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Small mammals of Kaka and Hunkolo, southeast Ethiopia

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Abstract: A study on small mammals was carried out in four habitat types (afroalpine, *Erica* scrub, agricultural land and riverine forest) in Kaka and three habitat types (afroalpine, *Erica* scrub and agricultural land) in Hunkolo during August 2008 - March 2009. In each habitat type, a permanent 4900 m² live trapping grid was used to capture the small mammals. In Kaka, a total of 612 rodents and 79 insectivores were trapped in 2352 trap nights and in Hunkolo, 307 rodents and 49 insectivores were trapped in 1764 trap nights. The following were the species recorded from Kaka: *Lophuromys flavopunctatus*, *Lophuromys melanonyx*, *Stenocephalemys albipes*, *Stenocephalemys albocaudata*, *Stenocephalemys griseicauda*, *Arvicanthis blicki*, *Otomys typus*, *Dendromus lovati*, *Crocidura glassi* and *Crocidura fumosa*, *Tachyoryctes splendens* and *Hystrix cristata*. From Hunkolo, all of those species reported in Kaka, except for *O. typus*, were recorded. *L. flavopunctatus* was the most abundant species in both Kaka (26.1 %) and Hunkolo (28.9 %) and *D. lovati* and *A. blicki*, were the least abundant species in Kaka (0.4 %) and Hunkolo (1.9 %), respectively. *L. flavopunctatus* was the most widely distributed species.

Resumen: Se llevó a cabo un estudio de los mamíferos pequeños en cuatro tipos de hábitat (afroalpino, matorral de Erica, tierra agrícola y bosque ribereño) en Kaka y tres tipos de hábitat (afroalpino, matorral de Erica y tierra agrícola) en Hunkolo, entre agosto de 2008 y marzo de 2009. En cada tipo de hábitat se usó una cuadrícula permanente de 4900 m² para capturar vivos a los mamíferos pequeños. En Kaka se capturaron en total 612 roedores y 79 insectívoros en 2352 noches-trampa, y en Hunkolo se capturaron 307 roedores y 49 insectívoros en 1764 noches-trampa. En Kaka se registraron las siguiente especies: *Lophuromys flavopunctatus, Lophuromys melanonyx, Stenocephalemys albipes, Stenocephalemys albocaudata, Stenocephalemys griseicauda, Arvicanthis blicki, Otomys typus, Dendromus lovati, Crocidura glassi* y *Crocidura fumosa, Tachyoryctes splendens* e *Hystrix cristata*. En Hunkolo se registraron todas las especies reportadas para Kaka, con excepción de *O. typus*. *L. flavopunctatus* fue la especie más abundante tanto en Kaka (26.1%) como en Hunkolo (28.9%), y *D. lovati* y *A. blicki* fueron las especies menos abundantes in Kaka (0.4%) y Hunkolo (1.9%), respectivamente. *L. flavopunctatus* fue la especie de distribución más amplia.

Resumo: Um estudo sobre pequenos mamíferos foi realizado em quatro tipos de habitats (afroalpino, arbustos de Erica, terrenos agrícolas e florestas ribeirinhas) em Kaka e três tipos de habitat (afroalpino, arbustos de Erica e terrenos agrícolas) em Hunkolo, de Agosto de 2008 a Março de 2009. Em cada tipo de habitat, usou-se uma quadrícula permanente de 4.900 m² para a captura ao vivo de pequenos mamíferos. Em Kaka, foram aprisionados 612 roedores e 79 insectívoros em 2352 noites de armadilhagem, enquanto em Hunkolo foram capturados 307 roedorese 49 insectívoros em 1764 noites de armadilhagem. Em Kaka foram registadas as seguintes as espécies: *Lophuromys flavopunctatus, Lophuromys melanonyx, Stenocephalemys albipes, Stenocephalemys albocaudata, Stenocephalemys griseicauda, Arvicanthis blicki, Otomys typus, Dendromus lovati, Crocidura glassi* e *Crocidura fumosa, Tachyoryctes splendens* e *Hystrix*

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cristata. Em Hunkolo, foram registadas as mesmas que para Kaka excepto a *O. typus*. *A L. flavopunctatus* foi a espécie mais abundante quer para Kaka (26,1%) quer para Hunkolo (28,9%) sendo a *D. lovati* e a *A. blicki* as espécies menos abundantes em Kaka (0,4%) e Hunkolo (1,9%), respectivamente. A *L. flavopunctatus* foi a espécie mais amplamente distribuída.

Key words: Age structure, diversity, distribution, small mammals.

Introduction

Ethiopia is a large and ecologically diverse country with unique environmental conditions. Its topography varies from vast plains to high mountains having an altitudinal range of 110 m below sea level (Kobar sink) in the Afar depression to the highest peak of 4620 m asl (Ras Dejen) in the Simien Mountains (Tedla 1995). The country has more than 300,000 km^2 of land area above 2000 m asl and over 25,000 km^2 area above 3000 m asl, that forms more than 80 % of all the afro-alpine habitat in Africa (Yalden 1983; Yalden & Largen 1992). Rodents constitute the highest percentage of the Ethiopian mammals both in diversity and endemism, as they do in the world's mammalian fauna (Takele *et al.* 2011). There are 84 rodent species in Ethiopia, of which 15 are endemic (Lavrenchenko *et al*. 1998). They comprise 25 % of the Ethiopian mammal fauna and contribute about 50 % of the total endemic species (Bekele 1996).

Wide altitudinal variation and extensive area under afroalpine habitat, as compared to the rest of the Africa, have contributed to the diversity of flora and fauna of Ethiopia (Yalden 1983). Moreover, the highland mountains in Ethiopia are isolated from the rest of the East African highlands by broad lowlands. This isolation has probably contributed to the evolution and abundance of endemic fauna and flora. In Ethiopia, there are two major massifs that are separated by the Rift Valley, i.e., the western and southeastern highlands. The southeastern highlands have diverse landscape features, habitat types, climate and soil as compared to other parts of Ethiopia (Hillman 1993; Sillero-Zubiri 2004; Yalden 1983). As a result of extensive human pressure in the form of habitation and agriculture, most of the mammals are confined to a few uninhabited mountains and a few protected areas such as Bale Mountains National Park (Evangelista *et al*. 2007; Sillero-Zubiri 2004; Stephens *et al.* 2001). The isolated afroalpine fragments exhibit interesting patterns of floral and faunal distribution. Hunkolo and Kaka are among such intact fragments in the south-eastern highlands. Understanding the species diversity in these areas is of prime conservation importance. This paper deals with the species composition, relative abundance and distribution of small mammals (excepting bats) in Hunkolo and Kaka mountains and underlines conservation significance of these fragments.

Material and methods

Study area

The present study was conducted on Mount Kaka and Mount Hunkolo (Fig. 1), located in Oromia Regional State of Ethiopia, about 269 and 285 kms southeast of Addis Ababa, respectively (APEDO & ABRDP 2004). Mount Kaka is located between 39° 0'0" and 39° 15' 0" E longitudes and 7° 15' 0" and 7° 30' 0" N latitudes and covers 1442 ha. Mount Hunkolo is located between 39° 15' 0" and 39° 30' 0" E longitudes 7° 15' 0" and 7° 30' 0" N latitudes with a coverage of 560 ha. Mount Kaka ranges in altitude from 3,146 to 4,217 m and Mount Hunkolo from 3,120 to 3806 m asl (EASE 2002). Both the study areas are characterized by afroalpine vegetation at the higher altitudes, ericaceous vegetation at the middle and a few remnant afromontane forests at the lower altitudes. At Kaka, four habitat types with different altitudinal ranges were identified, viz., Afroalpine, *Erica,* agricultural land and riverine forest while at Hunkolo, only three habitat types were identified (Afroalpine, *Erica* and agricultural land). Afroalpine habitats represent the areas greater than 3700 m asl in altitude. This habitat covers a considerably large part of Kaka, while in Hunkolo, its extent is naturally diminished. It is characterized by sparse herb and shrub vegetation dominated by *Alchemilla* spp., *Helichrysum* spp. and the endemic *Lobelia rhynchopetalum* and some grass species. The Ericaceous zone ranges from 3,200 to 3,700 m

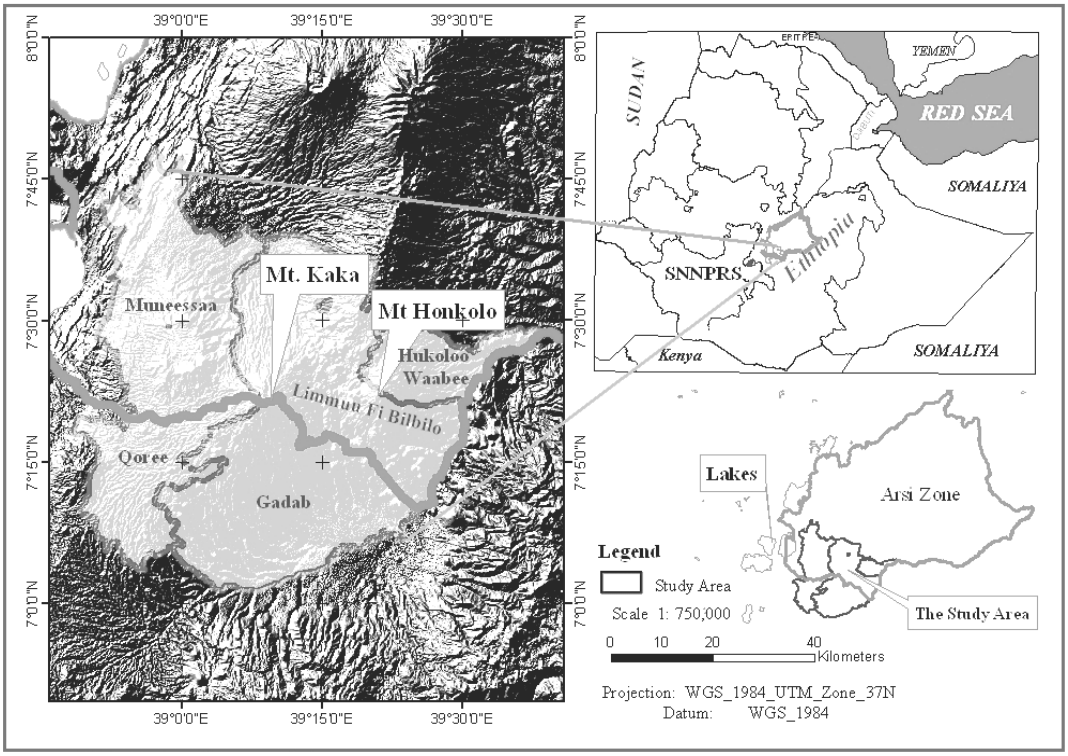

Fig. 1. Location map of Kaka and Hunkolo, Ethiopia.

in elevation. This habitat type is dominated by *Erica trimera* shrub at higher elevations and *Erica arborea* at lower elevations. This is the most dominant habitat type in both Kaka and Hunkolo comprising about 70 % of the fragments. In the lower boundary of this zone, *Erica* is intermixed with other shrub and tree species such as *Hypericum revolutum* and *Rapanea simensis*. The upper limit of the ericaceous belt is interspersed with mosaic distribution of *Alchemilla* and *Helichrysum*. Historically, agricultural lands have been described as having dense cover of afromontane tree species such as *Hagenia abyssinica, Hypericum revolutum* and *Juniperus procera* (Brown 1969; Hedberg 1971; Miehe & Miehe 1994). Presently the natural vegetation of these areas is reduced to remnant woody patches represented by rare and old trees of *Juniperus procera* in Kaka and *Hagenia abyssinica* in Kaka and *Hagenia abyssinica* in Hunkolo as most of these areas are dominated by agriculture and human settlement. An additional feature of Kaka area is the patches of remnant riverine forests along Kechema, Ketar and Debulo rivers, with characteristic species of *Juniperus procera* and *Hagenia abyssinica,* while riverine forests are absent in Hunkolo.

Both the study areas fall under humid montane climate having bimodal rainfall during the long rainy season (June to end of October) and the second shorter rainy season (March to April). The temperature of the study areas is relatively cool with a mean annual maximum temperature of 19.5 °C and minimum temperature of 4.6 °C recorded at an altitude of around 3000 m. Data collection for the present study was carried out in August and September, 2008 for the wet season and January, February and March, 2009 for the dry season.

Trapping

Trapping was carried out using Sherman live traps. In each habitat type one permanent 4900 m² live trapping grid was set up randomly. At each trapping site, a 7 x 7 trapping grid was set during wet (August - September) and again in dry (January - March) seasons. In the afroalpine habitat, grids were set up at altitudes of 4039 m and 3762 m in Kaka and Hunkolo, respectively. In the ericaceous belt, grids were set up at altitudes of 3493 and 3451 m in Kaka and Hunkolo respectively. In the agricultural lands sampling grids were set up at the altitudes of 3176 m and 3240 m in Kaka and Hunkolo, respectively. The riverine habitat unique

to Kaka was sampled at an altitude of 3195 m. A total of 49 Sherman traps were set per grid at 10 m intervals between points during both seasons. Traps were covered with leaves and grasses to protect against excessive heat and cold, and also to camouflage. They were baited with peanut butter and replenished during each trap check-up period. Trapping was carried out for three consecutive days during each trapping session. The traps were checked twice a day, early in the morning (06:00 - 07:00 h) and late in the afternoon (17:00 - 18.00 h).

Each trapped animal was identified, marked by toe clipping and released in the same habitat. Weight, sex, approximate age (juvenile, sub-adult, adult) based on their weight, pelage colour and reproductive conditions for female (closed or perforated vagina) and for males the position and size of testis (scrotal or abdominal) were recorded (Bekele 1996; Datiko *et al*. 2007).

Results

A total of 691 individuals of rodents and insectivores, belonging to 10 species were trapped from Kaka in 2352 trap nights (Table 1). These species were: *Lophuromys flavopunctatus*, *Lophuromys melanonyx*, *Stenocephalemys albipes*, *Stenocephalemys albocaudata*, *Stenocephalemys griseicauda*, *Arvicanthis blicki*, *Otomys typus*, *Dendromus lovati*, *Crocidura glassi* and *Crocidura fumosa*. From Hunkolo, 356 rodents and insectivores belonging to nine species (except *O. typus*) were captured in 1769 trap nights (Table 1). The proportions of insectivores trapped in both the sites were low i.e., 79 (11.5 %) and 49 (13.9 %) in Kaka and Hunkolo, respectively (Table 1). In addition to these species, presence of mole rat (*Tachyoryctes splendens*) and crested porcupine *(Hystrix cristata*) was confirmed based on the presence of mole hills and quills in both Kaka and Hunkolo. *T. splendens* was common in all sampled habitats, while *H. cristata* was observed only in riverine and agricultural habitats.

Among the rodents recorded during the study period, *L. flavopunctatus* was the most abundant species in both Kaka (26.1 %) and Hunkolo (28.9 %) and *D. lovati* and *A. blicki*, were the least abundant species in Kaka (0.4 %) and Hunkolo (1.9 %), respectively (Table 1).

The distribution of species varied among different habitats. In Kaka, the *Erica* habitat had the highest number of species (10), and the riverine forest had the least (5) (Table 2). Similarly, in Hunkolo, *Erica* had the highest species composition (8), while afroalpine had the least (4) (Table 2). The highest number of individuals was captured from Kaka agricultural land (193) and from the *Erica* habitat of Hunkolo (164).

Out of a total capture of 691 rodents and insectivores trapped in Kaka, 392 (56.7 %) were captured during the wet season and 299 (43.3 %) during the dry season. Similarly, out of the total of 356 rodents and insectivores captured in Hunkolo, 194 (54.5 %) were trapped during the wet season and 162 (45.5 %) during the dry season. Sampling was carried out using the same methodology (7 x 7 sampling grid) during both dry and wet seasons.

Table 1. Species composition, total catch and relative abundance of rodents and insectivores from Kaka and Hunkolo (figures in brackets show recaptures).

Species	Total catch		Relative abundance (%)	
	Kaka	Hunkolo	Kaka	Hunkolo
L. flavopunctatus	180(23)	103(14)	26.1	28.9
S. albipes	120(18)	64(17)	17.4	17.9
L. melanonyx	78(12)	58(9)	11.3	16.3
S. albocaudata	69(15)	25(8)	9.9	7.0
S. griseicauda	67(11)	42(6))	9.7	11.8
O. typus	58(9)	-	8.4	-
A. blicki	37(6)	7(2)	5.3	1.9
D. lovati	3	8	0.4	2.3
C. glassi	46	23	6.7	6.5
C. fumosa	33	26	4.8	7.4
Total	691	356	100	100

Table 2. Distribution and abundance of rodents and insectivores in different habitats in Kaka and Hunkolo (Ap = afroalpine, Er = *Erica* scrub, AgL = agricultural land, Rvf = riverine forest).

Species	Relative abundance						
	Hunkolo (habitat, m asl)			Kaka (habitat, m asl)			
	Ap (3762)	Er (3451)	AgL (3240)	Ap (4039)	Er (3493)	AgL (3176)	Rvf (3195)
L. flavopunctatus	46	48	9	40	55	21	64
S. albipes	-	23	41	-	11	63	46
L. melanonyx	-	25	33	5	7	33	33
S. albocaudata	15	10	-	33	36	-	-
S. griseicauda	-	28	14	20	26	21	-
O. typus	-	-	-	-	4	24	30
A. blicki	-	7	-	-	6	31	-
D. lovati	-		8	-	3	-	-
C. glassi	9	14	-	14	17	-	15
C. fumosa	17	9	-	18	15	-	-
Total	87	164	105	130	180	193	188
Percentage (%)	24.4	46.1	29.5	18.8	26.1	27.9	27.2
Number of species	4	8	5	6	10	6	5

Table 3. Sex and age distribution of rodents and insectivores from Kaka during wet and dry seasons.

Species	Abundance											
	Wet						Dry					
	Male			Female			Male			Female		
	A	Sa	Y	A	Sa	Y	A	Sa	Y	A	Sa	Y
Lf	35	12	3	40	15	5	14	12	8	17	13	6
Salb	20	10	-	19	9	-	14	10	5	18	15	-
Lm	14	6	2	13	5	2	11	3	1	15	6	-
Salbo	19	7	1	10	6	3	6	2	1	12	1	1
Sg	10	9	2	8	4	3	9	5	5	7	5	-
Ot	8	6	3	11	6	1	4	3	1	12	1	2
Ab	7	8	2	5	7	-	5	-	-	-	2	1
Dl	-	-	-	-	-	-	2	-	-	1	-	-
Cg	13	1	1	15	-	1	6	1	-	8	-	-
Cf	11	-	-	5	-	-	7	2	-	6	1	1
Total	137	59	14	126	52	15	78	38	21	96	44	11
%	14.8	8.5	2	18.2	7.5	2.2	11.3	5.5	3.1	13.9	6.4	1.6

(A = Adult, Sa = Subadult and Y = Young; Lf = *L. flavopunctatus*, Salb = *S. albipes*, Lm = *L. melanonyx*, Salbo = *S. albocaudata*, Sg = *S. griseicauda*, Ot = *O. typus*, Ab = *A. blicki*, Dl = *D. lovati,* Cg = *C. glassi* and Cf = *C. fumosa,* - shows absence of trapped individuals).

All age groups (adult, sub-adult and young) were represented in both Kaka & Hunkolo at least once per season (Tables 3 & 4), except young ones of *D. lovati*, both in Kaka and Hunkolo and *A. blicki* in Hunkolo. However, season wise *S. albipes* lacked young representatives during the wet season in Kaka and *L. melanonyx* lacked young representative during the wet season in Kaka (Table 3). *L. flavopunctatus*, *S. griseicauda* and *S. albocaudata* lacked young representatives during the dry season in Hunkolo (Table 4). The total capture and proportion of adult, sub-adult and young were 437 (63.2 %), 193 (28 %) and 61 (8.8 %) in Kaka and 264 (74.2 %), 57 (16 %) and 35 (9.8 %) in Hunkolo, respectively (Tables 3 & 4). Among the species of rodents and insectivores trapped, *L. flavopunctatus* had the largest number of adults both in Kaka (137) and Hunkolo (75). The number

Table 4. Sex and age distribution of rodents and insectivores from Hunkolo during wet and dry seasons.

Species	Abundance												Total	
	Wet						Dry							
	Male			Female			Male			Female				
	A	Sa	Y	A	Sa	Y	A	Sa	Y	A	Sa	Y	Male	Female
Lf	27	6	4	21	4	1	14	7	-	13	4	2	58	45
Salb	10	4	1	13	1	2	9	1	3	12	6	2	28	36
Lm	9	2	4	8	2	1	12	2	3	10	4	1	32	26
Sg	16	1	2	4	2	1	6	1	-	6	1	2	26	16
Salbo	4	1	1	7	1	1	5	-	-	4	1	-	11	14
Dl	2	-	-	3	-	-	2	-	-	-	1	-	4	4
Ab	1	-	-	2	-	-	3	-	-	1	-	-	4	3
Cg	3	1	1	9	-	-	2	-	1	4	2	-	8	15
Cf	3	1	-	7	-	-	7	-	1	5	1	1	12	14
Total	75	16	13	74	10	6	60	11	8	55	20	8	183	173
(%)	21.1	4.5	3.6	20.8	2.8	1.7	16.9	3.1	2.2	15.5	5.6	2.2	51.4	48.6

(A = Adult, Sa = Subadult and Y = Young; Lf = *L. flavopunctatus*, Salb = *S. albipes*, Lm = *L. melanonyx*, Salbo = *S. albocaudata*, Sg = *S. griseicauda*, Ab = *A. blicki*, Dl = *D. lovati,* Cg = *C. glassi* and Cf = *C. fumosa*, - shows absence of trapped individuals).

and proportion of age group varied among species and seasons. There were 347 males (50.2 %) and 344 females (49.8 %) in Kaka, whereas in Hunkolo, there were 183 males (51.4 %) and 173 females (48.6 %).

Discussion

During the study period, a total of 10 species of rodents and insectivores were trapped and presence of two additional species was confirmed using indirect evidences in the study areas. Seven endemic species of small mammals were recorded in the study areas including 5 species of muridae, one each of Dendromurinae and Soricidae. This result is in conformity with earlier studies in comparable eco-climatic regions of Ethiopia. For example, Yalden (1988a) identified 10 species of small mammals using similar rodent grids (7 x 7) in the Harena forest of Bale mountains of comparable altitudes and Kasso *et al.* (2010) recorded 17 species of small mammals in the near-by Chilalo-Galama Forest Priority Area, using similar standard grids (7 x 7) and small survey grids in similar adjacent habitats consisting of afroalpine, *Erica*, agricultural land and riverine forest.

The abundance of rodents and insectivores in Kaka was higher compared to Hunkolo. It is plausible that the abundance and diversity of rodents is strongly influenced by the nature and diversity of the vegetation for cover and food (Happlod 1984). The vegetation cover in all habitat types of Hunkolo is severely degraded as a result of expansion of agriculture and livestock grazing, affecting the abundance of small mammals in the area. Similar scenario has been revealed in a survey of rodents in Simien Mountains National Park (Busby 2005).

Among the small mammals trapped in Kaka and Hunkolo, only 11.5 % and 13.9 %, respectively, were insectivores. This correlates with the comparatively less number of species and abundance of insectivores and the low sampling grids. Various studies carried out in different parts of Ethiopia have also revealed similar results (Datiko *et al.* 2007; Kasso *et al.* 2010; Yalden 1988a).

L. flavopunctatus was the most abundant species in both Kaka and Hunkolo. It is known to be the most successful and ubiquitous among rodents in tropical Africa and moist areas of East Africa (Clausnitzer 2003; Kingdon 1974). This is presumably as a result of its ability to colonize less favourable habitats like heath and afroalpine, and due to its omnivorous diet (Misonne 1969). The relatively high number of the three Ethiopian endemics (*S. albipes, S. albocaudata* and *L. melanonyx*) in the present study area is attributed to the adaptation of the species to a high mountain environment (Lavrenchenko *et al.* 1998). The abun-

dance of these endemics in the Ethiopian high mountains is also confirmed earlier (Bekele & Corti 1994; Kasso *et al.* 2010; Sillero-Zubiri *et al.* 1995; Yalden 1988a, 1988b).

D. lovati was a rare species in Hunkolo and Kaka, each comprising 2.3 % and 0.4 % population respectively. This is mainly because the habitat requirement of the species is relatively dense afromontane vegetation having high cover of understorey vegetation. This result is comparable with the data of a study in Bale Mountains National Park (Yalden 1988b), in which only five individuals of them were trapped out of a total of 535 captures. *A. blicki* was limited in abundance and *O. typus* was totally absent in Hunkolo, reflecting the effects of severe habitat disturbance and degradation in this area.

Insectivores were largely confined to the afroalpine and ericaceous belts. This might be due to higher abundance of insects adapted to the cold temperature. Moreover, the afroalpine habitat is characterized by sparse herb and shrub vegetation dominated by *Alchemilla* species, *Helichrysum* species and the endemic *Lobelia rhynchopetalum* and different grass species. These provide ideal habitat for the insects as cover, breeding ground and food source compared to lower altitude bare agricultural land that is only covered by cereal crops seasonally. Recently, a study in the Arsi massif by Kasso *et al.* (2010) in the nearby adjacent area, using similar sampling techniques and similar habitats and altitudes has revealed 27 individuals of *C. glassi* out of a total of 39 individuals from ericaceous and afroalpine grids. Furthermore, *C. fumosa* was confined to the *Erica* forest, afroalpine and moorland grids.

In the present study, *Erica* scrub had the highest number of small mammal species in both Kaka and Hunkolo. This contradicts with the earlier studies in similar localities (Bekele & Corti 1994; Sillero-Zubiri *et al.* 1995; Yalden 1988a, 1988b). These authors have shown that the abundance of small mammals is high in the low altitude montane forests. They have also revealed that *Erica* contains better number of small mammals compared to afroalpine habitat. The present study recorded maximum number of small mammals in the ericaceous belt because montane forest is lacking as a result of deforestation. Furthermore, ericaceous belt supports relatively thick underground cover compared to the afroalpine habitats. The *Erica* is intermixed with other indigenous trees like *Hypericum revolutum* and other shrubs forming thick cover especially in the lower altitudes. But, afroalpine habitat supports only sparse grasslands and very scattered endemic giant lobelia with very cold temperature resulting in low number of small mammals. Farmlands are highly modified habitats, where the abundance of rodents depends on the cropping season. After harvesting, the ground becomes bare and unattractive to rodents.

Hence, *Erica* was a relatively better habitat providing protection and foraging opportunity. Agricultural land had the highest percentage of individuals of small mammals in Kaka, while in Hunkolo, this was outnumbered by *Erica* habitat. This was the result of barley farm in Kaka, which provided quality food for the rodents. In addition, the riverine habitat of Kaka had almost as many individuals as recorded in agricultural land. This might be due to this habitat providing a diversity of microhabitats which is absent in Hunkolo. Riverine areas provide diverse micro-habitat and thick under ground cover surrounded by farmlands. As a result, seasonal migration between farmlands and riverine habitats is expected. The result is comparable with the observation of Bekele & Corti (1994), where 48 % of rodents trapped were from montane forest of Menagesha, Yalden (1988a) who trapped 20 - 25 % of the rodents from Harenna Forest. More recently, Kasso *et al.* (2010) recorded 31.3 % of the rodents from disturbed montane forest of Gefersa in the Arsi massif. The abundance of species in a particular area depends on the habitat complexity, which in turn depends on the combination of microhabitats characterized by differences in aspects of soil, vegetation, nutrients and water (Simonetti 1989). Less abundance of cover and food, and harsh cold weather might have threatened the survival of rodents in the afroalpine peaks of Kaka and Hunkolo. Further more, afroalpine habitat is the summit and mostly covered with big rocks limiting the growth of vegetation and the burrowing effect of small mammals with minimal cover, breeding site and foraging requirements.

L. flavopunctatus was the most widespread species in all habitats of Kaka and Hunkolo. This was mainly because of its ability to colonize less favourable afroalpine habitat and its insectivorous feeding habit. This is in conformity with the findings by Kingdon (1974), Sillero-Zubiri *et al.* (1995), Clausnitzer (2003) and Kasso *et al.* (2010). *S. albocaudata* and *S. griseicauda* were confined to the uplands mainly on afroalpine belt and ericaceous belt. This was due to their ability to colonize such habitats through adaptation. Various studies

held in Bale Mountains have confirmed similar results. Ascending from lower montane forest up to the afroalpine belt, these two species were increasingly abundant (Sillero-Zubiri *et al*. 1995; Yalden 1988b). *S. albipes* and *L. melanonyx* were abundant at the lower altitudes of *Erica* and agricultural land, which may be due to their adaptability as evaders of middle altitudes. This was also revealed in studies carried out by Bekele (1996), Yalden (1988b) and Sillero-Zubiri *et al*. (1995). Unlike other study sites, *A. blicki* was restricted to the lower altitudes of Kaka and Hunkolo, perhaps as a result of habitat modification for agriculture and livestock grazing.

Erica scrub exhibited the highest species diversity in both Kaka and Hunkolo. This is attributed to higher vegetation cover that provides better protection from predators and foraging opportunities. The afroalpine habitat had the least species diversity. This might be due to the less diverse micro-habitat that is less favourable for many species as already revealed in similar ecological zonations by Yalden (1988b) and Busby (2005). More rodents were captured during the wet season than during the dry season in both Kaka and Hunkolo. The greater abundance of rodents during the wet season was presumably the result of abundant rainfall, which in turn provided better cover, favourable breeding season and foraging opportunities (Busby 2005; Kasso *et al*. 2010).

In the present study, all age groups of all species, except *D. lovati* and *A. blicki* were trapped in most of the trapping sessions. It appears that these species reproduce throughout the year as far as sufficient food is available. Both Kaka and Hunkolo represent high summits of southeastern highlands in Ethiopia, and are home to several small mammals including 7 endemic species. The unique habitats, viz., afroalpine, *Erica* scrub and riverine habitats are highly threatened due to expanding agriculture, human settlement, heavy livestock grazing and seasonal burning of ericaceous belt. Hence, conservation of these habitats is crucial for continued survival of endemic small mammals.

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