

Biodiversity Surveys of Kidepo Valley National Park



The Kidepo Valley and Mt Morungole

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May 2009



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EXECUTIVE SUMMARY

The Kidepo Valley National Park (KVNP) in northern Uganda was gazetted as a national park in 1962 although prior to this it existed as the Kidepo Valley Game Reserve which was established in 1958. It covers 1,440 km² of *Acacia* and *Combretum* savanna, steppe and thickets and is surrounded by volcanic hills that have *Juniperus-Podocarpus* forest.

Survey teams from the Wildlife Conservation Society and Makerere University assessed the species of large and small mammals, birds and plants (ferns and higher plants) in the reserve during a three week inventory in November-December 2008. A mixture of quantitative and qualitative methods were used to provide species lists for the park and also measures of relative abundance and species accumulation curves. A total of 40 mammal species were recorded for the reserve of which three were new species for the Karamoja region, 154 bird species of which seven were new records for KVNP, and 692 plant species (we did not have species lists for KVNP that we could compare with).

Signs of human impact were minimal with most concentrated in the south east of the Kidepo valley. It is clear that the Kidepo valley, Morungole hills and the Narus valley are quite distinct regions in the park which conserve very different faunas and floras. This contributes to the high biodiversity found in the park as a result.

ACKNOWLEDGEMENTS

We would like to thank many people who helped WCS implement these surveys. The warden of Kidepo Valley National Park, Mr Justus Kisubira, and the warden Monitoring and Research, Raymond Kato, were very helpful in organizing logistics for the field teams and providing advice on where teams could access safely. We are grateful to the field assistants who collected the data for these surveys, particularly: Joram Turyeigurira, Moses Gonya, Sam Isoke, Obed Kaleba, Joseph, and Richard Musumererwa. We are also grateful to the UWA rangers who accompanied the field teams when in the field.

Ellen Bean and the WILD Team in Kampala played an important role in setting up the teams and organising equipment. We want to thank USAID for its financial support for the surveys and also Uganda Wildlife Authority for permission to carry out the surveys.

INTRODUCTION

The Kidepo Valley National Park (KVNP) was initially gazetted as the Kidepo Valley Game Reserve in 1958. It was upgraded to national park status in 1962 because of its tourism potential and conservation value. It is composed of two main valleys, the Kidepo and Narus valleys, which are surrounded by volcanic hills. It varies in altitude from 914 metres in the valleys up to 2,749 metres at the summit of Mt Morungole in the south-east of the park (Olivier 1992) which is also within the Morungole Forest Reserve. Three forest reserves border the park: Nyangea-Napore in the west, Morungole in the south east and Zulia in the east (figure 1). The park headquarters is situated at Apoka in the Narus valley and this is the main area where tourism takes place in the park.

KVNP contains semi arid plains interspersed with hills, rocky outcrops and mountain ranges. A third of the park lies within the Narus Valley in the south and west and the other two thirds occupy the Kidepo valley in the east and north-east. Life in the park is said to revolve around these two seasonal rivers. The Narus Valley has water for about 6 months a year and has well developed *Acacia gerrardii* woodland. The Kidepo valley only contains water in the wettest seasons. Besides the *Acacia gerrardii* woodland, the park also has extensive grasslands, tree and shrub steppe, and bush land. Overall the vegetation of KVNP can best be described as open tree Savannah that varies much in structure and composition.

As part of the WILD (Wildlife, Landscapes and Development for conservation) project of the Wildlife Conservation Society a biodiversity survey was made of the Kidepo Valley National Park to assess its contribution to the conservation of biodiversity in Uganda. Surveys focused on the following taxa: large and small mammals, birds and plants as surrogates for overall biodiversity. Some areas were relatively insecure as a result of Karamajong warriors being present and these areas were not visited as a result. However the teams managed to access most of the park. This report summarises the results of this survey which was carried out between the 17th November and 10th December 2008.

Kidepo Valley National Park

The park includes 1,440 km² of *Acacia* and *Combretum* savanna, steppe and thickets and is surrounded by volcanic hills that have *Juniperus-Podocarpus* forest. It is one of Uganda's most seasonal parks with one long dry season (October –March) and a long wet season (April-September). The only area which receives rain in the dry season is the Narus Valley where annual rainfall is about 890 mm per year. In the Kidepo valley rainfall is only about 635 mm per year (UWA 2000)

A vegetation map (figure 1) was digitized from aerial photos that were taken in 2007 by the WCS flight program. These images were captured and joined using the ENSO Mosaic hardware/software package to produce a digital photographic map of the region. A grid of 250 metre cells was overlaid on the photo imagery and all cells classified into the various habitat types based on the most abundant habitat type in each cell. When selecting survey sites the vegetation map was used to identify different habitat types for surveying. In addition the vegetation maps made by Langdale Brown, Osmaston and Wilson (1964) were used to ensure that the different plant community types they mapped were also surveyed.

METHODS

Transects were allocated using a systematic segmented random sampling procedure with the DISTANCE software (Buckland et al. 2004) across the whole park. Transect length and orientation were varied in the design to ensure that an even coverage and probability of sampling occurred. Three km long transects oriented north-south proved to produce the best coverage and 40 transects were established across the park (figure 2). However of these eight could not be visited because of security problems.

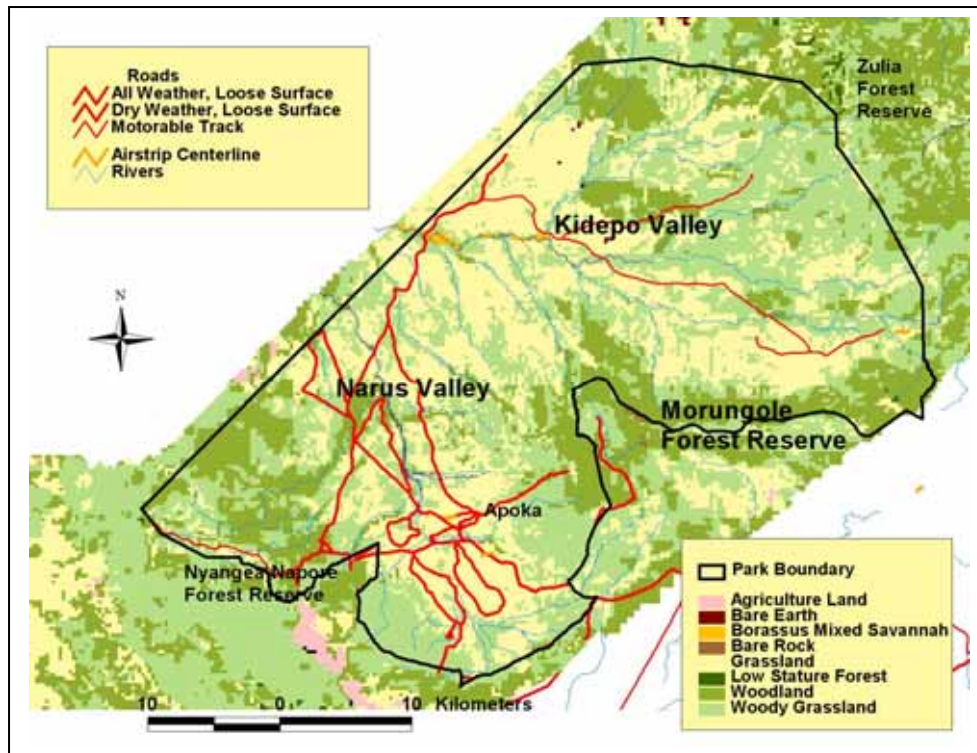


Figure 1. Vegetation types as classified from aerial photography collected in 2008 (WCS GIS Lab). The white areas in the centre were covered by cloud in the photos and are unclassified as a result.

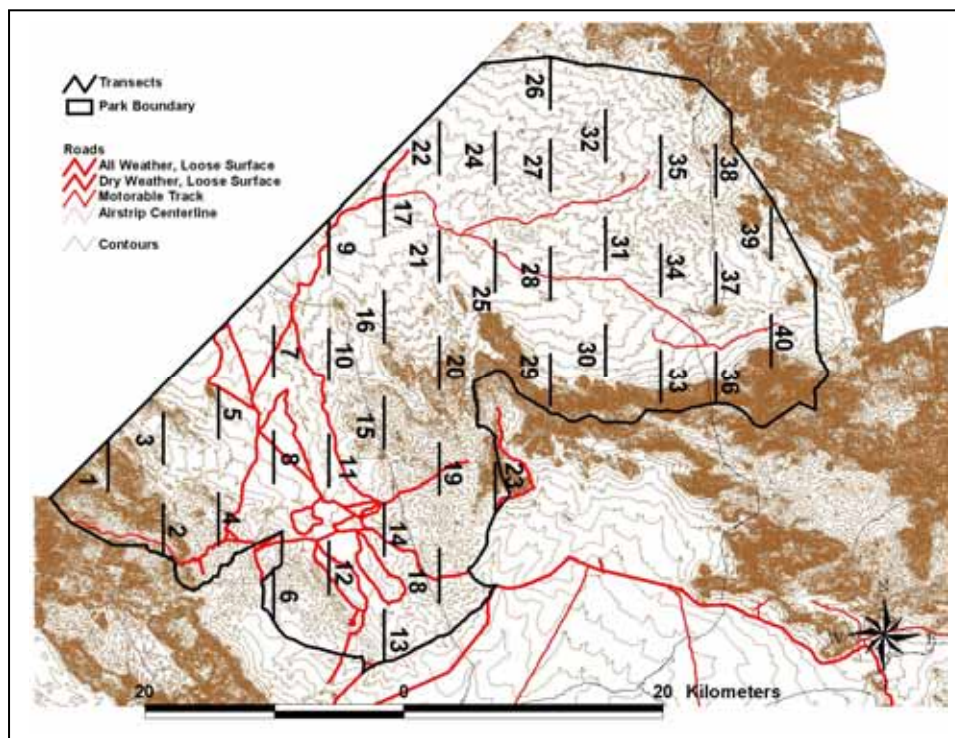


Figure 2. Map of Kidepo Valley National Park showing the locations of the 40 transects in the park. Transects 1,2, 20,26,29, 35, 38, and 39 were not visited because of insecurity. Contour lines are shown in brown and show how the outskirts of the park are steep and hilly.

The GPS locations of the start and end points of the transects were calculated by DISTANCE and these were used in the field to locate the transects. Data were analysed for three sites in the park:

Narus Valley, Kidepo Valley and Morungole foothills.

Large mammal surveys

Large mammals were surveyed by two teams of two people with an armed ranger, walking each of the transects once, recording droppings and sightings of all species. Perpendicular distances were measured to the centre of each observation using a tape measure (for dung) and lazer range finder (for animals). Points every 250 metres along the transects were marked with flagging tape and used by the bird and plant teams (see below). A total of 128.2 km were walked in the park. Encounter rates of sightings were calculated per kilometer walked for each transect separately and mapped. Where sightings were greater than about 25 we attempted to calculate a density using DISTANCE.

Small mammal surveys

The small mammals (bats, insectivores and rodents) were surveyed using conventional trapping and netting methods. A mixture of Sherman, Museum special and Victor rat traps were used to capture the rodents and insectivores, while mist nets were used to sample the bat fauna.

Table 1. Distribution of netting and trapping locations in the Kidepo Valley National Park

	Deg Lat	Min Lat	Sec Lat	DDLAT	Deg Long	Min Long	Sec Long	DDLONG
Narus Valley Near Park HQ	3	44	6.41	3.735	33	43	42.93	33.73
Trap site 1: Kalabe Rocks	3	43	40.6	3.728	33	44	7.57	33.74
Station 2	3	43	37.8	3.727	33	44	7.93	33.74
Station 3	3	43	37.3	3.727	33	44	11.6	33.74
Trap site 3 Station 5	3	43	57.5	3.733	33	43	59.8	33.73
Station 6	3	44	1.24	3.734	33	43	40.9	33.73
Station 7	3	44	37.4	3.744	33	44	34	33.74
Netline 3	3	39	51.7	3.664	33	43	27.4	33.72
Station 8	3	44	53.2	3.748	33	44	39.5	33.74
Station 9	3	44	53.5	3.748	33	44	36.8	33.74
Station 10	3	44	54.4	3.748	33	44	33.7	33.74
Trap site 6: along River Narus	3	43	31	3.725	33	42	36.4	33.71
Station 11	3	43	31	3.725	33	42	35.9	33.71
Station 12	3	43	29.5	3.725	33	42	35.2	33.71
Trap site 6: Along river Narus (or the Narus swamp)	3	44	23.6	3.74	33	41	60	33.7
Station 14 Narus Valley	3	44	22	3.739	33	42	11.8	33.7
Station 15	3	44	11.9	3.737	33	42	30.7	33.71
Trap site 7 Opotpot area. Station 16	3	41	34.4	3.693	33	37	12.4	33.62
Trap site 8: Station 17. Katuruk Post area	3	57	27.3	3.958	33	44	40.8	33.74
Trap site 9: Kidepo River area Station 18	3	56	47.6	3.947	33	44	15	33.74
Katuruk Line 1	3	57	25.4	3.957	33	44	40	33.74
Nawiapie Line 1	3	58	20.5	3.972	33	44	38.5	33.74
Majimoto area	3	59	42.5	3.995	33	45	57.9	33.77

Table 1 details the latitude/longitude coordinates for the locations in which the trapping and netting for small mammals were done. All of the trapping and netting were generally made in the southern part of KVNP around the Narus and Kidepo valleys. Traps were deployed in groups of from as low as 15 traps each trapping night to as many as 45 at different trapping stations. Owing to the presence of large mammals moving through the areas surveyed, the team did not conduct as much mist netting for bats, for fear of having the nets destroyed in the night especially by buffaloes.

The surveys were conducted such that a variety of habitat types were sampled that could be easily accessed from base camps. The trapping and netting were therefore conducted in areas of tall and short open grassland, rocky areas, wooded areas, a palm savanna and a variety of tree steppes. Plates 1, 2, 3 & 4 show some of the different habitat settings in the areas where the trapping and netting were conducted.

Bird Surveys

Every 250 metres along the transects birds were recorded during 5 minute point counts by two experienced ornithologists who know most bird calls in Uganda. A total list of birds was also recorded at each site by recording any observations or calls identified during the team's time at the site. In this way nocturnal species were recorded as being present even if no quantitative data were obtained.

A total of 135, 44 and 115 point counts were made at sites Kidepo valley, Morungole foothills and Narus valley respectively and a total of 294 point counts for the whole park.

Plant surveys

Every 250 metres along the reconnaissance walk trails a nested circular plot was measured with all herbs identified within a radius of two metres, all lianas, woody shrubs and trees less than 10cm DBH but greater than 2.5 cm DBH within a radius of 10 metres and all trees greater than 10 cm DBH within a radius of 20 metres. Plant specimens were collected and dried for all species identified to confirm IDs and also to make identifications of unknown species. These identifications were made at the Makerere University Herbarium by Ben Kirunda.

A total of 77, 30 and 66 plots were measured for Kidepo valley, Morungole foothills and Narus valley respectively, and a total of 173 plots for the whole park.



Plate 1: Open grassland and Rocky landscapes in the Kalabe rocks area



Plate 2: Open short grassland with a few scattered trees in the River Kalabe area.



Plate 3: More wooded parts of the Park with Acacias and a lot of bare ground



Plate 4: A Borassus Palm Savanna around the Kidepo River

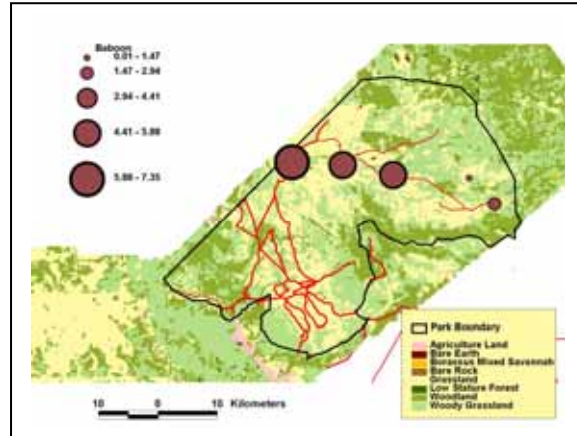
RESULTS

Mammals

Large mammals

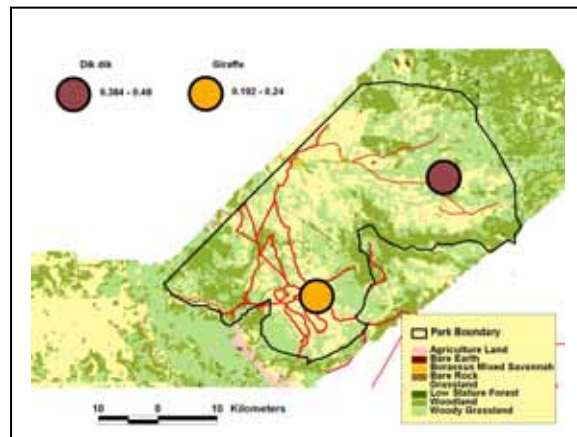
Sightings of large mammals or their sign was limited from these ground surveys and there were not enough sightings to attempt to calculate any densities for most of the large mammals. We were able to calculate relative abundances from encounter rates (no per km walked) for each site and these are mapped in figure 3.

Primates

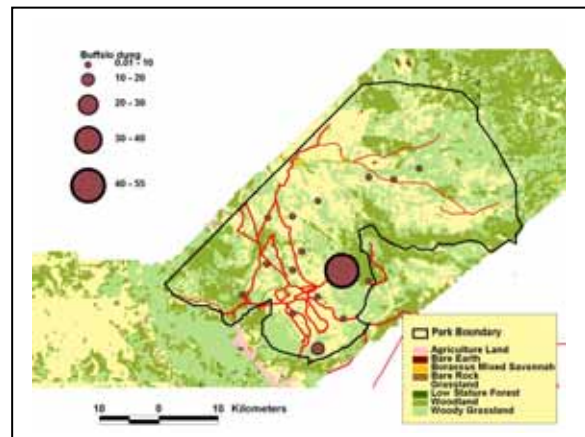


Baboon sighting

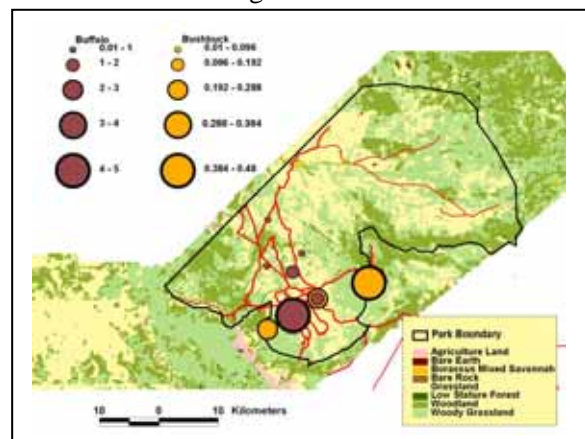
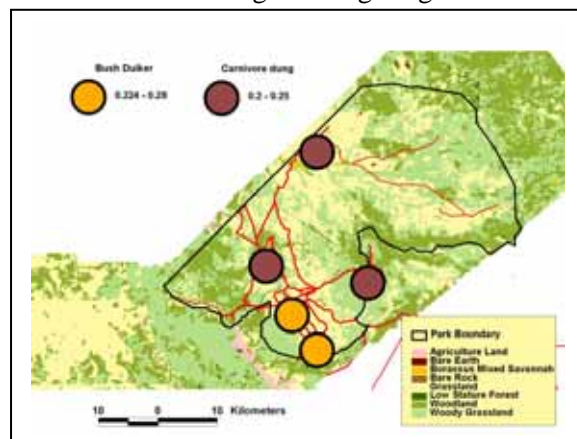
Ungulate sightings or dung



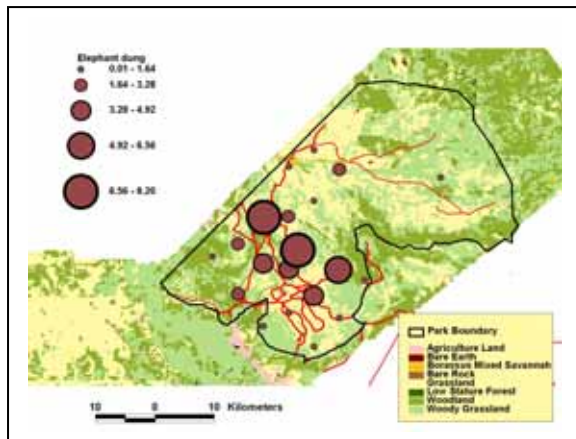
Dik dik and giraffe sightings



Buffalo dung

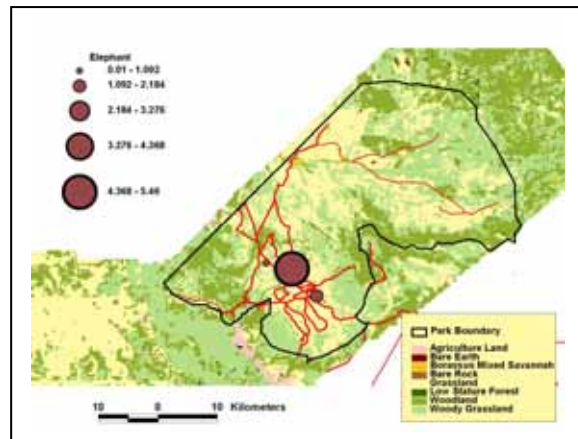


Bush duiker and carnivore dung

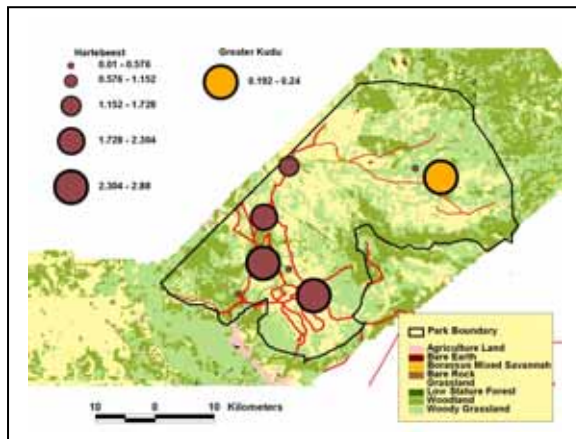


Elephant dung

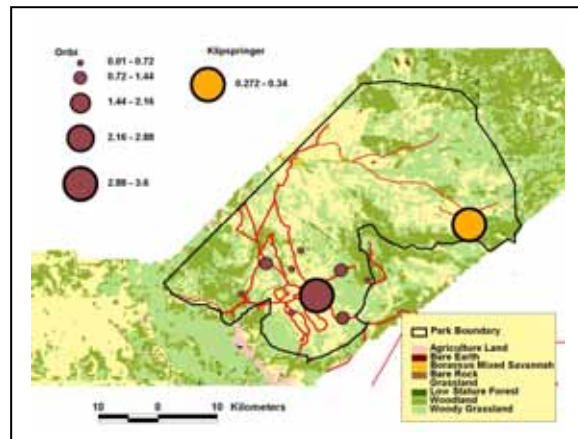
Bushbuck and Buffalo sightings



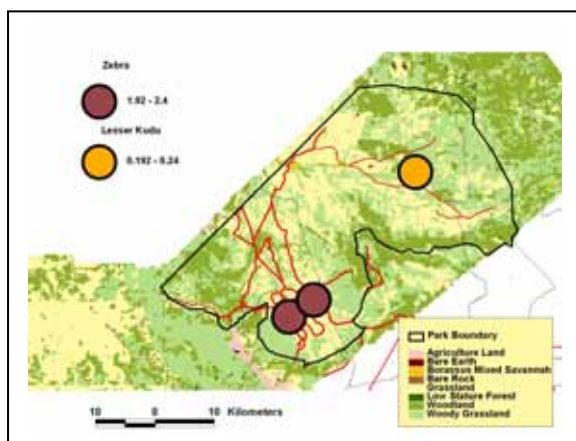
Elephant sightings



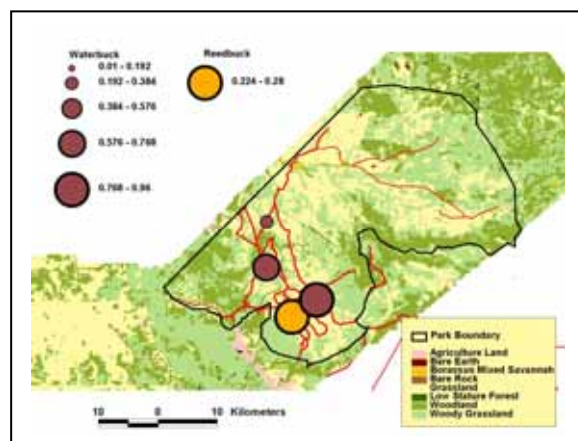
Hartebeest and Greater Kudu



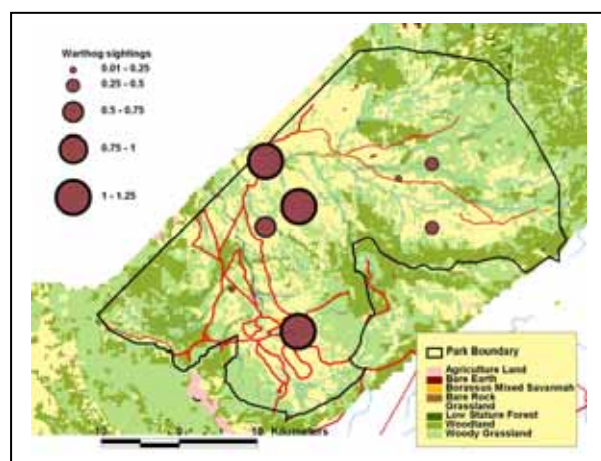
Oribi and Klipspringer



Zebra and Lesser Kudu



Reedbuck and Waterbuck



Warthog sightings

Figure 3. Relative abundance (Number per km walked) for large mammals that were observed several times in KVNP.

Additional mammal species for which sign was encountered rarely included the Hyaena.

It was possible to calculate densities of elephant and buffalo dung from the transects. Elephant dung was at a density of 159 elephant dung piles per km². We know from aerial surveys that the number of elephant in the park are about 387 from a total count (WCS Flight Program 2008) and if we assume a defaecation rate of 17 per day as often used in the literature this would mean that the average decay rate of the dung would be about 35 days. Buffalo dung density was 302 per km². The aerial surveys of Kidepo in 2008 estimated 3,643 from a total count (WCS Flight Program 2008) and with a defaecation rate of 5 per day from the literature this would give an estimate of a 24 day decomposition rate of the dung on average. The only other species with any frequency of sightings (n=12) was the Oribi. Although this is really too few to estimate density accurately an analysis gave 2.9 per km² (95% confidence limits: 1.1-7.5). This would give about 4,100 (1,500-10,800) for the park, significantly higher than estimated from the aerial surveys (108).

Small mammals

Rodents and shrews

A total trapping effort of 675 trap-nights were used to capture a total of 100 individuals. This gave a trap success of 14.8% and resulted in the capture of 17 species of small mammals (5 insectivores and 12 rodents (Table 2)) altogether from the different locations.

The species recorded comprise of a mix of species that are fairly common and wide spread through the country (* in table 2). The other species (** in table 2) are species that are only so far known from Northern Uganda. *Acomys wilsoni* is one of several other species of spiny mice (genus *Acomys*) that are restricted to semi arid environments in which again they are common in areas with rocky outcrops. These surveys only recorded one species of the spiny mice that would be expected in the Karamoja area.

Figure 4 plots the cumulative number of species (rodents and shrews) recorded in the parts of KVNP that were surveyed. At a sampling effort of 675 trap nights the cumulative number of species recorded appears to be increasing still or has a slight asymptote at the end.

Table 2. Species of rodents and shrews recorded for KVNP

Order	Family	Species	Numbers caught
Insectivora	<i>Soricidae</i>	<i>Crocidura fumosa</i> *	1
		<i>Crocidura gracilipes</i> *	1
		<i>Crocidura olivieri</i> *	2
		<i>Crocidura parvipes</i> *	3
		<i>Crocidura luna</i> *	1
Rodentia	<i>Muridae</i>	<i>Acomys wilsoni</i> **	7
		<i>Aethomys hindei</i> **	8
		<i>Arvicanthis niloticus</i> *	12
		<i>Grammomys dolichurus</i> *	7
		<i>Graphiurus murinus</i> *	10
		<i>Lemniscomys striatus</i> *	3
		<i>Mastomys hildebrandtii</i> *	20
		<i>Mus minutoides</i> *	7
		<i>Mus triton</i> *	1
		<i>Myomys fumatus</i> **	13
		<i>Rattus rattus</i> *	1
		<i>Gerbillidae</i>	<i>Tatera valida</i> *

* - Species of wide occurrence ** - Species restricted to northern Uganda

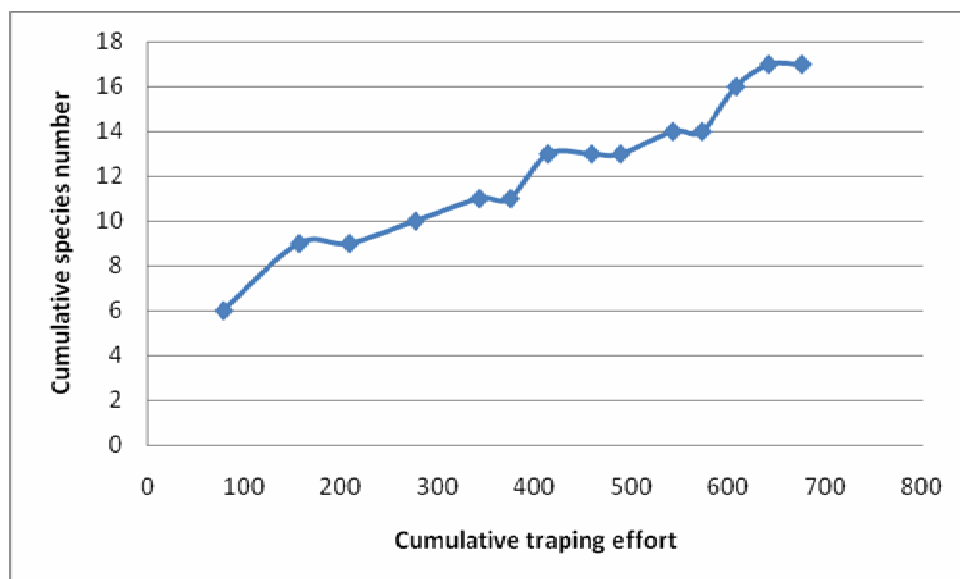


Fig 4. Species accumulation curve for the small mammals (rodents & shrews) of KVNP recorded between 17th November - 10th December 2008

Numbers of individuals captured may be a function of several factors such as the bait used, placement of traps, trap shyness or readiness to get into traps, season etc. Nevertheless numbers captured, can be used as a fair index of relative abundance for the different species. Very common species would ordinarily encounter a trap frequently while those occurring in lower abundances would also rarely come into contact with the traps.

Table 3. Rodent species known for the Karamoja area from previous studies (Delaney 1975 and Davenport *et al* 1996 *a, b & c*).

Family	Species	Labwor Hills	Moroto	Kadam	Napak
Muridae	<i>Acomys cineraceus</i>				
	<i>Acomys percivali</i>				
	<i>Acomys subspinosus</i> *				
	<i>Acomys wilsoni</i>				
	<i>Aethomys hindei</i> *				
	<i>Aethomys kaiseri</i>				
	<i>Arvicanthis niloticus</i> *				
	<i>Arvicanthis testicularis</i>				
	<i>Grammomys dolichurus</i> *				
	<i>Grammomys rutilans</i>				
	<i>Graphiurus murinus</i>				
	<i>Hylomyscus stella</i>				
	<i>Lemniscomys barbarus</i>				
	<i>Lemniscomys macculus</i>				
	<i>Lemniscomys striatus</i> *				
	<i>Lophiomys imhausi</i>				
	<i>Lophuromys flavopunctatus</i>				
	<i>Lophuromys sikapusi</i>				
	<i>Mastomys hildebrandtii</i> *				
	<i>Mus minutoides</i> *				
<i>Mus triton</i>					
<i>Myomys fumatus</i> *					
Cricetidae	<i>Cricetomys gambianus</i>				
	<i>Deomys ferrugineus</i>				
	<i>Dendromus mystacalis</i>				
	<i>Dendromus melanotis</i>				
	<i>Otomys tropicalis</i>				
	<i>Otomys typus</i>				
	<i>Praomys jacksoni</i>				
	<i>Saccostomus campestris</i>				
	<i>Steatomys parvus</i>				
Gerbillidae	<i>Tatera leucogaster</i>				
	<i>Tatera nigricauda</i>				
	<i>Tatera valida</i> *				
	<i>Taterillus emini</i>				
Barthyergidae	<i>Cryptomys ochraceocinereus</i>				
Lophiomidae	<i>Lophiomys imhausii</i>				
Scuridae	<i>Helioscirus gambianus</i>				
	<i>Xerus erythropus</i>				

Based on numbers captured (table 2), it would appear that *Mastomys hildebrandtii*, *Myomys fumatus*, *Graphiurus murinus*, *Arvicanthis niloticus* in that order are the most common species in the KVNP, while many of the rest occurred at very low levels of abundance. These 4 species together with *Lemniscomys striatus* (although very few individuals for this species were captured) normally characterize the small mammal fauna of savannas. Changes in their relative abundance could therefore be useful indices for monitoring habitat as well as seasonal changes.

During these surveys, signs of the presence of the Crested Porcupine (*Hystrix cristata*) and the Larger Cane rat (*Thryonomys swinderianus*) were also recorded although both species were not captured. Although figure 4 suggests a possible quasi asymptote, the potential species richness of small mammals that could have been recorded for KVNP was most likely not exhausted. Table 3 lists 32 species of rodents that have been recorded from earlier studies (Delaney 1975 and Davenport *et al* 1996 *a, b & c*) in different selected parts of Karamoja. The filled in blocks are of records made during the Forest department biodiversity inventories in four reserves of Karamoja (Davenport *et al* 1996 *a, b & c*). The unfilled blocks are some of the records from Delaney (1975) that were not recorded by the biodiversity surveys.

All species of rodents recorded from the surveys in KVNP for this report (Table 2) except for *Crocidura fumosa*, *Rattus rattus* and *Mus triton* have also been known from several Karamoja locations before (* in Table 3). The three species named here are therefore new additions for the Karamoja area rodent species richness.

The rodent fauna of the Karamoja sub region is fairly well documented, however, the same cannot be said of the shrew (Insectivores) and bat faunas, as surveys for these have not been extensively conducted in the area. Table 4 details the shrew species richness that are known for the Karamoja area from surveys conducted in four reserves (Davenport *et al* 1996 *a, b & c*). The list comprises 10 species to which the surveys in KVNP now add one species *C. fumosa* (Table 2). Species marked (*) in Table 4 are those also recorded during the surveys for this report in KVNP.

Table 4. Shrew species known for the Karamoja area from previous studies (Davenport *et al* 1996 *a, b & c*).

Species	Labwor Hills	Moroto	Kadam	Napak
<i>Crocidura fuscomurina</i>				
<i>Crocidura gracilipes</i> *				
<i>Crocidura hildegardae</i>				
<i>Crocidura luna</i> *				
<i>Crocidura macarthuri</i>				
<i>Crocidura olivieri</i> *				
<i>Crocidura parvipes</i> *				
<i>Crocidura pasha</i>				
<i>Crocidura planiceps</i>				
<i>Crocidura turba</i>				

A richer diversity of shrews is usually sampled by using pitfall traps. This method however tends to pay off in longer survey programs in which traps can be left in place for longer than just the few days that can be afforded in rapid surveys. The surveys for this report and the Forest department biodiversity surveys (Davenport *et al* 1996 *a, b & c*) didn't use any pitfall traps due to the fact that the surveys were rapid in nature. It is possible therefore that several other species of shrews could have been recorded by diversifying the survey techniques and using pitfalls as well. In a rapid assessment survey the use of pitfall traps may not yield very much, since the pitfall traps need to be left in place for several days which is not possible in rapid surveys.

Two other species of insectivores not normally caught in Sherman, Victor or museum special traps, the Rufous Elephant Shrew (*Elephantulus rufescens*) and the Hedgehog (*Atelerix albiventris*) are known for the Karamoja area and may well be present in the KVNP.

Bats

As mentioned earlier, the presence of herds of buffaloes and other wildlife, made the sample areas unsafe to work at night or to leave many nets in place overnight. For these reasons only a limited amount of netting was done to record the bats of KVNP.

Table 5 lists 5 species of bats that were recorded in KVNP. They included one megachiropteran bat (*E. labiatus*) and four microchiropteran bats belonging to 3 families. One species of the bats recorded *Cardioderma cor* is only found in the Karamoja area of Uganda where it co-occurs with the other similar sized megadermatid bat *Lavia frons*. Besides *Cardioderma cor*, all the other species of bats that were recorded are widely occurring in other parts of Uganda. Thorn *et al* (in press) citing Williams (1967), have listed several other species of bats (*Hipposideros caffer*, *Rhinolophus landeri*, *Nycteris hispida*, *Scotophilus dingani*, *Mops condylurus*, *Chaerephon pumilus*, *Platymops setiger*, *Rousettus aegyptiacus* and *Rhinopoma hardwickei*) as occurring in KVNP. Two of these (*Platymops setiger* and *Rhinopoma hardwickei*) are however considered doubtful and needing confirmation with new field records, which we are however unable to do at the present time either.

Table 5. Bat species recorded in KVNP

Family	Species
Pteropodidae	<i>Epomorphorus labiatus</i>
Rhinolophidae	<i>Rhinolophus fumigatus</i>
Embalonuridae	<i>Taphozous mauritianus</i>
Megadermatidae	<i>Lavia frons</i>
	<i>Cardioderma cor</i>

Mammal species richness

A total of 40 mammal species were recorded on these surveys out of an old list of 86 for the park (Wilson 1995). An additional 13 species are known for the park (table 6) from a recent compilation of museum records (R. Kityo pers comm.). Of these, three species were new to the Karamoja region: *Crocidura fumosa*, *Rattus rattus* and *Mus triton*. KVNP is fairly well surveyed for mammals and it is unlikely that new species will be easily found. No sightings were made of Oryx, Roan Antelope or Grant's Gazelle which were historically known for the park but are probably extinct now (although a recent report indicated possible Roan sightings in Nyangea Napore Forest Reserve (M. Mapesa pers. comm.). The total list of mammals for the park is therefore still 96 given the losses of these three species.

Table 6. List of mammal species recorded fro Kidepo Valley Park from museum specimens.

Fruit bats	Insectivorous bats
1. <i>Rousettus aegyptiacus</i>	1. <i>Taphozous mauritianus</i>
2. <i>Epomorphorus labiatus</i>	2. <i>Nycteris hispida</i>
3. <i>Epomorphorus minimus</i>	3. <i>Rhinolophus landeri</i>
	4. <i>Rhinolophus hardwickei</i>
Shrews	5. <i>Scotophilus dingani</i>
1. <i>Crocidura montis</i>	6. <i>Tadararida aegyptiaca</i>
Rabbits/Hares	7. <i>Chaerepjon pumila</i>
1. <i>Lepus victoriae</i>	8. <i>Mops condylurus</i>

Birds

A total of 154 bird species were recorded in KVNP during these surveys; 111 species in Kidepo Valley, 69 species in the Morungole Foothills and 107 species in the Narus Valley (see Appendix 1). Data from point counts were used to calculate rarefaction curves for the three sites (figure 5). These show some leveling off but indicate that with more time and effort more species would be found. The number of bird species in the two valleys are similar per unit effort while the morungole foothills had a poorer bird fauna. The bird community composition is very different at all these sites with only a 38-47% similarity in species composition (figure 6).

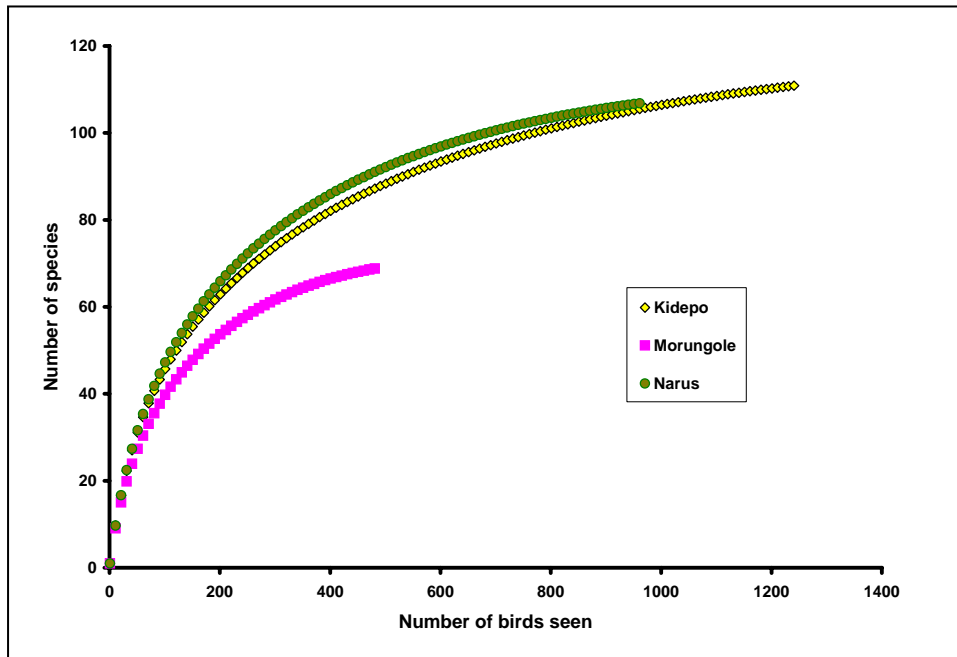


Figure 5. Rarefaction curves for the three sites plotted against the number of birds observed. Data from point counts.

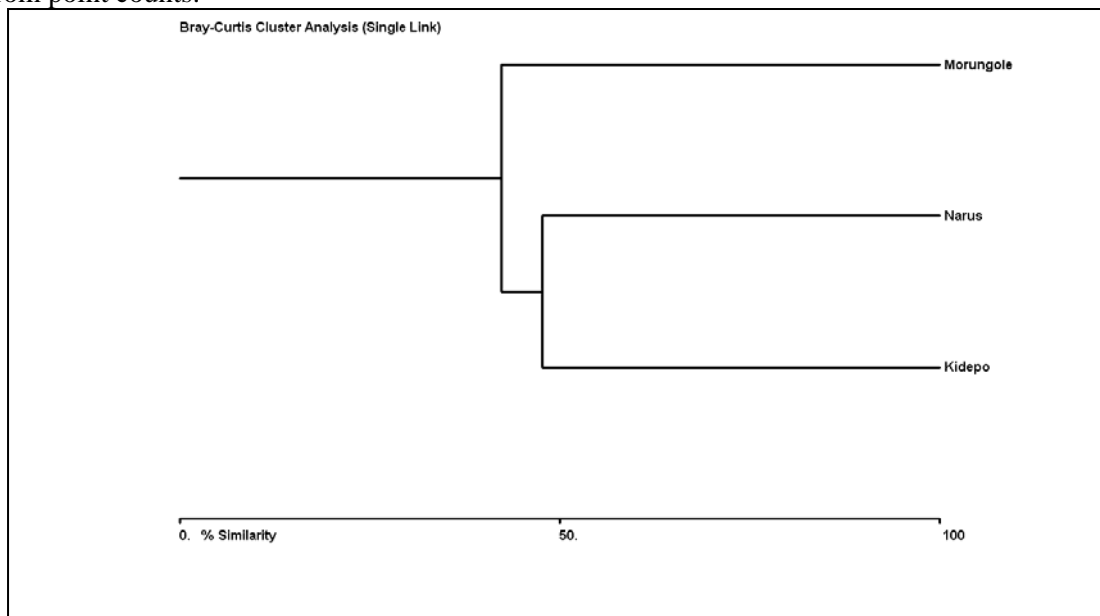


Figure 6. Similarity in bird community composition between the three sites. Data from point counts.

The relative abundance in species richness in birds between the transects shows that the Kidepo valley tends to be richer in species at any one site in the valley (fig. 7).

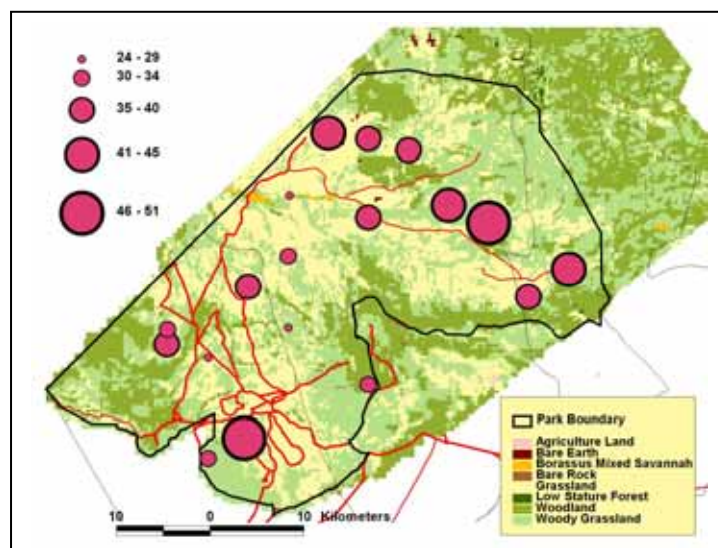


Figure 7. Relative species richness at the transects surveyed.

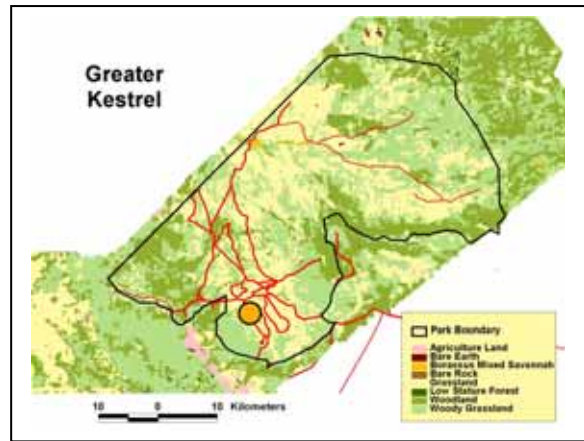
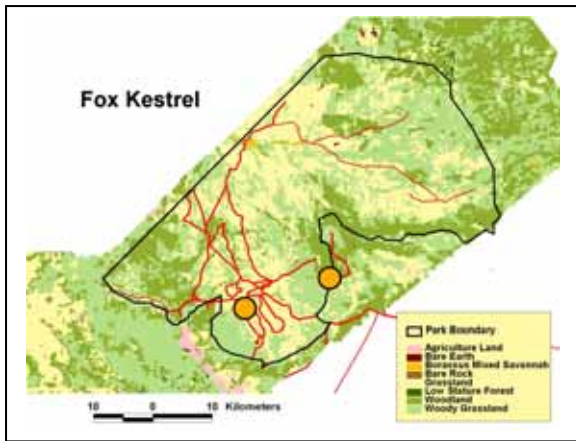
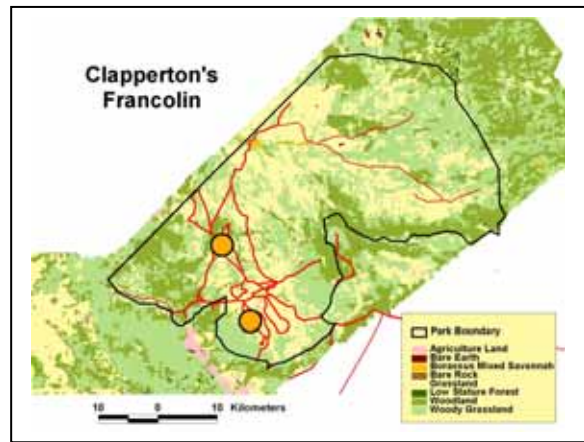
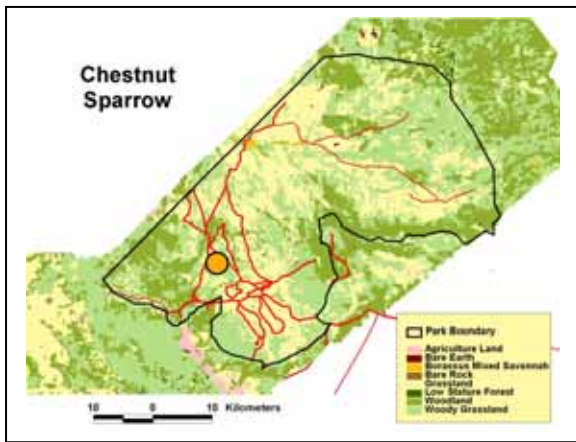
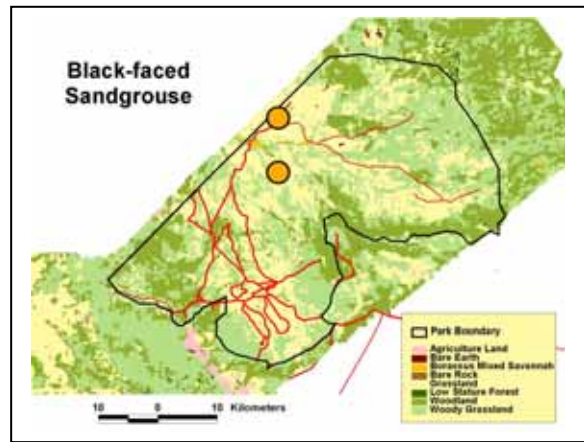
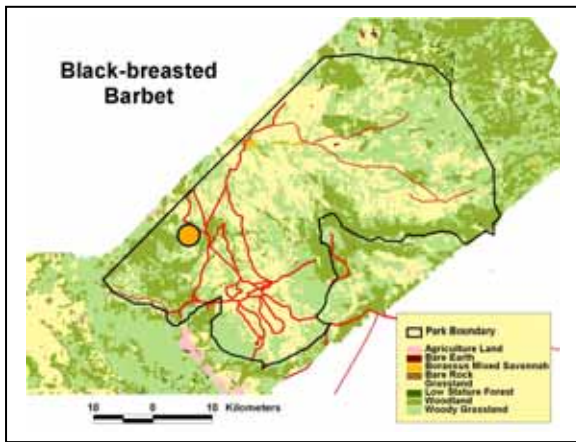
Bird diversity was calculated using the Shannon-Wiener Index and the alpha index and shows that the two valleys are more diverse than the Morungole foothills for birds (table 7).

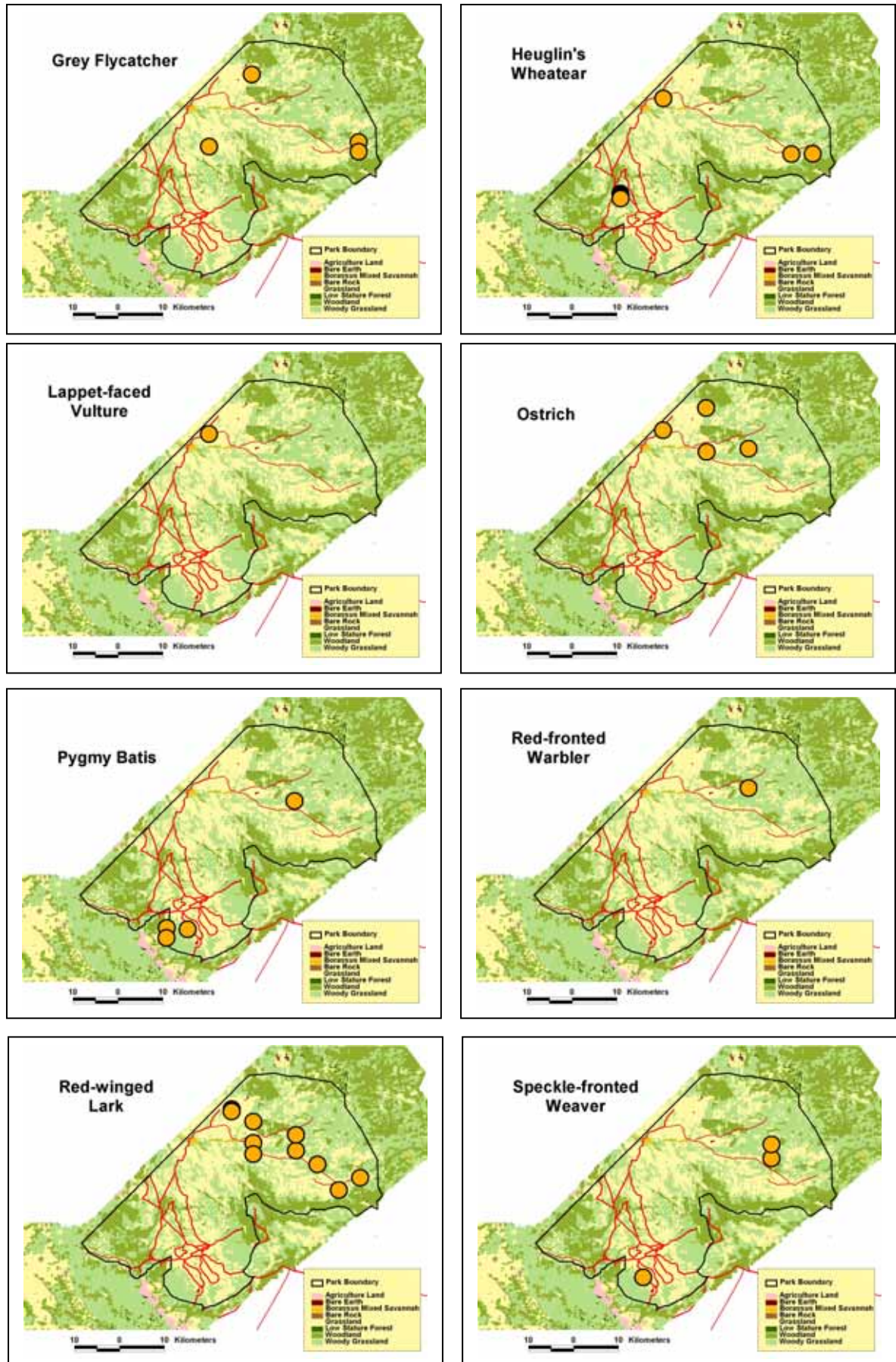
Table 7. Shannon Wiener diversity and evenness and the Alpha diversity index calculated for the three sites.

Index	Kidepo	Morungole	Narus
Shannon H' Log Base 10.	1.738	1.565	1.751
Shannon Hmax Log Base 10.	2.045	1.839	2.029
Shannon J'	0.85	0.851	0.863
Alpha	29.44	21.917	30.727

The total number of birds recorded for KVNP now numbers 473 species with seven new species that this study added to the list given by Wilson (1995) and confirming three that had been reported. The new species include: Cattle Egret, Common Quail, Red-fronted Warbler, Pygmy Batis, Eastern Violet-backed sunbird, Black-faced Sandgrouse and Heuglin's Wheatear. The Black-faced sandgrouse is a new record for Uganda. Although it had been reported twice in the 1970s and early 1980s for KVNP it was not accepted by Carswell et al. (2005) for the Bird Atlas of Uganda. The confirmed species include: Booted Eagle, White-billed Buffalo Weaver and White-bellied Canary.

The distributions of some of the species that are not seen that frequently in Uganda or the park are mapped in figure 8. These show that the often a species is confined for the most part to one of the two valleys in Kidepo.





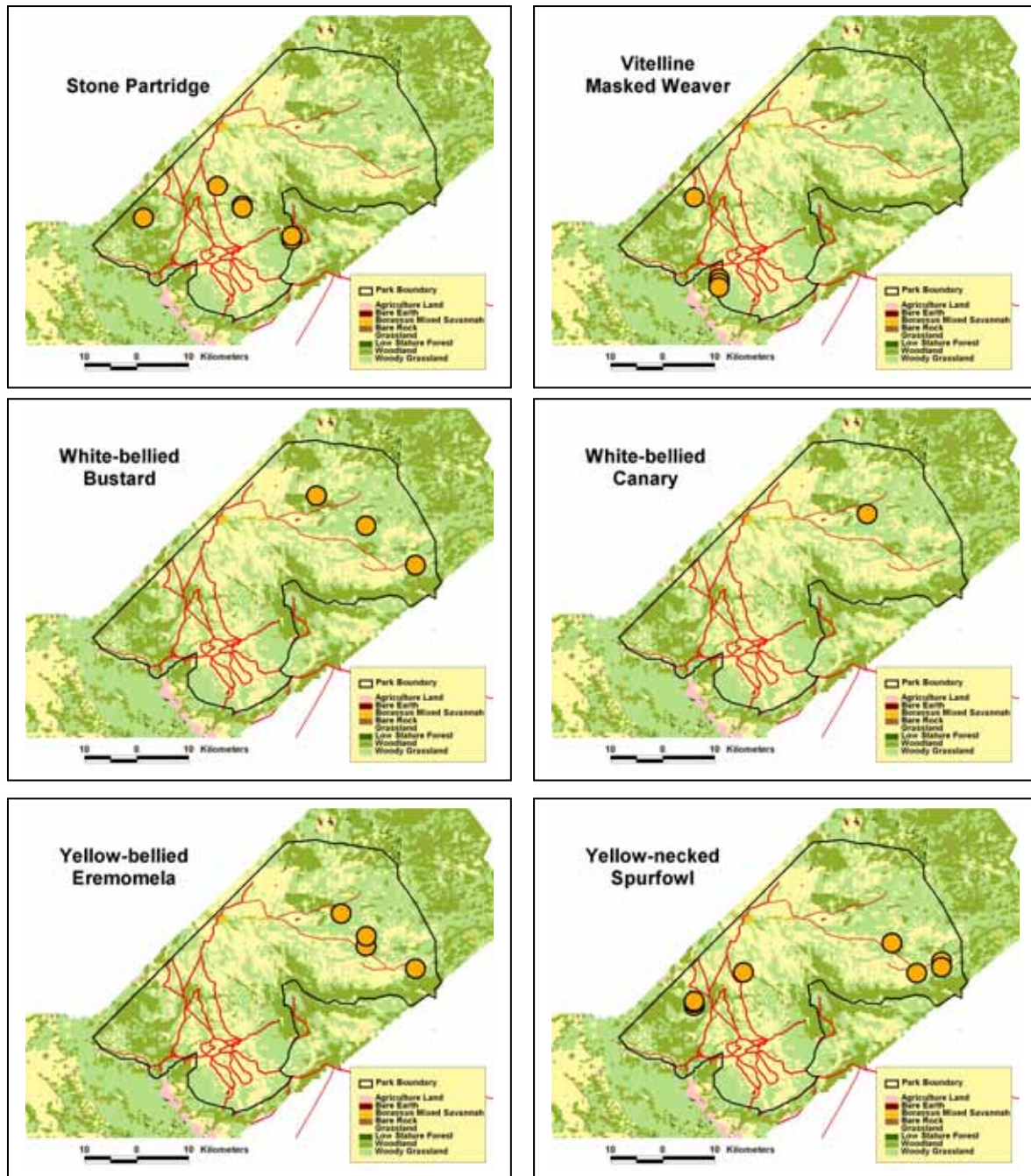


Figure 8. Distribution of some species of national and regional conservation interest in KVNP. Each point is a sighting of that species or a group of the species.

Plant species

A total of 692 plant species were identified as separate species for all sites combined (some specimens remain to be identified and may prove to be separate species so this number should be considered a minimum count). Kidepo valley had 190 species, Morungole foothills had only 53 species but only two transects were visited here, and Narus valley had 440 species. A total of 192 tree and shrub species were identified with 88 lianas, 293 herb species, 101 grasses and 5 fern species. There is no prior listing of plant species for this park that is published so that these numbers cannot be compared with previous lists.

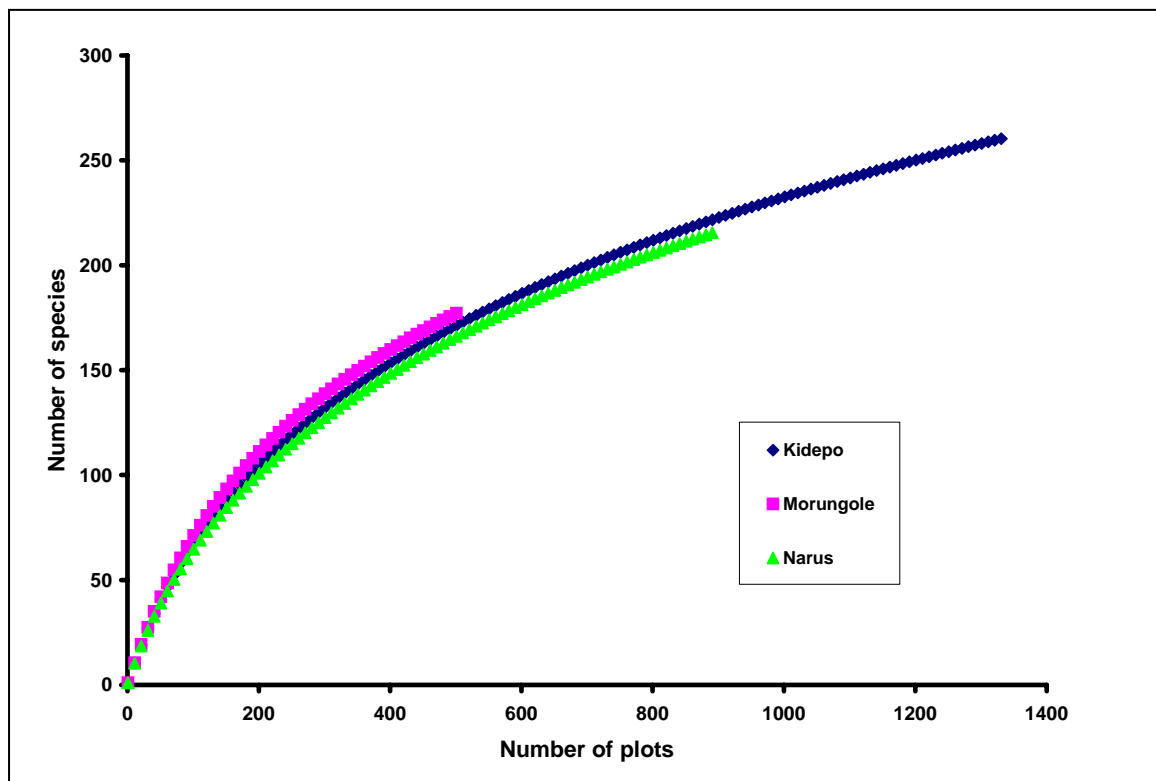


Figure 9. Rarefaction curves for plant species. Data from plots.

The rarefaction curves in figure 9 show that the relative species richness of plants at each of the three sites in the park are similar as the curves follow similar trajectories. However, the species composition is quite different (Fig. 10). Overlap in species composition was 34.9% between Kidepo valley and Morungole foothills; 36.9% between Kidepo valley and Narus Valley; and 38.9% between Narus Valley and Morungole foothills. Each region therefore contributes important aspects of the plant flora for the park and explains the high diversity found in the park. A list of the plant species for the park is given in appendix 2.

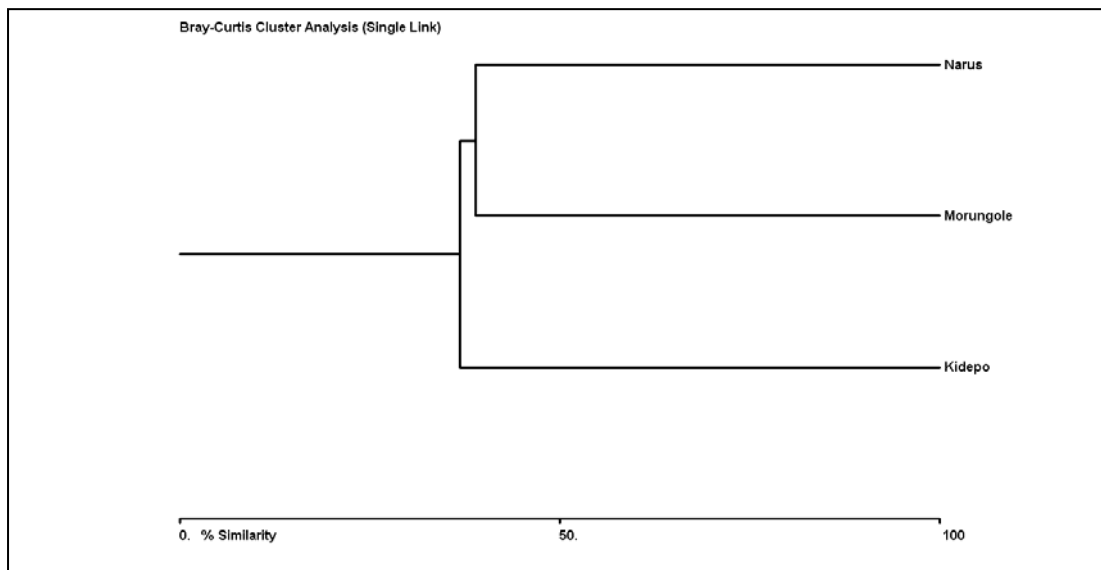


Figure 10. Similarity in plant communities between sites. Data from plots.

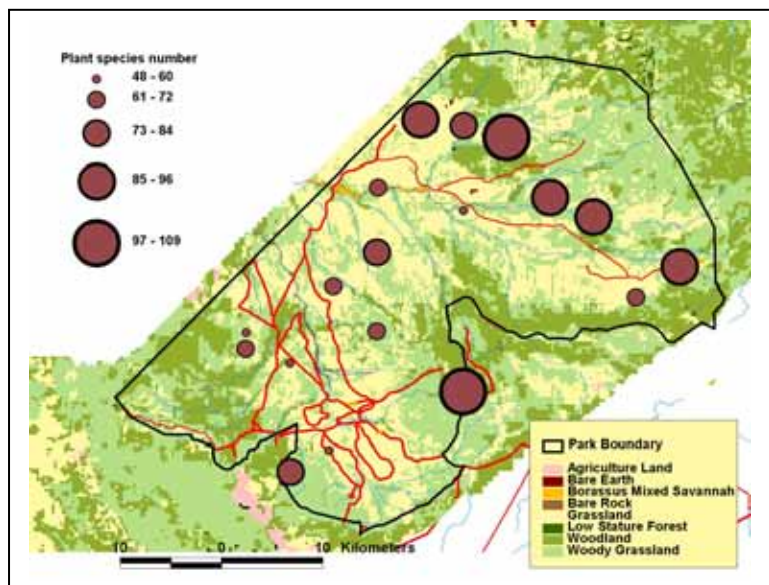


Figure 11. Plant species richness. Data from Plots along the transects.

Plant species diversity indexes were also calculated as for the bird community: Shannon-Wiener and Alpha diversity (table 8). These also show that the diversity of the sites were similar.

Table 8. Diversity of the plant community at each site.

Index	Kidepo	Morungole	Narus
Shannon H' Log Base 10.	2.142	2.103	2.063
Shannon Hmax Log Base 10.	2.417	2.25	2.334
Shannon J'	0.886	0.935	0.884
Alpha	96.704	97.753	90.352

Human Impacts

Signs of human activity were recorded along transects by the team looking for large mammal signs. These included sightings of cattle, firewood collection, collection of poles for building and fireplaces showing signs of humans camping in the park. In general signs of human activity were limited (figure 12) and mostly occurred in the Kidepo valley in the south east.

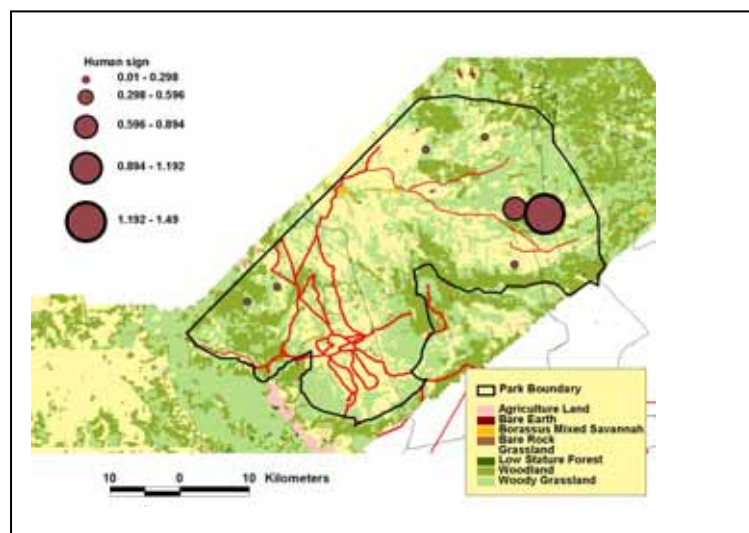


Figure 12. Encounter rates (no. per km walked) of signs of human impact along transects.

CONSERVATION IMPLICATIONS

These surveys show that KVNP is very diverse with at least 86 mammal species, 473 bird species and 692 plant species. Table 9 compares KVNP’s species diversity with other savanna-woodland sites in the Albertine Rift region of western Uganda. This shows that KVNP is second only to Queen Elizabeth National Park in terms of its known plant diversity and third behind Queen Elizabeth and Murchison for its mammal and bird diversity. Unfortunately few plant surveys have been made in Uganda in the savanna protected areas and those that have been carried out such as in Murchison Falls Park are mainly of tree/shrub species rather than all plants. It is likely more species would be found for this park if surveyed intensively.

Table 9. Comparison of species numbers for the three taxa surveyed here in other savanna protected areas in western Uganda. Data from Plumptre et al. 2003.

Site	Mammals	Birds	Plants
Kidepo Valley National Park	86	473	692 (192 trees)
Murchison Falls Park	109	476	149 (145 trees)
Queen Elizabeth Park	97	610	950 (288 trees)
Kyambura Wildlife Reserve	37	450	n/a
Toro-Semuliki Wildlife Reserve	69	435	n/a
East Madi Wildlife Reserve	50	181	374 (224 trees)

In Kidepo human impacts are relatively few in comparison with forest reserves WCS field teams have surveyed.

We were able to confirm the presence of some of the larger mammal species that are rarely observed in KVNP such as Greater and Lesser Kudu and reedbuck.

The species of small mammals that were recorded from these surveys for Kidepo Valley National Park are mostly common and wide spread species. The only exceptions to these include *Acomys wilsoni*, *Crocidura parvipes*, and *Cardioderma cor* whose distribution in Uganda is restricted to northern Uganda for the first species and only north eastern Uganda for the other two species. Several other species (*Crocidura macarthuri*, *C. pasha*, *Lophiomys imhausii*, *Steatomys parvus*, *Saccostomus campestris*, *Acomys subspinosus*, *A. percivali*, *A. cineraceus*) although not recorded by the present study, also have their ranges in Uganda either restricted to the Karamoja or extending into the Karamoja area. Some of these species have been recorded in KVNP or other areas of Karamoja before (Delany 1975).

All species of small mammal recorded from the surveys for this report are classified as species of least concern (LC) following the IUCN (2003) threat categories. The lists in Tables 2 – 4 plus the additional species *Hystrix cristata* and *Thryonomys swinderianus* that were recorded for KVNP (although not captured), as well as *Atelerix albiventris* and *Elephantulus rufescens* that also occur in other parts of Karamoja and may well occur in KVNP, make up a total non flying small mammal richness of 54 species representing 15.7% of Uganda's total mammalian diversity or a little over 40% of the rodent and shrew diversity for the country. Many of the species in the 3 tables may occur in KVNP making the richness much higher than that recorded from the surveys for this report.

The bird fauna found in the park is about 47% of all of Uganda's recorded species. Many of these species are confined to northern and eastern Uganda and are not effectively conserved anywhere else in the country. As a result KVNP is critically important for bird conservation in Uganda. The patterns of species distributions shown in figure 8 indicate the importance of the differences in the habitats in the Kidepo and Narus valleys as this affects both bird and plant distributions. Ensuring the effective conservation of both valleys and the surrounding hills is necessary to conserve the full suite of biodiversity in the park. Simply focusing efforts where large mammals occur most commonly (Narus valley) could lead to loss of biodiversity over time in the park.

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Appendix 1. Bird species sighted or heard at each site from the point counts.

Bird species	Kidepo	Morungole	Narus
Common Ostrich	1		
Cattle Egret			1
Abdim's Stock			1
Palm-nut Vulture	1		
African White-backed Vulture	1		1
Egyptian Vulture			1
Lappet-faced Vulture	1		
White-headed Vulture			1
Pallid Harrier	1		1
Montagu's Harrier	1	1	1
Black-chested Snake-Eagle			1
Bateleur	1	1	1
Tawny Eagle	1		1
Augur Buzzard		1	1
Booted Eagle	1		
Dark Chanting Goshawk	1		
Eastern Chanting Goshawk	1		1
Martial Eagle	1		1
Black Kite	1	1	1
Black-shoulderd Kite	1	1	1
Fox Kestrel		1	1
Grey Kestrel	1		1
Lesser Kestrel			1
Greater Kestrel			1
Common Kestrel			1
African Pygmy Falcon	1		1
Blue Quail	1		
Common Quail	1		
Harlequin Quail	1		
Clapperton's Francolin			1
Yellow-necked Spurfowl	1	1	1
Crested Francolin	1		1
Stone Partridge		1	1
Helmeted Guineafowl	1	1	1
Black-bellied Bustard	1	1	
White-bellied Bustard	1	1	
Speckled Pigeon	1	1	1
Ring-necked Dove	1	1	1
Red-eyed Dove	1	1	1
Laughing Dove	1		
Bruce's Green Pigeon	1	1	1
Black-faced Sandgrouse	1		
Brown Parrot	1	1	1
White-bellied Go-away Bird	1	1	
Eastern Grey Plantain-eater			1
Ross's Turaco	1		1
White-crested Turaco		1	1
Black-and-white Cuckoo	1		
White-browed Coucal	1	1	1
Verreaux's Eagle-Owl			1
African Palm Swift	1	1	1
Blue-naped Mousebird	1		1
Striped Kingfisher	1	1	
Swallow-tailed Bee-eater	1	1	1

Biodiversity Surveys of Kidepo Valley National Park

Bird species	Kidepo	Morungole	Narus
Little Bee-eater	1		1
Abyssinian Roller	1	1	1
Rufous-crowned Roller	1		1
Eurasian Hoopoe	1	1	1
Abyssinian Scimitarbill		1	
Green Wood-hoopoe	1		1
Red-billed Hornbill	1	1	1
Jacksons Hornbill			1
African Grey Hornbill	1	1	1
Abyssinian Ground Hornbill	1		
Black-billed Barbet			1
Spot-flanked Barbet	1		
Black-breasted Barbet			1
Red-fronted Tinkerbird	1	1	1
D'Arnaud's Barbet	1		1
Greater Honeyguide	1		
Nubian Woodpecker		1	
Cardinal Woodpecker			1
Red-winged Lark	1	1	
Flappet Lark	1	1	1
Lesser-striped Swallow			1
Rock Martin		1	
Barn Swallow	1	1	1
Sand Martin	1		1
Fork-tailed Drongo	1	1	1
African Black-headed Oriole	1	1	1
Fan-tailed Raven		1	1
Piapiac	1		1
White-bellied Tit	1	1	1
Rufous Chatterer	1	1	
Common Bulbul	1	1	1
Brown-backed Scrub-Robin	1		
White-browed Scrub-Robin	1		
Spotted Morning Thrush			1
Cape Robin Chat			1
White-browed Robinchat			1
Isabelline Wheatear	1	1	1
Heuglin's Wheatear	1	1	1
Northern Wheatear		1	1
White-fronted Black Chat	1	1	1
Common Redstart			1
Whinchat	1		1
Mocking Cliff Chat		1	1
Familiar chat			1
Grey-backed Camaroptera	1	1	1
Wing-snapping Cisticola	1		
Singing Cisticola	1		
Rattling Cisticola	1	1	1
Red-faced Cisticola	1		
Croaking Cisticola	1		1
Foxy Cisticola	1	1	1
Yellow-bellied Eremomela	1	1	
Green-backed Eremomela	1		
Buff-bellied Warbler	1	1	1
Willow Warbler	1	1	
Tawny-flanked Prinia	1	1	1
African Moustached Warbler	1		

Biodiversity Surveys of Kidepo Valley National Park

Bird species	Kidepo	Morungole	Narus
Red-fronted Warbler	1		
Northern Crombec	1		
Red-faced Crombec	1		
Grey Flycatcher	1	1	
Pale Flycatcher	1		
Silverbird	1	1	1
Northern Black Flycatcher	1		
Black-headed Batis	1	1	1
Pygmy Batis	1		1
Plain-backed Pipit	1	1	1
Yellow Wagtail	1	1	
Northern Puffback			1
Slate-coloured Boubou	1		
Black-crowned Tchagra	1	1	1
Yellow-billed Shrike	1	1	1
Grey-backed Shrike	1	1	1
Northern White-crowned Shrike	1	1	1
White-crested Helmet-Shrike	1	1	1
African Wattled Starling	1		
Bronze-tailed Starling			1
Greater Blue-eared Starling	1	1	1
Lesser Blue-eared Starling	1		1
Ruppell's Long-tailed Starling	1		1
Red-winged Starling		1	1
Superb Starling	1		1
Red-billed Oxpecker	1		1
Eastern Violet-backed Sunbird		1	
Marico Sunbird	1	1	1
Beautiful Sunbird			1
Scarlet-chested Sunbird	1		
Red-headed Weaver		1	
Little Weaver			1
Vitelline-masked Weaver			1
White-billed Buffalo Weaver	1	1	
White-headed Buffalo Weaver	1		
White-browed Sparrow Weaver	1	1	1
Chestnut Sparrow			1
Speckle-fronted Weaver	1		1
Common Waxbill			1
Crimsons-rumped Waxbill			1
Red-cheeked Cordon-bleu	1	1	1
Bronze Mannikin			1
White-bellied Canary	1		

Appendix 2. Plant list for KVNP with presence/absence data for each sector surveyed.

Family	Identification
Acanthaceae	<i>Asystasia guttata</i>
	<i>Asystasia mysorensis</i>
	<i>Barleria eranthemoides</i>
	<i>Barleria lanceata</i>
	<i>Barleria prionitis</i>
	<i>Barleria steudneri</i>
	<i>Barleria stuhlmannii</i>
	<i>Barleria ventricosa</i>
	<i>Blepharis integrifolia</i>
	<i>Blepharis maderaspatensis</i>
	<i>Crabbea velutina</i>
	<i>Crossandra nilotica</i>
	<i>Crossandra subacaulis</i>
	<i>Dyschoriste clinopodioides</i>
	<i>Dyschoriste radicans</i>
	<i>Hygrophila auriculata</i>
	<i>Hygrophylla pobeguinii</i>
	<i>Hygrophylla</i> sp
	<i>Hypoestes triflora</i>
	<i>Isoglossa vulcanicola</i>
	<i>Justicia betonica</i>
	<i>Justicia caerulea</i>
	<i>Justicia calyculata</i>
	<i>Justicia exigua</i>
	<i>Justicia flava</i>
	<i>Justicia heterocarpa</i>
	<i>Justicia ladanoides</i>
	<i>Justicia matammensis</i>
	<i>Justicia ornatopila</i>
	<i>Lepidagathis diversa</i>
	<i>Monechma ciliatum</i>
	<i>Monechma debile</i>
	<i>Nelsonia canescens</i>
<i>Peristrophe paniculata</i>	
<i>Ruellia bignoniiflora</i>	
<i>Ruellia megachlamys</i>	
<i>Ruellia otaviensis</i>	
<i>Ruellia patula</i>	
<i>Thunbergia alata</i>	
Actiniopteridaceae	<i>Actiniopteris dimorpha</i>
Adiantaceae	<i>Doryopteris kirkii</i>
	<i>Pellaea dura</i>
	<i>Pellaea viridis</i>
Aizoaceae	<i>Corbichonia decumbens</i>
	<i>Zaleya pentandra</i>
Aloaceae	<i>Aloe lateritia</i>
	<i>Aloe secundiflora</i>
	<i>Aloe tweediae</i>
	<i>Aloe volkensii</i>
	<i>Aloe wilsonii</i>
Amaranthaceae	<i>Achyranthus aspera</i>
	<i>Aerva javanica</i>
	<i>Aerva lanata</i>
	<i>Alternanthera pungens</i>

Family	Identification
Amaranthaceae	Amaranthus graecizans
	Centemopsis kirkii
	Cyathula achyranthioides
	Cyathula cylindrica
	Cyathula orthacantha
	Digera muricata
	Gomphrena celosioides
	Pupalia lappacea
Anacardiaceae	Lannea barteri
	Lannea fulva
	Lannea humilis
	Lannea schimperi
	Lannea schweinfurthii
	Ozoroa insignis
	Rhus natalensis
	Rhus ruspolii
	Rhus vulgaris
	Sclerocarya birrea
	Annonaceae
Anthericaceae	Chlorophytum cameronii
	Chlorophytum macrophyllum
Apiaceae	Centella asiatica
	Pimpinella lindblomii
	Steganotaenia araliacea
Apocynaceae	Adenium obesum
Araceae	Anchomanes difformis
Araliaceae	Cussonia arborea
Asclepiadaceae	Calotropis procera
	Ceropegia denticulata
	Dregea abyssinica
	Gomphocarpus physocarpus
	Leptadenia hastata
	Mondia whitei
	Pentarrhinum insipidum
	Pergularia daemia
	Pergularia extensa
	Sarcostemma stoloniferum
	Sarcostemma viminale
	Secamone parvifolia
	Secamone stuhlmannii
	Stathmostelma rhacodes
	Stomatostemma monteiroae
Asparagaceae	Asparagus africanus
	Asparagus falcatus
	Asparagus racemosus
Aspleniaceae	Asplenium erectum
Asteraceae	Acmella caulirhiza
	Acmella mauritiana
	Ageratum conyzoides
	Aspilia kotschyi
	Aspilia pluriseta
	Berkheya spekeana
	Bidens grantii
	Bidens pilosa
	Bidens schimperi
	Blumea adamsii
	Blumea crispata

Family	Identification
Asteraceae	Conyza aegyptiaca
	Conyza gouanii
	Conyza sumaturensis
	Crassocephalum montuosum
	Crassocephalum sarcobasis
	Crepis rueppellii
	Dichrocephala chrysanthemifolia
	Emilia coccinea
	Emilia debilis
	Emilia discifolia
	Guizotia scabra
	Gutenbergia cordifolia
	Gutenbergia rueppellii
	Helichrysum rhodolepis
	Kleinia abyssinica
	Kleinia grantii
	Lactuca attenuata
	Lactuca inermis
	Launaea cornuta
	Melanthera scandens
	Pluchea ovalis
	Sonchus luxurians
	Sonchus schweinfurthii
	Synedrella nodiflora
	Tagetes minuta
	Tridax procumbens
	Vernonia adoensis
	Vernonia cinerea
	Vernonia biafrae
	Vernonia galamensis
	Vernonia infundibularis
Vernonia karaguensis	
Vernonia purpurea	
Vernonia viatorum	
Balanitaceae	Balanites aegyptiaca
	Balanites pedicellaris
	Balanites rotundifolia
Bignoniaceae	Kigelia africana
	Stereospermum kunthianum
Boraginaceae	Cordia crenata
	Cordia monoica
	Cordia quercifolia
	Cordia sinensis
	Heliotropium strigosum
	Heliotropium zeylanicum
Burseraceae	Boswellia papyrifera
	Commiphora confusa
	Commiphora madagascarensis
	Commiphora rostrata
	Commiphora schimperi
Caesalpiniaceae	Cassia absus
	Cassia kirkii
	Cassia mimosoides
	Cassia nigricans
	Cassia singueana
	Daniellia oliveri
	Piliostigma thonningii

Family	Identification
Caesalpiniaceae	Pterolobium stellatum
	Tamarindus indica
Campanulaceae	Walhenbergia hirsuta
Capparidaceae	Boscia angustifolia
	Boscia salicifolia
	Cadaba farinosa
	Cadaba mirabilis
	Capparis erythrocarpos
	Capparis fascicularis
	Capparis tomentosa
	Cleome monophylla
	Maerua angolensis
	Maerua decumbens
	Maerua edulis
	Maerua oblongifolia
	Maerua pseudopetalosa
	Maerua triphylla
	Thylachium africanum
Caryophyllaceae	Polycarpaea eriantha
Celastraceae	Maytenus buchananii
	Maytenus heterophylla
	Maytenus senegalensis
	Maytenus undata
	Mystroxyton aethiopicum
	Pleurostyliia capensis
Colchicaceae	Gloriosa superba
Combretaceae	Anogeissus leiocarpa
	Combretum aculeatum
	Combretum adenogonium
	Combretum apiculatum
	Combretum collinum
	Combretum constrictum
	Combretum hereroense
	Combretum molle
	Terminalia brownii
	Terminalia schimperiana
	Terminalia spinosa
	Commelinaceae
Commelina africana	
Commelina benghalensis	
Commelina diffusa	
Commelina elgonensis	
Commelina erecta	
Commelina latifolia	
Commelina purpurea	
Commelina thomasii	
Cyanotis foecunda	
Floscopa glomerata	
Convolvulaceae	
	Dichondra micrantha
	Evolvulus alsinoides
	Hewittia barica
	Ipomoea asarifolia
	Ipomoea blepharophylla
	Ipomoea cairica
	Ipomoea cordofana
	Ipomoea crepidiformis

Family	Identification
Convolvulaceae	<i>Ipomoea indica</i>
	<i>Ipomoea involucrata</i>
	<i>Ipomoea ochracea</i>
	<i>Ipomoea spathulata</i>
	<i>Seddera bagshawei</i>
	<i>Turbina stenosphon</i>
Crassulaceae	<i>Kalanchoe crenata</i>
	<i>Kalanchoe glaucescens</i>
	<i>Kalanchoe laciniata</i>
	<i>kalanchoe prittwitzii</i>
Cucurbitaceae	<i>Coccinia adoensis</i>
	<i>Cucumella engleri</i>
	<i>Cucumis ficifolius</i>
	<i>Cucumis prophetarum</i>
	<i>Gerrardanthus macrorrhizus</i>
	<i>Lagenaria abyssinica</i>
	<i>Momordica foetida</i>
	<i>Momordica friesorum</i>
	<i>Mukia maderaspatana</i>
	<i>Peponium vogelii</i>
	<i>Trochomeria macrocarpa</i>
	<i>Zehneria adoensis</i>
	<i>Zehneria capillacea</i>
	<i>Zehneria scabra</i>
Cyperaceae	<i>Abildgaardia abortiva</i>
	<i>Abildgaardia cardiocarpoides</i>
	<i>Courtoisina assimilis</i>
	<i>Cyperus difformis</i>
	<i>Cyperus dives</i>
	<i>Cyperus involucratus</i>
	<i>Cyperus leavigatus</i>
	<i>Cyperus niveus</i>
	<i>Cyperus rubicundus</i>
	<i>Mariscus dubius</i>
	<i>Mariscus rubrotinctus</i>
	<i>Mariscus squarrosus</i>
	Dioscoreaceae
Dracaenaceae	<i>Sansaviera conspicua</i>
	<i>Sansaviera robusta</i>
Ebenaceae	<i>Diospyros mespiliformis</i>
	<i>Euclea divinorum</i>
	<i>Euclea racemosa</i>
Eriospermaceae	<i>Eriospermum abyssinicum</i>
Euphorbiaceae	<i>Acalypha bipartita</i>
	<i>Acalypha brachystachya</i>
	<i>Acalypha ornata</i>
	<i>Acalypha psilostachya</i>
	<i>Acalypha villicaulis</i>
	<i>Bridelia ndellensis</i>
	<i>Bridelia scleroneura</i>
	<i>Croton dichogamus</i>
	<i>Croton megalocarpus</i>
	<i>Erythroccoca trichogyne</i>
	<i>Euphorbia bongensis</i>
	<i>Euphorbia candelabrum</i>
	<i>Euphorbia crotonoides</i>
	<i>Euphorbia depauperata</i>

Family	Identification
Euphorbiaceae	Euphorbia hirta
	Euphorbia inaequilatera
	Euphorbia prostrata
	Euphorbia ugandensis
	Flueggea virosa
	Phyllanthus amarus
	Phyllanthus fischeri
	Phyllanthus fraternus
	Phyllanthus muellerianus
	Phyllanthus odontadenius
	Phyllanthus sepialis
	Phyllanthus suffrutescens
	Ricinus communis
	Tragia hildebrandtii
	Fabaceae
Alysicarpus glumaceus	
Baphia wollastonii	
Crotalaria agatiflora	
Crotalaria axillaris	
Crotalaria brevindens	
Crotalaria cephalotes	
Crotalaria cylindrica	
Crotalaria cylindrocarpa	
Crotalaria glauca	
Crotalaria goreensis	
Crotalaria incana	
Crotalaria laburnifolia	
Crotalaria leprieurii	
Crotalaria macrocarpa	
Crotalaria microcarpa	
Crotalaria natalitia	
Crotalaria polysperma	
Crotalaria pycnostachya	
Dalbergia melanoxylon	
Dolichos oliveri	
Eriosema buchananii	
Eriosema elliotii	
Erythrina abyssinica	
Galega lindblomii	
Glycine wightii	
Indigofera acepus	
Indigofera arrecta	
Indigofera brevicalyx	
Indigofera dendroides	
Indigofera emarginella	
Indigofera garckeana	
Indigofera hochstetteri	
Indigofera mimosoides	
Indigofera oblongifolia	
Indigofera schimperii	
Indigofera spicata	
Indigofera stenophylla	
Indigofera subargantea	
Indigofera trita	
Kotschya africana	
Lonchocarpus bussei	
Lonchocarpus laxiflorus	

Family	Identification
Fabaceae	Macrotyloma axillare
	Ormocarpum kirkii
	Ormocarpum trichocarpum
	Pseudarthria hookeri
	Rhynchosia goetzei
	Rhynchosia hirta
	Rhynchosia malacophylla
	Rhynchosia minima
	Rhynchosia resinosa
	Rhynchosia sublobata
	Rhynchosia verdcourtii
	Rothia hirsuta
	Sesbania sesban
	Stylosanthes fruticosa
	Tephrosia elegans
	Tephrosia interrupta
	Tephrosia linearis
	Tephrosia purpurea
	Tephrosia pumila
	Tephrosia rhodesica
	Tephrosia vogelii
	Teramnus labialis
	Teramnus uncinatus
	Vicia sativa
	Vigna heterophylla
	Vigna kirkii
	Vigna luteola
Vigna membranacea	
Vigna vexillata	
Flacourtiaceae	Oncoba spinosa
	Trimeria glandifolia
Geraniaceae	Monsonia angustifolia
Hippocrateaceae	Loeseneriella africana
	Loeseneriella apiculata
Hyacinthaceae	Drimia altissima
Hypericaceae	Psorospermum febrifugum
Lamiaceae	Aeollanthus repens
	Hoslundia opposita
	Leonotis nepetifolia
	Leucas deflexa
	Leucas glabrata
	Leucas neuflyzeana
	Ocimum forskolei
	Ocimum gratissimum
	Ocimum lamiifolium
	Ocimum masaiense
	Orthosiphon parvifolius
	Plectranthus caninus
	Plectranthus comosus
	Plectranthus igniarius
	Plectranthus lanuginosus
	Plectranthus thyrsoides
	Solenostemon latifolius
	Solenostemon sylvaticus
	Tetradenia riparia
	Tinnaea ethiopica
Leguminosae	Craibia brownii

Family	Identification	
Liliaceae	Albuca abyssinica	
Loganiaceae	Nuxia oppositifolia	
	Strychnos henningsii	
	Strychnos innocua	
	Strychnos memecyloides	
Lorantaceae	Plicosepalus curviflorus	
Malvaceae	Abutilon longicuspe	
	Abutilon mauritianum	
	Hibiscus cannabinus	
	Hibiscus ovalifolius	
	Hibiscus physaloides	
	Pavonia propinqua	
	Pavonia urens	
	Sida alba	
	Sida cordifolia	
	Sida rhombifolia	
	Wissadula amplissima	
	Meliaceae	Lannea fruticosa
Pseudocedrela kotschy		
Trichilia emetica		
Turraea robusta		
Menispermaceae	Chasmanthera dependens	
	Cissampelos mucronata	
Mimosaceae	Acacia abyssinica	
	Acacia albidum	
	Acacia brevispica	
	Acacia condyloclada	
	Acacia dolichocephala	
	Acacia drepanolobium	
	Acacia elatior	
	Acacia gerrardii	
	Acacia hamulosa	
	Acacia hockii	
	Acacia kirkii	
	Acacia lahai	
	Acacia mellifera	
	Acacia nilotica	
	Acacia polyacantha	
	Acacia senegal	
	Acacia seyal	
	Acacia sieberiana	
	Acacia tortilis	
	Albizia amara	
	Albizia coriaria	
	Albizia ferruginea	
	Albizia schimperiana	
	Cassia singueana	
	Dichrostachys cinerea	
	Entada abyssinica	
	Moraceae	Ficus cordata
		Ficus exasperata
Ficus glumosa		
Ficus ingens		
Ficus mucoso		
Ficus natalensis		
Ficus ovata		
Ficus platyphylla		

Family	Identification
Moraceae	<i>Ficus stuhlmannii</i>
	<i>Ficus sycomorus</i>
	<i>Ficus thonningii</i>
	<i>Ficus vasta</i>
Myricaceae	<i>Myrica salicifolia</i>
Nyctaginaceae	<i>Boerhavia coccinea</i>
	<i>Boerhavia diffusa</i>
	<i>Commicarpus pedunculatus</i>
Nymphaeaceae	<i>Nymphaea nouchali</i>
Ochnaceae	<i>Ochna holstii</i>
	<i>Ochna inermis</i>
	<i>Ochna schweinfurthiana</i>
Olacaceae	<i>Ximenia americana</i>
Oleaceae	<i>Jasminum floribundum</i>
	<i>Jasminum pauciflorum</i>
	<i>Jasminum schimperi</i>
	<i>Olea africana</i>
Opiliaceae	<i>Opilia amentalea</i>
Orchidaceae	<i>Aerangis brachycarpa</i>
Oxalidaceae	<i>Biophytum abyssinicum</i>
	<i>Biophytum umbraculum</i>
	<i>Oxalis corniculata</i>
Palmae	<i>Borassus aethiopicum</i>
Papilionoidae	<i>Desmodium velutinum</i>
	<i>Vigna multinervis</i>
Pedaliaceae	<i>Sesamum angustifolium</i>
	<i>Sesamum calycinum</i>
Poaceae	<i>Acritochaete volkensis</i>
	<i>Alloteropsis cimicina</i>
	<i>Alloteropsis paniculata</i>
	<i>Andropogon chinensis</i>
	<i>Andropogon distachyos</i>
	<i>Andropogon gayanus</i>
	<i>Andropogon schirensis</i>
	<i>Anthephora elongata</i>
	<i>Anthephora pubescens</i>
	<i>Aristida adoensis</i>
	<i>Aristida ascensionis</i>
	<i>Aristida hordeacea</i>
	<i>Arthraxon lanceolatus</i>
	<i>Arthraxon micans</i>
	<i>Bothriochloa bladhii</i>
	<i>Bothriochloa insculpta</i>
	<i>Bothriochloa radicans</i>
	<i>Brachiaria brizantha</i>
	<i>Brachiaria jubata</i>
	<i>Brachiaria leersioides</i>
	<i>Brachiaria leucacrantha</i>
	<i>Brachiaria longiflora</i>
	<i>Brachiaria scalaris</i>
	<i>Cenchrus ciliaris</i>
	<i>Chloris gayana</i>
	<i>Chloris pilosa</i>
	<i>Chloris pycnothrix</i>
	<i>Chloris roxburghiana</i>
	<i>Chrysopogon serrulatus</i>
	<i>Ctenium somalense</i>

Family	Identification
Poaceae	Cynodon dactylon
	Dactyloctenium aegyptium
	Digitaria abyssinica
	Digitaria diagonalis
	Digitaria longiflora
	Digitaria milaniana
	Digitaria ternata
	Digitaria velutina
	Echinochloa haploclada
	Echinochloa pyramidalis
	Eleusine indica
	Enneapogon desvauxii
	Enteropogon macrostachyus
	Eragrostis aspera
	Eragrostis cilianensis
	Eragrostis schweinfurthii
	Eragrostis surperba
	Eragrostis tenuifolia
	Eragrostis tremula
	Eriochloa fatmensis
	Hackelochloa granularis
	Heteropogon contortus
	Hyparrhenia collina
	Hyparrhenia figariana
	Hyparrhenia filipendula
	Hyparrhenia madarapoda
	Hyparrhenia rufa
	Hyperthelia dissoluta
	Hypoestis forskalii
	Ischaemum afrum
	Leersia hexandra
	Leptocarydion vulpiastrum
	Leptochloa obtusiflora
	Leptochloa rupestris
	Lintonia nutans
	Loudetia flavida
	Loudetia simplex
	Melinis repens
	Microchloa kunth
	Panicum adenophorum
	Panicum atosanguineum
	Panicum chionachne
	Panicum coloratum
	Panicum deustum
	Panicum massaiense
	Panicum maximum
	Panicum nervatum
	Panicum paucinode
	Paspalum scrobiculatum
	Pennisetum mezianum
Pennisetum procerum	
Pennisetum purpureum	
Pennisetum unisetum	
Perotis patens	
Rottboellia conchinchinensis	
Schoenefeldia transiens	
Setaria megaphylla	

Family	Identification
Poaceae	<i>Setaria pumila</i>
	<i>Setaria sphacelata</i>
	<i>Setaria verticillata</i>
	<i>Sorghum arundinaceum</i>
	<i>Sorghum purpurea-sericeum</i>
	<i>Sporobolus africanus</i>
	<i>Sporobolus cordofanus</i>
	<i>Sporobolus festivus</i>
	<i>Sporobolus ioclados</i>
	<i>Sporobolus microprotus</i>
	<i>Sporobolus panicoides</i>
	<i>Sporobolus piliferus</i>
	<i>Sporobolus pyramidalis</i>
	<i>Sporobolus spicatus</i>
	<i>Sporobolus stapfianus</i>
	<i>Tetrapogon cenchrifomis</i>
	<i>Thelepogon elegans</i>
	<i>Themeda triandra</i>
	<i>Trachypogon spicatus</i>
	<i>Tragus berteronianus</i>
	<i>Urochloa oligotricha</i>
<i>Urochloa panicoides</i>	
Polygalaceae	<i>Polygala abyssinica</i>
	<i>Polygala albida</i>
	<i>Polygala arenaria</i>
	<i>Polygala erioptera</i>
	<i>Polygala sphenoptera</i>
Polygonaceae	<i>Oxygonum sinuatum</i>
	<i>Polygonum strigosum</i>
Portulacaceae	<i>Portulaca kermesina</i>
	<i>Portulaca oleracea</i>
	<i>Portulaca quadrifida</i>
Ranunculaceae	<i>Clematis hirsuta</i>
	<i>Clematis simensis</i>
Rhamnaceae	<i>Helinus mystacinus</i>
	<i>Ziziphus abyssinica</i>
	<i>Ziziphus mauritiana</i>
	<i>Ziziphus mucronata</i>
	<i>Ziziphus pubescens</i>
Rubiaceae	<i>Catunaregam nilotica</i>
	<i>Gardenia ternifolia</i>
	<i>Kohautia coccinea</i>
	<i>Kohautia grandiflora</i>
	<i>Kohautia longifolia</i>
	<i>Meyna tetraphylla</i>
	<i>Mitracarpus villosus</i>
	<i>Multidentia crassa</i>
	<i>Oldenlandia corymbosa</i>
	<i>Oldenlandia herbacea</i>
	<i>Pavetta gardeniifolia</i>
	<i>Pentanisia ouranogyne</i>
	<i>Pseudomussaenda flava</i>
	<i>Psychotria kirkii</i>
	<i>Psydrax schimperianum</i>
	<i>Rytigynia beniensis</i>
	<i>Spermacoce pusilla</i>
<i>Spermacoce sphaerostigma</i>	

Family	Identification
Rubiaceae	<i>Tricalysia niamniamensis</i>
	<i>Vangueria apiculata</i>
Rutaceae	<i>Teclea nobilis</i>
	<i>Vepris glomerata</i>
	<i>Zanthoxylum chalybeum</i>
	<i>Zanthoxylum leprieurii</i>
Salvadoraceae	<i>Salvadora persica</i>
Santalaceae	<i>Osyris compressa</i>
	<i>Osyris quadripartita</i>
Sapindaceae	<i>Allophylus africanun</i>
	<i>Allophylus ferrugineus</i>
	<i>Allophylus macrobotrys</i>
	<i>Allophylus rubifolius</i>
	<i>Cardiospermum grandiflorum</i>
	<i>Cardiospermum halicacabum</i>
	<i>Haplocoelum foliolosum</i>
	<i>Pappea capensis</i>
Sapotaceae	<i>Mimusops bagshawei</i>
	<i>Vitellaria paradoxa</i>
Scrophulariaceae	<i>Alectra var senegalensis</i>
	<i>Buchnera hispida</i>
	<i>Cycnium tubulosum</i>
	<i>Cycnium volkensii</i>
	<i>Harveya obtusifolia</i>
	<i>Sopubia ramosa</i>
	<i>Striga gesnerioides</i>
	<i>Striga hermonthica</i>
	<i>Striga linearifolia</i>
Simaroubaceae	<i>Harisonia abyssinica</i>
Solanaceae	<i>Solanum hastifolium</i>
	<i>Solanum incanum</i>
	<i>Solanum macrocarpon</i>
	<i>Solanum nigrum</i>
	<i>Solanum renschii</i>
	<i>Solanum thruppii</i>
	<i>Withania somnifera</i>
Sterculiaceae	<i>Dombeya burgessiae</i>
	<i>Dombeya rotundifolia</i>
	<i>Hermannia kirkii</i>
	<i>Melhania velutina</i>
Tiliaceae	<i>Corchorus trilocularis</i>
	<i>Grewia bicolor</i>
	<i>Grewia floribunda</i>
	<i>Grewia mollis</i>
	<i>Grewia tenax</i>
	<i>Grewia trichocarpa</i>
	<i>Grewia vilosa</i>
	<i>Triumfetta flavascens</i>
	<i>Triumfetta rhomboidea</i>
	<i>Triumfetta trichocarpa</i>
Turneraceae	<i>Streptopetalum serratum</i>
Typhaceae	<i>Typha domingensis</i>
Verbenaceae	<i>Clerodendrum myricoides</i>
	<i>Clerodendrum umbellatum</i>
	<i>Lantana trifolia</i>
	<i>Lippia javanica</i>
	<i>Priva curtisiae</i>

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Family	Identification
Verbenaceae	Stachytarpheta indica
	Stachytarpheta mutabilis
Vitaceae	Ampelocissus africana
	Cissus cornifolia
	Cissus oliveri
	Cissus rotundifolia
	Cyphostemma adenocaulis
	Cyphostemma cyphopetalum
	Cyphostemma heterotrichum
	Cyphostemma serpens
	Rhoicissus tridentata