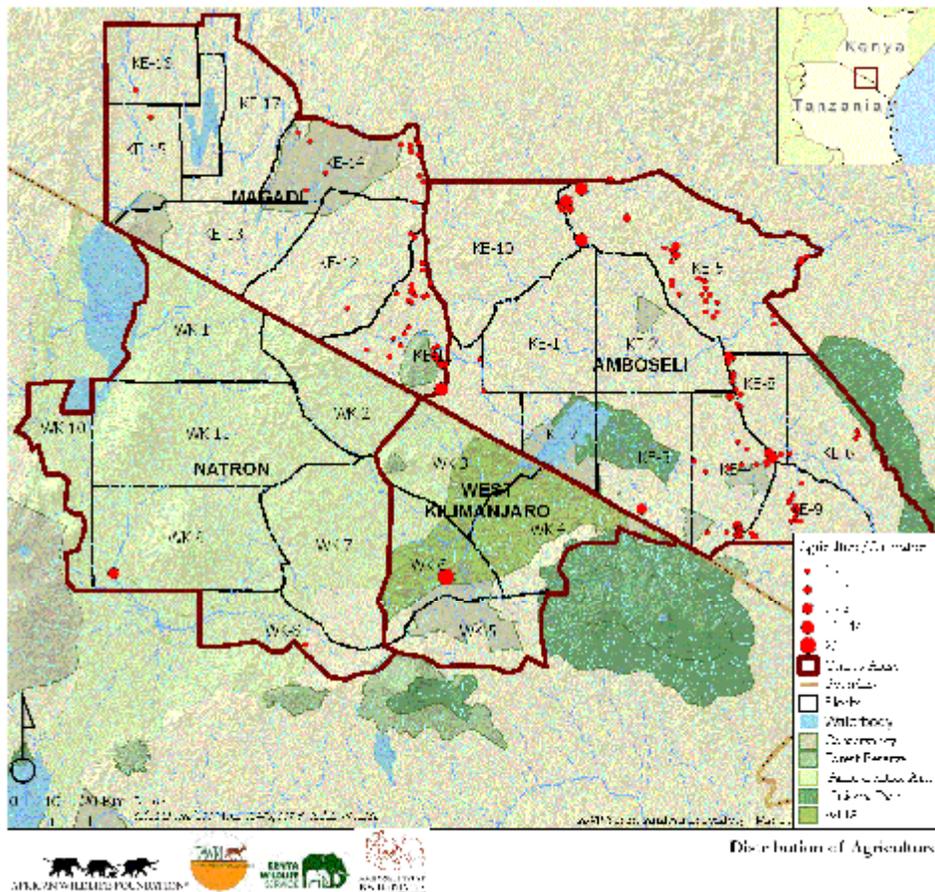


Figure 21 Distribution of crop cultivation in the study area

Water resources

Both artificial water sources and seasonal streams were widely distributed across the entire ecosystem (Table 3). Most of the water sources recorded in the study area were water dams that usually get filled after the rains. Most of the water pumps were sighted near the wetlands. Permanent water sources were the swamps and rivers associated with Mt Kilimanjaro (in the Amboseli region), and the Uaso Ngiro river (KE-15 and KE-16) (Figure 22).

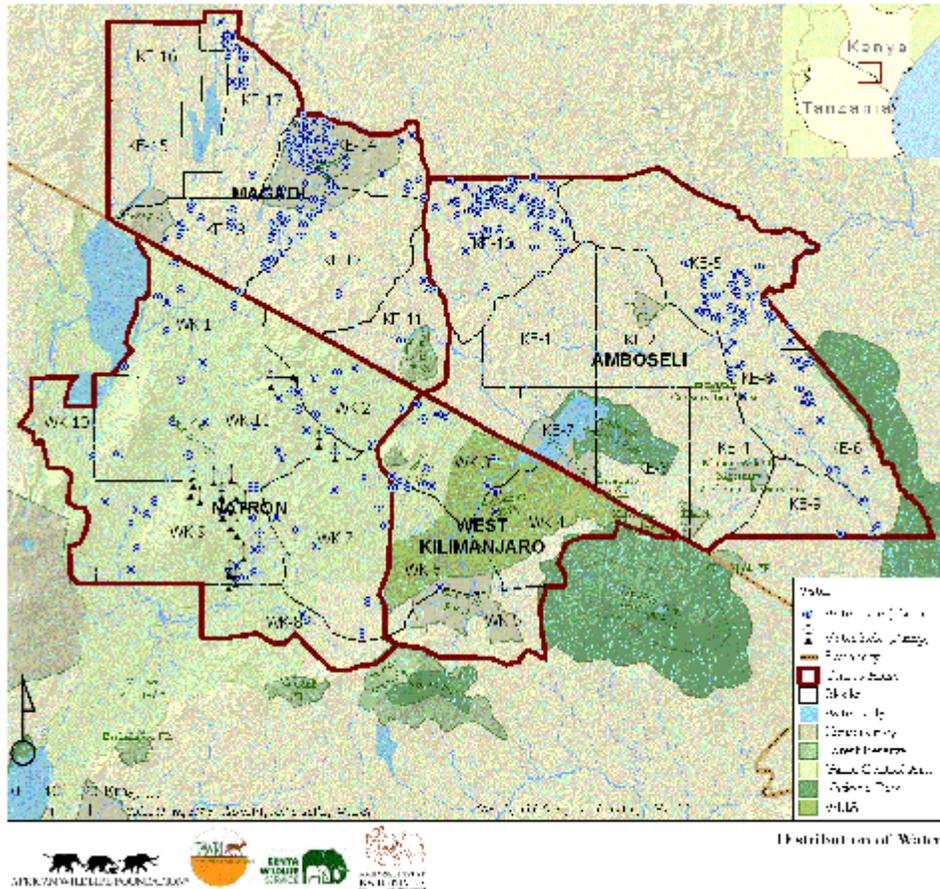


Figure 22 Distribution of water resources in the study area

Camels

There were 762 camels recorded in the survey area. The density of camels was highest in Amboseli (0.06 / km²), followed by Magadi (0.03 / km²) and was lowest in West Kilimanjaro (0.01/ km²). No camel was recorded in the Natron area (Table 3). Like other livestock species, most of the camels were recorded on the northern part of the survey area (Figure 25).

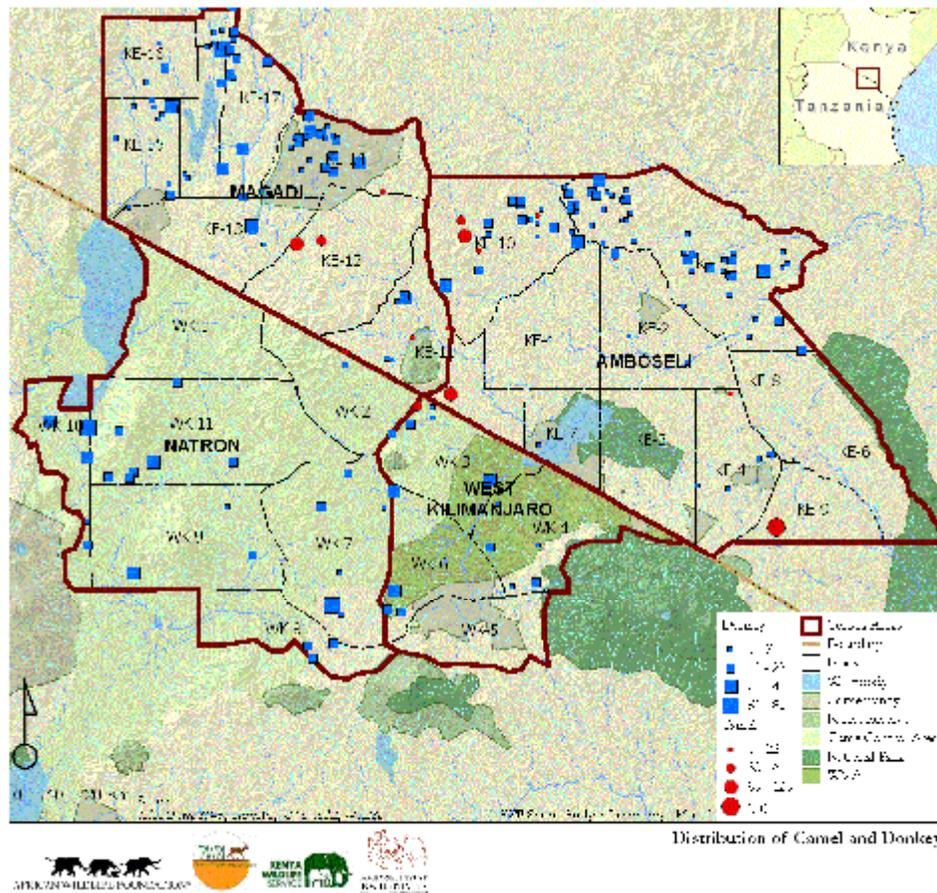


Figure 25 Distribution of Camels and Donkeys in the study area

Donkeys

A total of 2258 donkeys were counted in the entire survey area. The species was widely distributed in the surveyed area (Figure 25), with higher density recorded at Namanga-Magadi (0.14 / km²) followed by Natron (0.09 / km²) and both Amboseli and West Kilimanjaro had a similar lowest density of 0.07 / km².

Charcoal Production

Charcoal production was concentrated in the northern part of the survey area (Figure 27). The main areas under charcoal production were blocks KE 10 (Osilalei), K1 (Mailua), KE 11 (Meto), KE 14 (Elangata Wuas), KE 5 (Kaputiei), and KE 12 (Longorsua). Close to Amboseli National Park, Block KE-4, to the southern end of Kimana group ranch, towards Oloitokitok farmlands were the most affected.

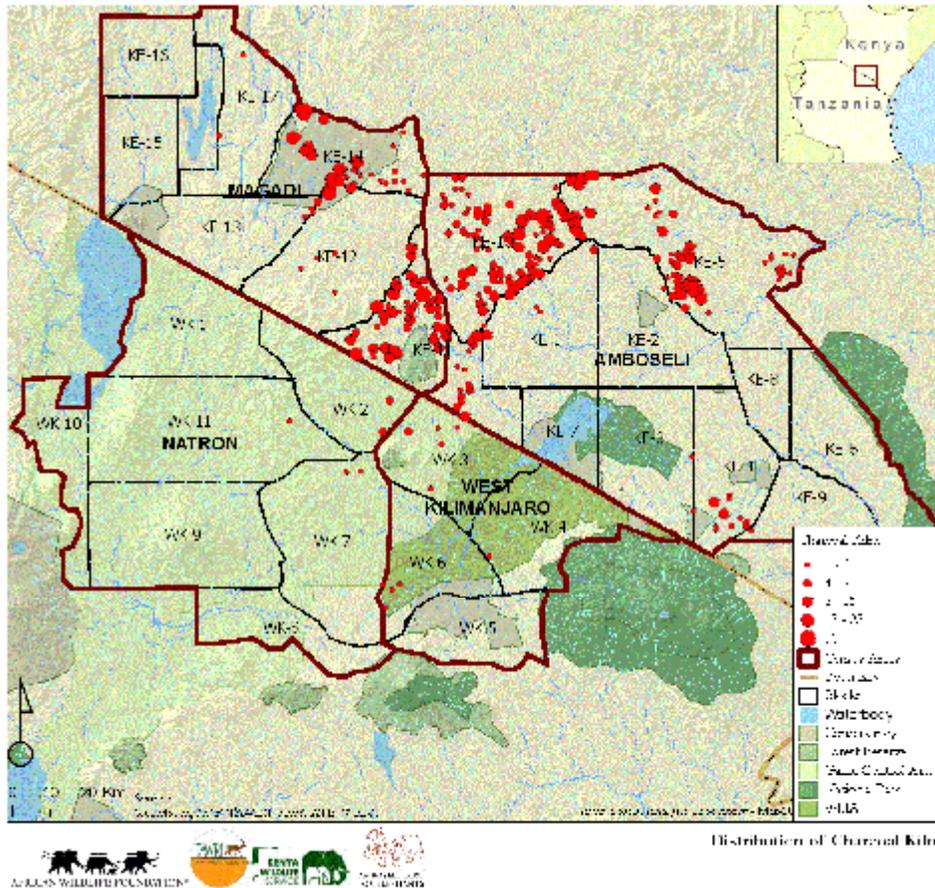


Figure 27 Distribution of charcoal kilns in the study area

Mining

Mining activities recorded were quarrying, hole mines for blue stones, open cast limestone mining and associated infrastructure such as camps and roads in the survey area. These activities were concentrated in block KE 5 in Kaputiei area and the major roads such as Emali-Oloitokitok road and Namanga-Arusha road (Table 3, Figure 28).

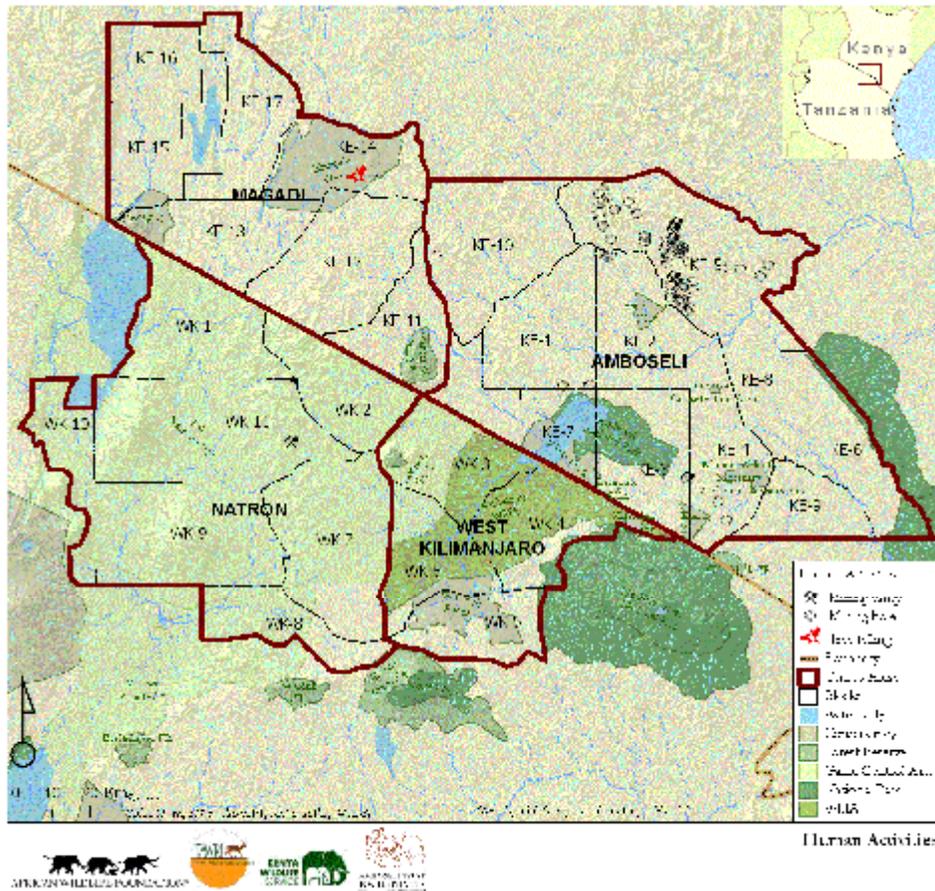


Figure 28 Distribution of mining activities in the study area

DISCUSSION

This survey is the first of its kind as it covered a large portion of the Amboseli-Kilimanjaro/ Magadi –Natron cross-border landscape and was conducted concurrently and collaboratively by several conservation stakeholders from both Kenya and Tanzania. Such survey arrangement has the potential to provide a better understanding of wildlife numbers and distributions in the entire ecosystem. This contrasts but enhances past surveys which were mainly confined to selected areas of the ecosystem; and which resulted in partial understanding of the broader landscape as a conservation unit.

The need to consider the entire study area as a conservation unit is apparent as the areas that compose the cross-border landscape namely; Amboseli, West Kilimanjaro, Namanga-Magadi and Lake Natron are ecologically and hydrologically interlinked. Wildlife move across and within the entire area with respect to prevailing seasonal weather changes. In addition, due to an erratic rainfall pattern and the existence of two distinct rain seasons, forage and surface water availability vary in turn affecting wildlife and livestock movements and distribution. Moreover, Mt. Kilimanjaro has a profound effect on the rainfall and water distribution of most parts of the surveyed area.

The results of this study showed that wildlife species are widely distributed in the ecosystem. This can be attributed to the predominant land-use that has remained largely pastoral thus allowing relative coexistence between humans, livestock and wildlife. In areas where crop farming and urban areas existed, the wildlife densities were low for example the Longido-Namanga area and the upper slopes of Mt. Kilimanjaro.

The current study highlights the effects of the 2007 - 2009 drought on the population of both wildlife and livestock species. Results indicate that there was a dramatic decline in a number of large herbivore species between the year 2007 and the year 2010. This decline can be attributed to the prolonged drought experienced in the area (Ndambuki and Kioko, 2009). Compared to the year 2007 census results (Ngoru and Mwangi, 2007), results from this census within the same spatial extent as the 2007 census show lower populations among several wildlife and livestock species. In the Amboseli area for example, wildebeest declined by about 83% (Figure 29) from 18,538 to 3098 individuals (Table 4) while zebra and buffalo declined by 71% and 63% from 15328 to 4432 individuals and 588 to 231 individuals respectively. In contrast however, Eland appeared to be hardy species that can survive drought conditions (Estes, 1991; Stuart and Stuart 2006) and only declined comparatively marginally by 8%. Table 4, provides comparison of selected animal species in Amboseli area while figure 28 expounds on population changes between 2007 and 2010 counts.

In the West Kilimanjaro area, the number of wildebeest decreased from about 813 in 2009 to 132 in 2010. Zebra declined from 3150 to 686 in the same period (TAWIRI, 2009). However, this should be interpreted with caution due to the different survey methods used in each period.

The present census showed that the Amboseli-West Kilimanjaro Ecosystem is extensively utilized for livestock keeping. However, livestock numbers declined in most part of the surveyed area probably due to drought-related mortalities between 2007 and 2009. In the Amboseli area for example, data from comparable blocks in the 2007 and 2010 censuses, (i.e. Blocks KE-1, KE-3, KE-4, KE-7 and KE- 9) show that cattle declined by 56% from about 40,703 (Ngoru and Mwangi, 2007) to 17,721 while shoats decreased by 62% from 69,605 to 26,274 in the same blocks excluding block KE- 7. In contrast, camels increased from 14 to 252. In the West Kilimanjaro area, cattle declined by 68% from 42,668 in the year 2009 to 13,422 in the year 2010. In the same period, shoats declined by 69% (TAWIRI, 2009). The high impact of the drought on the grazers can be attributed to overgrazing due to overstocking and reduced cattle mobility (Burnsilver et al., 2008).

Table 4: Comparison of animal numbers between 2007 and 2010 counts.

Animal species	2007	2010*
Baboon	60	11
Cape Buffalo	588	231
Cape Eland	1,161	1,061
African Elephant	967	1,266
Gerenuk	112	31
Maasai Giraffe	1,458	1,991
Grants gazelle	4,054	2,769
Common Hippopotamus	10	34
Impala	426	607
Kongoni	102	357
Lesser kudu	220	4
Fringe-eared Oryx	84	112
Maasai Ostrich	736	657
Thomson's gazelle	396	233
Warthog	31	18
Common Wildebeest	18,538	3,098
Common zebra	15,328	4,432
Total	44,293	16,965

* It is worth to note that the 2010 census covered the whole area covered in 2007 and much more hence comparisons is only made for common blocks in the two censuses.

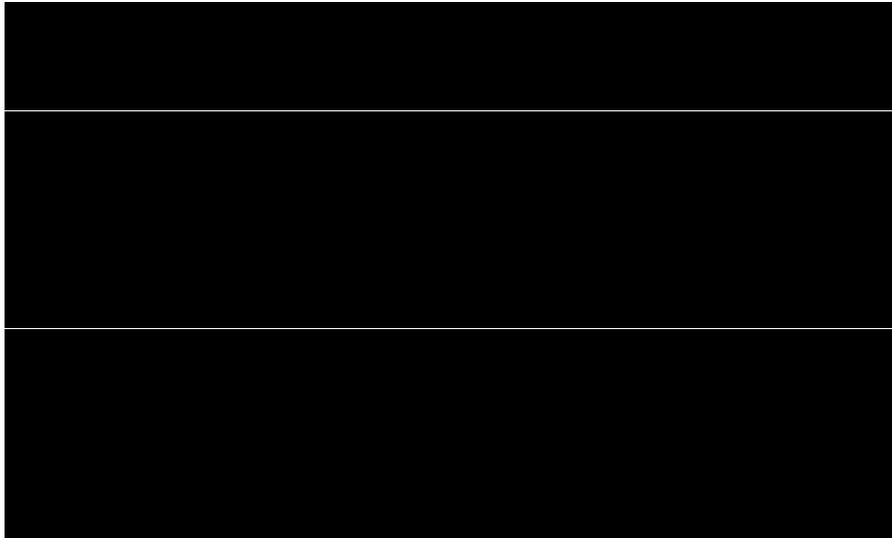


Figure 29 Change in population of some selected animal species within the Amboseli area between the year 2007 and year 2010. Same spatial extent has been used in comparison between the two censuses

Most of the wildlife species recorded during the census in the Amboseli area occurred outside Amboseli National Park. According to Obari (2007) and Ndambuki and Kioko (2009), past animal counts show high concentrations of wildlife around the swamps within the park during the dry season. The extensive distribution of wildlife species observed in the present census underscore the importance of the areas outside the park as wet season dispersal ranges for wildlife. During the wet season, forage and surface water are widely distributed hence animals move out of the park.

Four main elephant cluster areas were identified during the present survey and they include block KE-6 (Chyulu), Blocks KE-2, KE-3, KE-4, & WK-4 (Amboseli-West Kilimanjaro area), east of Lake Natron and block KE 15 (Nguruman area) of Magadi. These areas had a combined population of 1420 elephants. There was notable absence of elephants in Kimana sanctuary probably due to displacement by the high livestock numbers observed.

The Amboseli Elephant population is a subject of long term studies (Western 1973; Western, and Lindsay 1984; Moss 2001; Kioko et al. 2006). Trends from continuous monitoring show an increasing population since 1990s. Recent surveys show that the elephant population is relatively stable (1087 in 2000, 1090 in 2002 and 967 in 2007), compared to the present population numbers of 1266 counted within the same blocks. With reference to elephant ranging patterns, studies show that elephants move widely in the ecosystem (Poole & Reuling 1997). Elephants in Amboseli make seasonal movements into and out of the park (Western and Lindsay 1984). Although there may be no direct evidence linking the Magadi- Nguruman population with the Amboseli population, recent studies of collared elephants indicate that the Amboseli elephants wander to most of the West Kilimanjaro area and further into

Natron area which is also utilized by elephants from Magadi-Nguruman area (Kikoti, 2009). These studies suggest that there maybe more interactive elephant movements within the greater Amboseli-West Kilimanjaro ecosystem and that elephant numbers in one area need to be evaluated in the context of numbers within other areas. It is also possible that the slight fluctuations in elephant numbers recorded in previous counts could be accounted for by elephant movements since most of the previous counts focused on relatively smaller areas of the ecosystem.

Elephants found in the extreme east end of the study area could be of the Chyulu-Amboseli meta-population. The estimates from known individuals suggest that there were about 1,500 individuals in the area before the drought and about 200 deaths occurred as a result of drought and/or poaching (Moss *pers com*, 2010). Considering these deaths and elephant movement into West Kilimanjaro, it can be estimated that Amboseli- West Kilimanjaro area (Park and adjacent group ranches) had 1,353 elephants.

The number of carcasses (54) recorded during the census may not be a true reflection of drought and/or poaching-related mortalities in the survey area. This figure is most likely an under count given the widths of transects used in the census (1-2) KMs and that the count was done in the wet season. Hamilton and Burrell (1991) recommend that carcass numbers be evaluated using narrower transects of about 200 Meters and preferably during dry seasons when carcasses are less likely to be hidden in vegetation. They further suggest that should the above conditions not be met, the carcass figures need to be worked upwards to factor in the ones missed. In this survey however, none of these requirements have been done which therefore limits further inferences into the causes of elephant mortalities from carcass ratios recorded in this survey. It is however noted that all elephant carcasses recorded were located along water sources (swamps in Amboseli and along rivers), indicating that mortalities were probably drought-related.

The population of baboons is an underestimate as it is hard to detect the species from the air. An earlier ground survey yielded 142 olive baboons in Amboseli National Park alone. The Amboseli baboon population is part of a larger extended population of baboons in southern Kenya and northern Tanzania that roam widely within the survey area (Loisel et al. 2006). The method too underestimated the lion population as well as hyena due to crepuscular and/or nocturnal nature of their behavior.

There are glaring changes in land-use and land tenure, particularly the introduction of crop farming, charcoal burning and development of urban centers. Both rain-fed and irrigated farms are rapidly encroaching into the wildlife dispersal area on the south eastern range of the Amboseli area. Several clusters of irrigated farming on the eastern range of the Amboseli National Park had taken up the dry season wildlife and livestock foraging

area. The net effect of this endeavor is reduction of available graze/browse for livestock and wildlife. Furthermore, charcoal burning in the area has detrimental effects through loss of browse for species such as giraffe and elephant, and further leads to habitat degradation.

Wildlife and settlements are mutually exclusive due to displacement effects. Increased proliferation of human settlements in wildlife areas leads to habitat fragmentation, habitat loss and associated human-wildlife conflicts such as crop raiding by wildlife. While most of the settlements were of the traditional Maasai model, the high number of corrugated roofed houses shows an emerging culture change within the Maasai community and/or influx of immigrants into Maasai land. Some of the areas have excluded wildlife as they are now fenced such as the Kimana and Namelok fences that cover a combined area of over 63km².

CONCLUSIONS AND RECOMMENDATIONS

The current survey underpins the importance of the Amboseli-Kilimanjaro/Magadi -Natron cross-border landscape as a wildlife conservation and dispersal area. While much of the wildlife species were found in the Amboseli area, there is evidence of high connectivity in terms of wildlife movement in the entire study area. Migratory species such as elephants, wildebeest, zebra and eland move within and across the various constituent areas of the landscape hence data from a particular area need to be evaluated in the context of the broader landscape and not in isolation.

The 2007-2009 drought had significant effects on the populations of wildebeest, zebra and buffalo. While the population of wildebeest and zebra declined by more than 70%, there is still substantial remnant populations that is fairly well distributed and will recover given favorable conditions. However given the reduced prey base for carnivores, closer study of herbivore numbers is required to monitor recovery of the populations. In contrast, the Amboseli elephants remained stable and utilized the Amboseli National Park as an important drought period refuge, although they made long range movements outside the park.

The decreased cattle numbers is likely to have major adverse effects on the economic livelihoods of the local communities. High numbers of charcoal kilns recorded especially on the Kenyan territory is a warning signal that all is not well as far as environmental conservation is concerned. There is grave danger of habitat degradation unless concerned parties move with speed to stem the practice.

Recommendation

- ✓ There is need for a dry season aerial count in 2010, to establish seasonal changes in numbers and distribution of wildlife
- ✓ Regular total aerial surveys to monitor wildlife populations in the region preferably a dry and a wet count once in every three years
- ✓ Continued collaboration and information exchange among conservation stakeholders across the border.
- ✓ Collaborative and improved law enforcement to prevent wildlife crimes including poaching and wanton habitat destruction, for instance charcoal burning
- ✓ Coordinated ecosystem wide research and data sharing among the stakeholders

- ✓ There is need for harmonized wildlife management policies between Kenya and Tanzania

ACKNOWLEDGEMENTS

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Appendices

Appendix 1: Amboseli-West Kilimanjaro checklist of Species recorded in the census -

Mammals

Common Name	Scientific Name
Baboon	<i>Papio cynocephalus</i>
African Buffalo	<i>Syncerus caffer</i>
Bushbuck	<i>Tragelaphus scriptus</i>
Cheetah	<i>Acinonyx jubatus</i>
Dikdik	<i>Madoqua kirkii</i>
Duiker	<i>Sylvicapra grimmia</i>
Eland	<i>Taurotragus oryx</i>
African Elephant	<i>Loxodonta africana</i>
Gerenuk	<i>Litocranius walleri</i>
Maasai Giraffe	<i>Giraffa camelopardalis</i>
Grant's Gazelle	<i>Gazella granti</i>
Hartebeest	<i>Alcelaphus buselaphus</i>
Hippopotamus	<i>Hippopotamus amphibius</i>
Impala	<i>Aepyceros melampus</i>
Kongoni	<i>Alcelaphus buselaphus</i>
Lesser Kudu	<i>Tragelaphus imberbis</i>
Lion	<i>Panthera leo</i>
Fringe-Eared Oryx	<i>Oryx beisa callotis</i>
Spotted Hyena	<i>Crocuta crocuta</i>
Thomson's Gazelle	<i>Gazella thomsoni</i>
Warthog	<i>Phacochoerus aethiopicus</i>
Common Waterbuck	<i>Kobus ellipsiprymnus</i>
Common Wildebeest	<i>Connochaetes taurinus</i>
Plains Zebra	<i>Equus burchelli</i>

Birds

Ostrich	<i>Struthio camelus</i>
Kori Bustard	<i>Ardeotis kori</i>
Secretary bird	<i>Sagittarius serpentarius</i>
Crowned Crane	<i>Balearica regulorum</i>

Appendix 2: Summary of Wildlife numbers by blocks Namanga - Magadi area.

AREAS (Size KM ²)	(A)NAMANGA - MAGADI (5513 Km ²)							
BLOCK SPECIES	KE-11A*	KE-12	KE-13	KE-14	KE-15	KE-16	KE-17	Total
Common Zebra	0	18	628	120	2399	503	178	3846
Grants Gazelle	0	76	503	834	1303	289	460	3465
Common Wildebeest	4	0	60	2	1502	1	35	1604
Maasai Giraffe	0	115	136	40	237	141	111	780
Eland	16	25	22	59	6	101	18	247
African Elephant	0	0	0	0	48	0	0	48
Maasai Ostrich	0	11	45	58	167	50	4	335
Impala	20	40	12	15	314	57	5	463
Kongoni/Hartebeest	0	0	0	0	0	0	0	0
Thomson's Gazelle	17	3	19	0	0	5	0	44
African Buffalo	0	0	0	0	52	10	0	62
Fringe - Eared Oryx	0	0	1	8	6	9	0	24
Baboon	0	0	0	0	121	1	12	134
Gerenuk	0	0	0	2	1	2	0	5
Cheetah	0	0	0	0	0	0	0	0
Hippopotamus	0	0	0	0	0	0	0	0
Warthog	0	0	0	0	1	6	0	7
Elephant carcass	0	0	0	0	0	0	0	0
Grey Crowned Crane	0	0	0	0	0	0	0	0
Lesser Kudu	0	0	0	1	0	0	0	1
Lion	0	0	0	0	0	0	0	0
Bushbuck	0	0	15	0	178	0	0	193
Dik Dik	0	0	0	0	3	0	0	3
Common Waterbuck	0	0	0	0	2	0	0	2
Spotted Hyena	0	0	0	0	0	0	0	0
Duiker	0	0	0	0	0	0	0	0

*Part of Block 11 West of Namanga- Nairobi road

Appendix 2B: Summary of wildlife numbers by block - Natron area

AREAS (Size KM²)	(B)NATRON (7047 Km²)							
BLOCKS								
SPECIES	WK-1	WK-10	WK-11	WK-2	WK-7	WK-8	WK-9	Total
Common Zebra	313	496	337	137	220	121	1555	3179
Grants Gazelle	168	0	149	13	28	4	543	905
Common Wildebeest	66	126	108	0	45	138	1611	2094
Maasai Giraffe	167	4	311	96	70	30	160	838
Cape Eland	5	0	17	53	11	16	22	124
African Elephant	0	0	17	0	0	0	2	19
Maasai Ostrich	44	40	19	7	20	26	33	189
Impala	7	0	0	47	8	0	16	78
Kongoni/Hartebeest	2	0	9	5	9	0	0	25
Thomson's Gazelle	40	0	10	8	45	20	222	345
African Buffalo	4	0	33	0	0	0	0	37
Fringe - Eared Oryx	0	0	0	0	0	0	0	0
Baboon	0	0	0	0	0	0	0	0
Gerenuk	1	0	11	5	11	0	0	28
Cheetah	0	0	0	0	0	0	0	0
Hippopotamus	0	0	0	0	0	0	0	0
Warthog	2	0	0	2	2	0	4	10
Elephant carcass	0	0	1	0	0	0	0	1
Grey Crowned Crane	0	0	0	0	0	0	0	0
Lesser Kudu	0	0	0	5	1	0	0	6
Lion	0	0	0	0	0	0	0	0
Bushbuck	0	0	0	0	1	0	0	1
Dik Dik	0	0	2	0	0	0	4	6
Common Waterbuck	0	0	0	0	3	11	0	14
Spotted Hyena	1	0	0	0	0	0	0	1
Duiker	0	9	0	0	0	0	0	9

Appendix 2C: Summary of Wildlife numbers by block- Amboseli Area

AREAS (Size KM ²)	(C)AMBOSELI (8797 Km ²)											
Blocks												
Species	KE-1	KE-10	KE-11B*	KE-2	KE-3	KE-4	KE-5	KE-6	KE-7	KE-8	KE-9	Total
Common Zebra	414	314	47	240	1062	982	1289	679	437	311	254	6029
Grants Gazelle	390	603	14	201	734	390	519	589	129	166	170	3905
Common Wildebeest	178	22	5	76	882	456	309	247	151	1048	36	3410
Maasai Giraffe	377	16	97	78	88	379	185	430	20	310	303	2283
Cape Eland	282	22	33	42	8	264	505	51	38	62	314	1621
African Elephant	24	20	0	0	785	32	8	115	257	0	51	1292
Maasai Ostrich	51	49	15	117	102	124	155	45	83	106	29	876
Impala	15	66	26	2	90	226	54	141	12	9	112	753
Kongoni/Hartebeest	10	0	0	25	6	0	20	292	0	0	24	377
Thomson's Gazelle	0	0	17	9	23	17	81	135	43	3	3	331
African Buffalo	0	4	0	0	206	0	0	3	22	0	0	235
Fringe - Eared Oryx	0	56	0	0	8	20	0	0	0	84	0	168
Baboon	0	20	0	0	0	1	45	0	0	10	0	76
Gerenuk	7	22	0	3	6	2	20	0	0	13	0	73
Cheetah	0	2	0	0	0	0	14	0	0	0	50	66
Hippopotamus	0	15	0	0	23	0	0	0	11	0	0	49
Warthog	0	5	3	0	2	8	3	2	4	2	0	29
Elephant carcass	0	0	0	0	26	3	1	8	0	0	3	41
Grey Crowned Crane	0	10	0	0	0	0	1	2	0	0	0	13
Lesser Kudu	1	0	0	0	0	3	6	0	0	0	0	10
Lion	0	0	0	0	0	0	0	2	1	0	0	3
Bushbuck	0	0	0	0	0	0	0	0	0	0	0	0
Dik Dik	0	0	0	0	0	0	0	0	0	0	0	0
Common Waterbuck	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Hyena	0	0	0	0	0	0	0	0	0	0	0	0
Duiker	0	0	0	0	0	0	0	0	0	0	0	0

*Part of Block 11 East of Namanga- Nairobi road

Appendix 2D: Summary of wildlife numbers by block -West Kilimanjaro area

AREAS (Size KM ²) BLOCKS	(D)WEST KILIMANJARO (3014 Km ²)				Total
	WK-3	WK-4	WK-5	WK-6	
SPECIES					
Common Zebra	314	192	0	180	686
Grants Gazelle	34	23	0	30	87
Common Wildebeest	32	65	0	35	132
Maasai Giraffe	98	60	0	105	263
Cape Eland	0	0	0	0	0
African Elephant	0	49	12	0	61
Maasai Ostrich	20	7	0	34	61
Impala	12	0	0	11	23
Kongoni/Hartebeest	39	0	0	0	39
Thomson's Gazelle	20	2	80	111	213
African Buffalo	0	0	0	0	0
Fringe - Eared Oryx	4	0	0	0	4
Baboon	0	0	0	22	22
Gerenuk	11	0	0	0	11
Cheetah	0	0	0	0	0
Hippopotamus	0	0	0	0	0
Warthog	0	0	0	0	0
Elephant carcass	0	0	0	1	1
Grey Crowned Crane	0	0	0	0	0
Lesser Kudu	4	0	0	0	4
Lion	0	0	0	0	0
Bushbuck	0	0	0	0	0
Dik Dik	4	0	0	0	4
Common Waterbuck	0	2	0	0	2
Spotted Hyena	0	0	0	4	4
Duiker	0	0	0	0	0

Appendix 3 Summary of wildlife species densities by areas

	Area (Size) Species	MAGADI (5513 Km ²)	AMBOSELI (8797Km ²)	W/KILI (3014 Km ²)	NATRON (7047km ²)
1	Common Zebra	0.698	0.685	0.228	0.451
2	Grant Gazelle	0.629	0.444	0.029	0.128
3	Common Wildebeest	0.291	0.388	0.044	0.297
4	Maasai Giraffe	0.141	0.260	0.087	0.119
5	Eland	0.045	0.184	0.000	0.018
6	Maasai Ostrich	0.061	0.100	0.020	0.027
7	African Elephant	0.009	0.147	0.020	0.003
8	Elephant Carcass	0.000	0.005	0.004	0.000
9	Impala	0.084	0.086	0.008	0.011
10	Thomson's Gazelle	0.008	0.038	0.071	0.049
11	Kongoni/ Hartebeest	0.000	0.043	0.013	0.004
12	African Buffalo	0.011	0.027	0.000	0.005
13	Baboon	0.024	0.009	0.007	0.000
14	Fringe -Eared Oryx	0.004	0.019	0.001	0.000
15	Bushbuck	0.035	0.000	0.000	0.000
16	Gerenuk	0.001	0.008	0.004	0.004
17	Hippopotamus	0.000	0.006	0.000	0.000
18	Warthog	0.001	0.003	0.000	0.001
19	Common Waterbuck	0.000	0.002	0.001	0.002
20	Dik Dik	0.001	0.000	0.001	0.001
21	Grey Crowned Crane	0.000	0.001	0.000	0.000
22	Duiker	0.000	0.000	0.000	0.001
24	Spotted Hyena	0.000	0.000	0.001	0.000
25	Lesser Kudu	0.000	0.001	0.001	0.001
26	Lion	0.000	0.000	0.000	0.000
27	Cheetah	0.000	0.000	0.000	0.000
	Total	2.043	2.455	0.540	1.122

Appendix 4: List of report writing participants

#	Name	Institution
1	John Kioko	ATE
2	Dr. Alfred Kikoti	AWF
3	Rose Mayienda	AWF
4	Lekishon Kenana	KWS
5	Daniel Muteti	KWS
6	Joseph Edebe	KWS
7	Stephen Ndambuki	KWS
8	Honori Maliti	TAWIRI
9	Samwel Bakari	TAWIRI
10	Edeus Massawe	TAWIRI
11	Hamza Kija	TAWIRI

LIST OF SURVEY PARTICIPANTS - KENYA

Appendix 5: List of participants from Kenya

#	Name	Institution
Coordination		
1	Lekishon Kenana	SCA-KWS
2	Stephen Ndambuki	Amboseli NP-KWS
Front Seat Observers (FSO)		
1	David Kimutai	HQ-KWS
2	Elphas Bitok	TCA-KWS
3	Godfrey Bundotich	ECA-KWS
4	Shadrack Ngene	TCA-KWS
5	Sospeter Kiambi	CRCA-KWS
6	Cedric Khayale	TCA-KWS
7	Stephen Ndambuki	Amboseli NP-KWS
Rear Seat Observers (RSO)		
1	Daniel Muteti	SCA-KWS
2	Joel Lesale	SCA-KWS
3	Kenneth Kimitei	TCA-KWS
4	Galma Wario	Amboseli NP-KWS
5	Soila Sayialel	Amboseli-ATE
6	Norah Njiraini	Amboseli-ATE
7	John Kioko	Amboseli-ATE
8	Joseph Edebe	HQ-KWS
9	John Kariuki	TCA - KWS
10	Joseph Nyongesa	Amboseli NP-KWS
11	Raymond Kato	UWA-UG
12	Roselyn Aseyo	Amboseli NP-KWS
13	Robert Sayialel	Amboseli-ATE

#	Name	Institution
14	Godfrey Bundotich	ECA-KWS
15	Cedric Khayale	TCA-KWS
Data Entry Personnel		
1	Christine Mwinzi	SCA-KWS
2	Jackie Ben	HQ-KWS
3	Jackie Muturi	HQ-KWS
4	Eston Kimaswoch	HQ-KWS
5	Faith Mutavi	HQ-KWS
6	Peter Kimani	HQ-KWS
7	Peter Maina	HQ-KWS
8	Peter Hongo	HQ-KWS
9	Natalie Waithera	HQ-KWS
GIS Personnel		
1	Daniel Muteti	SCA-KWS
2	Lekishon Kenana	SCA-KWS
Aircraft Attendant		
2	Dominic Mumo	Air wing-KWS
Aircraft Technicians		
1	Samson Sanare	Air wing-KWS
2	Alfred Mutinda	Air wing-KWS
Pilots		
1	Peter Zanetti	Mwaluganje Elephant Sanctuary
3	Harvey Croze	ATE
4	Captain Ochieng	HQ-KWS
5	Captain Mwangi	HQ-KWS
6	Robert Obrien	HQ-KWS
Community Representatives		
1	John Marinka	
2	Solomon Lompaa	
3	Samuel Kangi	
4	Richard Supet	
5	Luka Kipaa	Area councilor
6	Noah Kitesho	Area chief
Drivers		
1	Mugambi	HQ-KWS
2	Bernard Mwanza	SCA-KWS
3	Charles	ECA-KWS
4	Mohamed Guyo	Tsavo East NP-KWS
5	Nyaga	Amboseli NP-KWS
6	Emanuel Mwatsuma	Amboseli NP-KWS
7	Nicodemus Masila	AWF
Officials		
1	Wilson Korir	SCA-KWS

#	Name	Institution
2	Erustus Kanga	HQ-KWS
3	Fiesta Warinwa	AWF
4	Adan Kalla	Amboseli NP-KWS

LIST OF SURVEY PARTICIPANTS - TANZANIA

Appendix 6 List of participants from Tanzania

#	Name	Institution
Coordination		
1	Honori Maliti	TAWIRI
2	Dr. Alfred Kikoti	AWF/TAWIRI
Front Seat Observers (FSO)		
1	Hamza Kija	TAWIRI
2	Samwel Bakari	TAWIRI
Rear Seat Observers (RSO)		
1	Edeus Massawe	TAWIRI
2	Nelson Ole Kuwai	TANAPA
Data Entry Personnel		
1	Hadia Haji	TAWIRI
	Zuena	TAWIRI
2	Chediell Kazaeli	TAWIRI
GIS Personnel		
1	Hamza Kija	TAWIRI
2	Honori Maliti	
Pilots		
1	Benard Shayo	Wildlife Division-TZ
2	Mackiyu Kajwangya	TANAPA

Appendix 7: Summary of human activities by blocks- Namanga and Natron areas

blocks activities	NAMANGA MAGADI							NATRON							TOTAL
	KE-11A	KE-12	KE-13	KE-14	KE-15	KE-16	KE-17	WK-1	WK-10	WK-11	WK-2	WK-7	WK-8	WK-9	
Agriculture/Cultivation	96	2		14	1	1							2	14	
Boma abandoned		2	13					50	10	69	19	46		29	238
Camel	64	130		5											199
Cattle	1428	360	4754	5737	1605	1022	1692	1073	3676	5501	867	3077	3594	4950	39336
Cattle dip											2	2	1		5
Charcoal kiln	874	73	5	259			3			2	9	2			1227
Donkey	104		48	219	73	28	329		333	115	6	110	45	58	1468
Hut with mabati roof	276	11		1	2	13	12			6					321
Maasai boma - Occupied	520	69	207	575	664	190	312	35	74	388	61	327	65	189	3676
Market Place	4	1	2	7	2	0	2								18
Mining camp										1					1
Mining hole				1											1
Poachers camp															0
School	12	9	0	8		1	5								35
Sheep and Goats	4846	2420	19243	13037	10532	4817	17497	1640	2930	13532	2246	4372	5794	12741	115647
Tourist Camp				1	1										2
Water hole (Dam)	8	8	25	88			30	14	8	28	9	23	5	56	302
Water hole (Pump)										10				27	37

Appendix 8: Summary of human activities by block- Amboseli and West Kilimanjaro area

Blocks	AMBOSELI											WEST KILIMANJARO				TOTAL
	KE-1	KE-10	KE-11B	KE-2	KE-3	KE-4	KE-5	KE-6	KE-7	KE-8	KE-9	WK-3	WK-4	WK-5	WK-6	
Agriculture/Cultivation	1	3	2		5	34	68	4		20	21				20	178
Boma abandoned	1		1	1					15			28	7		27	80
Camel		201	80	1		1					250	30				563
Cattle	2085	11540	1062	991	2343	7922	12020	3551	403	1050	4968	1616	2641	6088	2817	61097
Cattle dip			1									2				3
Charcoal kiln	39	561	115	2	2	35	409				1	9	1		8	1182
Donkey		190		21		19	331		4			74	45		106	790
Hut with mabati roof	20	83	425	29	13	4	702	14	10	7	22		1		9	1339
Maasai boma - Occupied	26	818	171	124	50	416	841	76	40	179	85	113	31	1	94	3065
Market Place	1	3	4	3		3	9	1	1	2	3					30
Mining camp						2	5									7
Mining hole	21	1		8		3	72									105
Poachers camp													1			1
School	7	10	2	3	0	4	11	2		5	3					47
Sheep and Goats	5085	30328	3267	3489	2381	11066	26903	5316	965	2391	7742	4134	2492	3450	5392	114401
Tourist Camp		2		2	2		1	1	1							9
Water hole (Dam)	1	80					38	17		7	1	25	2		8	179
Water hole (Pump)																0