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Population Status and Feeding Ecology of the Ethiopian Wolf (Canis simensis) in and around Borena - Sayint National Park, South Wollo, Ethiopia

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Abstract
A study on the population status, distribution and feeding ecology of the Ethiopian wolf (*Canis simensis*) was carried out in the Borena-Sayint National Park, Southern Ethiopia during October, 2010 – March, 2011 including wet and dry seasons. Distance sampling line-transect count method was used to estimate the population of Ethiopian wolf. A total of 29 and 34 wolves were counted during wet and dry seasons, respectively. The sex ratio of adult male to adult female was 2.5:1.00. Pack size changed seasonally. The sex structure of Ethiopian wolf was adult male 34.48%, adult female 13.79%, sub-adult males 27.59%, sub-adult females 13.79 % and young 10.34%. The age ratio of adult to young was 1:4.67 both during dry and wet seasons. There was no significant difference among the total population number, age and sex categories, and the pack size during dry and wet seasons ($P > 0.05$). The mean pack size was 3 ± 0.25. The pack composition varied with season, forming larger packs during the dry season. The occurrence of food items in the scats significantly differed ($P < 0.01$). Rodents were the principal prey items with 69.2% frequency of occurrence. Grass blades and bird feathers also formed the diet components. Among livestock, remains of sheep were identified in few scats. Distribution and vegetation utilization of the Ethiopian wolf showed a marked preference for Lobelia-Hypericum habitats. However, there was a seasonal change in the preference of habitat. The main threats of the Ethiopian wolves in the study area were grass collection, livestock grazing, encroachment and related environmental problems. It is necessary to educate the local people and conservation issues of the Ethiopian wolf to enhance the coexistence of the Ethiopian wolf with human beings.
Keywords: Ethiopian wolf, feeding ecology, habitat preference, population status, threat.

Introduction

The wildlife of the region is mainly restricted in the protected areas and National Parks, one of which is Borena-Sayint National Park in the South Wollo Zonal Administration. This region falls in different agro-ecological zones, Kolla, Weina Dega, Dega and Wurch (PaDPA, 2006). BSNP (former Denkoro Forest) is one of the recently declared National Parks of the country. It has relic biodiversity with significant natural forest and high altitude grassland flora and fauna. The park has the largest extent of afro-alpine and sub-afro-alpine habitat. These ecosystems are characterized by the giant herb, lobelia (*Lobelia rhynchopetalum*), the evergreen tree heather (*Erica arborea*) and shrubby and herbaceous everlasting flowers (*Helichrysum* spp.) The endemic wild mammals in this ecosystem include the walia ibex (*Capra ibex walia*), mountain nyala (*Tragelaphus buxtoni*), Starck's hare (*Lupus starcki*), Ethiopian wolf (*Canis simensis*), and the gelada baboon (*Theropithecus gelada*) and giant mole rat (*Tachyoryctes macrocephalus*).

According to Boddicker *et al*. (2002), many mammalian species, especially those indigenous to tropical forests are cryptic, discrete and inhabit areas that are not easily accessible. During the last glacial age, afro-alpine habitats were widespread across the highlands of the country. A wolf like *Canid* ancestor is thought to have colonized this expanding habitat and given rise to a new species, remarkably well adapted to the afro-alpine environment. This endemic species is described as the Ethiopian wolf (*Canis simensis,* RÜppell, 1835) (Gottelli *et al*., 2004). This wolf used to occur at lower elevations before becoming subject to severe human persecution (Nowak, 1999). It is an afro-alpine specialist with a restricted distribution in the high elevations (Zelealem Tefera and Sillero-Zubiri, 2007). It is also considered as the world's rarest *Canid* and qualified as a "Critically Endangered" species in the Red Data Book of IUCN (Sillero-Zubiri, 1996).

Reliable estimate of population and information on feeding habits are essential for effective management of wildlife species (Putman, 1984; Matrai *et al*., 1998). Ethiopian wolf is one of the endemic mammals of Ethiopia (Sillero-Zubiri and Gottelli, 1995a) and it is also one of the most important flagship species of the country. Marino *et al*. (1999) studied the distribution range and population status of the Ethiopian wolf in all the seven isolated pockets of afro-alpine ecosystem including in the South Wollo and Denkoro State Forest. However, the present studies on the population status and feeding ecology of Ethiopian wolf in some of these sites of its distribution are yet to be available.

Materials and Methods

Description of the study area

The study was conducted in Borena-Sayint National Park (BSNP), South Wollo Zone (Amhara Regional State) and lies between $10^0$50'45.4"- $10^0$53'58.3" latitude and $38^0$40'28.4"-38o54'49" longitude (Fig.1). The altitude ranges between 1900 – 3699 m asl. The Park is located in the northeastern part of Ethiopia about 600 km by road from Addis Ababa. The Park is situated among three Woredas, namely, Borena in the south, Sayint in the north and Mehal Sayint (a newly established Woreda) in the east. Legambo Woreda is located bordering the two Woreda, Borena and Sayint. The largest portion of the Park is found in Borena Woreda.

The mean monthly maximum temperature ranged between 17.8^{0}C (August) and 24.4^{0}C (March); whereas the mean monthly minimum temperature ranged between 9.5^{0}C (November) and 11.8^{0}C (May) (ENMSA, 2010).

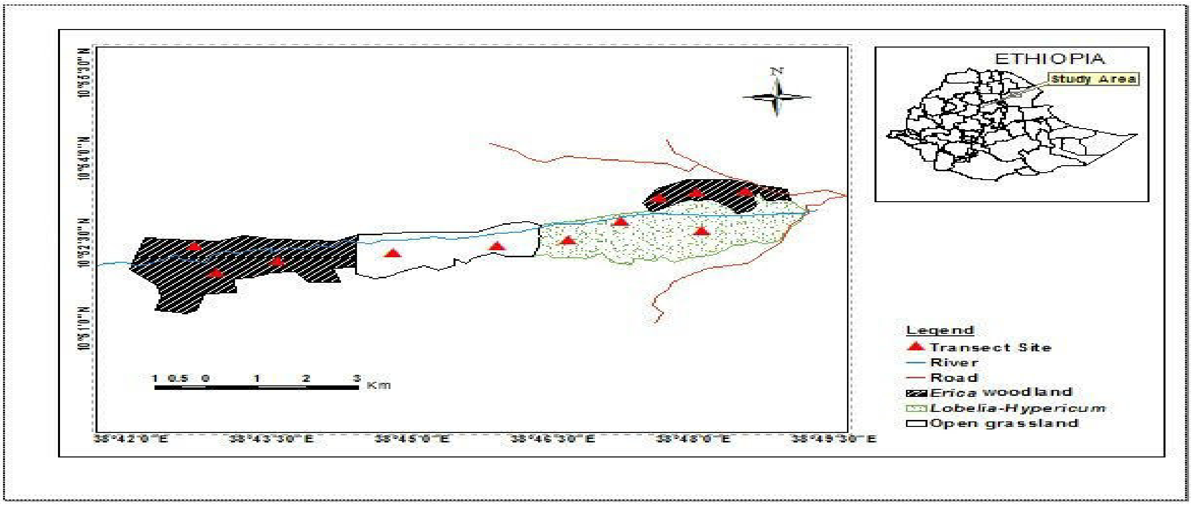

Figure 1. Location map of the study area

Sampling method

In the present study area, stratifying sampling method were used. Three vegetation zone was selected these includes; Open grassland, Erica woodland and Lobelia- Hypericum. Line-transect sampling technique was used to assess the population status of Ethiopian wolf as adopted by Sillero-Zubiri and Macdonald (1997). Eleven transect lines in to four selected kebeles; each of 1.5 to 3 km long was located randomly in the study area using Global Positioning System (GPS). Among these, two were in the open grassland (Bizu Gemera kebele) habitat, three were in the *Erica* woodland (Keta Chilaga kebele), three were in *Lobelia- Hypericum* (Lemesk kebele) and three were in *Erica* woodland (Mentaw Gora kebele) habitats. Transects were placed by stratified random sampling approach in which transect placement was proportional to the area of the habitat type. Adjacent transects were at least 300 m apart. All transects were roughly parallel to each other. Silent detection method was followed to minimize disturbances (Wilson *et al*., 1996). During transect walking, the observer recorded the start and end time, start and end GPS locations, and GPS ID. Whenever an Ethiopian wolf was encountered, the observer recorded the time, GPS location, pack size, distance from the observer, transect – animal distance or perpendicular distance (PD) and habitat type where the animal was located (Table 1). Censuses were conducted once per month on foot by the researcher and a well trained field assistant of the Park and two trained scouts who were familiar with the area. In the beginning of the study, the field assistant was trained to estimate animal - observer distance, and perpendicular distances. Surveys were conducted during 6:00- 10:00 h in the morning and 16:00 to 18:00 h in the afternoon, at an average speed of 1 km /hr in the *Erica* woodland and *Lobelia- Hypericum* or 2 km/hr in the open grassland habitats.

Animals observed at a distance of 300 m from the center line showed little reaction, whereas animals observed at <300 m showed variable responses, but were easily observed. Perpendicular distance was measured accurately by using GPS. Censuses were conducted for both seasons (wet and dry) in order to achieve representative estimates. The number of animals in the pack, the sighting distance and perpendicular distance of the animal from the observer were recorded each time an animal or a pack was spotted and the following estimation was made (Buckland *et al*., 1993).

$D = ns/2LW$

Where

D = estimated density of animals (or animal packs) n = number of animals (or animal packs) seen

s = mean pack size

L = length of transect line(s)
W = mean perpendicular distance of animals (or packs) seen

The population size of Ethiopian wolf was estimated by multiplying the population density (D) with total extent of habitat of the present study (A = 24 km2), following the method of Buckland *et al*. (1993), Sutherland (1996) and Yisehak Doku *et al*. (2007).

N= D x A
Where, N= Total Population Size
D= Population Density (individual per km2) A=
Total extent of habitat (in km2)

Each individual in the pack was identified into respective age and sex category during counting. Adult male, adult female, sub-adult male, sub-adult females and young were identified. Identification of sex and age category was carried out in the field by using relative body size, colour, raised-leg urination and external genitalia (Sillero–Zubiri and Gottelli, 1995a). When the distance between individuals was <50 m, they were considered as members of the same pack (Lewis and Wilson, 1979; Hillman, 1987; Borkowski and Furubayshi, 1998).

During the time of faecal collection, the age of the sample was categorized into fresh, recent and old (Breuer, 2005). Area, location, date of collection, age of faeces, time of collection, altitude of the collection site and position were also recorded. Faecal droppings were checked regularly for hairs, feather and bones of the animal matters that were consumed by wolves (Breuer, 2005). Identification of carnivore faeces was carried out based on shape, colour, ingested hair, diameter and odour (Fig. 11). The faecal samples of the Ethiopian wolf were sun dried and grounded in a mortar, and then washed in a sieve (1 mm) using hot water to separate hairs, bones, teeth and other prey components from other organic materials. Then the separated hairs were washed in acetone, dehydrated by 100% ethanol and dried on filter paper. Finally, it was observed under a stereo microscope by considering form, length, colour and diameter (Breuer, 2005).

Data Analysis

Descriptive statistics, t-test, chi-square test and one-way ANOVA were used for analysis.

Results

Ethiopia wolf population in the study area

A total of 29 (5.8 ± 1.50 individuals/km2 (obtained from 11 packs) were counted during the wet season and 34 (6.8 ± 1.8 individuals/km2) individuals were obtained during the dry season. The mean number of Ethiopian wolf was counted as 31.5 individuals/km2. Counts during the dry season were not significantly higher than that during the wet season (t= -5.000, df = 3, p 0.05). Out of the 11 packs of Ethiopian wolf, two were in open grassland, six were in Erica woodland and three were in Lobelia- hypericum habitats were observed during the wet season and dry season. The Ethiopian wolf preferred *Erica* woodland habitats in both wet and dry seasons (Table 1).

The number of wolves counted during the dry season increased by five individuals when compared to that of the wet season. This difference might be due to the fact that during the wet season, the weather in the study area was cloudy, which could reduce the detectability of individuals while counting. Erica woodlands have abundance of mammals due to high vegetation cover, food and water availability and stability of the area from disturbances. However, the present investigation is in agreement with what was reported by Sillero-Zubiri and Gottelli (1995) that the Ethiopian wolves were abundant in *Lobelia* with *Hypericum* habitat. This is strongly agreed by Eshetu Moges (2008), noted that there was a large number of small mammal diversity was recorded in Erica woodland. This might be due to the difference in the vegetation cover, foliage and availability of food in this habitat type (Mugatha Mebratu, 2002).

Table 1. Abundance of Ethiopian wolf packs in different habitat types during the wet and dry seasons.

Sites	Habitats	Numbers of Ethiopian wolf observed					
		Wet season		Dry season		Mean	
		Pack No.	Ind. No.	Pack No.	Ind. No.	Pack No.	Ind. No.
Keta Chilaga	*Erica* woodland	3	8	3	9	3	8.5
Lemesk	*Lobelia-Hypericum*	3	9	3	11	3	10
Mentaw Gora	*Erica* woodland	3	7	3	8	3	7.5
Bizu Gemera	Open grassland	2	5	2	6	2	5.5

Ethiopia wolf population structure in the study area

During the wet season, a total of 29 wolves were observed. Their population was composed of 10 (34.48%)

adult males, 4 (13.79 %) adult females, 8 (27.59%) sub-adult males, 4 (13.79 %) sub adult females and 3 (10.34%) young. The number of adult males was significantly higher than adult females, sub-adult females and young (df = 4, $p < 0.05$) during wet season. There was significant difference between sub-adult males and young (t=5.000, df = 3, $p < 0.05$) (Table 2). The average population density of Ethiopian wolf counted during the wet season was 1.8 ± 0.49/km2 at Lemesk, 1.4±0.245/km2 in Keta Chilaga, 1.00±0.316/km2 in Bizu Gemera and 1.6±0.40/km2 in Mentaw Gora. The overall density was 5.8 ± 1.50 individuals /km2 for the study area. The total population counted at Lemesk was significantly higher than Bizu Gemera (t = 4.000, df = 3, p < 0.05).Compared to Lemesk and Keta Chilaga, which accounted 58.82% of the total population, the wolf population was less (41.2%) in Mentaw Gora and Bizu Gemera. Lemesk and Keta Chilaga are more ecologically intact than Mentaw Gora and Bizu Gemera. Mentaw Gora and Bizu Gemera sites are highly affected by habitat changes and fragementation as a result of illegal extraction of trees and grasses by the local communities and relatively poor habitat quality because of intense livestock grazing.

Table 2. Population structure of the Ethiopian wolf during the wet season

Study sites	Adult male	Adult female	Sub-adult male	Sub-adult female	Young	Mean (±SE)
Lemesk	3	1	3	1	1	1.8 ± 0.49
Keta chilaga	3	1	2	1	1	1.6 ± 0.24
Bizu Gemera	2	1	1	1	0	1.00 ± 0.316
Mentaw Gora	2	1	2	1	1	1.4 ± 0.245
Total	10	4	8	4	3	5.8 ± 1.50

During the dry season, a total of 34 wolves were counted. Among these, 29.41% were adult males, 11.76% adult females, 38.24% sub-adult males, 11.76% sub-adult females and 8.82% young (Table 4). Adult males were significantly more than young (t=3.656, df =3, $p < 0.05$), adult females (t= 3.000, df =3, $p < 0.05$) and sub-adult females (t= 3.000, df =3, $p < 0.05$). There was significant difference between sub-adult males and sub-adult females (t=4.700, df =3, $p < 0.05$) and young (t= 8.660, df =3, $p < 0.05$). There was significant difference between adult females and sub-adult males (t=4.700, df =3, $p < 0.05$). The density of Ethiopian wolf counted during the dry season was 2.20 ± 0.735/km2 at Lemesk site, 1.8±0.49/km2 in Keta Chilaga, 1.20±0.374/km2 in Bizu Gemera and 1.6±0.245/km2 in Mentaw Gora. The overall density was 6.8 ± 1.8 individuals /km2 for the study area. The total population counted at Lemesk was significantly more than that of Bizu Gemera (t = 3.162, df = 3, $p < 0.05$) (Table 3). More wolves were observed during the dry season. The dry season coincides with the availability of more food and shelter in the present study area. The afro-alpine climate is very cold and hence rodents are intolerant to such adverse weather condition. As a result, they avoid extreme cold by going underground. This reduced the forage efficiency of the wolf and the wolves hide themselves during cold weather in the denning sites and under thick vegetation cover (Marino, 2003).

Table 3. Population structure of the Ethiopian wolf during the dry season

Study sites	Adult male	Adult female	Sub-adult male	Sub-adult female	Young	Mean (±SE)
Lemesk	4	1	4	1	1	2.2 ± 0.735
Keta chilaga	2	1	4	1	1	1.8 ± 0.49
Bizu Gemera	2	1	2	1	0	1.20 ± 0.374
Mentaw Gora	2	1	3	1	1	1.6 ± 0.245
Total	10	4	13	4	3	6.8 ± 1.8

Ethiopia wolf population sex ratio in the study area

The age ratio of young to adult was 1:4.67.Sub-adults to adults was 1:1.167 and 1:1.21, sub- adult males to sub-adult females was 1:2 and 1:3.25, sub-adult male to adult males was 1:1.25 and 1.13, Adult female to sub-adult female was 1:1 and young to sub-adult was 1:4 and 1:5.67 during wet and dry seasons, respectively (Table 4). The high number of male wolf individuals indicates the average heterozyogsity of wolves was reduced and the low fecundity rate and population growth rate of the wolves.

Table 4. Proportions of different age and sex categories of the Ethiopian wolf

Season	Sex and Age categories					Ratio			
	Sex		Age			Sex	Age		
	AM	AF	SAM	SAF	Y	AM : AF	Mean (±SE)	Yg :Ad	Mean (±SE)
Wet	10	4	8	4	3	1.00:2.5	1.25±0.25	1:4.67	2.750 ± 0.25
Dry	10	4	13	4	3	1.00:2.5	1.50±0.50	1:467	2.750 ± 0.957
Mean	10	4	10.5	4	3	1.00:2.5	1.38±0.38	1:4.67	2.750 ±0.60

Ethiopia wolf diet from the scat samples in the study area

A total of 100 faecal droppings were collected. Five categories of distinguishable items were found in the faeces of the Ethiopian wolf from the four study sites. These were: hair or bone, bird feather, sheep wool, grass and plastic materials. The occurrences of food items in the scats significantly differed (X^2= 199.59, df = 4, P < 0.01). Rodents were the principal food type (Table5). According to Sillero-Zubiri and Gottelli (1995a) were reported that different rodent species such as *T. Macrocephalus*, *A. blicki, L. melanonyx, O. typus* and *S. griseicauda* that were preyed by the Ethiopian wolf through direct observation and scat analysis in Bale Mountain National Park. In a similar study in Guassa (Menz), rodents constituted for 96% of all prey occurrences in droppings (Zelealem Tefera, 2004).this finding is also in consistent with a study in BMNP (Sillero-Zubiri and Gottelli, 1995a), where the frequency of occurrence of plant materials was found next to that of small mammals. Bird feather and sheep wool were also the food items of wolves in BSNP (Sillero-Zubiri and Gottelli, 1995a; Malcolm, 1997). In a similar study in Guassa (Menz), bird feather and sheep wool were reported as food items (Zelealem Tefera, 2004).

Table 5**.** Prey and other food items of Ethiopian wolves recorded from faecal samples (N=100) collected in and around Borena**-**Sayint National Park.

Food items	Frequency in scats observed	Percentage (%)
Rodents	92	69.2
Sheep	4	3.01
Grass blades	25	18.8
Birds	7	5.26
Plastic materials	5	3.76
Total	**133**	**100**

Conclusion and Recommendation

The population structure and pack size of the Ethiopian wolf were adult male and sub-adult male biased. The high percentages of males showed that Ethiopian wolf population might decrease in BSNP in the near future. Data related to the habitat preferences show that the Ethiopian wolf mostly preferred Lobelia-Hypericum and Erica woodland in the study area. This study also revealed that rodents are the principal diet of the Ethiopian wolf. Among livestock, sheep was identified as a prey of the Ethiopian wolf. One of the greatest threat that becomes appear in the BSNP to decline the wolves population was human-induced habitat loss and degradation through grass collection, livestock grazing, encroachment and environmental degradation. Therefore, Changing personal attitude and practice through environmental education focusing on the effects of grass collection, livestock grazing and encroachment is important to increase the awareness of the local people about the resources of BSNP.

References

Boddicker, M., Rodriguez, J. J. and Amanzo, J. (2002). Indices for assessment and monitoring of large mammals within an adaptive management framework. *Environ. Monit. Assess*. 76: 105- 123.

Borkowski J. and Furubayashi, K. (1998). Seasonal and diet variation in group size among Japanese Sika deer in different habitats. *J. Zool., Lond*. 245: 29-34.

Breuer, T. (2005). Diet choice of large carnivores in Northern Cameroon. *Afr. J. Ecol.* 43: 97-106.

Buckland, S .T, Anderson, K. P, Burnham and Laake, J. J. (1993). *Distance Sampling. Estimating Abundance of Biological Population*. Chapman and Hall, London. Pp.77

ENMSA (2010). Rainfall and temperature data of Mekane Selam Station. *Ethiopian National Metrological Service Agency*. Addis Ababa.

Eshetu Moges (2008). *Species composition, Distribution, Relative Abundance and Habitat Association of Small Mammals in Denkoro Forest, South Wollo, Ethiopia*. M.Sc Thesis, Addis Ababa University, Addis Ababa.

Gottelli, D., Marino, J., Sillero-Zubiri, C. and Funk, S. M. (2004). The effect of the last glacial age on speciation and population genetic structure of the endangered Ethiopian wolf (*Canis simensis*). *Mol. Ecol*. 13: 2275-2286.

Hillman, J. C. (1987). Group size and association patterns of the common eland (*Tragelaphus oryx*). *J. Zool., Lond*. 213:641-663.

Lewis, J. G. and Wilson, R. T. (1979). The ecology of Swayne's hartebeest. *Biol. Conserv.* 15: 1-12.

Malcolm, J.R. and Sillero-Zubiri, C. (1997). The Ethiopian wolf: distribution and population status. In: *The Ethiopian Wolf Status Survey and Conservation Action Plan.* Pp. 12–25, (Sillero- Zubiri, C. and Macdonald, D.W. eds). IUCN, Gland.

Marino, J., Laurenson, M. K. and Sillero-Zubiri, C. (1999). *Distribution of the Ethiopian Wolf (Canis simensis): Population Status and Habitat Analysis*. Ethiopian Wolf Conservation Programme, Oxford.

Marino, J. (2003). Threatened Ethiopian wolves persist in small isolated Afro-alpine enclaves. *Oryx* 37: 62-71.

Matrai, K., Altbacker, V. and Hahn, I. (1998). Seasonal diet of rabbits and their browsing effect on Juniper in Bugae Juniper Forest. *Acta. Theriol*. 43: 107-112.

Mugatha Mebratu (2002). *Influences of Land-use Patterns on Diversity, Distribution and Abundance of Small Mammals in Gachoka Division, Mbeere District, Kenya.* Land- Use Change, Impacts and Dynamic Working Paper Series Number: 8, Nairobi. Pp.8-15

PaDPA (2006). *Report Review.* Amhara National Regional State Park Development and Protection Authority. Bahir Dar.

Putman, R. J. (1984). Facts from faeces. *Mamm. Rev*. 14: 79-97.

Sillero-Zubiri, C. (1995). *Ethiopian Wolf Conservation Update*. IUCN/SSC Canid Specialist Group, Oxford.

Sillero-Zubiri, C. (1996). Field immobilization of Ethiopian wolves (*Canis simensis*). *J. Wildl.Dis*. 32: 147- 151.

Sillero-Zubiri, C. and Gottelli, D. (1995a). Diet and feeding behaviour of Ethiopian wolves (*Canis simensis*). *J. Mamm.* 76: 531-541.

Sillero-Zubiri, C. and Macdonald, D. W. (1997). *The Ethiopian Wolf: Status Survey and Conservation Action Plan*. IUCN/ SSC Specialist Group, Gland and Cambridge.

Sutherland, W.J. (1996). *Ecological Census Technique, Hand Book.* Cambridge University Press, Cambridge. Pp. 1-12

Wilson, D. E., Cole, F. R, Nichols, J. D., Rudran, R. and Foster, M. (1996). Measuring *and Monitoring Biological Diversity. Standard Methods for Mammals*. Smithsonian Institution Press, Washington D.C. Pp. 5-19

Yisehak Doku, Afework Bekele and Balakrishnan, M. (2007). Population status of plain Zebra (*Equus quagga*) in Nechi Sar National Park, Ethiopia. *Trop. Ecol.* 48: 79-86.

Zelealem Tefera, Coulson, T., Sillero-Zubiri, C. and Leader-Williams, N. (2004). Behaviour and ecology of the Ethiopian wolf (*Canis simensis*) in a human dominated landscape outside protected areas. *Anim. Conserv*. 8: 113-121.

Zelealem Tefera and Sillero-Zubiri, C. (2007). A flagship species for afroalpine conservation: an over view of the status and conservation of the Ethiopian wolf. *Walia* 25: 13- 21.