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Population density, feeding and, reproductive ecology of rodents from Alemsaga Priority State Forest and adjacent farmlands

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ABSTRACT: A study on population density, feeding, and reproductive ecology of rodents from Alemsaga Priority State Forest and the adjacent farmlands was conducted from July 2018-September 2020. Live and snap traps were used for capturing rodents from the study area. The Capture-Mark-Release method was employed to estimate the population size and respective density of rodents. Snap traps were used to capture rodents for body measurement and stomach content analysis. Embryo count was carried out from 64 pregnant females. Data were computed using descriptive statistics and compared with chi-square. *Lophuromys simensis*, *Arvicanthis abyssinicus*, *Desmomys harringtoni, Mastomys natalensis, Stenocephalemys albipes*, *Rattus rattus, Arvicanthis dembeensis*, *Mus musculus*, and *Acomys cahrinus* were recorded from the six habitats. The result indicated that a total of 1140 and 171 individuals were trapped in the study area with live and snap traps, respectively. The average population density of rodents was 47.4 h^{-1}. The highest density was recorded in bushland habitat (75.1 h^{-1}) while the least was in *Carissa* land (32.2h^{-1}). In terms of species, *L. simensis* showed the highest density (111.65 h^{-1}) whereas *A. cahrinus* was the lowest (1.7 ha^{-1}). The overall densities of rodents were 224.82 ha^{-1} and 162.93 ha^{-1} during the wet and dry seasons, respectively. The total rodent biomass in the study area was 160,495 g. The number of embryos counted ranged from 4-12 and 2-8 during the wet and dry seasons, respectively. However, there was no statistical significance between the two seasons (χ^2 = 0.74, df=1, p> 0.05). Plant matters constituted a higher proportion of stomach contents (64.4%) compared to animal matters (13.2%). Generally, Alemsaga State Forest harbors rodent species with high density and biomass. Proper conservation of the area will contribute to the betterment of species density and biomass.

Keywords/phrases: Adjacent farmlands, Alemsaga Forest, Feeding and Reproductive ecology, Rodents density

INTRODUCTION

Rodents are a diverse group of mammals that constitute 42% of mammals (Aplin *et al*., 2013). Geographical and habitat differences affect the population dynamics of rodent species (Wilson *et al*., 2018). Rodent populations show temporal and spatial fluctuations in their number and composition. Environmental and ecological factors like habitat heterogeneity and complexity play a vital role in population fluctuation (Wilson *et al*., 2018; Ashetu Debelo and Afework Bekele, 2020). Some species exhibit variability in demographic parameters locally rather than on a regional scale (Wilson *et al*., 2018). Population density of one or more species of rodents is also related to different environmental factors such as vegetation cover, farming practices, crop type and stages, season, and predation (Ashetu Debelo and Afework Bekele, 2020).

To understand the relationship between rodent species and their environment, studying their diet composition is essential. This relationship can govern species diversity, community structure, relative abundance, and resources (Morris *et al*., 2011). Diets of rodents are usually evaluated by examining stomach contents or fecal materials (Davies, 2002). According to Workneh Gebresilassie *et al*. (2004), rodents are opportunistic feeders, capable of changing their feeding habits depending on the availability of food from season to season. This behaviour makes them the most diverse and destructive pest species in farmland and human-dwelling habitats. For

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instance, a study on food habits of Black rats (*Rattus rattus*), multi-mammate rat (*Mastomys natalensis*), giant rat (*Cricetomys gambianus*), and pygmy mouse (*Mus minutoides*) showed that vegetable items contribute more than animal food items (Davies, 2002). Demographic processes such as reproduction, mortality, survival, immigration, emigration, temperature, and humidity have also a significant role in determining rodents' density and activity (Mesele Yihune and Afework Bekele, 2012).

Rodents have high biotic potential and short breeding cycles, explorative and adaptive abilities, capable of exerting changes on population structures and density (Vaughan *et al.*, 2000). However, information on the density, feeding ecology, and reproductive status of rodents is non-existent in the present study area. Therefore, the present study focuses on the density, feeding, and reproductive ecology of rodents in Alemsaga Priority State Forest and adjacent areas.

MATERIALS AND METHODS

Study area

The Alemsaga Priority State Forest is located 90 km away from Bahir Dar and 667 km north of Addis Ababa (Fig. 1). It is found between Fogera and Farta districts, South Gondar Zone (Dagnachew Nega *et al.*, 2019). It lies at a latitude of 11°54'-11°56'N and a longitude of 037°55'-037°57'E with an elevation between 2100- 2600 m asl (Worku Endale *et al.*, 2014). The forest covers about 850 ha. The district consists of four major agro-ecological zones: 69% highland, 25% lowland, and 6% valley. The annual temperature oscillates from 9-25°C and precipitation ranges from 1250 mm in the lowland to 1500 mm in the highland. Agriculture is the main economic activity in the study area (Worku Endale *et al.*, 2014).

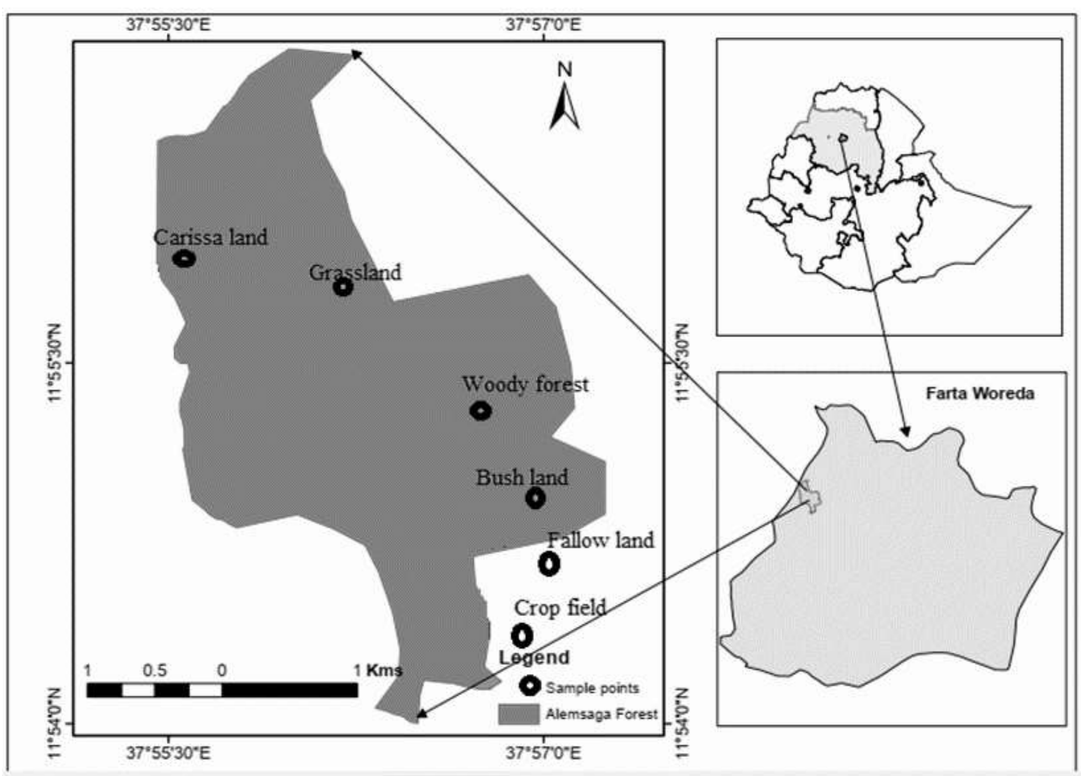

Figure 1. Map of Alemsaga Priority State Forest and sampling areas

METHODS

Sampling design

The study was conducted from July 2018 to September 2020 during both the wet and dry seasons. The forest was classified into four patches based on altitude, habitat type, and accessibility (Grid setting, inspection, and collection suitability). These include *Carissa*-dominated habitat type, grassland, woody forest, and bushland. Two additional study sites (Fallow land and crop field) were also selected from the adjacent areas (Fallowland and Crop field).

From each habitat type, a sample grid was selected across altitudinal gradients (Ashetu Debelo and Afework Bekele (2020). Forest stratification was used to get more accurate data, and to maintain the representativeness of sample areas. Relative homogenous unit of elevation was defined at each elevation point, starting from the low to the higher elevations.

Rodent trapping

A permanent live trapping grid of 70 x 70 m (4900 m^2) size with 49 total Sherman live traps were set for five consecutive nights each wet and dry seasons (Ashetu Debelo and Afework Bekele, 2020). For accurate body measurement, stomach content analysis, and embryo count, additional 25 snap traps were set at 200 m away from the Sherman live trap stations to avoid home range overlaps. Trap stations were marked with the yellow plastic tags on the visible part of a tree near the traps to easily access the location of traps during checking (Mohammed Kasso and Afework Bekele, 2011).

Traps were baited with peanut butter, bread, and barley flour to attract rodents (Kingdon *et al*., 2013). Then traps were covered by available material like grasses and leaves to minimize visibility against predators. Traps were checked twice a day early in the morning (6:30 a.m. to 8:30 a.m.) and in the late afternoon (4:30 p.m. to 6:30 p.m.). Traps were cleaned and rebaited when checked if dried, lose odour, and sprung by wind, rain, and consumed by non-targeted animals. Traps that were shut without capturing were reset during inspection time. Each trapped animal by Sherman live traps was identified to species level, marked by toe clipping using specific number coding, weighed, and released back to the site from where it was trapped (Aplin *et al*., 2003; Kingdon *et al*., 2013).

Information such as sex, approximate age based on their weight and coat colour (Afework Bekele, 1996a) and reproductive conditions (for females: imperforate or perforated vagina, the size of nipples and distended abdomen and for males: the position of testicles (scrotal or abdominal) and the size of the testicles were recorded (Afework Bekele, 1996a; Mahlaba and Perrin, 2003). Embryo count was also carried out from both left and right uterine horns by dissecting pregnant females (Aplin *et al*., 2003).

Diet analysis

Snap trapped rodents were dissected for stomach content analysis during the study period in both the wet and dry seasons. In the field, the stomach contents were collected and kept in a plastic tube, and preserved with10% formalin until further laboratory analysis. During laboratory work, the stomach contents were spread onto a Petri dish and mixed thoroughly. The contents then were added into a 0.25 mm sieve and washed with distilled water to remove finely chewed and digested food particles for proper identification. Stomach contents then were dried in the open air for a day. Four slides were prepared for each sample and the contents were put on a glass slide to observe the type and proportion of food items under compound light microscopes (40*40 magnification powers). Even though identifying dietary items was problematic, stomach contents were grouped as plant, animal, and unidentified matters. Heads, legs, and wings were the keys for arthropod identification whereas head parts and body segmentations were used for worms. Mono and dicotyledonous plant tissues were also identified and differentiated based on the nature of venation in the laboratory (Aplin *et al*., 2003; Mosisa Geleta *et al.,* 2011). Each food fragment was counted from the entire slide, summed up, and converted to the mean percentage for each sample. The laboratory works were carried out at Addis Ababa and Debre Markos Universities.

Data analyses

Data were analyzed using SPSS version 21. The density of each species was determined from the estimated total population (Balete and Heaney, 1997). In each trapping session and grid, the density of a species was estimated as the total population number per hectare (10,000 m^2). The biomass of each rodent species in each habitat was estimated as a product of the mean weight of each species and density (Balete and Heaney, 1997). For population estimation of rodents in each live trapping grid, the following formula was used (Aplin *et al*., 2003):

$$N = \frac{M_2 C_2 + M_3 C_3 \ldots}{R_2 + R_3 \ldots}$$

Where N is the estimated population size of rodents,

M_2 is the number of marked individual rodents in the first capture

M_3 is the number of new captured individual rodents in the second capture plus M_2

C_2 is the number of marked and new individual rodents in the second capture

C_3 is the number of marked and new individual rodents in the third capture

R_2 is the number of re-captured individual rodents in the second capture

R_3 is the number of re-captured individual rodents in the third capture

Chi-square (χ^2) tests were used to test possible associations between rodent abundance and habitats, study periods, number of pregnant females and embryos, density, and food items between seasons.

RESULTS

Density of rodents

Nine rodent species were recorded from live-trapping during the study period. These were *Lophuromys simensis*, *Arvicanthis abyssinicus*, *Desmomys harringtoni*, *Mastomys natalensis*, *Stenocephalemys albipes*, *Rattus rattus*, *Arvicanthis dembeensis*, *Mus musculus*, and *Acomys cahrinus*.

A total of 1140 individual rodents were trapped in all habitats using live traps. The total mean population density of live-trapped rodents in the study area was 47.4 ha^{-1} (Table 1). The highest mean rodent density was recorded in the bushland habitat (75.1) followed by crop fields (53.7) and grassland (45.35). The least rodent means density per hectare was recorded in *Carissa* land (32.2). The highest mean density (111.65) was observed for *L. simensis* followed by *S. albipes* (88. ha^{-1}).

There was a significant variation (χ^2=9.907, df=1 and P<0.05) in rodent density between seasons. The overall rodent density was found to be 224.82 ha^{-1} during the wet and 162.93 ha^{-1} during the dry season. *L. simensis* showed the highest density during both wet (77.89ha^{-1}) and dry seasons (60.54 ha^{-1}) followed by *A. abyssinicus* (wet = 55.44 and dry=30.27 ha^{-1} seasons). The least density per hectare was recorded in *A. cahrinus* (2.04 during the dry season and 8.16 ha^{-1}during the wet season) (Fig. 2).

Table 1. The density of live-trapped rodent species in different habitat types in the study area.

Species	Habitats							
	CL	GL	WF	BL	FL	CF	Mean	SD
L. simensis	120.41	122.45	167.35	155.10	20.92	83.67	111.65	53.29
A. abyssinicus	0.00	0.00	0.00	0.00	212.24	251.02	77.21	120.24
D. harringtoni	132.65	71.43	51.02	89.79	4.08	0.00	58.16	51.15
M. natalensis	0.00	48.97	59.18	75.51	46.94	61.22	48.64	25.92
S. albipes	12.24	83.67	93.88	338.78	0.00	0.00	88.1	129.75
R. rattus	14.29	79.59	0.00	0.00	0.00	0.00	15.65	31.84
A. dembeensis	0.00	0.00	0.00	0.00	20.41	71.43	15.31	28.68
M. musculus	0.00	2.04	0.00	16.33	26.53	16.33	10.21	10.1
A. cahrinus	10.20	0.00	0.00	0.00	0.00	0.00	1.7	4.16
Total	289.79	408.15	371.43	675.51	331.12	483.67	426.61	455.13
Mean	32.2	45.35	41.27	75.1	36.8	53.7	47.4	50.57

Cl=*Carissa* land; GL= Grassland; WF=woody forest: BL= Bushland; FL= fallowland; CF= Crop field and AD=Standard deviation).

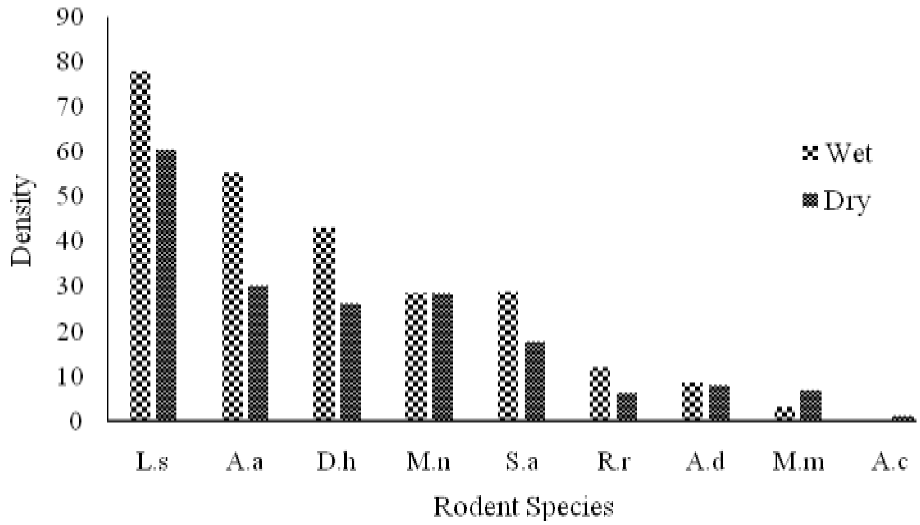

Figure 2. The density of rodent species during the wet and dry season in the study area.

(L.s=*L. simensis*, A.a=*A. abyssinicus*, D.h=*D. harringtoni*, *M. natalensis*=, S.a=*S. albipes*, R.r=*R. rattus*, A.d=*A. dembeensis*, M.m= M. *uasculus* and A.c=*A. cahrinus*).

The density of rodents varied significantly (χ^2=52.79, df=5 and P<0.05) among habitats in the study area. The highest density was recorded in crop fields (548.98 ha^{-1}) followed by grassland (485.71ha^{-1}) (Fig. 3). The least density per hectare was recorded in Carissa land (328.57ha^{-1}). Fallow land, bushland and woody forest have nearly the same density per hectare.

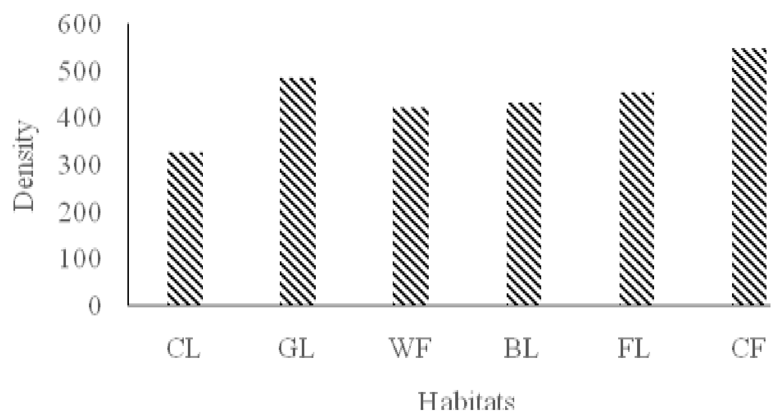

Figure 3. The density of live-trapped rodents in each habitat

(CL=Carissa land; GL= Grassland; WF=woody forest: BL= Bushland; FL= fallowland and CF= Crop field)

The population density of live-trapped rodents along altitudinal ranges of the study area is given in Table 2. The highest overall mean density of rodents (58.17 h^{-1}) was recorded between altitudinal ranges of 2350-2400 m asl followed by 2470-2560 m asl (45.27 h^{-1}) and the lowest (38.8 h^{-1}) was recorded in lower altitudinal ranges, 2109-2228 m asl. However, there was no statistically significant variation in mean rodents density among the three altitudinal ranges (χ^2=3.87 df=2, P>0.05).

Table 2. The density (ha^{-1}) of rodents across altitudinal ranges

Species	Altitudinal Zonation (m asl)				
	2109-2228	2350-2400	2470-2560	Mean	SD
L. simensis	121.43	161.23	52.295	111.65	55.12
A. abyssinicus	0	0	231.63	77.21	133.73
D. harringtoni	102.04	70.41	2.04	58.16	51.11
M. natalensis	24.51	67.35	54.08	48.65	21.93
S. albipes	47.96	216.33	0	88.1	113.61
R. rattus	46.94	0	0	15.65	27.10
A. dembeensis	0	0	45.92	15.31	26.51
M. musculus	1.02	8.17	21.43	10.21	10.36
A. cahrinus	5.10	0	0	1.7	2.94
Mean	38.8	58.17	45.27	47.4	49.16

AD=Standard deviation

The biomass of trapped rodent individuals of each species for each habitat was given in Table 3. The total rodent biomass in the study area was 160495 gm.

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Table 3. Biomass of rodent species in the different habitats of the study area.

Species (mean weight in g)	Habitats						
	CL	GL	WF	BL	FL	CF	Total
L. simensis (51.42)	6191.4	6296.4	8610.3	7975.2	1075.7	43.2.3	30149
A. abyssinicus (91.02)	0	0	0	0	19318.1	22847.8	42165.9
D. harringtoni (57.6)	7640.6	4114.4	2938.8	5171.9	235.1	0	20100.8
M. natalensis (53.42)	0	2615.9	3161.4	4033.7	2507.5	3270.4	15588.9
S. albipes (65.02)	795.8	5440.2	6104.1	22027	0	0	34367.1
R. rattus (98.9)	1413.3	7871.5	0	0	0	0	9284.8
A. dembeensis (79.9)	0	0	0	0	1630.8	5707.3	7338.1
M. musculus (17.4)	0	35.5	0	284.2	461.6	284.2	1065.5
A. cahrinus (42.6)	434.5	0	0	0	0	0	434.5
Total	16475.6	26373.9	20814.6	39492	25228.8	32109.7	160495
Mean	3295.1	4395.7	52.3	7898.4	4204.8	6421.9	17832.8

Cl=*Carissa* land; GL= Grassland; WF=woody forest: BL= Bushland; FL= fallowland; CF= Crop field).

Population estimation

The total rodent population recorded in Alemsaga Priority State Forest was estimated to be 2754 (Table 4). The estimated population size showed variations among the six habitats (χ^2 = 97.79, df=5, p<0.05). The highest population size (349) was estimated in crop field habitat and the least in bushland habitat (169). The highest population of rodents was during the wet season (882) and the least was during the dry season (441). There was a significant variation (χ^2=147.00, df=1, p<0.05) among rodent populations between the wet and dry seasons.

Table 4. Population estimate of rodents in different habitat types during the wet and dry seasons in the study area

Season	Habitats							
	CL	GL	WF	BL	FL	CF	Total	Mean
Wet season	146	133	132	92	150	229	882	147
Dry season	36	75	90	77	43	120	441	74
Total	182	208	222	169	193	349	1323	387
Mean	91	104	111	85	97	175	662	110

Cl=*Carissa* land; GL= Grassland; WF=woody forest: BL= Bushland; FL= fallow land; CF= Crop field).

Reproductive status

During the present study, embryo count was carried out from 64 individuals pregnant females of seven snap trapped rodent species during both the wet and the dry seasons (Table 5). The number of counted embryos ranged from 4-12 and 2-8 during the wet and dry seasons, respectively. *M. natalensis* accounted for the highest number of embryos (*N*=12) followed by *A. abyssinicus* (*N*=7) and the lowest two. An adult female of *A. dembeensis*was caught, but a pregnant female was not recorded during the wet season. The total number of pregnant females was higher during the wet season (*N*=45) compared to the dry season (*N*=19). However, statistically significant difference was not observed (χ^2 = 0.74, df= 1, p> 0.05) between seasons.

Table 5. Embryo count of rodents at different seasons.

Species	Season	Number of pregnant females trapped	Number of embryos counted
L. simensis	Wet	10	4-6
	Dry	3	2-4
A. abyssinicus	Wet	12	5-7
	Dry	5	4-5
D. harringtoni	Wet	8	4-5
	Dry	2	2-4
M. natalensis	Wet	6	7-12
	Dry	2	5-8
S. albipes	Wet	5	4-6
	Dry	4	2-5
R. rattus	Wet	3	4-5
	Dry	2	3-4
A. dembeensis	Wet	-	-
	Dry	2	2-4

Diet analysis

A total of 117 rodents were snap trapped (60 wet and 57 dry seasons) for diet analysis. Plant matters constituted the highest proportion (64.4%) followed by unidentified food items (22.4%) and animal matters (13.2%). There was a significant difference among the percentage of food items consumed by rodents (χ^2=43.28, df=2,p<0.05). Regardless of the season, leaves and grasses constituted the highest proportion (27.2%) followed by seeds (26.7%) and roots (11.7%). On the other hand, animal matters and unidentified materials occupied 13.2% and 15.5%, respectively. In all rodent species, the rate of consumption of animal matter was more during the wet season than during the dry season. *L. simensis* consumed more animal matter during the wet season (33%) followed by *M. natalensis* (22.5%) and the least was *D. harringtoni* (2%) during the dry season (Table 6).

Table 6. Percentage diet components of snap trapped rodents in the study area (L. si=*L. simensis*, A. ab= *A. abyssinicus*, D.ha=*D. harringtoni*, M.na= *M. natalensis*, S. al=*S. albipes*, M.cot = Monocot; and D.cot = Dicot).

Species	Examined individual	Seasons	Seed		Leaves and grasses		Root	Animal component	Unidentified components
			M. cot	D. cot	M. cot	D. cot			
L. si	14	Wet	14.28	11.91	19.04	23.81	1.2	33.00	7.14
	12	Dry	13.91	11.11	10.22	8.33	5.56	11.05	13.91
A. ab	11	Wet	17.07	12.19	19.51	21.95	-	14.63	9.75
	11	Dry	23.81	16.71	10.81	16.71	4.57	11.9	7.14
D. ha	12	Wet	16.00	20.00	8.00	12.00	5.71	10.20	22.00
	14	Dry	6.12	4.08	18.57	12.24	16.33	2.00	22.45
M. na	12	Wet	10.34	27.58	3.45	13.81	6.24	*22.50*	20.71
	10	Dry	10.00	7.50	12.50	7.50	17.50	6.91	22.50
S. al	11	Wet	15.22	8.71	19.57	13.04	18.74	13.64	13.04
	10	Dry	9.10	11.36	9.10	11.36	29.55	6.52	15.91

DISCUSSION

The population density of rodents in the study area showed variation from habitat to habitat, season to season and species to species during the present study period. The mean rodent population density was 47.4 h^{-1}. Sintayehu Workineh *et al.* (2011) reported lower density than the present study area, (21ha^{-1}) in Nechsar National Park and Krebs *et al.* (2011) reported 25 h^{-1} in northern Canada. Wilson and Lee (2010) reported less than 6 rodent individuals' ha^{-1} in New Zealand. However, Goldwater *et al*. (2012) revealed 160 ha^{-1} rodent densities in small forest patches of New Zealand. Parker *et al*. (2016) reported also house mouse population densities of 150–500 ha^{-1} on subantarctic islands (Georgia). Moreover, Singleton *et al*. (2007) reported 2000 individuals' ha^{-1}in wheat-growing farms of Australia. Apia *et al*. (2011) also reported 140 rodent densities in Tanzania, 20 in Namibia and 120 ha^{-1} in Swaziland. Variations in predator density, interspecific and intraspecific competitions, nature of the habitats, availability of food and shelter and climatic conditions might have a great impact on the above density variations among countries. Moreover, trapping techniques linked with the breeding of rodent species and season, number and size of grids and types of traps used for capturing rodents might have also their own contribution (Singleton *et al*., 2007). According to Apia *et al*. (2011) and Sintayehu Workineh and Reddy (2016), intra-specific competition by rodents for resources can restrict population growth by depressing reproduction and existence, or by emigration from their habitats.

The overall rodent density varied seasonally. Seasonal breeding and density oscillations observed in the present investigation confirmed that the reproduction of rodent species depends mainly on rainfall. Similarly, Mahlaba and Perrin (2003) stated that rainfall influences rodent population dynamics in sub-Saharan Africa. Apia *et al*. (2011) reported in Swaziland, Tanzania and Namibia where breeding takes place during the wet season, attributed to the direct effects on rodents primary productivity. Sluydts *et al*. (2008) also revealed that the maturation and survival of rodents increase during the wet season as food availability is high. When a rainy season is extended and abundant, factors such as accessibility of food, cover and nesting places become high (Apia *et al*., 2011). Sintayehu Workineh and Reddy (2016) also reported that a rainy season increases food accessibility for small mammals in the form of foliage, seeds and roots, insects and worms, which increases the carrying capacity of fitting habitats for rodents. Most African murid rodents also respond with high density during the wet season through high reproduction initiated by new foliages containing chemical ingredients that promote rodent reproduction following rainy seasons (Apia *et al*., 2011).

The highest mean rodent density was recorded in bushland habitats. Similarly, Apia *et al*. (2011) and Ashetu Debelo and Afework Bekele (2020) reported high population rodent density in bushland habitats. The population status of rodent species is also linked with geographical (latitude and longitude) and habitat differences (Sintayehu Workineh and Reddy, 2016). Resource availability and low predation risk can be the possible reasons for this.

The number of counts was variable during the wet and dry seasons. The variation in the number of litters among rodent species can be related to environmental factors, age, genetic makeup, uterine capacity, deficiency of luteal tissue and the differences in the sample numbers on pregnant female rodents. Similar findings were reported by Pillary (2003), Mosissa Geleta *et al*. (2011), Demeke Datiko and Afework Bekele (2013) and Dobigny (2014). The variation in litter size among rodent species can be also related to maternal care, nipple-clinging behaviour, physiological weaning, evolutionary or life-history traits and phylogenetic constraints (Pillay, 2003). Pillay (2003) also stated nipple clinging outwardly improves the survival of pups by reducing predation risks in rodents that nest under uncovered environments.

The number of pregnant females was higher during the wet season than the dry season in the present study. Dobigny (2014) stated that most small mammals demonstrate a seasonal reproduction pattern related to rainfall, associated with resource accessibility. The result agrees with the finding of Mosissa Geleta*et al*. (2011) in which rodent reproduction was initiated during the wet season and sustained through the early dry season. According to Morris *et al*. (2011), supplemental food items during the wet seasons may initiate conversion rates from non-reproductive to reproductive states. Unlike the present result, Dobigny (2014) revealed all-year-round reproduction of urban commensal rodents in Niger, where resources are permanently available. Survival and reproduction are the most significant demographic elements that play a vital role in regulating population abundance.

Evidence on diet composition may have a role in shaping the ecology of rodents. In the present study, the omnivorous behaviour of rodents was observed in most dissected species. The proportions of food items vary from season to season and species to species. Mossisa Geleta *et al.* (2011) and Getachew Simeneh (2016) reported the feeding habits of rodents to be variable. Nearly all rodent species relied on plant parts (seeds, grasses, leaves and roots) than animal matters for their diet during both wet and dry seasons. Similarly, Sefcikova and Mozes (2002) reported that rodents showed granivorous feeding habits. Rodents mostly prefer plant matter to any other category of food (Misissa Geleta *et al*., 2011). The proportion of plant matters also varied in most species between seasons. This is associated with the feeding habits of rodents changing between seasons (Sefcikova and Mozes, 2002). Workneh Gebresilassie *et al.* (2004) and Demeke Datiko and Afework Bekele (2014) also reported that rodents have opportunistic feeding habits, changing their feeding styles based on the obtainability of food types between seasons. The secret behind successful species diversity and richness of rodents can rely on high ranges of feeding habits in the ongoing environmental changes of the earth. Feeding of animal matter (worms and arthropods) was higher during the wet season than in the dry season. This might be due to the high population of worms and arthropods following the rainy seasons. According to Misissa Geleta *et al*. (2011), the rainy season enhances the population of worms and arthropods to increase serving as a source of food for rodents and other animals like birds.

The highest proportion of food items (33.0%) was recorded in *L. simensis* during the wet season, which was animal matter (worms and arthropods). According to Clausnitzer (2003), the uncommon consumption of invertebrates by the *Lophuromys* species permits the species to inhabit areas not usually appropriate for other rodents in Ethiopia. The occurrence of a relatively high proportion of plant materials in most rodents during the wet season might be due to the unimodal nature of the rainy season in the study area. Consumption of roots as food by rodents increases during the dry season than during the wet. This could be associated with ingesting succulent roots to compensate for the need for water during the dry season.

The feeding habits of *A. abyssinicus* tend mostly to seeds, leaves and grasses during both seasons. The present finding agrees with the reports of Demeke Datiko and Afework Bekele (2014). The predisposition of seed predation especially during the dry season was higher by *A. abyssinicus*. This may be associated with pest nature and habitat preference (recorded only in the crop and farmlands only) in the present study. Differences in resource use among the five tested rodents show the importance of the environment and sharing of similar resources (food types) thereby improving their coexistence in the study area. The ecological role of rodents in the present study also confirmed seed predation due to the scattering of the different plant species. Demeke Datiko and Afework Bekele (2014) revealed that seeds, leaves, grasses and invertebrates are the major food components at different growing stages. However, the occurrence of monocot and dicot seeds in the stomach contents of individual rodents confirmed conflict with local farmers or the pest nature of rodents.

Alemsaga Priority State Forest and the adjacent habitats harboured rodent species with varied densities among habitats that need habitat conservation. Plant matters contributed the highest proportion of rodent feed showing the presence of human-rodent conflict in the study area. The stomach contents of rodents varied during the wet and dry seasons showing the opportunistic nature of rodents in their feeding habits.

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