

ORIGINAL ARTICLE

Small mammal diversity and habitat requirements in the Kahuzi-Biega National Park and surrounding areas, eastern Democratic Republic of Congo

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Abstract

We conducted a study on diversity and habitat requirements of small mammals in the western part of the Albertine Rift, eastern Democratic Republic of Congo. The work aimed at providing a more complete list of species recorded to date and their habitat requirements to aid conservation efforts in the region. Trapping was conducted using Museum special, Victor traps, Sherman live traps and pitfall traps in four different habitats. A total of 57 species was recorded. Plantations and open habitats harbored the same species. In the forested areas we recorded 30 species which are not tolerant to disturbance. Eighteen species are Albertine Rift endemics. One species (*Lophuromys cinereus*), which is vulnerable and data deficient, has been recorded only in swamp. This study has recorded more species than the previous studies, some of which have not been reported in earlier studies. Differences between this and earlier studies are attributed to methods and the areas sampled. Some of the habitats sampled by previous workers have not been assessed. More research is needed, especially in swamps in mountain areas and in deep forests inhabited by species not present at lower altitudes.

Key words: diversity, habitat requirements, Kahuzi-Biega, small mammal.

INTRODUCTION

Geographical variation in biological diversity is one of the most conspicuous patterns in biology. While research on patterns of diversity in natural habitats takes place in an unprecedented rate, less information is available for Eastern and Central Africa where biodiversity at all taxonomic levels is high and habitats are under exceptional threats (Plumptre 2003). Previous research on small mammals in the west of Lake Kivu (which comprise Kahuzi-Biega National Park, KBNP) included

programs on the zoonoses in Central Africa (Rahm 1967), studies of mammals of Central Equatorial Africa, East of Congo (Rahm 1966), expeditions to forested areas of east and central Africa (Allen & Loveridge 1942), and studies of the population ecology of murids of Kivu/Congo (Dieterlen 1967-1985 a,b). These extensive studies resulted in species lists with information on the ecology of a few selected species.

Since the 1980s, attention of researches was focused on a few species of the KBNP that appealed to tourists, such as gorillas, chimpanzees and forest elephants, neglecting the small mammals that are the most abundant component in terms of individuals and species numbers. The current study started in 1999, motivated by the need to update the species list and explore particular habitats

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such as montane swamps and forests.

Previous studies by Dieterlen (1967), van der Straeten and Kerbis (1999), Fahr *et al.* (2002) and Kityo *et al.* (2003) have reported some unique species from the region: *Crocidura kivuana* (Insectivora: Soricidae), *Lophuromys cinereus* (Rodentia: Muridae), *L. medicaudatus* (Rodentia: Muridae), *L. rahmi* (Rodentia: Muridae), *Micropotamogale ruwenzori* (Insectivora: Tenrecidae), *Praomys degraaffi* (Rodentia: Muridae) *Rhinolophus ruwenzori* (Chiroptera: Rhinolophidae), and *R. hilli* (Chiroptera: Rhinolophidae). A recent report states that the endemic mammalian communities of the Albertine Rift contain 25 strictly endemic species and a further 11 species are regarded as near endemic (Blom & Bowie 2004). The endemic mammal fauna is dominated by small mammals with 10 species of shrews and 12 species of rodents (Plumptre 2003). The few large mammals endemic to the region include the gorilla subspecies, *Gorilla beringei graueri*. The area is characterized by habitat transformation and loss, exacerbated by an increase of the human population over the last four decades (current average population density is approximately 300 inhabitants/km²). Pressure resulting from the increasing human population endangers species and threatens ecosystem (Inogwabini *et al.* 2000). This threat has been aggravated by the successive wars the region has experienced.

This paper aimed at updating the list of species recorded in the region and to compare it with previous studies in the same region (Rahm 1967, Rahm & Christiaensen, 1966, Dieterlen 1967, 1969, 1985 a,b) in order to determine changes in species composition and distribution.

MATERIALS AND METHODS

Study area

The study area was located in the eastern Democratic Republic of Congo, on the western side of the Albertine Rift, which is characterized by high species richness and levels of endemism at all altitudes. It extends from Idjwi Island in Lake Kivu to the montane sector of KBNP and comprises five sites outside the park and five others inside the park (Table 2). Outside the park, sites were characterized by degraded forests surrounded by cultivated fields or transformed into cultivated fields (Idjwi Island, 2001; Kakondo (2), Mugeru (1), 2002, Lwiro and Tshibati (3) 1999-2005). Dominant plant species in these degraded forests were *Albizia grandibracteata*, *Craterispermum schweinfurthii*, *Maytenus spp.* and *Syzigium*

africanum. Within KBNP, three habitat types were sampled. 1) Primary forest dominated by *Parinari excelsa*, *Conopharyngia durissima*, and *Albizia gummifera*. 2) Secondary forests dominated by *Macaranga kilimandscharica*, *Bridelia bridelifolia*, *Sapium ellipticum*, *Maesa lanceolata*, *Neoboutonia microcalyx*, *Poliscia fulva*; and 3) *Cyperus latifolius* swamp.

Further details regarding the vegetation are given elsewhere (Yamagiwa *et al.* 1993, 1996). The forests in the montane sectors of KBNP were characterized by dense and abundant undergrowth. In agricultural areas crops such as maize, sorghum, manioc and beans were grown.

Trapping and analysis

A combination of traps was used including two kinds of snap traps (Museum Special and Victor Rat traps), Sherman live traps and Pitfall buckets. Two to four traps were set up at every trapping station, each transect had 10-20 trapping stations. The distance between traps was 1 m, and the distance between trapping stations was ± 10 m. In forested habitat, some traps were set above ground level to catch climbing species as suggested by Dickenson & Kityo (1994). Other traps were placed in streams. Drift fences were placed between buckets to minimize the loss of individuals passing between buckets.

Traps were baited with a mixture of peanut butter and oat, manioc, groundnuts, bananas, dried fish or meat. Some specimens caught with live traps in the park were released after identification and recording of standard measurements.

Preliminary identification of specimens was carried out in the field and the type of trap, microhabitat and name of collector were noted. In the laboratory, identification was confirmed following Delany (1975), Kingdon (1997), Wilson & Reeder (1992) and Meester & Setzer (1971). All specimens collected were prepared as skin and skeleton (SSK) for intact animals, skeleton only (SK) for the deteriorated specimens or preserved in formalin (5 %) or alcohol (90 %). Tissue samples for genetic studies were preserved and the results of the analyses will be reported elsewhere. Areas inside or around cultivation are considered open habitats because in this region, cultivation is only practiced outside the forest which is only found in protected areas.

RESULTS

Species composition and habitat requirement

A total of 57 small mammal species were recorded dur--

Table 1 Species list, habitat requirement of small mammals in west of Lake Kivu, eastern DR Congo

No	Species	Primary forest	Secondary forest	Swamp	Cultivation/ Plantation	Gallery forest	Bamboo forest	Homes
01	<i>Atherurus africanus</i>	x	x	x				
02	<i>Chlrysochlorys stuhlmanii</i>			x				
03	<i>Colomys goslingi</i>			x				
04	<i>Cricetomys gambianus</i>	x	x					
05	<i>Crocidura hildegardae</i>					x		
06	<i>Crocidura kivuana</i>		x	x			x	
07	<i>Crocidura lanosa</i>		x	x				
08	<i>Crocidura litoralis</i>			x				
09	<i>Crocidura olivieri</i>		x		x			
10	<i>Crocidura turba</i>		x	x				
11	<i>Crocidura nigrofusca</i>			x				
12	<i>Dasymys incomtus</i>	x		x				
13	<i>Dasymys sp.</i>	x	x					
14	<i>Delanymys brooksi</i>	x	x	x				
15	<i>Dendromys insignis</i>		x	x				
16	<i>Dendromys nyasae kivu</i>		x			x		
17	<i>Dendromys sp.1</i>	x						
18	<i>Dendromys sp.2</i>	x	x					
19	<i>Funisciurus carruthersii</i>	x	x					
20	<i>Grammomys dolichorus</i>	x		x		x		
21	<i>Graphiurus murinus</i>							x
22	<i>Hybomys univittatus</i>	x	x	x				
23	<i>Hybomys sp.</i>	x	x					
24	<i>Hylomyscus vulcanorum</i>	x	x	x			x	
25	<i>Lemniscomys striatus</i>				x	x		
26	<i>Lophuromys flavopunctatus</i>	x	x	x	x	x	x	x
27	<i>Lophuromys luteogaster</i>	x		x				
28	<i>Lophuromys medicaudatus</i>	x	x	x				
29	<i>Lophuromys rahmi</i>	x	x	x				
30	<i>Lophuromys woosnami</i>	x	x	x				
31	<i>Malacomys longipes</i>	x	x					
32	<i>Mastomys coucha</i>				x	x		
33	<i>Mastomys natalensis</i>				x			
34	<i>Micropotamogale ruwenzori</i>			x				
35	<i>Mus bufo</i>	x	x	x				
36	<i>Mus gratus</i>	x	x					
37	<i>Mus minutoides</i>				x	x		
38	<i>Mus sp.</i>		x					
39	<i>Mus triton</i>			x	x			
40	<i>Myosorex babaulti</i>			x				
41	<i>Oenomys hypoxanthus</i>		x	x	x	x	x	x
42	<i>Otomys denti</i>		x	x				
43	<i>Otomys irroratus</i>	x	x					
44	<i>Otomys tropicalis</i>		x		x			
45	<i>Paraxerus boehmi</i>	x	x					
46	<i>Pelomys fallax</i>				x			

(to be continued)

(continued)

47	<i>Potamogale velox</i>			x				
48	<i>Praomys degraaffi</i>	x	x	x				
49	<i>Praomys jacksoni</i>	x	x	x	x	x	X	x
50	<i>Praomys</i> sp.	x	x					
51	<i>Rattus rattus</i>				x	x		x
52	<i>Scutosorex somereni</i>			x				
53	<i>Suncus megalura</i>			x				
54	<i>Sylvisorex lunaris</i>	x	x	x				
55	<i>Sylvisorex megalura</i>			x				
56	<i>Sylvisorex vulcanorum</i>			x				
57	<i>Tachyoryctes rwandae</i>			x				

ing this study comprising 42 rodent species and 15 shrew species (Table 1). Of these species, *Praomys jacksoni* was the most abundant in terms of individuals captured. *P. jacksoni*, *Lophuromys flavopunctatus*,

Graphiurus murinus, *Grammomys dolichorus*, *Oenomys hypoxanthus*, *Otomys denti* and *Otomys tropicalis* were wide spread and were present in all the habitat types sampled. Most of these species were forest dependent. *Colomys goslingi* was the only species whose habitat was restricted to streams or swamps, while five species (*Lemniscomys striatus*, *Mus munitoides*, *Mastomys coucha*, *Mus triton* and *Pelomys fallax*) relied on open habitats, mostly near cultivation (Table 2). Some shrew species such as *Crocidura lanosa* and *Crocidura olivieri* were collected in open habitats but most shrews were found in swamps or wet habitats and could occur in deep forest (primary or secondary forest). Open habitats were not important in terms of surface area covered in the sampled sites. The bamboo forest was poor in species diversity: *Praomys jacksoni*, *Hylomyscus vulcanorum* and *Lophuromys flavopunctatus* were present with one individual each.

New records for the study area

Ten species were new records in the study area. These comprised of five rodent species namely: *Atherurus africanus*, *Dasimus benthelyae*, *Grammomys surdaster*, *Mus gratus* and *Praomys degraaffi*. Five species of shrew were also new records. These are: *Crocidura kivuana*, *Crocidura litoralis*, *Crocidura turba*, *Sylvisorex megalura* and *Sylvisorex vulcanorum*. Further, five other unidentified species could also be added to the list: *Dasymsus* sp, *Dendromus* sp.1 and *Dendromus* sp.2, *Mus* sp., and *Praomys* sp. Genetic analyses will be used to

identify these species.

Species conservation status and levels of threat

Our study had recorded 18 Albertine Rift endemic species of which six were shrews and twelve were rodents; one species (*Funisciurus carruthersi*) was vulnerable, one other (*Micropotamogale Ruwenzori*) is endangered and one, a data deficient species (*Lophuromys cinereus*), has never been caught since its first description in this area. Two species are near endemics and three species are near threatened (Table 2). Habitat transformation continues in an unprecedented rate outside the park; this may lead many forest dependant species to become threatened because of habitat loss.

Elevational distribution

Crocidura kivuana, *Crocidura* sp., *Hylomyscus vulcanorum*, *Lophuromys medicaudatus*, *L. rahmi*, *L. woosnami*, *Praomys degraaffi*, and *Sylvisorex vulcanorum* were caught at altitudes between 2000 and 2500 m; no individual of these species was captured below this altitude. *Grammomys dolichorus*, *Hybomys lunaris*, *Lophuromys flavopunctatus*, *Mus bufo*, *Oenomys hypoxanthus* and *Praomys jacksoni* were present in all altitudinal ranges, while *Lophuromys luteogaster* occurred below 2000 m. During the sampling, we could not reach altitudes above 2500 m because of the precarious security in those parts.

DISCUSSION

Species composition

The species list is slightly different to the previous

Table 2 Comparison of species lists for different works in the study area

No	Species	R-C		Diet		Rahm		PB01	PB02	PB03	PB04	PB05	Opportunistic		Status
		IDJ	Lwiro	ELK	IDJ	LW-MU	KBNP	KBNP	KBNP	KBNP	Out Park				
01	<i>Atherurus africanus</i>											x			
02	<i>Chrysochloris stuhlmanii</i>	x									x				
03	<i>Colomys goslingi</i>			x								x	x	x	
04	<i>Cricetomys gambianus</i>			x										x	
05	<i>Crocidura hildegardae</i>												x		
06	<i>Crocidura kivuana</i>											x	x	x	AR
07	<i>Crocidura lanosa</i>											x	x	x	AR
08	<i>Crocidura litoralis</i>											x			
09	<i>Crocidura olivieri</i>											x	x		
10	<i>Crocidura nigrofusca</i>												x		
11	<i>Crocidura turba</i>											x			
12	<i>Dasymus incomtus</i>			x									x	x	
13	<i>Dasymus</i> sp.												x		
14	<i>Delanymys brooksi</i>			x	x										AR
14	<i>Dendromus insignis</i>			x								x	x	x	
15	<i>Dendromus kahuziensis</i>			x											LR/nt/AR
16	<i>Dendromus nyasae</i>											x	x		
17	<i>Dendromus</i> sp.1											x			
18	<i>Dendromus</i> sp.2											x	x		
19	<i>Deomys ferrugineus</i>			x											
20	<i>Funisciurus carruthersi</i>	x												x	VU/AR
21	<i>Grammomys dolichorus</i>	x	x	x	x	x	x	x	x	x	x	x	x	x	
22	<i>Grammomys surdaster</i>													x	
23	<i>Graphiurus murinus</i>	x			x						x	x	x		
24	<i>Hybomys lunaris</i>			x									x	x	NE
25	<i>Hybomys univittatus</i>			x	x			x	x				x	x	
26	<i>Hybomys</i> sp.											x			
27	<i>Hylomyscus vulcanorum</i>				x			x	x	x				x	
28	<i>Lemniscomys striatus</i>			x								x		x	
29	<i>Lophuromys cinereus</i>			x											DD/AR
30	<i>Lophuromys flavopunctatus</i>	x	x	x	x	x	x	x	x	x	x	x	x	x	
31	<i>Lophuromys luteogaster</i>			x	x			x	x	x	x	x			
32	<i>Lophuromys medicaudatus</i>			x								x			LR/nt/AR
33	<i>Lophuromys rahmi</i>				x			x	x	x	x	x	x		LR/nt/AR
34	<i>Lophuromys woosnami</i>				x			x	x	x	x	x	x		AR
35	<i>Malacomys longipes</i>			x	x					x	x	x			
36	<i>Mastomys coucha</i>			x								x		x	
37	<i>Mastomys natalensis</i>													x	
38	<i>Micropotamogale ruwenzori</i>												x		EN/AR
39	<i>Mus bufo</i>	x	x	x	x	x	x	x	x	x	x	x	x		AR

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40	<i>Mus gratus</i>							x				
41	<i>Mus minutoides</i>		x					x			x	
42	<i>Mus sp.</i>							x				
43	<i>Mus triton</i>		x					x				
44	<i>Myosorex babaulti</i>									x		AR
45	<i>Oenomys hypoxanthus</i>	x	x	x	x	x	x	x	x	x	x	
46	<i>Otomys denti</i>						x	x	x	x	x	
47	<i>Otomys irroratus</i>		x						x			
48	<i>Otomys tropicalis</i>	x	x	x				x		x	x	
49	<i>Rattus rattus</i>										x	
50	<i>Paraxerus boehmi</i>	x						x		x		
51	<i>Pelomys fallax</i>		x						x		x	
52	<i>Potamogale velox</i>									x		
53	<i>Praomys degraaffi</i>								x	x		AR
54	<i>Praomys jacksoni</i>	x	x	x	x	x	x	x	x	x	x	
55	<i>Praomys sp.</i>					x	x	x	x			
56	<i>Scutisorex somereni</i>								x			NE
57	<i>Sylvisorex lunaris</i>									x		AR
58	<i>Sylvisorex megalura</i>							x				
59	<i>Sylvisorex vulcanorum</i>								x	x		AR
60	<i>Tachyoryctes ruandae</i>			x				x		x	x	AR
	Total	10	25	15	5	5	12	20	39	34	22	

The Area surveyed differs from one author to the other. R-C= Rahm & Christiaensen (1967) in Idjwi Island, Diet = Dieterlen 1965 – 1989 at Lwiro, areas in KBNP and Irangi (west of Kahuzi-Biega), Rahm = Rahm 1966 in areas west of Lake Kivu (comprising only montane sector of KBNP), PB = Program Beatra: PB01 = 2001 Idjwi Island, PB02 = 2002 at Lwiro and adjacent areas, PB03 = 2003 2003 in KBNP, PB04 = 2004 in KBNP, PB05 = 2005 in Kahuzi KBNP, Opport 1999 –now =Opportunistic collection since 1999 until February 2006. Conservation status: VU = Vulnerable, DD = data deficient, LR/nt = near threatened. AR = endemic to the Albertine Rift.

ones. Three rodent species found in the previous surveys are missing in the current work's list: *Dendromus kahuziensis*, *Deomys ferrugineus*, *Lophuromys cinereus* (Dieterlen 1974, 1976a, 1976b; Rahm 1966, 1967). The explanation can be the fact that these species were caught in special locations where we could not trap for security reasons, *Deomys ferrugineus* was captured in mid altitude where we did not trap. The work on shrews is scarce and not much information is available for this group in the study area.

Ten new species were reported for the study area. Rahm (1967) suggested that the differences in species records can be attributed to the location of the studies or methods used to sample. Some species have a restricted distribution and can only be obtained by very specific means of capture. One of these, *Praomys degraaffi* was recently described (van der Straeten & Kerbis 1999) and recognized for the first time in Kahuzi-Biega in 2005. It could have been present in the collection but misidentified as *P. jacksoni*. *Mastomys coucha* was present only near or in crop fields as reported by Dieterlen (1966)

because it feeds on crops.

None of the squirrel species, nor *Dendromus spp.*, *Hybomys spp.*, *Hylomyscus spp.*, *Lophuromys luteogaster*, *L. rahmi*, *L. cinereus*, *L. woosnami*, *Praomys degraaffi* were present in open habitats as they were forest dependent, and especially localized in undisturbed areas. Only two shrew species were present in disturbed areas: *Crocidura lanosa* and *Crocidura olivieri*.

An single specimen of *Trynomys swinderianus* was seen in a trap in KBNP but not during the small mammal surveys and was excluded from the analyses.

Habitat requirement

Praomys jacksoni, *Lophuromys flavopuctatus*, *Graphiurus murinus*, *Grammomys dolichorus*, *Oenomys hypoxanthus* and *Otomys denti* were present in all the sampled habitats. Muginzi *et al.* (2005) recorded these same species as widespread in the lowland forest near Kisangani. All shrew species were recorded in wet, undisturbed areas, with exception for *Crocidura lanosa*

and *Crocidura olivieri* that can be found in all habitats and altitudinal ranges.

Praomys jacksoni was present in all of the habitats sampled; this was also reported in the Ugandan side of the Mount Ruwenzori (Kerbis *et al.* 1998), in the periphery of Kisangani (Mukinzi *et al.* 2005) and for the Itombwe massif (Kaleme, unpublished data). *Lemniscomys striatus*, *Mastomys* spp. and *Oenomys hypoxanthus*, which were widespread in open habitat, have been found in cultivations as they feed on leaves (beans and maize) or bulbs of manioc and potatoes (Dieterlen 1966). Our work confirms the hypothesis that the bamboo forest is poor in species diversity (Rahm 1967, Kaleme unpublished data) because this habitat has a poor litter in which food is scarce. *Colomys goslingi* was present in streams and swamps only. Most of the shrew species were caught in swamps or in deep undisturbed forest.

Species conservation status

Eighteen species of the twenty five mammal species of conservation importance in the Albertine Rift (Kityo *et al.* 2003) including regional endemics and IUCN red-listed were reported (Table 2). Kerbis Peterhans *et al.* (1998) found 21 endemic and/or IUCN-red-list species in the Ugandan side of the Ruwenzori Mountains whereas eight endemic species were recorded in the Itombwe massif (Kaleme unpublished). This highlights the importance of this area for conservation in the Albertine Rift region. The numbers of endemics for KBNP could be increase if the flying small mammals (bats) were sampled in this study.

New records

Species recorded as new in this study appear to be uncommon in the area. This comprises the Albertine Rift endemics *Crocidura kivuana*, *Sylvisorex megalura*, *Scuttsorex megalura*. Some species reported in the previous works in the area, such as *Lophuromys cinereus* (Dieterlen 1974, 1976a) and *Dendromus kahuziensis* (Dieterlen 1976b) were absent in the subsequent studies because specimens were collected in localized habitats where no other study was possible at the time of our research. The other species (*Atherurus africanus*, *Dasimus benthelyae*, *Funisciurus carruthersi*, *Grammomys surdaster*, *Mus gratus* and *Praomys degraaffi*) were present but either not recorded or must have been misidentified as was the case for *Praomys degraaffi* which was previously identified as *P. jacksoni* by our team and all the previous workers in the region (van der

Straeten & Kerbis 1999).

More studies are needed in this area, especially in swamps in mountainous areas or in deep forests as well as in specific micro-habitats where some species which are not present in lower altitudes are supposed to occur.

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