



Species Composition and Habitat Association of Small Mammals in Nechi Sar National Park, Ethiopia

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Abstract

Species composition, habitat association and feeding preference of small mammals were studied in Nechisar National Park, Ethiopia, during August 2010 – March 2011. Grassland, Acacia woodland, ground water forest, riverine forest, deciduous bush land, Lake Abaya shore and Lake Chamo shore were randomly surveyed. Twenty species of rodents and four species of insectivores were recorded from the study area. *Mastomys natalensis* (17.37%), *Arvicanthis dembeensis* (17.09%), *Mastomys erythroleucus* (8.90%), *Stenocephalemys albipes* (8.76%), *Arvicanthis niloticus* (8.19%), *Acomys cahirinus* (7.34%), *Lemniscomys striatus* (6.92%), *Gerbilliscus nigricauda* (6.21%), *Grammomys dolichurus* (3.67%), *Gerbilliscus robusta* (2.12%), *Mus proconodon* (1.98%), *Mus mahomet* (1.41), *Dendromus melanotis* (1.27%), *Arvicanthis abyssinicus* (1.13%), *Mus musculus* (0.99%), *Praomys fumatus* (0.85%), *Xerus erythropus* (0.85%), *Lemniscomys barbarus* (0.71%), *Mus tenellus* (0.71%) and *Otomys typus* (0.28%) were the rodents and their respective relative abundance in the study area. *Crocidura olivieri* (1.55%), *Crocidura fumosa* (0.85%), *Crocidura bicolor* (0.57%) and *Elephantulus rufescens* (0.28%) were the insectivores recorded with their respective relative abundance. The highest small mammal diversity was in grasslands and the lowest was in Lake Chamo shore. Small mammal density varied from 5 to 43 ha and biomass varied from 244 to 2559 g/ ha with significant changes in relation to seasons and habitats.

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Key words: Ethiopia; feeding preference; habitat association; Nechisar National Park; small mammals.

1. Introduction

Small mammals are the most diverse group of mammals. In East Africa, rodents account for 28% of the total mammalian fauna with 62 genera and 161 species [1]. The most common rodents in sub-Saharan Africa belong to the genus *Mastomys* [2]. Insectivore fauna are also diverse having 429 species worldwide, of which 312 are shrews. Among them, 140 species are found in East Africa [1].

Ethiopia's past geological history, unique topography and wide ranging climate have made home for diverse biological resources with 284 species of mammals of which 39.4% are small mammals [3]. Of these, 31 (11%) are endemic [4]. The rodent fauna of Ethiopia consists of 84 species [3] of which 15 are endemic. Rodents comprise 30% of the Ethiopian mammal fauna and contribute about 50% of the total endemic species in the country [5]. Small mammals are important components of biological diversity. Small mammals, principally rodents and insectivores, are important residents of a variety of habitats [6] as expected from the large number of species distributed all over the world.

Small mammal populations have experienced with dramatic seasonal and inter-annual variations in habitat preference [7]. Although each small mammal species is distributed according to its unique requirements for food, space and shelter, communities often retain a certain degree of structure over space and time. According to [8] distribution of small mammals can be affected by several biological and physical factors, including predator avoidance, competition within or with other species, and resource levels, especially the availability of food and water [9]. In Ethiopia, extensive surveys for small mammals of the country were confined in relatively accessible parts of these highground areas that account for little more than 17% of the total area [3]. The south western forest, southeastern highlands, the Rift Valley, the Simien massifs and few isolated forest blocks of central Ethiopia are the only surveyed areas [10]. Many regions in Ethiopia are underexplored as a result of inaccessibility, remoteness and inhospitability of these areas. Besides lack of scientific information about the fauna of such areas, opportunities to collect such data are rapidly diminishing due to the ever accelerating human demand for arable land. Nechisar National Park (NNP) is one of the southern extensive lowland areas of Ethiopia, where diverse types of small mammals are found. To fulfill the gap on information on the small mammal fauna of the area, the present paper aimed investigating species composition, relative abundance, habitat association and feeding habit of rodents and insectivores in NNP.

2. The study area

Nechisar National Park is located at about 510 km south of Addis Ababa, east of Arba Minch Town. The Park was established in 1974 with an area of 514 km², of which 85% is land and 15% is water (lakes Chamo and Abaya). It lies within the floor of the East African Great Rift Valley, situated between 5°51' - 6°10'N and 37°32' - 37°48' E (Fig. 1) with an elevation ranging between 1108-1650 m asl. The area has a bimodal rainfall pattern with the rainy seasons from March to May and from September to October with a mean annual rainfall of 800-1000 mm. The

dry seasons of the area are from December to January and June to August, the latter being heavy and longer. The temperature ranges from 12.2 to 34.3 °C [11]. The habitat types of the Park were identified as Acacia woodland (AWL), bushland (BL), grassland (GL), ground water forest (GWF) (with low ground water table and diverse floristic make up), riverine forest (RF), Lake Abaya shore (LAS) and Lake Chamo shore (LCS).



Figure 1: Map of the study area

3. Material and Methods

Trapping of small mammals was carried out in August and October of 2008 and January and March of 2009. Two representative grids were randomly identified from each of the habitat types. Same grids were used during all trapping sessions. A total of 49 Sherman traps (5.5 · 6.5 · 16 cm) were set per grid at 10-m intervals between points. Trapping was performed during both wet and dry seasons. Traps were baited with peanut butter mixed with crushed raw maize. Traps were covered with plant leaves during the dry season to provide protection against heat. Traps were checked twice a day in the morning (between 7:00 and 9:00 am) and in the afternoon (between 4:00 and 6.00 pm). Each of the live-captured animals was marked by toe clipping and released after recording sex and body weight. For species identification, taxonomic characteristics listed in [12] and [13] were used. Voucher skins and skulls were prepared and compared with the specimens available in the Zoological Natural History Museum of Addis Ababa University. Shannon–Weiner Index (H') was used to compute species diversity in the habitats. Density was estimated as number of individuals per hectare, and biomass was estimated by multiplying the estimated density with mean body weight of each of the species. Density and biomass were separately estimated for both dry and wet seasons and for each of the habitat types. Chi-square tests were used to compute the species abundance, distribution, relative abundance and habitat association.

4. Results

4.1. Species composition

Table 1: Small mammals recorded in different habitats in Nichisar National Park

Family & Species	Individuals recorded in different habitat types							Total	RA,%
	GL	BL	AW	RF	LA	GW	LC		
Family Muridae									
Mastomys natalensis♦❖	29	23	21	11	19	9	11	123	17.37
Arvicanthis dembeensis♦❖	59	21	28	4	3	7	7	121	17.09
Mastomys erythroleucus♦❖	13	28	5	11	3	3	0	63	8.90
Stenocephalemys albipes♦❖	11	16	5	9	7	11	3	62	8.76
Arvicanthis niloticus♦❖	9	17	5	11	8	4	4	58	8.19
Acomys cahirinus♦❖	16	6	10	3	2	8	7	52	7.34
Lemniscomys striatus♦❖	6	10	8	5	4	8	8	49	6.92
Grammomys dolichurus♦	11	4	0	1	3	5	2	26	3.67
Mus proconodon♦	3	1	4	1	2	3	0	14	1.98
Mus mahomet♦	1	1	2	3	2	1	0	10	1.41
Dendromus melanotis♦	4	2	2	0	0	0	1	9	1.27
Arvicanthi abyssinicus♦	2	3	1	1	1	0	0	8	1.13
Mus musculus♦	2	1	1	1	1	0	1	7	0.99
Praomys fumatus♦	2	3	0	1	0	0	0	6	0.85
Lemniscomys mice♦	2	1	1	1	0	0	0	5	0.71
Mus tenellus♦	1	1	0	1	0	2	0	5	0.71
Otomys typus♦	1	0	0	0	0	0	1	2	0.28
Family Cricetidae									
Tatera nigricauda♦❖	4	5	7	16	6	0	6	44	6.21
Tatera robusta♦	2	6	2	0	3	1	1	15	2.12
Family Sciuridae									
Xerus erythropus♦	1	1	2	1	0	0	1	6	0.85
Family Soricidae									
Crocidura flavescens♦❖	2	3	1	2	1	1	0	10	1.41
Crocidura fumosa♦	2	1	1	0	1	1	0	6	0.85
Crocidura bicolor♦	1	0	1	1	0	0	1	4	0.57
Crocidura olivera♦	0	1	0	0	0	0	0	1	0.14
Family Macroscelidae									
Elephantulus rufescens ♦	0	1	0	1	0	0	0	2	0.28
Total	176	156	107	85	66	64	54	708	100
%	24.86	22.03	15.17	12.01	9.32	9.04	7.63	100	

(♦= trapped by live-traps, ❖= trapped by snap-traps ♦❖= trapped by both live and snap-traps, GL = grassland, BL= bushland, GW = ground water forest, RF= riverine forest, AW = Acacia woodland, LC = Lake Chamo shore, LA = Lake Abaya shore).

During this study, a total of 708 individuals of small mammals belonging to 20 species of rodents and four species of insectivores were trapped, in 2744 trap nights. Among them, 685 (96.75%) were rodents of three families. The remaining 23 individuals (3.25%) represented four species of insectivores of two families. The number of individuals of each of the species recorded from different habitat types is shown in Table 1. *M. natalensis* was the most abundant in all habitat types, with a total of 17.37% of the live-trapped small mammals. The next commonly trapped species was *A. dembeensis*. It accounted for 17.09% of the trapped small mammals and also trapped from all habitat types.

The highest percentage (24.86%) of small mammals trapped was from grassland, followed by 22.03% from bush land habitat. The lowest percentage (7.63%) was from Lake Chamo shore. There was statistically significant variation in the trapping of small mammals among habitat types ($P < 0.01$).

Table 2: Trap success of small mammals in different seasons and habitat types*

Habitat types	Season	Total trapped	Trap success, %	Mean trap success, %
Grassland	Dry	94	47.96	44.90
	Wet	82	41.84	
Bush land	Dry	82	41.84	41.84
	Wet	74	37.76	
Ground water forest	Dry	33	16.84	16.33
	Wet	31	15.82	
Riverine forest	Dry	43	21.94	21.68
	Wet	42	21.43	
<i>Acacia</i> woodland	Dry	56	28.57	27.29
	Wet	51	26.02	
Lake Chamo shore	Dry	31	15.82	13.77
	Wet	23	11.73	
Lake Abya shore	Dry	41	20.92	16.83
	Wet	25	12.75	

*There were 196 trap night for all seasons in each habitat

M. natalensis, *A. dembeensis*, *Stenocephalemys albipes*, *Arvicanthis niloticus*, *Acomys cahirinus* and *Lemniscomys striatus* were present in all habitat types. *Elephantulus rufescens* was trapped from bush land and riverine forest.

The number of trapped individuals was high during the first trapping session of the dry season. More individuals

(n = 176) were recorded from grassland, followed by bush land (n = 156). The lowest (n = 54) was from Lake Chamo Shore. There was statistically significant difference ($P < 0.001$) in the proportion of small mammals trapped from different habitat types.

1.2. Evenness and diversity

Small mammal species evenness and diversity in different habitat types are given in Table 3. Diversity of small mammals ranged from 2.299 to 2.625 with an average of 2.412. The highest diversity index was recorded in grassland habitat (2.625). This was followed by bush land habitat, and the lowest was in Lake Chamo Shore (2.299). The diversity of small mammal species trapped from different habitat types was statistically significant ($P < 0.05$).

Table 3: Small mammal species richness, evenness and diversity in different habitat types in the study area.

Habitat type	Σ	SR	SI	TS	J	H'
Grassland	176	20	3	23	0.773	2.625
Bushland	156	19	4	23	0.811	2.524
Acacia woodland	107	16	3	19	0.807	2.376
Riverian forest	85	16	4	20	0.836	2.503
Ground water forest	64	12	2	14	0.897	2.368
Lake Abaye shore	66	14	2	16	0.856	2.374
Lake Chamo shore	54	13	1	14	0.871	2.299

(SR= species of rodents, SI= species of insectivores, TS= total species,

J = evenness, H' = Shannon-Weaver index).

1.3. Feeding preference

The food items recorded from the stomach contents of snap-trapped small mammals were monocotyledon seeds, dicotyledon seeds, monocotyledon leaf, dicotyledon leaf, roots and animal matters (Table 4). The diet of *A. dembeensis* comprised mostly grass. The consumption of animal matter was higher during the dry season than during the wet season. There was no significant variation among the snap-trapped small mammals in the type of food items recorded ($p > 0.05$). However, there was a significant variation ($P < 0.01$) in the proportion of the diet of each species. Seeds and leaves were the major food items for most of the small mammals, although all of them consumed roots and animal matters.

5. Discussion

The number of small mammal species recorded during the present investigation in NNP is higher than the previous records in and around the same area. For instance, [14] recorded eight species of rodents and two species of shrews in NNP, and [15] recorded fourteen species of rodents and two species of insectivores from

Arba Minch Forest and farmlands. *Mus proconodon*, *Arvicanthis abyssinicus*, *O. typus*, *Xerus erythropus* and *E. rufescens* were recorded for the first time from the area. Habitat use associated with vegetation structure is an important factor governing the assemblage of small mammals both within and between habitats. During the present study, high small mammal diversity was recorded in the grassland and low diversity in Lake Chamo shore. This may be due to the difference in vegetation cover, foliage and availability of food in the habitat type [16]. Some studies on the relationships between small mammal assemblages and habitat structure have revealed that habitat structure is a good predictor of assemblage of small mammals [17]. Several studies have shown close relationships between small mammal diversity and habitat structure [18]. During the present study, the site where small mammals occurred in high diversity and abundance was also the site where enough food, water and cover were available. Among the seven habitat types of the present study area, most small mammals preferred grassland and bushland, except *E. rufescens* and *C. olivera*. Grasslands continuously provide palatable grasses, which serve as food and cover against predators [19] and [20]. Bushland had also high abundance and diversity of small mammals. [21] and [22] have also recorded high density of small mammals in bushland areas, which is near or adjacent to river in the present study area. This type of habitat is advantageous for small mammals as a good cover reducing the risk of predation. The availability of different food items and sufficient amount of water in the bushland habitat might have also contributed for the high number or population level of small mammals.

Table 1: Identified food fragments from stomach content of snap-trapped small mammals.

Species	Identified food items							
	MS	DS	ML	DL	R	AM	UM	
<i>Mastomys natalensis</i>	x	x	x	x	x	x	x	
<i>Arvicanthis dembeensis</i>	x	x	x	x	x	x	x	
<i>Mastomys erythroleucus</i>	x	x	x	x	-	x	x	
<i>Stenocephalemys albipesx</i>	x	x	x	x	x	x	x	
<i>Arvicanthis niloticus</i>	x	-	x	x	x	x	x	
<i>Acomys cahirinus</i>		x	x	x	x	-	-	x
<i>Lemniscomys striatus</i>	x	x	x	x	x	x	x	
<i>Tatera nigricauda</i>	x	x	x	x	-	x		
<i>Crocidura flavescens</i>	x	x	x	x	-	x	x	

(MS= Monocot Seed, DS= Dicot seed, ML= Monocot leaves, DL= Dicot leaf, R= Root, AM= Animal matter, UM= Unrecognized material)

Small mammals in the present study area showed seasonal movements between habitats. High reduction in the abundance of small mammals from the riverine, Lake Abaya shore and Lake Chamo shore during the wet season and their high abundance during the dry season strengthens this possibility. They migrate into the grassland, bushland and Acacia woodland habitats during the wet season and back to the riverine forest and Lake shore during the dry season. This is due to floods and due to more moist and humid microhabitats around water bodies during the wet season, which are inhospitable to small mammals. On the other hand, dry season forest fire and excessive grazing remove most of the cover, food and water for small mammals in the grassland and Acacia woodland habitats forcing to move into the riverine habitats during the dry season. In general, the result of the present study revealed that the densely covered habitats with high diversity of plant species were more preferred by most small mammal species in the study area.

The overall trap success varied from habitat to habitat and from season to season. The lowest trap success obtained was from Lake Chamo shore during the wet season (9.96%), whereas the highest was from the grassland (42.53%) during the dry season, followed by bushland (37.10%). As discussed before, grasslands provide continuous supply of food, as a result of which the abundance of small mammals was high in this habitat. In the present study, trap success during the wet and dry seasons was 21.85% and 23.92%, respectively. The seasonal fluctuation in food and water availability has considerable role to play with the seasonal fluctuation of small mammal populations. As more natural food is available during the wet season, capture rates is reduced significantly. This might be due to the bait used becoming unattractive as a result of sufficient food resource in the habitat. The mean trap success rate during the present study was 22.88%. The highest trap success (36.8%) was recorded by [20]. An average trap success between 24 to 27% was also recorded by [23] from various sites in Harena Forest in the Bale Mountains National Park (Ethiopia). [24] reported 9.1% success rate from Menagesha State Forest, central Ethiopia.

Feeding ecology of small mammals is highly diverse. Most species of small mammals appear to be opportunistic feeders. The present study has revealed that all small mammals consume plant and animal matters. For instance, the stomach contents of *M. natalensis*, *A. dembeensis* and *C. flavescens* included all types of seeds, leaves and animal matters based on the availability in the habitat from season to season. The stomachs of *A. dembeensis* contained high percentage of grass in addition to other ingredients. [25] have also recorded higher percentage of grass and monocot seeds in the stomachs of *A. dembeensis*.

Acknowledgements

The authors are indebted to Addis Ababa University and the Horn of Africa Regional Environmental Center / Network (HoA-REC / N) for financing this research project, and the authorities of Nechisar National Park Administration for permission for the study and for the help rendered during the field work.

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