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Source: Journal of East African Natural History, 85(1) : 49-63

Published By: Nature Kenya/East African Natural History Society

URL: https://doi.org/10.2982/0012-8317(1996)85[49:OOTDAE]2.0.CO;2

Journal of East African Natural History **85**: 49–63 (1996)

OBSERVATIONS ON THE DISTRIBUTION AND ECOLOGY OF BATS IN UGANDA

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ABSTRACT

Bat community patterns in Uganda are examined in relation to their occurrence in the different vegetation zones of the country. The data available so far cover only three of the country's floristic regions. These data suggest that the northern drier region U1 has more microchiropteran bats and that species diversity of megachiropteran bats tends to increase in the more forested western U2 and southern U4 regions. Species accounts in the appendix largely summarise the known information, they reveal that much more work is required to fully document the bats of Uganda.

INTRODUCTION

At the present time, 90 species of bats are thought to occur in Uganda (Davies and Vanden Berghe, 1994) comprising about 24% of the mammalian fauna of the country. They are represented by 13 species of mega-bats and 77 species of micro-bats. The distribution of Uganda's bats is as yet poorly known. A few species are widespread and migratory, (*e.g. Eidolon helvum*), and live in large roosts making them easy to see; the majority remain hidden until nightfall. Perhaps due to their activity periods and difficulty of observing them, very few studies of bats have been conducted in Uganda. Such studies include Mutere (1967) and Baranga and Kiregyera (1982) on *Eidolon helvum*; Mutere (1996), on bats of Uganda; Ogden-Odoi (1983), on the bat ecology of Entebbe peninsula; and Okia (1974a, 1974b, 1987) on breeding biology. Elsewhere in Africa, researchers such as Ansell (1960, 1989); Bergmans (1979); Happold *et al.* (1987); Herselman and Norton (1985); Jacobsen and du Plessis (1976) and Koopman (1975) have presented distributional information for various countries. Kingdon's 1974 monograph on insectivores and bats also contains a good amount of useful data on bats in East Africa.

This paper presents records of bat species accumulated in the course of general mammal surveys between January 1990 and July 1992. Except where museum specimens have been examined, species suspected to occur in the recording areas, but not encountered on these surveys, have been omitted until further surveys substantiate these. The paper also presents brief species accounts and breeding information where available.

The terms "mega-bat" and "micro-bat" are used in reference to mega-chiroptera and micro-chiroptera, respectively.

STUDY AREAS

Uganda is exceptionally diverse ecologically; a fact largely attributed to its location in east central Africa, a zone of overlap between ecological communities. According to White (1983), five of mainland Africa's 18 phytochoria (plant formations) are represented in Uganda.

When the work on the *Flora of Tropical East Africa* started in the 1950s, the East African region was, for convenience, subdivided in 'floral regions' corresponding with the then provinces (Turrill & Milne-Redhead, 1952). These regions are still widely used for biogeographical work in East Africa (for example, Vanden Berghe & Bytebier, 1995; Berg & Hijman, 1989). Uganda is divided into four such regions (figure 1). The bat surveys covered only patchy sampling in three of the regions.

1. The northern region: Sampling was done in the extreme west of floral region U1 (figure 1). This region is a savannah mosaic with riparian forest. In the extreme east, the floral region extends into a steppe of *Acacia* woodland. Biodiversity in this region is poorly known because very few ecological surveys have been done in this area. A recent survey (file report Forest Dept. Surveys), however, indicates the occurrence of about 200 species of trees with a rich avifauna. In this study, surveys here were done at different localities in:
   a) Mt Kei White Rhino Sanctuary which is characterised by a *Butyrospermum* savannah (Langdale-Brown *et al.*, 1964).
   b) Mt Otzi Forest Reserve characterised mainly by a moist thicket and a *Combretum* savannah to the south (Langdale-Brown *et al.*, 1964).
2. The western region: floral region U2 (figure 1) extends south from the north of Lake Albert. This region is fairly well documented as far as the more conspicuous biodiversity is concerned. For example, from ten forest reserves sampled, a total of 391 species of trees was found (Howard, 1991). Floristically, this is a region of savannah mosaic, tropical high forest and alpine montane vegetation. Surveys of bats have been conducted in six forest blocks (Kalinzu, Maramagambo, Kasyoha/Kitomi, Bwindi Impenetrable, Mt Rwenzori and Semliki Forests). The last three are now forest national parks.
3. The southern region: U4 (figure 1), has a mosaic of savannah and tropical high forest. Sampling from two forests in this region resulted in a pooled total of 257 species of trees (Howard, 1991). Surveys of bats in this region have been conducted on four islands in the Sese archipelago (Bugala, Bukasa, Bufumira and Semuganja) and a mainland site at Bukakata.

The vegetation figures for the northern region are based on general floral surveys in both savannah and riparian forest. In the western and southern regions, on the other hand, the figures represent only forest species; hence the figures for these two will be higher if savannah tree species are included.

METHODS

This paper is based principally on collections made in Uganda by Robert Kityo, on surveys supported by the Uganda Forest Department and Biodiversity Data Bank of Uganda, and a survey of the Rwenzori mountains, with W. Stanley, J.C. Kerbis and P.K. Austin of the Field Museum of Natural History, Chicago.

Additional confirmed country records have also been obtained from museum specimens at Field Museum of Natural History (FMNH), the Natural History Museum, London (NHML) and Makerere Zoology Museum (MUZM).

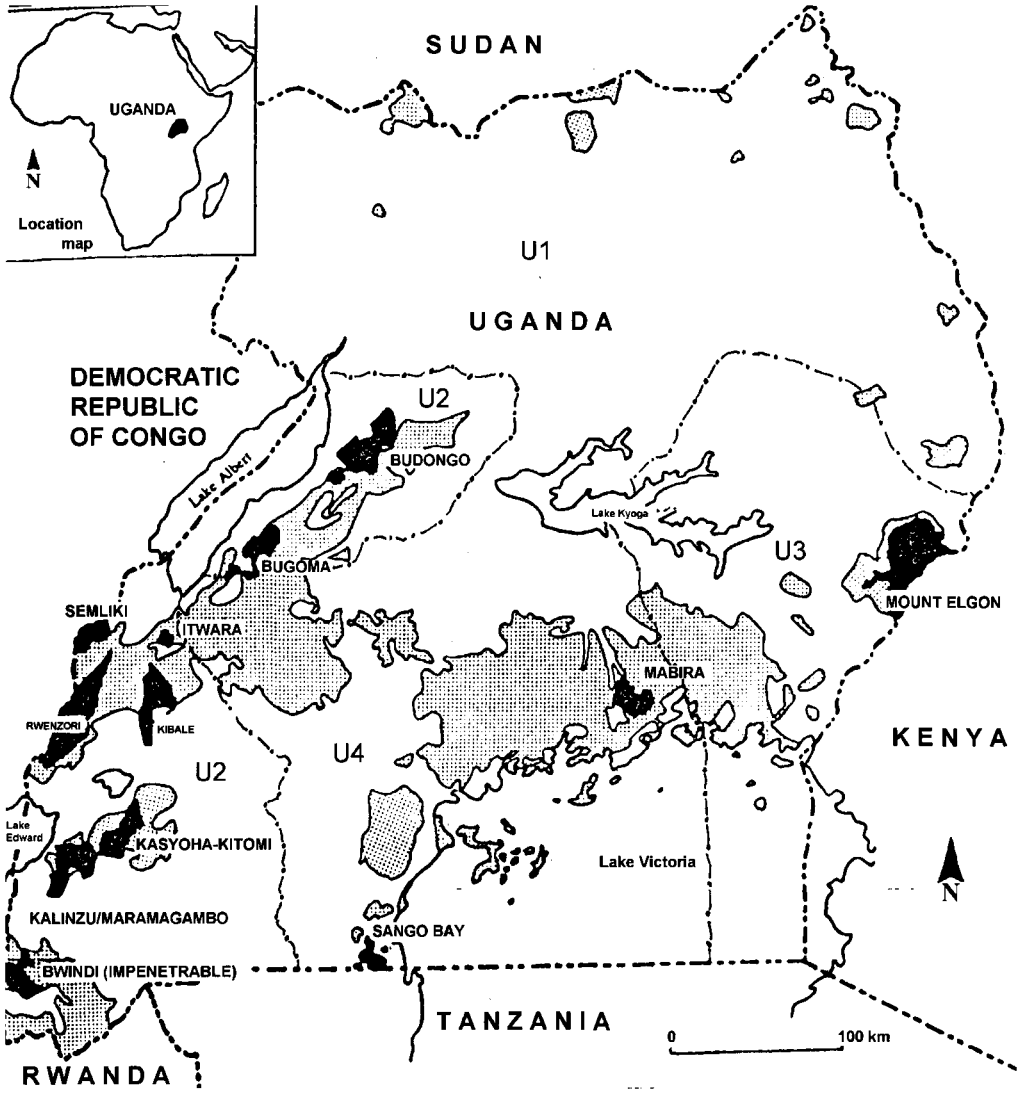

Figure 1. Map of Uganda showing the floral regions (as described in the text), and location of principal forest reserves, five of which today are forest National parks.

In an ongoing countrywide survey of mammals, mist nets have been used to sample bats. Bats are captured with 12m x 2m mist nets set in different habitat types in the sampling areas at a spacing of 5 to 10 metres. Wherever possible the nets are set across streams, paths or under fruiting trees, but where these do not exist, the nets are set randomly in the sampling habitat. The sampling regime is maintained for at least three nights and a maximum of seven nights with nets open from 1800 to 0600 in the morning.

The sampling effort has been measured in metre net hours (mnh)=total net length set x time of exposure in hours.

The capture data for each of the sites have been expressed per 100 metre net hours to make them comparable for the different sampling areas.

The captured animals were identified, measured, weighed, sexed and processed as museum voucher specimens now deposited with the FMNH at Chicago, and the MUZM at Makerere.

Ansell (1989) groups Hipposiderids and Rhinolophids under the same family, Rhinolophidae; in this paper we consider them as separate families as recognised in the *Checklist of Mammals of East Africa*.

RESULTS

The surveys resulted in a total sample of 397 bats, comprising 11 mega-bat and 24 micro-bat species. The micro-bats represent four species in the family Nycteridae, 13 species in the family Vespertilionidae, five species in the family Rhinolophidae, and two species in the family Molossidae.

Table 1 summarises records of the bat species encountered. These 35 species represent about 38.8% of the species that are expected to occur in the country. None of the regions so far shows the full array but 11 out of 13 species of mega-bats and 24 out of 77 species (31%) of the micro-bats have been encountered.

Overall, there is little apparent overlap so far between regions in species composition, with the following exceptions;

1. *Hipposideros ruber* and *Pipistrellus nanus*, which have been captured in all three regions.
2. *Micropteropus pusillus* and *Nycteris hispida* which have been captured in both the northern and southern regions.
3. *Epomophorus minimus*, which has been found in the western and northern regions. In the latter region, it is the second most abundant bat, after *M. Pusillus*. In the western region, it is known from only two specimens, one from Kasyoha/Kitomi and the other from Itwara forests.
4. Three species, *Rousettus angolensis*, *Rousettus aegypticus* and *Epomops franqueti* occur both in the western and southern regions.

The highest level of species overlap is observed between the southern and western regions, amounting to 25% of the recorded total bat fauna for both regions. These two regions also have a high floral similarity.

In comparison, there are 319 recorded species of forest related birds against 17 species of bats for the western region, and 166 recorded forest-related bird species against 13 species of bats for the southern region. The species number of birds in the northern region is not available for comparison but 16 species of bats were recorded.

Most species of mega-bats appear to have southerly distributions, ranging into the more forested region. There are three species of mega-bats in the northern region, six in the southern region, and nine in the western region. One species, *Epomophorus labiatus*, has been recorded only in the northwestern region.

In contrast to mega-bats, the northwestern region shows a higher micro-bat species count than either of the other two regions. Fourteen species (seven genera) have been recorded here, compared to eight species (five genera) and seven species (six genera) in the western and southern regions, respectively. Species like *Myotis welwitschii* and *Rhinolophus ruwenzorii*

have restricted distributions, with *Rhinolophus ruwenzorii* endemic to the Albertine rift. Such endemism has yet to be shown for any southern and northern species or genus. Kingdon (1974) commented that *R. ruwenzorii* is a rare relic species confined to forest refuges, so far recorded only in the Rwenzori mountains. Three species, *N. schlieffenii* (this paper), and *P. kuhlii* and *M. welwitschii* (Stanley *et al.*, 1996), are documented for Uganda for the first time.

Table 1. Bats encountered on the survey.

	Southern	Western	Northwestern
(1) Family Pteropodidae			
Megaloglossus woermanni	–	+	–
Eidolon helvum	+	+	–
Epomophorus labiatus	+	–	+
Epomophorus minimus	–	+	+
Epomops franqueti	+	+	–
Hypsignathus monstrosus	–	+	–
Micropteropus pusillus	–	+	
Myonycteris torquata	–	+	–
Rousettus aegyptiacus	+	+	–
Rousettus angolensis	+	+	–
Rousettus lanosus	–	+	–
(2) Family Nycteridae			
Nycteris arge	–	+	–
Nycteris hispida	+	–	+
Nycteris macrotis	–	–	+
Nycteris thebaica	–	–	+
(3) Family Rhinolophidae			
Hipposideros abae	–	–	+
Hipposideros caffer	–	–	+
Hipposideros ruber	+	+	+
Rhinolophus hildebrandtii	–	+	–
Rhinolophus ruwenzorii	–	+	–
(4) Family Vespertilionidae			
Eptesicus capensis	–	–	+
Eptesicus rueppellii	+	–	–
Eptesicus somalicus	–	–	+
Eptesicus tenuipinnis	–	–	+
Glauconycteris variegata	+	–	–
Miniopteris schreibersi	–	–	+
Myotis welwitschii	–	+	–
Nycticeinops schlieffeni	–	–	+
Pipistrellus inexpectatus	–	+	–
Pipistrellus kuhlii	–	+	–
Pipistrellus nanus	+	+	+
Scotoecus albofuscus	–	–	+
Scotophilus leucogaster	–	–	+
(6) Family Molosidae			
Tadarida condylurus	+	–	–
Tadarida pumila	+	–	–
Total	13	17	17

INFERENCES FROM CAPTURE DATA

Table 2 is a summary of the capture data for the surveys. It is apparent that there is a correlation between total sampling effort and the total number of animals caught (=0.523, p=0.05). But total capture may also depend on the location of the nets in the sampling habitat, for example, either over a stream or under a fruiting tree. However, increased sampling effort does not seem to increase the number of species caught. Therefore, to get a conclusive picture of the species occurrence another strategy will have to be sought. Further analysis suggests that:

- The number of species caught increased with trap rate.
- The total number of bat species occurring in a region seems to be unrelated to an increase in the number of tree species. Assuming that increase in tree species number may also directly reflect an increase in canopy cover, the results seem to presuppose that total number of bat species declines with increase in canopy cover or a difficulty capturing bats in forested areas.
- Similarly netting success is also lowered in the more forested southern and western regions.
- An increase in the richness of mega-bat species may be favoured by an increase in tree species diversity.
- The micro-bat species do not constitute a large proportion of the animals netted in forested areas.

Table 2. Summary of the netting capture data from the surveys. Trap rate is expressed per 100 m net hours of the sampling effort (total net length set x time of exposure in hours).

Region	Areas worked	Metre net hrs.	Species number	Number of individuals	Trap rate
Southern					
	Bukasa Is.	5616	4	37	0.658
	Bugala Is.	1872	6	19	1.015
	Bufumira Is.	1440	4	16	1.111
	Semuganja Is.	1440	2	6	0.417
	Bukakata	1752	4	9	0.514
Totals		12120	13	87	0.717
Western					
	K./Kitomi FR	3168	4	48	1.515
	Kalinzu FR	3312	4	25	0.755
	Maramagambo	432	2	3	0.694
	Bwindi	2736	5	6	0.219
	Rwenzori mts.	95040	5	73	0.076
Totals		104688	14	155	0.148
North–Western					
	Adjumani	144	2	2	1.38
	Metu	1080	2	14	1.296
	Dufile	1080	2	9	0.833
	Mt Kei	7056	4	42	0.595
	Mt Otze	2160	8	32	1.482
	Zoka	3456	11	56	1.620
Totals		14976	16	155	1.035

DISCUSSION

Use of mist nets to sample bats probably biases collections because only a small vertical elevation of about 4 m is trapped. Several authors including Cranbrook and Barrett (1965), and Kunz and Brook (1975), have discussed the problems and biases of using mist nets. Laval (1970), Kunz (1973), and Laval and Fitch (1977) discussed net avoidance especially by micro-bats that depend on echolocation in orientating and foraging.

Capture biases may also reflect flight behaviour; for example Kingdon (1974) presented some data on the heights at which bats fly. The lowest were recorded for *Cardioderma* and *Nycteris* at 3 m and *Myotis* and some *Pipistrellus* at 1 m. Some species, *e.g. Taphozous peli*, hunt for food above the canopy (Kingdon, 1974), and beyond the stratum sampled by nets.

However evidence from these surveys shows high flying species getting caught in nets at 3 m or lower (e.g. *Epomops* that fly at 10 m, and *Tadarida* at 3000 m (Kingdon, 1974). Also proportionately higher numbers of mega-bats are recovered from nets compared to micro-bats.

Though the results provided here are preliminary, they indicate that more species of bats are found in open environments than in forest in Uganda

There is also a suggestion of mega-bats tending more to forested zones, which no doubt fulfils their ecological requirement for food and probably shelter. However, they are not restricted to forest, with the only exceptions so far being *Epomops franqueti*, *Myonycteris torquata*, and *Megaloglossus woermanni*. And as Nadar (1978) observes, some species, for example *Rousettus aegyptiacus* have wide distributions in a range of habitats.

Kingdon (1974) believed that *Rousettus aegyptiacus* emanated from forest. Most of the specimens of this species during this survey were also captured from forest. *Eidolon helvum*, on the other hand, is capable of long distance migrations following food availability (Kingdon 1978, DeFrees and Wilson 1988). Kingdon (1978) suggested that was a tactic for exploiting the seasonal and widely dispersed fruit of the woodlands and savannahs. These bats appear to be specialists of open environments in Uganda. There is no evidence as yet to suggest that the rest of the species of bats recorded in Uganda have any elaborate migratory trends. For example, the Southampton University expedition of 1970 found no evidence of bats migrating from one island to another in the Sese archipelago even when the distance between the islands was only a few kilometres. Epomophorine bats, except for *Epomops franqueti*, appear to be more closely adapted to the savannah and woodland. Capture data available from the western and southern regions indicate they are very rarely caught deep into the forest.

R. aegyptiacus, *Tadarida pumila*, *Nycticeinops schlieffenii*, *Nycteris macrotis*, *N. thebaica*, and *N. arge*, are associated with the Afrotropical region and show trends suggesting that forest-related species, such as *R. aegyptiacus* and *N. arge*, range further south into the southern and western regions, unlike the non-forest related species. Note however that *Nycteris thebaica* has been recorded in Rwanda before (Baeten *et al.* 1984), where, as in Uganda, it is restricted to savannah areas. Numerous gaps have yet to be filled as regards the geographical range of bat species in the country. Several important systematic questions also remain to be answered, for instance whether *Rousettus lanosus* on Mt Elgon (Kingdon, 1974) is the same sub-species as that on the Rwenzoris.

Based purely on coincidental co-occurrence, the coefficients of association (table 3) show highly significant dissimilarities between the faunas of the Southern and Northwestern regions,

Table 3. Coefficients of similarity in species distribution of bats in the three Ugandan regions surveyed.

	Total	N/Western	Western	Southern
Total	1			
Northwestern	0.472	1		
Western	0.472	0.100	1	
Southern	0.361	0.115	0.250	1

and Western and Northwestern regions. This is because the Northwestern region fauna is composed mainly of micro-bats, with Afrotropical regional affinity. It remains to be seen whether the propositions made here will stand the test of time.

ACKNOWLEDGEMENTS

We would like to thank our collaborators, particularly from Uganda Forestry Department and the National Biodiversity Data Bank Makerere University Institute of Environment and Natural Resources. Funding from these Institutions made the fieldwork possible. Surveys in the Rwenzori Mountains were made possible by funding through the Field Museum of Natural History Chicago (FMNH). For permission to examine and work on Ugandan material at FMNH we thank the Administration of the Mammal section and at Natural History Museum, London (NHML) we thank Dr Paula Jenkins. Grants from FMNH scholarships committee and USAID Uganda made it possible for Robert Kityo to visit and work on Ugandan material at FMNH and NHML. Dr B. Patterson, Dr L. Heaney and W. Stanley of FMNH, and Dr D. E. Pomeroy, W. Olupot, C. Dranzoa and J. Arinaitwe of Makerere University read through the manuscripts and provided very useful comments.

REFERENCES

Addy, P.A.K., P.M. Tukei and A.B.C. Killango (1978). The immune status of East African bats to arboviruses. In R.J. Olembo, J.B. Castelino and F.A. Murere, eds., *Proceedings of the Fourth International Bat Research Conference*. Kenya National Academy for the Advancement of Arts and Sciences, Nairobi.

Ansell, W.F.H. (1960). Some fruit bats from Northern Rhodesia, with the description of a new race of *Epomophorus gambianus* Ogliby. *Revue Zoologique Botanicae Africaines*, Vol. **61**: 160–166.

Ansell, W.F.H. (1989). Mammals from Malawi: Part II. *Nyala* **13**(1/2): 41–65.

Baeten, B.L, V. Van Cakenberghe & F. De Vree. 1984. An annotated inventory of bats from Rwanda (Chiroptera). *Revue Zoologique Africaine*, **98**(1):183–196.

Baranga, J. & B. Kiregyera (1982). Estimation of the fruit bat population in the Kampala Bat valley, Uganda. *African Journal of Ecology*, **20**: 223–229.

Berg, C.C. & M.E.E. Hijman (1989). *Flora of Tropical East Africa: Moraceae*, Published on behalf of the East African Governments by A.A. Balkema. Rotterdam /Brookfield.

Bergmans, W. (1979). Taxonomy and zoogeography of the fruit bats of the People's Republic of Congo, with notes on their reproductive biology (Mammalia, Megachiroptera). *Bijdragen Tot De Dierkunde*, **48**: 161–186.

Claessen, C.J. and F. De Vree (1990). Systematic and taxonomic notes on the *Epomophorus anarus-labiatus-minor* complex with the description of a new species (Mammalia: Chiroptera: Pteropodidae). *Senckenberg. Biologica* **71**: 209–238.

Cranbrook, The Earl of, and H.G. Burrett (1965). Observations on noctule bats (*Noctalus noctula*) captured while feeding. *Proceedings of the Zoological Society of London*. **144**: 1–24. (with an appendix on net shyness by F. Yates)

Davies, G. and E. Vanden Berghe (eds) (1994). *A checklist of East African Mammals*. East African Natural History Society, Nairobi.

DeFrees, S.L. & Wilson, D.E. (1988). *Eidolon helvum. Mammal Species* **312**: 1–5.

Hayman, R.W. & J. Hill (1971). Order Chiroptera. In J. Meester & H.W. Setzer, eds. *The Mammals of Africa: An Identification Manual.* Smithsonian Institute Press, Washington.

Happold, D.C.D., M. Happold & J.E. Hill (1987). The bats of Malawi. *Mammalia* **51**: 337–414.

Herselman, J. & P. Norton (1985). The distribution and status of bats in the Cape Province. *Annals of the Cape Provincial Museum (Natural History)* **16**: 73–126.

Howard, P.C. (1991). *Nature Conservation in Ugandaś Tropical Forest Reserves*. IUCN, Gland, Switzerland and Cambridge, UK.

Jacobsen, N.H.G., & E. Du Plessis. (1976). Observations on the ecology and biology of the Cape fruit bat *Rousettus aegyptiacus leachi* in the Eastern Transvaal. *South African Journal of Science* **72**: 2 70-273.

Kingdon, J. (1974). *East African Mammals. An Atlas of Evolution in Africa*, Vol. 2. Part A. Academic Press, London and New York.

Kingdon, J. (1978). African bats in the context of forest-savannah interaction. In R.J. Olembo, J.B. Castelino & F.A. Mutere, eds. Proceedings of the Fourth International Research Conference. Kenya National Academy of Arts and Sciences, Nairobi

Koopman, K.F. (1975). Bats of the Sudan. *Bulletin of the American Museum of Natural History* **154**: 355–443.

Kunz, T.H. (1973). Resource utilisation: Temporal and spatial components of bat activity in central Iowa. *Journal of Mammalogy* **54**: 14–32.

Kunz, T.H & C.E. Brook (1975). A comparison of mist nets and ultrasonic detectors for monitoring flight activity of bats. *Journal of Mammalogy* **56**: 907-911.

Langdale-Brown, I., H.A. Osmaston & J.G. Wilson (1964). *The vegetation of Uganda and its bearing on land-use*.

Laval, R.K. (1970). Banding returns and activity periods of some Costa Rican bats. *Southwestern Naturalist* **15**: 1–10.

Laval, R.K. & H.S. Fitch (1977). Structure, movements and reproduction in three Costa Rican bat communities. *Occasional Papers Museum of Natural History, University of Kansas* **69**: 1–28.

Mutere, F.A. (1966). On the bats of Uganda. *Uganda Journal*. **30**: 75–79

Mutere, F.A. (1967). The breeding biology of equatorial vertebrates; reproduction in the fruit bat *Eidolon helvum*, at latitude 00°20' N. *Journal of Zoology (London)* **153**: 153–161.

Mutere, F.A. (1980). *Eidolon helvum* revisited.. In D.E. Wilson and A.L. Gardener, eds. *Proceedings of the Fifth International Bat Research conference*. Texas Tech Press, Lubbock, Texas, pp. 145–150.

Okia, N.O. (1974a). The breeding pattern of the Eastern epauletted bat, *Epomophorus anarus* Heuglin, in Uganda. *Journal of Reproductive Fertility* **37**: 27–31.

Okia, N.O. (1974b). Breeding in Franquet's bat, *Epomops franqueti* (Tomes) in *Journal of Mammalogy* **55**: 462–465.

Okia, N.O. (1987). Reproductive cycles of East African Bats *Journal of Mammalogy* **68**(1): 138–141.

Rosevear, D.R. (1965). *The bats of west Africa*. British Museum (Natural History) London, 418 pp.

Southampton University Expedition. (1970). Report on the Southampton University expedition to the Sese Islands, Uganda, 1970.

Stanley, W.T., J.C.P. Kerbis & R.M. Kityo (1996). New records of bats for Uganda and Burundi. *African Journal of Ecology* **34**: 196-241.

Turrill, W.B. & E. Milne-Redhead, (eds.) (1952–continuing). *Flora of Tropical East Africa*. (numerous vols.) Crown Agents, London. (Later volumes by other editors, and published by A.A. Balkema, Rotterdam.)

Vanden berghe, E.V. & B. Bytebier (1995). Orchids of East Africa: some statistics on their distribution. *EANHS Bulletin* **25**:2.

White, F. (1983). *The Vegetation of Africa*. Natural Resources Research 20. Paris: UNESCO.

APPENDIX: SPECIES ACCOUNTS

Family Pteropodidae

Megaloglossus woermanni

Judging from collections, this species is not very common. It is known from a few specimens from Uganda. One specimen was collected 22 miles west of Kampala, (Hayman and Hill, 1971). Mutere (1966) reported this bat being captured in Mabale forest, west of Kampala. Kingdon (1974) reported seven bats netted in the Bwamba forest, an adult female from north Kigezi and also specimens from Entebbe. Addy *et al.* (1978) netted four specimens in Zika forest. The latter is probably the most easterly range of these bats in East Africa. A female that had one embryo was captured in Maramagambo forest by this survey in March 1992 (specimen 1466 at MUZM). Reproductive activity has however previously been recorded for this bat to occur over much of the year.

Kingdon (1974) supposes this bat might migrate or at least follow the local flowering cycles of its favourite trees.

Eidolon helvum

Baranga and Kiregyera (1982) reported a colony of about 70,388 roosting on trees in the Kampala bat Valley, Uganda. The average number of bats per tree was 310; the average number of clusters per branch was four; and the average cluster size about eight. This colony has since broken up into smaller groups found roosting at different areas around Kampala. A colony of *Eidolon helvum* was also recorded in Hoima town in 1990 by this survey. Mutere (1980) and DeFrees and Wilson (1988) reported that *E. helvum* are migratory. Reproductive activity in this species shows a peak from October to February.

Epomophorus minimus

The taxonomic characterisation for this and the next species presents some difficulty. Claessen and de Vree (1990) examined the *Epomophorus anarus-labiatus-minor* complex and pointed out the mix up in taxonomy for specimens that until then were described either as *Epomophorus anarus* or *Epomophorus labiatus*. Basing on the materials examined they suggested the new name *E. minimus* we also use here, and dropped the earlier *E. anarus*. However, Addy *et al.* (1978) reported having netted *E. anarus* at Bugabo, Kisubi, Lunyo,

Zika, Sebei, Tororo, Mbale, Soroti, Lira, Mubende, Fort Portal, and Bwamba. These materials if re-examined based on criteria similar to those employed by Claessen and de Vree (1990) might also turn out to represent the two species *E. labiatus* or *E. minimus* or either of these. *Epomophorus minimus* has been recorded by these surveys in western and northwestern Uganda.

Epomophorus labiatus
This species of bat was commonly netted in northwestern Uganda. It may be restricted to savannah habitats in northern Uganda since no specimens have been taken from elsewhere.

Epomops franqueti
A common species in some of the forested areas surveyed, but probably restricted to low altitude forests in Uganda. Addy *et al.* (1978) reported this bat in Uganda netted from Bugabo, Lunyo, Masaka, and Zika forests.

A few instances of gravid females with twins were recorded, but the majority of gravid females carried only single embryos. These surveys have recorded these bats from Bufumira, Bugala, Bukasa and Semuganja islands, as well as from Bukakata, Kasyoha/Kitomi, Kalinzu and Smiliki forest reserves.

From observations made by these surveys and earlier documentation, reproductive activity in this bat appears to continue all year round.

Hypsignathus monstrosus
Probably a wide spread species in Uganda. Bat calls attributed to this species have been recorded in different areas, but its presence has yet to be confirmed. This survey took two adult female bats from Itwara forest July 1992; specimens P1456 and P1457 at MUZM; a third specimen of unknown origin is also deposited at MUZM.

No reproductive data is so far available for this bat in Uganda.

Micropteropus pusillus
Records so far available suggest this to be an abundant species in open environments; it has been netted in regions U1 and U4. A few specimens have, however, been captured in nets set in forests near the forest edge. Robert Kityo observed these bats roosting either singly or in pairs in the forest on Bugala Island. Capture results suggest they may congregate at a food resource. Addy *et al.* (1978) reported this species netted at Bugabo, Zika forest, and Soroti. No reproductive activity was observed on these surveys for this species; however, Okia (1987) showed its reproductive activity to occur between November and March.

Myonycteris torquata
Rosevear (1965), based on collections, commented that this genus is among the rarest of mega-bats. An adult male and female were captured in a closed mixed swamp forest in Kalinzu forest on 6 March 1992. The male had scrotal testes with a crown rump of 2.6 x 2.9 mm and the female was pregnant with a single embryo. The female bat had heavy layers of fat all over the body while the male had a little fat only around the neck.

Rousettus aegyptiacus
In Uganda this appears to be a predominantly low-altitude bat. In these surveys, it was netted in Kasyoha-Kitomi forest and Kalinzu forest reserves. Addy *et al.* (1978) reported specimens captured from Entebbe, Masaka, and Zika forests. According to Okia (1987) reproductive activity in this species occurs all year round.

Rousettus angolensis
This species has been captured in the Rwenzori mountains, Kasyoha-Kitomi and Kalinzu Forests, and on Bukasa Island. It is probably a widespread species and sympatric with *Rousettus aegyptiacus* and *R. lanosus* in different habitats. The reproductive data available for this species so far is too scanty to warrant any interpretation of trends.

Rousettus lanosus
This rousettine bat is restricted to montane forest; it has been netted from altitudes of 2917 m to 3683 m on the Rwenzori Mountains. A single specimen, though, was captured here at 2067 m while two others were captured at 2150 m in the Bwindi forest. It is also reported to occur on Mt Elgon in eastern Uganda (Kingdon, 1974). These bats are probably abundant in suitable habitats and possibly are aggregate feeders because as many as ten animals may be caught in a single net. So far there is no clear trend for the reproductive cycle of this species.

Family Nycteridae
Nycteris hispida
A common species in region U4, but not commonly caught in nets. They have been observed to roost on the lower side of opened banana leaves and in short bushes, singly or in groups of two to six. They have been captured on Bugala and Bufumira islands. Two adult males with scrotal testes (in April 1990) and an adult female (in November 1989) were taken. A female netted on Bugala in October 1991 had one embryo in the left uterine horn (CRL=5.5 mm), while a male taken at the same time had scrotal testes of 4 x 4 mm. Two specimens were netted on 30 January 1992 in Otze Forest Reserve an adult male (KRM 1417 at MUZM) and an adult pregnant female (KRM 1418 at MUZM). These observations appear to suggest that reproductive activity for this species may continue throughout the year.

Nycteris arge
From capture data, this species does not appear to be common. Three specimens have been taken, two adult males with large scrotal testes from Maramagambo Forest in March 1992, and a single adult female with an embryo in the left uterine horn from Semliki Forest in June 1992. From these specimens it may appear that this species is restricted to forest.

Nycteris macrotis
Two adult male bats were netted on the 30th January 1992 on a hill in Otze Forest Reserve, an area of mixed undifferentiated semi-deciduous thickets and *Butryospermum-Daniellia-Hyparrhenia* savannah. The specimens KRM 1419 and 1420 are deposited at MUZM.

Nycteris thebaica
Is represented by two specimens netted at the same time on these surveys from the same location as *N. macrotis*. The specimens KRM 1417 and 1418 are deposited at MUZM.

Family Rhinolophidae
Rhinolophus ruwenzorii
Four specimens of this montane endemic bat were netted by these surveys from the Rwenzori mountains, at altitudes of 2100 m and 2700 m. All four animals were adult males, but only one had scrotal testes. The low netting success for this bat may suggest that it is uncommon.

Rhinolophus hildebrandtii
A single specimen was taken from an old mine tunnel in Bwindi forest in August 1989. These bats have been observed roosting in groups: in the Bwindi forest tunnel they were observed to roost singly or in groups not larger than five individuals. The specimen taken (BF3 at MUZM) was an adult male with scrotal testes of 5 x 5 mm.

Family Hipposideridae
Hipposideros abae
One specimen, an adult male (KRM 1423 at MUZM) was netted in Otze Forest Reserve in January 1992.

Hipposideros caffer
Three adult females were netted next to a small river in Otze forest reserve, specimens KRM 1410, 1411, 1412 at MUZM. This species is probably sympatric with *Hipposideros ruber* but has not been netted in the places where *H. ruber* is common.

Hipposideros ruber
Common bat in Uganda that roosts in caves, roofs, or other suitable shelter in fairly large colonies. A colony roosting in a cave on Bugala Island about 1.5 km south of Kalangala town and another one in the roof of the administration building at Makerere University were recorded in the last two years. These bats have been netted in all three regions surveyed. Two adult females (KRM 1389, 1400 at MUZM) were netted over a small river in Otze Forest Reserve with one of them gravid. Nine adult females and four adult male bats were netted on Bugala Island (April 1990). Another adult male was netted on the same island in October 1991 with large scrotal testes (of 4.7 x 5 mm). One adult female netted at Ruhiza, Bwindi forest, in September was pregnant with a foetus of CRL=22 mm. Four females netted in Semliki forest in June 1992 were all pregnant

Family Megadermatidae
Lavia frons
A common bat of woodlands, often observed flying during the day. The species has been recorded by this survey in Queen Elizabeth National Park, Lake Mruro National Park, and Kasese town. Addy *et al.* (1978) examined a specimen caught at Zika.

Family Vespertilionidae
Myotis welwitschii
Probably restricted to montane forest in Uganda. The present specimen (FMNH144313) is a new country record (Stanley *et. al.* 1996.) known from a single specimen. The specimen was netted at an elevation of 2066m above the confluence of Rivers Mubuku and Kyoha in the Rwenzoris.

Pipistrellus nanus
Apparently a widespread species in the country, specimens having been taken from all three regions surveyed. Five bats recovered from a young folded banana frond on Bukasa Island in May 1990 consisted of two females that were post parous with large nipples. Three males had large scrotal testes of 4 x 2.5, 5 x 4, and 6 x 3 mm. A specimen netted on Bugala island in

October 1991 was also an adult female with large nipples but not pregnant. An adult pregnant female was netted in Semliki forest in June 1992.

Pipistrellus kuhlii
Represented by one specimen (FMNH144317) netted from the Rwenzori mountains in April 1991. This specimen represents the first record of this bat in Uganda. Stanley *et al.* (1996) present more information on this specimen.

Pipistrellus inexpectatus
A single adult female with large nipples, netted at Ruhiza, Bwindi forest in September 1991, was lactating.

Pipistrellus rueppellii
Not a common species in the collection of this survey, a single adult male was collected at Nkozi hospital in 1990. It is also represented by one specimen (FMNH29432) collected from Rhino Camp in March 1927 by J.T. Zimmer.

Eptesicus tenuipinnis
A single bat (specimen KRM1433 at MUZM) was netted outside Zoka forest in February 1992.

Glauconycteris variegata
One specimen was netted in July 1990 at the forest edge of Jubiya forest at Bukakata. The single adult female had a swollen uterus and large nipples. Addy *et al.* (1978) also reported one specimen netted at Bugabo.

Miniopteris schreibersi
One specimen (KRM1435 at MUZM) was collected by this survey outside Zoka forest in February 1992.

Miniopteris inflatus
Represented by a single male specimen (FMNH144314) netted in the Rwenzoris (2300m) above the Mubuku and Mahoma rivers confluence in November 1990.

Another five species of this family, *Eptesicus capensis*, *Eptesicus somalicus*, *Scotoecus albofuscus*, *Nycticeinops schlieffeni* and *Scotophilus leucogaster*, were only recorded by these surveys in the Northern region in Zoka forest.

Family Molosidae
Tadarida pumila
This is probably a more widespread species than is suggested by the capture data. Specimens have been taken from Bukasa, Bugala, and Bufumira islands, and at a forest edge at Bukakata. A fairly large colony was recorded roosting in a roof of a house at Lwankima forest station, Mabira Forest in 1987.

Tadarida condylurus
One specimen netted at the forest edge near Bukakata in July 1990.

Other species

This section is based upon museum specimens examined at FMNH, MUZM, and NHML that were not encountered on the surveys.

Hipposideros cyclops is represented by a single male (FMNH73076) in the FMNH collection and another (52.16707) at NHML netted in November 1945 by the Walter Buchen Africa Expedition and October 1951 by P.C. Perry respectively in the Bwamba (Semliki) forest.

Rhinolophus clivosus is represented by three males and three females at FMNH (FMNH26510 to 26515) that were netted in Kigezi by Heller in January 1926, and four specimens (31.4.1.5 and 34.4.1.4–34.4.1.6) at NHML, collected by Foster on Mt Elgon.

Eptesicus somalicus is represented by a single specimen (FMNH86012) deposited at FMNH. This was taken from Kigumba by H. Hoogstral in August 1956.

Myotis bocagi is represented by six specimens deposited at FMNH (FMNH26501–26506), collected by E. Heller in November 1925 in Kigezi around Lake Bunyonyi. Another six specimens are deposited at NHML. Five of these (11.12.3.4–11.12.3.8) were netted at Entebbe in March 1911 by Robin Kemp, while 11.6.6.5 was netted from Harubale in Toro by Someren.

Scotoecus hirundo is represented by three specimens deposited at NHML (74.1, 74.3, 74.4) that were netted by J.E. Kingdon in May 1971 from Budongo forest.

Scotophilus nigrita is represented by four specimens deposited at NHML, (60.1983 netted from Kitgum by T.S. Jones; 66.3610 netted from Moroto April 1960 by A.C. Brooks; 66.3611 netted in Masindi April 1966 by A.C. Brooks and 0.6.21.2 netted form northern Uganda by Lord Delamere.

Mops trevoli: Five specimens of this species are deposited at NHML, (63.1154, 64.197, 64.193 and 64.195 netted from Metu rest camp, West Nile by T.S. Jones in 1962; and 75.2712 netted over the Semliki plains by A.N. Start in July 1968).

Chaerophon ansorgei is represented by a single specimen (66.3613) at NHML netted by A.C. Brooks in June 1959 in Masindi.

Chaerophon major is represented by three specimens (63.1 to 63.3) at NHML that were netted by Trucker near Ngora rest house in Teso in August 1962.