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Habitat Quality Assessment of the Ethiopian Wolf in the Simien Mountains National Park, Ethiopia

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ABSTRACT

The present study documents on habitat quality assessment of the Ethiopian wolf in the Simien Mountains National Park, Ethiopia. Data collection was carried out between November, 2010 and October, 2012, seasonally. During data collection, variables relevant to rodents distribution were measured, including percentage cover of vegetation and physical variables. Data were analyzed using descriptive statistics and variables were compared with one way ANOVA. The result indicated that the average No. ±SE of murid rodents per quadrat was 2.5±0.19. On the other hand, the average No. ±SE of common mole rat per quadrat was 0.82±0.13. There was weak correlation ($r^2 = 0.09$, slope = 0.244, $p<0.05$) between the presence of livestock droppings and murid rodent burrows in the study area. There was also weak correlation ($r^2 = 0.03$, slope = 0.10, $p<0.05$) between common mole rat mound and livestock droppings. Livestock droppings were high in all sample areas (68.7%). The average number of livestock droppings per quadrat was lower in higher herbaceous level cover whereas the average number of livestock droppings per quadrat was higher in higher ground level cover. This indicated that livestock have significant impact on vegetation cover which affects rodent distribution and abundance. This in turn affects the Ethiopian wolf population by reducing its prey base in the study area. Therefore, this should be curtailed to create a suitable and high quality habitat for the Ethiopian wolf in the study area.

Key words: Ethiopian wolf, habitat quality, rodents, Simien Mountains National Park

INTRODUCTION

There is an intimate relationship between species and their habitats (Pullin, 2002). Some organisms require different environments for different uses. Welfare of a species depends on the condition of each component of its habitat. For an environment to be habitable by an organism, it must fall within the range of conditions that the organism can tolerate (Reid, 1993). In some species, habitat requirements are more specific than others (Pullin, 2002). Habitat can affect the fitness of animals through variation in resources and environmental conditions (Bernstein *et al.*, 1991; Pulliam, 2000). Spatial and temporal variations in habitat conditions can generate strong selective pressure for habitat selection (Cody, 1985). David (2000) defined the term habitat quality as the ability of a habitat to sustain life and support a given animal population growth. Habitat quality can be determined by the availability of rodent prey in the area for the Ethiopian wolves. Classes of vegetation-soil-rock complexes were considered as useful tool for predicting relative abundances of rodent prey in the study area.

The Ethiopian wolf (*Canis simensis*, Rüppel, 1835) is a unique canid endemic to Ethiopia. It is a medium-sized canid having long legs and an elongated muzzle (Gottelli and Sillero-Zubiri, 1992; Sillero-Zubiri, 1994). The average weight of male Ethiopian wolf is 16 kg and the female is 12 kg (Sillero-Zubiri and Macdonald, 1997). The Ethiopian wolf commonly preys on small mammals and is specialized in rodent hunting. The Ethiopian wolf mainly lives in Afro-alpine habitats characterized by short grasslands (Sillero-Zubiri and Gotteli, 1995b). The density of the Ethiopian wolves is mostly correlated with the abundance of rodent prey population (Sillero-Zubiri and Gotteli, 1995a; Ashenafi *et al.*, 2005). They become sexually mature during their second year. Mating occurs between August and November (Sillero-Zubiri, 1994). The Ethiopian wolves live in packs but, they become solitary during foraging. This makes them unique from other canid groups (Sillero-Zubiri and Gottelli, 1995a). Therefore, the present study focuses on habitat quality assessment of the Ethiopian wolf in the Simien Mountains National Park. Particularly, it focuses on the abundance of grass rats and common mole rat, impact of livestock on the quality of the Ethiopian wolf habitat.

MATERIALS AND METHODS

Study area: The Simien Mountains National Park (SMNP) is about 860 km north of Addis Ababa. It is part of the Simien Mountains (between 38000'-38012'E and 13012'-13019'N) (Falch and Keiner, 2000) (Fig. 1). Originally, the area of SMNP used to be 136 km^2 but recently the area has

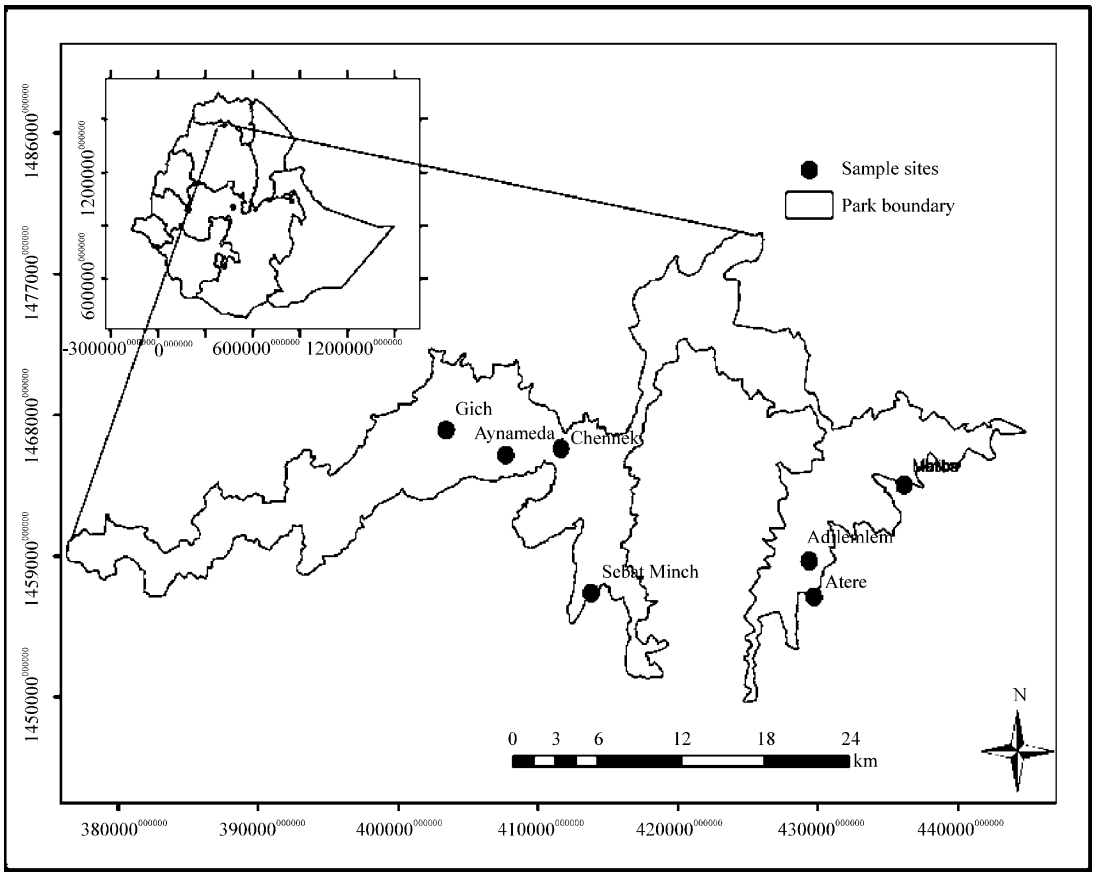

Fig. 1: Map of the Simien Mountains National Park and study sites

been extended to 412 km^2 in order to encompass potential area of wildlife. The area occupies chains of plateau and grassy plains and is part of the Simien massif which includes the highest peak in Ethiopia, Ras Dejen Mountain (4,543 m asl) (Nepal, 2000). The topographic feature of the SMNP is characterized by unique landscape composed of a broad undulating plateau. It is also known by its precipitous cliffs, deep gorges and high peaks (Hurni, 1986).

The Park was nationally gazetted in 1969. It represents one of the most marvelous natural areas in the world. The presence of high number of endemic species, unique bio-physical features and its international significance made SMNP to become a World Heritage Site in 1978 (Falch and Keiner, 2000). The climate of the SMNP varies from area to area. Generally, highlands have a relatively low temperature. They are cold in the early mornings of the dry season (Hurni, 1986). The climatic difference between escarpments and gorges is the cause for the difference in vegetation type in the area.

The SMNP is part of the Afro-alpine centre of plant diversity with high level of endemism (Puff and Nemomissa, 2001). The Park harbours a representative part of the Ethiopian Tropical Highland Biome and contains vegetation characteristics of each (Puff and Nemomissa, 2001; Debonnet *et al*., 2006). The rich natural vegetation of the SMNP only exists due to the steep gorges (Hurni and Ludi, 2000). In the SMNP, 57 tree species and herbaceous plants have been recorded (Falch and Keiner, 2000). Numerous species of mammals and birds exist in the SMNP which is an indication of its unique ecosystem. In the SMNP, 22 large mammals, 13 small mammals and 180 bird species have been recorded (Hurni, 1986).

Data collection: Extensive field surveys were conducted in different sample areas to record variables relevant to the quality of habitat for the Ethiopian wolf. A total of 403 point samples from the selected sample areas (Gich, Chennek, Aynameda, Sebat-Minch, Matiba, Adilemlem and Atere) were surveyed to study vegetation types and land characteristics. At each site, variables relevant to rodent distributions were measured, including the percentage cover of vegetation (grasses, shrubs and herbs) and physical variables (bare ground and stone). Vegetation type was also determined in each point sample area. Soil and rocks can form a significant portion of the landscape (Lewis, 1998). Other environmental variables were also recorded to represent the landscape in which the sample was found for instance, landform and slope. The point samples were located every 200 m along line transects running across the study areas of different sample sites. This helped to avoid spatial auto-correlation and ensure independence. The percentage cover of bare ground, stone and plants as visually assessed and estimated on a circular area of 5 m radius quadrat. Vegetation cover was measured following Braun-Blanquet's scale: 1 = <5%; 2 = 5-25%; 3 = 26-50%; 4 = 51-75%; 5 = 76-100% (Hurst and Allen, 2007). For additional information on the structure of vegetation, the cover of vegetation layer was also recorded that typically describes the structure of Afro-alpine type vegetation: modal height <5 cm ground level; 5-30 cm herbaceous level and >30 cm shrub level. The overall habitat type for the area immediately surrounding the quadrat was classified.

Grass cover was recorded as 'short grass' or 'tall grass' where they belonged to the ground or herbaceous layer, respectively. Landscape environmental variables included four categories of slope: Flat, gentle, moderate and steep and terrain forms: swamp, plateau, crag (rock face) and slope. Furthermore, the number of the Ethiopian wolf scat and dig outs were recorded in each quadrat. Livestock droppings were also counted to investigate their impact on the quality of habitat by affecting the number of rodents. These were classified as cattle, pack animals and sheep and goats. Fresh and recent wildlife droppings were also counted and identified in each quadrat.

Measurements of rodent abundance using counts of holes in each quadrat were used to assess the use of vegetation classes in predicting prey abundance and distribution. This is because, the distribution of the Ethiopian wolf was correlated with the abundance of rodents (Sillero-Zubiri *et al.*, 1995). Counts of rodent signs were assumed to be an appropriate measure of prey availability to the Ethiopian wolves (Sillero-Zubiri *et al.*, 1995). Number of rodent holes were measured in each 5 m radius quadrat. During counting, old unused rat holes that were distinguished by plant growth around the entrance were excluded. Mole rat signs were also included in counting.

Data analysis: Average number of murids and common mole rats were calculated using holes and common mole rat mound, respectively. Descriptive statistics was used to calculate percentage ground cover and proportion of vegetation cover (ground level, herbaceous level and shrub level) in the study area. Correlation between livestock droppings and rodent signs (murids hole and common mole rat mound) were calculated. Variable were tested and compared with one way ANOVA.

RESULTS

The Simien Mountains National Park has different landscape characteristics. Its terrain consisted of plateau, slope, crag and swamp types of landscape. Largest proportion (74.5%) of the Park belonged to slope terrain while plateau terrain accounted for 15.1%. On the other hand, crag represented 6.3% and swamp represented the least proportion of terrain feature (4.1%).

Vegetation (52%) was the dominant ground cover in the study area while soil cover accounted for 27.1% followed by rock cover (20.9%). Ground cover was significantly differed ($F_{6\ 510} = 2.6$, $p<0.05$) across different sample areas. The highest proportion of vegetation cover was recorded in Sebat Minch (65.8%) whereas the least recorded was in Adilemlem (34.5%). In addition, the highest soil cover was recorded in Adilemlem (44.8%) and the least was in Sebat Minch (13.1%). On the other hand, Aynameda was identified with the presence of highest percentage of rock cover (35.8%) and the least one was recorded in Chennek (8.1%) (Fig. 2).

The majority (46.4%) of the sample points (quadrats) had 76-100% ground level cover while the lowest (7.4%) proportion was recorded for 5-25% of the quadrats. On the other hand, of the total sample points, 85.2% accounted for <5% herbaceous level vegetation cover of the quadrats while 2.7% represented 76-100% herbaceous level cover of the quadrats. Majority (94.6%) of the quadrats accounted for <5% of shrub level vegetation cover whereas only 0.2% of the quadrats represented 76-100% of shrub level vegetation cover (Table 1).

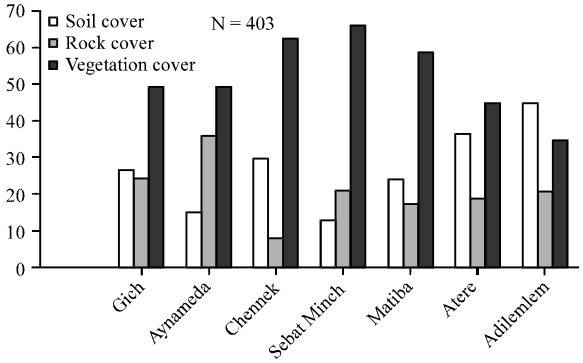

Fig. 2: Percentage of soil cover, rock cover and vegetation cover across different sample areas

Table 1: Proportion of quadrats with different ground level, herbaceous level and shrub level vegetation cover (%)

Proportion of quadrats	Ground level (%)	Herbaceous level (%)	Shrub level (%)
<5	14.9	85.2	94.6
5-25	7.4	4.4	3.5
26-50	19.7	4.6	1.5
51-75	11.6	3.1	0.2
76-100	46.4	2.7	0.2
Total	100.0	100.0	100.0

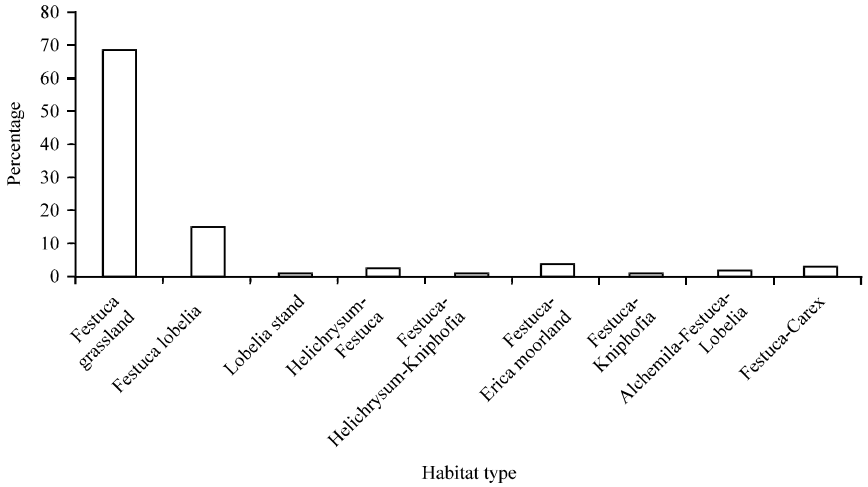

Fig. 3: Percentage of habitat types of the Simien Mountains National Park based on different vegetation composition

There are different habitat types identified in the study area based on vegetation composition. These include *Festuca* grassland, *Festuca-Lobelia*, *Lobelia* stand, *Helichrysum-Festuca*, *Festuca-Helichrysum-Kniphofia*, *Festuca-Erica* moorland, *Festuca-Kniphofia*, *Alchemila-Festuca-Lobelia* and *Festuca-Carex*. The majority (68.5%) of the study area has *Festuca* grassland habitat followed by *Festuca-Lobelia* (15.4%). *Festuca-Kniphofia* (1.2%) and *Lobelia* stand (1.2%) was identified as the least abundant habitat type in the study area (Fig. 3).

Murid rodent burrows and common mole rat mounds were counted in the quadrat of the study area. However, the abundance of common mole rat mounds was relatively low compared to murid rodent burrow. The average No.±SE of murid rodents per quadrat was 2.5±0.19. Murids accounted for 45.6% of all quadrats and the remaining 54.4% had no rodent burrow. On the other hand, the average No.±SE of common mole rat per quadrat was 0.82±0.13. Lower (13.3%) proportion of common mole rat was recorded from all quadrats and the remaining 86.7% did not posses common mole rat mound.

The presence of murid rodents significantly differed ($F_{8,508}$ = 1.7, $p<0.001$) across different habitat types. The Mean±SE of murid rodents burrow per quadrat ranged from 0.27±0.27 in *Alchemila-Festuca-Lobelia* habitat to 7.8±2.24 and 7.8±1.3 in *Festuca-Kniphofia* and *Helichrysum-Festuca* habitats, respectively (Fig. 4).

There was also a significant variation ($F_{8,508}$ = 6.7, $p<0.05$) in the presence of common mole rat mound across different habitats. The highest average number of common mole rat mound was recorded in *Festuca-Helichrysum-Kniphofia* (4.14±1.62) habitat and the lowest was recorded in *Alchemila-Festuca-Lobelia* habitat (0.36±0.36) (Fig. 5).

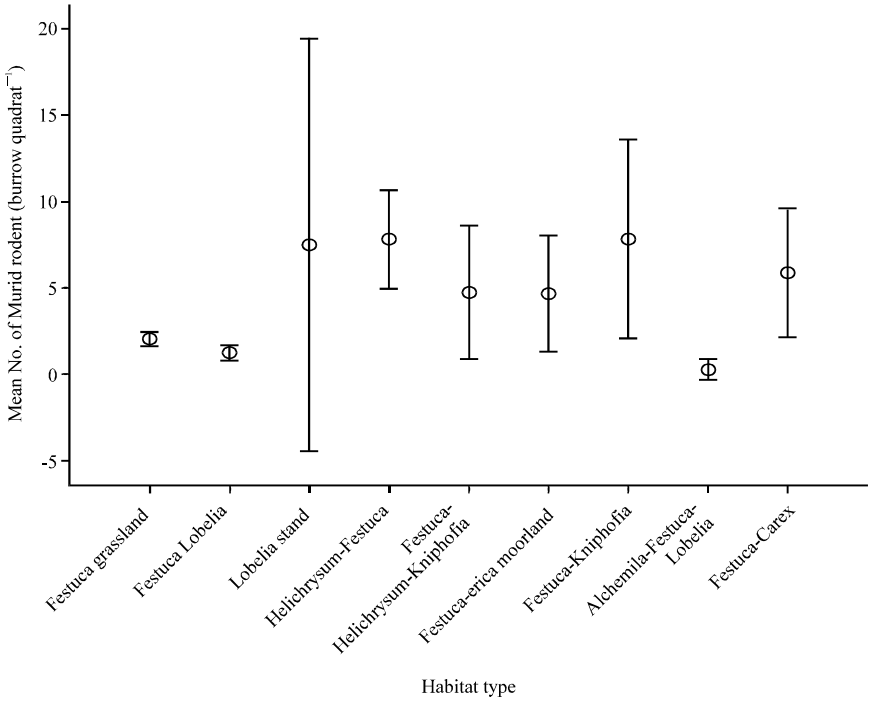

Fig. 4: Mean±SE No. of murid rodent burrow in different habitat types

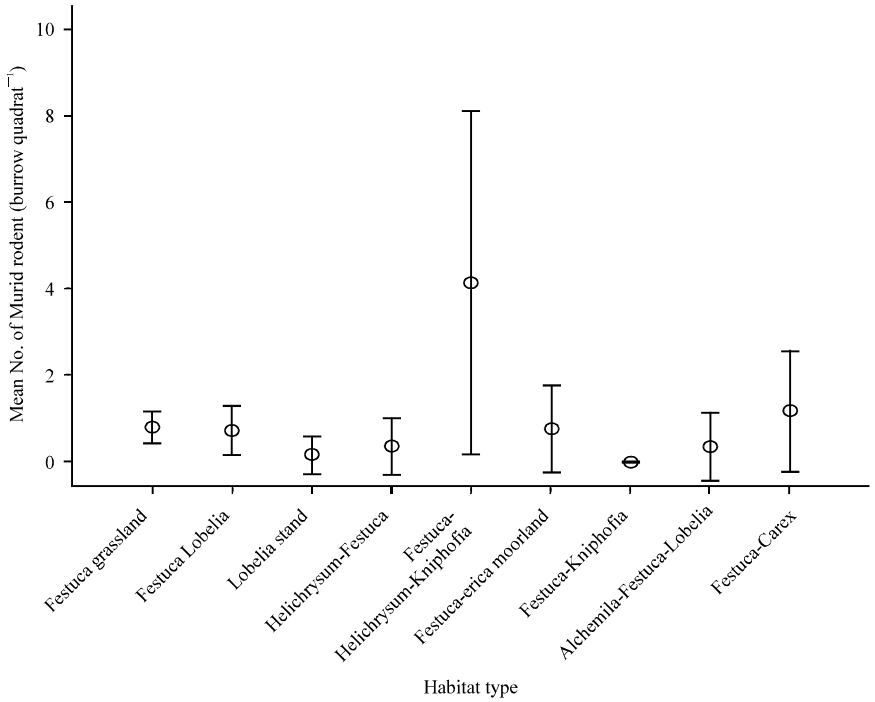

Fig. 5: Mean±SE No. of common mole rat mound in different habitat types

There was weak correlation ($r^2 = 0.09$, slope = 0.244, $p<0.05$) between the presence of livestock droppings and murid rodent burrows in the study area. In the area of high livestock dropping,

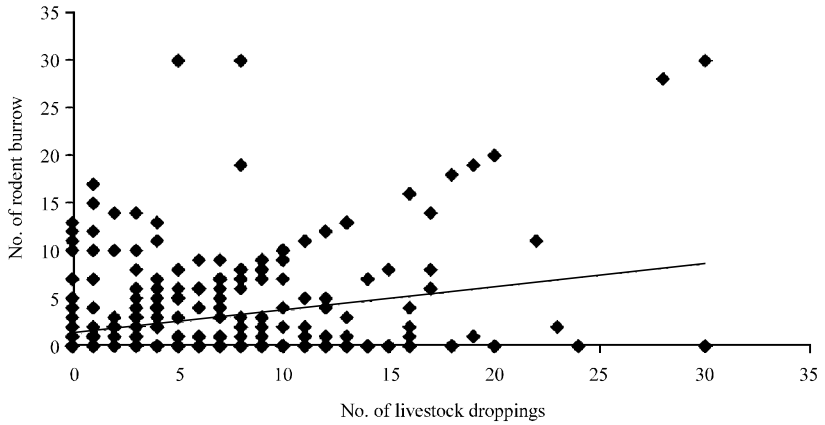

Fig. 6: Relationship between No. of murid rodent burrow and livestock droppings

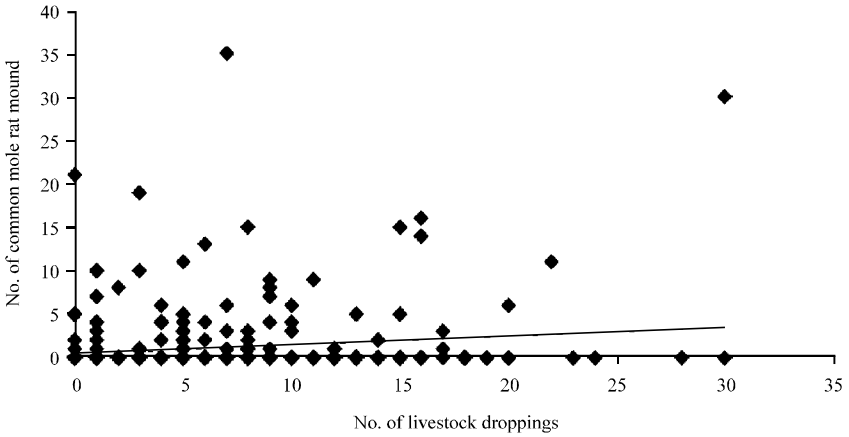

Fig. 7: Relationship between No. of common mole rat mound and livestock droppings

there was lower number of murid rodent burrows (Fig. 6). There was also weak correlation ($r^2 = 0.03$, slope = 0.10, $p<0.05$) between common mole rat mound and livestock droppings. In the area where there is high livestock dropping, less number of common mole rat mound was observed (Fig. 7).

Livestock droppings were high in all sample areas (68.7%). Across the study areas, sheep/goats were the most common type of domestic animals (42.5%) followed by cattle (30.1%). In addition, pack animals (horse/mule/donkey) accounted for 27.4%. The average number of livestock droppings per quadrat was lower in higher herbaceous level cover (26-50%, 51-75% and 76-100%) whereas, it was high in lower herbaceous level cover having <5% vegetation cover (Fig. 8).

The average number of livestock droppings per quadrat was higher in higher ground level cover (26-50%, 51-75% and 76-100%) while it is lower in <5% and 5-25% of the ground level cover (Fig. 9).

Besides livestock, droppings of other wildlife species such as walia ibex (*Capra walie*), common jackal (*Canis aureus*) and Gelada baboon (*Theropithecus gelada*) were also found in the study area. The average No. ±SE of the Ethiopian wolf signs (scats and dig out) per quadrat in the study area was 0.18±0.2.

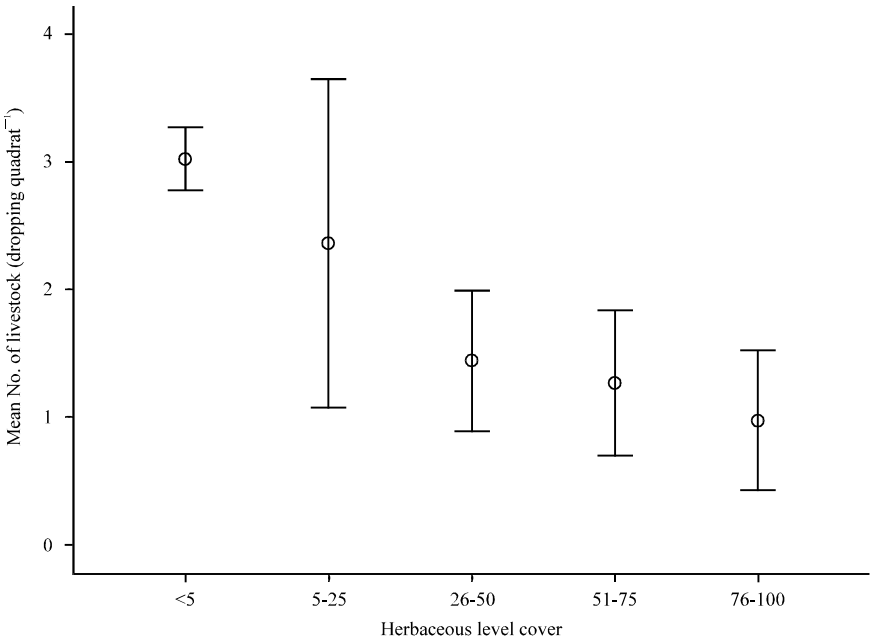

Fig. 8: Mean±SE No. of livestock droppings quadrat^{-1} in herbaceous level cover (%)

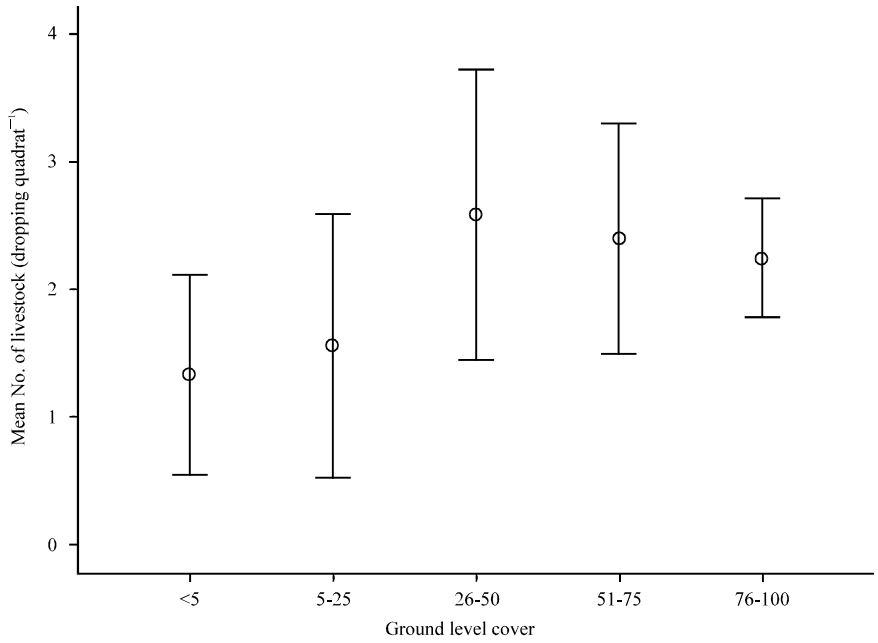

Fig. 9: Mean±SE No. of livestock droppings quadrat^{-1} in ground level cover (%)

DISCUSSION

Understanding habitat quality is crucial for ecologists and wildlife managers to conserve wildlife species (Johnson, 2007). Habitat occupied by a particular species usually graded from low to high quality affecting the survival and reproductive capacity of an individual occupying a particular level of habitat (Van Horne, 1983). The landscape characteristic of the Simien Mountains National

Park is largely expressed by slope terrain (74.5%) which is different from the Bale Mountains National Park which is characterized by extensive plateau. The Simien Mountains National Park is known by its steep highland split by deep valleys (Busby *et al.*, 2006). The available suitable habitat for the Ethiopian wolves in the SMNP is 267 km^2.

Vegetation was the most common ground cover (52%) in all sample areas of the study area. However, in sample area such as Adilemlem, the proportion of soil cover was greater than the proportion of vegetation cover. This might have been caused by the presence of higher grazing intensity than other sample areas, consequently, resulting in soil erosion. Similarly, Busby *et al.* (2006) indicated that Adilemlem had higher soil cover than other areas. Of the vegetation layers, 46.4% of the quadrats had 76-100% ground level vegetation. This is an indication that there was high degree of grazing pressure in the study area. On the other hand, of the total sample points, 85.2% accounted for <5% of herbaceous level vegetation cover per quadrat. Likewise, 94.6% of the sample points accounted for <5% of shrub level vegetation cover per quadrat. This also confirms the presence of high grazing intensity. Similarly, it was common to find <5% of herbaceous cover per quadrat in the Simien Mountains National Park due to widespread grazing activities (Busby *et al.*, 2006).

The availability of prey is one of the major factors that contribute to habitat quality of a given area (Gibson, 1994). The average No.±SE of murids (prey of the Ethiopian wolf) per quadrat was 2.5±0.19 whereas the average No.±SE of common mole rat per quadrat was 0.82±0.13 in the Simien Mountains National Park. This value is considerably lower compared to the Bale Mountains National Park where an average number of 3-22 murids and 0-11 mole rat per quadrat was estimated (Marino, 2003). In terms of the distribution of rodents across habitat types, the highest average number±SE of murids hole per quadrat was recorded in *Festuca-Kniphofia* (7.8±2.24) and *Helichrysum-Festuca* (7.8±1.3) habitats. This is because such habitats might have provided good cover to the rodents. Thus, such habitats can be considered as good quality habitat for the Ethiopian wolf in terms of the abundance of rodent community. In fact, the quality of a given habitat is not only determined by the availability of prey but also by other additional factors. Based on the Ethiopian wolf population census data of the present study, most of the Ethiopian wolves were also recorded in *Helichrysum-Festuca* habitat during both wet and dry seasons. This is because, such habitat consisted of the most prefered rodent prey. Therefore, the Ethiopian wolves use rodent rich habitats for foraging purpose and other habitats for other activities. There was a weak correlation ($r^2 = 0.09$, slope = 0.244, $p<0.05$) between the number of livestock droppings present and the number of murid rodents burrow in the study area. As the number of livestock droppings increase, the number of murid burrows decreases. Similar situation is observed between the number of livestock droppings and the number of common mole rat mound ($r^2 = 0.03$, slope = 0.10, $p<0.05$). Therefore, the number of livestock has its own impact on the rodent community in the study area. Consequently, this also affects the Ethiopian wolf population. Livestock droppings were high in all sample areas (68.7%). Similarly, previous study conducted in the Simien Mountains National Park showed that evidence of livestock droppings was 98% (Busby *et al.*, 2006). Based on the number of livestock droppings per quadrat, livestock had significant influence on the vegetation layers. The average number of livestock droppings was high at lower herbaceous level cover per quadrat. Similar situation happened in shrub level cover of vegetation. This might have been caused by overgrazing and trampling of vegetation. Busby *et al.* (2006) also showed that quadrats having higher amount of grass cover had fewer livestock

droppings and vice versa in the SMNP. Livestock have significant impact on the abundance of rodents in the study area which in turn affect the Ethiopian wolf population. Therefore, such interference should be curtailed.

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