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Habitat Use and Diet of Wild Goat in Cehennemdere, Turkey

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Abstract: Wild goats chose highly sloped, rocky and steep areas as habitat. The species is known to be distributed in areas at 4000-5000 m elevation from sea level. The diet of wild goats consists of particularly the shoots and fruits of bush species, leaves of trees and herbaceous species. This study analyzed the habitat and feeding characteristics of wild goat population distributed in East Taurus Mountains. Direct area observation conducted in each season between the years of 2007-2009 indicated that the main diet of the wild goats varied according to the seasons. In the observations characteristics of wild goat habitat such as density mixed species and frequency were determined. Based on this data, the diet of wild goats in the study area mainly consisted of mushrooms in winter, Kermes oak and Fabaceae species in summer. Wild goats generally preferred rock vegetation for feeding and red pine forests for lying and resting.

Key words: Wild goat, ecology, habitat, diet, Dogu Akdeniz, taurus mountains

INTRODUCTION

Demirsoy (1992) and Çanakçioglu and Mol (1996) reported that the diet of wild goats generally comprised vegetative food and the species preferred to eat various grass leaves, shoots, thin branches, algae and fruits. The researchers further indicated that wild goats ate the shoots and buds of the trees and shrubs such as oak *Quercus* sp., alder *Alnus* sp., elm tree *Ulmus* sp., smoke tree *Cotinus coggyria* and the grape-like cones of junipers *Juniperus* sp. Hus (1963, 1967) reported that in addition to all these species, wild goats also fed on fresh cereal leaves and the shoots and fruits of terebinth *Pistacia terebinthus* sp. In a study carried out in Greece it was reported that the diet of wild goats mainly consisted of olaster tree *Olea europeae* var. *sylvestris*, mastic tree *Pistacia lentiscus*, laden *Cistus* sp. and Kermes oak *Quercus coccifera* (Sfougaris *et al*., 1996).

Nicholson and Husband (1992) reported that resting and feeding behavior of wild goats significantly varied according to gender, season and length of day. Korshunov (1994) reported that the diet of wild goats mainly consisted of juniper, bush leaves and various herbaceous plants. Furthermore a stomach content analysis performed in summer time indicated that 61.1% of wild goats diet consisted of grass belonging to Poaceae family and 14.2% consisted of *Acer torcomanicum*, while juniper and bushes constituted secondary diet. In addition, diet composition of the wild goats varies throughout the year grass constitutes the main diet in summer, while 30% of the diet consists of trees and bushes. In some cases, the whole diet consists of herbaceous plants. Especially in snowy days in winter, *Juniperus* sp. constitutes 80% and *Ephedra intermedia* constitute 10% of the diet of wild goats. Hus (1963, 1967) and Canakcioglu and Mol (1996) reported that wild goats lived in rocky and steep areas at 1500 m or higher altitudes in caves and thick forests. The researchers further indicated that wild goats left the forest early in the morning and turned back to the forest in the evening at noon, they ceased grazing and rested in shadowy places and in the afternoon, they began grazing again and kept grazing until the weather gets dark.

It was also reported that during the nights with moon light, grazing continued until the morning and that they went to drink water for once in a day. Turan (1987) and Demirsoy (1992) reported that wild goats lived in areas from sea level to 3000 m altitude in the mountains covered with steep rocks, trees and shrubs, bushes and grass. Korshunov (1994) reported that the habitat preference of wild goats was not restricted with mountains and that they were distributed in rocky and steep areas at any altitude from sea level to 4200 m.

The researcher further indicated that the main habitat type of wild goats included rocks, steep cliffs, the valleys covered with juniper, bushes and that during the birth seasons the females mostly preferred to live in the skirts of the mountains. These areas were reported to be covered with plenty of food at every season. In addition, the researchers identified five main habitat types for wild goats and determined that ratios of utilization of these habitats. According to this analysis, wild goats use small hills at a ratio of 5.3%; plateaus at a ratio of 7.2%; grass covered slopes at a ratio of 15.3%, rocky slopes at a ratio of 42.1% and rock edges and cuts at a ratio of 30.1%.

Study area: The study was carried out in Cehennemdere Wildlife Improvement Area which is 29.419 ha large. Cehennemdere region is located in Bolkar Mountains that lies in eastern part of Central Taurus in Southeastern Anatolia (Fig. 1).

Study area is located in Mediterranean climate belt and has a long summer drought in vegetation period. Annual vegetation duration is 322 days which is quite a long period. Number of annual frosty day is 5 days which is quite short. Average relative humidity was 64%. Relative humidity was observed to have a regular distribution in the year. Total annual precipitation is 1118.3 mm (Yilmaz, 2005). Annual average temperature varied between 10,1 and 13,8°C (Gurses *et al*., 1996).

There is hard, crystallized and cracked old limestone in the study area. Furthermore, there is sandy, clayey, marl rock in the southern parts (Atalay, 1987). Towards the end of Mesozoic along with the Alps, Taurus Mountains also folded and elevated. In the early tertiary Taurus Mountains turned to mainland (Gemici, 1995). The soils of the study area are formed by the weathering of sedimentary bedrock. Large soil groups in ten region include Brown frost soils, non-calcerous Brown forest soils, red Mediterranean soils, red Brown Mediterranean soils, rendzina soils and colluvial soils. In parallel to the slope and erosion degrees, highly sloped and steep sloped highland soils of the region were observed to be generally shallow and highly shallow. The soil is generally moderately deep and shallow in slight and moderate slopes.

Bolkar Mountains is located in the intersection of two large biogeographic regions: Mediterranean Region and Irano-Turanien Regions. Thus, the region is referred to as the area, where Asia steppes embrace Mediterranean (Gemici *et al*., 1996). Southern slopes of the region reflect the characteristics of Mediterranean vegetation, while the northern slopes reflect the characteristics of Irano-Turanien region. With >1500 plant species (corresponds to one seventh of Turkey flora) and >300 endemic species (corresponds to one tenth of Turkey's endemic plant species) Bolkar Mountains are considered as one of the important flora areas of Turkey (Gemici, 1994).

This area also has a rich fauna. Until now detected species are *Felis lynx*, *Canis vulpes*, *Vulpes vulpes*, *Canis aureus*, *Lepus europaeus, Sus scrofa, Aquila chrysaetus*, *Aquila heliaca*, *Falco subbuteo*, *Falco peregrinus*, *Falco biarmicus*, *Accipiter nisus*, *Buteo buteo, Buteo rufinus, Tetraogallus caspius, Alectoris chukar, Salmo trutta macrostigma* and *Barbus capito pectoralis* (Yilmaz, 2005).

MATERIALS AND METHODS

To determine the texture and structure of the vegetation in the study area, which are consumed by the wild goats as a food and cover, systemic sampling method was applied. In three different homogenous areas where the species is mostly distributed, coniferous forests and rock vegetation were considered as two different vegetation units. Sample areas were taken from each vegetation unit in three replications. The size of the sample area was determined in such a way to contain all plant species in the area with a radius of 10 m at every 50 m which corresponds to approximately 300 m^2. This size is consistent with the limits of 200-500 m^2 as reported by Eraslan (1971) and Yaltirik (1966). In these sample areas, species composition and frequency of vegetation in coniferous forests and covering degrees of the tree layer in the area were taken into account. With

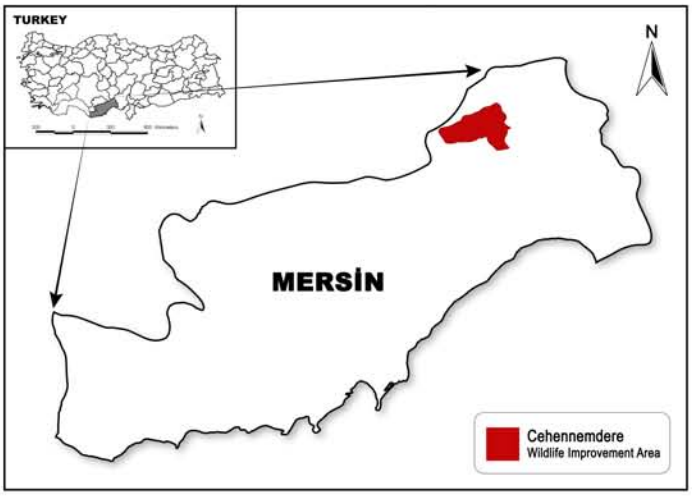

Fig. 1: Study area

this purpose, the area was first divided into storied classification based on limit values of Scamoni. According to this limit the vegetation taller than 5 m constituted tree layer; the vegetation between 5 m to 50 cm constituted the bush layer and the vegetation <50 cm constituted the grass layer (Aksoy, 1978). Covering degrees of the plant communities in the sample area collected from coniferous forests were calculated based on the method developed by Braun-Blanquet (1964). According to this method:

r = Refers to very sparse species (1-5 species) covering a very limited area
+ = Refers to sparse species covering a small area
1 = Refers to abundant species covering <1/20 of the area or very sparse, however having a greater covering value
2 = Refers to the species covering 1/20-1/4 of the area independently from number of individuals
3 = Refers to species covering 1/4-1/2 of the area independently from number of individuals
4 = Refers to species covering 1/2-3/4 of the area independently from number of individuals
5 = Refers to species covering >3/4 of the area independently from number of individuals

In this method, covering degree refers to the percentage of the area of vertical projections of the above-soil organs of the species in the sample area to the sample area (Aksoy, 1978). Since the wandering area of wild goats generally consist valley slopes and valley basins, their predators overlook to the valley basin from the hills and plan their attacks on the species. Thus, wild goats use horizontal closure in the area as hiding cover. Based on this finding as the covering degree of the woody species in the area, the present study measured horizontal closure.

In rock vegetations as these areas are also used for feeding purposes by the species-herbaceous flora and particularly the elements which constitute the diet of the wild goats were tried to be determined. In these areas, plant species consumed by wild goats were identified based on direct observations performed in the study area and based on the teeth marks on the plants. In addition, using point frame method based on the photographs taken in rock vegetations in the study area, horizontal closures of trees and shrubs in this vegetation in other words their covering degrees were determined.

During these studies, the species in tree and bush layers were identified based on the researche of Yaltirik (1993a, b). Herbaceous flora was collected in line with the plant collection techniques reported by Yaltirik and Efe (1989) and Aksoy (1978). Herbaceous flora was dried by placing into pressing device and was then identified according to Flora of Turkey and East Aegean Islands of Davis (1965).

During the observations in the study area, main diet of wild goats according to seasons was determined based on their feeding behavior particularly in the groups which were observed for a full day. In addition, undigested food parts were identified from the stomach content of an individual which was shot in the autumn.

RESULTS AND DISCUSSION

In the study area is covered with the typical maquis flora up to 500 m. The dominant species of this cover is kermes oak *Quercus coccifera*, while carob *Ceratonia siliqua*, olive *Olea europaea*, laurel *Laurus nobilis* and mastic tree *Pistacia pentiscus* are the other main species in maquis flora. Between 500-1100 m, red pine *Pinus brutia* is dominant; the areas where red pine forests are damaged are covered with kermes oak. black pine *Pinus nigra* belt are distributed between 1100-1600 m. The damaged parts of this belt are covered with damaged crimean juniper *Juniperus excelsa* forests. Taurus cedar *Cedrus libani* species are distributed between 1200-1700 m. The damaged parts of these forests are covered with damaged crimean juniper communities.

The northern slopes of the same elevation are covered with taurus fir *Abies cilicica subsp. cilicica* forests. Black pine, cedar and fir species are distributed either in pure or mixed communities. Among these, taurus cedar and black pine are more dominant. The bush and herbaceous layer in lower elevations offer a wide variety of species.

This species are *Ostrya carpinifolia*, *Rosa canina*, *Quercus infectoria*, *Rubus canescens*, *Prunus divaricata*, *Styrax officinalis*, *Coronilla varia*, *Coronilla emerus*, *Colutea cilicica*, *Juniperus drupacea*, *Sorbus torminalis*, *Fraxinus ornus cilicica*, *Crataegus monogyna*, *Rhus coriaria*, *Euphorbia kotschyana*, *Teucrium chamaedrys*, *Teucrium polium*, *Sanguisorba minor*, *Potentilla recta*, *Verbascum splendidum*, *Poa bulbosa*, *Vicia cracca*, *Lapsana communis*, *Turritis laxa*, *Arabis caucasica*, *Dactylis glomerata*, *Asyneuma amplexicaule*, *Silene italica*, *Pilocella xauriculoide*, *Clinopodium vulgare*, *Lecokia cretica*, *Listera ovata*, *Luzula dirulsa*, *Erisimum thyrseideum* sp. *thyrseideum*, *Ferulago pauciradiata*, *Dorycnium pentaphyllum*, *Inula heterolepis*, *Laser trilobum*, *Pistacia lentiscus*, *Quercus ilex*, *Thymus sibthorp* and *Astragalus glycyphyllos*. The study area consists of two types of vegetation, which are coniferous forests and rock vegetations. Vegetation structure of coniferous forests which consists of red pine, pure cedar,

Table 1: Tree-shrubs and bush species in sample plots, their covering degrees and frequency

Species	Covering degrees	Frequency
Sample plot: Cehennemdere-ss hill (1665 m)		
Cedrus libani A. Rich	5	15
Pinus nigra Arnold	3	12
Juniperus excelsa Bieb	2	2
Pinus brutia Ten	1	1
Quercus coccifera L.	1	5
Quercus ilex L.	+	1
Juniperus oxycedrus L.	r	2
Phillyrea latifolia L.	r	1
Robinia pseodoacasia L.	r	1
Sample plot: Cehennemdere-gelinuçtu (1679 m)		
Cedrus libani A.Rich	3	6
Pinus nigra Arnold	2	2
Juniperus excelsa Bieb.	5	12
Pinus brutia Ten.	1	1
Arbutus andrachne L.	1	5
Rosa canina L.	+	4
Sample plot: Cehennemdere-karaancik (1339 m)		
Pinus brutia Ten.	5	6
Quercus coccifera L.	1	15
Phillyrea latifolia L.	+	2
Pistacia terebinthus L.	r	2
Arbutus andrachne L.	r	1
Juniperus oxycedrus L.	r	3
Styrax officinalis L.	r	2
Arceuthos drupacea Ant. et Kotschy.	r	2
Pyrus sorbus Gaertn.	r	1
Quercus robur L.	r	1
Quercus petrea L.	r	1
Sample plot: Cehennemdere-sandalcucugu (1052 m)		
Pinus brutia Ten.	5	12
Arbutus andrachne L.	3	6
Quercus coccifera L.	r	2
Styrax officinalis L.	r	1
Quercus robur L.	r	1
Quercus petrea L.	r	1
Sample plot: Cehennemdere-Kizilgoçuk (1164 m)		
Pinus brutia Ten.	5	9
Cedrus libani A.Rich	1	1
Pinus nigra Arnold	1	1
Arbutus andrachne L.	r	2

cedar-black pine-juniper, red-pine juniper and juniper-fir stands varies according to elevation. On the other hand, rock vegetation consists of typical maquis elements sometimes-dispersed cedar, red pine, juniper, kermes oak, phillyrea and sandal communities. The covering ratio of these dispersed trees and shrubs in rock vegetation were found to be 20-25%. In the general of the area, the slope in the forest and rocks vary between 70-80 degrees which correspond to 150-170%. In addition there are deep cuts and caves in steep rock sections of the area. As a water source in the area, Cehennemdere which divides the area thoroughly into two is a permanent water source. It was observed that wild goats preferred dispersed or full closed red pine stands as hiding cover

Table 2: Main diet of wild goats according to seasons

Seasons	Diet (from much to little)
Autumn	Red pine mushroom *Lactarius delicious* (L.:F.)
	Sandal *Arbutus andrachne* L.
	Kermes oak *Quercus coccifera* L.
Winter	Kermes oak *Quercus coccifera* L.
	Sandal *Arbutus andrachne* L.
	Juniper *Juniperus* sp.
Spring	Muscari *Muscari muscarimi* Medicus
	Bellevalia sp.
	Liliaceae species
Summer	Poaceae, Lamiaceae and Fabaceae species
	Juniper *Juniperus* sp.
	Cistus creticus L.

and that they were extremely irritated when using rocky or plain areas which lacked this cover. It was observed that wild goats never used these areas as a shelter. Among the vegetation units in the area, the trees, shrubs and bush species in coniferous forests and covering degrees and frequency of these species were determined and were shown in Table 1 and 2 together with their locations. As shown in Table 1, four different structures were identified in the analyzed sample area. Although, these structures vary in terms of two or three species in the lower layer, they are generally comprised of similar species.

It was found that in addition to dispersed cedar, red pine, juniper, kermes oak, phillyrea and sandal communities made up of 3-5 individuals in rock vegetations, the majority of these areas were found to be comprised of herbaceous species on the rocks in these rocky areas. The covering ratios of these dispersed tree and shrubs in the rock vegetation were found to be 20-25%. Furthermore, wild goats were observed to prefer rock vegetation as a feeding area however used coniferous forests as a shelter at night or for safety reasons as a resting place at noon.

In addition, it was observed that wild goats used cedar, red pine, juniper, kermes oak, phillyrea and sandal communities in the rocky areas as a hiding cover, while they fed on the rocks. The wild goats were always observed to stand near a cover while feeding, unless in case of an emergency. In addition, the species were observed to use rock layers and small caves between these slopes as an escaping cover. These rocks have a wide variety of herbaceous species (Table 1).

Main diet of wild goats according to seasons is shows in Table 2. Based on direct observations and undigested parts in stomach content, the species shown in the Table 1 were found to constitute 50% and more of the diet of wild goats in the mentioned seasons. It was observed that approximately 80% of this stomach content which was found in autumn contained red pine mushroom *Lactarius delicious*. Although, the diet of wild goats indicated in the present study is in parallel to the literature, there are also some differences. Korshunov

(1994) reported that main diet of wild goats consisted of juniper, bush leaves and various herbaceous plants. In addition, according to a stomach content analysis the researcher conducted in summer time, the majority of wild goats diet consisted of grass. In the present study it was observed that general diet of wild goats mainly consisted bush species rather than grass. Furthermore, it was found that according to the seasons, hyacinth, mushroom and acorns had a significant role in the diet of wild goats.

CONCLUSION

During the observations in the study area, it was found that the wild goats almost never hided, while they were eating the hyacinths which constitute their main diet. Thus, if the observations in spring time are conducted in the areas covered with hyacinth, it becomes easier to see will goats. However, it is rather difficult to see wild goats in autumn. In autumn wild goats almost never walk out of the forest areas and humid valley basins, constantly search for mushrooms. In this season, mushrooms were observed to be the main diet of the species. The reason for this is that prior to mating season during which the animals will spend a lot of energy; the animals prefer to consume foods with high-protein content.

In the study area, as silvicultural procedure in regeneration research carried out by the Forestry Department, clear-cutting method is applied. Unfortunately, like the general wild life, this kind of cutting has a huge negative impact on the habitats of wild goats. This method should be replaced by Group Cutting (Genc, 2004) among small zone cutting clean methods. When cuttings are applied on small areas instead of damaging, it becomes advantageous fort he wild goats. The thick vegetation that grow after a short time in cut areas serve as a good structure for both the diet and hiding of wild goats. Wild goats were observed to prefer these kinds of areas.

In addition, it was observed that small openings in the stands and the edges of the stands are important for the growth of secondary species and thus had a significant role in the diet of wild goats. Therefore after cutting works during the natural regeneration activities of completing the gaps in the areas, the gaps can be specifically left and an edge effect and variety of species can be achieved. In addition, bush species that grow within the natural succession are recommended to be maintained in the area during maintenance works. In the study area it was observed that even in winter time under harsh weather conditions, wild goats did not have a shortage of food. Thus, no artificial feeding is required in the area.

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