GREATER VIRUNGA LANDSCAPE

LARGE MAMMAL SURVEYS, 2010

August 2010

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Financed by the US Fish and Wildlife Service, CITES/MIKE and Wildlife Conservation Society

Introduction

The Greater Virunga Landscape is one of the most biodiverse landscapes in the World, and contains more vertebrate species than any other landscape in Africa. Straddling the borders of Democratic Republic of Congo, Rwanda and Uganda it encompasses a great variety of habitats due to its wide altitudinal range (600-5,100 metres a.s.l.) which contributes to this high species richness. A large part of the centre of the landscape is made up of savanna grassland and woodland (figure 1) in the Virunga and Queen Elizabeth National Parks, a habitat which can be surveyed by aircraft to estimate large mammal numbers.

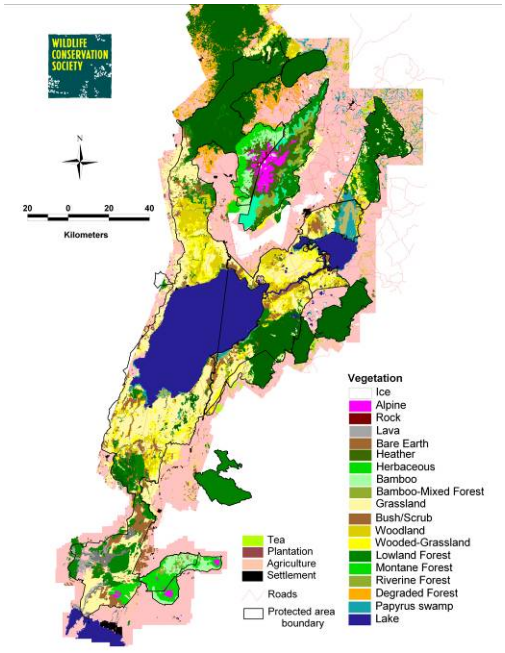

Figure 1. Map of the Greater Virunga Landscape showing the various vegetation types. This survey covers the savanna areas in the centre of the landscape.

Historically aerial surveys of large mammals have been made separately in these two parks and censuses date back to the 1960s. However these parks are connected t the north and south of Lake Edward and it has been known for at least 50 years that animals move back and forth between the two parks. Plumptre *et al.* (2007) showed the importance of this ability for animals to migrate between the parks for the survival of elephant populations in the landscape. In the 1970s heavy poaching in Queen Elizabeth National Park probably led to elephants fleeing into Virunga National Park. The instability and rise in poaching in Virunga National Park since 1996 has led to elephants fleeing back into Queen Elizabeth. We can be certain of this because the population in Queen Elizabeth National Park rose from 150 individuals to 2950 in 2006 over a period of 25 years, an increase that could not have been achieved solely by births alone.

It is clear that these movements hamper assessments of the large mammal populations in this landscape at an individual park scale because if the numbers decrease it is unclear whether it is due to mortality or to emigration. In 2006 the Wildlife Conservation Society supported the Institut Congolais pour la Conservation de la Nature (ICCN) to undertake an aerial census of Virunga National Park (Kujirakwinja *et al.* 2006) at the same time as a census was carried out by Uganda Wildlife Authority (UWA) of Queen Elizabeth National Park (Wanyama , 2006). As a result we were able to estimate the total population of large mammals in the savannas of the Greater Virunga Landscape at that time.

This aerial survey aimed to repeat this survey by carrying out a large mammal census of both parks at the same time to estimate the large mammal populations and assess changes since 2006 as well as previous time periods. The main objectives of the survey were to:

1. Provide training to ICCN and UWA staff in aerial survey techniques
2. To estimate the population numbers of the large mammal species in both Queen Elizabeth and Virunga National Parks

3. To estimate the distribution and density of each of the species across the savanna areas of the Greater Virunga Landscape.
4. Identify threats to the parks from people.

Training of ICCN and UWA staff in aerial census techniques

A four day training course was held at Mweya Peninsula in Queen Elizabeth National Park to train staff of ICCN and UWA in aerial survey methods. The training was undertaken by Howard Frederick, who has been working with the Tanzania Wildlife Research Institute (TAWIRI) improve and organise their aerial survey data and methods in Tanzania. He was contracted by WCS to provide this training and also to develop a methods manual for protected area staff to be able to undertake aerial surveys in a rigorous manner. This manual will be produced in late 2010.

A total of 4 UWA staff and 8 ICCN staff were trained in the techniques which included practical training in calibration methods (see below) and in Systematic Reconnaissance Flights (SRF) and Total Aerial large mammal count techniques. Following the training individual participants were tested for their ability to see and identify animal species, and two UWA staff and three ICCN staff were selected as observers for the actual aerial surveys.

Figure 2. Trainees calibrating the airplane for SRF surveys

Methods used

Standard systematic Reconnaissance Flight methods as proposed by Mike Norton Griffiths (1978) and Craig (undated) were used for the survey flights. SRF surveys were flown over both parks between 7th- 11th July 2010 and a total count of elephants and buffalos was made in Queen Elizabeth National Park from 9-10th July 2010. A second SRF survey targeting Uganda Kob was flown in the Kasenyi area of Queen Elizabeth National Park on 12th July to check the numbers because of a significant drop since the 2006 count. The area surveyed by the SRF

counts (figure 3) was divided into 2.5 x 2.5 km cells that are used to survey animal distribution. These same cells have been used in Queen Elizabeth National Park since 1996 and in Virunga National Park since 2006.

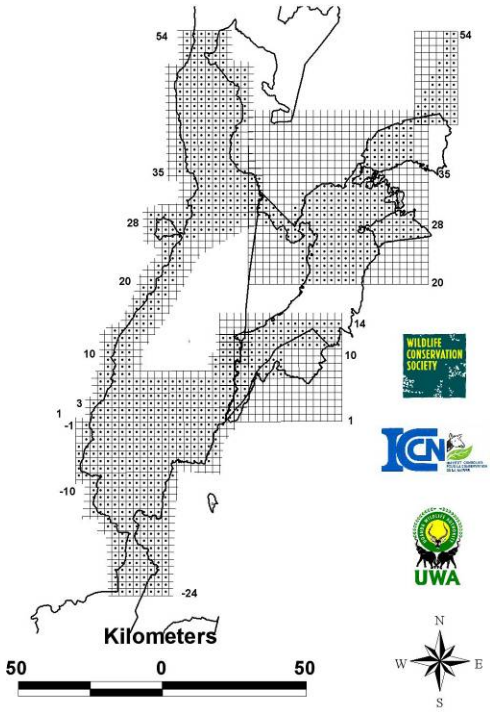

Figure 3. The 2.5 x 2.5 km grid used for SRF surveys of the Greater Virunga Landscape. The cells with a point indicate the cells surveyed in 2006 and 2010 (except the western coast of Lake Edward).

In 2006 the western coast of Lake Edward was surveyed but no large mammal was observed because of extensive encroachment of this area. This situation had not changed by July 2010 and so we did not fly this area.

Calibrations of the wing strut streamers and Rear Seat Observers (RSO) were made along the main Kasese-Ishaka highway through Queen Elizabeth National Park to obtain a relationship between area surveyed between the streamers on the plane and the height of the plane above the ground. Initial calibrations were not sufficiently accurate and they were repeated to ensure that an R^2 value greater than 0.90 was obtained for both observers (figure 4).

The same two rear seat observers were used for the entire SRF survey in both parks to ensure that the results were comparable.

The total count of elephants and buffalos involved two planes and five rear seat observers. Parts of Virunga National Park near the Ishasha river were included in this total count but the paucity of large mammals in Virunga National Park precluded a total count for this park.

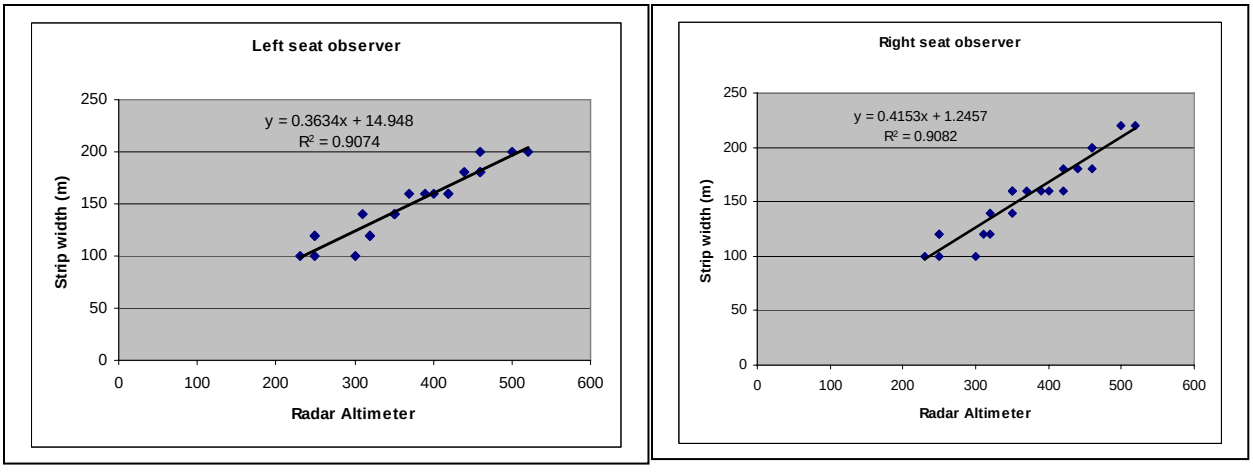

Figure 4. Calibration lines between height above ground from the Radar Altimeter and strip width on the ground calculated for the left and right seat observers.

Census Results

SRF surveys

The results of the large mammal counts are given separately for Queen Elizabeth National Park (Table 1) and Virunga National Park (Table 2). The second count of Uganda Kob in the Kansenyi region of Queen Elizabeth National Park was about 40% higher but this was not significantly different (Z-test: Z=0.03, P=0.43). However because the SRF started in this region of Queen Elizabeth National Park and the observers were less likely to have developed a search image for Uganda Kobs we have used the numbers calculated from the second count.

Table 1. Estimates of large mammal numbers in Queen Elizabeth National Park and comparisons with the count in 2006.

Species	**NORTH (north of Maramagambo)**			**SOUTH (Ishasha)**			**2010 Total**	**2006 Total**
	Population Estimate	**SE**	**95% Confidence Limit**	**Population Estimate**	**SE**	**95% Confidence Limit**		
Buffalo	**5,534**	1,241	2,729	**2,594**	1,038	2,284	**8,128**	14,858
Elephant	**2,024**	708	1,558	**478**	198	437	**2,502**	2,959
Reedbuck	**8**	7	17				**8**	7
Topi				**262**	193	424	**262**	1,521
Uganda Kob	**6,677**	1,638	3,604	**1,806**	624	1,373	**8,483**	20,971
Warthog	**1,319**	246	541	**147**	50	111	**1,466**	1,388
Waterbuck	**1,881**	307	676	**602**	188	413	**2,483**	3,548

Table 2. Estimates of large mammal numbers in Virunga Park and comparisons with the count in 2006.

Species	**NORTH (norh of Lake Edward)**			**CENTRAL (south of Lake Edward)**			**2010 Total**	**2006 Total**
	Population Estimate	**SE**	**95% Confidence Limit**	**Population Estimate**	**SE**	**95% Confidence Limit**		
Buffalo	**649**	409	899	**1,505**	797	1,753	**2,154**	3822
Elephant	**51**	49	108	**296**	287	631	**347**	348
Reedbuck							**0**	0
Topi				**1,040**	671	1,477	**1,040**	1353
Uganda Kob	**3,647**	1,949	4,287	**3,307**	2,016	4,435	**6,954**	12982
Warthog	**42**	31	68	**254**	71	157	**296**	694
Waterbuck	**84**	43	96	**85**	42	93	**169**	374

Numbers of animals have dropped in Queen Elizabeth Park for all species except warthogs which show an increase. However, standard errors around these numbers, and those of the 2006 were relatively high. As a result Z-Tests only showed a statistically significant decline in Uganda

Kob numbers in both the north (Z=1.74, P=0.07) and Ishasha sectors (Z=2.32, P=0.02) of the park. There was also a significant decline in numbers of buffalo from 8,900 to 2,500 in Ishasha (Z=2.31, P=0.02) but not in the north of the park.

In Virunga National Park there was a significant decline for all species except buffalo, topi and elephants in the area south of Lake Edward while in the north there were significant increases in the numbers of Waterbuck, although mean estimates for all species have increased. The increases in the north may be a result of breeding but are also probably a result of emigration from Queen Elizabeth to Virunga National Park.

Comparisons of the estimates of large mammals numbers from the SRF estimates made in 2006 and 2010 for the Greater Virunga Landscape (Table 3) show that all of the species have declined except for reedbuck ,which are so rare that the numbers estimated have large errors.

Table 3. Total large mammal population sizes in the Greater Virunga Landscape from SRF surveys in 2006 and 2010.

Species	2010	2006
Buffalo	10,282	18,680
Elephant	2,849	3,307
Reedbuck	8	7
Topi	1,302	2,874
Uganda Kob	15,437	33,953
Warthog	1,762	2,082
Waterbuck	2,652	3,922

Long term trend in elephants

The long term trend in elephant numbers can be plotted for Queen Elizabeth Parks from data from the 1960s up to the present (figure 5). In the 1960s and early 1970s regular survey flights were made each year but numbers fluctuated widely even within years. At this time many of these estimates were from total counts of elephants from surveys that aimed to cover the whole park (see next section) rather than using SRF methods, developed in the mid 1970s.

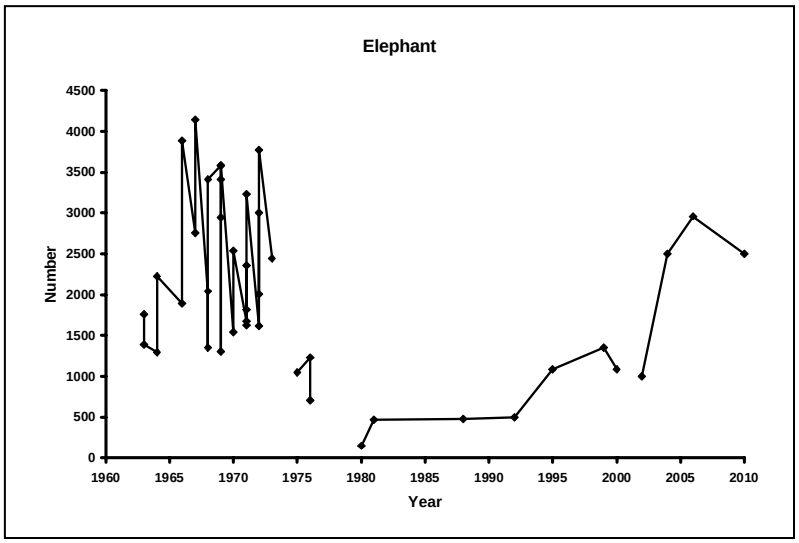

Figure 5. Estimated elephant numbers in Queen Elizabeth Park since 1962.

Total Counts

A total of 8,364 buffalo (307 groups) were counted in Queen Elizabeth National Park together with 1,570 elephants (172 groups) during the total count. This compares with 8,128 buffalo and 2,502 elephants from the SRF surveys. The buffalo numbers are comparable but elephant numbers differ by about 1,000 individuals. It is known that elephants move move into the shade after about 10am, coming out again after about 4pm and are thus difficult to see during the heat of the day. The total count method takes much longer than the SRF so that proportionally more of the sampling effort occurs between 10am and 4 pm which may mean that more animals are missed in the total count as a result. However, we are unlikely to have missed 1000 individuals because they were under trees and difficult to spot. It is therefore probable that the SRF survey method is overestimating elephants using the current positioning of transects. However, the fluctuation between 2006 and 2010 is not as great as the fluctuations that were observed in the 1960s where fluctuations of over 1000 animals was observed within the same year sometimes, and this may be a result of the method or the observers given the fairly wooded nature of this park.

The distribution of elephant and buffalo groups/individuals are shown in figure 6. Elephants in particular were clustered near water sources – along the lake shore and Kazinga Channel linking Lake George and Lake Edward. Few animals were found in the west of the northern sector of the park, the craters area and corridor to Virunga Park north of Lake Edward. This is the area where pastoralists invaded in 2006 and spent nearly a year in residence. They continue to graze their livestock illegally in the park in this area (see below).

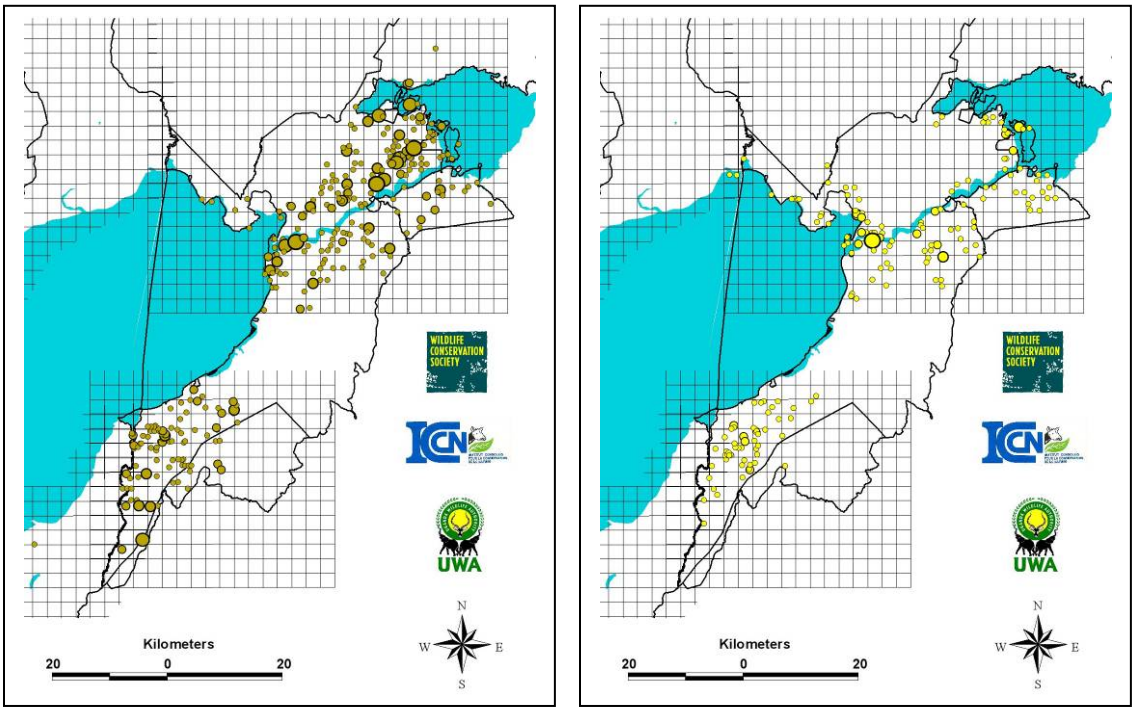

Figure 6. Distribution of buffalo (left) and elephants (right) from the total counts made in Queen Elizabeth Park.

Distribution of large mammals in the Greater Virunga Landscape

The census methods count animals observed during the SRF survey in each of the 2.5 x 2.5 km subunits across the parks. This allows us to calculate the density of each species per cell and then map their distributions in the landscape. We here present a comparison between the distributions and relative abundance in 2006 and 2010 for each of the large mammals censused.

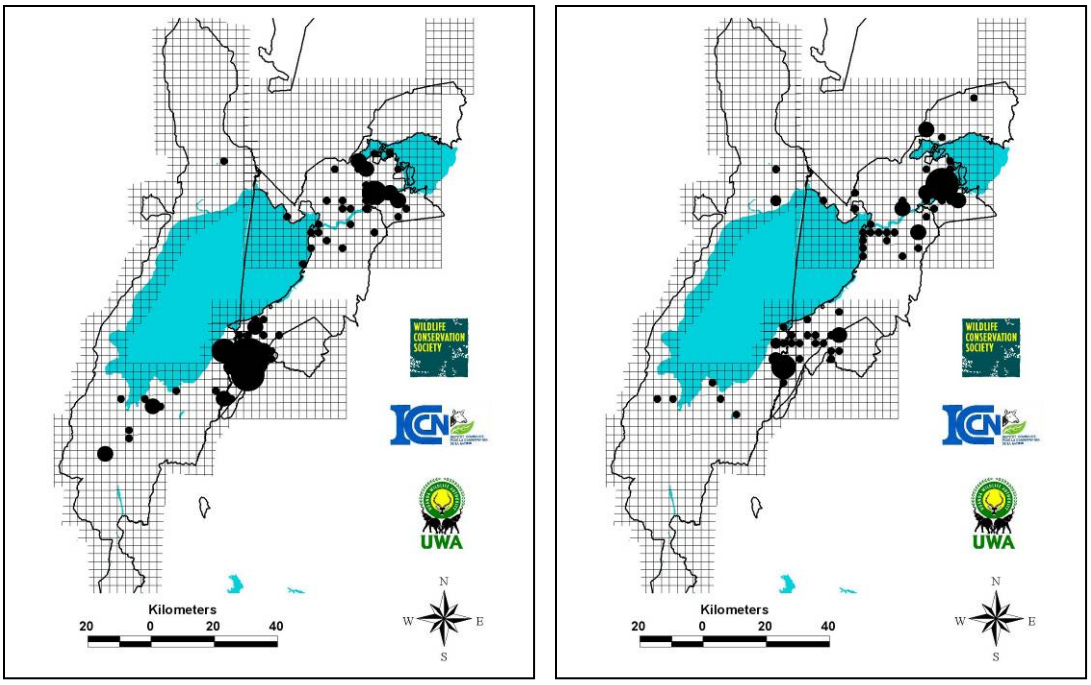

Figure 7. Distribution of buffalo in 2006 (left) and 2010 (right) from the SRF surveys.

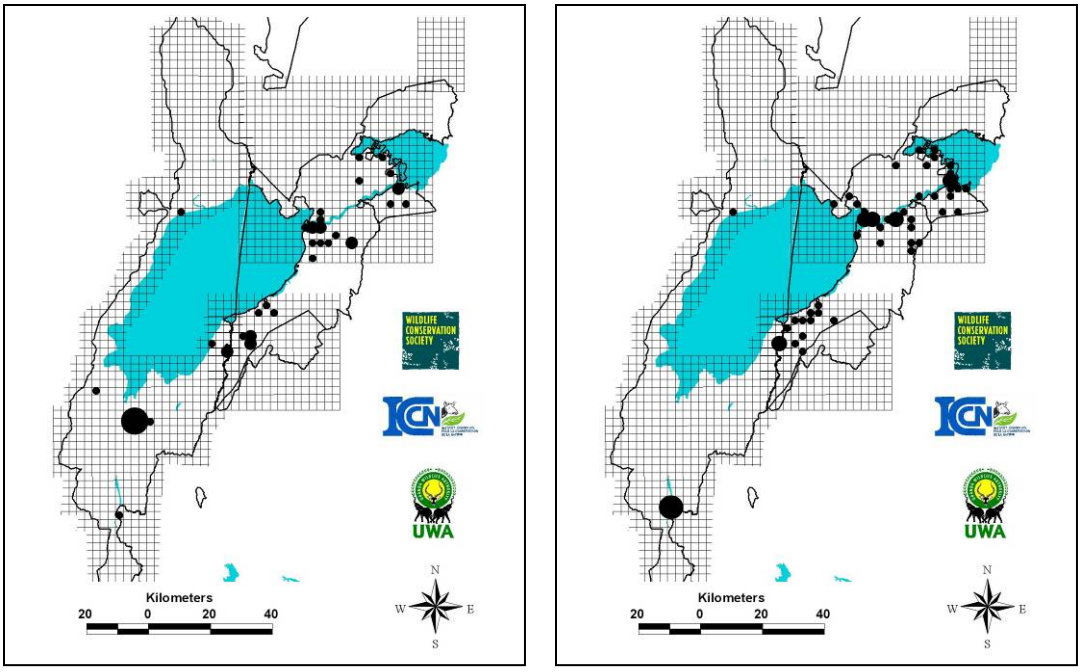

Figure 8. Distribution of elephant in 2006 (left) and 2010 (right) from the SRF surveys.

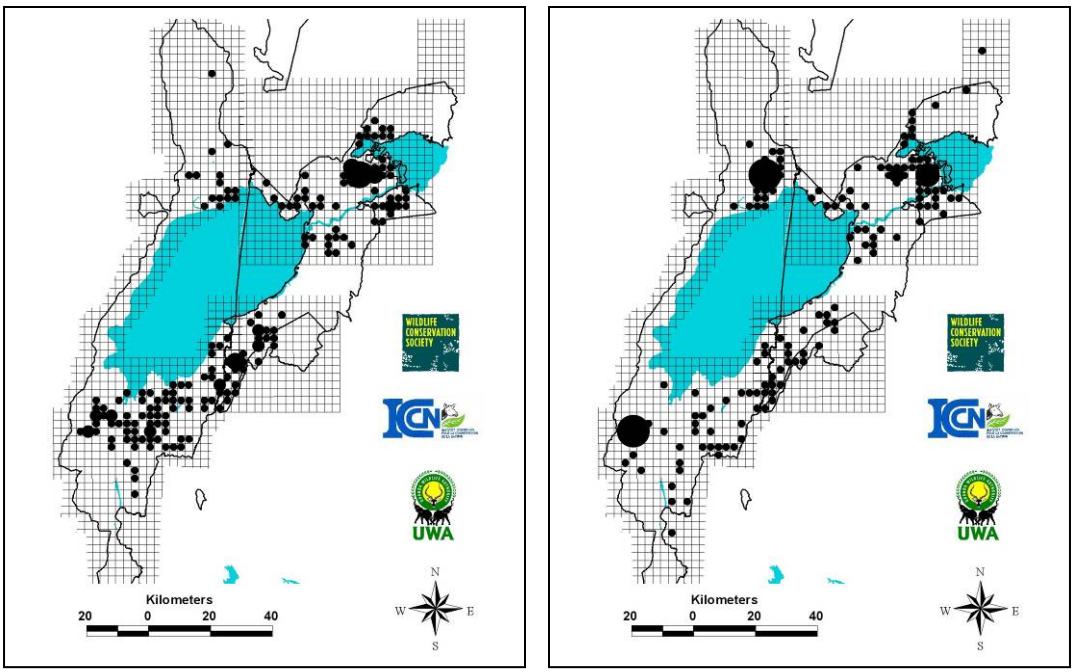

Figure 9. Distribution of Uganda Kob in 2006 (left) and 2010 (right) from the SRF surveys.

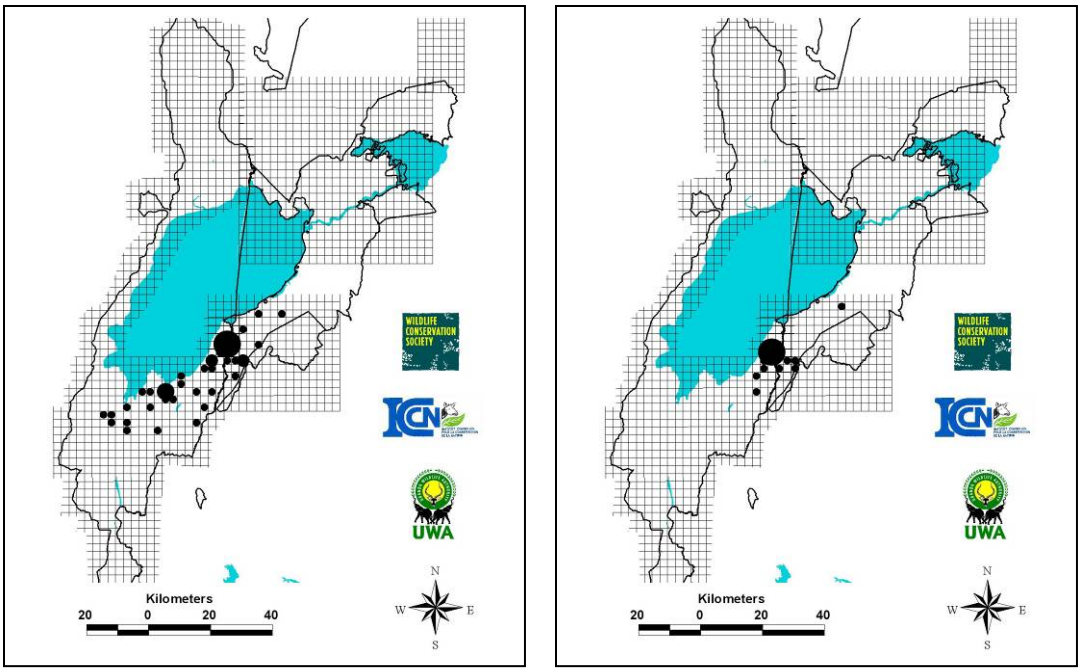

Figure 10. Distribution of topi in 2006 (left) and 2010 (right) from the SRF surveys.

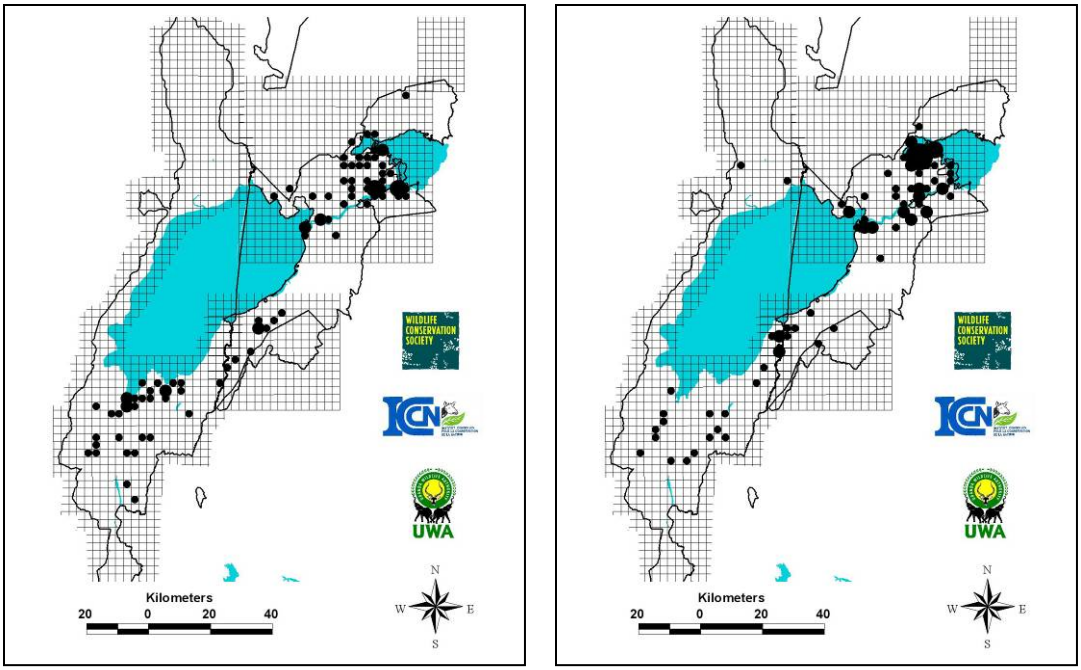

Figure11. Distribution of warthog in 2006 (left) and 2010 (right) from the SRF surveys.

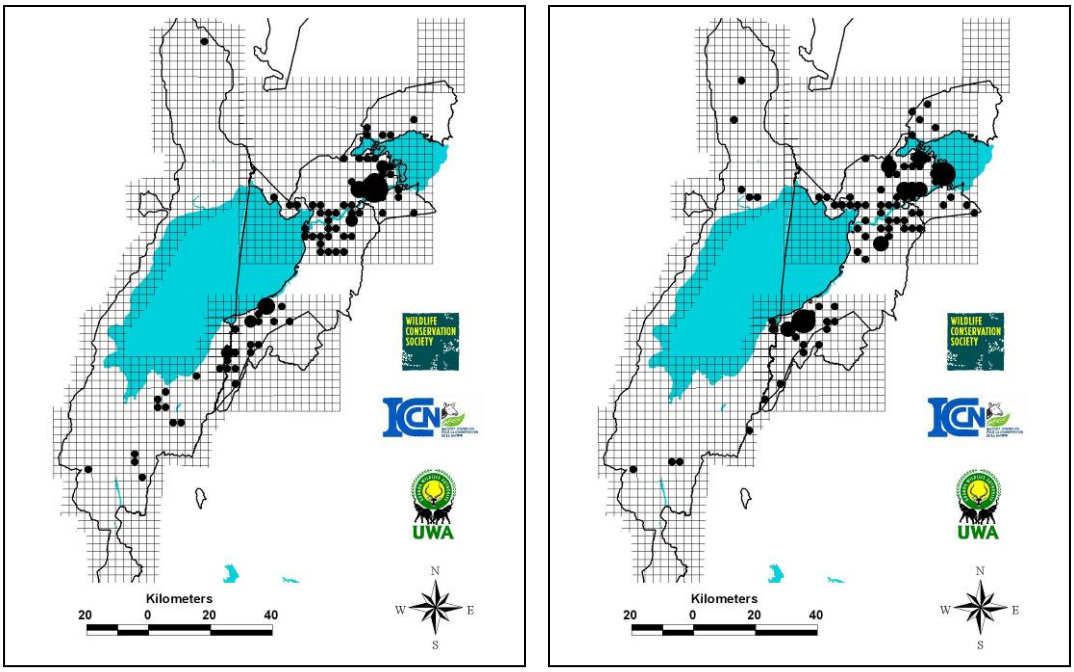

Figure 12. Distribution of waterbuck in 2006 (left) and 2010 (right) from the SRF surveys.

The distributions depicted above (figures 8-12) are plotted to the same scale between 2006 and 2010 so that the relative abundances per cell can also be compared. The surveys were also carried out at approximately the same time (mid June 2006 and early July 2010) so that we would expect the distributions to be similar. The 2010 survey was after a more prolonged dry period which probably meant that more animals were found near waterholes in a clumped distribution. However, it is clear from these maps that the number of cells with animals in the

central sector of Virunga Park (south of Lake Edward) is fewer in 2010 than in 2006. This can be attributed to the rampant poaching that has been taking place here both by the military and rebel groups.

Human impacts on the Greater Virunga Landscape

As well as censusing the large mammals in these two parks the observers also noted any sign of human impacts (figures 13 & 14). Signs included illegal settlements, cultivation, illegal fishing camps and the presence of livestock in the landscape (see appendix).

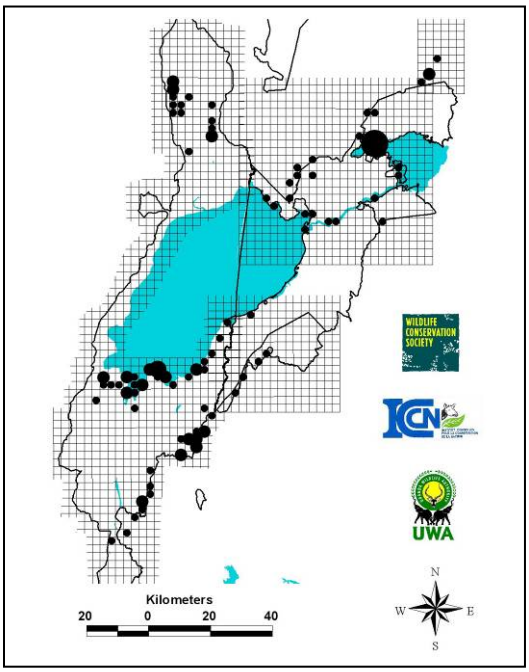

Figure13. Distribution of signs of illegal activities in the landscape.

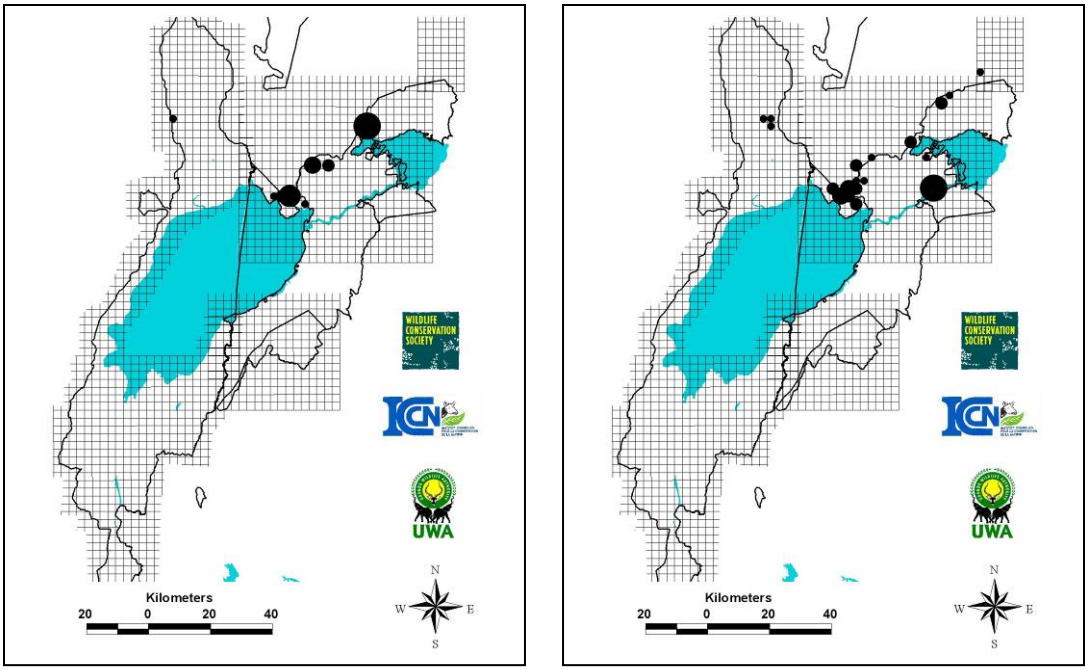

Figure 14. Distribution of cattle in 2006 (left) and 2010 (right) from the SRF surveys.

The estimate of the livestock numbers in the northern part of Queen Elizabeth was 10,767 cattle (se: 4,541) and 428 sheep/goats (se: 242) both increases on the 2006 estimates of 8,138 cattle and 110 sheep/goats. Virunga Park also had cattle in the northern sector but not south of Lake Edward. Estimates of numbers here were 657 cattle (se: 447) but no sheep or goats were observed in the park (animals in settlements such as fishing villages were not counted).

It is clear that despite the resettlement of the pastoralists that were settled temporarily in Queen Elizabeth Park in 2006 that there is continued grazing of many cattle in the park four years later. In fact cattle were the most abundant species found in this park. Their presence in more areas of Queen Elizabeth Park is also a concern as they probably reduce the food available to other grazing species such as buffalo and Uganda kob and may be partially responsible for the decline in these species observed here. It is know that the lion population in the park is particularly threatened by the presence of the pastoralists in the park and many have been poisoned in recent years for attacking livestock both inside and outside the park. More effort needs to be made at a political level to reduce the presence of livestock in this park if Uganda's tourism industry isn't to suffer from the long term effects of the continual grazing.

Conclusions

These results show that large mammal numbers have tended to decline in the Greater Virunga Landscape over the past four years, although not all the declines are significantly different from the 2006 census. However, the general trend is of concern and is probably due to two main factors:

1. The level of poaching in the parks could be driving the animal numbers down. Poaching in Virunga Park is known to be high and ICCN has been struggling to control it. More recently the rebel groups have mostly been driven from the park and the military have been moved to the edge of the park rather than having bases in the park. It is hoped this will reduce the poaching levels taking place. Poaching does occur in Queen Elizabeth Park but it was not thought that these were at levels that could affect the populations of large mammals. One possibility is that animals have been moving into Virunga Park from Queen Elizabeth Park and have been poached there or else the level of poaching is higher than was thought.
2. The continued presence of livestock grazing in both parks will mean that competition occurs over water and food with other grazing ungulates. The decline in Uganda kob and buffalo, in particular in Queen Elizabeth's northern sector, could be partly a result of loss of grazing fodder. These animals are also not seen in the crater highlands where historically they used to be present and this may be due to regular disturbance from people visiting this region.

Other factors that might explain some of the declines are the spread of Spear Grass or Cogongrass (*Imperata cylindrica*) in Queen Elizabeth Park which is unpalatable and not eaten much by any of the ungulates. There is a need to assess its abundance and ways in which it could be managed. Increased frequency of fires may also lead to less fodder for the grazing ungulates but there is not much evidence this is happening.

The number of large mammals in Virunga Park is at its lowest ever for nearly all species. This park used to have the highest biomass of large mammals in the world (Plumptre *et al.* 2007).

This will have longer term impacts on the vegetation which is likely to become more wooded as a result over time.

Both parks need continued support from the international community to tackle threats which result from increasing human populations living around the parks and within enclaves in the parks. More needs to be done to find ways in which benefits from tourism can be channeled to the people living adjacent to the parks so that they perceive a benefit of the park. We recommend that some patrols in Virunga Park focus on the key areas where large mammals still occur, particularly the Lulimbi and Kabaraza regions where the main concentrations remain.

Past SRF surveys have taken place every 3-4 years and we recommend that due to current reduced populations of large mammals in Virunga National Park that the frequency of SRF surveys should be increased to once every year to help park management better orient their anti-poaching patrols as well as monitor the impact of their operations.

Acknowledgements

These surveys were supported financially by the US Fish and Wildlife Service Elephant Conservation Fund, the Monitoring the Illegal Killing of Elephants (MIKE) program of CITES and the Wildlife Conservation Society. We are grateful to all of the people who took part in the survey: David Okiring, Kato Robinson, Elige Balole, Damien Mashagiro, Deogratias Sinyambuba, Deo Kujirakwinja, Margaret Dricuru, David Moyer and Jim Foley. Norbert Mushenzi, Captain Mbusa and Tom Okello helped with the logistics in the Virunga and Queen Elizabeth Parks respectively and also with checking on the security situation. We are grateful to Howard Fredricks who provided the training course for the Ugandan and Congolese staff of UWA and ICCN. Crispin Mahamba, Solange Osako and MAF helped support the permit applications for the aerial surveys and we are grateful for their support in this. We would also like to acknowledge the support of UWA staff at Mweya where the survey team was based for their help with logistics.

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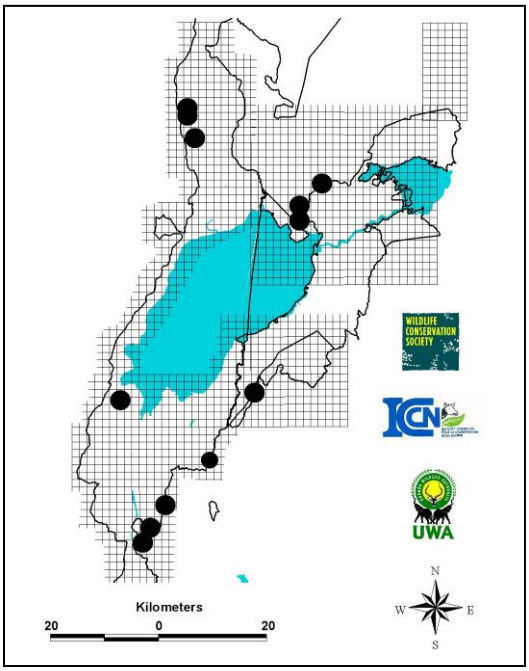
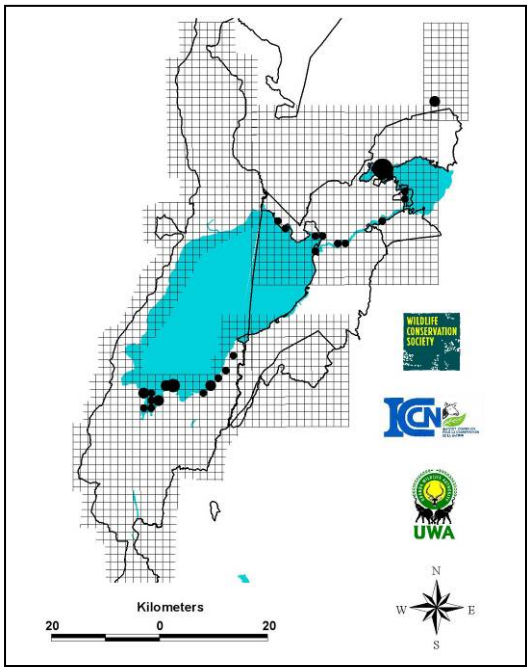
Appendix

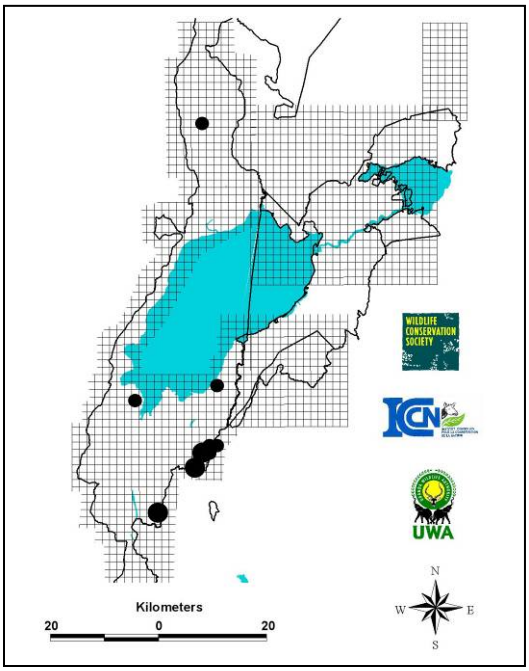
The following maps show the relative abundance of various human activities in the landscape found during the 2010 census.



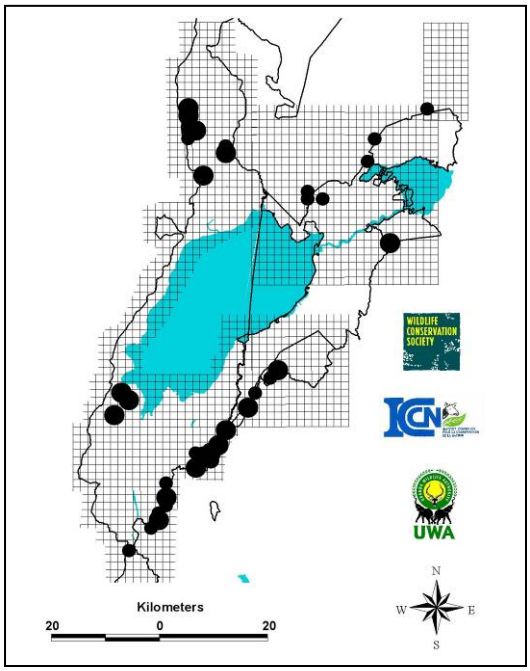
Density of huts



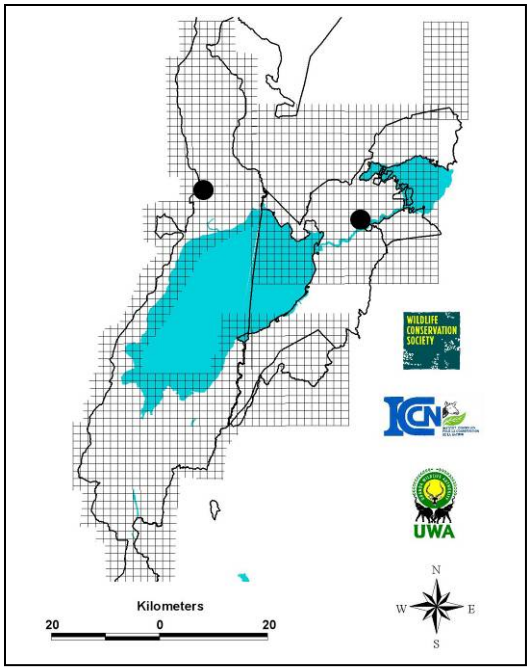
Density of canoes



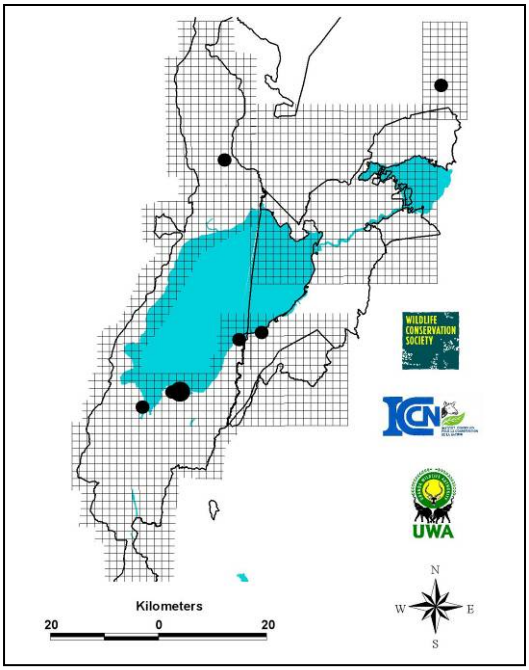
Density of charcoal sites



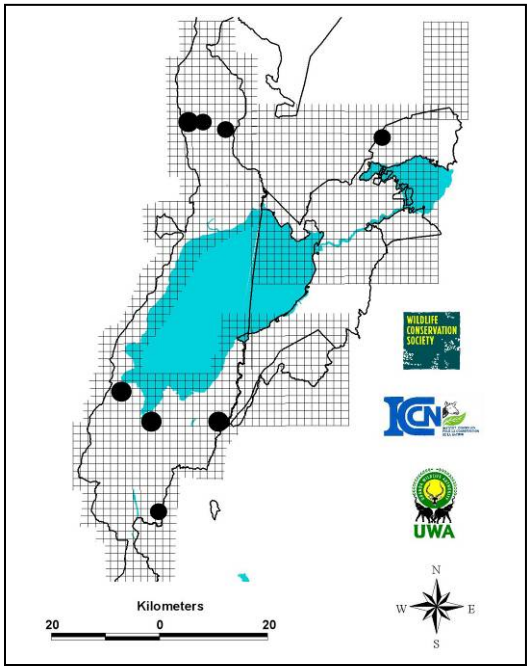
Frequency of cultivation



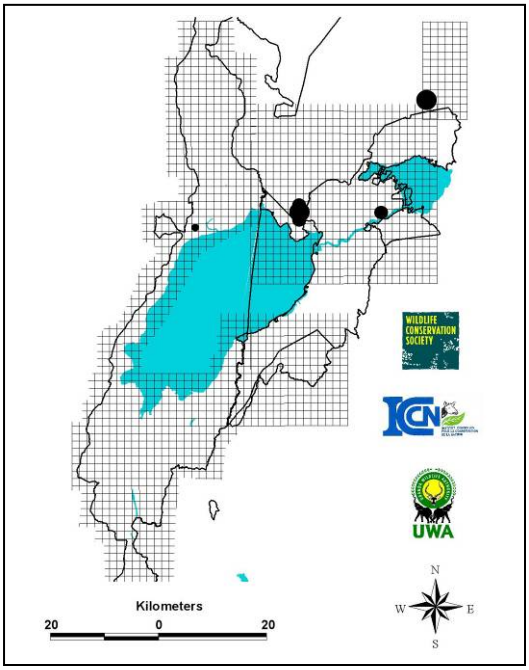
Sites of elephant carcasses



Density of poachers camps



Sites of tree felling



Density of goats/sheep