DECLINING POPULATIONS: WHAT IS THE STATUS OF VULTURES IN QUEEN ELIZABETH NATIONAL PARK-UGANDA?

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Summary

Avian scavengers are declining globally but this phenomenon remains largely unstudied. Given scavengers' important role in decomposition and disease control, losses can have severe economic and ecological effects; thus, preserving these birds is essential. This research focuses on the population of six vulture species in Queen Elizabeth National Park, Uganda and monitors key members of this guild, showing how potentially threatening human activities are contributing to their decline. GIS backpacks were attached to two White-backed Vultures *Gyps africanus* to study their ranging patterns and habitat use and counts of both live and dead vultures at provisioned and random carcasses generated information about numbers.

Vulture numbers appear to be stable for the most part in Uganda. Counts from 2011 when compared with counts from 2001, 2003 and 2009 indicate that numbers for most species are stable or increasing slightly. However, numbers are all very low for most species except the white-backed vulture and there should be cause for concern about the viability of populations of vulture species.

Radiotracked individuals were shown to move widely between Queen Elizabeth and Virunga Park and also across 100km to Lake Mburo National park. It is clear that the collared vultures know about the presence of the other parks because they flew directly from Queen Elizabeth to Lake Mburo with only one stop on the way and none on the way back.

Generally, indirect poisoning poses the largest threat to vulture species with 58 killed in one event on the DRC-Uganda border during this study (about 17% of the population). Habitat alteration due to land-use change is resulting in declines in numbers also. Understanding how poisoning and habitat change affect vulture numbers is essential for determining appropriate conservation and management solutions.

1. Introduction

Avian scavengers are currently known to be declining in most parts of the African continent (Thiollay, 2007, Virani *et al*., 2010) but remain largely unstudied. Scavenger population changes have often escaped notice, as have the serious consequences on ecosystems though gradual human population growth. A recent research in the Masai Mara ecosystem in Kenya indicates major declines in vulture species and calls for listing of the Gyps vultures on the IUCN red list (Virani *et al*., 2010). This decline was not noted previously as the trends in raptor numbers in the 1980s were showing stability in the region (Brown et al, 1982). However, even with the evident declines at certain sites there is still no large-scale monitoring of scavenger populations in East and Central Africa leading to few quantitative data on the long-term dynamics of these birds. Information, when available, often comes from biased impressions of visiting tourists and ornithologists who have little or no experience of past species abundances and who tend to focus on rich spots not representative of more widespread areas (Thiollay 2006b). Global concerns are emerging about the ecological and socio-economic consequences of the decline of vultures, acknowledging their important role in ecosystem services in decomposition and disease control.

The current status of many scavenging birds in East and Central Africa is poorly known, partly due to lack of active resident ornithologists. In East & Central Africa, most published information on raptors is from the Serengeti-Mara area (Kruuk, 1967; Pennycuick, 1972; Houston 1974, 1975, 1979) dating back to 1960s–1980s indicating healthy populations. However, this status has changed with some species being listed under high threat categories by IUCN. Species such as Lappet-faced Vultures *Torgos tracheliotus* have been listed as vulnerable for the past 12 years (Birdlife international 2000, 2010). Any preliminary data are a warning call to prompt new investigations, and to promote conservation measures including revising and updating the threatened bird list. Ruppell's Vulture has since changed status from Least Concerned to Vulnerable while the Lappet-faced Vulture moved from Near Threatened to Vulnerable. There have also been extinctions in some parts of West Africa for the Lappet-faced

vulture. Not much research has been conducted in Africa on Vultures since the 1990s and figures from Mundy, 1992 are still quoted for population estimates.

There are seven species of vultures known to Uganda with one, Egyptian Vulture *Neophron percnopterus* known to be migratory. The resident species are Hooded Vulture *Necrosyrtes monachus* (majorly living in towns especially feeding around abattoirs), African White-backed Vulture *Gyps africanus,* Rüppell's Vulture *Gyps rueppellii*, Lappet-faced Vulture *Aegypius tracheliotus*, and White-headed Vulture *Aegypius occipitalis.* Previous road counts for raptors in Uganda indicate few individuals while counts at provisioned carcasses are not conclusive about individual numbers but generally indicate declining populations (Pomeroy *et al* 2011).

Diurnal raptors are good indicators of changes in ecosystems and the impacts of human activity not only because they are sensitive to poisoning, contamination, persecution and disturbance, but also because the numerous species range over many habitat types (Newton 1979). Habitat transformation, however, is the major cause of biodiversity loss globally and a potential threat to raptors (Donazar *et al*., 1993). Pressure from an increasing human population is driving agricultural intensification, deforestation, overgrazing, erosion, increasing pesticide use, predator poisoning, overhunting, overfishing and direct persecution of raptors.

The need for extensive censuses, ecological studies focusing on breeding, roosting, feeding and general survival of these birds in the face of these increasing threats is urgent. In addition, long-term studies of the effects of habitat alteration are scarce because the current design of management strategies typically cannot wait the years or decades required to get results. As a result, it is rare for management strategies to adequately address the long- term capacity of long-lived species to cope with environmental alteration (Donazar *et al*., 2002). Agricultural development, grazing, and natural and human-induced disturbances, such as fires, have given rise to highly fragmented landscapes adversely affecting nesting and other requirements for stable vulture populations.

2. Methods

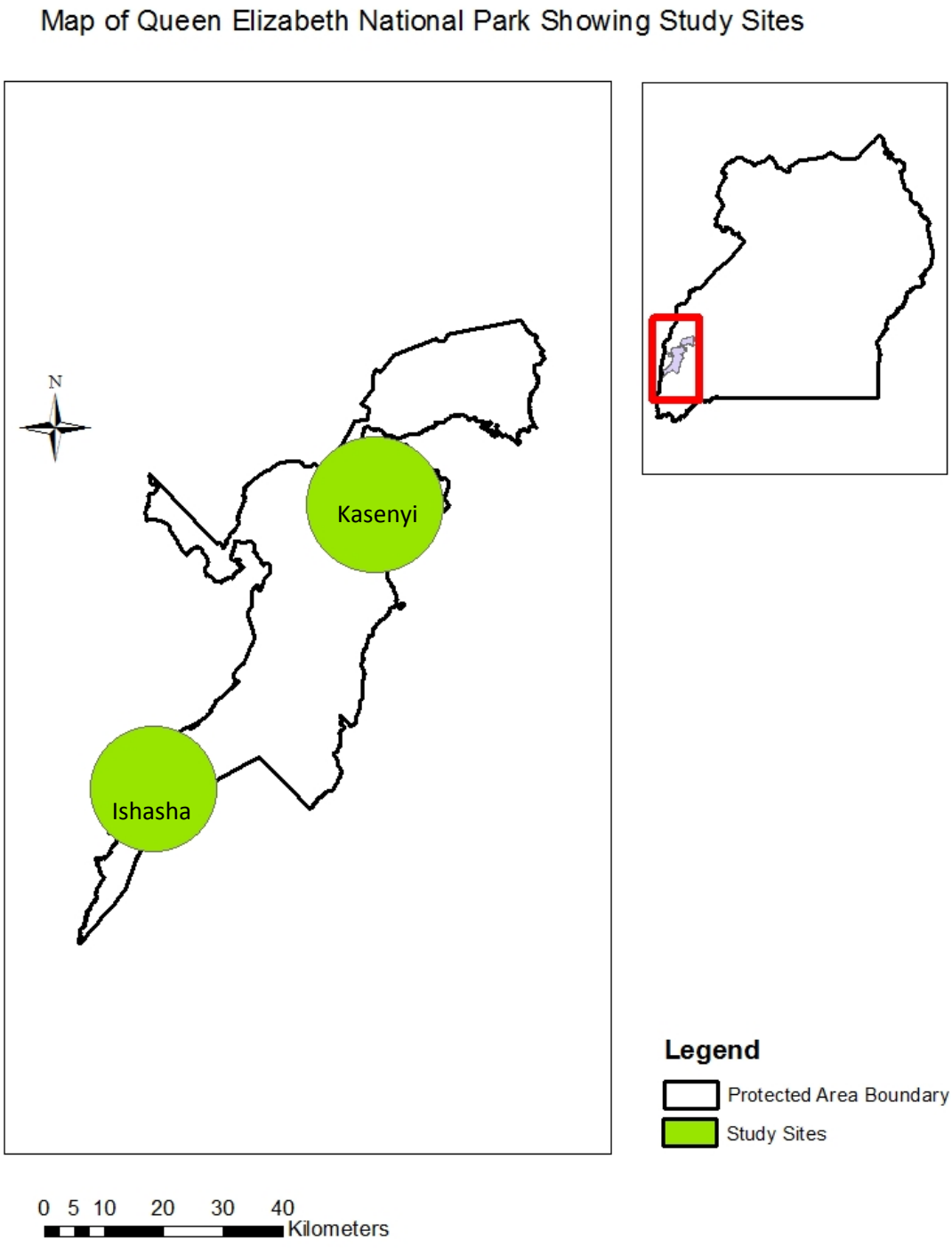
The study was carried out in Queen Elizabeth National Park (QENP) from September 2010 to June 2011 and involved counting of vultures at both provisioned and non-provisioned carcasses and the capture of vultures to attach radio tracking devices.

2.1. Study area

QENP is a biosphere reserve designated by IUCN. From North to South, successive wooded and grassland vegetation belts follow the increasing rainfall in Maramagambo forest before opening up again in the Ishasha sector famous for the tree-climbing lions. The grass cover is greater than one meter high, dominated by *Hyparrhenia, Cymbopogon* and *Pennisetum*. The savanna

woodlands are 4–10 m high dominated by *Acacia, Albizzia, Anogeissus, Lannea*, and *Combretum* while Maramagambo forest is dominated by taller trees typical of tropical forest. Narrow gallery forests with trees over 20 m run along seasonal watercourses and a few permanent rivers with a special gorge within the Kyambura Wildlife Reserve. The park has several crater lakes and two fresh water lakes (George and Edward) connected by the Kazinga channel, marshes and grasslands, inundated for half of the year, where raptors, large, medium-sized and small mammals and illegal grazing cattle concentrate during the dry season (see map below).

Figure 1


Map of Queen Elizabeth National Park Showing Study Sites
N
Kasenyi
Ishasha
Legend
Protected Area Boundary
Study Sites
0 5 10 20 30 40
Kilometers

2.2. Counts at provisioned carcasses

Essentially, the method involved slaughtering two cows at an open, grassy site in Kasenyi (North) and Ishasha (South) on the same day, and at approximately the same site as in past years (Pomeroy *et al*., 2001). The observers stationed their vehicle at 100-200 metres from the carcass, in a place with shade and a clear view of the carcass and surrounding trees. The cow was slaughtered and exposed at 0800 and from then on, counts of vultures and other scavengers were made every 15 minutes and numbers recorded until most of the vultures that came had all left. Some preliminary observation in 2009 suggested that the maximum count from these observations might still be less than the true maximum, since birds could both come and go within a 15-minute interval between counts (Pomeroy *et al*, 2011).

2.3. Counts at random carcasses and along roads

Carcasses were located by watching flying vultures and following any individuals that were descending to the ground (Houston 1974). On location of the carcass, the GPS point was taken and used to locate the carcasses the next morning. Carcasses still intact by 7:00pm were not eaten up until the next morning. The observers would then station in their vehicle, as in counts above, from 0600 am and conducted counts. For days when there was no carcass for the next morning, the team conducted counts on other carcasses found during the drive. All observations were made using the naked eye (since vultures are big birds) or, where it necessitated, a pair of field glasses. All vultures found dead during surveys were recorded and where possible, the cause of death was established. Birds were also counted along transects (10km long) of existing roads in a 4x4 motor vehicle. Counts were repeated six times during the study and encounter rates calculated per km traveled. On some days each month an attempt was made to locate buffalo carcasses in Ishasha and Kasenyi on the same day so that counts could be made at the same time of day to estimate the numbers of vultures at two sites at the same time. This would provide a minimum count of the numbers of vultures.

2.4. Bird capture and attachment of GSM-GIS backpacks

The use of GIS technology to monitor wildlife is becoming common practice. However, its application in bird studies is limited due to the small size of most species and the weight of GIS transmitters. In this study, I captured vultures using noose ropes made of fishing line. The line was cut into short lengths and fixed onto 2-m ropes to make five circular loops on each rope. Two to three ropes were tied onto a heavy carcass or ground-fixed hinge next to the carcass. The circular loops were spread out and entangle vultures during scuffling and tearing of the carcass. In case of more than one capture, other vultures were let off the loops and only one would be restrained and fitted with the telemetry device. The backpack had an in-built VHF that was tested for the best frequency level. The bird was then released into the wild at the point of capture. Only two birds (White-backed vulture) were attached with telemetry devices in June 2011, one from each study site. This method has been successfully used on vultures in Masai Mara, Kenya (Virani *et al*., 2010). The telemetry data was analysed using RANGES VI to provide information on the ranging patterns of the species, its use of the GVL and surrounding sites, overlap of the two vultures and feeding stress parameters.

3. Results

3.1. Provisioned carcass vulture counts and comparison with previous counts

Table 1 shows the number of vultures recorded at provisioned carcasses in all four Uganda National parks on 26th January 2011 where they were surveyed. It also compares numbers for 2001, 2003 and 2009 for the same four parks. Individual species numbers varied widely within and among National Parks. The Egyptian Vulture, a migrant, was not sighted throughout the counts but 2003 records in Ishasha (table 2) show its presence.

Table 1 Numbers of vultures at four Ugandan National Parks on 26 January, 2011

	2001 total	2003[a]	2009[b]	2011 - details			
				Lake Mburo	Queen Elizabeth-Kasenyi	Murchison Falls	Kidepo Valley
Egyprian Vulture *Neophron percnopterus*	0	0[c]	0	0	0	0	0
Hooded Vulture *Necrosyrtes monachus*	14	8	16	0	6	5	3
African White-backed Vulture *Gyps africanus*	242	216	228	18	153	51	25
Rüppell's Griffon Vulture *Gyps rueppellii*	41	6	24	3	4	27	7
Lappet-faced Vulture *Aegypius tracheliotus*	14	25	9	3	5	0	6
White-headed Vulture *Aegypius occipitalis*	3	11	3	1	0	0	2
Total vultures	**319**	**266**	**290**	**25**	**168**	**83**	**43**

Notes: a From Pomeroy *et al.* 2004: four main sites only.
b From Pomeroy *et al.* 2011

3.2. Provisioned carcass vulture counts for a selected single site

Table 2 summarizes number of vultures at Ishasha in QENP for 2003 and 2011. The Egyptian Vulture was last recorded in Uganda at this site in 2003 with only a single record. All other species have recorded increasing numbers at the site except the White-headed Vulture which has declined. Hooded vulture numbers recorded at a single carcass are steadily growing within the park.

Table 2 Number of vultures at Ishasha in QENP for 2003 and 2011

Vulture species	2003	2011	2010-2011[a]
Egyptian Vulture *Neophron percnopterus*	1	0	0
Hooded Vulture *Necrosyrtes monachus*	0	14	11
African White-backed Vulture *Gyps africanus*	31	156	71
Rüppell's Vulture *Gyps rueppellii*	0	6	5
Lappet-faced Vulture *Aegypius tracheliotus*	0	11	12
White-headed Vulture *Aegypius occipitalis*	1	0	1
Total vultures	**33**	**187**	**100**

The result 2010-2011[a] is a summary of counts at five buffalo carcasses between September 2010 and January 2011 while the 2011 count is from the cow carcass.

3.3. Estimates of vulture population through mean total counts and relationship between vulture numbers and carcass size

Table 3 shows averages of each vulture species per count at different carcass types, IUCN Red List Category and mean total number encountered per visit during the period September 2010-May 2011. A total of 74 carcasses of six species of mammal, African elephant *Loxodonta africana*, African buffalo *Cyncerus caffer*, Uganda kob *Kobus kob*, Topi *Damaliscus korrigum*, Waterbuck *Kobus ellipsiprymnus* and Hippopotamus *Hippopotamus amphibius* where monitored throughout the survey period and the number of carcasses of each are shown. Larger carcasses attracted higher numbers of vultures than smaller ones, except the case of elephants which were discoverd after some level of decay. This could have affected the number

of vultures. There was also great variation between total numbers of the different vulture species with the vulnerable ones recording fewer than 30 individuals.

Note: At least two carcasses recorded dead vultures, two White-backed Vultures killed by a lion while protecting a buffalo carcass (Ishasha), 56 White-backed vultures and two Rüppell's died of poison from an unknown carcass (probably across the border in D. R. Congo).

Table 3. Average numbers of vulture species observed on different carcasses in the Greater Virunga Landscape, their IUCN Red List Category, and the maximum total number counted on buffalo carcasses at Kasenyi and Ishasha on the same day.

Species	**IUCN cat**	**Average vulture numbers per count per Carcass type**						**Total counted**
		Eleph (n=5)	**Hipo** (n=2)	**Buff** (n=23)	**Wtbk** (n=4)	**Topi** (n=3)	**Kob** (n=37)	
African White-backed	NT	30.4	93.0	44.5	79.3	22.3	19.2	325
Lapped-faced Vulture	Vu	0.8	0.0	2.1	4.8	3.0	1.7	27
White-headed Vulture	Vu	0.0	0.0	0.0	0.0	1.3	0.1	4
Ruperell's Vulture	NT	0.4	1.0	1.4	1.5	0.0	0.2	38
Hooded Vulture	LC	3.8	3.0	6.2	3.8	6.0	2.5	48
Palm-nut Vulture	LC	0.2	0.0	1.1	1.0	2.0	1.1	105
Total vultures								**547**

The total numbers counted were made by counting the numbers of vultures on buffalo carcasses in Kasenyi and Ishasha on the same day and around the same time. This should avoid the possibility of vultures moving between the carcasses. Only five counts were ade in this way so these should be considered minimum population estimates.

3.4. Encounter rates along road counts in different parts of the park

Table 4 shows number of birds encountered per km during road counts conducted in the North of the park and Sothern sector. Of all the vultures encountered, 92% were White-backs and there was no single sighting of the White-headed vulture. Generally, the south (Ishasha) had higher encounter rates but these figures mainly depended on large flocks in a single sighting.

Table 4. Encounter rates of all vulture species per kilometer along roads within Queen Elizabeth National Park

Site	Encounter rates (per km)
North of park	
Kabatoro	0.367
Kasenyi	0.483
Hamukungu	0.350
South of park	
Ishasha-south	1.600
Ishasha flats	0.383
Ishasha-north	2.050

3.5. Preliminary results of following vultures with GSM back packs

Table 5 shows average actual and direct daily flight distances for the two vultures in range from June-September 2011. Direct distances were calculated from direct distance between the first and last points (two points considered) while actual distances involved calculation of distance from one point to another for all points lying between the first and last point. Vulture-Ks flies more than double the distance flown by Vulture-Is for both actual and direct distances in most instances. The maximum actual daily average distance travelled by Vulture-Ks is 41.674km compared to 21.159 km for Vulture-Is.

Table 5. Average actual and direct daily flight distances flown by vulture-Ks and vulture-Is.

Month	Average actual and direct daily flight distances (km)			
	Vulture-Is (Ishasha)		**Vulture-Ks (Kasenyi_**	
	Actual distance	Direct distance	Actual distance	Direct distance
June	21.159	12.170	41.674	30.527
July	19.689	11.980	37.354	29.038
August	19.837	16.060	37.120	28.069
September	18.021	10.621	36.822	29.882

Figure 2

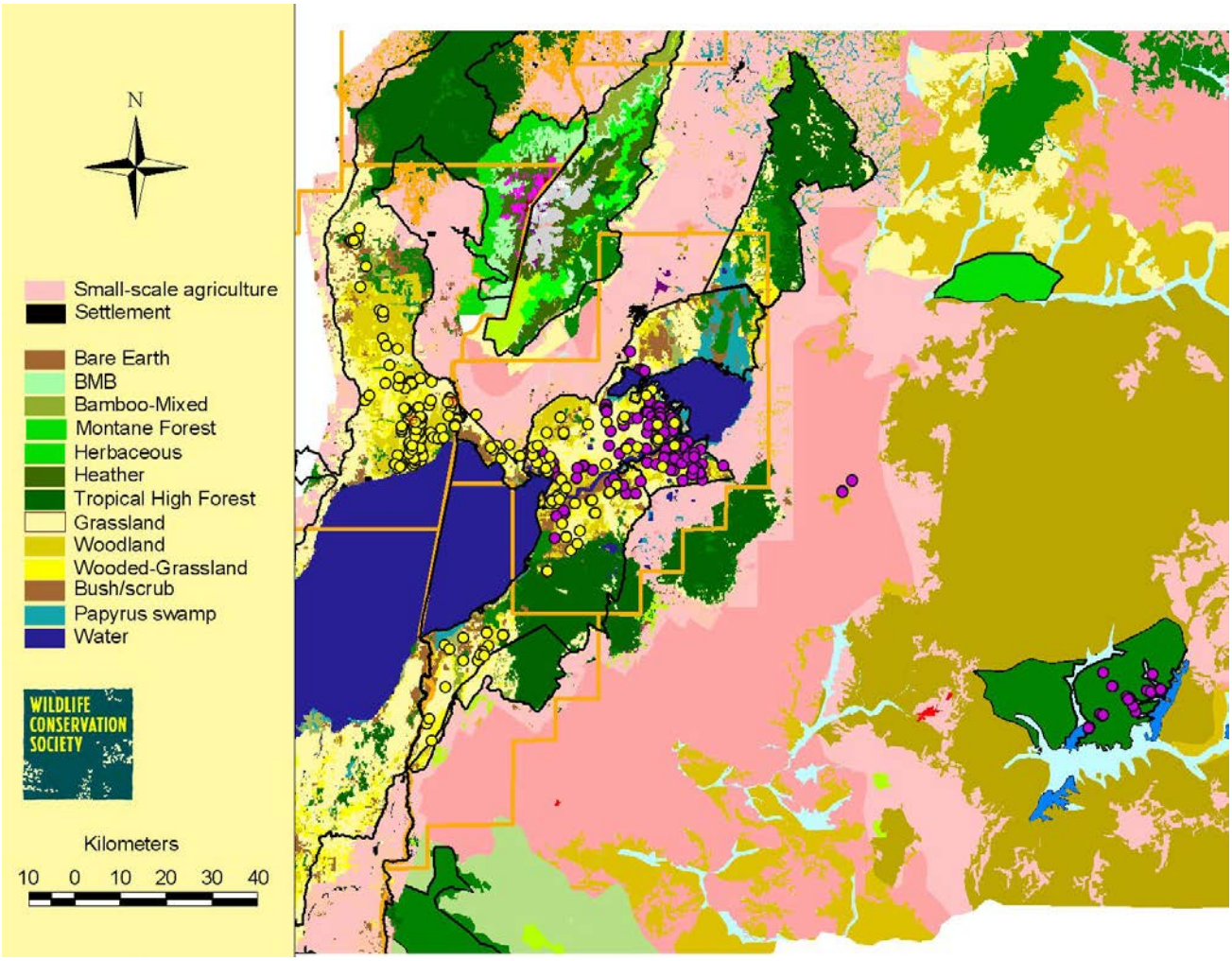


Figure 2. Map showing the locations of the two vultures (yellow and purple circles) fitted with GSM back packs between June and October 2011.

The vulture collared in Kasenyi flew to Lake Mburo National Park in these five months and only stopped at one site on the way there and no sites on the way back (figure 2). It is clear this individual knows where other parks with possible carcasses can be found indicating that the management of this species needs to happen at a much larger scale than in individual protected areas.

4. Discussion

The vulture population on the African continent has shown a declining trend in all species since 1992 to date resulting in up-listing of Ruppell's Vulture from Least Concern to Vulnerable and Lappet-faced Vulture from Near Threatened to Vulnerable (Mundy, 1992). There are also recorded extinctions of the Lappet-faced vultures in some parts of West Africa. Previous counts

in Uganda's national parks indicate fluctuations rather than declines except for recent censuses of the hooded vulture in urban Kampala that showed declines from 424 in 2004 to 260 individuals in 2009 (Ssemmanda & Pomeroy, 2010). Counts at provisioned carcasses (Pomeroy *et al*., 2011 in press) showed slight declines in Lappet-faced and White-headed vultures over the past decade but their numbers have generally been low throughout the counts. This study stresses the similar trends in these two species.

The White-backed vulture has generally shown healthy populations in Uganda's national parks. This is also seen in their high numbers from the road counts (table 4). In our study, species numbers at carcasses varied widely, with this species most numerous, sometimes more than 80 individuals. We recorded 0-16 individuals of the other five species. Captures had juvenile birds indicating a breeding population within the range. The 2011 provisioned carcass counts indicate a population of about 355 individual white-backed Vultures (168 in Kasenyi and 187 in Ishasha). However, it is also important to note that the migrant Egyptian Vulture has no single record in Uganda since 2003. There was no observation of this species in this study indicating its absence for close to a decade.

Data from telemetry (fig 2) show the wide ranging characteristics of vultures using both protected and unprotected areas. Occasional visits to L. Mburo National Park by vulture-Ks and frequent stays in Virunga (D. R. Congo) by vulture-Is is a clear indication of a similar population using the region's wide network of habitats, although most of the time they are confined to the protected areas. Though poisoning of these birds is rampant within and close to protected areas, it is equally wide-spread on community rangelands. On 4th November, 2011 a migrant Steppe Eagle *Aquila nipalensis* with an unknown backpack was found among dead raptors in Mubende district after scavenging on a poisoned goat carcass.

Unpublished studies in Uganda show mostly the use of carbofuran products for poisoning and during our study, samples from carcasses showed carbofuran as the major cause of death. Only two species, the white-backed and Rüppell's vultures were found dead, with 58 and two individuals respectively. Anderson, 2000, Brandl *et al*., 1985, Herremans and Herremans-Tonnoeyr, 2000, Thiollay, 2006a and Virani *et al.,* 2010 showed that rapid vulture population declines in the region are due to wide spread use of poison, especially in habitats outside protected areas. Other sited causes of death noted by Allan, 1989; Anderson, 2007; Anderson et al., 2005; Bamford et al., 2009a,b; Kissui, 2008; Margalida et al., 2008; Mundy et al., 1992; Murn and Anderson, 2008; are persecution for body parts for cultural purposes, electrocution on and collision with power lines but these were not observed among threats for the Ugandan population.

The nesting ecology and requirements of vultures is poorly known in the region. Though suspected nesting areas of the collared birds have been identified (from repeated returns to the

same place) they have not yet been visited, because of inaccessibility and security issues. Both vultures returned frequently to a spot in north Virunga (Vulture-Is) and Kyambura Wildlife Reserve (Vulture-Ks). Both areas are characterized by a dense network of tall trees proving the importance of protected areas in the management of wide-ranging raptors. In all, management of habitats should be done at scales factoring the wide ranges required by these birds to forage and breed. Further, provisioned carcass counts should be conducted on the same day and time to avoid repeating counting of the same birds since there is now evidence of one individual using several protected areas in its range.

5. Single species accounts

5.1. White-backed Vulture

This is the most numerous of all species in QECA and accounts for over 80% of the total vulture population. The species is ranked as Globally Near-threatened by IUCN, 2011 and numbers are reckoned to be declining within the region. A recent survey in the Masai Mara in Kenya suggests up-grading the species on the IUCN Red List. Uganda's population of this bird recorded over a few years through monitoring cow carcasses indicates a slight increase in their numbers since 2003 but these counts are not conclusive. The 2011 counts suggested a total count of 355 in QECA implying 0.18 vultures per square kilometer of the area. However, this number was immediately reduced by 58 vultures (16%) that died in Ishasha due to suspected poisoning in May 2011. Another two vultures were killed by lions protecting their kill. Though the population may look healthy in the area, it should be noted that vultures move considerable distances in search for food and GSM data so far collected indicates that the D.R. Congo section of the Virunga is being used by the population in Ishasha. Whether this same population is shared between the Greater Virunga Landscape and beyond is a question that requires more research.

The breeding biology of the species is still unknown in Uganda and no active nests have been identified. However, four nests within the Kyambura Gorge in Kyambura Wildlife Reserve were identified during the research but these were only occasionally visited by the birds with no activity. One old nest was being re-visited by a pair of White-backed vultures in an Acacia tree in Kasenyi. Observations and captures at carcasses showed sizable population of juveniles but since there was no capture-mark-recapture, it was impossible to identify the already captured birds.

5.2. Lappet-faced Vulture

It is one of the least commonly seen species within the QECA and usually appears in very small numbers of one to seven at carcasses. Most observations were on small isolated carcasses or left-over bones while the few sightings at big carcasses first stayed a distance from the carcass

as other species fought to tear it up. The largest of the vulture species in this area is very elusive and attempts to use noose ropes did not yield a single capture.

The Lappet-faced vulture is globally threatened and listed as Vulnerable on the IUCN Red Data List. It is also one of the Landscape species within the Greater Virunga Landscape. Recent research by Munir *et al* (2010) in Masai Mara-Kenya did not show any improvement in numbers and status of the bird. Our research did not find significant numbers of the bird in the area and neither have the total carcass counts since 2003. In some cases, no Lappet-faced Vultures have been recorded during these counts. Little is known about their breeding with no records of nesting in Uganda. This study shows a population of about 30 birds using the conservation area. Without telemetry information, it is still hard to conclude that this is the total population for QECA and not shared between other protected areas. The population in other parks within the country does not show any difference in patterns with records of zero to three during carcass counts.

5.3. **Hooded Vulture**

Across most of Uganda this is an urban dwelling species with the largest population in Kampala. However, this population increased from less than 100 individuals in the early 1970s to about 400 individuals in 2005 (Pomeroy 1973, Ssemmanda, 2005). The population has since declined to between 250 and 300 individuals in recent years (Ssemmanda & Pomeroy 2010). This is partially explained by new abattoirs in emerging towns that have attracted some of the birds but could also be due to other causes. Regionally, numbers of this species have been declining (Virani *et al* 2010) and there is suggested close monitoring of the species population.

Within Uganda's National Parks, the population is not high and has not shown significant changes in the recent years. However, during this research the number of individual birds reporting at carcasses showed improvement with some carcasses registering a record high of 15 birds. Though the species is one of those listed as Least Concern by IUCN Red Data List, its declining numbers in most of its habitat may eventually call for a revision of its ranking. The QENP population can be currently estimated at 75 individual birds which are insignificant for an area of about 2000 km^2. There are two records of nesting for the urban population in Namuwongo, a Kampala suburb in Uganda (Roger Skin pers.com).

5.4. **White-headed Vulture**

This is the rarest of all species of vultures in Uganda being uncommon within all parks. Total counts from 2003 show no records while a single bird was recorded during the first four months of this research. It is rare at carcasses and when seen near any carcass, it is perched in trees, hardly feeding. There were only four records throughout the nine months of fieldwork. During my two weeks in the Masai Mara working with vultures, the species was rare and did not attend carcass congregations. It is listed by IUCN Red Data List as vulnerable, a rank that may not depict its rarity. It was hard to estimate its population as only few individuals were sighted. There are no nesting records for Uganda.

5.5. **Rüppell's Vulture**

Another uncommon species within QECA with 1-5 birds recorded at a carcass. However, previous counts have several records from MFNP and here the bird is uncommon. Records from other regional research such as in Kenya-Serengeti suggest that the numbers are on the decline and there is need to raise its category on the IUCN Red Data List. The bird is currently listed as globally Near-threatened. Several research studies conducted indicate that the bird nests in cliffs but observations have been made of birds nesting in old nests of the White-backed Vulture in the Masai Mara-Kenya (per obs.). However, there is no single record for nesting in Uganda but two juvenile birds were trapped during this research, indicating they are breeding here.

5.6. **Palm-nut Vulture**

This is one of the commonest vultures in QECA. It is common on roads normally showing the highest numbers during road counts that have been conducted here since 1970s. It turns up first at carcasses or after the Tawny Eagle *Aquila rapax* but usually in small numbers of about one to four. This species recorded the second highest individual numbers after the White-backed Vulture during the study. It is listed by IUCN as Least Concern and there are no records of declining populations as seen with other vulture species. There are a few records of suspected nesting birds within the park (Ranger, Africa pers.com) but this has not been confirmed.

6. Implications of a vulture population crash in Uganda

Vultures everywhere fulfill an important ecological role, and their absence could cause ecological imbalance (Anderson & Mundy, 2001). In Uganda for example Hooded vultures alongside other scavengers clean up abattoir waste disposed of around Kampala's abattoirs in addition to other waste and their absence could result in a spreading of disease. Animals

knocked down on roads, those taken to the city and town council dumps are part of the daily clean-up activity of these birds. Several national parks cannot do without the large population of the White-backed Vulture as accumulation of rotting carcasses would increase disease risks to wildlife. Disease outbreaks such as Anthrax within parks can have a much wider impact through quick spreading since several carcasses will multiply millions of anthrax spores without interference in the absence of vultures.

6.1. Management implications

Quantification of wildlife resources is critically important for impact assessment and management planning (Carrete & Donazar, 2005). The conservation of vultures in Uganda and the region has been primarily focused on population censuses while breeding; nesting failure, foraging habitat requirements and prey depression among others have had no focus. Population depression through habitat degradation and fragmentation for agriculture has resulted in reduced habitat for vultures which require wide ranging areas for their survival. As a result, poisoning through indirect means, not intended for vultures, is a rampant practice. Elephant poisoning (for tusks) and carnivore poisoning by adjacent park communities and poachers is resulting in high raptor mortality. Although large home ranges of vultures allow for distant nesting and foraging habitats, birds would benefit from maintenance of good habitat types around their colonies and this would reduce costs associated with long travels. However, as management decisions on lands outside protected areas are primarily in private hands, the need for interventions such Payment for Ecosystem Services (PES) to allow for low intensity exploitation could play a major role in their longevity as well as in the conservation of species dependant on them. PES can also be used to re-establish wildlife corridors that play an important role in the genetics of wildlife and maintenance of viable populations.

7. Conclusions

Vultures range widely and their conservation cannot be confined to protected areas. Management options embracing community conservation are therefore paramount. These require trans-boundary collaboration to address the need for tackling carbofuran poisoning, not only for conserving vultures and other raptors but also for large predators. Furthermore, collaboration should aim to reduce human pressure on existing protected areas by control of invasive species such as *Lantana camara* that reduce grazing lands outside the parks and drive livestock into parks. Habitat alterations within parks such as those due to oil exploration need to be investigated in relation to nesting and breeding grounds.

Recommendations

1. Further investigation into breeding is paramount for the survival of vultures in the region. This requires use of more telemetry equipment on different age groups and on a variety of species for larger sampling and characterization of safe nesting requirements
2. Provisioned carcass counts should have a wider coverage of the region beyond Uganda's national parks, all carried out at the same date and time to provide information on the region's vulture population. Other easily replicable methods could be adopted.
3. Management of the region's protected areas should be harmonized with similar policies adapted and enforced especially on cross boarder issues such as habitat protection, control of carbofuran among others.
4. Conducting species studies at an advanced level are required in order to unearth details on inter and intra-specific competition since observations at carcasses indicate different levels of dominance by different species.
5. A detailed study on urban populations of the Hooded Vulture is urgently required to provide information about the rapidly declining numbers within major townships. These vultures are now a rare sighting in Nairobi and have shown rapid declines in Kampala.

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