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**Biodiversity of Karuma Wildlife reserve based on
studies conducted in two of the encroached areas,
the Kibyama and Mpumwe villages .**

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The field work for this report was done by:

**Mathias Behangana
Patrick Etyang
Hillary Bakamwesiga
Isaiah Owionji
Andrew Martin (Peace Corp Volunteer)**

This report was compiled and edited by:

Florence Namukasa and Robert Kityo

**For: EPED Project
P. O. Box 253 Masindi**

1 INTRODUCTION

Karuma Wildlife Reserve lies in an enclave of protected areas which comprise of Murchison Falls National Park, Bugungu Wildlife Reserve, Kaniyo Pabidi and Budongo Forest Reserves. This system of protected areas mostly lies in Masindi District western Uganda and was traditionally an expansive ranging ground for large game like elephants and buffaloes besides the smaller species.

Karuma Wildlife Reserve (KWR) with an area of 820 km² was gazetted in 1964. Gazetted as a Game Reserve, the original conception was for the reserve to act as a buffer zone between Murchison Falls National Park (MFNP) and the adjacent villages and other un-protected areas. However over the years, the reserve was slowly losing its role of buffering against animal incursion from the park to the surroundings and instead now seems to buffer the park against pressure from human population expansion. The result has been massive encroachment in the reserve. The presence of a refugee settlement at Kiryandongo where over 7,000 people have been settled, has led to a severe burden on the resources of the reserve.

The area around four of the encroaching villages i.e. Kibyama, Mpumwe, Kigangara and Rwamudompyo, which lie at the southern end of the reserve, were chosen for the study. The cultivation in all four villages which are currently settled by peasant farmers, is mostly covered in maize, frequently inter-cropped with beans, ground nuts and cassava.

The area receives annual rainfall estimated at 1,500 mm with the heaviest rainfall in April-May and August-September. The vegetation of the general area was described by Langdale-Brown *et. al.* (1964) as forest/savannah mosaics and moist *Combretum* savannahs. Both vegetation types are typical of relatively high rainfall areas.

The time available for the field work in this study was devoted to sampling different taxa (plants, butterflies, birds and mammals) in select areas of KWR to accumulate species lists for these four taxa. Most sampling was conducted in Kibyama, the largest of the four villages.

Over the past 30 years, Uganda's protected areas, including wildlife reserves, have come under intense human pressure largely due to the increasing human population which has more than doubled since 1960's (Hamilton, 1984). Habitats in a number of protected areas have been lost due to both agricultural encroachment and increased demands for fuel. Man's influence in the encroached areas is greatly modifying the soil, plant and animal systems (Hamilton, 1984) and this is directly or indirectly accelerating species loss. To reverse this trend in Karuma wildlife reserve, EPED, with funds from ACDI, intends to resettle all people who had encroached on the reserve for agriculture. It is hoped that after such resettlement, habitats in the encroached areas will regenerate and that the areas will be re-colonized by species which had previously been driven out.

In order to assess the extent of species recovery in the area, the selected plant and animal taxa will be monitored over a period of time. The purpose of this inventory was to establish baseline data upon which the monitoring program will depend.

1.1 RATIONALE

Birds have often been suggested as an appropriate group (Furness et al., 1993) for an indicator taxon. These and the other taxa (plants, butterflies, and mammals) fulfil most of the criteria listed by Pearson (1995) and (Pollard, 1977) for good indicator groups that could be used for monitoring. These taxa are taxonomically well-known and stable, their populations are readily surveyed and manipulated, and (for many species at least) may be specialised within a narrow habitat.

Additionally, butterflies and birds are conspicuous, day-flying and easy to collect or observe, they form an important component of the natural environment, significantly influencing plant population dynamics through their interactions with plants both as herbivores and as pollinators. All four groups are sensitive to environmental changes and to anthropogenic habitat modifications. They can therefore serve as ideal indicators of ecological change.

2 SURVEY PLAN

Strip-transects, 5m wide and 3km long running in a North-South direction were established at each village -three in Kibyama (fig. 1) and one each in Mpomwe, Kigangara and Rwamudompyo. The transects through Kibyama (T1, T2 and T3) run from a baseline defined by the grid references 3-87-489E 36 02-09-874N and 3-86-512E 36 02-09-892N taken at places KIBR and PK01 (fig. 1). This baseline approximates a segment of the southern boundary.

Mature trees within each of the transects were painted with water-fast oil-paint to permanently mark-out the transects so that they will easily be located throughout the monitoring program. The transects were randomly chosen and traversed as many habitats types within the areas as possible.

2.1 VEGETATION

Two plots of 10m² and one plot of 20 x 50 m² were placed at 200 m intervals along the transects, for assessing species composition of grasses and woody plants respectively. Each plot was then systematically searched in order to locate every species. All species in the first plot were listed, and only additional/new species would be recorded in subsequent plots, so that species-accumulation curves could be generated.

Where the plot fell in a cultivated area, no recording was done on such a plot, instead the transect was followed until the next uncultivated area. In areas too small to fit the plots only opportunistic recording was done so as to produce a more complete species list.

2.2 BUTTERFLIES

All sampling was done during the warm hours of the day, usually between 0900hrs and 1700hrs when most butterflies are active. The Taxonomy of butterflies in this report follows D'Abbrera (1980) and Larsen (1991). The methods used included:

Sweep-netting

Sweep-netting along each transect usually lasted three hours. A total of 60 transect-sweep-net hours were used. The transects were covered from one end to the other at a constant speed, catching with the aid of an ordinary insect sweep-net every butterfly encountered. Details of the technique are described by Pollard (1977). The specimens caught were identified, recorded and released, but at least one voucher specimen of all the species caught was preserved dry to permit verification of the identifications later.

Sampling with baited net-traps

A total trap effort of 60 trap-days (480 trap-hours) was used - each trap set is equivalent to a trap-day. This method was employed to specifically target the fast and high flying butterfly species which frequent tree-tops or spend most of their lives in the canopy. A cylindrical net-trap with fermenting banana fruit placed at its base to serve as bait was used. 10 traps were suspended 2-5m above the ground along each transect at 50m intervals. Traps were set in sections of the transect with some woody vegetation, and were checked twice on each trapping day, usually between 1200hrs and 1300hrs and between 1700hrs and 1800hrs.

Random sweep-netting

To generate a species list for the area that is as complete as possible, every opportunity was often taken to randomly survey parts of the area that lie outside the transects. During such surveys, a sweep-net was used to catch butterflies encountered. The specimens caught were identified, recorded and released.

2.3 MAMMALS

Museum special rat traps were laid on grids along the transects to sample the small mammal diversity. An effort of 500 trap-nights (each trap set each night is equivalent to a trap-night) was used in sampling the small mammal diversity in Kibyama.

Traps were checked and re-baited every morning and evening, and to recover any animals trapped. These were saved as voucher specimens for verification of their identification.

Two mist nets were also set up to trap bats along the transects.

On the transect that run through Mpumwe village a trap effort of 400 trap-nights was used to sample the small mammals.

Information on the larger mammals that could not be documented using the above methods was gathered through direct observation, by looking for spoor or foot impressions as well as recordings by game rangers.

2.4 BIRDS

Three methods were used during this study;

Timed-Species counts (TSC),

A TSC consists of a species list, in which all species positively identified are listed, in the order seen (or heard), within a period of one hour (Pomeroy, 1993).

Bird species which were anywhere within the study site were listed, including species flying over the study area. The recording for birds was done following foot paths or trails already established in the area by the local people. These trails were convenient because they cut through most of the study area traversing the different habitat types (Figure 1).

Mist-netting

Five standard BTO (British Trust for Ornithology) mist-nets of 18m long x 2.5m high and two of 12m long x 2.5m high were placed for a total of 14 hours along transects cut in two intact blocks of woodland surrounded by maize plantations on three consecutive days. On two of the days, nets were opened at 0630h and closed at 1200h. Nets were checked every after one hour. Birds in the field were identified using Williams and Allot (1980), Perlo (1995) and confirmed using Mackworth-Praed & Grant (1964) and Keith et al (1992). These two blocks were marked with yellow oil-based paint for future reference. The method of mist netting helped in the identification of less conspicuous understorey birds and confirmation of other confusing species of birds e.g warblers, honeyguides and babblers.

Opportunistic observations

To maximise the number of species encountered in the area, species were also recorded using opportunistic methods. This method involved moving around the study area at different times of day and listing different bird species as they were encountered. There was no limit on the time taken to make the observations and the area covered.

3 RESULTS

3.1 VEGETATION

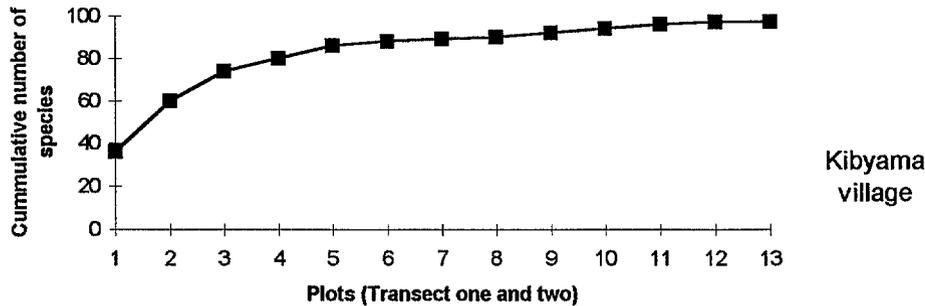
The shifting type of cultivation practised by the peasant farmers in these areas, has resulted in the disturbance of large areas of the reserve due to the cultivation and burning practices. The process of cultivation involves indiscriminate cutting of trees which are burnt to clear the land in preparation for planting of the crops. The plots are abandoned once they become infertile and new sites are located for the agricultural activity. Frequent bush fires also characterise the study area. The adjacent intact areas consist of *Acacia* sp., *Albizia* sp., *Combretum* sp., and *Terminalia* sp.. The farming practices in the areas have largely resulted into an impoverished type of savannah woodland.

The general vegetation in the two villages, Kibyama and Mpumwe was not significantly different. The herb layer was dominated by grasses ie. *Panicum maximum*, *Bracharia* sp, *Setaria* sp, *Pennisetum purpureum*, *Echinochloa* sp and the shrub *Lantana camara* some of which are colonisers of recently cultivated areas and road sides.

The dominant tree species include - *Combretum molle*, *Acacia seiberiana*, *Acacia hockii*, *Acacia recifiens*, *Ficus sp*, *Pileostigma thorningii* and *Cassia sp*.

The riverine woodland, has a canopy cover greater than 50% and canopy height of between 10-20 m. This vegetation assemblage appeared similar to the riverine forest described by Lock (1977) as vegetation type 48. It occurred as thin (10-20m wide) or sparse (only one or two trees wide) strips along rivers or swamp fringes often blending into *Phoenix reclinata* swamp forest fragments. Altogether a total of 94 species of plants were recorded (Appendix 1).

Fig 2. Species-accumulation curve for plant species recorded in Kibyama village



The species cumulative curve for plants indicates a plateau suggesting that not many more species were being discovered.

3.2 BUTTERFLIES

A total of 57 species belonging to 4 families and 28 genera were recorded (Appendix 2). The species accumulation curve for the sampling period is shown in figure 3. It indicates that the asymptote was being approached. A majority of the species recorded belong to families Nymphalidae (54%) and Pieridae (28%). Few in the families Lycaenidae (14%) and Papilionidae (4%) and none in family Hesperidae were recorded (Table 1).

Fig.1 Species accumulation cuve for butterfly suvey of Karuma Wildlife Reserve

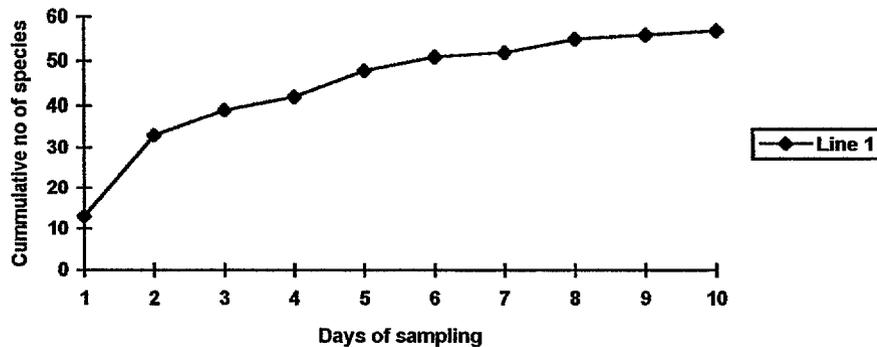


Table 1: Number of Species Recorded Per Family

FAMILY/SUB-FAMILY	NUMBER OF SPECIES
<i>Lycaenidae</i>	8
<i>Papilionidae</i>	2
<i>Nymphalidae:Acraeinae</i>	4
<i>Danainae</i>	2
<i>Satyrinae</i>	12
<i>Charaxinae</i>	2
<i>Nymphalinae</i>	11
<i>Pieridae</i>	16
<i>Hesperiidae</i>	0
TOTAL	57

The highest proportion of the Nymphalids recorded (38%) belong to subfamily Satyrinae while the genus *Eurema* dominated the Pierids constituting 43.8% of all the recorded species in the family. The pierids appeared to occur in higher numbers than members of the other families. The relative abundance of the species recorded in the area is shown in Appendix 2. Generally most of the species recorded are known to be generalists that can exploit a variety of habitats.

3.3 MAMMALS

A small mammal fauna of 11 species of rodents, one shrew and one bat were recorded for the area from the trapping effort deployed. Two species of monkeys were also observed namely the Black and White Colobus, (*Colobus guereza*), which was mostly found in the less disturbed habitat in Mpumwe and Kigangara villages, and the Vervet Monkey (*Cercopithecus aethiops*) which was cosmopolitan. These and all the other species recorded for the area by this survey are listed in table 2. The species accumulation of the small mammals from the trapping results was yet to reach the asymptote, indicating, that more species could still have been discovered. The composition of the small mammals encountered is that typical of such savannah habits. Of these, *Mastomys hildebrandtii*, was the most commonly encountered rodent. This is commonly a commensal rodent where it normally builds up high populations in areas that have not been invaded by the exotic black rat *Rattus rattus* as well as in area with a lot of grain.

Table 2. Mammals recorded for Kibiyama and Mpumwe areas, Karuma Wildlife Reserve

Small Mammals

Insectivores

Crocidura hildegandae Hildegard's Musk Shrew

Bats

Lavia frons Yellow-winged Bat

Rodents

Dendromus mesomelas Brant's Climbing Mouse

Aethomys kaiseri Kaiser's Bush Rat

Grammomys dolichurus Common Thicket Rat

Lemiscomys striatus Common Striped Grass Rat

Lophuromys flavopunctatus Eastern Brush-furred Rat

Lophuromys sikapusi Common Brush-furred Rat

Mastomys hildebrandtii Northern Savanna Multimammate Rat

Mus minutoides Pygmy Mouse

Mus triton Grey-bellied Pygmy Mouse

Tatera leucogaster Savanna Woodland Gerbil

Tatera valida Northern Savanna Gerbil

Other Mammals

Cercopithecus aethiops Vervet Monkey

Colobus guereza Black & White Colobus Monkey

Potamochoerus porcus Bush pigs

Tragelaphus scriptus Bushback

Syncerus caffer Buffalo

Loxodonta africana Elephant

Sylvicapra grimmia Bush Duiker

Hystrix cristata Crested Porcupine

Xerus erythropus Geoffrey's Ground Squirrel

3.4 BIRDS

One hundred and twenty six bird species of thirty nine families were recorded in the encroached area (Appendix 3). The listing in this and Tables 3 - 7 is arranged taxonomically following the format of the East African Ornithological subcommittee). Five species recorded during the study (table 3) are listed in Birds to watch in East Africa (Bennun and Njoroge 1996), as species of special conservation concern and their status deserves to be recognised.

The classification for forest birds by Bennun *et.al.*(in press) was used to assign categories to some species in order to assess their habitat type requirements. These categories were:-

F-species- the 'generalist' - are typically birds of forest edges and gaps. They are common in secondary forest than in the interior of intact forest. Breeding is typically within forest of some type.

f-species are birds which are not infrequently recorded in forest, but are not depended upon it; they are almost always more common in non forest habitats, where they are most likely to breed.

Species accumulation curve for Kibyama which was most intensively studied is shown in Fig 2. The curve levels after the fifth day of the count indicating that not many new species of birds are added during the consequent counts.

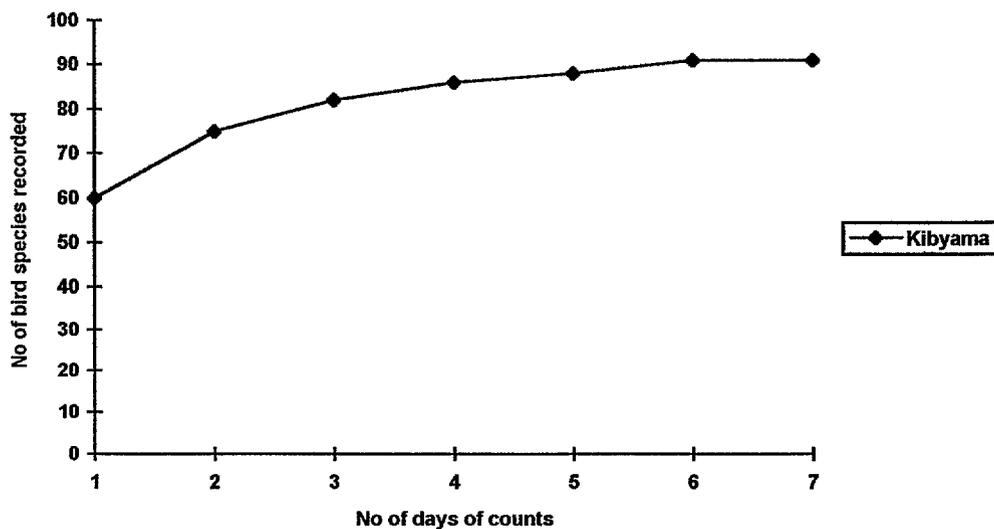
Table 3. Showing five species of birds which are either threatened or are of regional responsibility in encroached parts of Karuma Wildlife Reserve.

Common name	Habitat category	Threat/RR category
Brown Snake Eagle	NF	NT
Banded Snake Eagle	F	VU
Spotted-flanked Barbet	NF	RR
White-headed Rough-wing	F	RR
Red-headed Quelea	NF	RR

Key: NF = Not Forest Species, F = Forest generalist, NT = Near threatened, VU = Vulnerable, RR = Regional Responsibility (90% + of their range or population in East Africa)

Twelve bird species associated with forests or require forest for breeding are also recorded in the study area (marked F in Appendix 3). This was only 10% of the total number of bird species recorded in the study.

Figure 2. Species accumulation curve for Kibyama village in Karuma Wildlife Area



40 individuals of 19 species were captured using mist-nets at a catch rate of 0.13 per 100-metre-net-hour. Out of the 19 species, one is F-species 13 species were f-species and 4 are more open country type of birds (Table 4).

Table 4. The bird species which were captured and number of individuals caught in the net.

Common name	Habitat category	Number of individuals caught
Common Bulbul	f	8
Snowy-capped Robin Chat	F	1
Black-crowned Waxbill	f	2
Grey-backed Camaroptera	f	3
Brown-backed Scrub Robin	f	2
Stuhlmann's Weaver	f	2
Scally-throated Honeyguide	f	2
Arrow-marked Babbler		1
Pygmy Kingfisher	f	3
Shiffling Cisticola		2
African Firefinch		2
Wattle-eye	f	2
Lesser Honeyguide	f	2
Brown Twinspot	f	3
Tropical Boubou	f	1
Paradise Flycatcher	f	1
Red-faced Cisticola		2
Reed Warbler		1

Table 5, gives summarised analyses of TSC from Kibyama village. 53% (68 species) of the bird species recorded in the study were also recorded using the TSC method. Species were scored 6 if seen in the first ten minutes of a count, 5 when seen between 10 and 20 minutes and so on to 1 for the last ten minutes. The analysis showed that there were few common species and many rarer ones e.g. Among the ten most common species (average score 6-3.7), there was no F-species.

Table 5. Analysis of TSCs from Kibyama.

Common name	Hab. cat	1	2	3	4	5	6	7	Mean score
Cattle Egret		3							0.4
Banded Snake Eagle	F	4							0.6
Bateleur				5					0.7
Augur Buzzard				5					0.7
Lizard Buzzard	f					2	5		1.0
Long-crested Eagle	f	5							0.7
Heuglin's Francolin			6						0.9
Red-eyed Dove		6	6	6	4	6	6	6	5.7
Laughing Dove		6			4	3		5	2.6
Tambourine Dove	F		5		6	6		5	3.1
Green Pigeon	F	3	4						1.0
Red-headed Lovebird	f	0	6	0					0.9
Brown Parrot		6	4			1	2	3	2.1
White-crested Turaco	f		3						0.2

Black Cuckoo	f	6	6						1.7
White-browed Coucal		6	6		3	6	6	6	4.7
Speckled Mousebird		2							0.2
Striped Kingfisher			1			6	3		1.2
Woodland Kingfisher		5	4	6					2.1
Broad-billed Roller		3	4	6	6		6	6	4.4
Green Wood Hoopoe			1						0.1
Double-toothed Barbet								6	0.9
Nubian Woodpecker					6		6	6	2.6
Cardinal Woodpecker				5					0.7
Grey Woodpecker	f		5	5					1.2
Brown-backed Woodpecker			3		5		4		1.7
Mosque Swallow			1		6				1.0
White-headed Rough-wing	f				3			4	1.0
Drongo	f	4	6			5	1		2.3
Black-headed Oriole	f	5		5					1.4
Black Tit	f						3		0.4
Arrow-marked Babbler					6	5	1		1.7
Common Bulbul	f	6	6	6	6	6	6	6	6.0
Brown-backed Scrub Robin			1						0.1
African Thrush	f		5	6	6	6		1	3.4
Red-faced Cisticola		6	6						1.7
Green-backed Eremomela				6		2	6	6	2.8
Grey-backed Camaroptera	f	5	5	5	6	6	6	6	5.6
Tawny-flanked Prinia	f	5	5	6	4	6	6	5	5.3
Red-faced Crombec	f							3	0.4
Black Flycatcher		6		6	5	5	6	2	4.3
Lead-coloured Flycatcher	f			5					0.7
Black-headed Batis	f			1		1		5	1.0
Northern Puffback	F					1	6		1.0
Tropical Boubou	f	6	6		6	6	6	6	5.1
Sulphur-breasted Bush Shrike		2						3	0.4
Brown-headed Tchagra		2	6	6					2.0
Violet-backed Starling			1						0.1
Purple-headed Glossy Starling		5							0.7
Splendid Glossy Starling	F		4						0.6
Copper Sunbird	f		5	6	5	6		4	3.7
Scarlet-chested Sunbird		5			1			1	1.0
Yellow White-eye	f	4	5			6			2.1
Red-headed Weaver								1	0.1
Black-headed Weaver		3	2		4	4	4	6	3.3
Black Bishop		6	6	2		5	4	5	4.0
Southern Red Bishop			6		4	4	3	6	3.3
Baglafaecht Weaver	f				4	3	1	6	2.0
Vieillot's Black Weaver	f		1	6		4			1.6
Pin-tailed Whydah				6	6				1.7
Brown Twinspot	f							4	0.6
Waxbill		6							0.9
African Firefinch					5			5	1.4
Red-winged Pytilia						5	3		1.1
Red-cheeked Cordon Bleu		1							0.1
Black and White Mannikin	f					5	6	4	2.1
Bronze Mannikin				5		6		5	2.3
Yellow-fronted Canary		5				5	4	6	2.8

4 DISCUSSION

Furness and Greenwood (1993) have suggested that proper monitoring consists of surveillance (repeated survey using standardised methods) plus:

- Assessment of any changes against some standard or target
- The gathering of data in such a way that the reasons for the departures from the standard may be illuminated.
- Clear understanding of the objectives of the programme.

The simplest measure of diversity is species richness (Magurran 1988), this provides a convenient way of comparing different areas as for example Howard (1989) has done for forest trees. For a series of plots used, one can build up species accumulation curve, the steeper the curve, the greater the species richness. The plant species richness data for the sites surveyed in Kibiyama and Mpumwe shows a relatively impoverished flora. The results present a basic checklist on the basis vegetation evolution shall be assessed after the people are resettled .

Since this is the first ever biodiversity assessment of KWR on a scale similar to the present one, there were no data to compare with, that would have enabled interpretation of the changes. This report therefore, presents a set of data that only forms a basis of assessing environmental recovery after resettlement of the encroaching communities is effected. The changes in species composition and individual abundance or densities are important aspects which could be used for the monitoring program.

The ornithological results, are interesting because most of the birds caught were at least birds which required forests of some kind. Over 20% of the species recorded are in this category. The presence of these species indicates that the original vegetation of the area was either a savannah woodland or at least forested before agricultural activities.

The presence or absence of the F or f species could form an important aspect of the monitoring program. Most of the F species were recorded only where intact blocks of woodlands occurred or along the riverine forests in the area.

The TSC results also show that there were few very frequently encountered bird species but many infrequently encountered ones. This observation normally occurs when ever there is a habitat modification. Although, interpretation of such results should be treated with caution since the causal links between the numbers of birds and environmental changes in grassland habitats is not yet clear, clues to changes in the environment are always predictable when potential targets like birds are monitored for a long-term.

The asymptote in the species accumulation curve for butterflies is being approached, this implies that additional sampling effort would have probably resulted in a few more species, certainly not many, being found in the area. The butterfly fauna of the areas surveyed therefore consists of just about 60 species.

A great abundance of species recorded for sub-family Satyrinae and family Pieridae was to be expected because of the much opened up environment in the encroached areas of KWR. Similarly, the near absence of sub-family Charaxinae and family Papilionidae in the area was not surprising since these prefer a more wooded vegetation.

Grassland communities are characterized by a great abundance of Pierids and Satyrins, moderately high numbers of Nymphalins and a striking absence of Charaxes. The Pierids, in particular, are known to occupy early succession habitats (New, 1991), while the Charaxins and Lycaenids are predominantly tree canopy dwellers. That the area has been modified into a grassland-like habitat also explains why among the Pierids, genus *Eurema* is dominant and the number of species in the genus *Belenois* is also high. The two genera are known to show a preference for grassland.

Strong *et al.* (1984) suggest that diversity increases with successive stages of succession. The more complex and heterogeneous the physical environment becomes, the more complex and diverse the plant and animal community supported by the environment. The vegetation in the area surveyed has been greatly simplified through cultivation of mainly maize. This is probably one of the major factors responsible for the paucity of such groups as the Charaxes, Papilionids and, to some extent, the Lycaenids and the apparent absence of the Hesperids.

Most of the species recorded are generalists as is expected, since it is generalists that are relatively less sensitive to habitat modification. More generalists are therefore likely to survive such habitat disturbance as cultivation than specialists.

There is indication that several species of large mammals (Table 2) still range into the encroached areas of KWR. With the removal of the illegal settlement, one would hope these might be able to rebuild their population and re-colonise their former ranges.

The abundance of the rodent species *Mastomys hildebrandtii* presents one target species whose population dynamics can be used to assess habitat recovery. The reason for this being that high densities of this species are normally recorded in savannah areas with strong anthropogenic presence.

5 CONCLUSIONS

A basic checklist of species belonging to four taxa - plants, butterflies, mammals and birds existing in the encroached areas has been produced. In the absence of historical biodiversity data for KWR we are limited from making any general deductions of trends. This report simply assumes (and we believe justifiably), that there has been a loss of biodiversity following encroachment.

Following the resettlement exercise we believe that although initially slowly, the biodiversity status of the presently encroached area will recover.

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Appendix 1. PLANT SPECIES LIST

Acacia hockii
Acacia abyssinica
Acacia kirkii
Acacia gelardii
Acacia seiberiana
Acacia brevispica
Acanthus sp. A
Acanthus arboreus
Albizia coriaria
Albizia gummifera
Armona senegalensis
Asparagus africanus
Aspilia sp. A
Bauhinia sp. B
Bauhinia sp. A
Bidens pilosa
Bidens grantii
Bidens sp. C
Brachiaria sp. A
Brachiaria eruciformis
Brachiaria brizantha
Brachiaria decumbens
Cassia sp. B
Cassia sp. A
Cassia spectabilis
Chloris gayana
Cirsium vulgare
Combretum quenzii
Combretum collinum
Combretum molle
commelina benghalensis
Commelina africana
Crassocephalum vitellium
Crotalaria sp. A
Cyperus imbricatus
Cyperus papyrus
Cyperus sp. B
Cyperus sp. A
Cyperus sp. C
Digitaria sp. A
Digitaria velutina
Digitaria longiflora
Digitaria scalarum
Diospyros abyssinica
Dodonaea angustifolia
Echinochloa ugandensis
Eleusina indica
Erythrina abyssinica
Euphorbia heterophylla
Euphorbia macrophylla
Euphorbia hirta
Euphorbia tirucalli
Ficus incana
Ficus urceolaris
Ficus mucoso
Ficus natalensis
Gloriosa superba
Grewia mollis
Grewia nyanzae
Guizotia scabra
Hewittia sp. A
Hewittia subcordata
Hoslundia opposita
Hyperhenia sp. A
Indigofera sp. A
Indigofera sp. B
Indigofera indica
Lansea barteri
Lantana camala
Leonotis africana
Maariscus syperoides
Mangifera indica
Mangifera sp. A
Markhamia lutea
Melitia excelsa
Mimosa pigra
Momordica boirinii
Panicum maximum
Pennisetum purpureum
Phoenix reclinata
Rhus incana
Rhyncosia resinosa
Ricinus communis
Sapium ellipticum
Setaria sphacelata
Setaria longiseta
Solanecio angulatus
Sorghum verticilliflorum
Sporobolus pyramidalis
Stereospermum kunthium
Symphonia globulifera
Terminalis sp. A
Vernonia amygdalina
Vitex doniana

**APPENDIX 2: SPECIES OF BUTTERFLIES RECORDED IN THE ENCROACHED
AREAS OF KARUMA WILDLIFE RESERVE 2ND MAY-2ND JUNE 1997.**

FAMILY LYCAENIDAE

<i>Anthene larydas</i>	+
<i>A. lumulata</i>	++
<i>A. princeps</i>	+
<i>Azanus morigua</i>	+
<i>Euchrysops malanthana</i>	+
<i>Leptotes pirithous</i>	+
<i>Pentila pauli</i>	+
<i>Zizina antanossa</i>	++

FAMILY PAPILIONIDAE

<i>Papilio dardanus</i>	+
<i>P. demodocus</i>	++

FAMILY NYMPHALIDAE

SUB-FAMILY DANAINAE

<i>Danaus chrysippus</i>	++
<i>Tirumala petiverana</i>	+

SUB-FAMILY SATYRINAE

<i>Bicyclus angulosus</i>	++
<i>B. campinus</i>	++
<i>B. ena</i>	+
<i>B. mollita</i>	++
<i>B. safitza</i>	++
<i>B. vulgaris</i>	++
<i>Coenyropsis carcassoni</i>	+
<i>Honestia perspicua</i>	+
<i>H. phaea</i>	+
<i>Nelanitis leda</i>	++
<i>Ypthima antennata</i>	+
<i>Y. asterope</i>	+

SUB-FAMILY CHARAXINAE

<i>Charaxes varanes</i>	+
<i>C. viola</i>	+

SUB-FAMILY NYMPHALINAE

<i>Byblia arvatarata</i>	++
<i>B. ilithyia</i>	+
<i>Catacroptera cloanthe</i>	+
<i>Hamamumida daedalus</i>	++
<i>J. hierta</i>	++
<i>J. oenone</i>	++
<i>Neptis jordani</i>	+
<i>N. morosa</i>	+
<i>Phalanta phalanta</i>	+
<i>Vanessa cardui</i>	++

SUB-FAMILY ACRAEINAE

<i>Acraea caecelia</i>	+
<i>A. eponina</i>	++
<i>A. natalica</i>	+
<i>Acraea sp</i>	+

FAMILY PIERIIDAE

<i>Appias sabina</i>	+
<i>Belenois aurota</i>	++
<i>B. creona</i>	++
<i>B. subeida</i>	++
<i>Belenois sp.</i>	++
<i>Catopsilia florella</i>	+
<i>Colotis amatus</i>	+
<i>C. danae</i>	+
<i>C. evagore</i>	+
<i>Eurema brigitta</i>	+
<i>E. floricola</i>	++
<i>E. desjardinsi</i>	+
<i>E. senegalensis</i>	++
<i>E. hapale</i>	++
<i>E. hecabe</i>	++
<i>E. regularis</i>	++

NOTE: += Rare (Encountered less than thrice)
 += Common (Entered at least thrice)

APPENDIX 3. Bird list of encroached parts of Karuma Wildlife Reserve. Habitat category is indicated where applicable.

ARDEIDAE Herons, Bitterns and Egrets

Black-headed Heron *Ardea melanocephala* (w)
Cattle Egret *Bubulcus ibis*

HAMERKOP Hamerkop

Hamerkop *Scopus umbretta* (w)

CICONIIDAE

Open-billed Stork *Anastomus lamelligerus* (w)

THRESKIORNITHIDAE, Ibises and Spoonbills

Hadada *Bostrychia hagedash*

ACCIPITRIDAE Vultures, Eagles and Haws

Harrier Hawk *Polyboroides radiatus* (f)
Banded Snake Eagle *Circaetus cinerascens* (f) (VU)
Brown Snake *C. cinereus* (NT)
Bateleur *Terathopius ecaudatus*
Lizard Buzzard *Kaupifalco monogrammicus* (f)
Long-crested Eagle *Lophaetus occipitalis* (f)
Black Kite *Milvus migrans*
Black-shouldered Kite *Elanus caeruleus*

PHASIANIDAE, Quails and francolins

Heuglin's Francolin *Francolinus icterorhynchus*

NUMIDIDAE Guineafowls

Helmeted Guineafowl *Numida meleagris*

COLUMBIDAE Pigeons and Doves

Ring-necked Dove *Streptopelia capicola*
Red-eyed Dove *S. semitorquata*
Laughing Dove *S. senegalensis*
Blue-spotted Wood Dove *Turtur afer* (f)
Tambourine Dove *T. tympanistris* (F)
Green Pigeon *Treron australis* (F)

PSITTACIDAE Parrots and Lovebirds

Red-headed Lovebird *Agarponis pullaria* (f)
Brown Parrot *Poicephalus meyeri*

MUSOPHAGIDAE Turacos

Eastern Grey Plantain Eater *Criniger zonurus*
White-crested Turaco *Tauraco leucolophus* (f)

CUCULIDAE Cuckoos and Coucals

Didric Cuckoo *Chrysococcyx caprius*
Levaillant's Cuckoo *Clamator levaillantii*
Eurasian Cuckoo *Cuculus canorus*
Black Cuckoo *C. gabonsis*
Red-chested Cuckoo *C. solitarius* (F)
Blue-headed Coucal *Centropus monachus* (w)
Senegal Coucal *C. senegalensis* (f)
White-browed Coucal *C. superciliosus*

COLIIDAE Mousebirds

Speckled Mousebird *Colius striatus*

ALCEDINIDAE Kingfishers

Striped Kingfisher *Halcyon chelicuti*

Woodland Kingfisher *H. senegalensis*

Pygmy Kingfisher *Ispidina picta*

MEROPIIDAE Bee-eaters

White-throated Bee-eater *Merops albicollis*

CORACIIDAE Rollers

Broad-billed Roller *Eurystomus glaucurus*

PHOENICULIDAE Wood Hoopes

Green Wood Hoopoe *Phoeniculus purpureus*

BUCEROTIDAE Hornbills

Black and White Casqued Hornbill *Bycanistes subcylindricus* (F)

Grey Hornbill *Tockus nosotus*

CAPITONIDAE Barbets and Tinkebirds

Double-toothed Barbet *Lybius bidentatus*

Spotted-flanked Barbet *L. lacrymosus* (RR)

Yellow-fronted Tinkerbird *Pogoniulus chrysoconus* (f)

INDICATORIDAE Honeyguides

Lesser Honeyguide *Indicator minor* (f)

Scaly-throated Honeyguide *I. variegatus* (f)

PICIDAE Woodpeckers, Wrynecks and Piculets

Nubian Woodpecker *Campethera nubica*

Cardinal Woodpecker *Dendropicos fuscescens*

Grey Woodpecker *Mesopicos goertae* (f)

Brown-backed Woodpecker *Picooides obsoletus*

ALAUDIDAE Larks

Flappet Lark *Mirafra rufocinnamomea*

HIRUNDINIDAE Swallows, Martins and Rough-wings

Striped Swallow *Delichon urbica*

Mosque Swallow *Hirundo senegalensis*

White-headed Rough-wing *Psalidoprocne albiceps* (f) (RR)

DICRURIDAE Drongos

Drongo *Dicrurus adsimilis* (f)

ORIIDAE

Black-headed Oriole *Oriolus larvatus* (f)

CORVIDAE Crows, Ravens and Piapiac

Piapiac *Ptilostomus afer*

PARIDAE

Black Tit *Parus leucomelas* (f)

TAMALIIDAE Babblers

Arrow-marked Babbler *Turdoides jurdineii*

CAMPEPHAGIDAE Cuckoo Shrikes

Red-shouldered Cuckoo Shrike *Campephaga phoenicea*

White-breasted Cuckoo Shrike *Coracina pectoralis* (F)

PYCNONOTIDAE

Common Bulbul *Pycnonotus barbatus* (f)

TURDIDAE Thrushes Robins etc

Brown-backed Scrub Robin *Cercotricas hartlaubi*
White-browed Robin Chat *Cossypha heuglini* (f)
Snowy-headed Robin Chat *C.niveicapilla* (F)
African Thrush *Turdus pelios* (f)

SYLVIDAE Wabblers

Reed Warbler *Acrocephalus scirpaceus*
Grey-backed Camaroptera *Camaroptera brachyura* (f)
Siffling cisticolla *C.brachyptera*
Singing Cisticola *C.cantans*
Red-faced Cisticola *C.erythrops*
Green-backed Eremomela *Eremomela pusilla*
Tawny-flanked Prinia *Prinia subflava* (f)
Moustached Warbler *Sphenoeacus mentalis*
Red-faced Crombec *Sylvia whytii* (f)

MUSCICAPIDAE Flycatchers

Black Flycatcher *Melaenornis edolioides*
Lead-coloured Flycatcher *Myioparus plumbeus* (f)
Wattle-eye *Platysteira cyanea* (f)
Black-headed Batis *Batis minor* (f)
Paradise Flycatcher *Terysiphone viridis* (f)
Blue Flycatcher *Erannornis longicauda* (f)

MALACONOTIDAE

Northern Puffback *Dryscopus gambensis* (F)
Tropical Boubou *Laniarius ferrugineus* (f)
Sulphur-breasted Bush Shrike *Malaconotus sulphureopectus* (f)
Black-headed Tchagra *Tchagra senegala*

LANIIDAE Shrikes

Grey-backed Fiscal *Lanius excubitorius*

STURNIDAE Starlings and Oxpeckers

Blue-eared Glossy Starling *Lamprotornii chalybaeus*
Lesser Blue-eared Glossy Starling *L.chloropterus*
Splendid Glossy Starling *L. splendidus* (F)
Rupell's long-tailed Glossy Starling *L.purpuropterus*

NECTARINIIDAE Sunbirds

Collared Sunbird *Athreptes collaris* (F)
Olive-bellied Sunbird *Nectarinia chloropygia* (F)
Copper Sunbird *N.cuprea*
Scarlet-chested Sunbird *N.senegalensis*
Green-headed sunbird *N verticalus* (f)

ZESTEROPTIDAE White eyes

Yellow White-eye *Zosterops senegalensis* (f)

PLOCIDAE Weavers, Sparrows and Whydahs, etc

Grossbeak Weaver *Amblospiza albifrons* (f)
Red-headed Weaver *Anaplectes rubriceps*
Red-naped Weaver widowbird *Euplectes ardens*
Black Bishop *E. gierowii*

Yellow-mantled Widowbird *E. macrourus*
 Southern Red Bishop *E Orix*
 Buglafaecht Weaver *Ploceus buglafaecht* (f)
 Black-headed Weaver *Ploceus cucullatus*
 Little Weaver *P luteolus*
 Vieillot's Black Weaver *P.nigerrimus* (f)
 Black-necked Weaver *P. nigrocollis*
 Cardinal *Quelea cardinalis* (RR)
 Red-headed Quelea *Q. erythroptus*
 Grey-headed Sparrow *Passer griseus*
 Pin-tailed Whydah *Vidua macoura*

ESTRILIDAE Waxbills Firefinches and, Mannikins

Brown Twinspot *Clytospiza monteiri*
 Waxbill *Estrilda astrild*
 Black-crowned Waxbill *E.nonnulla* (f)
 Fawn-breasted waxbill *Estrilda paludicola*
 African Firefinch *Lagonosticta rubricata*
 Red-winged Pytilia *Pytilia phoenicoptera*
 Red-checked Cordon Bleu *Uraeginthus bengalus*
 Black and White Mannikin *Lonchura bicolor*
 Bronze Mannikin *Lonchura cucullata*

FRINGILLIDAE

Golden-breasted Bunting *Emberiza flaviventris*
 African Citril *Serinus citrinelloides*
 Yellow-fronted Canary *S. mozambicus*

