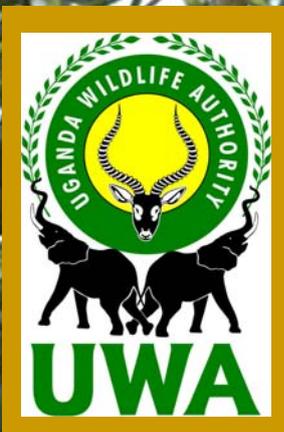


Strategic Action Plan for Large Carnivore Conservation in Uganda



2010-2020

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- Makerere University Biological Field Station
- Makerere University Department of Zoology
- Makerere University Wildlife and Animal Resource Management
- Ministry of Tourism, Trade and Industry
- Panthera Foundation
- Uganda Wildlife Authority
- Wildlife Conservation Society
- World Wide Fund for Nature
- Zoological Society of London

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Table of contents

Acknowledgements.....	2
Table of Contents.....	3
Abbreviations.....	4
Foreward	5
Executive Summary	6
Introduction	8
The status of large carnivores in Uganda	10
Lion.....	10
Queen Elizabeth National park.....	10
Murchison Falls National Park.....	11
Kidepo Valley National Park.....	12
Lake Mburo National Park.....	13
Toro-Semliki Wildlife Reserve.....	13
Other sites.....	14
Total number of lions in Uganda.....	14
Spotted Hyaena.....	15
Queen Elizabeth National Park.....	15
Murchison Falls National Park.....	16
Kidepo Valley National Park.....	16
Other sites.....	17
Leopard.....	19
Queen Elizabeth National Park.....	19
Murchison Falls National Park.....	20
Kidepo Valley National Park.....	20
Lake Mburo National Park.....	21
Mt Elgon National Park.....	22
Toro-Semliki Wildlife Reserve.....	22
Cheetah.....	23
African Wild Dog.....	24
Strategic Action Plan	25
Strategic Action Plan development.....	25
Problem trees.....	26
Problem tree for lions.....	27
Problem tree for leopards.....	28
Problem tree for hyaenas.....	29
Vision, goal and objectives.....	30
Objective 1. Habitat Loss and Degradation.....	31
Objective 2. Poaching of carnivores/prey.....	32
Objective 3. Human-carnivore conflict.....	33
Objective 4. Raise awareness/support for large carnivores in Uganda.....	34
Objective 5. Monitor and tackle diseases.....	35
Objective 6. Research and monitoring.....	36
Action plan Implementation.....	37
References	38
Appendix 1. Status and population dynamics of lions in northern QENP.....	40
Appendix 2. Status and population dynamics of lions in Ishasha, QENP.....	41
Appendix 3. National census of lions and hyaenas in Uganda.....	58

Abbreviations

AWF	– African Wildlife Foundation
CBO	– Community-based organisation
CTPH	– Conservation through public health
Hyaena	– Spotted Hyaena
ITFC	– Institute of Tropical Forest Conservation
IUCN	– International Union for the Conservation of Nature
LG	– Local Government
MAAIF	– Ministry of Agriculture, Animal Industry and Fisheries
MTTI	– Ministry of Tourism Trade and Industry
MUK	– Makerere University
NEMA	– National Environment Management Authority
NFA	– National Forestry Authority
NGO	– Non-governmental organisation
Se.	– Standard Error
UNCST	– Uganda National Council for Science and Technology
UWA	– Uganda Wildlife Authority
WARM	– Wildlife and Animal Resource Management Department, Makerere University
WCS	– Wildlife Conservation Society
WCU	– Wildlife Clubs of Uganda
WWF	– World Wide Fund for Nature

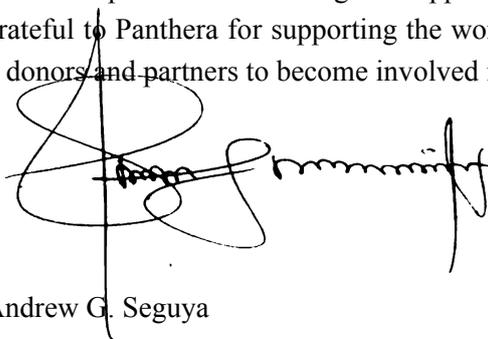
Foreword

Large Carnivores form part of the culture of any community on Earth. Whether its is the tales told in the village in Africa about lions, hyaenas and leopards or the fairy tales from Europe about wolves and bears. They convey the 'wildness' of a place and their presence usually is an indicator that an ecosystem is intact as they are often the first species to disappear. Large carnivores in Africa, particularly in the savannas of Eastern and Southern Africa, are a great attraction for tourists and draw large numbers of visitors from around the World.

Uganda contains five large carnivore species: lion, leopard, cheetah, hyaena and African wild dog. All of them occur at low density and their populations contain less than 150-200 individuals. In the case of cheetahs and wild dogs the numbers are probably less than 20 individuals. Conservation of these species is critical for Uganda's tourism industry which not only benefits the national economy but also benefits the people living at the edges of the parks through the revenue sharing scheme that Uganda Wildlife Authority (UWA) has with the District and sub-county authorities.

Numbers of lions are known to have been declining over the past 10 years (and this is probably true for all of the large carnivore species) and so it is timely that UWA together with its partner organizations, particularly with the support of the Wildlife Conservation Society (WCS), has developed the first large carnivore action plan for the country. This plan identities key objectives and activities that need to be implemented in order to address the threats to large carnivores and that are contributing to their declining populations. In particular these include poisoning of livestock carcasses killed by the carnivores in retaliation for the killing, and snaring of animals either accidentally in snares set for antelopes or deliberately for body parts.

UWA and its partners are looking for support to implement this plan over the coming 10 years. We are grateful to Panthera for supporting the workshop that led to this plan and hope that it will inspire other donors and partners to become involved in the implementation of the plan.



Dr. Andrew G. Seguya

Executive Director, Uganda Wildlife Authority

Executive Summary

Lions and other large carnivores are some of the greatest attractions for any ecotourism business in Africa. They are the quintessential species that come to mind when people think about the African savanna. They are also some of the most threatened species in Africa because of their conflict with man. Uganda hosts five large carnivore species: lion, leopard, hyaena, cheetah and African wild dog. An assessment of these five species shows that while many of them were widespread only 50 years ago now most are confined to protected areas and populations are declining even within these protected areas. After mountain gorillas, the large carnivores are the species tourists come to Uganda to see. As Tourism is Uganda's highest foreign currency earner these large predators also play an important economic role in the development of Uganda.

In April 2010 a workshop was held to develop a ten year strategic action plan for these large carnivores which brought together the different protected areas, the Ministry of Tourism Trade and Industry, International NGOs and National Universities to pool the current knowledge about the species and to develop the plan. The overall vision and goal were defined as follows:

Vision: *Populations of large carnivores increased to viable numbers or managed for long term viability, playing their functional roles in the ecology of the sites and with minimized conflicts with local community members. Large Carnivores generating tangible community (vital stakeholders) benefits from responsible consumptive and non-consumptive uses and substantial national and local support for their conservation.*

Goal: *By 2020 large carnivore populations increasing in protected areas and stabilized outside protected areas in Uganda.*

The following six objectives were identified from an assessment and prioritisation of threats (the threats addressed are identified in parentheses):

Objectives for 10 year plan:

1. Maintain and manage at least 100% of suitable habitats for large carnivores inside protected areas and 60% outside protected areas (Threats:Habitat loss and fragmentation).
2. Reduce poaching of large carnivores and their prey inside and outside protected areas to a point that populations are stable or increasing (killing for body parts, lack of prey)
3. Reduce conflict between livestock owners and large carnivores to levels that do not impact population viability adversely (Threats: poisoning, killing over livestock loss, grazing in protected areas and poor livestock husbandry).
4. Increase national awareness and support for large carnivore conservation among political leaders, law enforcement agencies (including judiciary), communities living with large carnivores and school children (future leaders)- (Threats:political interference, negative attitudes by people, road kills).
5. Establish a health monitoring and management program for carnivores in Uganda. (disease)
6. Map distribution and abundance of large carnivores in Uganda, monitor their populations, and quantify the major threats to their long-term survival (lack of knowledge).

Specific projects to achieve these objectives were identified and are documented in the plan with the prioritization of the project and estimated costs.



1. Introduction

Large carnivores are an important component of any functioning ecosystem. They regulate ungulate population numbers and help keep disease outbreaks down by killing off the sick and weak individuals in the population. They are also iconic species that both have cultural values in Uganda, as well as global recognition as species of conservation significance, representing values of the wild and being prominent in history and folklore. Five large carnivores are found in Uganda: lion (*Panthera leo*); leopard (*Panthera pardus*); spotted hyaena (*Crocuta crocuta*); cheetah (*Acinonyx jubata*) and African wild dog (*Lycaon pictus*). Other smaller carnivores such as the golden cat (*Felis aurata*), serval (*Felis serval*), side-striped (*Canis adustus*), golden (*Canis aureus*) and black-backed jackals (*Canis mesomelas*) and ratel (*Ratel ratel*) are also found in Uganda together with smaller carnivorous species such as mongooses, otters and genets but these species are not addressed in this plan.

Large carnivores are an important attraction for Uganda's Tourism Industry and after Mountain Gorillas (*Gorilla beringei beringei*) are the most sought after species by tourists (Plumptre and Roberts, 2006). Tourism is Uganda's highest foreign currency earner and is steadily growing as the country is becoming better known around the World. However, the ecotourism in Uganda is very much dependent on its mountain gorillas to attract tourists from elsewhere. The presence of large carnivores in parks such as Queen Elizabeth and Murchison Falls keeps tourists staying in the country and spending their income rather than flying in from Kenya or Tanzania as often happens in a place like Rwanda which does not have the large savanna animals that tourists seek. Their ability to be seen and photographed by tourists is therefore a key factor in keeping tourists in Uganda and helping the economy of the country grow. If they became too rare to be seen then this could have significant impacts on Uganda's tourism industry.

The numbers of large carnivores are known to have been slowly decreasing in Uganda as human population increases and habitat is lost. Current human population estimates are around 32 million people, with one of the highest population growth rates in the World at 2.5-3.0% per year. This increasing human population is still very much dependent on subsistence agriculture and the demand for and price of land has been increasing rapidly in the country. People are settling in what used to be fairly natural habitat and over the past 40 years there has been a major conversion of natural habitat to agricultural land. Most large carnivores are now confined to protected areas having been displaced by this land conversion or hunted out because they posed a threat to people. Of the five large carnivores considered in this plan only one, the leopard, is known to occur at any abundance outside protected areas. The others are occasionally sighted on private land but are usually moving through looking for somewhere to settle.

Appendix three summarises some of the historical census data for lions in Uganda and indicates that their numbers have been declining by at least 3% per year over the past 10 years and the same is likely to be true for hyaenas. Leopards are likely to have declined even more drastically because of their widespread presence outside protected areas but no data are available on their numbers. Recent camera trap surveys of forests in western Uganda by the Wildlife Conservation Society (WCS) show that there are probably no leopards left in most of these forests (None captured in Bwindi, Kalinzu, Kasyoha-Kitomi, Kibale, Budongo and Rwenzori forests; one leopard photographed in Maramagambo Forest). Cheetah and African wild dogs are confined to north eastern Uganda in Kidepo Valley Park and have been at low numbers over the past 40-50 years.

Threats to these large carnivores include loss of habitat, poaching for body parts, killing carnivores in retaliation for livestock loss or loss of human life, loss of prey species to the bushmeat trade, stealing of carcasses from carnivores by poachers, disease from other wild animals or from domestic animals and accidental snaring in traps set for antelope species. The plan has been developed to specifically address threats such as these to the large carnivores in Uganda and to try and halt the decline in their numbers across the country. These threats are assessed in more detail in this plan in chapter 3 as part of the planning process where threats analyses were made for lions, leopards and hyaenas separately. Part of the problem is that data on large carnivore numbers are few and often do not cover all of the protected areas. As such it has been difficult to raise awareness over the declining numbers of lions, hyaenas and leopards in the country. It is hoped that this plan will bring attention to the government and those that

benefit from tourism about the plight of these animals in the country and that this will galvanize support for the implementation of this plan.

The plan was developed at a meeting held at the Grand Imperial Hotel between 15-16th April 2010. This meeting was attended by representatives from MTTI, UWA, Makerere University (WARM, MUIENR, Zoology), International NGOs (WCS, WWF), and Panthera Foundation. It's development was funded by the Panthera Foundation, MacArthur Foundation, Daniel K. Thorne Foundation and WCS. The goal of the meeting was to compile all the available information on these five large carnivores, assess their current status and population trends over the past 20-30 years where data existed and to develop a coherent strategy to tackle the threats to the survival of these carnivores. The plan has been developed for a ten year period with the aim that it is reviewed after five years and revised if needed at this time.

This plan aims to build upon the regional East and Southern Africa lion conservation strategy (IUCN, 2007) which identified as a goal:

To secure and where possible restore sustainable lion populations throughout their present and potential range in East and Southern Africa, recognizing their potential to provide substantial social, cultural, ecological and economic benefits.

The regional strategy also set out six strategic objectives:

- 1) *Management: To ensure effective conservation management of lions, their habitats, and wild prey*
- 2) *Mitigation: To minimise and where possible, eliminate human-lion related conflicts*
- 3) *Socio-economics: To equitably distribute the costs and benefits of long-term lion management*
- 4) *Policy and land use: To develop and implement harmonious, comprehensive legal and institutional frameworks that provide for the expansion of wildlife - integrated land use, lion conservation and associated socio-economic benefits in current and potential lion range*
- 5) *Politics: To ensure that global policies better reflect the will and intent of regional and national sustainable use policies and practices.*
- 6) *Trade: To prevent illegal trade in lions and lion products while promoting and safeguarding sustainable legal trade.*

This current plan aims to operationalize the larger strategy within Uganda by identifying specific projects that if implemented would not only meet the objectives of this plan but also of the larger regional lion conservation strategy.

2. Status of Large Carnivores in Uganda

This action plan addresses the conservation of the five largest carnivores in Uganda: lion (*Panthera leo*); leopard (*Panthera pardus*); spotted hyaena (*Crocuta crocuta*); Cheetah (*Acinonyx jubata*) and African Wild Dog (*Lycaon pictus*). Information on the current status of each of these species is variable but what we know from the past 10 years is presented here. We know more about lions than the other species with some information on spotted hyaenas but far less about the populations and threats to the other three large carnivores. Distribution maps within the protected areas are produced using ranger-collected data while on patrols in the park and these data are housed at UWA.

Lion

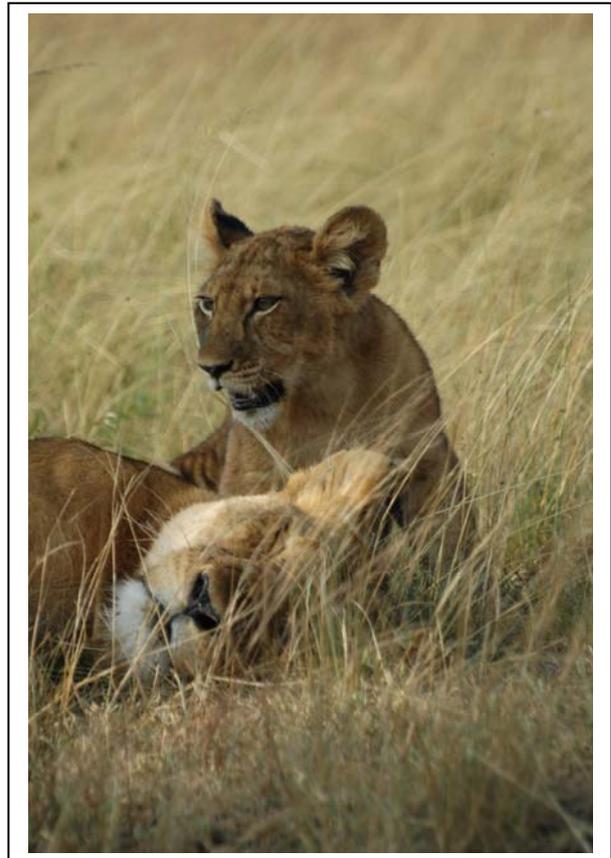
The data that exist on the status of lions in Uganda come from two main sources: a) detailed studies of lions in Queen Elizabeth National Park where individuals are recognized and known (WARM-Makerere University and WCS); and b) a lure count survey made in the three parks with reasonable lion populations (WCS). We present both sets of information here.

Queen Elizabeth National park

Queen Elizabeth National park is subdivided by two barriers: the Kazinga channel that links Lake George to Lake Edward and the Maramagambo Forest which separates the northern part of the park from the southern Ishasha sector. Lions have been observed to move between these areas but infrequently.

Individual recognition of lions

The Wildlife and Animal Resource Management department (WARM) of Makerere University has been undertaking a detailed study of lions in the northern sector of Queen Elizabeth (and to a lesser extent in the southern sector) over the past 20 years. They currently recognize 65-70 individuals in this part of the park.



The Wildlife Conservation Society (WCS) has been studying the lion population in the Ishasha Sector and to a smaller extent in the contiguous Virunga National Park in the Democratic Republic of Congo for the past 5 years. They currently recognize 17 individual lions in this sector. Details of the population dynamics of their research are given in Appendix 2.

Combining these data gives a total of 82-87 lions that are individually recognized in Queen Elizabeth Park. What proportion these form of the total population is not clear but it is thought to be most of them.

Lure count

In September 2008 a call of a distressed buffalo calf was played through a FX3 Snow Crow Pro Call box attached to two 50 watt SP108 deluxe cone speakers connected in series and played repetitively with the call machine playing at maximum volume. The entire exercise lasted for 30 minutes at each of

the 35 call stations spaced at about 5-km intervals apart. Response distances of lions were estimated by playing the same call to known individuals at different distances to assess if they would respond and arrive at the calling location within 30 minutes. Analyses were made as detailed in Buckland *et al.* (2006) giving an effective radius of 1.56km within which lions respond. Details of this survey in all three parks where it was undertaken is given in Appendix 3.

A total of 144 lions (standard error (se): 22) was estimated for the park with an estimate of 72 (se:49) in the area west of Kazinga channel; 41 (se:30) in the area east of Kazinga channel and 27 (se: 26) in the Ishasha sector. At the time of the survey there were known to be 28 individuals in Ishasha sector (excluding cubs) which was very close to the 27 estimated here giving us some confidence in the method.

Ranger-collected data show that lions are not found uniformly across the park (fig. 2.1).

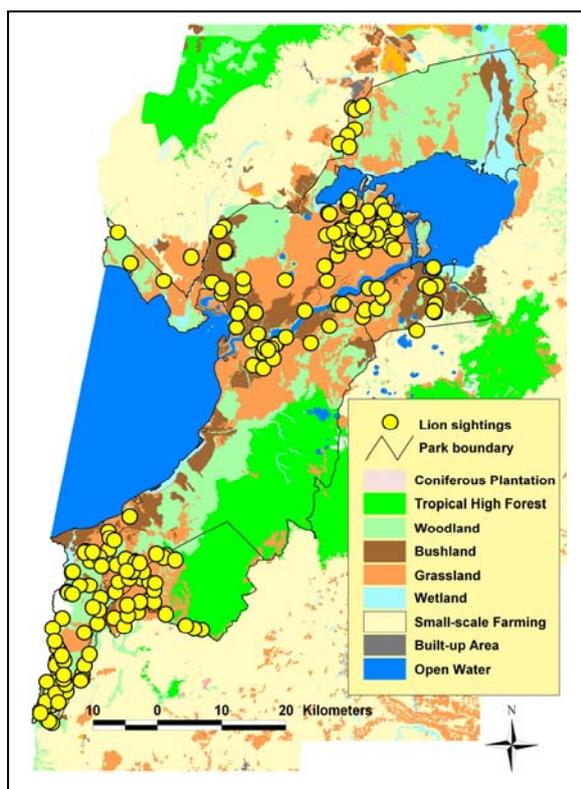


Figure 2.1. Lion sightings in Queen Elizabeth from ranger collected data between 2001-2009.

Murchison Falls National Park

No individuals are currently monitored in this park. The same lure count method was used as described for Queen Elizabeth Park but carried out in September-October 2009. A total of 75 call up stations were sampled to give an estimate of 132 (se: 24) lions for the whole park with an estimate of 83 (se:41) north of the Nile river and 27 (se:14) south of the river.

Ranger-collected data show few lions in the east and south-east of the park (fig. 2.2) which matches with the findings of the WCS census (appendix 3).

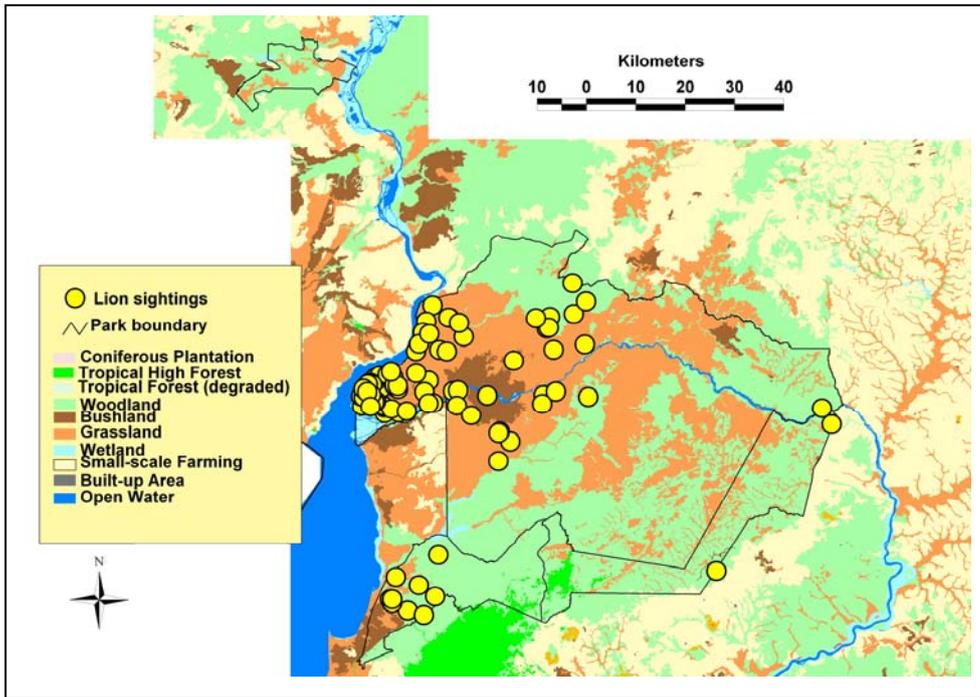


Figure 2.2. Lion sightings in Murchison Falls National Park from ranger-collected data between 1999-2009.

Kidepo Valley National Park

No individuals are currently monitored in this park. The same lure count method as described for Queen Elizabeth Park was carried out in March-April 2009. A total of 24 call up stations were sampled to give an estimate of 132 (se: 77) lions for the whole park.

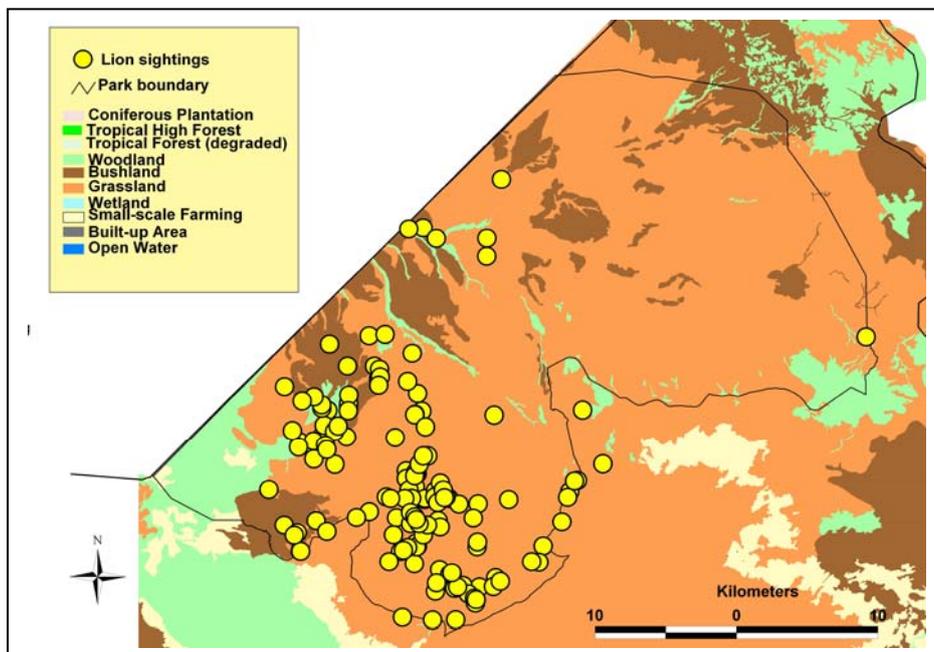


Figure 2.3. Lion sightings in Kidepo valley National Park from ranger-collected data between 2005-2009.

Ranger-collected data show most sightings of lions occur in the south and west of the park (in the Narus Valley) and very few sightings occur in the Kidepo valley (fig. 2.3).

Lake Mburo National Park

Lake Mburo National Park lost all its lions in the early 2000s due to poisoning by local cattle keepers. However, at least three individuals have recently been sighted by UWA staff in the park, possibly coming from northern Tanzania or eastern Rwanda.

Toro-Semliki Wildlife Reserve

UWA staff in the Toro Semliki Wildlife Reserve estimate that there are only about 5 lions left because of large declines in the prey base in the 1980s due to the civil war in Uganda and then continued attacks by pastoralists who want to graze their cattle in the reserve.

Sightings of lions by rangers are few and clustered at the edges of the reserve (fig. 2.4).

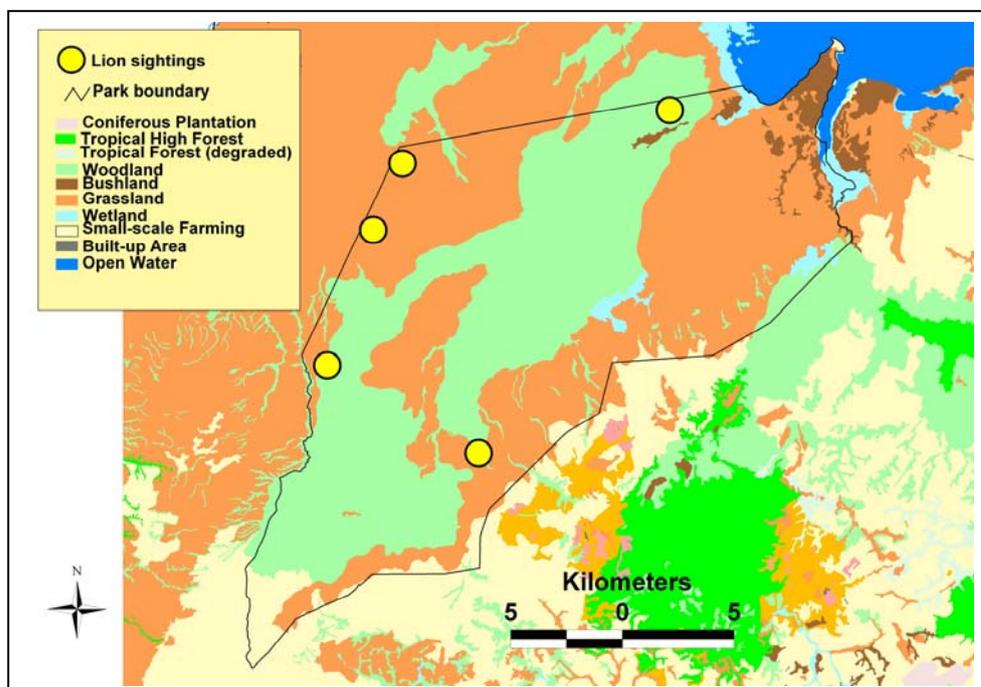


Figure 2.4. Locations of lions, observed by rangers while on patrol in the Toro-Semliki Wildlife Reserve.

Other sites

Other sites where lions have been observed include the Pian-Upe Wildlife Reserve in Karamoja in eastern Uganda (fig. 2.5).

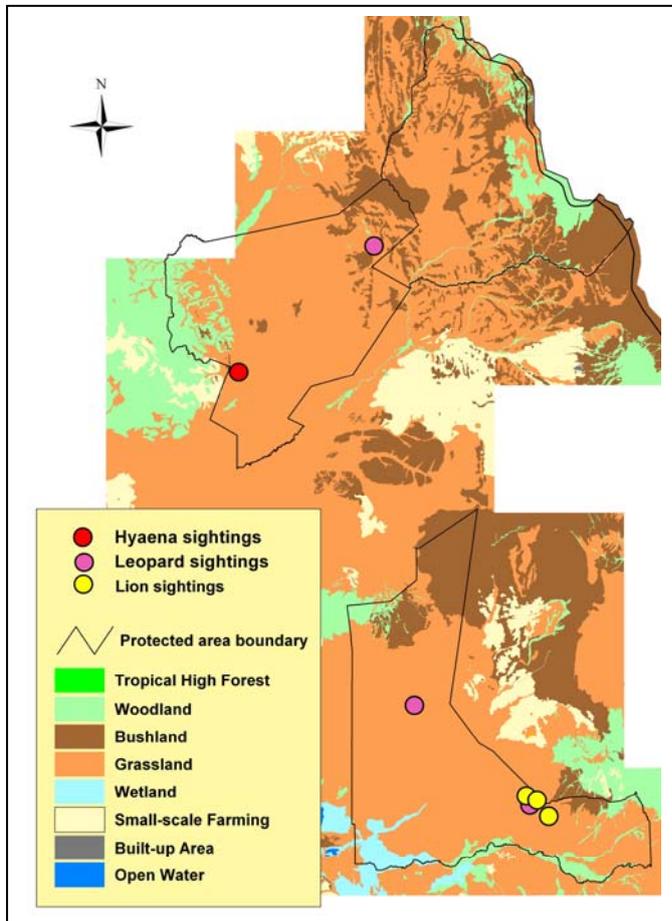


Figure 2.5. Locations of sightings of lions, leopards and hyaenas in Matheniko, Bokora and Pian-upe Wildlife Reserves in Karamoja. Data are from ranger-collected data between 2006-2009.

Total number of lions in Uganda

Given these figures we estimate that there are only about 416 lions in Uganda with none of the protected areas having viable populations. The population in Queen Elizabeth National Park are connected with the Virunga Population which will increase the numbers somewhat but it is estimated (using prey biomass estimates) that there are probably only about 70-80 lions in this park (Treves *et al.* 2009) which would make the total Greater Virunga Landscape population about 210 individuals.

Spotted Hyaena

WARM has been undertaking some studies and monitoring of spotted hyaenas in Uganda.

WCS in their 2008-2009 lure count survey (detailed in Appendix 3 and summarized above) also recorded the number of spotted hyaenas responding to the same buffalo distress call. Data on response distances were not measured for this species, however, because of the time available and the lack of known individuals. Instead response distances to a similar call (wildebeest calf distress call) were borrowed from a study made in Kruger Park in South Africa (Mills, Juritz and Zucchini 2001). These response distances indicated that the effective response distance was 2.75km for spotted hyaenas in Kruger Park so we used this measure to calculate estimated numbers for the surveys in Uganda.



Queen Elizabeth National Park

A total of 211 (se: 25) spotted hyaenas are estimated for Queen Elizabeth National Park with 64 (se:30) in the area west of Kazinga Channel, 98 (se:52) east of the Kazinga Channel and 62 (se 37) estimated from Ishasha sector.

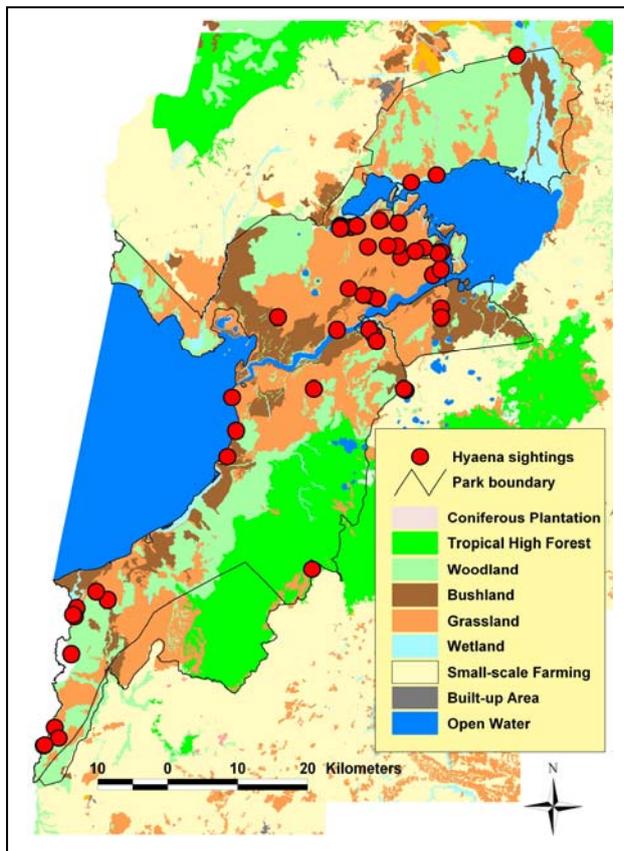


Figure 2.6. Locations of sightings of spotted hyaenas in Queen Elizabeth National Park from ranger-collected data between 2001 and 2009.

Murchison Falls National Park

A total of 38 (se: 7) spotted hyaenas were estimated from Murchison Falls National Park. This was unexpectedly low and results from a very low turn up at the playbacks. Only 12 (se:7) and 29 (se: 12) were estimated for the north and south banks of the Nile River in the park respectively, with the area surveyed in the south including parts of Bugungu and Karuma Wildlife Reserves.

Ranger-collected data show that few spotted hyaenas were seen south of the Nile River and also few in the woodlands in the east and south-east.

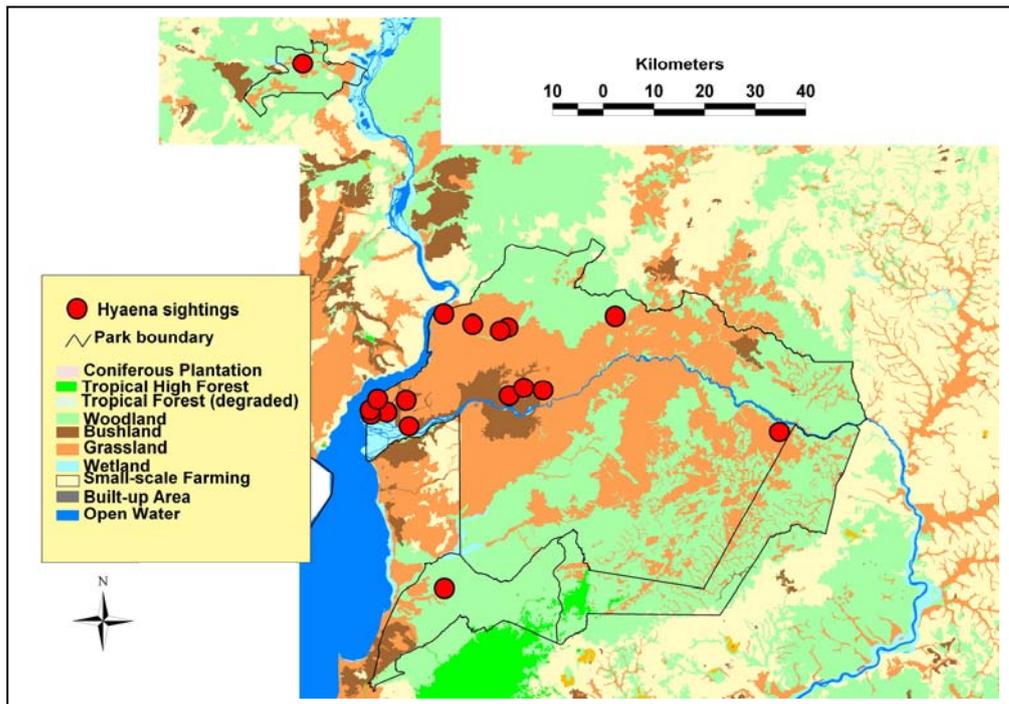


Figure 2.7. Locations of sightings of spotted hyaenas by rangers while on patrol in Murchison Falls National Park and Ajai Wildlife Reserve. Data for Murchison dates between 1999-2009 but for Ajai is only for 2008-2009.

Kidepo Valley National Park

A total of 75 (se:33) spotted hyaenas were estimated for Kidepo Valley National Park from the lure count surveys.

Their distribution in the park is different to the lions with sightings in both the Narus and Kidepo valleys in the park (fig 2.8). The prey base in the kidepo valley is very low so it is surprising to have many sightings in the south east of the park.

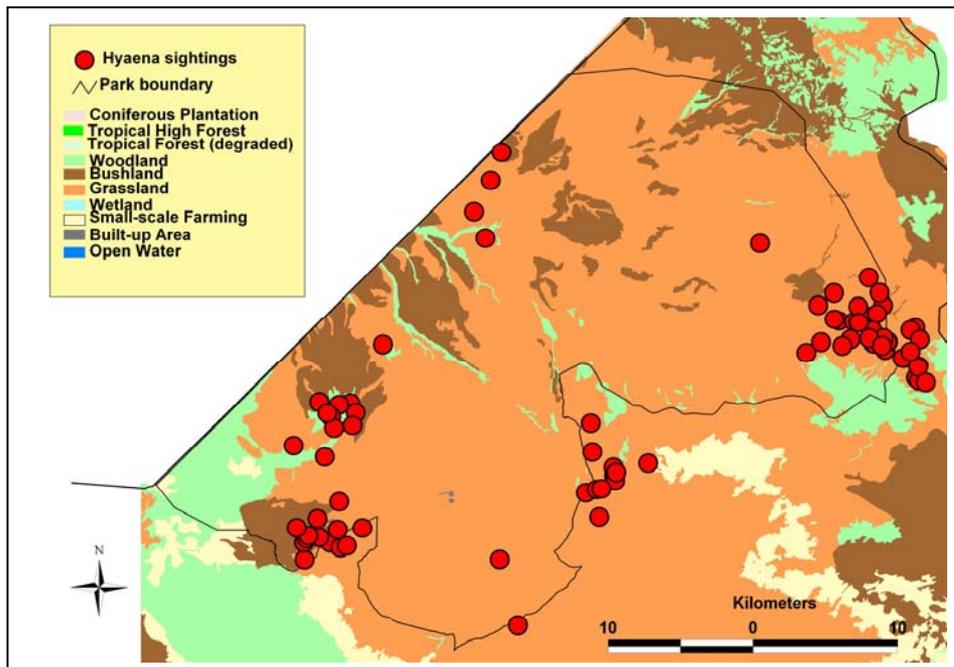


Figure 2.8. Locations of sightings of spotted hyaenas in Kidepo Valley National Park by rangers between 2005 and 2009.

Other sites

Spotted hyaenas also occur in Mgahinga Gorilla National Park (fig. 2.9), Toro-Semliki Wildlife Reserve (fig. 2.4), Lake Mburu National Park (fig 2.10), Bokora Wildlife Reserve (fig. 2.5) and Mt Elgon National Park (fig. 2.11). We do not know the numbers for these parks but show their distributions here.

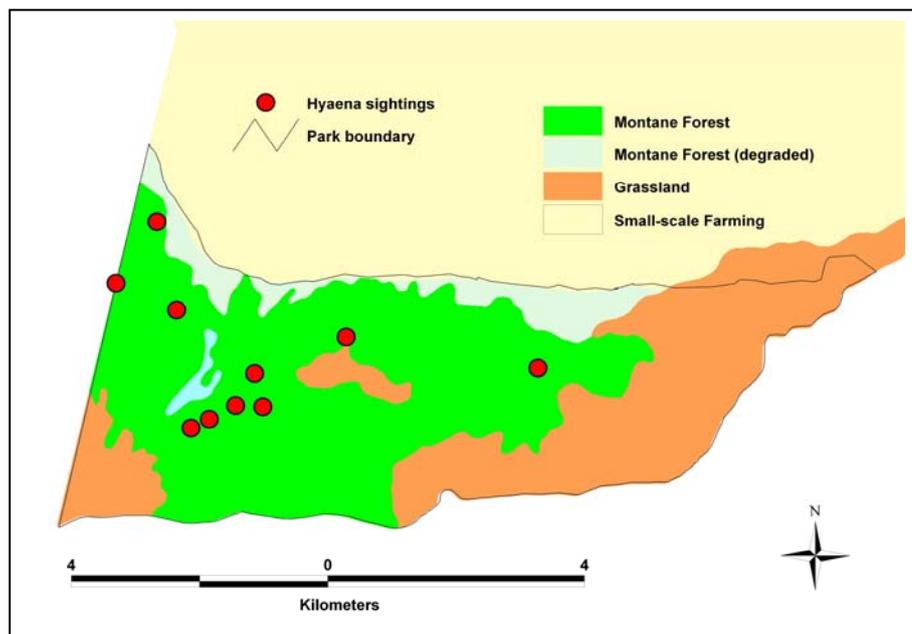


Figure 2.9. Locations of sightings of spotted hyaenas in Mgahinga Gorilla National Park by rangers between 2003 and 2009.

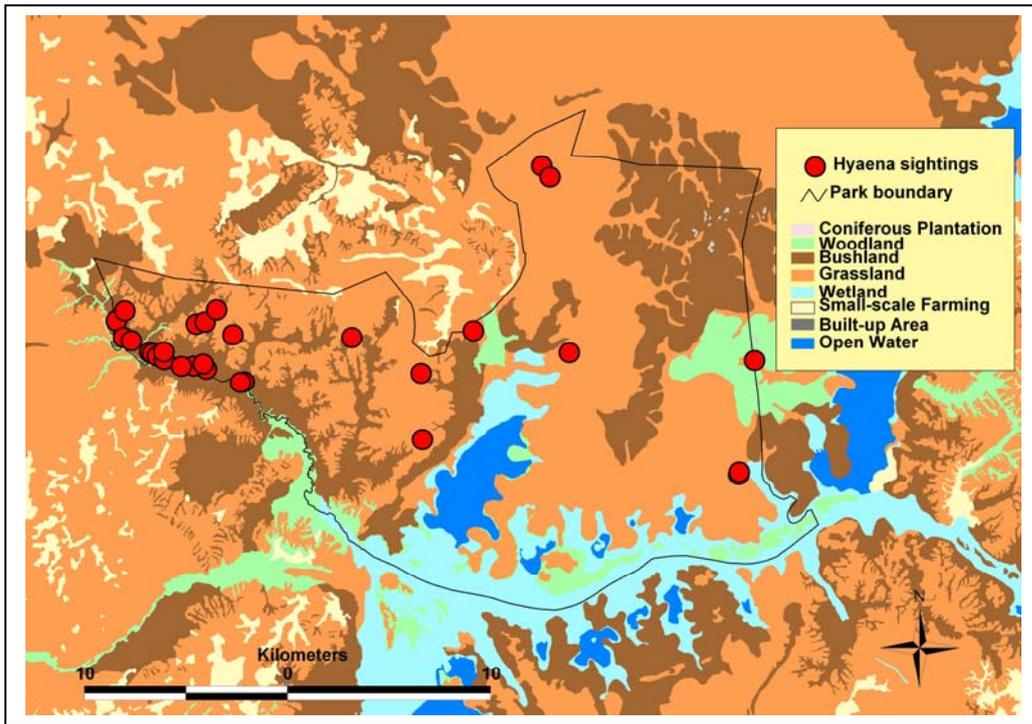


Figure 2.10. Locations of sightings of spotted hyaenas in Lake Mbuo National Park by rangers between 2003-2009.

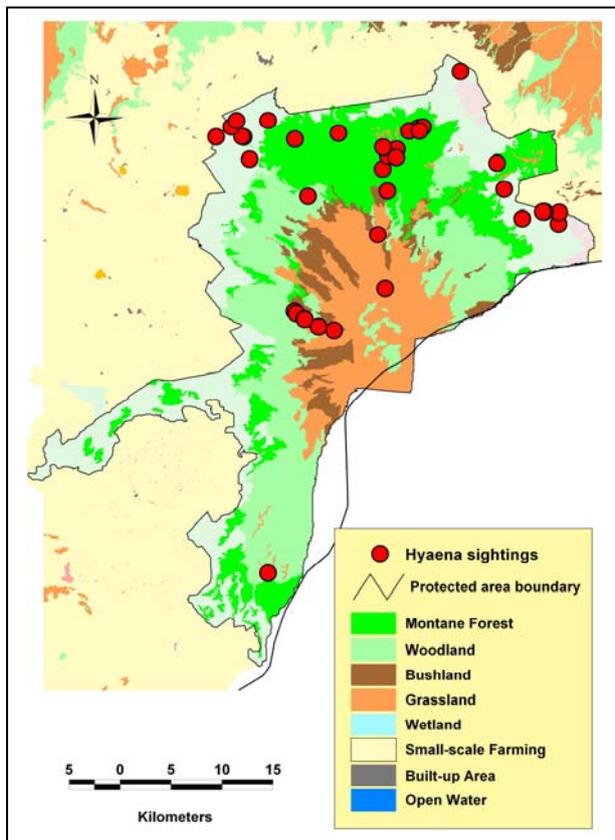


Figure 2.11. Sightings of spotted hyaenas in Mt Elgon National park by rangers between 2003-2009.

Leopard

Leopards differ from all of the other carnivores in Uganda in that there are regular sightings of this species outside protected areas. They are known to cause livestock loss on ranches in the west of the country and through much of the ‘cattle corridor’ that separates the western rift from the highlands around Kampala and Masaka.

We do not have any good measure of population numbers anywhere for this species. However we do have sightings from rangers which are collected while they are on patrol in the protected areas managed by UWA. We present these distributions here.



Queen Elizabeth National Park

Sightings in Queen Elizabeth National Park are relatively numerous in comparison with other sites in Uganda. It is likely that this park is one of the last strongholds for this species in the country.

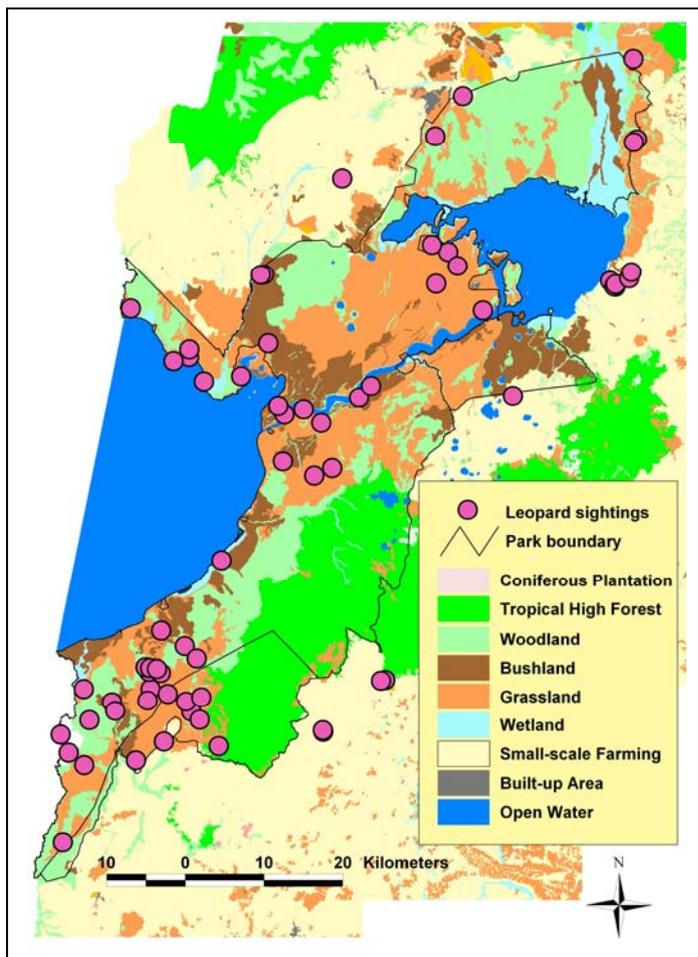


Figure 2.12. Distribution of sightings of leopards by rangers while on patrol in or around Queen Elizabeth National Park between 2001 and 2009.

Murchison Falls National Park

Leopards have mainly been sighted in the Buligi circuit area in north west Murchison Falls Park but this is likely to be due to higher patrol effort here also. Most of the sightings are concentrated around ranger patrol posts in the park. There are few patrols in the centre of the park each year and leopards are likely to be more abundant here than the figure below indicates.

Only one sighting of a leopard has occurred in Ajai Wildlife Reserve from the ranger collected data.

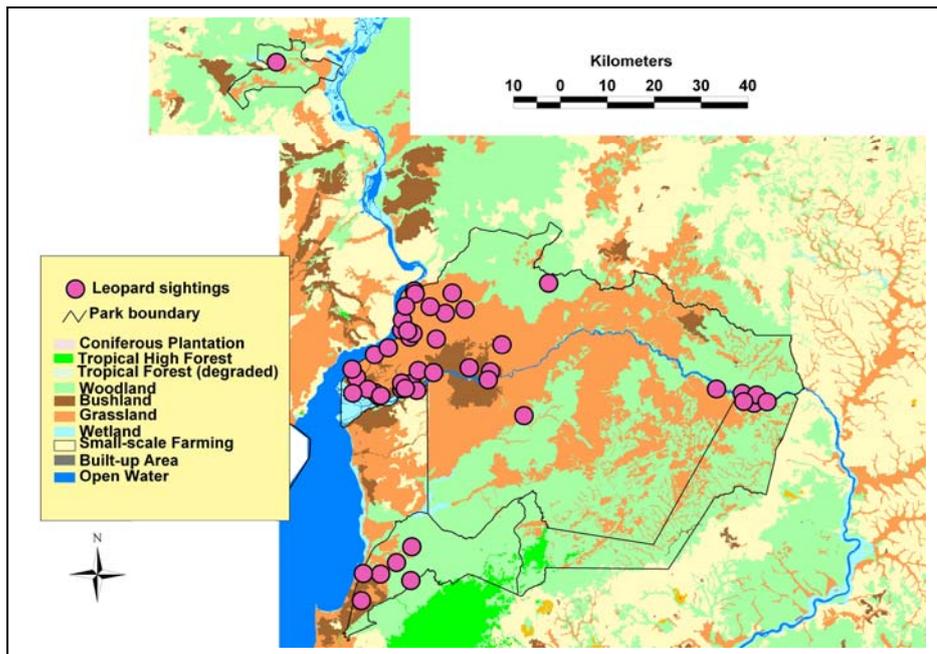


Figure 2.13. Locations of sightings of leopards by rangers while on patrol in Murchison Falls National Park and Ajai Wildlife Reserve. Data for Murchison dates between 1999-2009 but for Ajai is only for 2008-2009.

Kidepo Valley National Park

Leopards have been seen throughout most of Kidepo Valley National Park but more commonly in the Narus valley. This again is likely to be a result of patrol effort differences, although ungulate numbers are very low in the Kidepo Valley in the park and hence it would be expected that leopards are more numerous in the Narus valley as indicated (fig. 2.14).

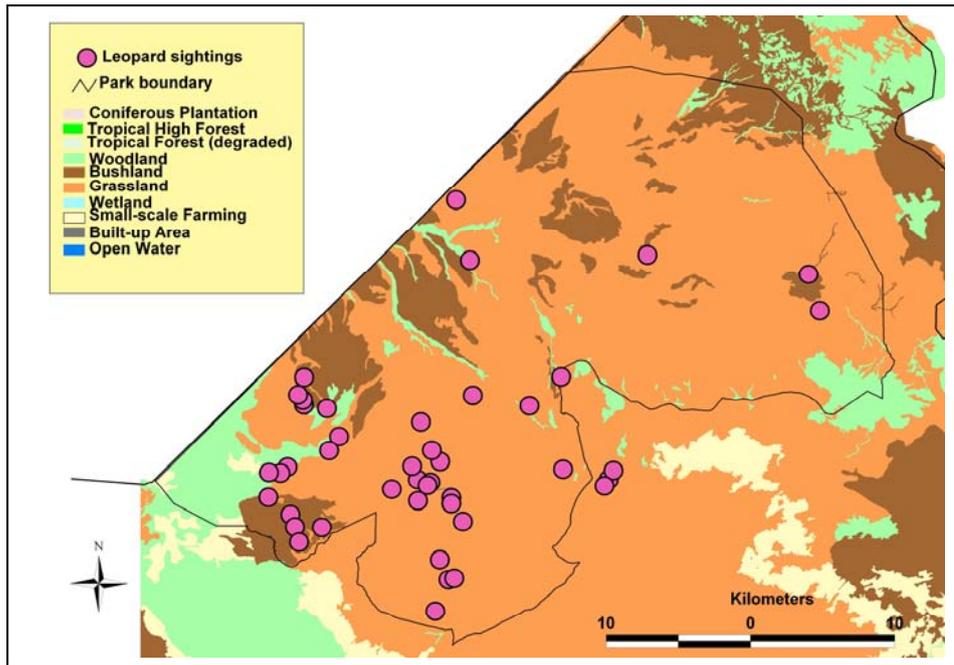


Figure 2.14. Locations of sightings of leopards in Kidepo Valley National Park by rangers between 2005 and 2009.

Lake Mburo National Park

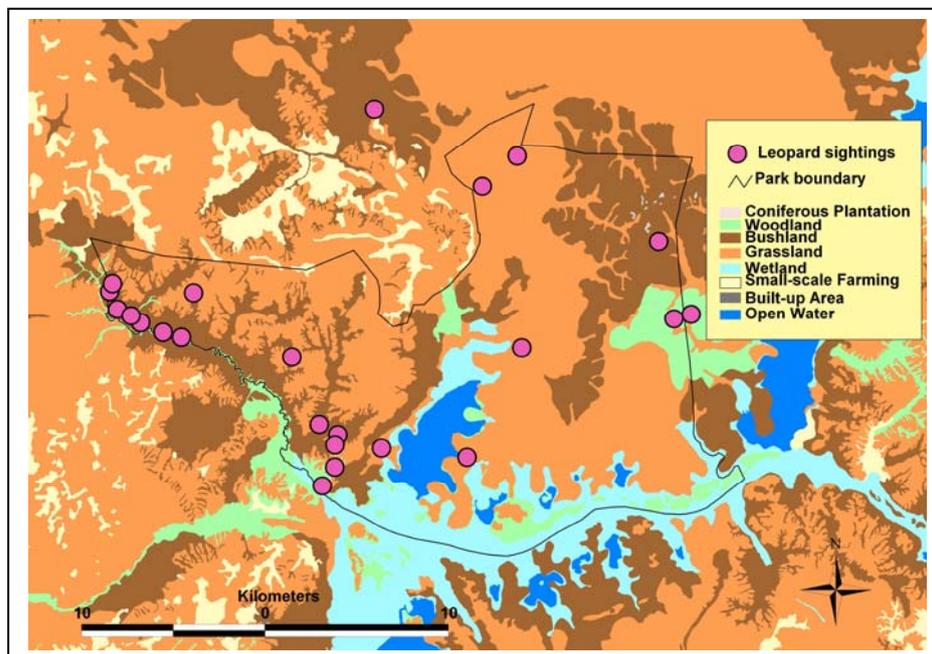


Figure 2.15. Locations of sightings of leopards in Lake Mburo National Park by rangers between 2003-2009.

Leopards have been frequently sighted in the west of Lake Mburo National Park with one sighting on the ranch lands to the north of the park. These ranchlands are seasonal grazing areas for many of the ungulates in the park and they move here in the wet seasons. A pilot sport hunting project in this area is encouraging conservation of wildlife on these ranchlands. Leopards are now offered as a trophy although there are no data on their numbers in the ranches.

Mt Elgon National Park

Mount Elgon national Park is a montane forest with alpine vegetation at high altitude. Most of the sightings of leopards are in the lower altitude montane forest or in degraded forest at the edge of the park.

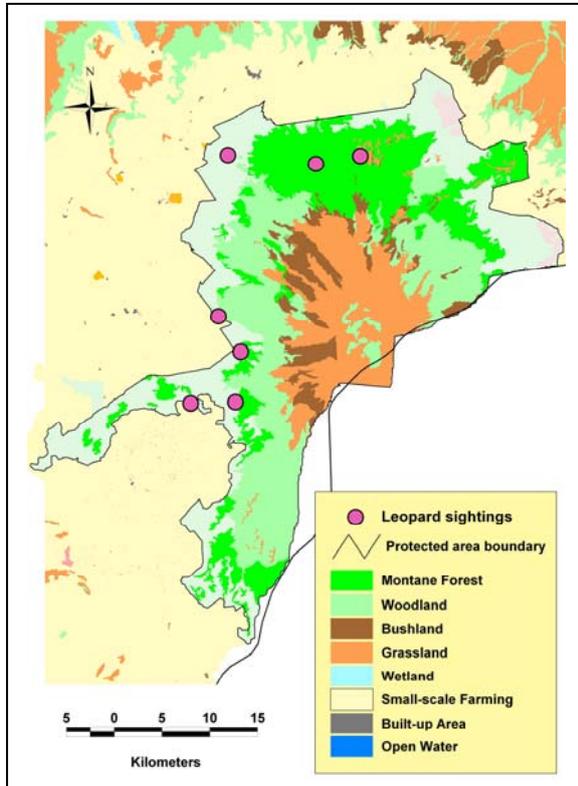


Figure 2.16. Locations of sightings of leopards by rangers in Mt Elgon National Park between 2003 and 2009.

Toro-Semliki Wildlife Reserve

Only two leopards have been sighted in the Toro-Semliki Wildlife Reserve (fig. 2.17) since observations started to be recorded in 2007.

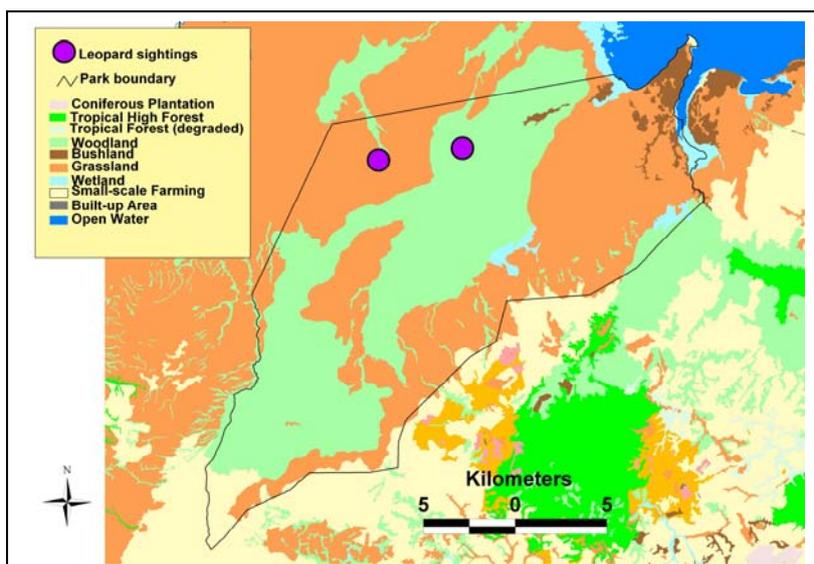


Figure 2.17. Leopard sightings in Toro-Semliki Wildlife Reserve since 2007.

Cheetah

Reports of Cheetah have been received from UWA staff in Kidepo Valley National Park, of resident animals but these probably number fewer than 5-10 individuals. The survey of lions and hayenas in the park by WCS staff, which is presented above, did not detect any cheetah but the use of buffalo distress calls is not known to attract this species readily. Kidepo Valley National Park is the only site where cheetah are known to occur in Uganda. It is possible that they range to the south in the Karenga Community Wildlife Area or elsewhere in Karamoja, and to the north in the Kidepo Game Reserve in Southern Sudan, but we know of no sightings to support this.



Specific survey methods are required for cheetah because of the difference in their behavior from other predators. They are not nocturnal, and are unlikely to respond to the call-in method that was used in the 2009 national carnivore survey. The locations where they have been sighted in Kidepo Valley National park show that they primarily use the Narus valley in the south west of the park but occasionally are seen in the Kidepo Valley in the east.

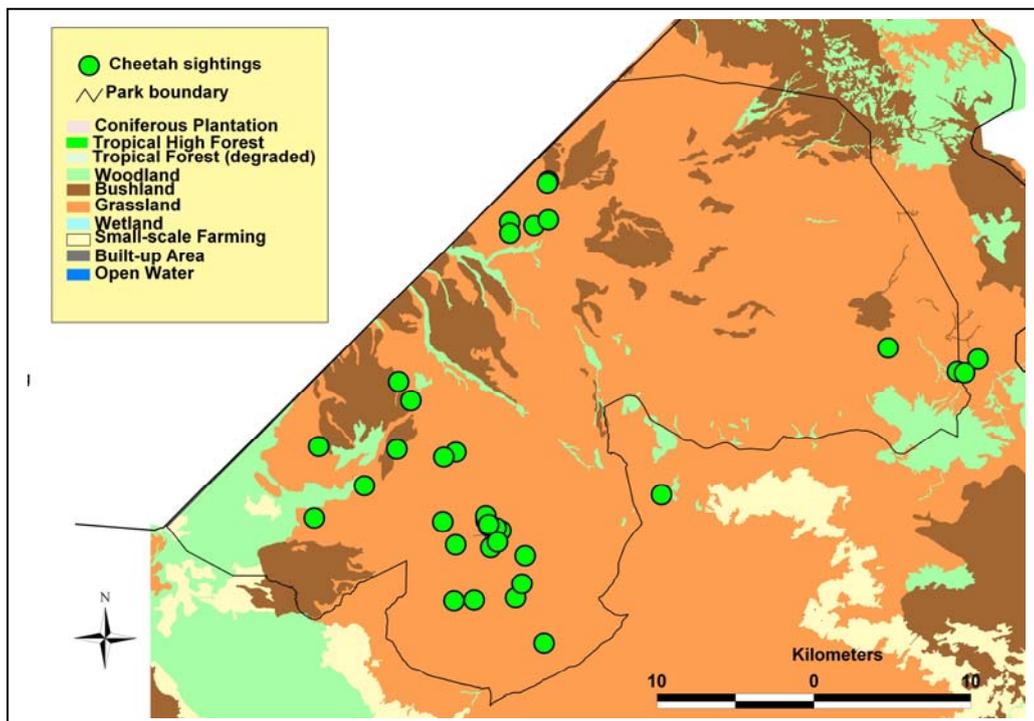


Figure 2.18. Locations of sightings of cheetahs in Kidepo Valley National park by rangers while on patrols between 2005 and 2009.

African Wild Dog

There were reported sightings of Wild Dogs in Uganda around 10 years ago, 5 years ago, and in 2009, all in and around Kidepo Valley National Park. None were detected in the carnivore survey made by WCS staff in 2009 and it is thought that this species is not resident in Uganda but ranges between Southern Sudan, Northern Kenya and Uganda.

There is a need to develop a regional survey for this species in north eastern Uganda, Southern Sudan and north western Kenya to identify where these animals are found in the region. Initially interview surveys with photos of the species would make sense as the pastoralists that

move through this region are likely to encounter them and would know where they might be found.

It is known that in the 1940s and 1950s the species occurred in Queen Elizabeth National Park and the adjacent Virunga National Park but there was a policy at the time to kill this species because they were considered to kill prey in a 'distressing manner' that tourists would not like to observe. As a result they were extirpated from the Greater Virunga Landscape. With rising numbers of prey species in the landscape it would be worth undertaking a feasibility study for the reintroduction of this species to the landscape.



3. Strategic Action Plan

Strategic Action Plan development

The main content of this strategic action plan was developed at a workshop held on 15-16th April 2010 in Kampala, Uganda. It used a process developed by BirdLife International (Sande and Hoffmann 2002) that has been used to develop species action plans for a variety of species, including a national action plan for chimpanzees (*Pan troglodytes schweinfurthii*) in Uganda. This process develops a Vision, a 10-year Goal and a set of Objectives, and Projects to attain the objectives.

Problem tree

The main tool used to develop objectives and projects is the analysis of a problem tree or threats analysis. The method BirdLife International developed is to create the problem tree starting with the biology of the species before any consideration of the threats that result from human activities, which often underlie the biological threats. In many conservation target threats analyses, conservation practitioners jump to the threats they know about, which are usually the human-caused ones, rather than considering first the biology of the species. The basic logic of the problem tree is as follows:

1. Assume that the population of carnivores is either stable or declining. If stable then we do not really need a plan and there is not much that can be added to what is already being done to conserve them. We have few data on trends at individual sites but as a whole we believe carnivore populations are declining across their range in Uganda (indicated by knowledge of killed animals as well as historical distribution data and census data).
2. If declining, then the direct causes of decline must be due to either high adult mortality or low productivity of the species.
3. Low productivity could be due to a low birth rate or high infant/juvenile mortality.

This is the starting point for the development of problem trees, and delegates work to tease out the underlying causes of the three main factors: a) low birth rate; b) high infant/juvenile mortality and c) high adult mortality. In many cases, the immediate causes of the factors affecting population growth are biological, and influenced by underlying changes in habitat, hunting and other human-caused threats. This focus encourages delegates to think about biology as well as human impacts. It often encourages the planners to include components of animal health to minimize disease issues or stress and also can assess the effects of the species' ecology on its long-term survival.

Stakeholder analysis

The stakeholders are identified by brainstorming in small groups. Each stakeholder is analysed to assess which (or who) potentially influences carnivore conservation, and whether the influence is positive or negative. The stakeholders are then ranked in terms of the scale of impact they have (high, medium or low).

Vision, Goal and Objectives

A vision of what conservationists need to achieve over the next 30–40 years is developed in plenary, usually early on in the proceedings and then revisited when the plan has begun to take shape. A 10-year goal for the plan is also developed in plenary. The aim in this case is to describe what can realistically be achieved in the first 10 years.

The objectives of the plan are developed from the problem tree. Initially the threats identified in the problem tree that result from human activities are ranked and grouped into similar themes, and objectives for the action plan are then pulled out of these grouped threats. For the large carnivores in Uganda, it was necessary to first combine objectives across species, and problem trees were developed separately for the lions, spotted hyenas and leopards.

Project development

In most action plans activities are developed for each objective identified. However, BirdLife International prefers instead to identify individual projects that can be marketed to potential donors. Groups were formed to develop projects that considered the following themes related to the objectives:

- a. Improving Habitat conservation for large carnivores
- b. Tackling the illegal killing of large carnivores
- c. Addressing conflicts between people and large carnivores over livestock loss
- d. Raising awareness about the plight of large carnivores
- e. Monitoring and tackling disease threats
- f. Improving our understanding of large carnivores in Uganda

Projects were ranked in terms of priority and cost and ordered by start date within the time frame of the action plan. The results of the planning process are presented in this chapter, forming the core of the action plan.

Problem trees

Three problem trees were developed one for each of the three more common large carnivore species in Uganda. A problem tree was not developed for cheetah and African wild dogs because there was just too little information to be able to identify threats to these two species given their very low numbers in Uganda.

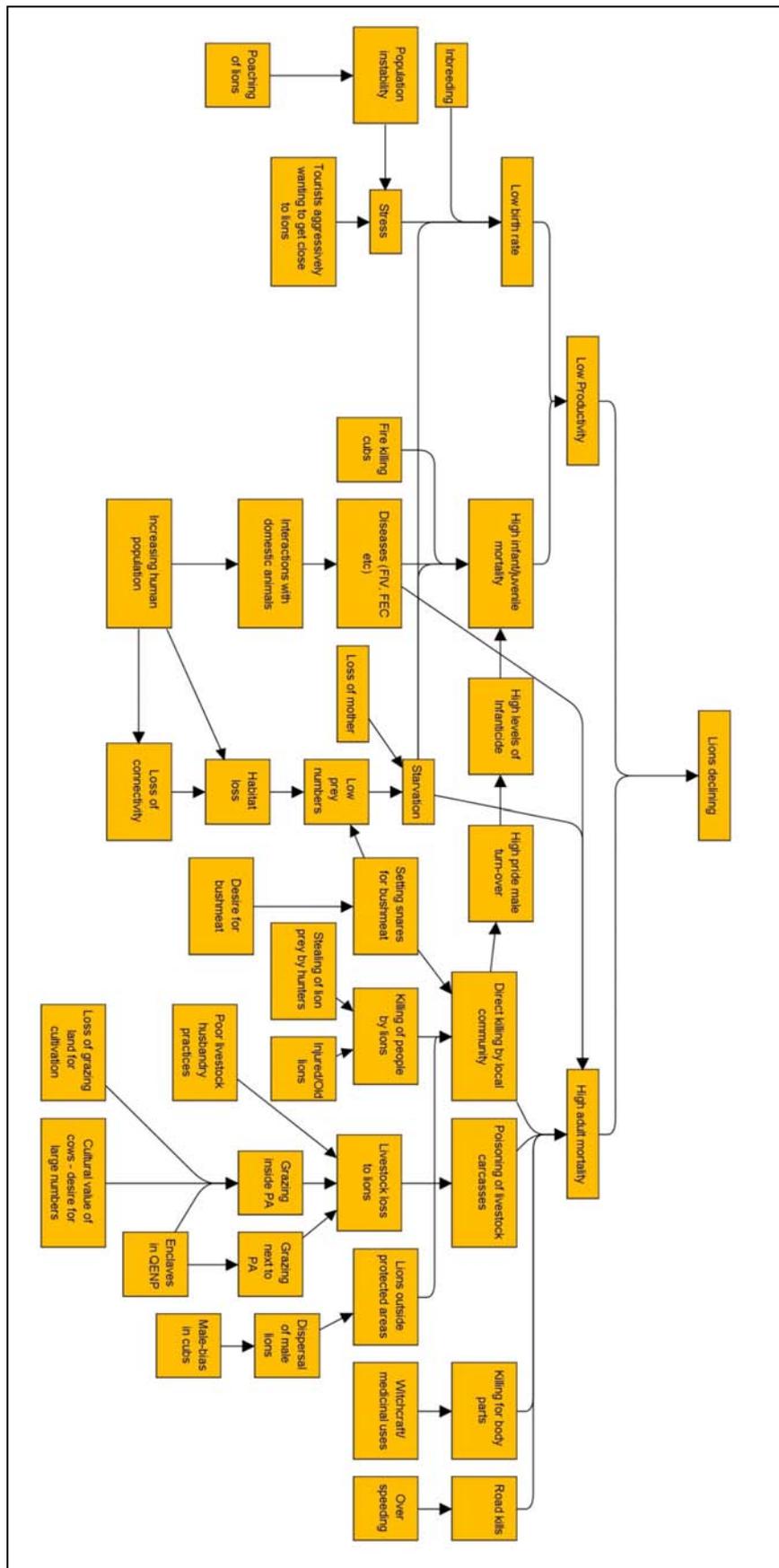
Threats were prioritised in each problem tree (Table 3.1) according to votes cast by the delegates. Ranks of the top threats were similar for both regions.

Table 3.1. Prioritisation of the human-caused threats (direct and indirect) to carnivores. The top ten threats are ranked from the most important at the top.

Lion	Spotted Hyaena	Leopard
Poisoning	Poisoning	Poisoning
Killing over livestock loss	Killing over livestock loss	Killing over livestock loss
Grazing of livestock in protected areas	Negative attitude by people towards hyaenas	Habitat fragmentation
Habitat loss	Habitat loss/fragmentation	Habitat loss
Disease	Weak law enforcement	Poaching for body parts
Increasing human population density	Political interference over their conservation	Livestock ranching near leopard populations
Poor livestock husbandry	Road kills	Low density and numbers
Lack of prey	Disease	Lack of prey
Poaching for body parts	Poaching for body parts	
	Lack of prey	

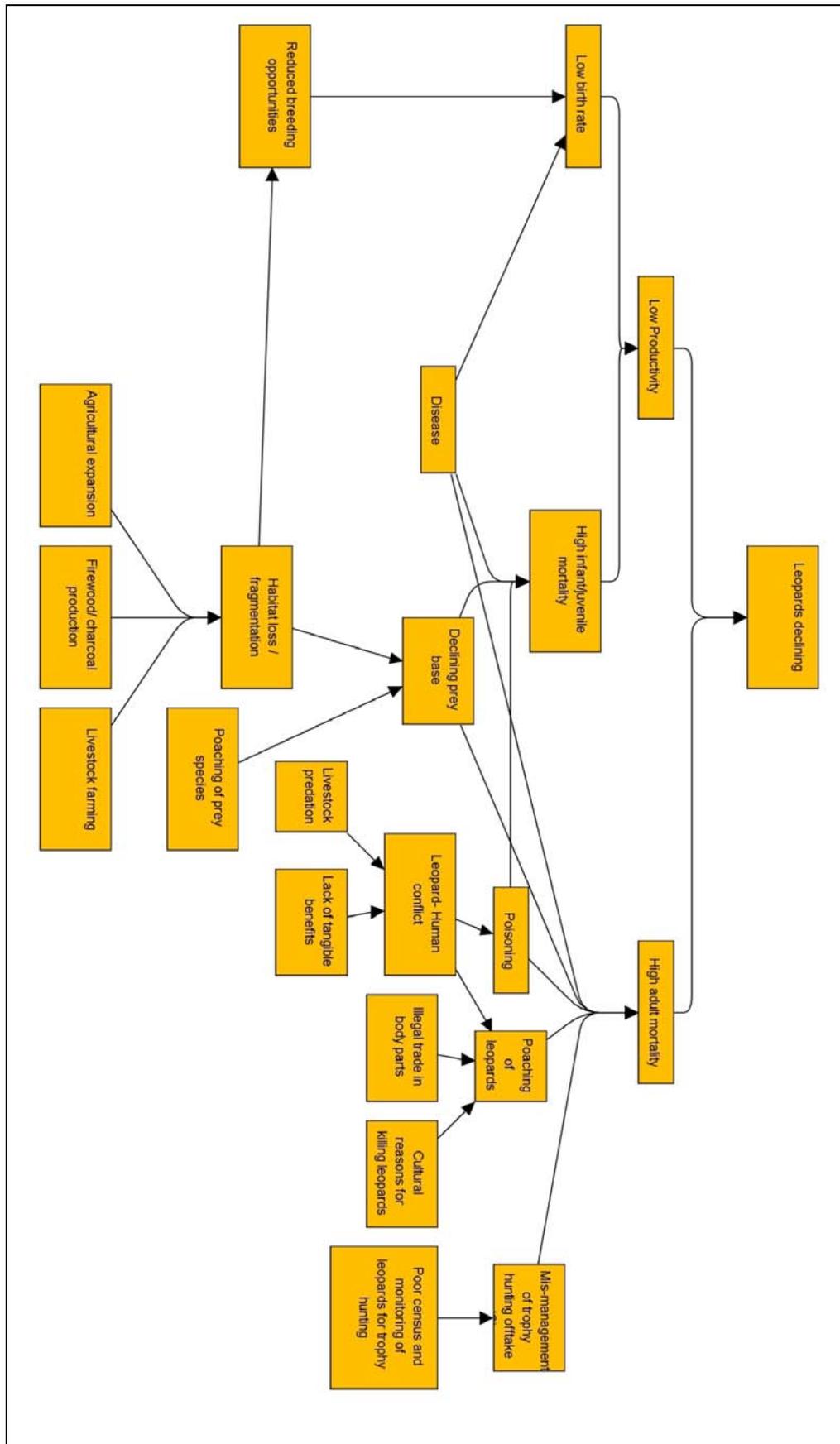
3.0.1 Problem tree: lions

A problem tree of the threats and underlying causes that contribute to declining lion populations was developed and is presented here:



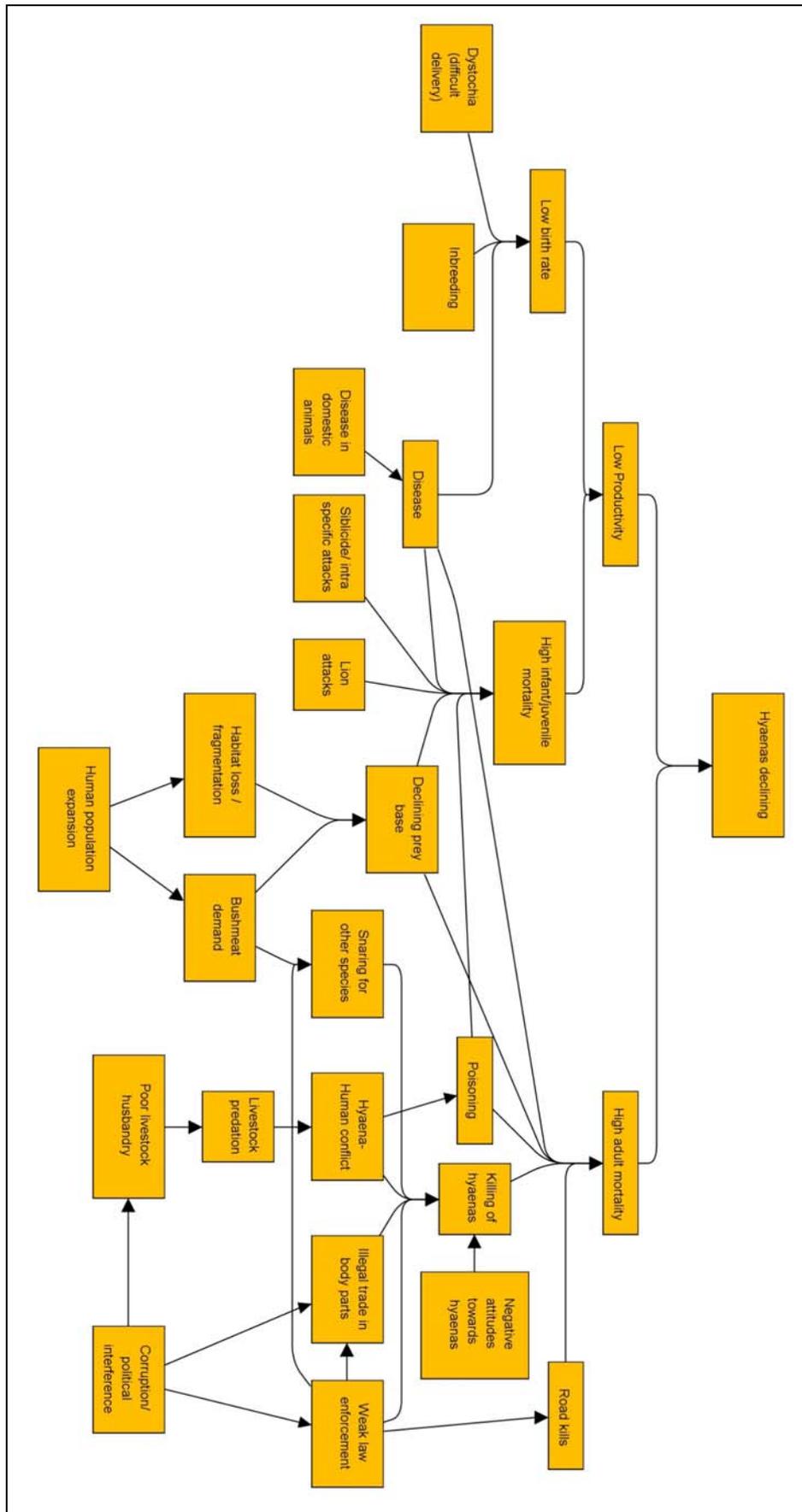
3.0.2 Problem tree: leopards

A problem tree of the threats and underlying causes that contribute to declining leopard populations was developed and is presented here



3.0.3 Problem tree: spotted hyaenas

A problem tree of the threats and underlying causes that contribute to declining spotted hyaena populations was developed and is presented here:



3.1. Vision, goal and objectives

The vision and goal of the action plan were developed by all participants at the workshop and accepted as follows:

Vision: *Populations of large carnivores increased to viable numbers or managed for long term viability, playing their functional roles in the ecology of the ecosystems where they occur, with minimized conflicts with local community members. Large Carnivores generating tangible community (vital stakeholders) benefits from responsible consumptive and non-consumptive uses with substantial national and local support for their conservation.*

Goal: *By 2020 large carnivore populations increasing in protected areas and stabilized outside protected areas in Uganda.*

The following six objectives were identified from the problem trees and the prioritisation of threats (the threats addressed are identified in parentheses):

Objectives for 10 year plan:

1. Maintain and manage at least 100% of suitable habitats for large carnivores inside protected areas and 60% outside protected areas (Threats:Habitat loss and fragmentation).
2. Reduce poaching of large carnivores and their prey inside and outside protected areas to a point that populations are stable or increasing (killing for body parts, lack of prey)
3. Reduce conflict between livestock owners and large carnivores to levels that do not impact population viability adversely (Threats: poisoning, killing over livestock loss, grazing in protected areas and poor livestock husbandry).
4. Increase national awareness and support for large carnivore conservation among political leaders, law enforcement agencies (including judiciary), communities living with large carnivores and school children (future leaders)- (Threats:political interference, negative attitudes by people, road kills).
5. Establish a health monitoring and management program for carnivores in Uganda. (disease)
6. Map distribution and abundance of large carnivores in Uganda, monitor their populations, and quantify the major threats to their long-term survival (lack of knowledge).

3.2. Objective 1: Habitat loss/degradation

Projects identified

Projects were identified for each of these six objectives. They are summarized in the following tables, which lists the main objective under which the project falls, the priority, who could implement the project, the time scale and a rough estimation of cost.

Projects table for Objective 1: *Maintain and manage at least 100% of suitable habitats for large carnivores inside protected areas and 60% outside protected areas.*

The projects and the potential agencies that should be involved, as identified by the group.
Priority: ♦♦♦♦ = high; ♦♦♦ = medium-high; ♦♦ = medium; ♦ = low.

Project	Priority	Agencies who will be Responsible	Time scale	Estimated Cost
a) Policy and legislation				
Regular review of the land use plans by LGs	♦♦♦♦	LG, UWA, NFA, NEMA, CARE	Year 2	\$10-25,000
b) Species and habitat				
Remove and control invasive plant species	♦♦♦	UWA, WCS, MUBFS, WARM, ITFC	Years 1 – 10	\$500-1,000,000
Rehabilitate habitat where sub-optimal through manipulation	♦♦♦♦	UWA, NFA, Oil companies	Years 1 – 10	\$500-1,000,000
c) Monitoring and research				
Mapping of habitats (suitable and preferred habitat)	♦♦♦	WCS, UWA, WARM	Years 1 – 5	\$25-50,000
Document and establish the species carrying capacity for large carnivores in different PAs	♦♦♦	UWA, WCS, WARM	Years 1 – 2	\$25-50,000
Document and reclaim encroached PAs lands (parks, reserves and wetlands)	♦♦♦♦	UWA, NFA, NEMA,	Years 2-5	\$50-100,000
d) Public awareness and training				
Sensitization of local community on land use practices	♦♦♦	UWA, NFA, WWF	Years 1-5	\$25-50,000
Mapping and habitat monitoring - (training PA staff)	♦♦♦	UWA, NFA, NEMA, WCS, AWF	Year 2	\$1-10,000
e) Community involvement				
Support community initiatives to improve animal husbandry practices	♦♦♦	LG, MAAIF, Development NGO	Years 1-10	\$100-150,000

3.3. Objective 2: Poaching of carnivores/prey

Projects table for Objective 2: *Reduce poaching of large carnivores and their prey inside and outside protected areas to a point that populations are stable or increasing.*

The projects and the potential agencies that should be involved, as identified by the group.
Priority: ♦♦♦♦ = high; ♦♦♦ = medium-high; ♦♦ = medium; ♦ = low.

Project	Priority	Agencies who will be Responsible	Time scale	Estimated Cost
a) Policy and legislation				
Existing wildlife act is not a deterrent, need to increase fines/sentences	♦♦♦♦	UWA	Years 1 - 3	\$10-25,000
b) Species and habitat				
Increase support to law enforcement	♦♦♦♦	UWA	Years 1 - 5	\$150-200,000
Pilot a camera surveillance project to assess effectiveness in reducing illegal activities	♦♦♦♦	WCS/UWA	Year 2	\$25-50,000
c) Monitoring and research				
Research on intensity and seasonality of poaching in PAs	♦♦♦	UWA	Year 2	\$10-25,000
Socio-economic surveys on poaching of carnivores and their prey	♦♦♦	UWA, Makerere University	Year 2	\$10-25,000
d) Public awareness and training				
Carry out sensitization programmes on dangers of poaching and values of the carnivores,	♦♦♦♦	UWA, NGOs	Years 1 - 10	\$50-100,000
Train in benefit sharing/alternative livelihood schemes e.g eco-tourism, community development projects.	♦♦♦	UWA, NGOs	Years 3-6	\$50-100,000
e) Community involvement				
Collaborate with local communities in information sharing about the poachers, - rewards for information schemes	♦♦♦	UWA, LOCAL LEADERS	Year 1 - 10	\$50-100,000
Involve communities in negotiating resource access MOUs with park authorities spelling out dos and don'ts where feasible	♦♦♦	UWA	Years 1-10	\$50-100,000
Employ ex poachers to support some of patrolling activities and removal of exotic species outlined above	♦♦♦♦	UWA	Years 1-10	\$25-50,000 (most costs in projects above)

3.4. Objective 3: Human-carnivore conflict

Projects table for Objective 3: *Reduce conflict between livestock owners and large carnivores to levels that do not impact population viability adversely*

The projects and the potential agencies that should be involved, as identified by the group.
Priority: ♦♦♦♦ = high; ♦♦♦ = medium-high; ♦♦ = medium; ♦ = low.

Project	Priority	Agencies who will be Responsible	Time scale	Estimated Cost
a) Policy and legislation				
Finalize regulations regarding activities permitted in wildlife sanctuaries	♦♦♦♦	MTTI, UWA, Parliament	Years 1-3	\$50-100,000
Review penalties for wildlife offenses in the Wildlife Act	♦♦♦♦	MTTI, UWA, Parliament	Years 1-2	\$25-50,000
b) Species and habitat				
Institute a programme for the removal of invasive species outside PAs to increase the available of rangeland	♦♦♦	WCS, WWF, AWF, IUCN, CARE & other NGOs, CBOs, FBOs, Universities	Years 1-5	\$100-150,000
c) Monitoring and research				
Socio-economic surveys around PAs to monitor human-carnivore conflicts	♦♦♦♦	WCS, WWF, AWF, IUCN, CARE & other NGOs, CBOs, FBOs, Universities	Years 1-10	\$50-100,000
Work with companies and request for manufacture of unpalatable pesticides	♦♦♦♦	Pharmaceutical Companies, Universities, Research Institutes	Years 1-4	\$25-50,000
d) Public awareness and training				
Training communities in appropriate conflict management strategies with large predators	♦♦♦♦	WCS, CTPH, UWA, CARE	Years 1-5	\$100-150,000
Demonstration of alternative livelihood options	♦♦♦♦	WCS, WWF, AWF, IUCN, CARE & other NGOs, CBOs, FBOs, Universities	Years 4-10	\$250-500,000
Improvement of livestock production (value addition, zero grazing, improved meat & milk processing, pasture improvement)	♦♦♦♦	WCS, WWF, AWF, IUCN, CARE & other NGOs, CBOs, FBOs, Universities	Years 2-7	\$150-200,000
Training in scientific fire management	♦♦♦♦	USGS/USFS, UWA,	Years 2-4	\$50-100,000
e) Community involvement				
Improvement of rangeland management outside the Protected Areas	♦♦♦♦	DVO, NAADS, UWA, NGOs	Years 2-10	\$200-250,000
Provision of water points outside the PAs	♦♦♦♦	CARE, Districts, CTPH	Years 2-5	\$200-250,000
Improve kraaling practices of livestock husbandry	♦♦♦♦	UWA, WCS, CTPH, NGOs	Years 2-8	\$150-200,000
Assess feasibility of an insurance scheme that can be implemented later on for losses incurred to livestock outside the PAs	♦♦♦	WCS, UWA	Year 3-5	\$100-150,000
Assess economic incentives that would encourage people to live with carnivores (eg tourism and sport hunting)	♦♦♦	UWA, NGOs	Years 2-10	\$200-250,000

3.5. Objective 4: Raise awareness/support for large carnivores in Uganda

Projects table for Objective 4: Increase national awareness and support for large carnivore conservation among political leaders, law enforcement agencies (including judiciary), communities living with large carnivores and school children (future leaders).

The projects and the potential agencies that should be involved, as identified by the group.
Priority: ♦♦♦♦ = high; ♦♦♦ = medium-high; ♦♦ = medium; ♦ = low.

Project	Priority	Agencies who will be Responsible	Time scale	Estimated Cost
a) Policy and legislation				
Harmonization of policies at Government level re oil exploration and wildlife	♦♦♦♦	UWA, MTTI	Years 1-3	\$25-50,000
Establish a carnivore working group for Uganda to promote carnivore conservation and influence policy	♦♦♦	UWA, MTTI, NGOs, Universities	Years 2-10	\$25-50,000
b) Species and habitat				
Develop carnivore focused tourism activities to increase revenues derived from carnivores	♦♦♦	UWA, MTTI	Years 1-5	\$200-250,000
Assess sustainability of leopard sport hunting and effectiveness in generating economic incentives for their conservation	♦♦♦	UWA, Sport hunting orgs, MTTI	Years 1-10	\$100-150,000
d) Public awareness and training				
Assess economic value of large carnivores through tourism and present to political leaders	♦♦♦♦	UWA, WCS, MTTI	Years 1-2	\$10-25,000
Tourism familiarization visits to national parks for political leaders	♦♦♦	UWA	Year 3	\$50-100,000
Initiate publicity and fund-raising campaign - Website to promote carnivores	♦♦♦♦	UWA, MTTI, NGOs.	Year 3	\$150-200,000
Sensitization of law enforcement agencies and judiciary on large carnivore related crimes and improve regular communication with wildlife authorities - sensitize Journalists/press also	♦♦♦♦	UWA, MTTI	Training Year 1 Ongoing coordination Years 1-10	\$100-150,000
Develop education materials and teacher training for large carnivore conservation in schools	♦♦	MTTI, WCU, UWA	Years 1-10	\$250-500,000
e) Community involvement				
Train local communities in carnivore conservation and ways to behave around them	♦♦♦	UWA, WCU, WCS	Years 1-5	\$25-50,000
Investigate ways radio can be used to educate people about carnivores eg. Soap operas	♦♦	UWA, WCU, UWEC	Years 1-10	\$50-100,000
Transboundary conservation of carnivores promoted and regional management of carnivores implemented	♦♦♦♦	WCS, TBCS, UWA, ICCN,	Years 1-10	\$250-500,000

3.6. Objective 5: Monitor and tackle diseases

Projects table for Objective 5: *Establish a health monitoring and management program for carnivores in Uganda.*

The projects and the potential agencies that should be involved, as identified by the group.
Priority: ♦♦♦♦ = high; ♦♦♦ = medium-high; ♦♦ = medium; ♦ = low.

Project	Priority	Agencies who will be Responsible	Time scale	Estimated Cost (US Dollars)
a) Policy and legislation				
Improve implementation of domestic animal vaccination policy	♦♦♦♦	MAAIF, UWA, LG, MUK, Communities.	Years 1-10	\$10-25,000
b) Species and habitat				
Support ongoing Carnivore Rescue operations (injured, problem carnivores)	♦♦♦♦	UWA, WCS, WWF, CTPH, WARM	Years 1-10	\$25-50,000
Monitor habitat utilization (spatial and temporal)		UWA, WCS, WARM	Years 1-10	\$50-100,000
c) Monitoring and research				
Monitor significant infectious diseases of carnivore (FIV, FPV, FCV, FHV,CDV, FEV, Rabies, Toxoplasmosis, Non-infectious diseases e.g. poisoning, traumatic conditions etc, Others)	♦♦♦♦	UWA, WCS, WWF, CTPH, WARM MAAIF, International diagnostic Labs	Years 1-10	\$50-100,000
Monitor stress hormone levels	♦♦♦♦	UWA, WCS, WARM, International diagnostic Labs	Years 2-5	\$25-50,000
Genetic studies to assess inbreeding of carnivores	♦♦♦♦	UWA, WCS, WARM, International diagnostic Labs	Year 3-5	\$50-100,000
Rabies study to assess vaccination protocols	♦♦♦♦	WARM, UWA, CTPH, International diagnostic labs	Years 2-4	\$50-100,000
d) Public awareness and training				
Sensitization and awareness of grassroots communities	♦♦♦♦	UWA,WCS, WARM, LG, Livestock owners	Years 1-5	\$10-25,000
e) Community involvement				
Training on principles of transmission of diseases at wildlife-domestic animals-human interface)	♦♦♦	UWA,WCS, WARM	Years 1-4	\$25-50,000

3.7. Objective 6: Research and monitoring

Projects table for Objective 6: *Map distribution and abundance of large carnivores in Uganda, monitor their populations, and quantify the major threats to their long-term survival.*

The projects and the potential agencies that should be involved, as identified by the group.
Priority: ♦♦♦♦ = high; ♦♦♦ = medium-high; ♦♦ = medium; ♦ = low.

Project	Priority	Agencies who will be Responsible	Time scale	Estimated Cost (\$)
a) Policy and legislation				
Review existing policies and laws in research and monitoring	♦♦♦	UWA, MTTI, NFA, UNCST, NGOs	Years 1-2	\$1-10,000
b) Species and habitat				
Surveys of carnivores inside and outside PAs	♦♦♦♦	UWA, Universities, NGOs	Years 1-10	\$100-150,000
Habitat suitability maps created for carnivore species	♦♦	NGOs, Universities, UWA	Years 4-5	\$100-150,000
c) Monitoring and research				
Modeling to predict carnivore abundance and distributions where data are few	♦♦♦♦	NGOs and Universities	Years 2-5	\$50-100,000
Data collection on mortality, recruitment, home range and longevity of monitored populations as well as threats to their survival	♦♦♦♦	UWA, Universities, NGOs	Years 1-10	\$250-500,000
Changes in Habitat loss and quality	♦♦♦♦	UWA, Universities, NGOs	Years 1-10	\$100-150,000
Establish database and mechanism for data reporting and networking	♦♦♦♦	UWA, Universities, NGOs	Years 1-10	\$50-100,000
e) Community involvement				
Train trackers (identify signs & use telemetry) and guides among the local community who can take tourists out	♦♦	UWA, Universities, NGOs	Years 2-4	\$25-50,000

3.8. Implementation of the plan

Many plans are developed that get filed on a shelf and are never implemented. This plan was developed with most of the stakeholders who have an interest in large carnivore conservation in Uganda and as a result we believe there is good support for the implementation of the plan. The presence of Panthera Foundation at the planning workshop and their support in funding the development of the plan leads us to believe that at least one donor will be interested in funding some of the projects identified in this plan also. There is a need, however, to use this plan to raise funding to support the implementation of the plan. It will be circulated amongst potential donors as well as amongst the relevant Ministries and political leaders in the Uganda Government.

Some activities identified in the plan are ongoing and already in the process of being implemented but there is a need to find funding to continue this. Others are completely new ideas and need to be tested before they are fully implemented to assess whether they will really achieve the results that we hope. Examples of these include the improvement of rangeland and provision of water points outside the parks so that cattle are not brought into the protected areas, assessing the sustainability of leopard sport hunting and developing carnivore specific tourism activities. Each of these makes assumptions about changes in behaviour of people as a result of the actions which need to be tested and assessed before the program is fully implemented.

Implementing this strategy not only requires attention within protected areas and at their periphery but also requires attention to be focused well outside protected areas, particularly in the case of leopards. It also requires attention across international boundaries; the large carnivores in Queen Elizabeth National Park are contiguous with the populations in Virunga Park; and the carnivores in Kidepo Valley National Park move into Southern Sudan and probably Kenya also.

Since Uganda Wildlife Authority is the national authority with the mandate to conserve wildlife throughout the country they are the appropriate body to ensure the implementation of this plan. However there will be a need to liaise with the Wildlife Department in Southern Sudan and also with the Institut Congolais pour la Conservation de la Nature (ICCN) in the Democratic Republic of Congo in any transboundary activities. There are already existing MOU's between these countries for the management of transboundary conservation activities. Other national agencies that need to be involved include the Ministry of Tourism Trade and Industry because of the Direct implications of large carnivore conservation for Uganda's tourism industry and also some of the other law enforcement agencies such as the police and judiciary who work with UWA to tackle wildlife crime in the country.

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Appendix 1. Status and population dynamics of lions in northern QENP.

The Wildlife and Animal Resources Management Department at Makerere University Veterinary Department has been undertaking lion research in northern Queen Elizabeth National Park for over 20 years. Unfortunately despite repeated requests for a summary of the findings of this research none was submitted for this action plan and there were no publications or reports summarising the type of data needed for this report. We would suggest interested parties contact them directly for information.

Appendix 2. Status and population dynamics of lions in Ishasha, Queen Elizabeth National Park



Edward Okot Omoya (MSc.), Joel Ziwa (BVM), Mustafa Nsubuga
& Andrew Plumptre (PhD)

April 15, 2010



Introduction

The Wildlife Conservation Society (WCS) has been studying lions in Queen Elizabeth National Park (QENP), in the Ishasha sector with Kaplan Foundation support and more recently Panthera Foundation support, since 2005. The technical and financial support have enabled us to assess the population size of lions in the Ishasha sector of the park which has fluctuated between 17-36 individuals over the time we have monitored them. We also have measured the home ranges of the two main prides in Ishasha and have monitored the movements of lions across the international border into Virunga Park in Congo.

More recently, we conducted a socio-economic survey which focused on Carnivore-Community Relations. The survey aimed to measure or collect data on the frequency of lion predation on livestock in the past 10 years with locations, frequency of lion killing in past 10 years with locations, a better understanding of how the Basongora and Bakonzo view the lions in Queen Elizabeth Park, the views of the Basongora and Bakonzo on how they think that killing of lions could be halted and a better understanding of where lion-human conflict take place.

It is clear that the population of lions in QENP is very threatened, with an estimate of only 144 individuals. Some are being killed in the north of the park by poisoning carried out by the Basongora pastoralists in retaliation for predation of livestock by lions. In Ishasha Sector (Figure A2.1), lions have died as a result of snaring, infanticide, trampling of cubs by buffalos, a probable disease outbreak in one pride which wiped out the entire pride, and one case of poisoning. Recently, lions from Virunga Park have been moving into the former range of the pride that was wiped out.

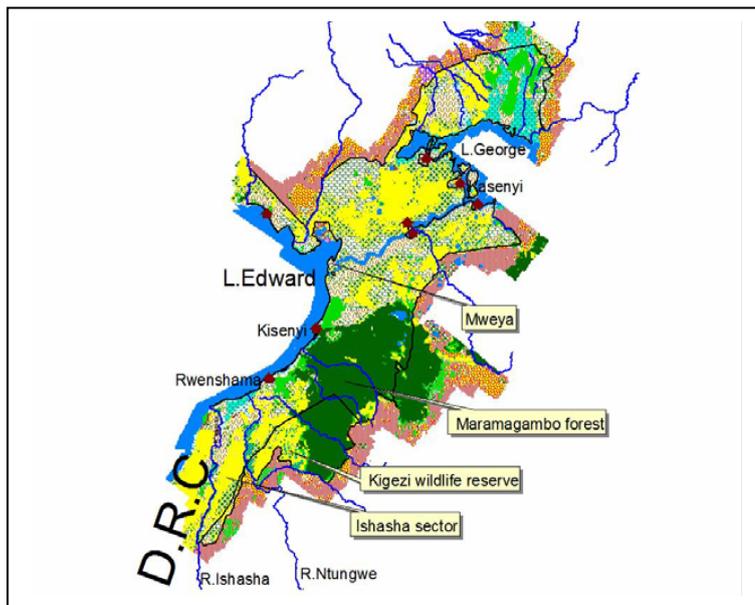


Figure A2.1. Map of Queen Elizabeth National Park showing the location of the study sites

Study area

Ishasha is located in south western Uganda and is contiguous with Virunga National Park in the Democratic Republic of Congo (DRC) (Figure A2.1). The study area is approximately 560 km².

Ishasha vegetation consists of open grassland, *Acacia* woodland, swamps, riverine forest, bush land and thickets. The southern part is dominated by short grass, *Acacia* woodland and scattered fig trees. The eastern and north eastern part is dominated by grassland with medium to tall grasses dotted with *Acacia* and fig trees.

Methods used

Determination of the population size of Ishasha lion

Lions are secretive, low density species with a drab coloration and they are mostly nocturnal. They usually confine themselves to inaccessible areas and are sufficiently wary that despite their large size, they are hard to detect (Loveridge, 2001). This makes accurate assessments of lion populations very difficult. Various methods developed to estimate lion density have been discussed and their relative merits described (Rodgers, 1974; Pennycuick and Rudnai, 1970; Smuts, 1976; Ogutu and Dublin, 1998). In this study a total count was carried out to obtain accurate data on population size and structure in Ishasha sector. Individual lions were recognized basing on photographic ID cards (Scott and Nancy Creel, 1997). The identification images considered whisker patterns and body scars and marks (Pennycuick and Rudnai, 1970) (Fig. A2.2). This protocol eliminated the possibility of double counting an individual making the census more accurate.



Figure A2.2. Individual lioness identification using vibrissa spot patterns, ear notch & scars on the face

Telemetry

Targeted candidates for telemetric study were drugged intramuscularly with a cocktail of 6-7.5mg Zolopine (Orion Corporation Finland) and 60-75mg of Zoletil (Virbac SA) delivered from a Dan-inject projection system in a stress minimized environment and manner. While under anesthesia, VHF radio and GPSArgos collars were fitted and the immobilized individuals were watched until they regained consciousness and could fend for themselves.

Radio collared individuals were tracked once every day and their geographic location reading taken using a handheld GPS unit (Garmin 72), whenever the individual being radio-tracked was encountered. Where the GPSArgos collar was used four fixes were collected daily and relayed to a satellite and the data were downloaded in Kampala.

In addition to the location data, additional information on body condition, other individuals encountered, vegetation, prey animals, activity and posture were also recorded in the daily field observation data sheets.

Data analysis

Ranges VI

Location fixes for home range estimates were taken once a day, when the radio tracked lion was encountered. The location fixes from the different radio collared individuals were analyzed using Ranges VI (Kenward, South and Walls SS, 2003) to estimate the home range of the lions. Methods of analyzing radio telemetry data have been reviewed by several authors and we based our analyses on these methods (White and Garrot, 1991; Kenward, 2001).

Kernel estimators, one of the most robust home range estimators (Seaman and Powell, 1996) were used to estimate the home range size. Kernel estimators use a probability of an animal's presence around each location point to estimate the home range. With Kernels, the possibility of exaggerating home range size due to the effect of outlying location fixes (outliers) is minimized in comparison with estimators such as the minimum convex polygon. To further minimize the over estimation error, the value of the 95% contour was considered as the home range area. Edge files produced from the Kernel analysis were exported for display with Arc view 3.2a (Environmental Systems Research Institute, USA) software to illustrate the home ranges of different lion prides in Ishasha sector.

Results

Pride population dynamics

We have been studying the changes in the size and age composition of the population of lions in Ishasha, and the biological and environmental processes influencing those changes from 2005 to date (June 2010). We have measured the way populations are affected by birth and death rates, and by immigration and emigration.

a) Birth rates:

The average litter size from the population we have been studying in Ishasha is 2.6 cubs per lioness per year. This figure is within the range of recorded natality rates in other protected areas (Stevenson-Hamilton, 1954; Guggisberg, 1961; Schaller, 1972; Van Orsdol, 1984). This aspect of our study has been the most challenging because identifying and accessing areas where females have their cubs is difficult and also poses a risk to the cubs. We therefore usually estimate litter size once the cubs venture out with their mother and it is possible some cubs die before this happens.

b) Interbirth interval

The average interbirth interval was calculated from data for two scenarios; 1) when cubs die before reaching one year of age and the mother starts cycling again and 2) when cubs survive longer than a year (table A2.1).

Table A2.1. Average interbirth intervals for litters of cubs

Survival of previous litter	Days	Months
If cubs from previous litter die before 1 year	243.5	8.1
If cubs from previous litter survive 1 year	620.5	20.7

Inter-birth interval refers to the time between the birth of successive litters; it is the length of gestation plus the time to the next conception, usually the length of lactation (Hausfater & Blaffer, 2008). Our results show that if cubs die before turning one year, the inter-birth interval would average 243.5 days

or 8.1 months, but if they survive up to one year, the inter-birth interval would be 620.5 days or 20.7 months.

c) Sex ratio of cubs:

From the 5 years of our research, 52.9% of the cubs born are male. The sex ratio of cubs is therefore 1.13 male to 1 female.

d) Causes of mortality

There have been seven known causes of mortality in Ishasha, the other causes are unknown (Table A2.2). We have lost 5 cubs to infanticide, 3 to starvation as a result of abandonment, 1 was trampled by a buffalo and 12 died due to unknown causes. One adult lioness was lost due to trauma, 2 lions were lost as result of poaching, they were caught in wire snares; 1 adult lioness died as a result of suspected poisoning, 2 adult lions and 2 adult lionesses were lost to disease, and 1 adult lion and 3 cubs died due to starvation.

A total of 30 individuals have so far died in Ishasha from the on-set of our project to-date.

Table A2.2. Causes of death of lions in Ishasha since 2005.

Age class	Sex	Infanticide	Trampling	Trauma	Poaching/snaring	Poisoned	Disease	Starvation	Unknown	Total
Adult	M	0	0	0	2	0	2	1	0	5
Adult	F	0	0	1	0	1	2	0	0	4
Sub Adult		0	0	0	0	0	0	0	0	0
Juvenile		0	0	0	0	0	0	0	0	0
Cub		5	1	0	0	0	0	3	12	21
Total		5	1	1	2	1	4	4	12	30

The highest mortality of Ishasha populations has been registered in cubs followed by adults, sub adults and lastly juveniles (Figure A2.3). In any ecosystem the viability of a population is measured by the survival of adults and recruitment rate of the young. Where lions have been studied they have been found to have high levels of mortality in cubs as a general rule. Increasing cub survival therefore is likely to have the greatest impact on the growth of the population.

Cub mortality in Ishasha is higher than in Masai Mara but cub mortality in the Serengeti higher still. Adult mortality however has been particularly high in Ishasha when compared with other African sites (Figure A2.4).

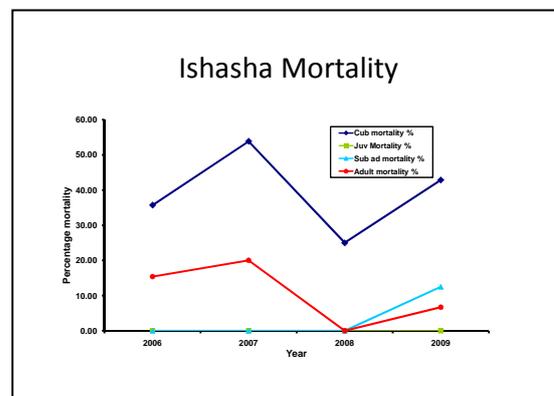


Figure A2.3. Mortality of the different age classes over the study period

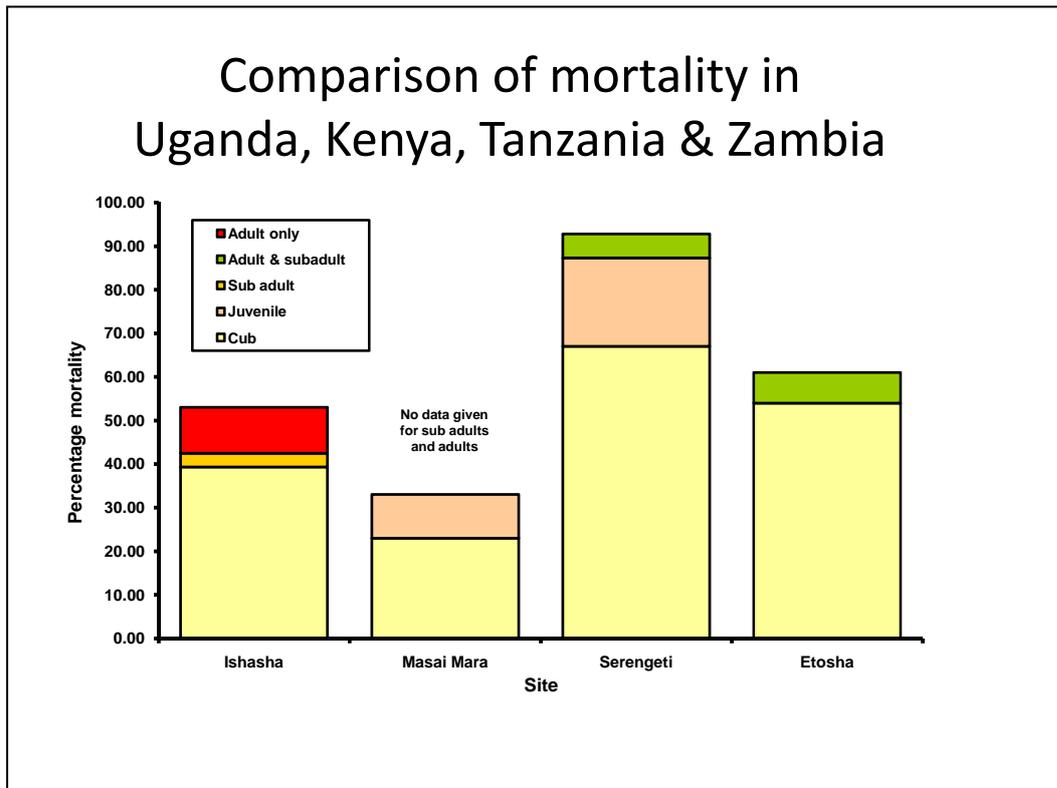


Figure A2.4. Comparison of Ishasha mortality rates with other sites in Africa.

Community involvement in carnivore conservation

There have been cases of poisoning of carnivores and birds of prey in the areas occupied by the Basongora in northern Queen Elizabeth National park: 9 lions, 2 hyaenas, 24 Cattle egrets and 1 Marabou stork in Akabale died as a result of direct poisoning and secondary poisoning due to bio-accumulation, which has led to a decline in their number (Okot E, 2009).

The preliminary findings by Okot (2009) which involved an interview with Basongora pastoralists in Nyakatonzi gave rise to a more intensive socio-economic survey which covered a wider scope of the Northern sector of QENP from L.Edward to North of L. George. A few responses from the questionnaire interviews are presented here.

Local community responses to large predators-North of QENP-Comparison of Nyakatonzi & Hamukungu

Nyakatonzi is the ancestral land of the Basongora pastoralists which is adjacent to the North Western part of QENP. Hamukungu is an enclave within the park, south west of Lake George, which was designated for fishermen during the time the park was gazetted. These two areas were of particular interest because of the long history of livestock grazing, and conflict with park authorities.

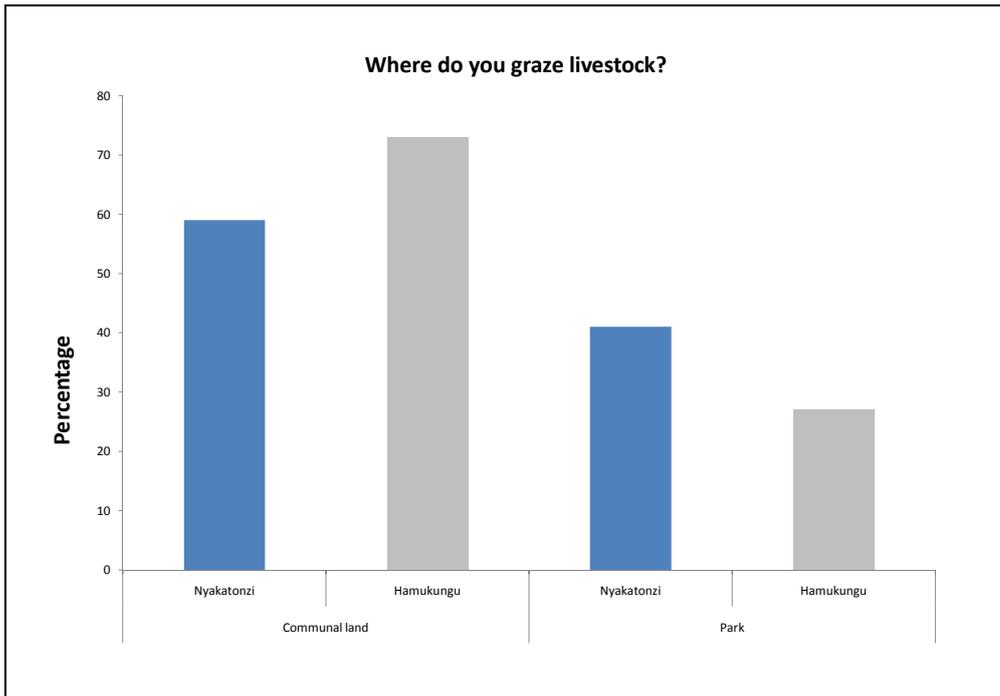


Figure A2.5. The percentage of respondents stating they graze their livestock in communal land or the park.

In Nyakatonzi, 59% of the respondents admitted to only grazing their livestock within the confines of the communal whilst 41% admitted to accessing the park for pasture (Figure A2.5). Of the Hamukungu respondents, 73% admitted to accessing the park for pasture and only 27% admitted to grazing only in the communal land. The high percentage of Hamukungu respondents accessing the park can be explained by the small size of their rangeland that cannot sustain the ever increasing livestock population in the area. Nyakatonzi on the other hand has a comparatively larger rangeland on communal land but the vast number of stock also renders it inadequate to sustain the growing livestock population especially during the dry seasons. The pastoralists are therefore compelled to encroach on the park resources for pasture and water.

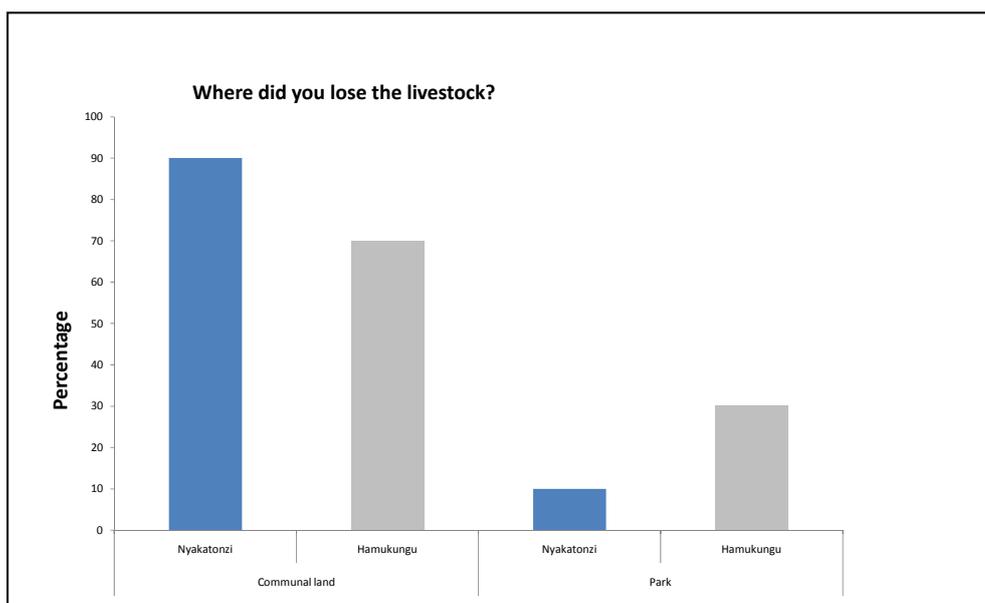


Figure A2.6. Percentage of respondents who have lost livestock on communal land or in the park.

Households were asked where they lost livestock to lion predation. 90% of the respondents in Nyakatonzi admitted to losing livestock from the communal land either while grazing or at night in the bomas, only 10% admitted to losing their stock while grazing in the park (Figure A2.6). However, 70% of the respondents in Hamukungu admitted to losing their stock within the communal land whilst 30% admitted to losing their stock while grazing in the park. This can be explained by the proximity of Hamukungu to an area of high lion numbers in the Kasenyi region of QENP. These are probably minimum estimates as some respondents may have concealed some information due to fear of arrest because they are very aware that grazing in the park is an illegal activity.

When asked about whether lions and other predators should be conserved in the park, 90% of the respondents in both Hamukungu and Nyakatonzi accepted that they should indeed be conserved in the park because of the benefits accrued in terms of revenue to the country's economy from tourism. This therefore shows that the community members are aware of the importance of carnivore conservation but they often bear more of the cost of conserving these animals rather than see any of these benefits. A case in point was a healthcare facility which was constructed in one of the enclaves but without any single medical supply or personnel assigned. The revenue sharing scheme is a welcome move by these pastoralists but the way it is managed at the district down to the Parishes, leaves a lot to be desired.

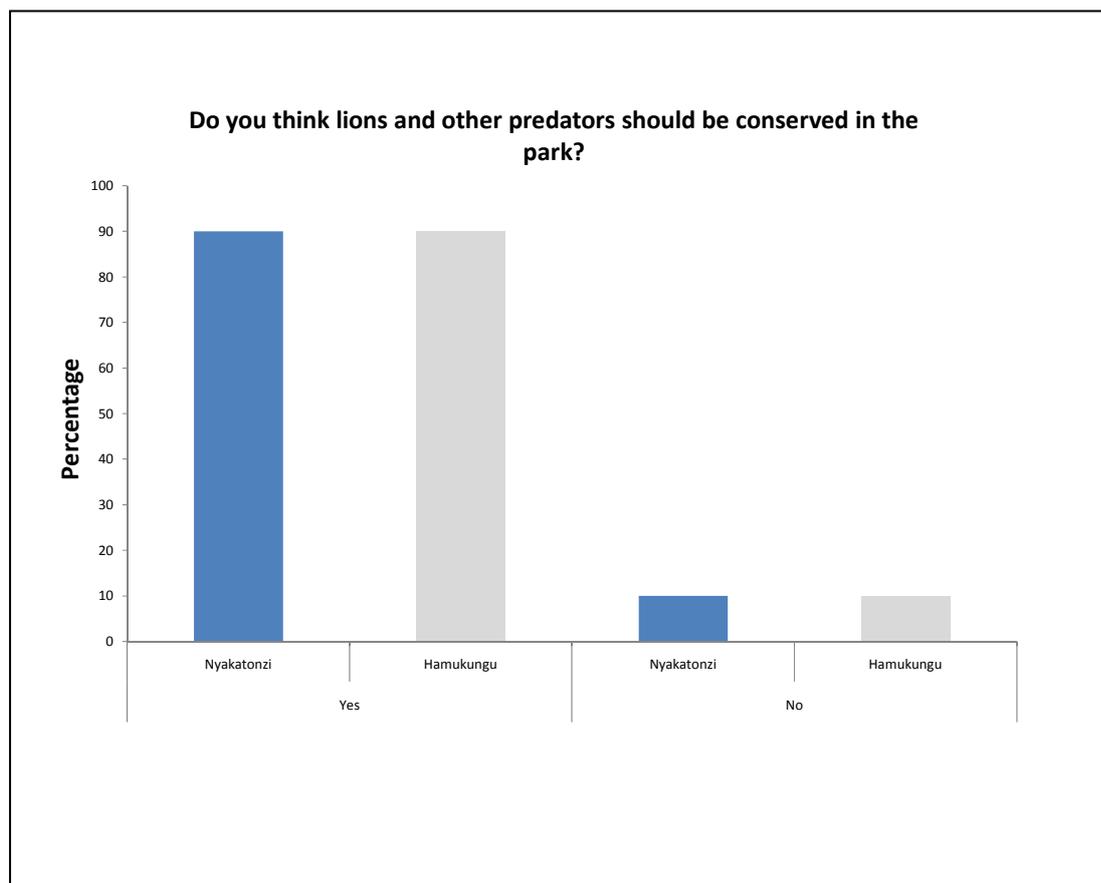


Figure A2.7. Percentage of respondents indicating whether lions should be conserved.

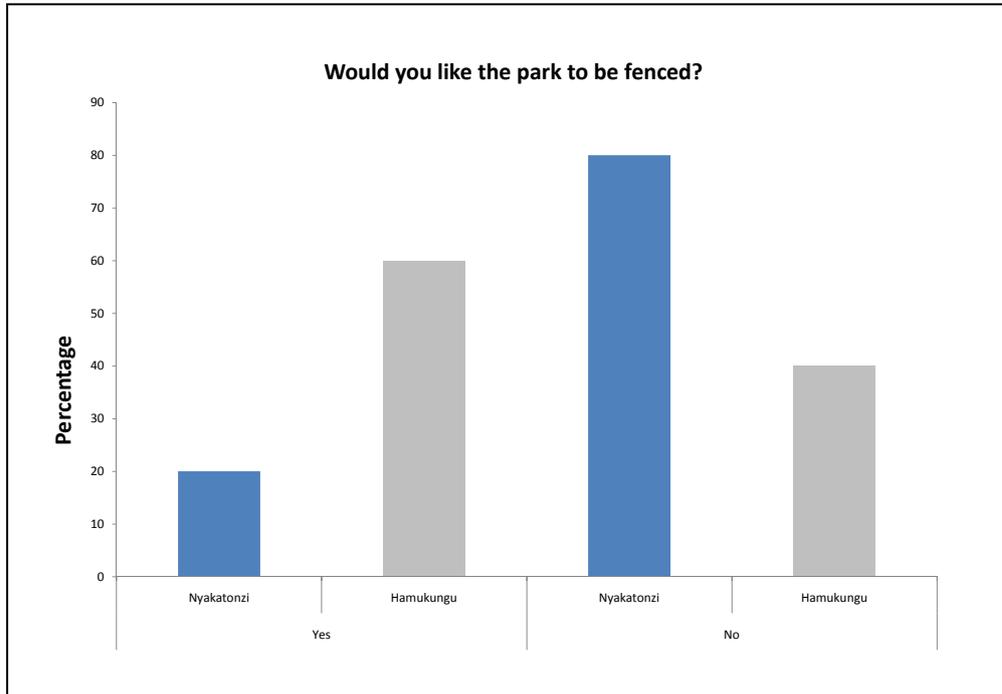


Figure A2.8. Percentage of respondents who would like the park to be fenced or not.

Respondents were also asked if they would like the park to be fenced to reduce livestock losses. 20% of respondents in Nyakatonzi and 60% of respondents in Hamukungu accepted that the park should be fenced (Figure A2.8) meanwhile, 80% of respondents in Nyakatonzi and 40% in Hamukungu did not want the park fenced. A greater percentage of the Hamukungu respondents were very willing for the fencing of the park than the Nyakatonzi respondents. This can partly be explained by the level of livestock losses resulting from carnivore attacks but the Nyakatonzi respondents were not very willing because they basically access the park during drought in search of pasture and water for their livestock.

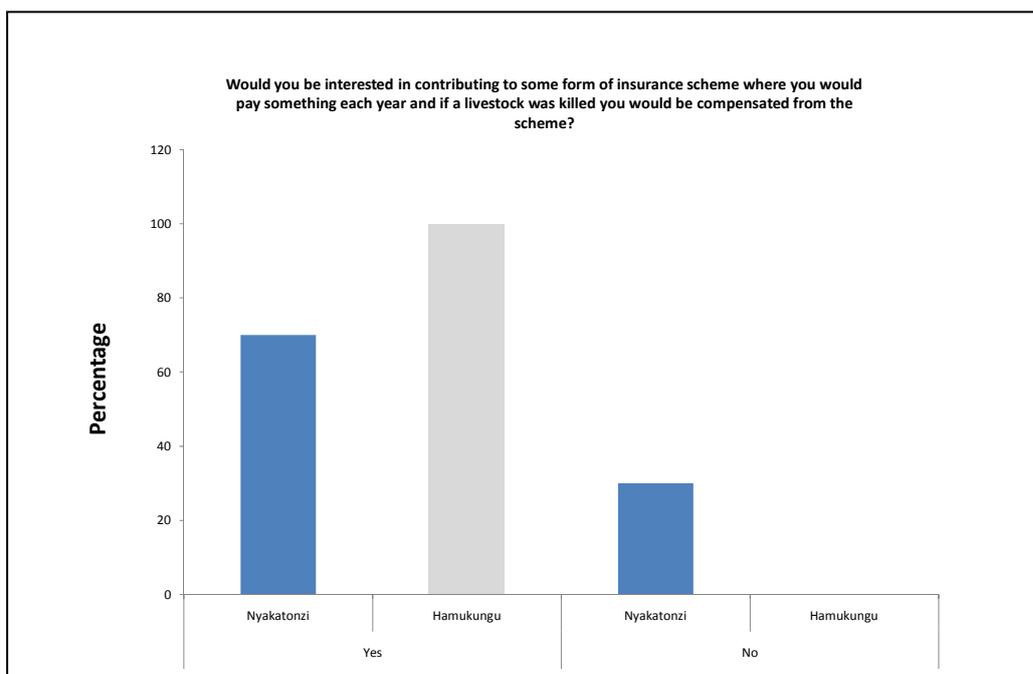


Figure A2.9. Percentage of respondents willing to contribute to an insurance scheme.

When asked whether they would be willing to contribute to an insurance scheme that would ensure compensation when they lose livestock to the carnivores, 70% of the respondents from Nyakatonzi were willing to contribute to scheme whilst an overwhelming 100% of the respondents from Hamukungu expressed willingness to contribute to the insurance scheme (Figure A2.9). However, the respondents expressed concern over how the scheme would be managed citing the high level of financial mismanagement at the various institutions in the country from the top to the grass root level. They therefore needed an assurance that the scheme would be managed with utmost integrity to achieve its goal.

Main prey Species-Ishasha Lion kill

We collected data on prey species from lion kills over the 5-year study period. Uganda kob was the main prey species followed by buffalo, topi, warthog, and lastly waterbuck and bushpig (Figure A2.10). The question now is do lions prefer Kob because of their high density which makes them readily available or ease of capture?

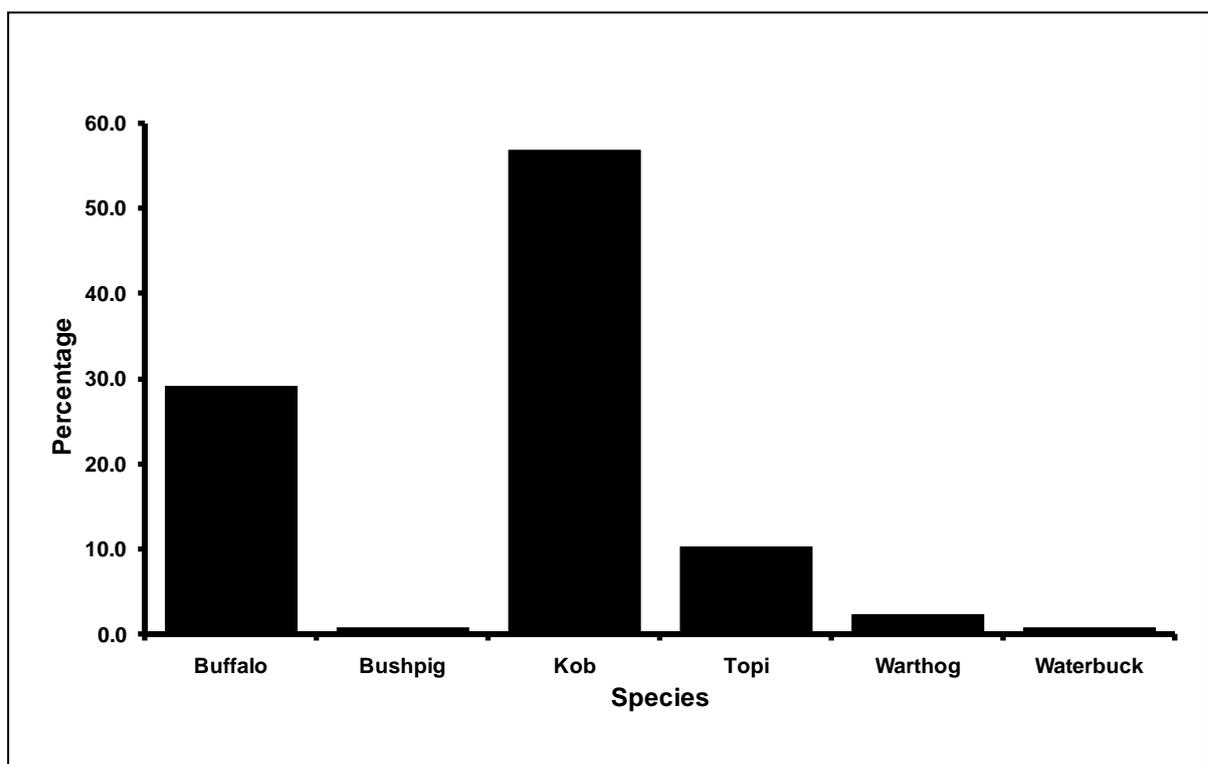


Figure A2.10. Percentage of kills formed by different prey species in Ishasha.

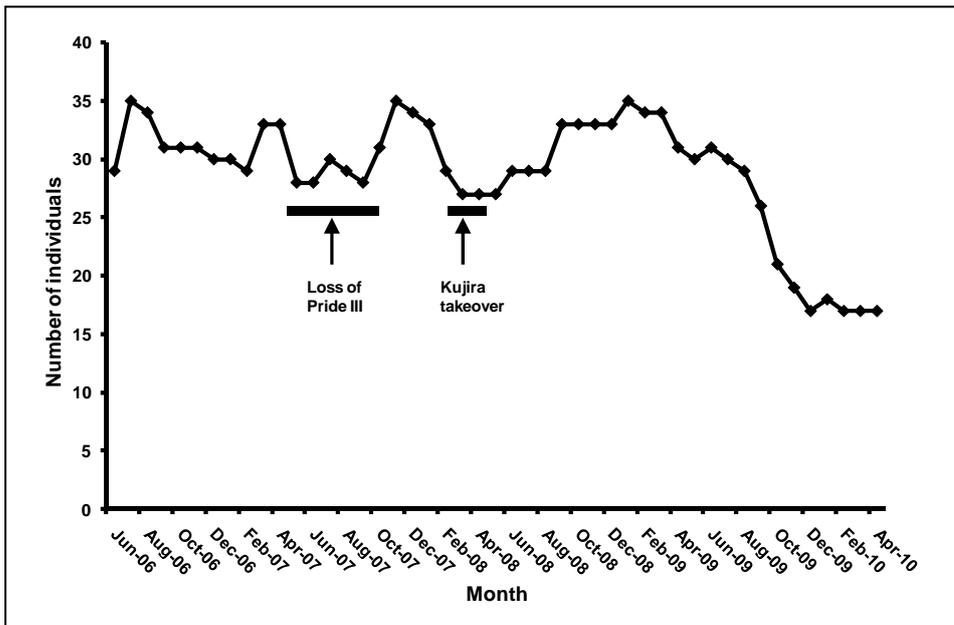


Figure A2.11. Population size of Ishasha lions from June 2008 to April 2010. Two key periods are shown; one when one pride (III) died of disease and the other when a male coalition took over the southern pride ousting the resident male.

Changes in the Ishasha Lion Population size

Generally, there is downward trend in the population size of lions in Ishasha. The probable reasons being; there was a complete loss of one pride (Pride III) to a probable disease. Thereafter, there was a slight increase in the population then a steady decline up to the time when Kujira one of the lions in a coalition pair took over southern pride. This led to infanticide of cubs and dispersal of subadults away from the pride range and into DRC or north through Maramagambo forest to the Mweya region.

Population based on Age Categories

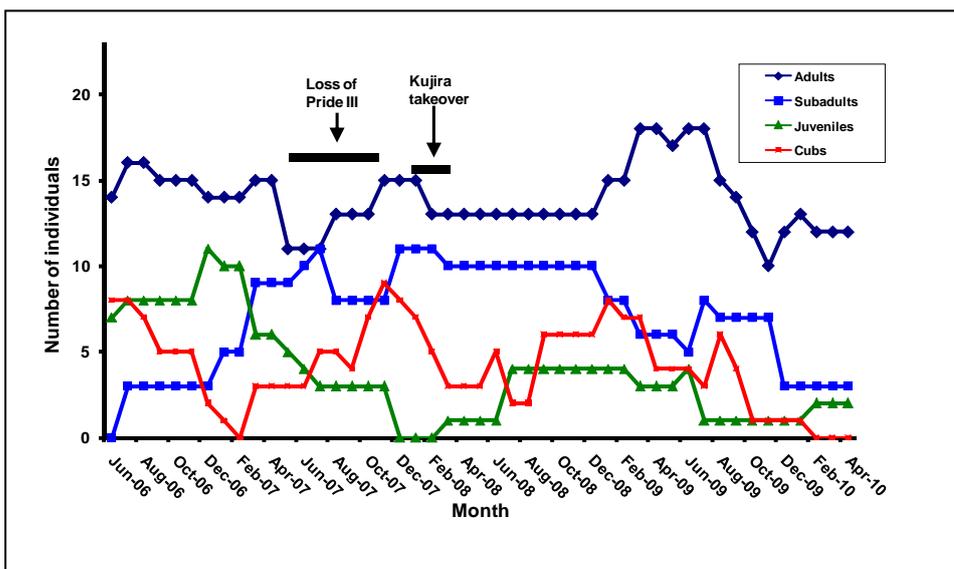


Figure A2.12. Number of individuals in the different age categories over the study period.

Figure A2.12 breaks down the total lion numbers into age categories over the time of the study period.

The population of cubs has fluctuated depending on when litters have been born and when cubs have died or become juveniles. The population of juveniles shows a steady decline over the period of our monitoring, sub adults however, showed a steady increase until June 2007 and then formed plateau in December 2008. Thereafter, the population declined steadily up to December 2009. This is partly explained by dispersal of sub-adults following the takeover of the southern pride. The Adult population remained relatively stable with a slight decrease in the past few months.

Lions in the Greater Virunga Landscape

The lion population in Ishasha is part of a larger population that extends across the Virunga National park in DRC as well as into the northern part of Queen Elizabeth Natrional Park. We worked with UWA and ICCN to compile sightings of lions by rangers while on patrol in both parks (fig. A2.13).

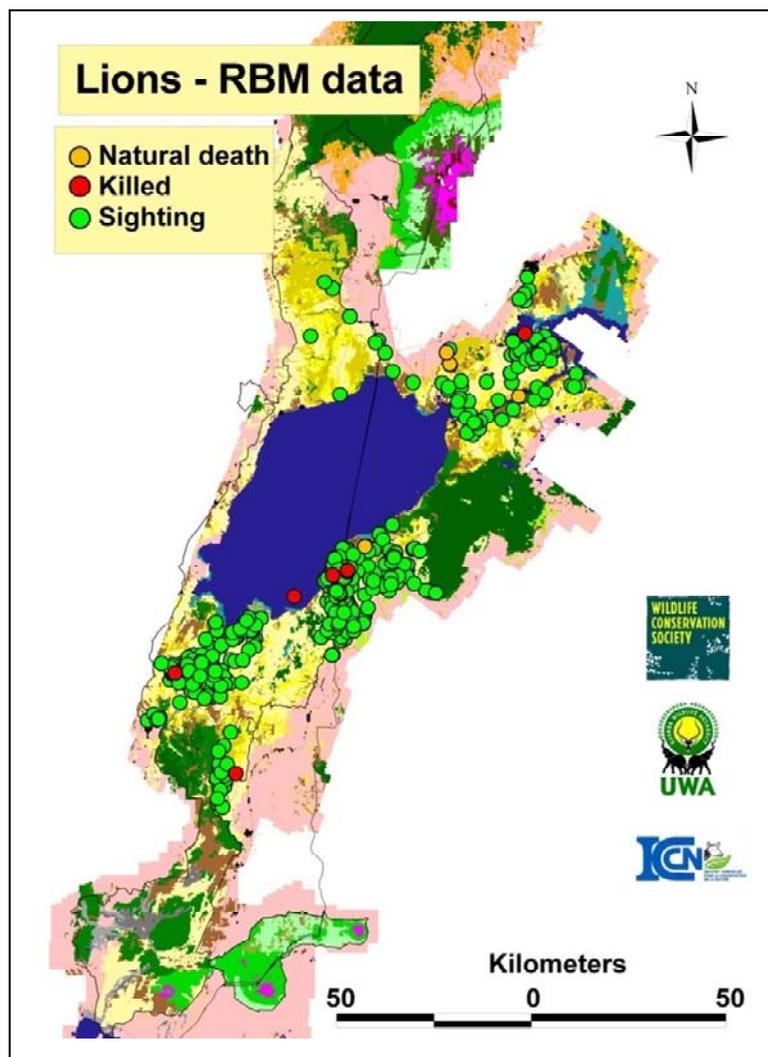


Figure A2.13. Locations of lion sightings by rangers in the Greater Virunga Landscape.

These sightings tend to coincide with areas where prey densities are high as measured by aerial survey flights (Figure A2.14), except in areas where insecurity limited access especially in the eastern part of Virunga Park. Prey biomass was calculated for the separate sectors of each park (Table A2.3) and these figures were used to estimate total lion numbers (Table A2.4) for the Greater Virunga Landscape using predictive equations in Treves *et al.* (2009).

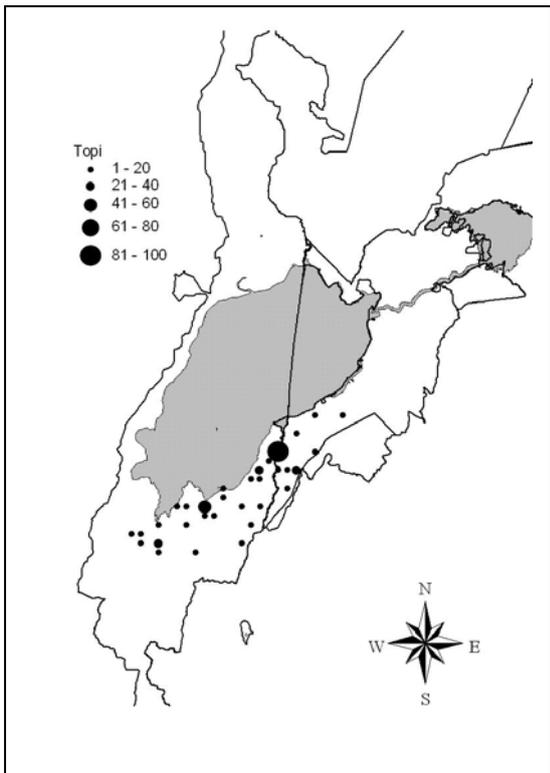
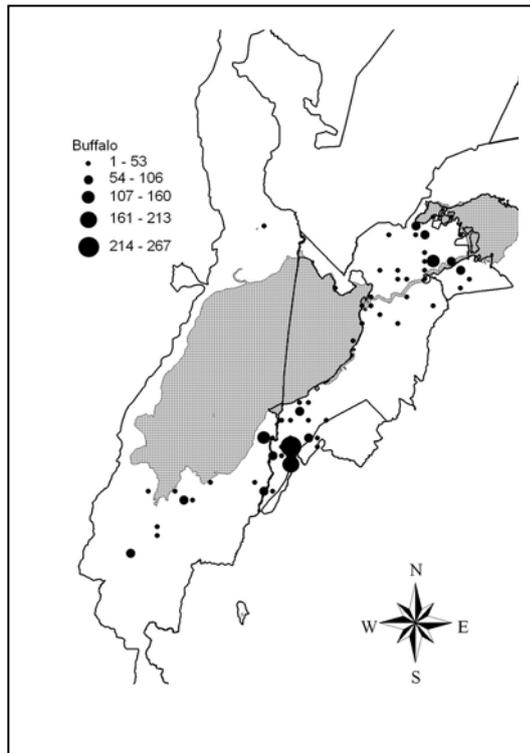
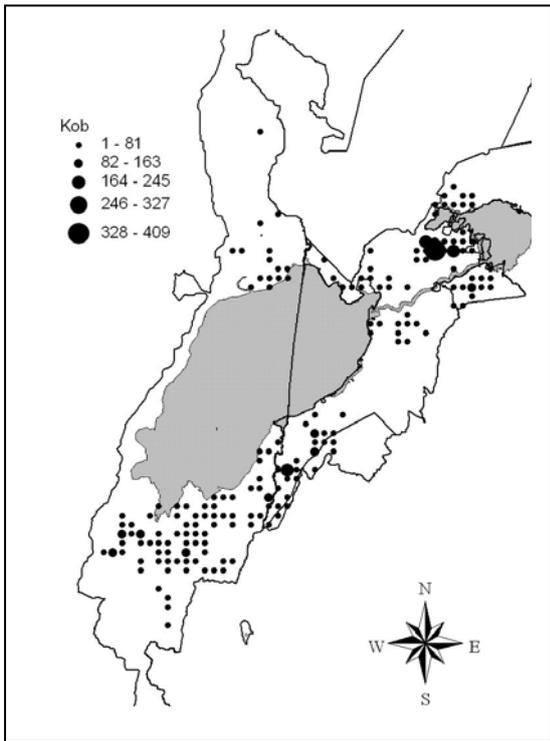


Figure A2.14 Aerial survey distributions of numbers of Uganda kob, buffalo and topi in the savanna regions of the Greater Virunga Landscape

Table A2.3. Prey biomass density calculated from aerial survey data.

	Area (km ²)	Biomass of prey kg/km ²	Biomass density per park kg/km ²
QENP North	1481	2568	4339
QENP North	425	10511	
PNVi central East	1639	1485	917
PNVi North	1082	56	

Table A2.4. Predicted lion density and numbers from prey biomass.

	QENP	PNVi	GVL
Area of suitable habitat (km²)	1386.00	3148.00	4534.00
Prey biomass density (kg/km²)	4339.00	917.00	1963.07
Estimated lion density	0.10	0.02	0.05
Lion numbers	139.88	67.18	207.06

Ref: Using equation 3, Treves *et al* (2009)

Population Viability Analysis-Vortex

The figures on population natality and mortality rates derived above as well as the population size were used in a VORTEX model to assess probabilities of extinction of lions in the Ishasha region. Various scenarios were modeled as follows:

1. The Ishasha population at its average structure over the past five years of about 30 individuals (figure A2.15).
2. Simulated reduction to 20 individuals as has happened recently
3. Simulated at 30 individuals but with steadily increasing prey biomass at 2% per year
4. In the initial model we assume a 50% survival of individuals if they contract a disease. We modeled what happens if survival is increased to 80%.
5. Simulated a reduced cub mortality from 55% to 45% to assess its effect on survival
6. Simulated a reduction in adult mortality from 10.5% to 5.5% to assess its impact on survival
7. Combining all of the above interventions (Figure A2.16).
8. We then incorporated some immigration from Kisenyi and Kyambura to the north of Maramagambo Forest to assess the impact of maintaining this existing connection – two levels of immigration were modeled (low and medium rates).
9. Finally we simulated medium immigration from the north and a reduction in disease.

Table A2.5. gives the results of these analyses as probabilities of extinction

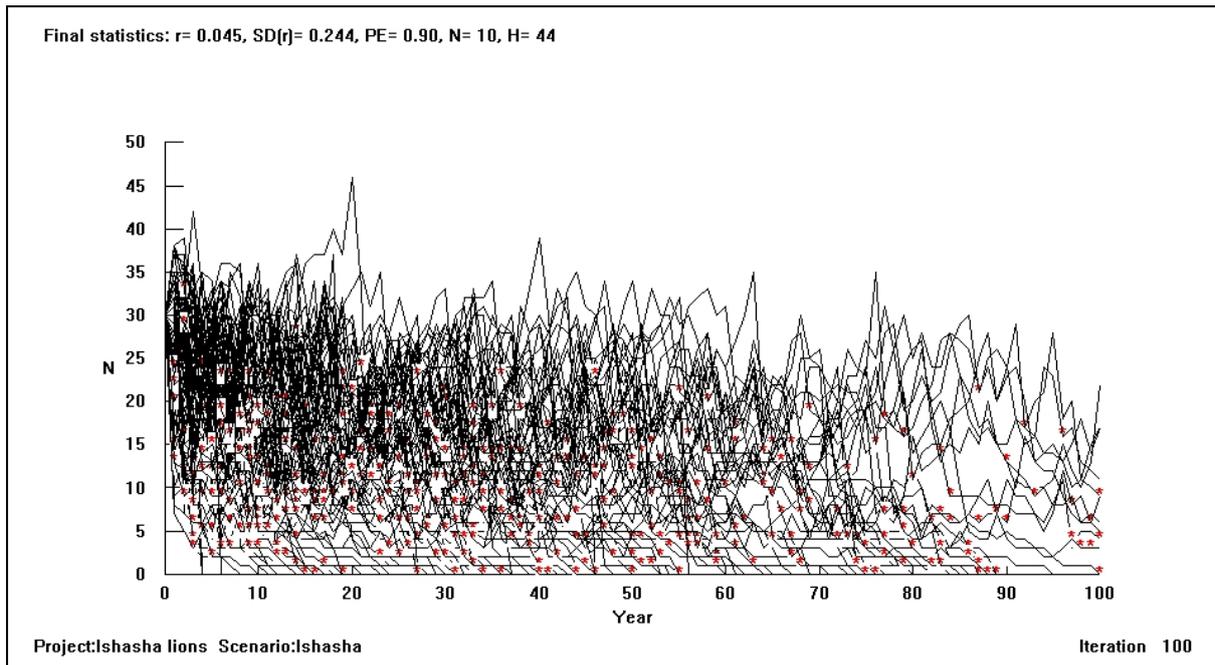


Figure A2.15. Vortex stochastic model for Ishasha without interventions with a starting population of 30 individuals and a carrying capacity of 40. Lines show changes in population size with each of 100 iterations of the model over 100 years.

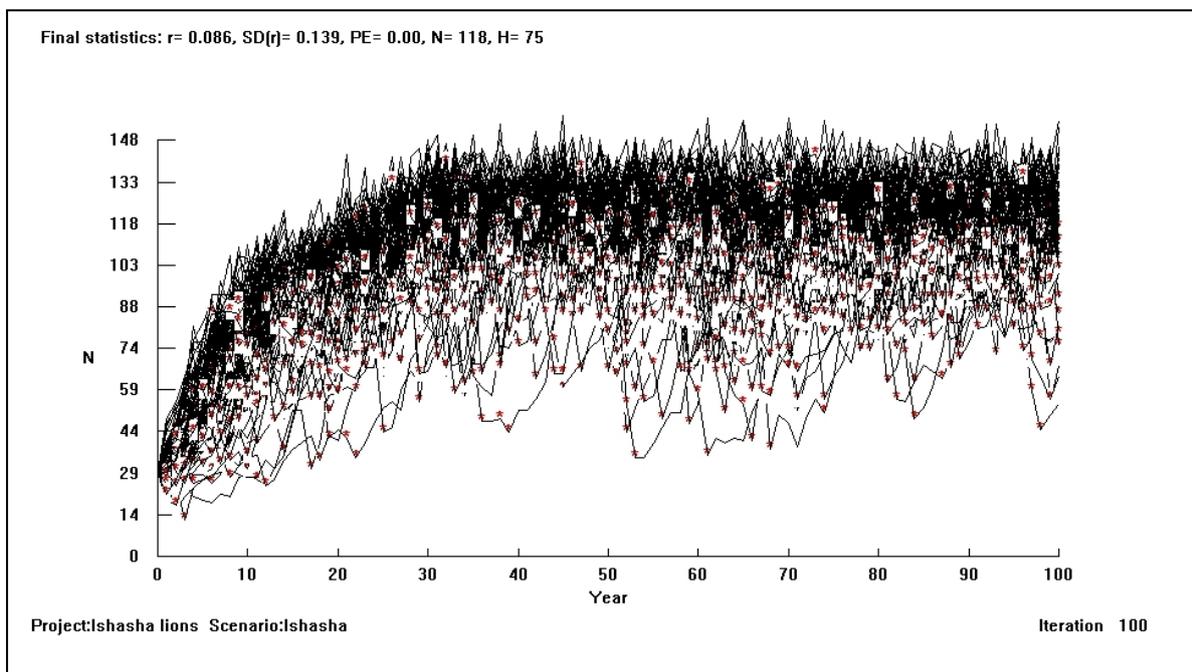


Figure A2.16. Vortex stochastic model for Ishasha with interventions to reduce disease and with connection to the north of Queen Elizabeth maintained with a carrying capacity of 50 and increasing prey base. Lines show each of 100 iterations of the model.

Table A2.5. Probabilities of extinction under the various scenarios described in the text with different carrying capacities in Ishasha (K=30, 40 & 50).

Probability of extinction	K=30	K=40	K=50
Ishasha Pop 30 individuals – baseline*	1	0.9	0.85
Reduced to 20 individuals	0.99	0.92	0.81
Increase prey base over 30 years by 2%/yr	0.91	0.75	0.63
Increase survival of disease to 80% from 50%	1	0.77	0.4
Reduce Cub mortality by 18% (55% to 45%)	0.97	0.74	0.51
Reduce adult mortality by 50% (10.5% to 5.5%)	0.98	0.78	0.65
Reducing mortality, increasing survival to disease and increasing prey base	0.2	0.01	0
Low immigration from Kasenyi and Kyambura	0.43	0.11	0.14
Medium immigration from Kasenyi and Kyambura	0.32	0.12	0.05
Medium immigration & disease reduced to 1% chance from 5%	0.15	0	0

*Baseline condition: Disease 5% chance, kills 50%; Poaching 10% chance kills 10%; 10% males breeding, Cub mortality 55%, Adult mortality 10.5%.

These results show that maintaining connectivity between the sub-populations in the north and south of Queen Elizabeth Park has the greatest impact in helping ensure long term survival of the Ishasha population of lions. Since we started monitoring the Ishasha population one lion has come from the north to the south and three males have moved to the north so that this connection is currently functional. Reducing mortality and disease impacts and increasing the prey availability all helps reduce the chances of extinction but working on all of these simultaneously has a much larger effect than any one individually.

If poaching is reduced to an appreciable level, there will be an increase in the density of prey for the lions and less death as result of accidental snaring of lions by the poachers. Alternative income generating activities should be identified as a source of livelihood and poachers helped to make an income. One option would be to employ reformed poachers to remove invasive species such as *Lantana camara* that occurs over much of Ishasha.

Regulating aggressive tourism whereby tour company drivers over speed and drive off track and end up running over cubs should be addressed as one option to reduce cub mortality. There is a need to increase disease surveillance of lions to be able to react to diseases when they strike. The low level of

monitoring of the third pride in Ishasha meant that it virtually died out before we knew what the problem was.

Improvement of transboundary movements would ensure gene flow which would strengthen population viability of the lions should there be a disease outbreak.

Future challenges- Oil drilling

The discovery of oil in the Albertine Rift is likely to have a detrimental impact on the conservation of lions in QENP and other National Parks. During the seismic operations in the Ishasha sector, the lions became harder to locate, the frequency of encountering the collared lions was drastically reduced, and we would find them very far from their normal range. This was partly attributed to the high level of disturbance caused by heavy trucks moving all over the drilling sites, presence of oil company personnel and multiple tracks that were constructed for the operation. The impacts of drilling and oil extraction need to be monitored and assessed.

Conclusion

There has been a slow decline in the population of lions in Ishasha sector over the past five years dropping from about 30 individuals to 17. This population attracts the highest number of tourists to the sector because of their unique tree climbing habit and is therefore important for Uganda's tourism industry. Unless this trend is reversed, there will be a very negative impact in the tourism industry especially those visiting QENP.

The threats to the population of lions through poaching, high cub mortality, disease and poisoning among others, must be addressed by a concerted effort involving all stakeholders to help mitigate these effects which may eventually lead to the extinction of this species of both national and international importance. Tourism is Uganda's highest foreign currency earner and after mountain gorillas, lions are the most sought after species by tourists. Ensuring their long term survival has both an economic importance as well as a conservation importance.

Appendix 3. National census of lions and hyaenas in Uganda



**T. Mudumba, P. Mulondo, E. Okot, M. Nsubuga, A. J. Plumptre
and S. T. Buckland**



Project Summary

Wildlife Conservation Society Uganda (WCS) in collaboration with Uganda Wildlife Authority (UWA) conducted a playback census of carnivores in Queen Elizabeth Conservation Area (QECA), Kidepo valley National Park (KVNP) and Murchison Falls Conservation Area (MFCA). The study started in QECA on 29th November, 2008 and ended on 26th November, 2009 in MFCA. Regions in the conservation areas that could not be reached by car for reasons such as insecurity and thick vegetation or un-motorable terrain were left out of the analysis and so were those that have been known not to harbor lions in the recent past. A total of 134 call sites were accessed with sampling effort of 19.31%, 14.29% and 14.32% for QECA, KVNP and MFCA respectively. Although the playback attracted other species such as jackals and leopards, only data for lion *Panthera Leo* and hyena *Crocuta Crocuta* were analyzed because the method used is not appropriate for these other species. The lion data were analyzed after calibrating responses to the playbacks with known individuals while the hyaena data were analyzed using response data from Mills et al 2001. Professor Steve Buckland of the University of St Andrews in Scotland analyzed the data using the lure count method (Buckland et al 2006).

In QECA, the playbacks gave an estimated 144 individuals for the park as a whole, with 72 estimated for the north (South of lake George but North of Kazinga channel), 41 for the centre (North of Maramagambo but South of Kazinga Channel) and 27 for Ishasha (Region South of Maramagambo forest). The Kidepo population of lions appears to be increasing and we recorded 19 at play back stations in the park, estimating about 132 lions in the park as a whole. Murchison Falls National Park constitutes the only other significant population of lions in Uganda with also about 132 individuals. Although no playbacks were conducted in other areas, there may be around 5 individuals in the Semuliki Wildlife Reserve and two have recently been recorded in Lake Mburo National Park which probably emigrated from Akagera ecosystem.

With these results, the Carnivore Research Project of the WILD Program is now moving into the phase of detailed research in MFNP. This is urgent because the park has oil exploration going on in lion habitat in Tangi and Buligi. Intensive monitoring of individuals and prides will begin as soon as the lions are collared.

Study Area

QECA, KVNP and MFCA were sampled for estimates of hyaenas and lions using the lure count method while Toro-Semuliki and Lake Mburo N. P. had estimates from total counts of lions by UWA staff.

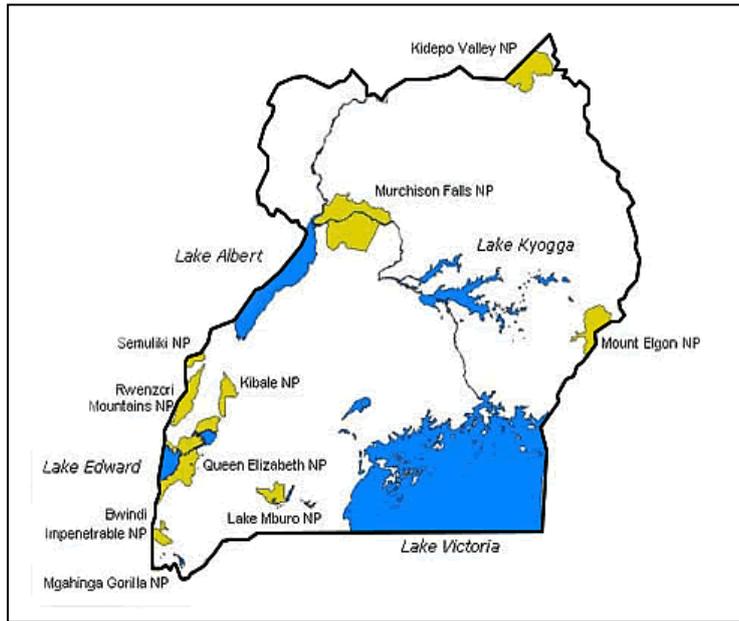


Figure A3.1. Map of Uganda showing the location of Uganda’s national parks. *Source: UWA*

Method and Materials

Lure Count Sampling

A 7 minute 27 second long sound of a distressed buffalo calf was played through a FX3 Snow Crow Pro Call box attached to two 50 watt SP108 deluxe cone speakers connected in series and played repetitively with the call machine playing at maximum volume and the entire exercise lasting for 30 minutes at each call station in QECA, KVNP and MFCA respectively spread out at about 4 call stations per 10km².

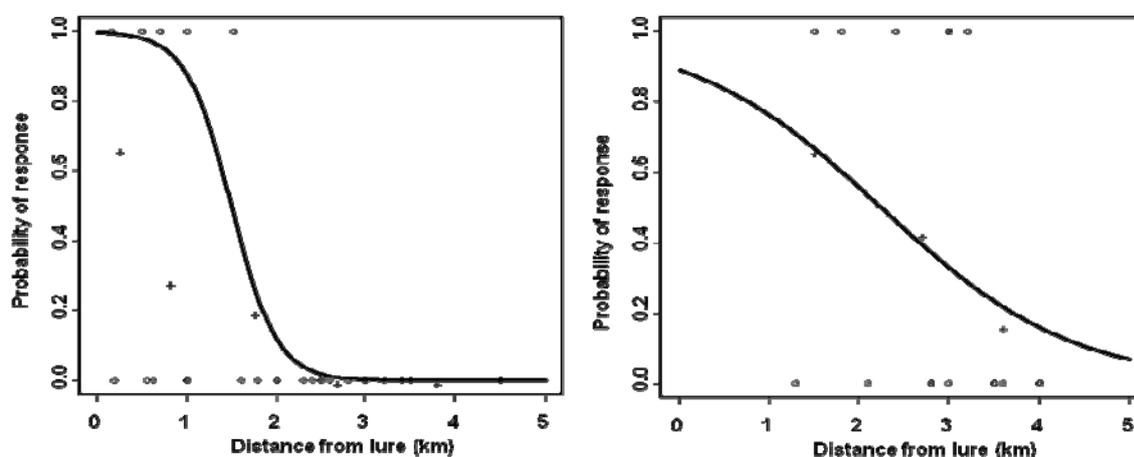


FX3 Snow Crow Pro Call box-center and SP108 Deluxe Cone Speakers

Before the survey, maps of the three conservation areas were overlaid with points randomly placed at about 5 kilometers apart. Recces were made by the team between 0900-1800hrs to determine areas within 50 meters of the call point that were open or raised so as to maximize visibility. For most points in QECA and KVNP this was not as difficult as it was in MFCA

with its dense woodland especially on the southern bank of river Nile. Later in the evening between 1900-0100hrs, the team drove to the areas visited in the day with the equipment and played the distress call. After 15 minutes of playing, the speakers were turned through 90° without interrupting the sound. Observers on the roof of the field car with eye height about 3 meters from the ground scanned the area with a 350000 candela spotlight on which they placed a red light filter when eye shine was first reported approaching. All animals that turned up were scrutinized to avoid double counting and different non overlapping sites were selected for subsequent nights.

Another experiment was conducted on known lions in QENP to establish the probability of response to the buffalo calf distress call. This was made on 27 occasions in QECA. Lion groups or individuals were located and a vehicle parked a distance away not to influence its movements while a second car drove off to a known distance between 500 meters and 5 kilometers and played the sound as was the case during the survey. Whether the monitored animal/group responded and arrived at the vehicle with the playback system within 30minutes was recorded. The lion data from these experiments together with hyena response data from Mills et al (2001) collected in Kruger national Park were then sent to Professor Steve Buckland at the University of St. Andrews-Scotland who analyzed it and fitted logistic regression curves on the graphs of probability of response against distance between the lure and the animals. Where possible we tried not to repeat calls on the same individual but where this occurred the number of the repeat was entered as a co-variable.



Lion detection function: Effective radius: 1.56km
Probability of detection if animal within 5km: 0.10

Hyena detection function: Effective radius: 1.75km
Probability of detection if animal within 5km: 0.30

Figure A3.2. Response functions of lions in QENP and hyaenas in Kruger national park to playbacks of buffalos in distress. From these effective radii, densities of lions and hyenas were calculated for the sampled area after Buckland et al (2006) lure count method

Literature Review

Efforts were made to gather data on large carnivore numbers of Uganda from several manuscript, books, websites and magazines. The earliest source of information on Uganda's carnivores is by Din (1978) on lions, then Van Orsdol (1981) and more work by Driciru et al (1996). Other sources included Driciru (1999) and the Uganda Large Predator Program (2000-2), Bauer and Van Der Merwe (2004), and Driciru (2005).

Educated Guesstimates

Uganda Wildlife Authority staff based in the parks in which large carnivores occur were called and asked to give an estimate of the population of lions in their conservation areas. Those who participated ranged from rangers to wardens. Their answers were then compared with the estimates from the lure count method.

Sample Size

A total area of 6,674km² was sampled in the three national parks with 35 points in QECA, 24 in KVNP and 72 in MFCA (Table A3.1).

Table A3.1. Total area surveyed at each site by the lure counts and the percentage of this area sampled by the points.

Park	Area Surveyed km ²	Sampling Effort (%)
QECA	1386	19.31
KVNP	1284	14.29
MFCA	4004	14.32

Coverage of the study area was limited by factors such as inaccessibility due to thick woodlands and un-motorable terrain. Also areas north of Kidepo River in KVNP were left out due to insecurity as a result of armed warriors in the area at the time of the survey. However, the areas left out are known not to harbor large carnivores because of low prey numbers and so their effect on the final estimates is marginal. Maps of QECA, KVNP and MFCA show the coverage of points at which the distress calls were played (Figs. A3.3-A3.5).

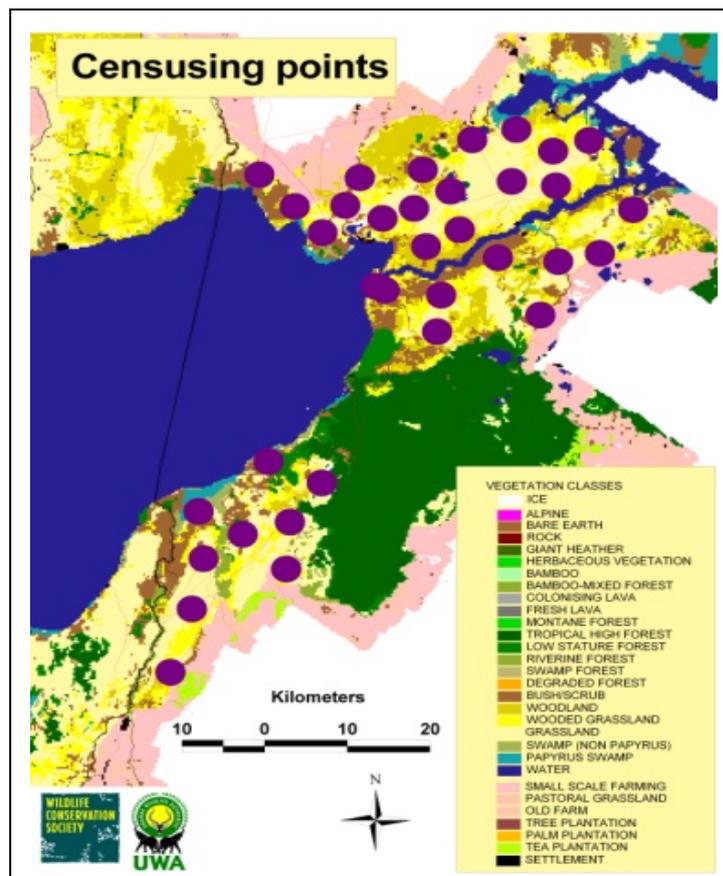


Figure A3.3. Map of locations of lure count points in QECA.

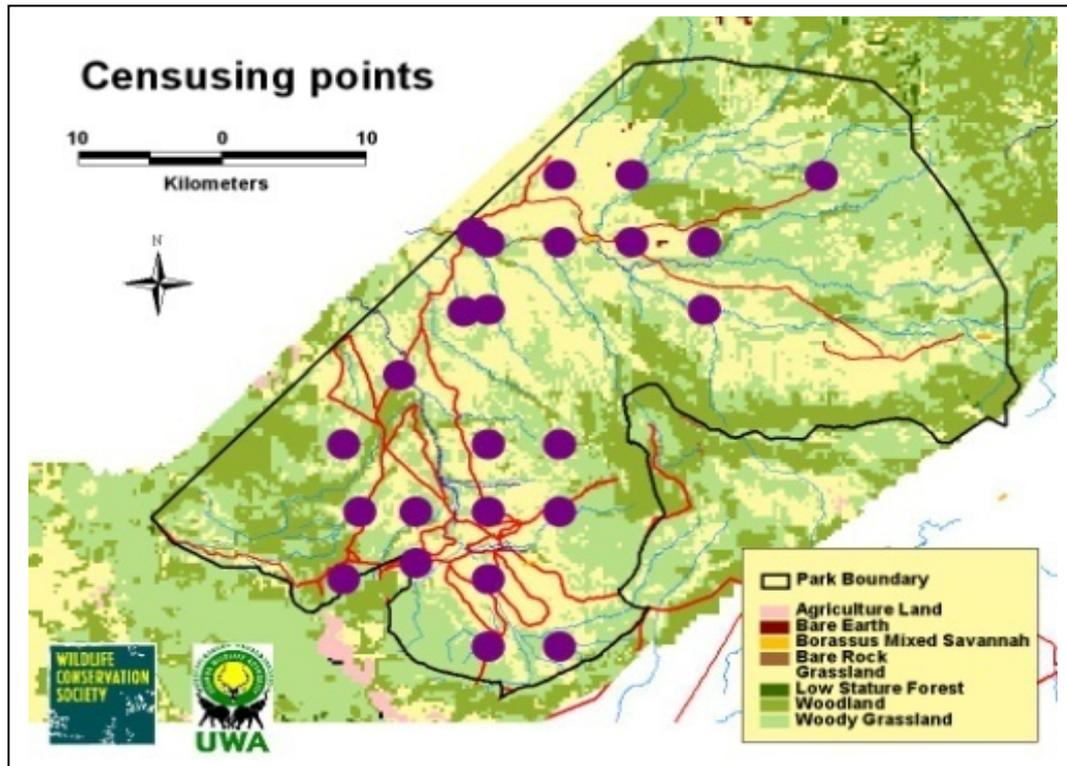


Figure A3.4. Map of locations of lure count points in KVNP.

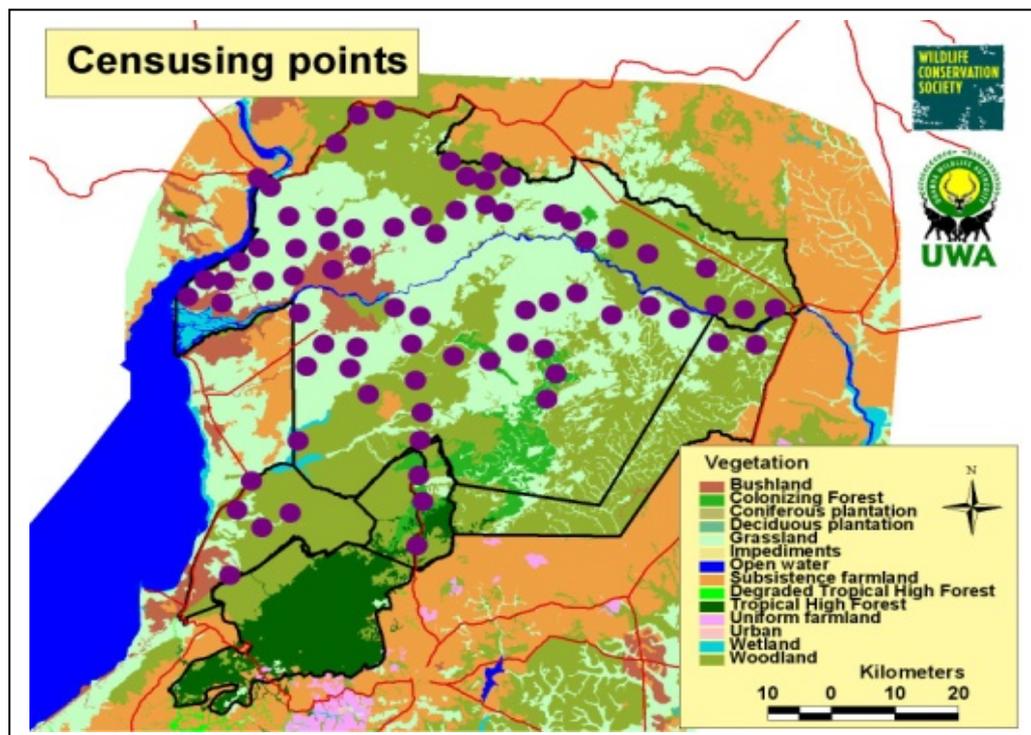


Figure A3.5. Map of locations of lure count points in MFCA.

Results

Lion studies in Uganda have not been consistent and exhaustive. The most surveyed park has been QECA with Toro-Semuliki and L. Mburo NP's having had no systematic surveys for carnivores. The

survey method used by previous researchers differs from the lure count method and also the researchers sampled small areas of the parks that were known to have lions. The estimates made by Bauer (2004) were educated guesstimates by M.Driciru and L. Siefert. However the trends in estimates show that lions are decreasing in Uganda (Table A3.2).

Table A3.2. Estimates of lion numbers in Uganda’s conservation areas from the literature or from knowledge of rangers.

Year(s)	Researcher/Organization	QECA	MFCA	KVNP	Toro Semuliki	L. Mburo NP	Total
1977-81	Din & Van Orsdol	400					
1994-97	UWA					7	
1997-99	Lion Project	185					
2000-02	Lion Project & UWA	206	324	58	10	2	600
2003-4	Lion Project		347				
2004	H. Bauer & S. Van Der Merwe	200	350	25			
2005	M. Driciru		263				
2010	UWA Guesstimates	200	40	125	5	10	380

Carnivore Turn-up during the Survey

The buffalo calf distress call attracted both small and large carnivores to the call stations. Side-striped (*Canis adustus*) and Black-backed jackals (*Canis m. schmidtii*) responded together with white-tailed mongooses (*Ichnuemia albicauda*) and Large spotted genets (*Genetta tigrina*) in KVNP and MFCA.

The numbers of responding lions and hyaenas to the lure was registered in all the parks as shown in the graph below.

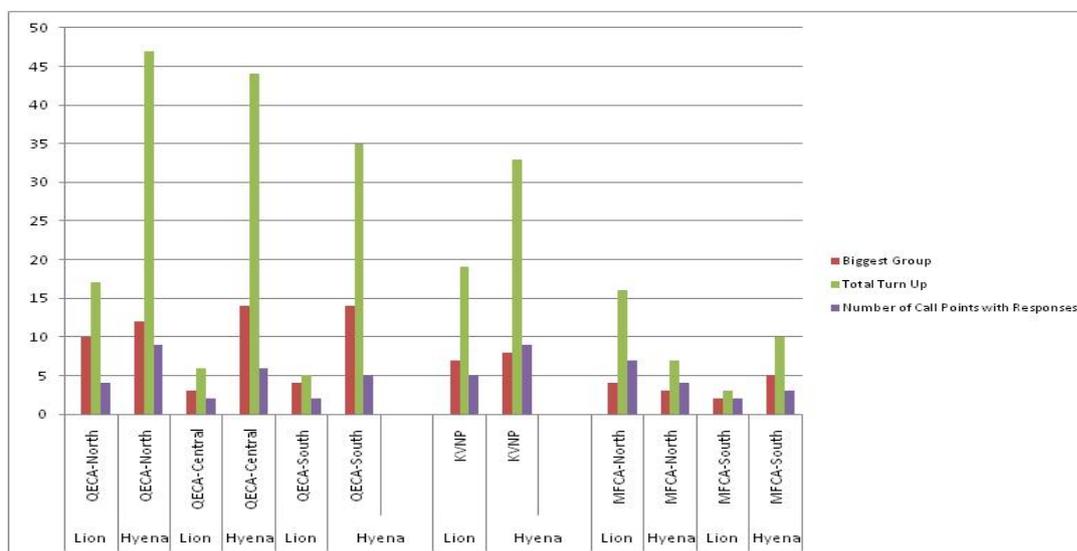


Figure A3.6. Numbers of lions and hyaenas repoding to lures in the different sectors of QECA, KVNP and MFCA.

A total of 66 lions, 176 hyenas and 7 leopards turned-up during the survey. The park with the largest single group turn-up of lions (10) and Hyenas (14) is QECA.

Queen Elizabeth Conservation Area

The survey was conducted from 29th November, 2008 to 8th February, 2009. The whole of Maramagambo forest and the area north of Lake George was left out during the survey. The largest lion group to turn up was at Kasenyi Kob mating ground (10), and for hyenas (14) at Lake Edward flats and again at the Katunguru-Ishasha road junction. Another group of 12 hyenas turned up at Track III in the Kasenyi tourist-zone. The Kasenyi pride was known to be about 17 individuals at this time (L. Siefert pers. comm.) but since then six individuals have been poisoned.

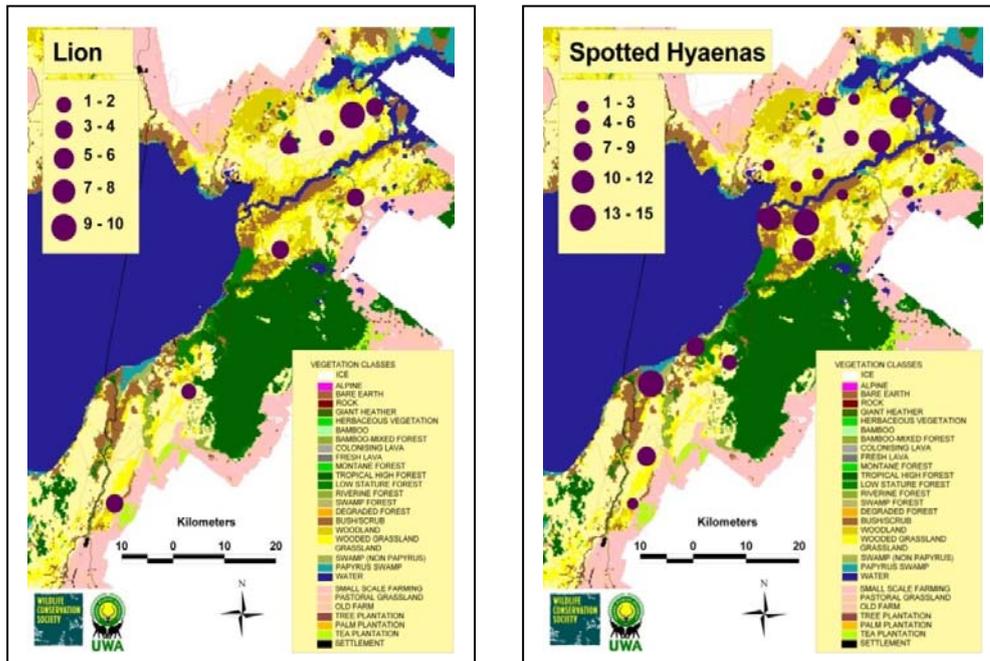


Figure A3.7. Location and relative group size of responding lions (left) and hyenas (right) in QECA.

Using the lure count method (Buckland *et al.*, 2006) QECA was estimated to have a total of 144 lions with a standard error 22. Hyenas were estimated at 211 (se=25). A total of 3 leopards turned up. It was divided into 3 parts for analysis; northern, central and southern (Table A3.3).

Table A3.3. Estimated total population sizes of lions and hyenas in QECA (standard errors in parentheses)

Carnivore	Estimate (se)			
	Northern	Central	Southern	Total
Lion	72 (49)	41 (30)	27 (25)	144(22)
Hyena	64 (30)	98 (52)	62 (37)	211(25)
Leopard	<2 turned up>	<1 turned up>	<No turn up>	3

Kidepo Valley National Park

In KVNP, the survey was made between 24th March, 2009 and 1st April, 2009. The northern part was left out due to insecurity and poor accessibility. However, this northern region also has low prey densities as most of it has been exterminated by cattle raiders and marauding karamajong warriors so it is thought few carnivores occur here.

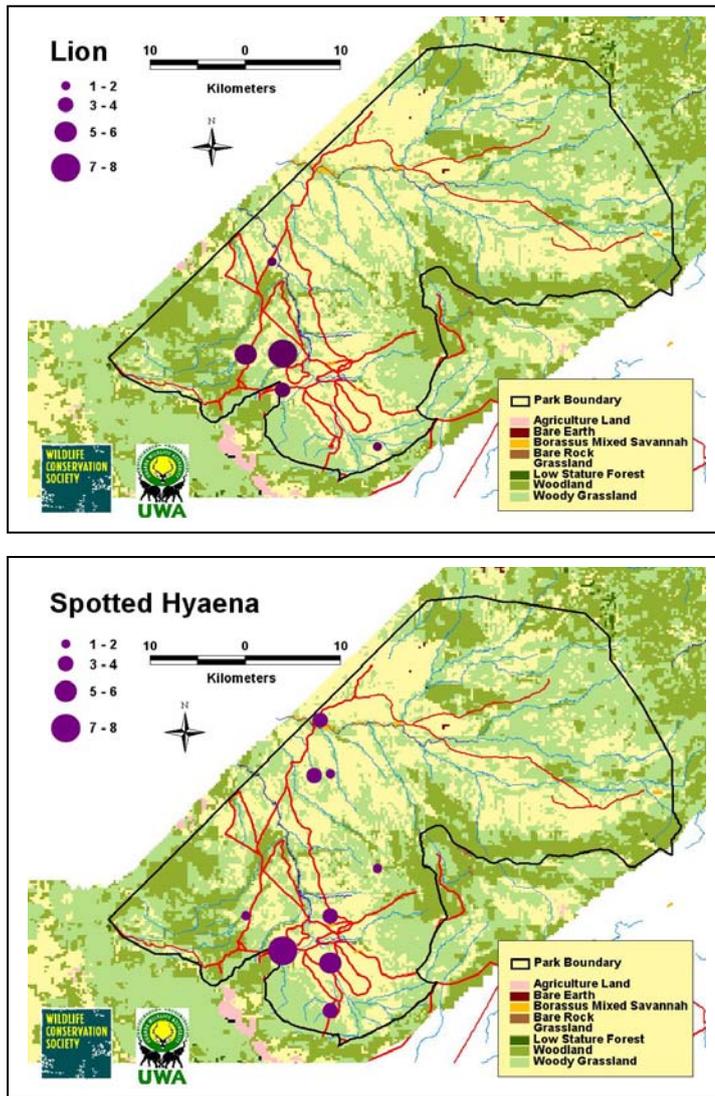


Figure A3.8. Location and relative group size of responding lions (top) and hyaenas (bottom) in KVNP.

The largest group of lions in KVNP turned up in Narus valley (4) with the largest hyena group at Kalokudo (8). With 5 call points with turn ups all in Narus valley, the estimated number of lions in KVNP was 132 with a standard error 77 and that of hyenas was 75 with a standard error 33. Just 1 leopard turned up during the survey of the park.

Murchison Falls Conservation Area

The survey in MFCA began on 6 September, 2009 and ended on 26th November, 2009. The largest lion group to turn up at a call station in MFCA was at Pakuba Airstrip (4).

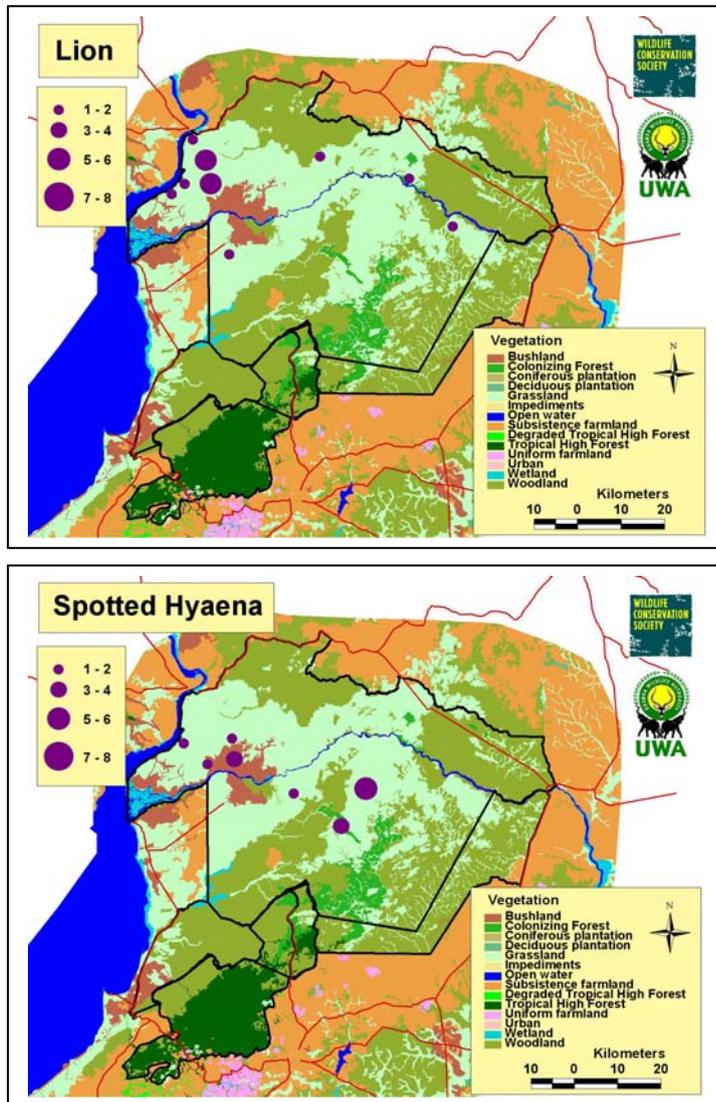


Figure A3.9. Location and relative group size of responding lions (top) and hyaenas (bottom) in MFC.

Using the lure count method (Buckland *et al.*, 2006) 132 lions were estimated (se 24) while hyenas were estimated to be just 38 (se7). 3 leopards turned up in MFC during the survey. The conservation area was divided into Northern and southern bank of the Nile during analysis and estimates made for each bank (Table A3.4). Considering the size of MFC with over 5000 km², the estimated number of hyenas at 38 is cause for concern although there was a group turn up along the Karuma-Rabongo forest road of five (5).

Table A3.4. Estimates of lion and hyaena numbers on the north and south banks and for all of MFC.

Carnivore	Estimate (se)		
	Northern	Southern	Total
Lion	83 (41)	27 (12)	132(24)
Hyena	12 (7)	29 (12)	38(7)
Leopard	<2 turned up>	<1 turned up>	3

Discussion and overall conclusions

UWA conducted aerial surveys of large mammals including lion prey species in QECA and so did WCS for Parc Nationale des Virunga in neighboring DRC. Prey included; buffalo, bushpig, bushbuck, kob, warthog, waterbuck, reedbuck, topi. Treves et al. (2009) used these surveys to propose among other things that it is possible to estimate the number of lions using the prey densities. Table A3.5. shows a comparison of the predicted lion numbers based on prey densities and estimates from the playbacks calculated using the lure count method.

Table A3.5. Estimates of lion numbers in QECA from the lure count method and from the estimated prey biomass which is thought to determine lion numbers (Treves *et al.* 2009).

Method	Lion Estimate
Lure Count	144
Prey Biomass	139.88

These calculations show that the estimated population of lions in QECA is around the carrying capacity in the park based on prey availability.

The estimates for KVNP show an increase in lion numbers from 2000-2 estimates by the WARM lion project and a decrease for QECA and MFCA as estimated using the Lure Count method (figure A3.10). Lions are therefore declining fairly rapidly with approximately a 3% decrease in numbers per year over the past 10 years.

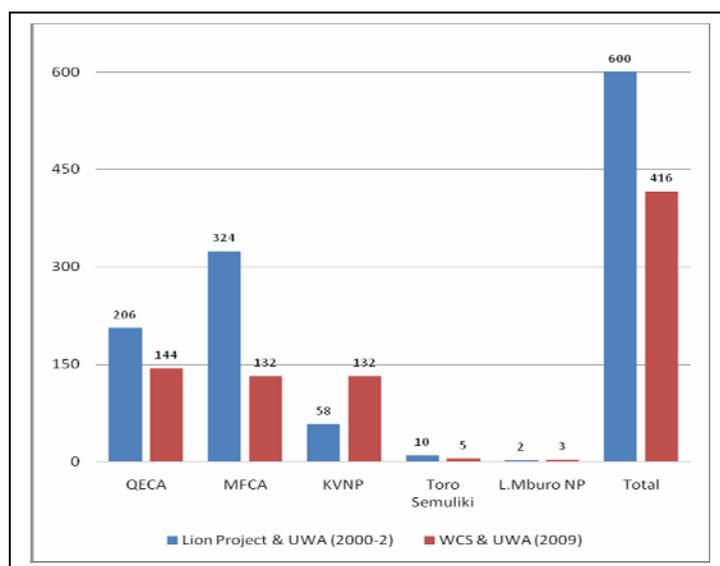


Figure A3.10. Estimates of lion numbers in 2000-2002 and in 2009 for conservation areas in Uganda which contain lions.

