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## **Population Size, Structure and Behaviours of Wild Goat in Cehennemdere Wildlife Improvement Area**

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### **ABSTRACT**

In this study, observations and inventories were conducted in distribution areas of wild goats in Mersin-Cehennemdere Wildlife Improvement Area. In this study, considering the population size of the species, Point Count Method was used for species inventory. The observations were made for two times, in summer and winter, in a year between the years of 2007-2008. The structural characteristics and behaviors of the population such as population size, gender ratio, age distribution of males and number of kids were tried to be determined in these inventory and observations. It was found that population size was the highest in 2007 summer count, in which a total of 728 individuals were determined. Population density in the area was found to be 2.5 animals/100 ha. Average male/female ratio was found to be 1.04. A total of 66% of the males were observed younger than 4 years old; 34% were observed older than 4 years old. Of the females, 58% were determined to give birth to 2 kids and 42% were observed to give birth to 1 kid. Red pine, cedar-black pine-red pine, cedar-black pine-juniper stands were determined in the field. Also, more than 100% slope was measured in the majority of the area.

**Key words:** *Capra aegagrus*, inventory, observation, wild goat, Turkey

### **INTRODUCTIONS**

Wildlife populations are rapidly devastated in the world and in Turkey. The reason of this is that, because of human activities, the environment is damaged and wildlife habitats disappeared. The land of Anatolia, which is one of the leading regions of the world in terms of flora and fauna with many of its endemic species, has been the scene for various civilizations for thousands of year. During all these periods, nature was damaged, this damage particularly increased in the last 200 years and as a result, many animals were extinct or endangered (Gundogdu, 2006). Wild goat, which is the subject of the preset study, is considered as a risky group and the continuity of its generation is estimated to be endangered. The species is listed as VU A2ede in IUCN Red List of Threatened Animals (IUCN, 2010). The literature contains limited number of studies on the population size of wild goat. Gundogdu (2006) carried out the first study on this subject on the ecology of a wild goat population in Isparta, Turkey. According to this study, population density in 3 different areas in 100 ha was found to be 0.62, 4.58 and 0.25, respectively.

Accordingly, Wild goat population consists of 15% male, 45% female, 40% kids in summer and 25% male, 35% female, 40% kids in winter. Average number of kids per female goat is 0.85. Abdominal size was found to be  $(b) = 1.72$ . The goats give birth to 2 kids at a ratio of 66%; 1 kid at a ratio of 30% and 3 kids at a ratio of 4% in annual basis.

The height of a mature male goat was 130-180 cm, height at withers was 80-100 cm, tail length was 15-20 cm and weight was 50-85 kg. The weight the female was 20-35 kg. The horns were longer in males (reaches 150 cm) and shorter in females (25-30 cm). The fur of wild goat is covered with short, thick and hard hairs; the color of the goat was pale grayish-yellowish in winter and reddish-brown in summer (Hus, 1974; Turan, 1987; Demirsoy, 1992; Gundogdu and Ogurlu, 2009). Tolunay (1953), Hus (1963, 1974), Turan (1987), Demirsoy (1992) and Canakcioglu and Mol (1996) reported that gestation period lasted 5 months; that the births took place in may and that the goats generally gave birth to twins and rarely triplets. Unlike these findings, Tolunay (1953) reported that the females give birth to 1-2 kids and Canakcioglu (1987) reported that the females give birth to generally one kid.

Korshunov (1994) reported that mating began in November, gestation lasted approximately 5 months and that births generally took place in late-April or early-may but sometimes late-may or early April or even in July. Korshunov (1994) further indicated that generally aged females gave birth to two kids, young females give birth to 1 kid, that one female rarely gave birth to 3 kids and approximately 20% of the females were infertile. Korshunov (1994) reported that male/female ratio was 1:2.1.

Demirsoy (1992) and Canakcioglu and Mol (1996) reported that males fought in rut period. In addition, the researchers reported that in rut period, due to a smell released from the glands at the bottom of the horns, the males smelled bad, they left this smell to any place they passed or stayed; the males made a deep and hoarse sound in this period and made a whistle-like sound and that the females made the same sound when they were frightened.

Hus (1963, 1974) reported that strong males, which used to live solitary joined the group of females in mating season; the females attracted the attention of the males by making sounds, sneezing and making noises by hitting o the rocks. According to Hus (1963, 1974) the same male mated with the same goat 3-4 times in one hour and thus in the following days, the male which joined the flock mates with each of the females in the group. In case of a danger, this male was first to attempt to save his life. He further indicated that when a new male joins the group, in case the first male feels himself weak, he leaves his place to the new-comer; however if the first one feels that he can beat the new-comer, than a fierce fight occurs between the males; the sound of hitting horns sounds like the sound of an axe that beats against a tree.

Demirsoy (1992) and Canakcioglu and Mol (1996) reported that wild goats were daytime animals, they easily climbed step rocks; although they actually moved slowly, they ran away by jumping when they are frightened; they grazed until late in the evening even sometimes in bright nights; during the day they lied under the shadow of the rocks, large caves and through the thick trees either ruminated or rested.

## **MATERIALS AND METHODS**

The study was carried out in Cehennemdere Wildlife Improvement Area, which is 29.419 ha large in between 2007 to 2008 years. 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 321.9 days, which is quite a long period. Number of annual frosty day is 5.1 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).

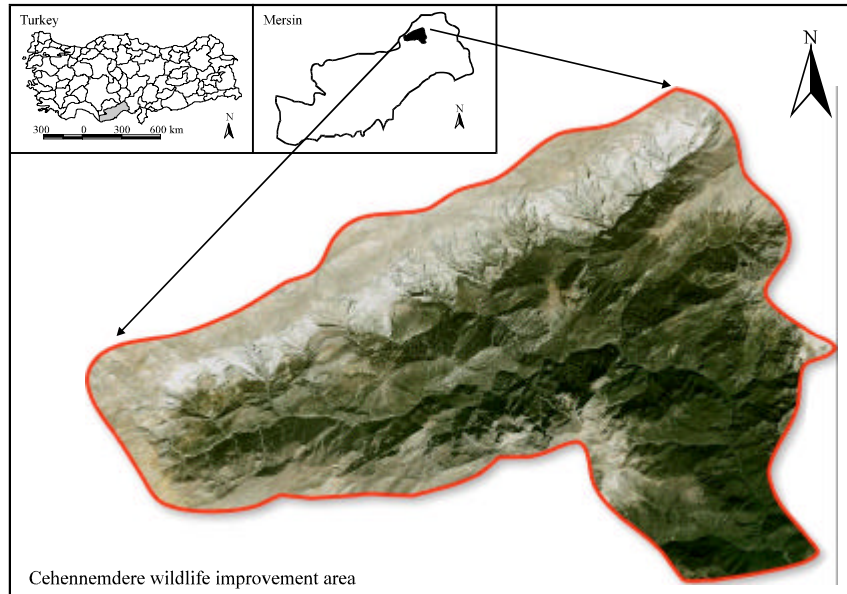


Fig. 1: Geographic location of study area

There are hard, crystallized and cracked old limestones 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 more than 1500 plant species (corresponds to one seventh of Turkey flora) and more than 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, 1995).

General survey was made in the localities where wild goats were reported to live according to the interviews conducted with the hunters and shepherds living in the study area. The determined points were marked on 1/25000 topographic maps. These points were visited and the coordinates were recorded using Global Position System (GPS). In addition, preliminary observations were made at these points. The accuracy of the obtained data was validated by detecting the existence of wild goats by tracking the signs such as the footprints or the feces of the animals or by directly observing the animals.

In this study, considering the population size of the species, point count method was used for species inventory. It is possible to determine the size, density and behaviors of the population (Gundogdu, 2006; Korshunov, 1994; Ogurlu, 2003).

The data of the population characteristics of the wild goat was obtained through direct observations performed in the areas where the species were determined to live. The observations were performed in 2-3 h periods in the morning and in the evening, from sunrise to sunset in summer; and during the entire day in winter (Ogurlu, 2003). Field study was carried out by setting camps with tents for 2-3 days. The study area was visited for 78 days between the years of 2007-2008. Based on these observations, the characteristics of population dynamics such as population distribution and structure; annual number of birth, gender ratio, mating behavior and group size and behaviors were tried to be determined.

Wild goats in the study area were considered as one population, presuming that they were in interaction through the mature males particularly in reproduction period. For the determination of group structure and group size in the area, based on the method specified by Garcia-Gonzales and Cuartas (1996) reported by Baskaya (2000), a social unit moving to the same direction with a distance smaller than 50 m between the individuals, was considered as a group (Gundogdu and Ogurlu, 2009).

In sex distinction and age classification in males, based on morphologic features, the individuals with a body weight of 25-30 kg on average and height of 60 cm, having thin and fragile horns ranging between 25-30 cm which were almost the half of that of a male goat were considered as female. The individuals that were smaller than females approximately 1/3 of which weight 5-10 kg were considered as kids. The individuals having thick horn of more than 30 cm reaching even 150 cm with a length of 155 cm and a body weight of 80-90 kg were considered as male (Gundogdu and Ogurlu, 2009). In age classification of the male individuals, the information available in the literature was reviewed (Hus, 1974; Serez, 1981; Turan, 1984; Demirsoy, 1992; Korshunov, 1994; Canakcioglu and Mol, 1996). In addition, a distinction was made based on the interviews with the experienced hunter of the species and our observations.

## RESULTS

**Population size:** To determine population size, counts were made in the area in summer and winter between the years of 2007 and 2008 (Fig. 2). It was found that population size was the highest in 2007 summer (728); population density was 2,5 animals/100 ha. Average male/female ratio was approximately 1.04. Of the observed males, 66% were younger than 4 years old, 34% were older than 4 years.

**Population structure:** In 2007 summer a total of 249 females and 245 goat kids were counted; ratio of kids per female was 0.98. In 2008, a total of 266 females and 231 kids were counted, corresponding to 0.87 kids per each female goat. In 2007 winter count, while only 48 males over the age of 4 were observed; in 2008, a total of 23 individuals over the age of 4 were counted (Fig. 3).

According to the data of 2008, in summer counts 27% of the population consisted of males; 39% consisted of and 34% consisted of kids; in winter counts on the other hand, as it was reproduction season and the aged makes joined to the population, the rate of males were observed to increase to 29%.

In the study, it was found that the goats give birth to 2 kids with a frequency of 58% and 1 kid with a frequency of 42% in annual basis. The births start in the third week of may and continue until the second week of July. Wild goats are polygamic species in terms of mating; a male can mate with more than one female.

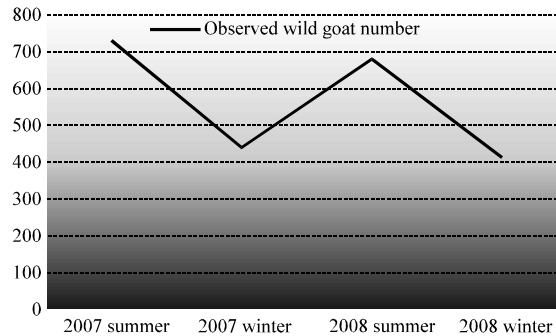


Fig. 2: Census results

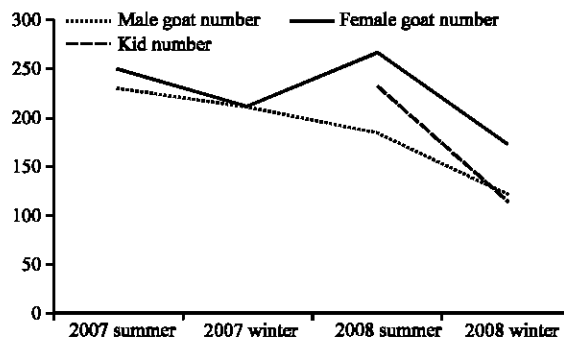


Fig. 3: Observed male-female-kid rates

**Behaviours:** The observations indicated that the population lived in groups in study area. It was found that the determinant factor in this distribution was the cover, which they used for protecting from enemies. It was observed that the primary factor determining the behavior of wild goats is the feeling of safety; while moving or grazing, the animals were observed to absolutely take a position to defend themselves from their enemies.

In this period, due to high temperature, wild goats were observed to need more water and thus while going to water, they were particularly attentive and cautious against dangers. It was observed that wild goats visited water areas for a number of times in winter- mostly in the morning and rarely during day time or in the evening- and generally turned back from the area where they drink water in the evening. When wild goats reached water, they were observed to wait without moving for 10-15 min; when it get fully dark, they walked into the water one by one and very slowly; a new goat did not enter in the water until the previous goat comes out form the water; they kneeled and drank water for 20-30 min and thus water drinking behavior lasted for nearly 1 hour. Furthermore, it was found that wild goats showed utmost attention towards dangers as they approached water, when they approached to the water in addition to showing utmost attention against dangers, when they felt a danger, they did not use the same route in the same day when they turn back from water. In addition to all these, it was observed that there was a strong hierarchical relationship between the flock members of wild goats; this hierarchy particularly manifested itself in water drinking behavior which takes place in the period between arid periods to the mating period. The dominant male was first to drink water, then the middle aged individuals under the protection of the dominant male and then the rest of the flock were observed to drink water.

It was observed that hierarchy was also very important in choosing mates. Large males of each flock fought in mating season and during this oppression process, young and sick males left the flock and the dominant male spent much energy and was then exhausted. Besides, it was observed that in the flock the male first chose to mate with the youngest females and reserved other females.

Wild goats were observed to be more active between 09:00 -11:00 and 14:00-16:00 O'clock in winter. Thus, during the mating season in winter, it is possible to observe behaviors such as water drinking, grazing, mating, resting and courtship of wild goat flock.

It was found that a typical wild goat flock was led by an aged female goat, followed by her kids and other females. Young male until the age of 3-4 followed the females, followed by the strongest male goat (which is generally the largest one). Less strong males over the age of 4 were observed to travel around the flock, serving as protectors of the flock. Furthermore, it was observed that while the wild goats changed location, the oldest female observed the flock and this observer female halted at every 5-10 sec and looked around for 3-5 sec, meanwhile other members of the group waited motionless and when the observed female walked, the rest of the flock followed her.

It was found that in case of a danger, different goats undertook the leader and the dominant member roles. In other words, in case of an emergency, an aged female or a young male frequently undertook the role of leader and the aged male moved to be backmost of the flock. While running away from a danger, all members first gathered around while his protector led the dominant male to the center of the gathering. After a few seconds, they left the flock and hid behind a coppice or a rock where they could detect the danger and the degree of the danger. The role of the dominant male begins right here. When the flock encounter unexpected barriers or when a predator attack is the case, the dominant male and his protector first takes up waiting position to estimate the danger. The dominant male determines the direction for running away and moves toward a safe direction, quickly followed by the rest of the flock. After a time, the flock gets dispersed and takes shelter under the hiding cover. The direction led by the dominant male can sometimes be the source of a danger. Another role of the dominant male was to establish hierarchy in the flock and to force the members who disturb this hierarchy. It was also found that the dominant male was responsible for protecting the members, which needed to be protected.

It was found that the wild goats in Cehennemdere Wildlife Improvement Area mated at a period between the first week of December and the second week of January. Two or three weeks before this period aged males joined the flock from the areas where they spent the summer and compete among themselves. The winners of the fights visit the groups with female members and choose females to mate with. Mating behavior generally starts with a precipitation like rain or snow and is most intensified under rainy and foggy weather conditions due to easy hiding. The male seeking to mate with a female, makes a goose-like sound from a certain distance (the distance can be 30-40 m or from one hill to another). The male repeats this sound for 4-5 times in 5 min and then approaches to the females. When the female sees the male chasing her, she quickly runs away. This chasing is repeated for 3-5 times and in the end he female gives up and allows for mating activity. The males firstly mated with the youngest female and lastly with the oldest female. One male was observed to mate with 3-4 females in a day.

In mating season, during the mating activity, the groups gather and make larger flocks. In these flocks, while the oldest male chases a female to mate with, young males lead the flock; the females and the kinds are in the middle; middle-aged males walk in the backmost of the flock.

While, the strong male mates with a female, middle-aged ones try to mate with other middle aged females. Apart from courtship and mating chases, young males, females and kids, aged males wander in separate groups.

After mating, the males visit the female groups they mated with for approximately 1 month and then travel to the areas where they spend the summer. It is quite difficult to see these males in summer because in summer they do not leave their hiding places expect for 10-15 min before the sunset and 10-15 min before it gets fully dark.

## **DISCUSSION**

Depending on the climatic conditions, it was found that the most appropriate time for inventory studies for wild goats in summer was the first week of August and the first week of December in winter. It was found that in the last week of December, heavy snow began in the area and that had a negative effect on the observations. Thus, it is thought that inventory in these recommended dates will make observing the species easier and will shorten counting duration and thus will reduce counting costs.

The counting indicated that there was a 50% decrease in population size in winter. The reason for this can be that the kids of 5-6 months old generally hide in winter, do not take part in mating and thus are difficult to see.

These observations indicated that wild goats mostly preferred the shadowy areas amongst closed stands and kermes oak communities for feeding and resting, however did not prefer to wander in sunny areas expect for running away to changing location. This result indicates that during observation activities, these sections should be observed more frequently.

In the study area births start between May-July. Therefore, counting of the kids should start by the end of June and should be completed before September, because 4 months after birth, the kids almost reach the size of 1-year old individuals and it becomes difficult to distinguish them.

The hunters generally prefer mating season for hunting. It is known that the most important mortality factor in the area was illegal hunting. As hunting wild goats is rather difficult, instead of hunting after following the animals, the hunters wait for a long time for the wild goats to come in caves. The hunters generally prefer mating season for hunting. In this period, solitary males, which do not generally leave the forest daringly, wander in the field for mating. In hunting of solitary males, especially foggy and rainy days are important for conservation activities. Since these weather conditions make approaching to the animal easier, the hunters generally prefer these times for hunting. Thus, especially in reproduction season, field conservation can be applied in these kinds of weather conditions.

Gundogdu and Ogurlu (2009) reported that in the flock the male first chose to mate with the youngest females and reserve other females. The reason for this behavior was thought to be the fact that relatively older females still milked their kids so the males mate with these females at a later period. The same results were determined in our study as well.

In our study the ratio of infertile females was found to be 12%. In their study, Korshunov (1994) reported an infertility ratio of 20%. So, this infertility ratio observed in this area can be considered to be rational.

Korshunov (1994) reported that they have found that lifespan of wild goats in their natural habitat was 10-12 years based on the horns, but the oldest horn they ever found was 11 years old. Also, Korshunov (1994) indicated that under captivity, wild goats lived until 14 years old. The sources in Turkey estimate that wild goats live for 15-20 years. But, Gundogdu and Ogurlu (2009)



reported that the oldest horn they ever found was 11 years old in Isparta. The oldest wild goat was determined 11 years old in the study area as well. Consequently, the data we obtained in the present study are consistent with the data of Korshunov (1994) and Gundogdu and Ogurlu (2009).

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