Survey of Chimpanzees in the Virunga Park and an assessment of a potential corridor to Mt Hoyo

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Introduction

The Virunga Park contains a mixture of habitats including wetlands, savanna grasslands, woodland and lowland and montane forest. The forested areas occur in the south of the park in the Virunga Volcanoes and around the active volcanoes up to Mt Kasali, along river courses in the central and eastern sectors of the park and the largest block occurs in the northern half of the northern sector of the park (fig 1.). Chimpanzees are known to have historically occurred in the Tongo region to the north of the forested part of the southern sector, along the Ishasha river and also in the lowland forest of the northern sector and part way up the Rwenzori massif. The continued presence of chimpanzees in Tonga and along the Ishasha River has been confirmed recently (FZS and WWF pers. comm..) but little is known about numbers at these sites or the abundance of chimpanzees in the northern sector. The northern sector of Virunga Park is also connected to the Ituri forest through a forest corridor to the north west. This links the park to Mt Hoyo Reserve, a Wildlife Reserve created in 1947, which is of interest from a biodiversity conservation standpoint because it contains large caves with bat colonies. Various proposals have been made since 1949 to link Virunga Park to Mt Hoyo and the Lake Albert flats (Verschuren, 1993; N. Mushenzi pers. comm..) but they have not been followed through. Lowland forest still links these two sites however, and there is still the potential to create this corridor more formally (fig. 2.). There is a need to survey this region to assess its conservation importance and whether a corridor should be gazetted.

Figure 1. The Greater Virunga Landscape (GVL) showing the location of the Virunga Park. Chimpanzee population estimates have been obtained for Uganda's forests in the GVL but not the Virunga Park component

The forested areas of Virunga National Park have been difficult to visit because of rebel activity since the early 1990s. The ADF (Allied Democratic Front – NALU in DRC) rebels have occupied the Semuliki forest region in northern Virunga Park for many years and have occasionally invaded parts of Bundibugiyo and Rwenzori Mountains National Park in Uganda. In the south of the park there have been *Interahamwe* groups (FDLR: Forces Démocratique de liberation du Rwanda) and *Mai Mai* rebels in parts of the active volcanoes, Nyamulagira and Nyiragongo. Recently it became possible to start working in the Semuliki forest area and for a while it was also possible to work in the active volcanoes area (at the time this proposal was made). Since September 2007 however, a rebel group (CNDP: Congrès National de Défense du Peuple) led by Laurent Nkunda has occupied the southern

forested part of Virunga park around the active volcanoes and in the Virunga massif also. The security situation in this region has remained volatile and we have been unable to access the area. However we were able to access the Mt Kasali –Mabenga region of the park to the north of the active volcanoes where we discovered relatively high concentrations of chimpanzee nests.

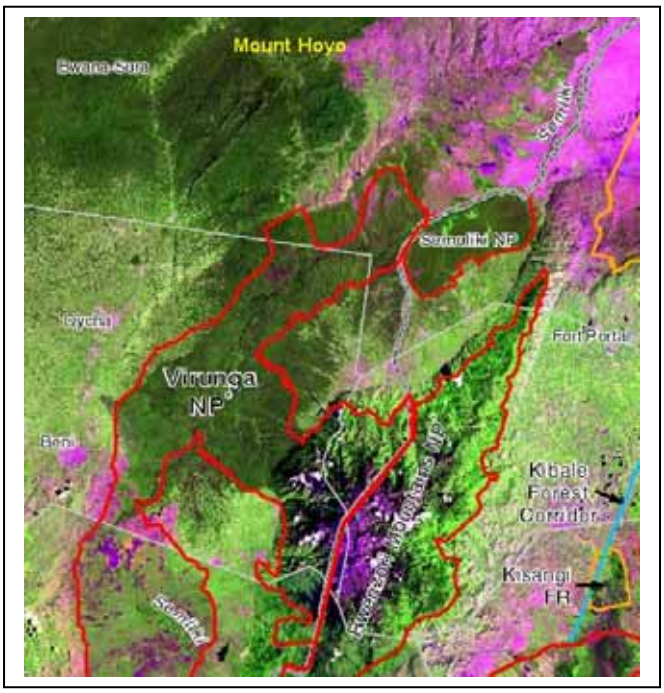


Figure 2. The location of Mt Hoyo to the north of Virunga Park showing the existing forest connection (satellite imagery from 2003).

Project Goals and Objectives

The overall goal of this project is to assess the impact of the civil war on the forested areas of the Virunga Park with particular attention to the chimpanzee population and to assess the possibilities of expanding the park to encompass the forest corridor to Mt Hoyo.

Specific objectives include:

1. Survey large mammals, particularly chimpanzees, birds and plants in the forest on the active volcanoes, riverine forest, and the northern block where security conditions allow
2. Undertake an aerial mapping of the potential corridor area to Mt Hoyo to assess current human impacts and where boundaries of any corridor might pass.
3. Where possible survey parts of the corridor area to assess its importance for conservation and make a proposal to Government of DRC about whether corridor should be created or not. In addition provide some basic equipment for rangers operating on Mt Hoyo.

Methods

Chimpanzee and large mammal censuses

Transects were established in the forest blocks at various locations which were determined by accessibility and security concerns. In some areas reconnaissance walks were also used to cover more distance in thicker forest. Three main sites were surveyed as follows:

1. Semuliki forest – northern PNVi. Here we established 4 transects at each of 7 sites in the forest (figure 3a).

2. Ishasha River – eastern PNVi. We identified three main forest blocks from satellite imagery, designed transect surveys using the DISTANCE software and established eight transects in these blocks with reconnaissance walks back through the forest to the next transect (figure 3b). Following the transect surveys a team of two observers walked the whole length of the Ishasha river from the edge of the park in the south at the bridge that crosses to Uganda north to the shore of Lake Edward.
3. Mt Kasali-Mabenga – southern PNVi. Here we established two transects and undertook one reconnaissance walk. The time spent here was limited by the security situation and we would like to have spent longer (figure 3b).

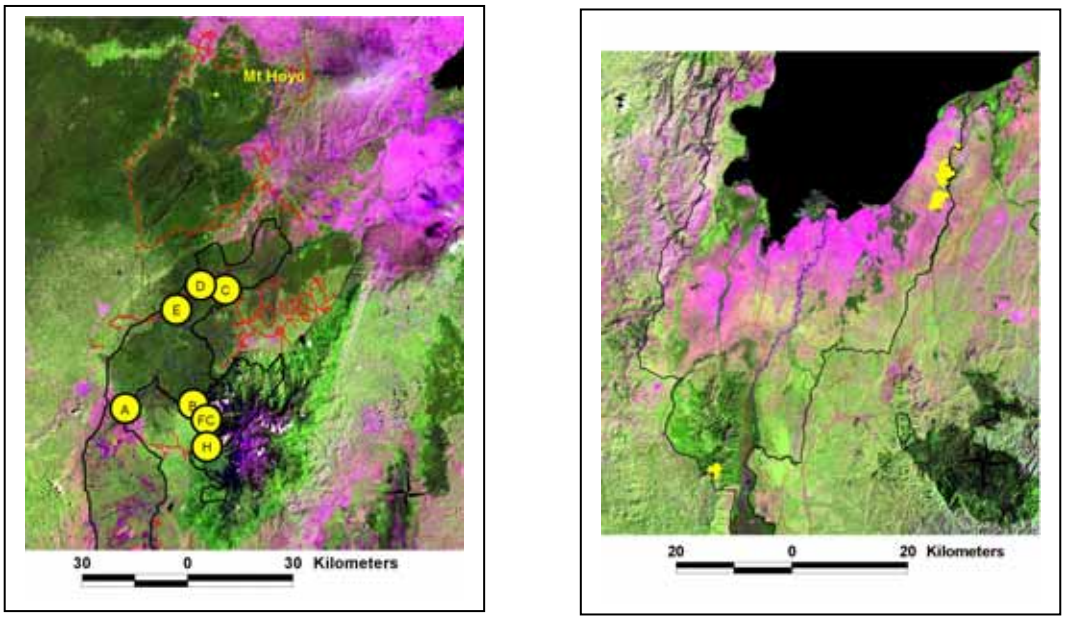


Figure 3. Locations of transects/reconnaissance walk points (yellow) in the survey areas. a) left map – northern PNVi; b) right map – Ishasha river in the east and Mt Kasali/Mabenga in south west

All sightings of large mammals, their sign (dung and tracks) and nests of chimpanzees were recorded from the transects, measuring perpendicular distances so that densities could be calculated using DISTANCE.

Bird and plant surveys
Two ornithological and two botanical teams also took part in the surveys of the Semuliki Forest in the north of Virunga Park. Every 250 metres along the transects a point was marked by the mammal team. The ornithological team made point counts at each of these points, spending five minutes at each site recording all birds seen or heard from the point. The botanical team established plots at each point measuring all herb species within 2 metre radius, all trees between 2.5-10cm DBH and all lianas greater than 1 cm diameter within 10 metre radius and all trees greater than 10 cm DBH within a 20 metre radius plot.

The ornithologists and botanists also recorded species observed between points to build up as complete a list as possible for each region surveyed in the northern forest block.

Aerial mapping
The northern part of the park and the extension towards and around Mt Hoyo was mapped with aerial photographs in late February 2008 (figure 4). This activity was delayed because of the weather conditions in November and December which prevented the flights taking place as planned. The images were mosaiced using ENSO Mosaic software in April 2008

and then on screen digitizing was used to map where people are present and cultivating, roads and buildings, so that we could assess the impact of people on the region. A vegetation map was also created by overlaying a 250 m x 250 m grid on the aerial photos and manually assigning a habitat type to each cell. One technician, Timothy Akuguzibwe, carried out this digitizing to ensure consistency between classifications. Classifications were also assessed by people who knew the area reasonably well.

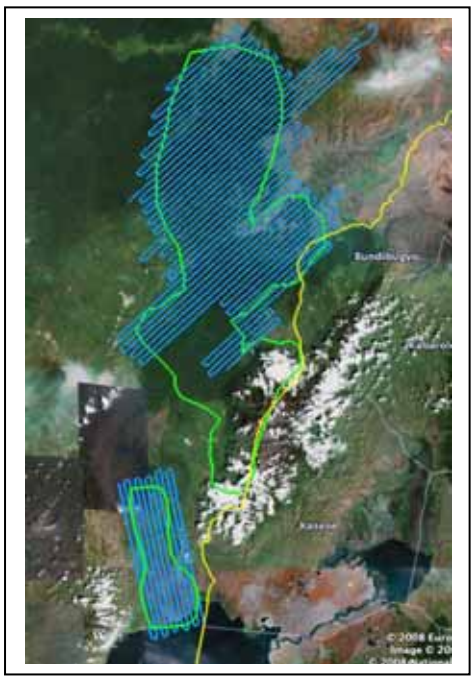


Figure 4. Flight lines for aerial mapping of northern Virunga Park and the extension to Mt Hoyo.

Results

Large Mammal Surveys

Chimpanzee surveys

Surveys of the Semuliki forest area were completed in January-February 2008. We surveyed seven sites within this forest block covering all of the northern forested part of the Virunga Park. A total of 72.7 km of transect were walked to assess chimpanzee abundance in this forest.

A total of 42.8 km was walked in the forest blocks in Ishasha region in May 2008 and an additional 8.3 km in Mt Kasali/Mabenga region also in May.

We had planned to also survey Mt Hoyo and the corridor region between the park and Mt Hoyo but the day the teams were due to enter the region there was a rebel attack on some villages near Mt Hoyo. Since that date up to the present the security situation has remained unstable and we have not been able to send field teams to this region. More time was spent therefore in the southern part of the park which was accessible: along the Ishasha river and for a short time in the Mt Kasali-Mabenga region.

Nest density estimates were calculated using DISTANCE for each of the sites surveyed in the park. Because of high variability between the estimates we also calculated an overall density estimate for the Semuliki Forest Area (Table 1). No chimpanzee nests were found in the Ishasha forest blocks despite the fact that we know chimpanzees are know to use the forest along the Ishasha river.

It is clear that there is a lot of variability between chimpanzee densities in different sites and even within sites there was a lot of variation which led to wide confidence intervals (table 1). At sites FC and H there were transects with many nests and some with no nests sighted.

Table 1. Nest density (no. per km^2) calculated from the transect data for each site.

Site	Nest groups	Nest Density	95% lower	95% Upper
Semuliki Forest				
A	0	0	-	-
B	0	0	-	-
C	3	36.8	9.1	148.6
D	3	13.3	2.1	85.5
E	4	11.6	0.7	163.7
FC	42	471.8	123.4	1804.0
H	21	572.5	50.1	6529.0
Average for Semuliki	73	96.6	34.7	269.1
Ishasha blocks	0	0	-	-
Mt Kasali/Mabenga	89	505.0	24.3	10505.0
All forest blocks	162	137.7	49.9	379.8

In the Semuliki Forest chimpanzee nests were found at five of the seven sites and a total of 257 nests were counted giving an encounter rate of 3.5 nests per km walked. Using an equation relating encounter rates to chimpanzee density for various forests in Uganda we would predict about 1.66 chimpanzees per km^2 from these numbers (Plumptre and Cox, 2006) which is relatively high compared with Ugandan forests.

This equation is as follows:

Density of chimpanzees = 0.471 x Encounter rate of nests per km walked

To convert nest density estimates to actual densities of chimpanzees conversion factors are needed for the average time it takes a nest to decay and also the average rate of nest production. Production rates in Budongo Forest Reserve in Uganda were 1.1 nest per day. No other site has published production rate data to date. Decay rates of nests could not be measured because of the insecurity in the forests in Virunga Park. However if we borrow a rate from Kibale Forest which is part of the Greater Virunga Landscape we can obtain an estimate of chimpanzee densities. Ghiglieri (1984) estimated a mean decay rate of 112 days while Skorupa (1988) estimated 144 days for the same forest. The estimates of chimpanzee density are given in table 2.

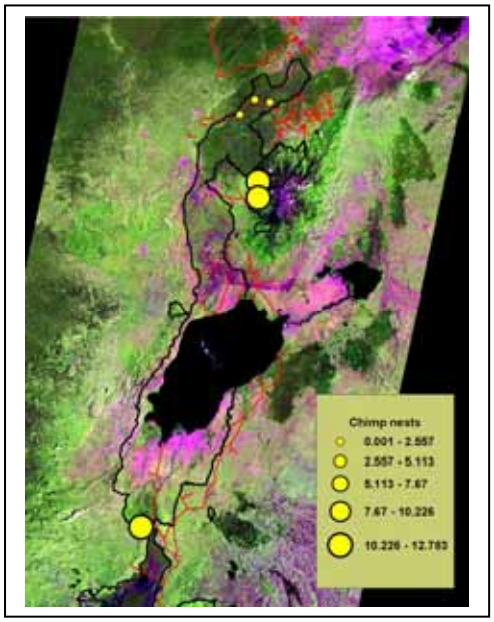


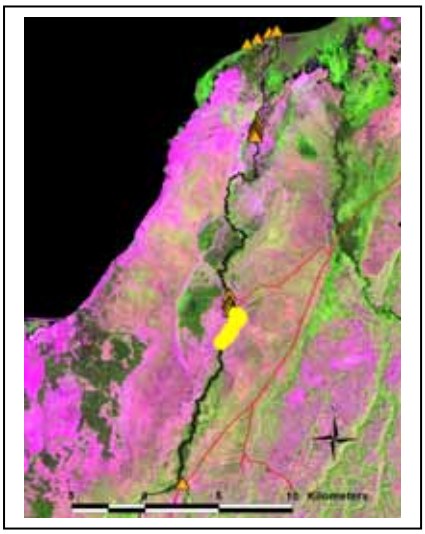
Figure 5. Relative encounter rates (no per km walked) of chimpanzee nests in the various areas surveyed.

Table 2. Estimates of chimpanzee density (no. per km^2) from a) the equation relating encounter rates to density (Plumptre & Cox 2006); b) using nest decay rates from Ghiglieri's study and c) using nest decay rates from Skorupa's study.

Site	Encounter rates	Ghiglieri 1984	Skorupa 1988
Semuliki Forest			
A	0	0	0
B	0	0	0
C	0.39	0.30	0.23
D	0.14	0.11	0.08
E	0.37	0.10	0.07
FC	4.96	3.86	2.98
H	6.02	4.69	3.61
Average for Semuliki	1.66	0.79	0.61
Ishasha blocks	0	0	0
Mt Kasali/Mabenga	5.31	4.14	3.19
All forest blocks	0.99	1.13	0.87

While there is some variation between estimates they are not too dissimilar and we would probably adopt the estimates using Skorupa's decay rate to be conservative in our estimates of chimpanzee numbers in Virunga Park.

The area of forest in Semuliki region including the corridor up to Mt Hoyo totals about 2,256 km^2 of lowland forest and 158 km^2 of montane forest. The area of forest on Mt Kasali and Mabenga totals about 47.8 km^2 – calculated from the map created from the aerial surveys (see below) and omitting human degraded forest. Using the estimates obtained using Skorupa's decay rates we therefore estimate about 1,376 chimpanzees in the Semuliki forest area and 152 chimpanzees in Mt Kasali-Mabenda. These calculations do assume that chimpanzee density is similar inside the park as within the corridor to Mt Hoyo. Given that few people have accessed this area because of rebel activity for about 20 years we believe that this is a reasonable assumption. However the high densities of chimpanzees occur at the higher altitudes and we feel that it might be better to use an average for the low altitude regions when calculating the numbers here rather than combining both low and medium altitude data. Taking the average density for sites C, D and E we can estimate that only 286 chimpanzees would be expected in the lowland forest area and 521 chimpanzees in the montane forest at the base of the Rwenzori massif – totaling about 800 chimpanzees.



Although no chimpanzees nests were found in the Ishasha forest blocks the walk along the river Ishasha did find nests (figure 6). A group of 10 individuals was also observed which we believe is a minimum estimate for the number of chimpanzees in this region.

Figure 6. Locations of chimpanzee nests (yellow circles) and hippo pods (orange triangles) sighted during a walk along the Ishasha river from the bridge at the border with Uganda in the south and Lake Edward (black) in the north.

Mammal distributions and relative abundances

Encounter rates of other mammal species were plotted on the map of the park (figure 7). There were not enough sightings of any individual species to calculate densities accurately using DISTANCE.

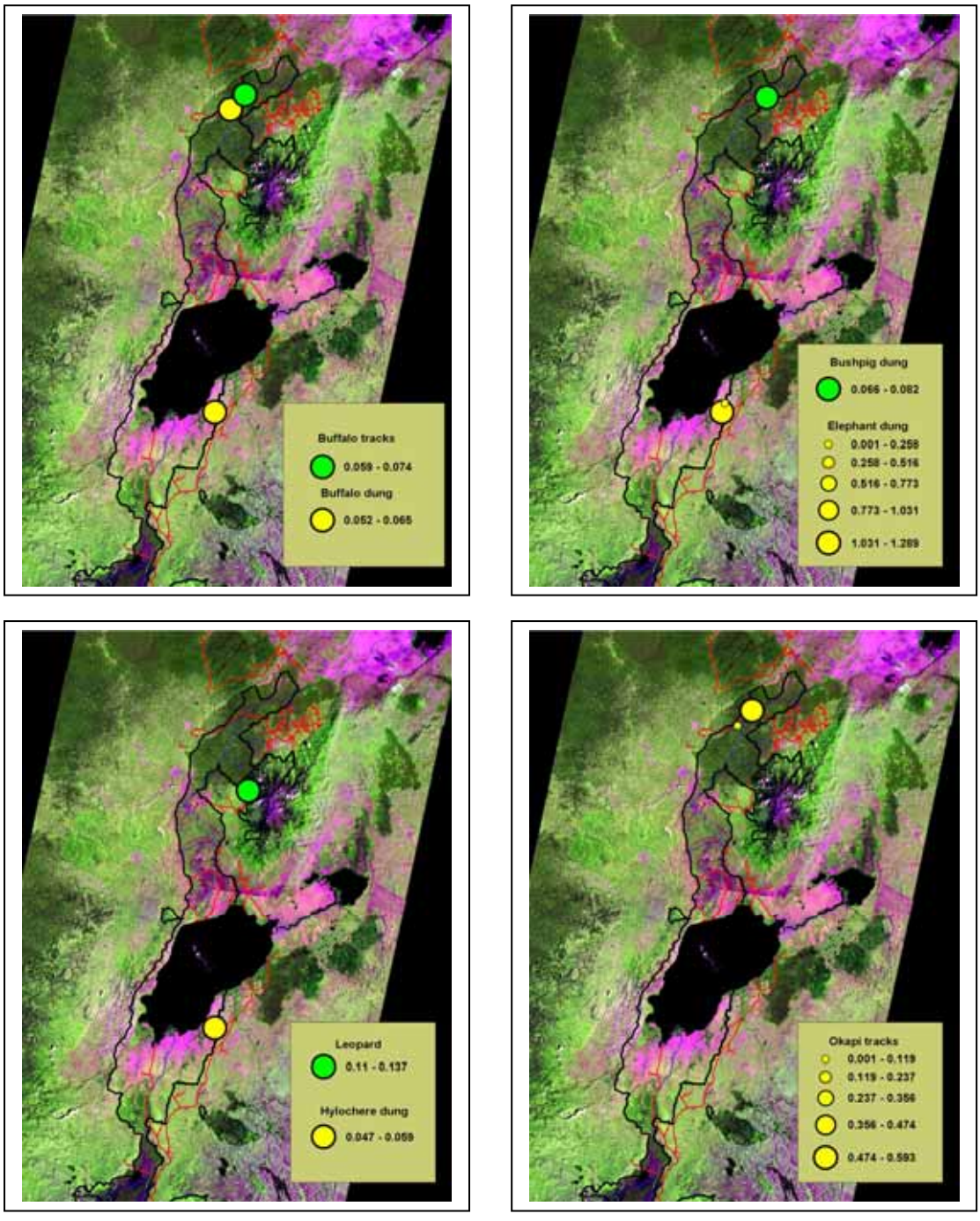


Figure 7a. Relative abundance and distribution of ungulate species in the forested areas surveyed in Virunga Park.

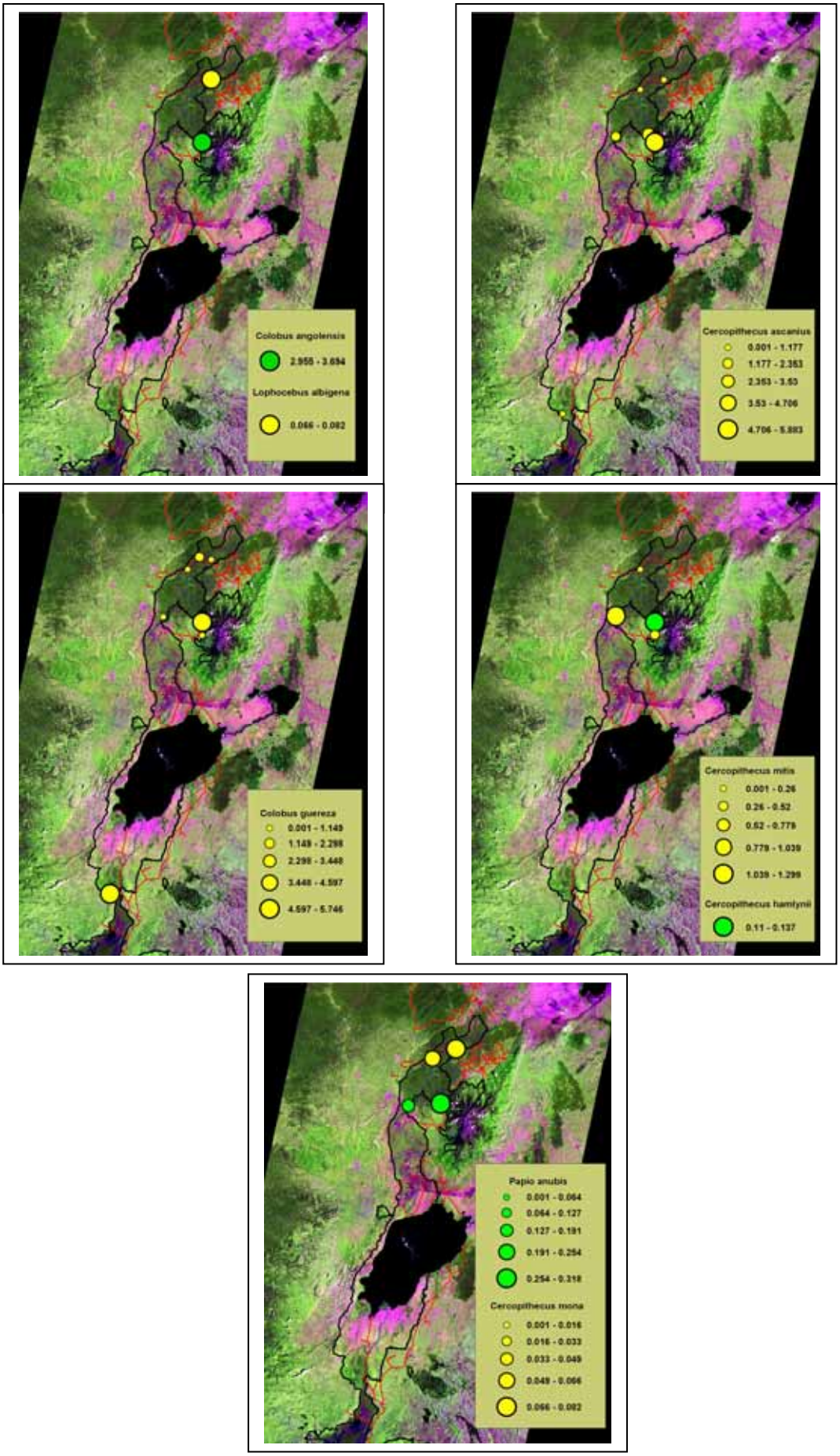


Figure 7b. Relative abundance and distribution of primate species in the forested areas surveyed in Virunga Park.

Camera traps were also placed out at some of the sites where transects were established. Very few photos were taken indicating the relatively low density of terrestrial ungulates. However the first ever photo of an Okapi in Virunga Park was captured as well as a water chevrotain confirming the presence of both these species in the semuliki region (figure 8).

Figure 8. Photo of the legs of an Okapi (left) and water chevrotain (right) captured using camera traps.

Human impacts on the forest

The relative encounter rates of different types of human activity were plotted on the map of the park also (figure 9).

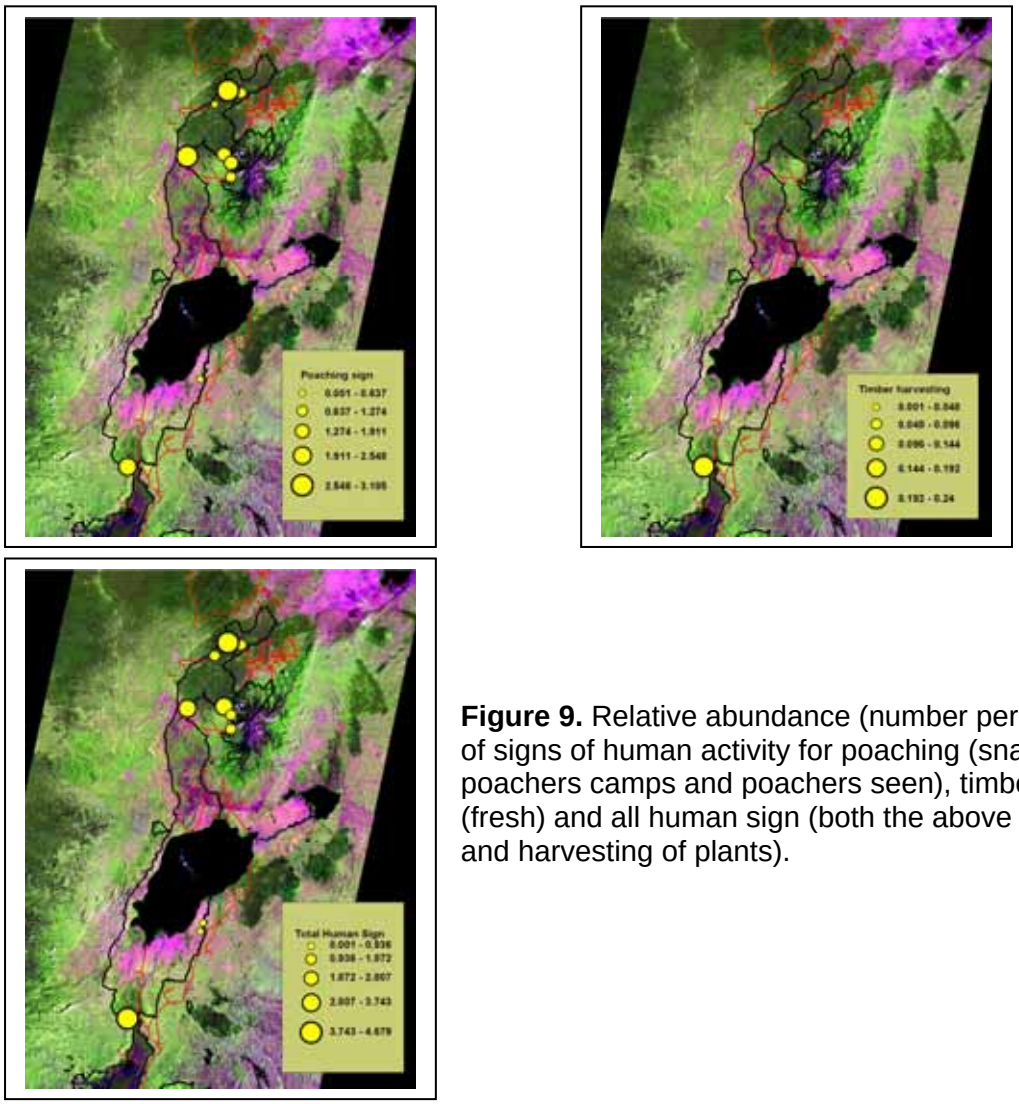


Figure 9. Relative abundance (number per km walked) of signs of human activity for poaching (snares, poachers camps and poachers seen), timber harvesting (fresh) and all human sign (both the above plus paths and harvesting of plants).

Much of the human sign was of activities related to poaching of wildlife. During these surveys 123 snares were found and removed and it is clear that in some areas more than 2 snares per km walked were found (fig. 9). There is a need to improve law enforcement and removal of snares in these forest blocks.

Biodiversity inventories

Bird surveys

Birds were inventories in the Semuliki Forest in the north of Virunga Park but not at the other two sites. A total of 203 bird species were recorded from this forest (appendix 1) in the short time teams were there. This is about 40% of the birds known from this area (Plumptre et al. 2003). The diversity of birds varied between sites (table 3). In general the lower altitude sites (A, D, and E) tended to be more species rich but site C which is also at low altitude wasn't particularly rich and FC was third richest using the alpha diversity index at a relatively high altitude.

Table 3. The diversity of bird species as measured by the Shannon Wiener index and Alpha diversity index

Diversity Index	A	B	C	D	E	FC	H
Average altitude (m)	898	1033	749	752	740	1687	1767
Shannon Index	1.732	1.346	1.585	1.664	1.674	1.562	1.344
Shannon Evenness	0.903	0.814	0.919	0.893	0.872	0.868	0.857
Alpha	23.544	15.415	12.877	20.781	21.573	21.026	11.816

Examination of rarefaction curves calculated for each site indicate that sites A, E and D were the richest (figure 10).

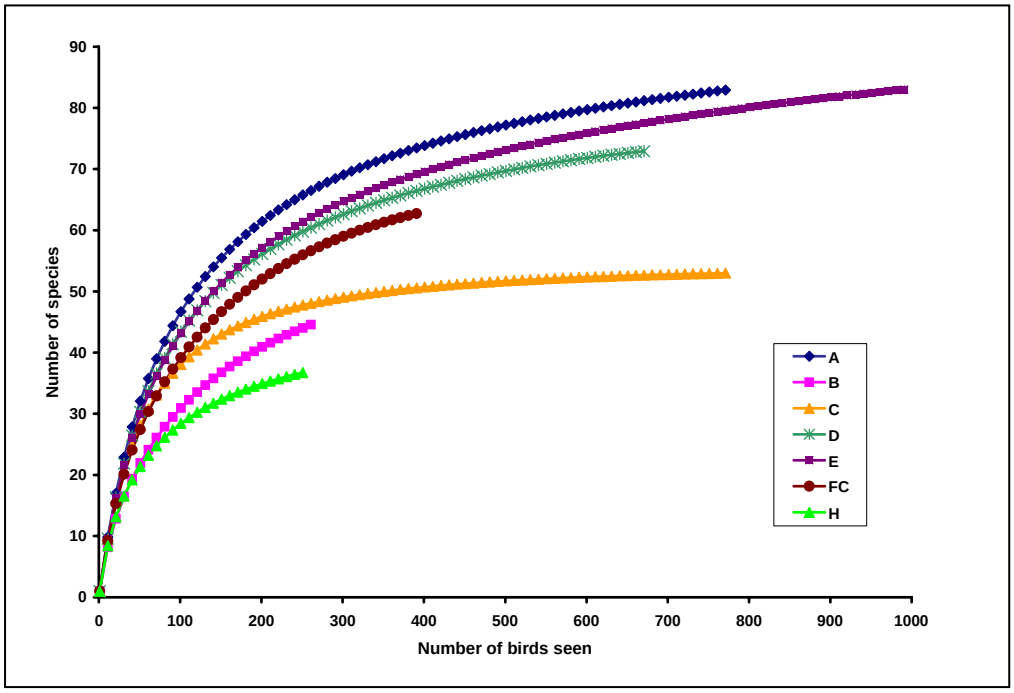


Figure 10. Rarefaction curves showing the increase in bird species in relation to the number of birds encountered at point counts.

Cluster analysis of the point count data show that the higher altitude sites separate from the lower altitude sites (figure 11). Altitude rather than location determines the species composition in this forest.

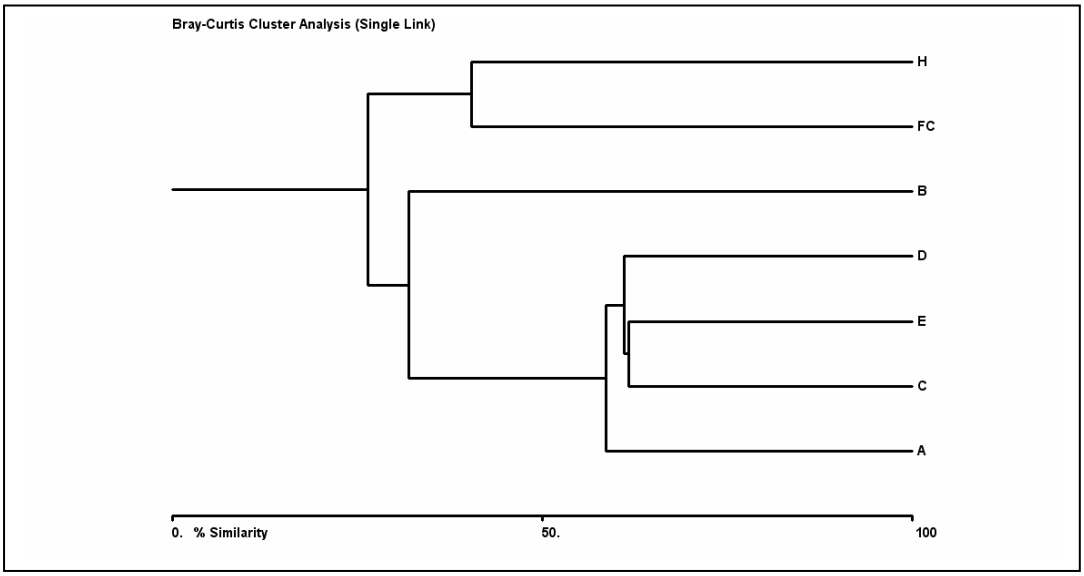


Figure 11. Cluster analysis of the bird point count data showing that the lower altitude sites (A,C,E,D) had more similar species compositions compared with the higher altitude sites.

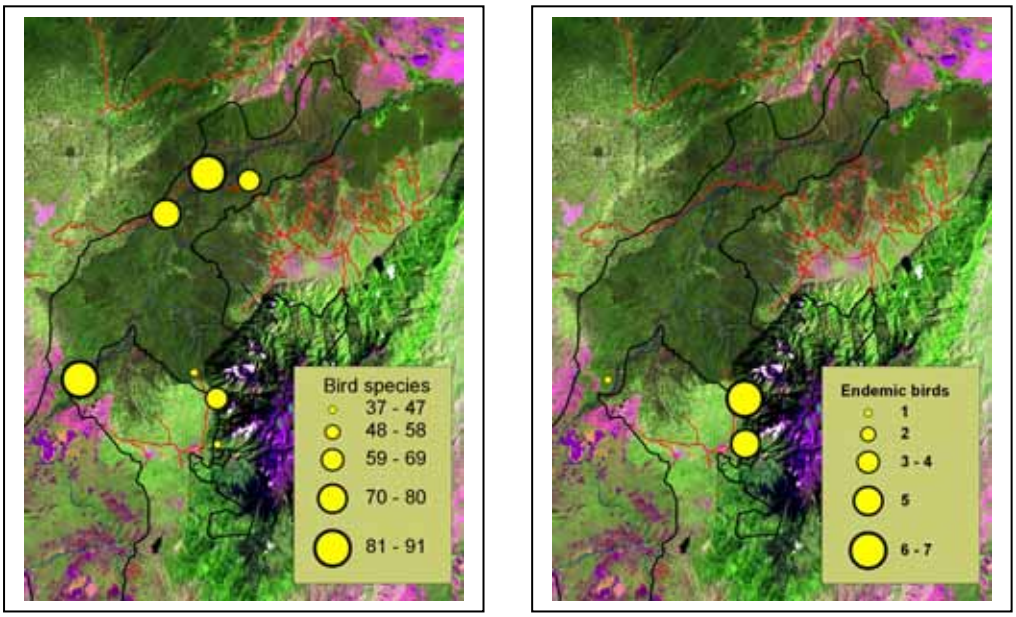


Figure 12. Distribution of bird species richness (left) and number of endemic species to the Albertine Rift (right).

Analysis of species distributions and distribution of the Albertine Rift endemic bird species show that the endemics are mostly confined to the higher altitude sites in the Rwenzori massif although the Albertine Owlet was recorded at site A (figure 12).

Plant surveys

A total of 1,173 plant species were recorded from the Semuliki forest in Virunga Park. Of these, 70 were ferns, 36 grasses, 253 other herbs, 257 lianas, 148 shrubs and 312 trees. Previously only 326 plants had been recorded from this region (Plumptre et al. 2003;2007), these studies have increased the number nearly fourfold.

The sites were fairly similar in their diversity as measured by the Shannon Wiener Index apart from site D. However the alpha diversity index recorded much larger variations between sites (table 4).

Table 4. The diversity of plant species as measured by the Shannon Wiener and Alpha diversity indices.

Diversity Index	A	B	C	D	E	FC	H
Average altitude (m)	898	1033	749	752	740	1687	1767
Number of species	442	314	407	259	293	290	310
Shannon Index	2.22	2.038	2.207	1.789	2.188	2.063	2.166
Shannon Evenness	0.91	0.921	0.917	0.875	0.902	0.93	0.923
Alpha Index	118.066	73.955	148.763	48.328	119.365	98.574	113.092

Analysis of the species accumulation curves shows that site C was by far the richest in terms of plant species (figure 13) but that most sites except site D and B were of a similar species richness (figure 14). However, most curves are still increasing steeply indicating that many more species would be expected at each of these sites.

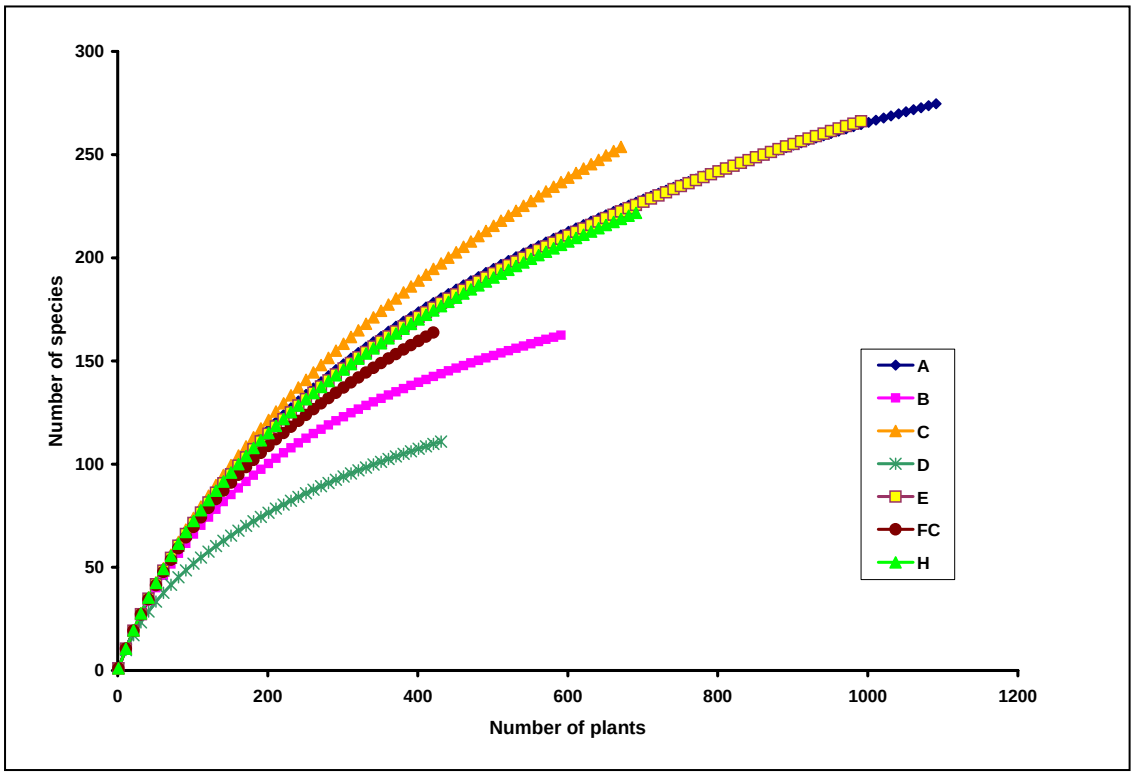


Figure 13. Species accumulation curves for plants in the Semuliki Forest of northern Virunga Park.

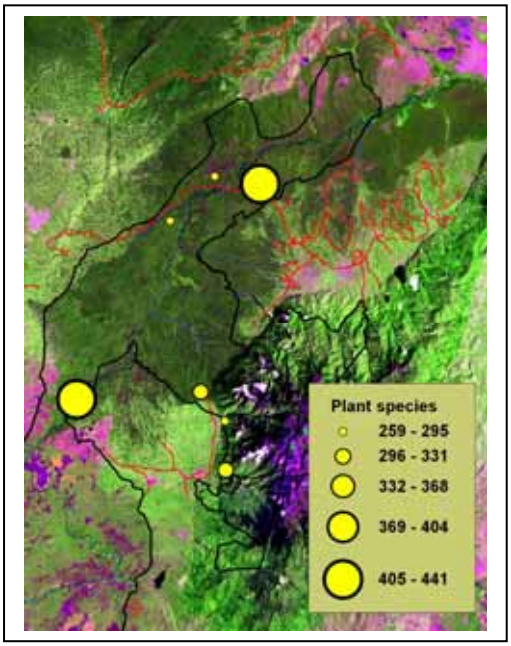


Figure 14. Distribution and relative abundance of plant species richness at each of the sites.

A cluster analysis using the species composition of plots at each site shows a similar picture to the same analysis for the bird communities (figure 15). The sites at low altitude are most similar with the highest altitude sites (H and FC) clustering separately.

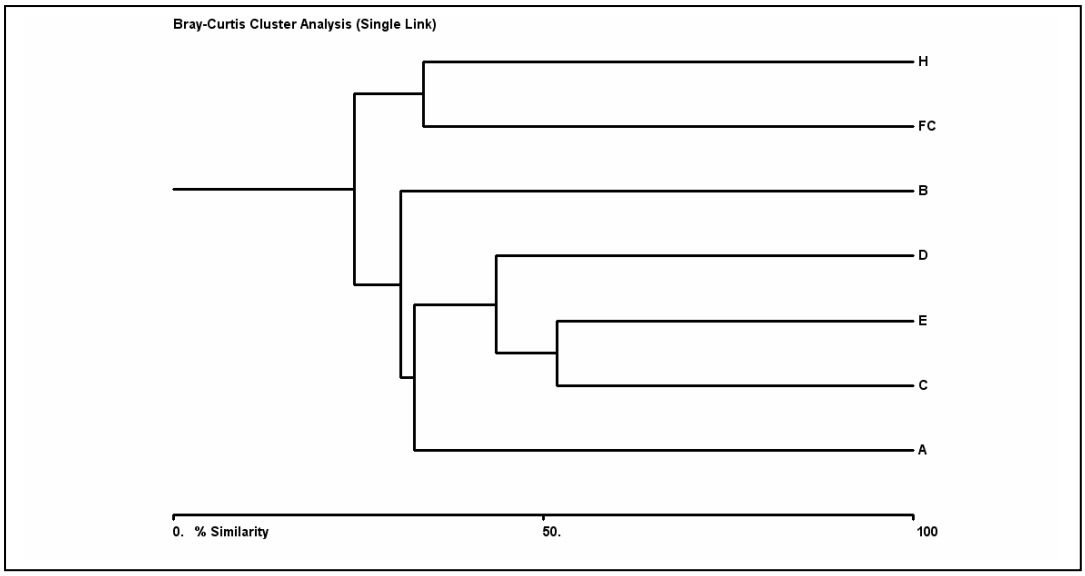


Figure 15. Cluster analysis of the seven sites measured in the Semuliki Forest area of northern Virunga Park.

Aerial surveys and mapping

Aerial surveys were completed for the northern part of Virunga Park and up to Mt Hoyo. The images were processed and orthorectified in ENSO Mosaic to produce an image of the whole area at between 60 cm and 1 metre resolution. A 250m x 250m grid was overlain on this map and each cell assigned a vegetation class by one technician. The resultant map of the northern part of the park is shown in figure 16. Using high resolution satellite imagery for the south of the park plus previous aerial photographic mapping work we were also able to complete the vegetation map for the park (figure 17).

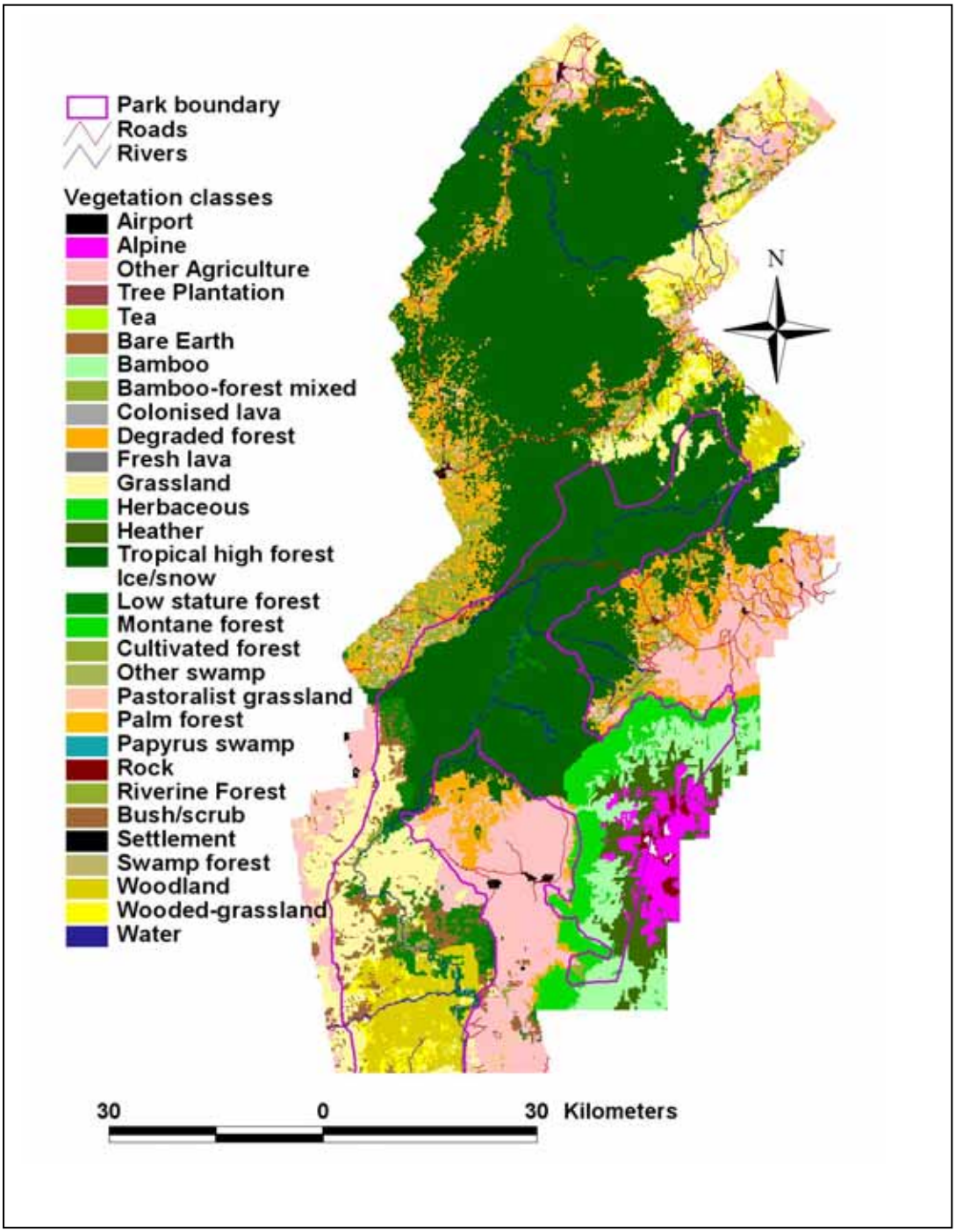


Figure 16. Map of vegetation types for the northern part of the Virunga park and the possible corridor to Mt Hoyo.

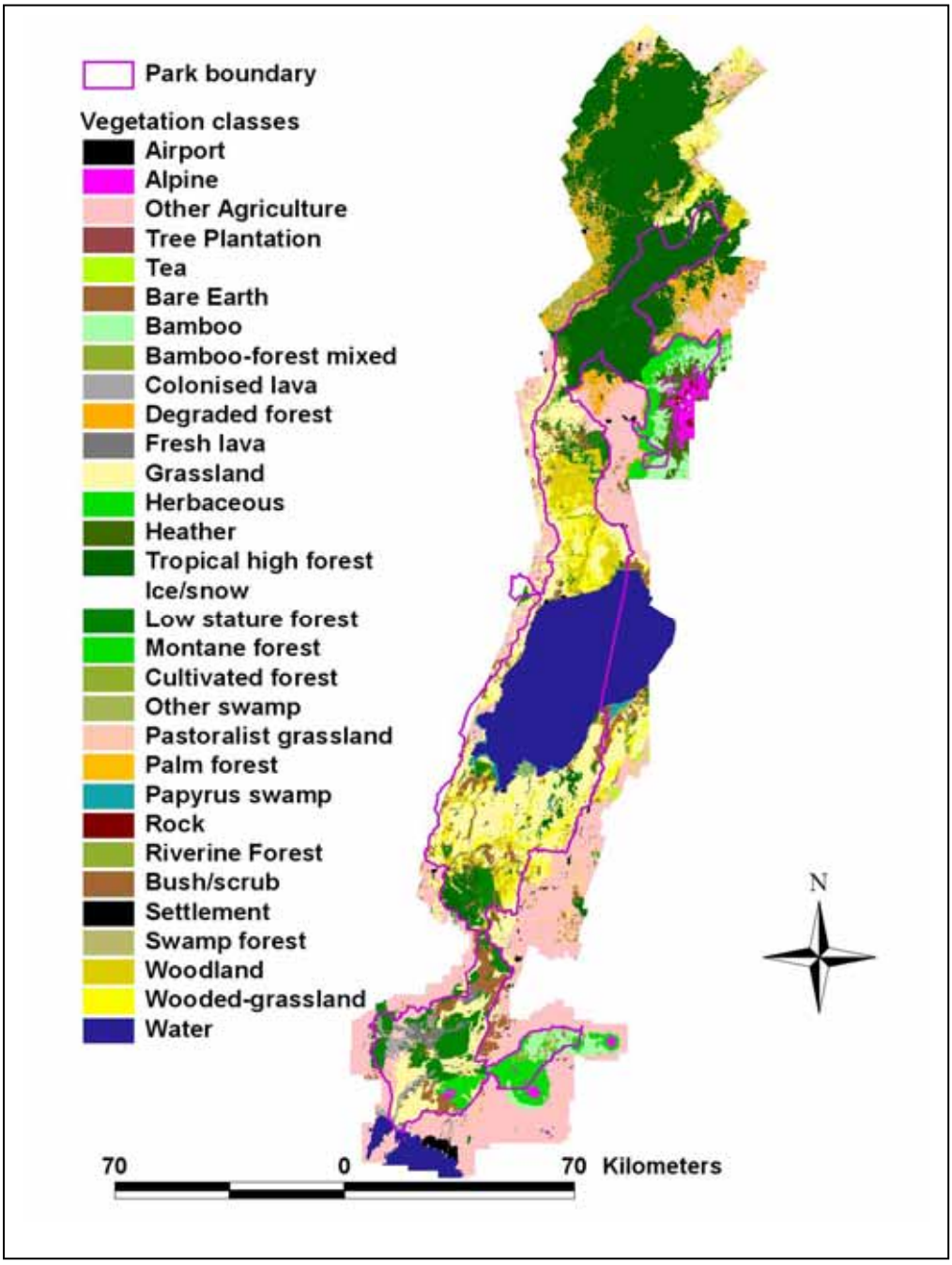


Figure 17. Vegetation map for the whole of the Virunga Park and within 2 km of the park boundary.

An assessment of the area of each vegetation type within the park boundary was calculated from the GIS mapping (table 5). This shows that Grassland, Tropical High Forest and Water form the largest habitat types in the park with other forest types and woodland/wooded grassland forming much of the rest of the habitats.

Table 5. Areas of each vegetation type within the boundary of the Virunga Park.

Vegetation	**km^2**
Rock	8.63
Ice and snow	1.06
Alpine	57.44
Heather	99.81
Bare earth	9.94
Bamboo	248.25
Bamboo-forest mixed	36.00
Herbaceous vegetation	16.25
Grassland	1,751.19
Wooded grassland	404.19
Woodland	420.19
Scrub/Bush	572.56
Tropical high forest	1,033.06
Low stature forest	675.06
Montane forest	355.13
Degraded forest	23.50
Palm forest	0.44
Riverine forest	41.94
Papyrus swamp	39.31
Other swamp	27.94
Water	1,601.00
Colonising lava	80.81
Fresh lava	101.69
Settlement	10.13
Pastoralist grassland	32.13
Tree plantation	0.25
Cultivated forest	18.69
Other agriculture	204.38
Total	**7,870.94**

The location of all buildings within 2 km of the park boundary as well as inside the park boundary were digitized around the northern part of the park (figure 18). The results show that there are many to the west and east of the park but the corridor to Mt Hoyo is relatively free of settlements apart from along the Mbau-Kamango road traversing the area to the north of the park boundary. This is probably the most critical area to protect in the immediate future. However most of the corridor can be seen to be relatively intact between the park and Mt Hoyo. The road from Beni north to Bunia however has many settlements along it and it probably acts as a more permanent barrier for animals that might want to migrate to the north east towards the Ituri forest and Okapi Wildlife Reserve.

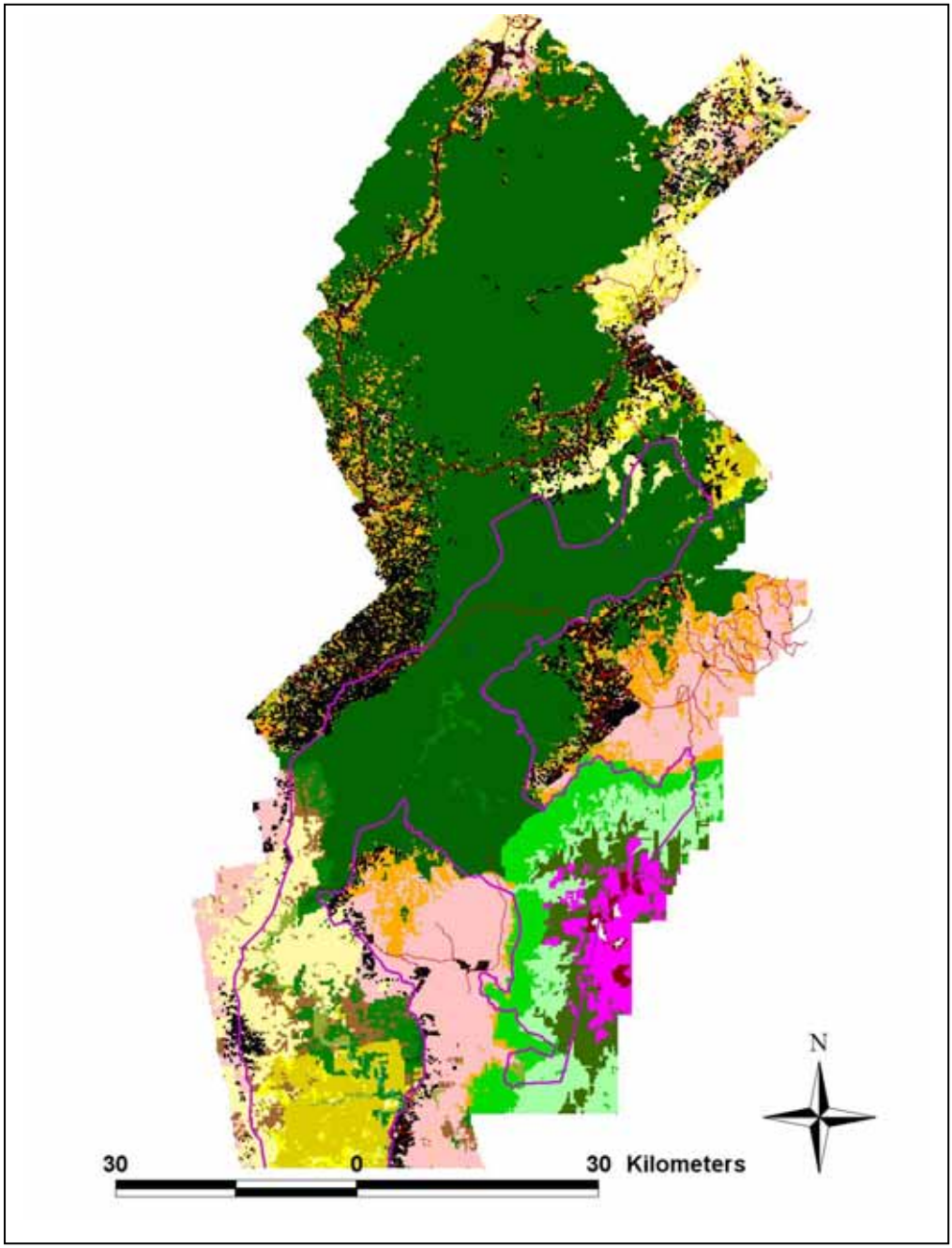


Figure 18. The location of buildings in and around the park boundary and in the potential corridor to Mt Hoyo. Each black circle represents one building.

Conservation Implications

The forested parts of Virunga Park have been home to various armed groups over the past 10-12 years and as a result they have been difficult to access by both parks staff as well as researchers. The northern forested area of Virunga Park has been poorly explored since the creation of the park in 1925 and little is known about this region as most research concentrated south of Lake Edward and focused on large mammal species.

Chimpanzees have been known to occur in the Kasali-Mabenga region, the forest along river Ishasha and Tongo outside the park as well as the Semuliki Forest in the north of the park (Verschuren, 1993). The Tongo chimpanzees are known to have been affected by charcoal activities which are deforesting this region and many have moved from there to Mabenga. However there have been no real attempts to census the population of this species. This survey estimates that conservatively between 950-1050 chimpanzees occur in the park although their distribution is very patchy and even in the northern forest the densities are very variable. We were not able to survey the whole area and so these should be considered preliminary estimates at present. Most of these animals occur at the higher altitudes (between 1,000-1,600 metres) where densities were recorded as high as 3-4 per square kilometer. Below this altitude densities were much lower – about 0.1-0.3 per square kilometer. Much larger areas of forest are therefore needed at low altitudes to conserve a viable population of this species.

The Okapi is also found in the low altitude forest in Semuliki in Virunga. Signs were only found at sites E and D in these surveys although ranger-based monitoring data collected by park rangers while on patrol indicate that this species does occur to the east/south of the Semuliki River. This species is obviously rare where it occurs in the park and again it is a species that would benefit from a larger area of intact lowland forest for its protection.

Both chimpanzees and okapis would benefit from any conservation of the forest between the northern part of Virunga Park and Mt Hoyo reserve. This corridor has been proposed at several times (N.Mushenzi pers.comm.) in the past but has never been created. Now is probably the last chance to be able to do this as it is probable that it is only the presence of the NALU/ADF rebels in this region that is preventing its conversion to agriculture. Creating an extension of the park would add an additional 1,224 km^2 to the park that would encompass Mt Hoyo and most of the remaining intact forest between Mt Hoyo and Virunga Park.

Illegal activities which were predominantly poaching signs were relatively high in the Semuliki forest block and at the same time sightings of large mammal sign and captures on camera traps were very low indicating that poaching has probably had a major impact on the large mammals in this forested part of the park. Given that the area has been inaccessible for over 10 years and also that armed groups, particularly the NALU/ADF have been hiding here and hunting wildlife to feed themselves this is not surprising. There is a need though to increase the antipoaching efforts here to minimize any additional poaching now that much of the park is secure. It has been possible to establish patrol posts with support from USAID and the EU in the north of the park on the road from Beni to Bundibugiyo and these are now being staffed by ICCN rangers. There is a need to establish regular patrolling further north in the park as well as on the northern side of the connection to the Rwenzori massif.

ICCN should work with its partners to move ahead with these increased patrols and the establishment of the corridor, however, as timber harvesting and clearing of the forest is accelerating north of the park already and much of the timber is crossing the border into Uganda east of Semuliki National Park and being transported to Kampala and on to Kenya. It will be difficult to halt the deforestation unless local people can receive some tangible benefit from conserving the forest corridor to Mt Hoyo. Given the existing deforestation rates in this region (estimated at about 8% per year – WWF pers. comm.) it should be possible to

use Avoided Deforestation Carbon funding through the REDD (Reduced Emissions from Deforestation and forest Degradation) process to help fund the conservation of this region. Using chimpanzees and okapis as flagship species it may be possible to obtain a premium price for the carbon from companies that want to also support wildlife conservation at the same time as offsetting their carbon emissions. Carbon funds should be used to both help conserve the area but also to give an incentive to the people living in this area to conserve it. These could be through some form of direct payments or through a Trust that could be used to help develop the area provided the forest remains intact and protected. Of the 53,614 houses digitized in the northern area around Virunga Park only 2,864 occur within 1 km of the park boundary and potential corridor to Mt Hoyo (figure 19). These households for the most part could be the beneficiaries of any funding if they agreed to conserve the forest. If the buffer is increased to two kilometers then a further 3,342 households (6,206 in total) would have to be included and up to three kilometers a further 3,251 households (9,457 in total) are currently present.

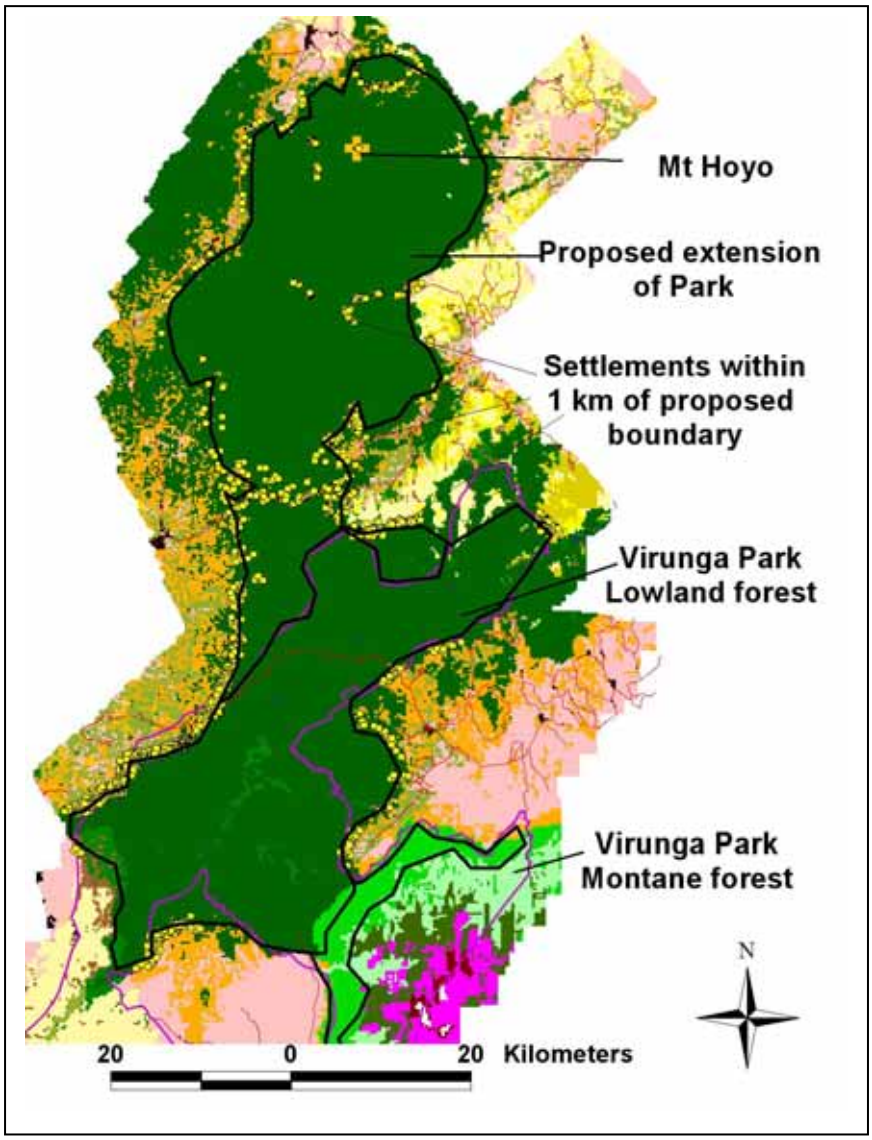


Figure 19. The proposed boundary of the extension of Virunga Park to include Mt Hoyo and existing buildings (yellow dots) located within 1 km of the proposed boundary.

A REDD mechanism for the Mt Hoyo corridor is in line with the DRC Government's objective to lay the groundwork for a carbon finance mechanism that will lead to sustainable forest

management and poverty alleviation in DRC (Laporte et al 2008). The DRC Government has already selected 3 sites: Mbandaka-Bikoro and Bumba areas in Equateur Province, and the Province of Katanga (specific site TBD). The DRC Government is looking for a fourth site in eastern DRC (Laporte et al 2008). As a result of this report, WCS would like to propose the Mt Hoyo corridor as a potential site for a REDD mechanism development in eastern DRC.

Some back of the envelope calculations for carbon based on data from other forests indicated that we can expect around 250 tonnes of Carbon per hectare at a price of about $5-6 USD. With an 8% deforestation rate this would amount to about 2,448 tonnes of Carbon lost per year which could provide about $12.2 million USD per year. If for example 60% of these funds go to people living within 2 km of the buffer and the rest is used for managing the carbon project and protecting the corridor and park, then each household would receive about $1,180 per year as compensation to conserve this forest corridor.

These are crude calculations and a more detailed study is needed to put real values on this but it certainly indicates the possibility of carbon funding as a mechanism to put value on this forest corridor and potentially conserve it for the chimpanzee and okapi populations in this region. Without it, the okapi population in particular is unlikely to remain viable in the long term and will need careful management to ensure the genetic stock remains viable, probably through the release of animals from the Okapi reserve at regular intervals.

Interim support to Mt Hoyo

With USFWS support through this grant some interim steps were taken to support the warden of Mt Hoyo and his rangers. A motorbike was purchased and provided for the staff so that they can more easily access Beni and villages for supplies. Raincoats were also purchased for rangers. There is a need to develop a more constant source of support for this reserve to ensure it remains protected while the corridor is developed and eventually protected.

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Appendix 1. Bird species recorded in the Semuliki Forest in north Virunga Park.

Common name	A	B	C	D	E	FC	H
Afep Pigeon				1			
African Broadbill			1		1		
African Crowned Eagle	1		1				
African Emerald Cuckoo	1	1	1	1	1	1	1
African Goshawk						1	
African Green Pigeon					1		
African Grey Parrot			1				
African Hill Babbler						1	1
African Palm Swift	1				1	1	1
African Paradise-Flycatcher	1		1				
African Pied Hornbill	1						1
African Pied Wagtail					1	1	
African Shrike Flycatcher					1	1	
African Wood Owl	1		1	1	1		
Albertine Owlet	1						
Alpine Swift					1	1	
Angola Swallow						1	
Ashy Flycatcher				1			
Baglafecht Weaver						1	
Banded Prinia					1		1
Barred Long-tailed Cuckoo							1
Bate's Nightjar				1			
Black Bee-eater	1	1		1		1	
Black Cuckoo	1		1				1
Black Kite	1						
Black Saw-wing			1	1	1	1	1
Black-and-white-casqued Hornbill	1	1	1	1		1	
Black-billed Turaco	1	1	1		1	1	1
Black-casqued Wattled Hornbill	1		1		1		
Black-collared Lovebird	1		1	1			
Black-crowned Waxbill						1	
Black-faced Rufous Warbler				1		1	1
Black-headed Weaver	1				1		
Black-throated Apalis							1
Black-wattled Hornbill		1					
Black-winged Oriole				1	1		
Blue-billed Malimbe	1			1			
Blue-breasted Kingfisher	1	1		1	1		
Blue-headed Coucal	1	1	1	1	1		
Blue-headed Sunbird						1	
Blue-shouldered Robin-chat	1			1			
Blue-spotted Wood Dove				1			
Blue-throated Brown Sunbird							1
Blue-throated Roller			1				1
Bronze Mannikin					1		
Brown Illadopsis	1	1	1	1	1	1	
Brown-chested Alethe		1			1		
Brown-crowned Eremomela				1			
Buff-Spotted Woodpecker			1				
Buff-throated Apalis	1		1	1	1		
Cabanis's Greenbul						1	
Cameroon Sombre Greenbul	1						
Cardinal Woodpecker						1	
Cassin's Honeybird					1	1	

Chestnut Wattle-eye	1		1	1	1		
Chestnut-breasted Negrofinch					1		
Chestnut-capped Flycatcher			1				
Chestnut-throated Apalis						1	1
Chin-spot Batis						1	
Chocolate-backed Kingfisher	1		1	1	1		
Chubb's Cisticola							1
Cinnamon-chested Bee-eater							1
Collared Apalis							1
Collared Sunbird		1				1	1
Common Bristlebill				1			
Common Bulbul	1		1	1	1	1	1
Common Waxbill	1						
Crested Guineafowl	1		1	1	1		
Crested Malimbe	1			1			
Crowned Eagle				1			
Crowned Hornbill		1				1	
Dark-backed Weaver	1		1			1	1
Diederick Cuckoo	1			1			
Doherty's Bushshrike		1					
Dusky Long-tailed Cuckoo	1		1	1	1		
Dusky Tit				1		1	
Eastern-bearded Greenbul					1		
Eurasian Bee-eater	1						
Fiery-breasted Bush-shrike				1			
Fire-crested Alethe	1	1		1	1		
Forest Robin	1				1		
Giant Kingfisher				1			
Grant's Bluebill	1						
Grauer's Warbler							1
Great Blue Turaco	1	1	1	1	1		1
Great Sparrowhawk						1	
Green Crombec	1		1	1	1		
Green Hylia	1	1	1		1	1	1
Green Pigeon	1		1		1		1
Green Sandpiper				1			
Green-headed Sunbird						1	
Green-tailed Bristlebill					1		
Grey Cuckoo-shrike						1	
Grey Longbill	1						
Grey Parrot				1	1		
Grey Wagtail						1	
Grey-backed Camaroptera	1	1	1	1	1		
Grey-chested Illadopsis							1
Grey-headed Negrofinch		1			1	1	
Grey-headed Sparrow						1	
Grey-headed Sunbird				1			
Grey-throated Barbet		1			1	1	1
Grey-throated Flycatcher	1			1	1		
Hadada Ibis	1						
Hairy-breasted Barbet	1		1	1			1
Honeyguide Greenbul	1			1		1	
Icterine Greenbul				1			
Jameson's Wattle-eye					1		
Joyful Greenbul	1						
Klaas's Cuckoo		1		1	1		1
Leaf Love	1		1	1	1		
Least Honeyguide				1			

Little Bee-eater					1		
Little Green Sunbird				1			
Little Greenbul	1		1	1	1	1	
Little Grey Greenbul				1	1		
Little Swift	1						
Lüdher's Bush-shrike	1					1	1
Magpie Mannikin					1		
Masked Apalis		1					
Mountain Black Boubou							1
Mountain Greenbul						1	1
Mountain Illadopsis							1
Mountain Masked Apalis						1	1
Mountain Wagtail						1	
Narina's Trogon	1		1	1	1		
Narrow-tailed Starling		1		1			
Northern Bearded Scrub Robin				1			
Northern Puffback						1	
Olive Pigeon		1				1	
Olive Sunbird	1		1		1	1	
Olive-bellied Sunbird						1	1
Olive-green Camaroptera	1	1	1		1		
Orange-cheeked Waxbill	1		1	1	1		
Palm-nut Vulture	1			1		1	
Pied Crow						1	
Pied Hornbill			1		1		
Pied Wagtail	1			1	1		
Pink-backed Pelican				1			
Purple-breasted Sunbird						1	
African Pygmy Kingfisher				1			
Red-bellied Paradise-flycatcher	1		1	1	1		
Red-billed Dwarf Hornbill				1			
Red-billed Malimbe			1				
Red-chested Cuckoo	1	1	1	1	1		1
Red-eyed Dove	1	1					1
Red-faced Woodland Warbler						1	
Red-rumped Tinkerbird				1			
Red-sided Broadbill				1			
Red-tailed Ant Thrush				1			
Red-tailed Bristlebill			1		1		
Red-tailed Greenbul	1		1	1	1		
Red-throated Alethe						1	
Rufous Flycatcher-Thrush	1		1	1	1		
Rwenzori Apalis						1	
Rwenzori Batis						1	1
Sabine's Spinetail				1	1		
Sand Martin			1		1		
Scaly Francolin	1						
Scaly-breasted Illadopsis	1	1	1	1	1		
Scarce Swift	1		1			1	
Shining Blue Kingfisher					1		
Short-tailed Warbler							1
Silverbird		1					
Simple Greenbul				1			
Slender-billed Greenbul	1			1		1	
Sooty Flycatcher		1					
Speckled Tinkerbird	1	1	1	1	1	1	1
Spectacled Weaver				1			
Spotted Greenbul	1			1			

Stuhlmann's Starling						1	
Swamp Palm Bulbul	1			1			
Tambourine Dove	1	1	1	1	1	1	1
Velvet-mantled Drongo			1				
Vieillot's Black Weaver	1		1			1	
Western Black-headed Oriole	1		1	1	1		
Western Bronze-naped Pigeon	1		1	1			
Western Nicator	1	1					
Whinchat	1						
White-breasted Negrofinch	1			1		1	
White-browed Crombec		1				1	
White-crested Turaco				1			
White-naped Dove		1					
White-spotted Flufftail	1		1	1	1		1
White-spotted Pygmy Crake		1					
White-tailed Ant-Thrush			1		1	1	
White-thighed Hornbill	1		1	1	1		
White-throated Bee-eater	1		1		1	1	
White-throated Greenbul				1		1	
Winding Cisticola	1						
Xavier's Greenbul				1			
Yellow Longbill				1			
Yellow White-eye				1		1	1
Yellowbill	1			1			
Yellow-billed Barbet	1	1	1		1	1	
Yellow-browed Camaroptera	1			1			
Yellow-crested Woodpecker				1			
Yellow-rumped Tinkerbird	1		1		1	1	1
Yellow-spotted Barbet	1	1		1	1		1
Yellow-throated Cuckoo				1			
Yellow-throated Nicator	1		1	1			
Yellow-throated Tinkerbird	1		1	1	1		
Yellow-whiskered Greenbul	1	1	1	1	1	1	1