

Seasonal Species Composition and Abundance of Rodents in Yerer Mountain Forest Area, Central Ethiopia

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Abstract: An ecological study on the seasonal species composition and abundance of rodents was carried out in the farmland, bushland, forest and grassland habitats of Yerer Mountain Forest Area from July 2010 to March 2011. From a total of 3312 trap nights, 402 individuals of small mammals were captured. Out of these, 400 (99.5%) individuals represented 6 species of the family Muridae and whereas the remaining 2 (0.5%) belonged to one shrew species (family Soricidae). The seasonal species composition within each habitat was not significant. But there was significant variation in their relative abundance during wet and dry seasons. High mean trap success (23.5%) and biomass (4151g/hectare) was obtained from the farmland habitat. Number of pregnant females and embryo count showed seasonal variation. Stomach content analysis showed high proportion of plant matter in all samples.

Keywords: Species Composition, Abundance, Trap Success, Biomass, Rodents

1. Introduction

Mammals are quite diverse both structurally as well as functionally. There are more than 5,000 extant mammalian species recognized throughout the world. Of all the mammalian orders, Rodentia constitute the largest number of species with more than 2,000 species within 32 extant families (Feldhamer *et al.* 2007; Kingdon, 1997; Vaughan *et al.* 2000). In Africa, there are about 14 families, 89 genera and 290 species of rodents. They are the most ubiquitous and abundant among the mammals (Mengistu and Bekele, 2003). East Africa has a wide variety of rodents. Most of them are endemic and account for about 28% of the total East African mammal fauna (Kingdon, 1997). Among the 284 species of mammals of Ethiopia, 31 are endemic, of which rodents hold 50% of the endemics (Bekele and Corti, 1997). The species richness of this order is the result of succession of radiation, adaptation and diversification (Auffray *et al.* 2009).

Among others, rodent community structure and species composition have been related to habitat structure and complexity, area productivity, predation, trampling and grazing, surrounding landscape and the distance between similar habitats, succession of the vegetation and the presence of exotics (Avenant and Cavallini, 2007). The

dynamics of population in many small mammals is the result of the combined effects of feedback structure (ecological interactions within and between populations), limiting factors (food, or predator), climatic factors (rainfall), and stochastic forces (Andreo *et al.* 2008).

Basically, rodent population exhibits a great seasonal and year to year variation. Their distribution pattern and relative abundance vary seasonally based on availability of food and vegetation cover. The seasonal distribution and quantity of rainfall are considered as major climatic variable in determining population dynamics of rodents in East Africa (Delany and Monro, 1985). The onset of the rainy season is swiftly followed by the appearance of good ground cover and quality diet leading to increased rate of reproduction. Population outbreak of many species of rodents occurs when prolonged rainfall allows better survival of the young. The driving factors for rodent outbreak could be climatic fluctuations and environmental variations (Bekele and Leirs, 1997).

Few ecological studies on the seasonal species composition of rodents have been carried out in different parts of Ethiopia. So far, no studies have been conducted on rodents in the area. The present study aimed to investigate the seasonal species composition and abundance of rodents in Yerer Mountain Forest Area, Central Ethiopia.

2. Materials and Methods

2.1. Study Area

The study was conducted in the Yerer Mountain forest area (40 km far from the capital city Addis Ababa, between 8° 52'00" N and 38°59'30" E). The mountain covers a total area of 6000 hectares with altitudinal ranges of 2000 m to the highest peak at 3100 masl. The area receives mean annual rainfall of 1000 mm with average minimum and maximum temperature of 10° C and 26° C, respectively. It is characterized by a unimodal rainfall having long rainy season. The area receives the highest rainfall during the wet season from June to September. Short rains occur at any months of the dry season, especially during March, April and May.

Vegetation composition of this study area is characterized by both natural forest (dominated by *Juniperus procera*) and man-

made plantations. The upper part of the mountain is highly dominated by bushes and shrubs. The most common species of shrubs are *Carisaedulis*, *Allophylus abyssinicus*, *Maytenus arbutifolia*, *M. undata*, *Erica arborea*, *Buddleja polystachya*, *Nuxia congesta*, *Entada abyssinica*, *Rosa abyssinica*, *Grewia ferruginea*, *G. villosa* and *Hypericum revolutum*. The man-made plantation is dominated by exotic plant species such as *Eucalyptus globulus*, *E. camaldulensis* and *Cupressus lusitanica*.

The area also supports diverse groups of bird species and fewer larger mammals. The most conspicuous large mammals in the area are Klipspringer (*Oreotragus oreotragus*), Menelik's bushbuck (*Tragelaphus scriptus menelikii*), Bush duiker (*Sylvicapra grimmia*), Anubis baboon (*Papio anubis*), Warthog (*Phacochoerus aethiopicus*) and the spotted hyena (*Crocuta crocuta*).

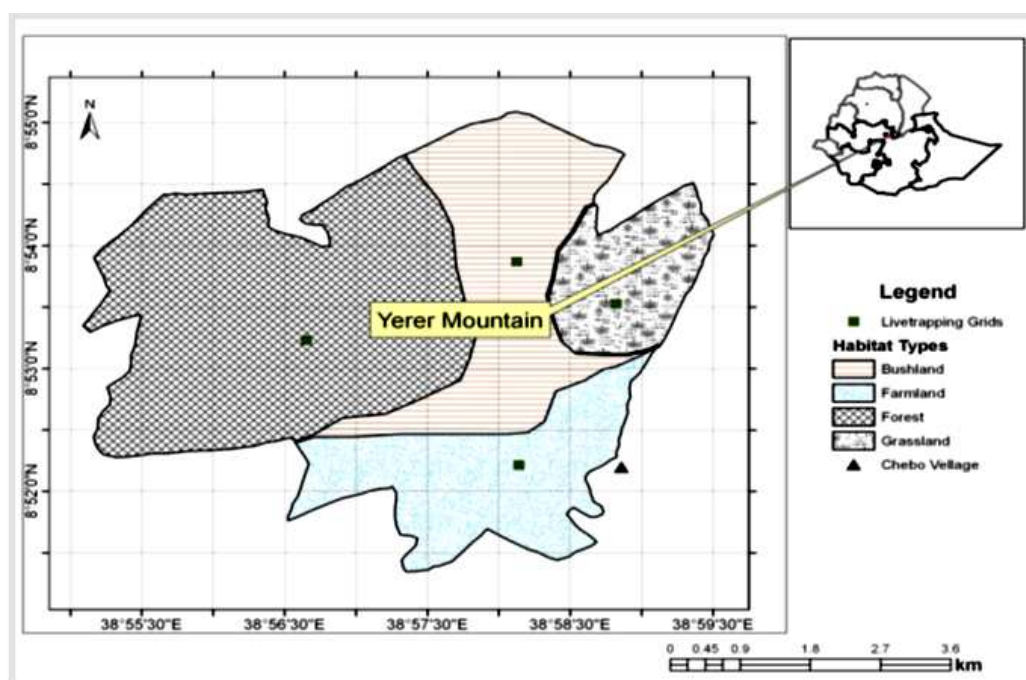


Figure 1. Map of the study area.

2.2. Study Design

Based on the topography and vegetation type, the study area was classified into, forest (FO), bushland (BL), farmland (FL) and grassland (GL) habitats. The representative live-trap grids were established randomly among the vegetation type based upon possible representation of different habitats. Each grid constituted an area of 4900 m² (70 x 70 m). Data collection was made in four trapping sessions (data collection periods). The wet season data was collected from August 2010 to October 2010 consisting of two trapping sessions. The dry season data collection was accomplished in between November 2010 and March 2011. During both seasons, data collection was performed by using Sherman live-traps and snap-traps. Sherman live traps to trap live rodents and for the analysis of stomach content and embryo count, snap-traps were used.

Comparison of seasonal species composition and habitat association of species in the study area, were made by Chi-square tests using SPSS Version 17.0 statistical program. The total number of trapped individuals and the overall trap night were used to compute trap success. The mean weight of each species was used to infer the study areas biomass. Stomach content analysis was made through calculating the mean percentage proportion of food fragments per slides.

3. Results

During both wet and dry seasons, a total of 7 species of rodents were recorded from Yerer Mountain Forest area. From a total of 3312 trap nights, 402 individuals of small mammals were captured (Table 1). Out of these, 400 (99.5%) individuals represented 6 species of the family Muridae and whereas the remaining 2 (0.5%) belonged to one shrew

species (family Soricidae).

Table 1. Species abundance of rodents in Yerer Mountain Forest Area.

Species	Total Catch	Abundance (%)
<i>Lophuromysflavopunctatus</i>	127	31.6
<i>Arvicanthisdembeensis</i>	66	16.4
<i>Arvicanthisabyssinicus</i>	71	17.6
<i>Stenocephalemysalbipes</i>	72	18.0
<i>Musmahomet</i>	55	13.7
<i>Dendromysmystacalis</i>	9	2.2
<i>Crociodurafumosa</i>	2	0.5
Total (7 species)	402	100

The seasonal species composition and distribution of live-trapped rodents among the different habitats are given in Table 2. Except for *D. mystacalis* and *C. fumosa*, all the remaining species of rodents were trapped during both wet and dry seasons. *Dendromysmystacalis* was trapped only during the dry season from the grassland habitat, whereas, *C.*

fumosa was trapped only from the farmland habitat during the wet season. Out of the total captured individuals (307), 152 (49.5%) individuals were trapped during the wet season and 155 (50.5%) during the dry season.

The difference in species composition between habitats during wet and dry seasons was not statistically significant ($\chi^2=2.3$, $df=2$, $P > 0.05$ and $\chi^2=3.6$, $df=2$, $P > 0.05$, respectively). The highest (138) as well as the lowest (21) numbers of individuals were recorded during both seasons from the farmland and forest habitats, respectively. During the dry season, the total number of trapped individuals increased from 35 to 51 in the grassland habitat. Conversely, the total number of rodents captured from the bushland habitat declined from 40 to 22. The difference between abundance of rodents between habitats during wet and dry seasons was statistically significant ($\chi^2=34.7$, $df=3$, $P < 0.05$ and $\chi^2=76.1$, $df=3$, $P < 0.05$, respectively).

Table 2. Seasonal species composition and abundance of live-trapped rodents from different habitats.

Species	Habitat types and seasons								Total
	Farmland		Bushland		Forest		Grassland		
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	
<i>L.flavopunctatus</i>	14	5	27	15	-	-	19	23	103
<i>A.dembeensis</i>	36	2	-	2	-	-	-	-	40
<i>A.abyssinicus</i>	3	59	-	-	-	-	-	-	62
<i>S.albipes</i>	-	-	10	3	13	6	5	6	43
<i>M.mahomet</i>	8	9	3	2	1	1	11	14	49
<i>D.mystacalis</i>	-	-	-	-	-	-	-	8	8
<i>C.fumosa</i>	2	-	-	-	-	-	-	-	2
Sum	63	75	40	22	14	7	35	51	307
Total (%)	138 (45.0)		62 (20.2)		21 (6.8)		86 (28.0)		
Trap Success (%)	21.4	25.5	13.6	7.5	4.8	2.4	11.9	17.3	

(-) = shows absence of trapped individuals.

The highest number of species from the farmland habitat was registered during the wet season, whereas, the least number of species was registered from the forest habitat during both wet and dry season. The other two habitats (bushland and grassland) harbored similar number of species during both seasons. The success of trapping different species varied between habitats as well as seasons (Table 2). Farmland habitat had the highest mean trapping success (23.5%) followed by the grassland habitat with a mean trap success of 14.6%. The lowest mean trap success (3.2%) was recorded from the forest habitat during the wet and dry seasons. The mean trap success in the bushland habitat was

10.5%. There was statistical variation in the trap success between the different habitat types during the two seasons ($\chi^2=17.2$, $df=3$, $P < 0.05$).

The sex ratio of trapped rodents from different habitats during the wet and dry seasons is given in Table 3. Out of the overall individuals captured by live-trap, females comprised 103 (33.5%) and males 204 (66.5%). The sex ratio of males captured from the different habitats was higher than females during wet as well as dry seasons. The ratio for males was also higher within each species during all trapping sessions. The difference in sex ratio of females and males was statistically significant ($\chi^2=33.2$, $df=1$, $P < 0.01$).

Table 3. Sex ratio of live-trapped rodents during the wet and dry seasons.

Habitat	Season	Number of male and female individuals trapped for each species							
		<i>L.f</i>		<i>A.d</i>		<i>A.a</i>		<i>S.a</i>	
		M	F	M	F	M	F	M	F
FL	Wet	9	5	19	17	2	1	-	-
	Dry	4	1	2	-	35	24	-	-
BL	Wet	17	10	-	-	-	-	8	2
	Dry	11	4	2	-	-	-	3	-
FO	Wet	-	-	-	-	-	-	8	5
	Dry	-	-	-	-	-	-	5	1
GL	Wet	12	7	-	-	-	-	3	2
	Dry	18	5	-	-	-	-	6	-
Total(%)		71 (23.1)	32 (10.4)	23 (7.5)	17 (5.5)	37 (12.0)	25 (8.1)	33 (10.8)	10 (3.3)

Table 3. Continue.

Habitat	Season	Number of male and female individuals trapped for each species							
		<i>M.m</i>		<i>D.m</i>		<i>C.f</i>		Total	
		M	F	M	F	M	F	M	F
FL	Wet	4	4	-	-	2	-	36	27
	Dry	7	2	-	-	-	-	48	27
BL	Wet	2	1	-	-	-	-	27	13
	Dry	2	-	-	-	-	-	18	4
FO	Wet	1	-	-	-	-	-	9	5
	Dry	1	-	-	-	-	-	6	1
GL	Wet	7	4	-	-	-	-	22	13
	Dry	9	5	5	3	-	-	38	13
Total(%)		33 (10.8)	16 (5.2)	5 (1.6)	3 (1.0)	2 (0.7)	-	204 (66.5)	103 (33.5)

(FL= farmland, BL= bushland, FO= forest, GL= grassland, L. f= *L. flavopunctatus*, A. d= *A. dembeensis*, A. a= *A. abyssinicus*, S. a= *S. albipes*, M. m= *M. Mahomet*, D. m= *D. mystacalis*, C. f= *C. fumosa*, (-) = shows absence of trapped individuals).

During the entire study period, a mean of 8341 g/hectare biomass of live trapped rodents was recorded from all habitat types (Table 4). A mean biomass of 1269 and 1114 g/hectare of rodents was collected during the wet and dry seasons, respectively. The highest biomass record was obtained from the farmland habitat (4151 g/hectare), which accounted to 49.8% of the total biomass record. Whereas, the lowest

biomass recorded was obtained from the forest habitat (513 g/hectare). The second habitat with highest biomass record was grassland (1843 g/hectare), followed by bushland habitat with 1834 g/hectare. Out of the overall livetrapped species of rodents, the maximum biomass was recorded for *L. flavopunctatus* (3384 g/hectare) and the lowest was for *C. fumosa* (20 g/hectare).

Table 4. Biomass (g/hectare) of live-trapped rodents from the different habitats during the wet and dry seasons. Numbers in bracket show individuals captured.

Species	Mean body weight (g)	Habitat type					Mean biomass
		Season	FL	BL	FO	GL	
<i>L.f</i>	65.7	Wet	920 (14)	1774 (27)	-	1248 (19)	3384
		Dry	329 (5)	986 (15)	-	1511 (23)	
<i>A.d</i>	85.4	Wet	3074 (36)	-	-	-	1708
		Dry	171 (2)	171 (2)	-	-	
<i>A.a</i>	58.1	Wet	174 (3)	-	-	-	1801
		Dry	3428 (59)	-	-	-	
<i>S.a</i>	52.8	Wet	-	528 (10)	687 (13)	264 (5)	1136
		Dry	-	158 (3)	318 (6)	317 (6)	
<i>M.m</i>	10	Wet	80 (8)	30 (3)	10 (1)	110 (11)	245
		Dry	90 (9)	20 (2)	10 (1)	140 (14)	
<i>D.m</i>	12	Wet	-	-	-	-	48
		Dry	-	-	-	96 (8)	
<i>C.f</i>	20	Wet	40 (2)	-	-	-	20
		Dry	-	-	-	-	
	Mean total (%)		4151 (49.8)	1834 (22.0)	513 (6.1)	1843 (22.1)	8341

(FL= farmland, BL= bushland, FO= forest, GL= grassland, L. f= *L. flavopunctatus*, A. d= *A. dembeensis*, A. a= *A. abyssinicus*, S. a= *S. albipes*, M. m= *M. Mahomet*, D. m= *D. mystacalis*, C. f= *C. fumosa*, (-) = shows absence of trapped individuals).

The overall number of pregnant female rodents and embryo count for each species during the wet and dry seasons are given in Table 5. A total of 15 pregnant females were trapped during all trapping period. Except for *D. mystacalis*, pregnant females were captured for the remaining five snap-trapped species. The maximum and minimum number of pregnant females was recorded for *A. dembeensis* and *M. mahomet*, respectively. There was seasonal difference in the total number of snap-trapped pregnant females ($\chi^2 = 0.6$, df= 1, $P < 0.05$). The number of embryos of pregnant females also showed seasonal variation among species as well as within the same species. For most

species, the left horn embryo implantation was higher than the right one.

The mean percentages of stomach content of snap trapped rodents during the wet and dry seasons given in Table 5. The percentage frequency of plant matters in the stomach was higher than animal matters in all species. The stomach contents of *L. flavopunctatus* and *S. albipes* contained relatively higher frequency of animal matter. Percentages of seed and stem in most stomach contents were higher during the dry season. The percentage of leaves in all stomach contents was higher during the wet season. Higher percentage of animal matter was recorded during the wet

season. The percentage of unknown materials was higher in the stomach samples collected during the dry season.

Table 5. The number of pregnant females, embryo count and mean percentage of stomach content composition for the snap-trapped species during the wet and dry seasons.

Species	Season	No. of pregnant females trapped	No. of embryos recorded	Plant matters (%)				Animal matters (%)		
				S	St	L	R	W	A	UN
<i>L. flavopunctatus</i>	Wet	2	3-4	5.9	13.1	48.6	9.5	6.2	8.5	8.2
	Dry	2	3	16.7	25.4	29.3	11.9	0	4.1	12.6
<i>A. dembeensis</i>	Wet	5	3-7	17.1	23.8	45.1	8.2	0	0.9	4.9
	Dry	1	4	12.3	27.3	29.9	15.2	0	0	15.3
<i>A. abyssinicus</i>	Wet	-	-	16.4	10.6	65.4	1.8	0	0	5.8
	Dry	3	4-7	22.5	19.3	38.8	6.1	0	1.9	11.4
<i>S. albipes</i>	Wet	1	7	5.6	14.7	22.9	15.6	9.7	16.3	15.2
	Dry	1	4	9.6	25.9	23.9	20.4	0	9.5	10.7
<i>M. Mahomet</i>	Wet	1	7	21.4	23.8	26.3	12.4	1.4	2.5	12.2
	Dry	-	-	32.4	26.2	19.1	8.8	0	2.2	11.3

(S= seed, St= stem, L= leaf, W= worm, A= arthropods, UN= unknown materials and bait, (-) indicates absence)

4. Discussion

The overall species abundance in the current study area did not show seasonal variation. However, the abundance of each species within the different habitats showed seasonal variations. For instance, the total number of *A. dembeensis* in the farmland was high during the wet season. But, it was outnumbered by its close relative *A. abyssinicus* during the dry season. Other species, such as *C. fumosa* and *D. mystacalis* were captured during one of the two seasons. During the dry season, grassland and farmland habitats showed increase in the total number of individuals captured; whereas the bushland as well as the forest habitats had less capture. Such seasonal fluctuation was frequently related to the abundance of vegetation cover, availability of food and water.

According to Sidorowicz (1960), different weather conditions can influence the mass appearance of rodents. For example, rainfall can influence different aspects of a given ecosystem. For many species of rodents, breeding often appears to take place during the rainy season (Teylor and Green, 1976). Food shortage and reduced ground cover might be the main reasons for the declined number of rodents in the bushland and forest habitats (Delany, 1964). During the wet season, farmers move their livestock into the mountain vegetation areas to protect their farmland. Cattle were observed grazing in the grassland habitat. Such effect was absent after harvest. The absence of such adverse effects and the presence of good ground cover during the dry season, might have favoured rodents to reproduce, leading to higher trap success.

In this study, trap success between habitats showed seasonal variation. The highest trap success was obtained from the farmland habitat during both seasons. Forest habitat was with the least trap success during both seasons. A mean trap success of 12.7% was recorded from the present study area. This was relatively lower than the previous findings from different parts of Ethiopia. For instance, Bekele (1996a) has obtained 9.1% from Menagesha-Suba State Forest; Datiko *et al.* (2007) have obtained 17.6% from Arbaminch Forest and Farmlands; Habtamu and Bekele (2008) have also

obtained 38.6% from Alatish National Park. Climatic factors, vegetation type, availability of food, and human interference might have contributed to the less trap success of rodents from the present study area.

There was significant variation in the success of trapping of the male and female individuals in the current investigation. The highest trap success for the males could be associated with their high rate of mobility. Trapping success for females was less during both seasons. This might be related with their reproductive behaviour. For instance, Odhiambo and Oguge (2003) have explained that males make wider field excursions than females, which usually care for the litters. This might have limited the mobility of females and, hence lowering their trap success. Higher trap success for juveniles during the wet season could be due to the higher rate of breeding in the wet season.

The highest biomass (1269 g/hectare) of rodents from the present study area was obtained during the wet season. The total biomass recorded varied among habitats. The highest biomass record was obtained from the farmland habitat; whereas the forest habitat was with the lowest biomass record (Table 4). The high biomass record from the farmland habitat could be related to the highest trap success of *Arvicanthis* spp. during both seasons. In consistent with, Gebresilassie *et al.* (2005), the presence of sufficient food supply in the farmlands could have contributed for better biomass record of rodents from the present study area.

The highest embryo count among the rodents was recorded during the wet season. During the dry season, less number of pregnant females was obtained for *L. flavopunctatus*, *S. albipes* and *A. abyssinicus*. According to Boutin (1990), the presence of good quality and quantity of food in a given habitat may have significant effect on the time of reproduction, litter size and body growth rate of rodents. There was also seasonal variation in the proportion of plant and animal matter obtained from the stomach contents of each species (Table 5). This shows omnivores and opportunistic feeding behaviour of the trapped individuals. Similarly, Kasso *et al.* (2010) have obtained comparable result from the stomach content analysis

5. Conclusion

Based on the statistical data obtained, there was no seasonal variation on the total live-trapped rodents. In contrast, the relative abundance of small mammals showed far more marked significant variation across habitats. This could be mainly attributed to population fluctuation in some species and capturing of some species only in one of the two seasons.

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