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The Distribution of Wild Goat *Capra aegagrus* Erxleben 1877 and Population Characteristics in Isparta, Turkey

Ebubekir Gundogdu and Idris Ogurlu
Faculty of Forestry, Suleyman Demirel University, Isparta, Turkey

Abstract: Wild goat *Capra aegagrus* Erxleben 1877, which is listed as VU A2 cde in IUCN Red List of Threatened Animals, is distributed in Aegean, Mediterranean, Southeast Anatolia, Eastern Anatolia and Blacksea Regions of Turkey up to 4000-4500 m altitudes from the sea level. Isparta Province is one of the distribution areas of wild goats, where these species exist for long years. Wild goat is almost extinct in Isparta Province. This study collected data on the ecology of wild goats such as the distribution of wild goats in the area, the morphology, sexuality, group size, distribution of age in males and number of kids in between the years of 2002-2008. This data indicated that wild goat is distributed in Yesilyurt, Candir, Muezzinler and Asagigokdere villages of Isparta Province. Home range of the species was around 150-400 ha. Color variations of wild goats varied according to season, sex and age. Wild goat population consisted of 15% male and 45% female and 40% kids in summer and 25% male, 35% female and 40% kids in winter. Average number of kids per female goat was 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 most significant mortality factor in the field was illegal hunting. Although, group size varied according to seasons, generally solitary individuals or dual groups were observed.

Key words: Mediterranean, observation, capra, population ecology, morphology, group size

INTRODUCTION

With its wildlife varieties, Turkey is the richest country of Europe. One of the most important components of this richness comes from approximately, 140 mammal species. Wild goat is one of the five species of Bovidae family, which is distributed in Turkey. *Capra aegagrus* is known to be distributed in Afghanistan, Armenia, Azerbaijan, Georgia, Iran, Lebanon, Russia, Turkey, Cyprus, Greece, India, Iraq, Italy, Amman, Pakistan, Slovakia, Syria and Turkmenistan (Shackleton, 1997). Apart from Turkey, *C. aegagrus aegagrus* is reported to be distributed in Armenia, Azerbaijan, Georgia, Iran, Russia, Afghanistan and Pakistan, namely from Caucasia, Iran, Northeast of Iraq and East Asia to Sindh and Baluchistan (Turan, 1987a, b; Demirsoy, 2000; Shackleton, 1997). Although, it is reported that this species is distributed in Greek islands, other sources (Sfougaris, 1994, 1995) reports that *C. aegagrus* cretica is distributed in Greek islands. Tolunay (1953) reported that *C. aegagrus aegagrus* is distributed in Southeast Europe and Western Asia.

As for Turkey, it was reported that over Taurus and Anti-Taurus mountains, this species was distributed in Eastern, North-Eastern and steep mountainous areas of South East Anatolia (Turan, 1987a, b; Canakcioglu and Mol, 1996; Kence *et al*., 2002). Defining this distribution area in detail, Hus (1963, 1967) reported that this species was distributed in Balan Mountains between Koycegiz and Marmaris; Botan Valley in Siirt Province; at 3200 m altitude in Geyik Mountain; 2900 m altitude in Akdag mountain; 2800 m altitude in Karayilan Mountain; at 220 m altitude in Susuz Mountain; 1600 m altitude in Caklica; at 1400 m altitude in Tastan and Ucansu localities and at 600 m altitude in Badem tree locality, Finike, Kas, Manavgat counties of Antalya, Beysehir county of Konya; steep rocky and forest areas in Marmaris, Ula, Yerkesik, Koycegiz and Fethiye counties of Mugla; steep areas overlooking the Taurus mountains in Isparta, Burdur, Denizli and Aydin Province; Mersin Province, Pozanti Mountains and suitable areas of Artvin and Tunceli Provinces. Zengingonul (1987) reported that wild goat is distributed in an area covering Marmaris county of Mugla, all parts of Taurus mountain range including Antalya, Mersin, Adana and Maras Provinces, Tunceli, Erzincan Provinces in Eastern Anatolia; Bitlis, Van, Hakkari Provinces in Southeastern Anatolia and in Artvin Province in North-Eastern Anatolia. Demirsoy (2000) reported that wild goat is distributed in an areas starting from Karadag mountain at the cape of Datca peninsula,

Corresponding Author: Ebubekir Gundogdu, Faculty of Forestry, Suleyman Demirel University, Isparta, Turkey

mountainous, forest areas in North of Marmaris, Koycegiz, Fethiye, Kas and Finike, Marcal mountains between Mugla-Milas in the mountains North-East of Mugla Province and South of Denizli Province. Demirsoy (2000) reported that the highest distribution area of wild goat in Western Anatolia was the Maymun Mountain in North-East of Cardak county of Denizli Province and that this species was extinct in this mountain in a recent date. Demirsoy (2000) further indicated that this species was distributed in the entire Taurus range in Antalya Province, South and East of Isparta Province in the mountains West and South of Beysehir lake in Seydisehir, Hadim, Ermenek localities in South of Karaman and Eregli in Aladag mountains in South-East of Nigde Province, Tahtali and Binboga mountains to the East in Engizek and Nurhak mountains between Kahramanmaras and Malatya Provinces in mountainous areas in Elazig, Tunceli, Bingol, Mus and Bitlis Provinces, East of Siirt Province, Hakkari and Van localities, North-East, East and South-East of Sivas Province in the mountains surrounding Erzincan, Erzurum and Gumushane Provinces in all rocky and mountainous areas of Black Sea mountains from Mesudiye county of Ordu Province to the Russian border.

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. Turan (1987a, b) and Demirsoy (2000) reported that wild goats lived in area 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.

Turan (1987a, b), Demirsoy (2000) and Canakcioglu and Mol (1996) reported that wild goats generally live in flocks, which are always led by an aged female goat, the males and females lived together from mating season, until birth season and that aged and strong males lived alone or in groups of 2-3 and in summer the females, kids and young males until 3 years of age came together and formed flocks. Tolunay (1953) reported that the goats lived in groups of 10-20 and an aged goat led the flock. Indicating that group structure in wild goats varied according to the size of population, Korshunov (1994) reported that group structure in wild goat populations should be analyzed separately in sparse populations and dense populations.

Turan (1987a, b), Demirsoy (2000) and Canakcioglu and Mol (1996) reported that 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. The researchers also reported that there was a black colored line called belt in the males from the tip of shoulders extending to the back, nape and front heels of the animal and that the color of this line gets darker in mating season. There is no such black belt in females and that the females also, lacked another black belt dividing abdominal line and that the color of the females was lighter. The researchers further reported that mature males had a black beard with hard hairs in their chin. Hus (1963, 1967) reported that the fur of wild goats was reddish or yellowish bronze, that the color mainly remained unchanged in females, however various color variations were observed in mature males. Hus (1963, 1967) further reported that the color of the males was lighter in summer however a the goat got older, this color turned to a whitish light color as the grayish hairs appeared in the back and whitish hairs appeared in the abdomen of the animals. Hus (1963, 1967) also indicated that aged males had a mane covering the area to the spine and the neck; after the age of 3 in winter a black line surrounding the chest and passing over the shoulders appeared in males; there was a brown line passing the back narrowing to the rear part of the animal's body and that both males and females had a quite long beard. Tolunay (1953) reported that the goats were reddish grizzled colored and had black lines on their bodies.

Turan (1987a, b), Demirsoy (2000) and Canakcioglu and Mol (1996) reported that mating started in early November and lasted 3-4 for weeks until mid-december. Hus (1963, 1967) reported a rut period of 40 days between the November to February. Tolunay (1953) reported that wild goats mated in November.

Tolunay (1953), Hus (1963, 1967), Turan (1987a, b), Demirsoy (2000), 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 1 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 2 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 (2000) and Canakcioglu and Mol (1996) reported that wild goats lived for 15-20 years.

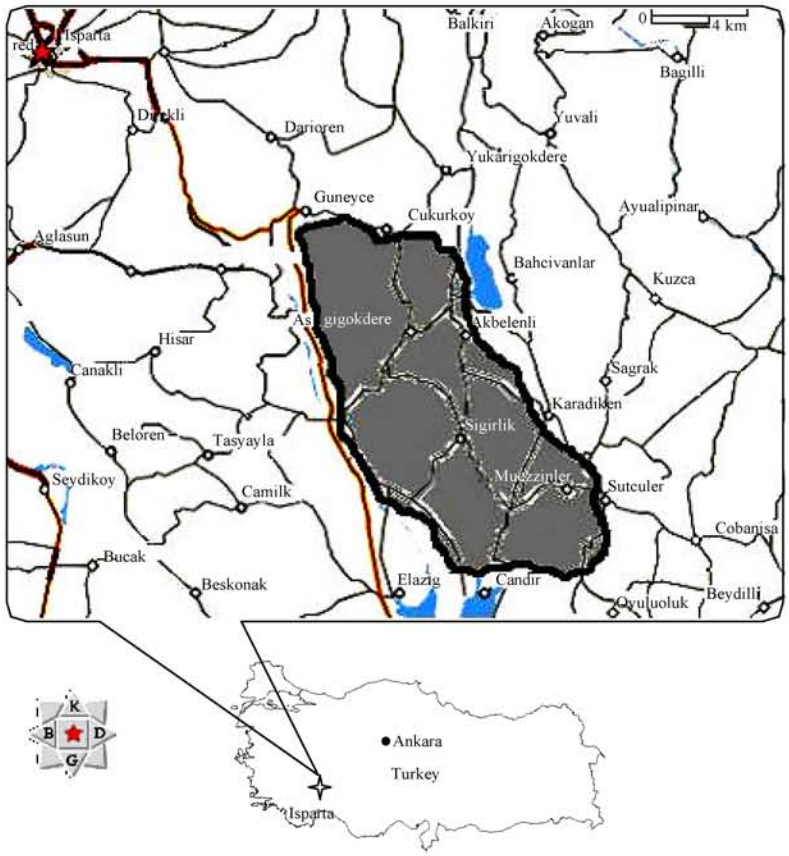

Fig. 1: Study area

Tolunay (1953) reported that the lifespan of wild goats was 20-25 years. Korshunov (1994) reported that wild goats lived for 10-12 years.

Study area: Study area was located in inner region of Western part of Mediterranean Region of Turkey. This area is in the center of Lakes Region, located at 30°20" and 31°33" East longitudes and 37°18" and 38°30" North latitudes. Isparta Province is surrounded by Konya on the East, Burdur on the East, Afyon on the North and Antalya on the South. The study was carried out in an area of approximately 20,000 ha between Kapikaya to the North, Isparta creek to the West, Beydilli-Anamas mountain to the East and Candir plateau-Bekiragalar village to the East, which was determined to be the distribution areas of wild goats as a result of the conducted general survey in an area of approximately, 8.933 km^2 within the provincial borders of Isparta (Fig. 1). The altitude of the field varies between 350-2000 m. This area is the edge natural distribution areas of wild goat in the North of Mediterranean Region. In terms of general soil properties, the study area is clayey-slime, non-saline, moderately alkali, calcic, poor in phosphor, rich in potassium and poor in organic substances (KHIIM, 1997). A large part of the study area is composed of red-brown Mediterranean soil (KHGM, 1994).

MATERIALS AND METHODS

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 (HGM, 1962, 1983). 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. The distribution areas of the wild goat in Isparta Province were determined with this method.

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 215 days between the years of 2002-2008.

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 reported by Baskaya (2000), a social unit moving to the same direction with a distance <50 m between the individuals, was considered as a group.

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 >30 cm reaching even 150 cm with a length of 155 cm and a body weight of 80-90 kg were considered as male (Hus, 1967; Turan, 1984; Demirsoy, 2000; Korshunov, 1994; Canakcioglu and Mol, 1996). In age classification of the male individuals, the information available in the study was reviewed by Hus (1967), Serez (1981), Turan (1984), Demirsoy (2000), Korshunov (1994) and Canakcioglu and Mol (1996). In addition, a distinction was made based on the interviews with the experienced hunter of the species and the observations.

RESULTS

Distribution: It was found that wild goat was distributed in an approximately 20,000 ha area in Isparta Province, covering Kapikaya on the North, Isparta Creek on the East, Sar Creek on the West and Candir Plateau on the South. It was found that 6-7 years old males of the population near Muezzinler locality lived in Zinar Bogazi locality except for reproduction season and that the goats in Asagigokdere passed summer near Oglanuctu locality, which is 3-5 km way. The observations indicated that a group of wild goats lived in an area covering valleys and ridge areas of 3-5 km long and 500-800 m wide, which demonstrates that the goats have a home range of approximately, 150-400 ha.

Morphology: The observations indicated that color variations in wild goats varied according to season, sex and age. It was found that in summer the colors of the goats were paler and that the least color variation was observed in females. The findings indicate that the females are brick red in summer, which turned to ashy yellow in winter. The females have a thin (1-2 cm wide) black line on their back and a white line under their abdomen. Old females, on the other hand were observed to have lighter colors. The kids were found to be ashy brown in color. Male kids were darker in color than the female kids. It was found that both males and females had horns and that the horns of the females were much smaller and fragile than those of males (approximately, 25 cm). It was found that the color and horn structure varied according to age in males. The males have significantly bigger horns starting from 2 years of age. As the goats get aged, the horn keep getting bigger and start curving. It was observed that in a 10-11 years old male goat having well-developed horns, the tip of the horn almost touched to the coccyx of the animal when, it raises its head. Furthermore, the goats have a black colored belt on their back and which covers the chest by extending down to the neck and then reaches to the front feet. This belt appears at the end of 3rd year of age and becomes clearly visible after the age of 5. It was found that this belt became wider and darker as the goat ages, then gets white and completely disappears to the end of the lifetime of the goat (10-11 years old) and that turns to a Gray-white color. Based on these detections, male individuals in the study area were classified according to color of their furs. It was found that the males between the ages of 2-4 had longer horns than the females. The belt was not completely visible and that fur color was yellowish-brown. In the males between the ages of 5-6, the belt in the neck and back was completely visible. This belt was approximately, 5-7 cm wide and black. The neck and head did not turn to black yet. As for the males between the ages of 7-9, patches of white color were visible on the fur; the belt reached to the chest and head of the animal and turned this area completely black. The males, which were 10 years old or older, the color of the fur turned white, the belt turned to a grayish color and almost disappeared.

Based on sudden chasing and jumping movements in the study area, it was observed that the feet of wild goats developed in such a way to enable them to move in step rock places easily.

Population dispersion and composition: 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 protection from enemies. It was observed that wild goats preferred

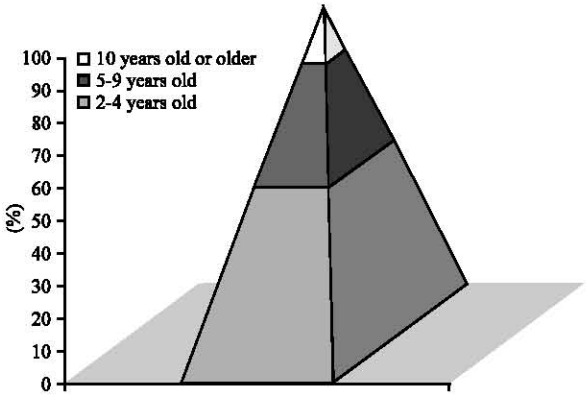

Fig. 2: Male age classification

dispersed or full closed red pine stands as hiding cover and that they were extremely irritated when using rocky or plain areas, which lacked this cover.

The counting made in summer of the last observation year indicated that the population consisted of 15% male, 45% female and 40% kids. As in winter, aged males also joined the population, the ratio of the males increased to 25%, the ratio of the females decreased 50 35% and the ratio of kids remained unchanged with 40%. As for the age ratio of the males, the ratio of the males, which were 10 years old and older was 15%, the ratios of the males between the ages of 5-9 was 35% and the ratio of the males between the ages of 2-4 was 50% (Fig. 2). The latest counting indicated that there were 83 females and 97 kids. So, the number of kids per female goat was found to be 0.85.

Natal factors: In the study, it was found that abdominal size of the wild goat was (b) = 1.72. As indicted in Fig. 3, wild goats gave birth to 2 kids with a frequency of 66%, 1 goat with a frequency of 30% and 3 kids with a frequency of 4%. It was found that the ratio of infertile females was 5%. The births start in 2nd week of may and continue, until the 1st week of July.

Mortality factors: In the interviews, the hunter themselves reported that illegal hunting was the most important factor in the mortality of wild goats in the study area. The interviews reported that around on average 80 wild goats were hunted in this area on annual basis.

As the predation factor, it is known that Anatolian leopard *Panthera pardus* tulliana, which is the most important predator of wild goat, existed until 1980s. However in observations no finding was obtained about *Panthera pardus* tulliana. In addition, Caracal, *Felis caracal*, which can be another predator of wild goat, was observed to exist in Asagigokdere locality. Based on the

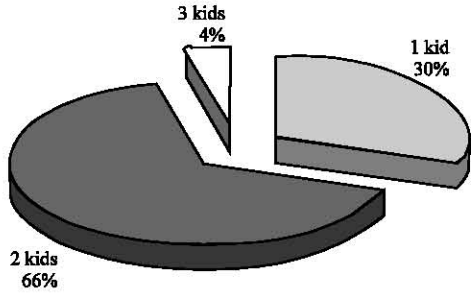

Fig. 3: Birthing ratio

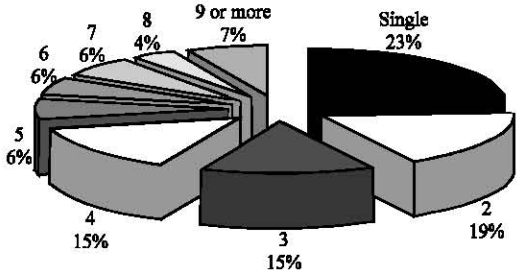

Fig. 4: Group size

asymmetrical and irregular foot prints of wild goats and caracal, we concluded that these two species had a struggle in this area. In Muezzinler locality, Wild cat *Felis sylvestris* was observed. Furthermore, numerous Fox *Vulpes vulpes* was observed in the study area. Apart from these species, although, there are rumors that Wolf *Canis lupus* and Wild cat *Lynx lynx* live in the study area, we found no traces of these species. Among the observed bird species, Golden eagle *Aquila chrysaetos* and Griffon vulture *Gyps fulvus* can be listed among the predators of wild goat. *Gyps fulvus*, which is an endangered species, was observed to live in couples in their nest between the cuts of the rocks and to fly in groups of 9-11.

During the study no data was obtained about any disease or parasite, stress or extreme climatic conditions causing mortality. But, one female wild goat was observed to have died in car accident.

Group size: The percentages of groups sizes observed in the observations are given in Fig. 4. These data indicate that, the frequency of solitary males was 63; the frequency of single females was 19. In other words, 76% of the single living individuals consisted of males. Seventy four percent of these single males were observed in winter. This difference results from the males, which graze alone for reproducing in winter. As for the wild goat groups living in nuclear family including female and the kids, it was found that dual or triple groups constituted 34% of the population 53% of the dual groups consisted 1 female and 1 male wild goat while, 67% of triple groups

consisted 1 female and 2 kids. When more crowded groups were analyzed, it was found that quadruple or larger groups were observed in winter with a ratio of 49%. Groups consisting nine or more individuals were observed in winter with a ratio of 64%.

DISCUSSION

Hus (1967) and Demirsoy (2000) reported that wild goat is distributed in the North of Turkey's Mediterranean region up to Isparta Province. The findings of the present study support this data. However in study review, no data was found on the distribution area of wild goat in Isparta Province. Thus, the present study will determine the distribution area of wild goat in Isparta Province-covering the skirts of Davraz mountain belonging to the last range of West Taurus mountains and Kapikaya on the North, Isparta creek on the West, Sarderesi on the East and Yazilidere on the South-for the first time.

It was found that Isparta-Antalya highway split the habitat of wild goat. Prior to the construction of this road, it was known that in mating season the males traveled from Asagigokdere-Karanlikdere locality to Karadigin locality of Aglasun county of Burdur Province. Furthermore, it is known that until the construction of this road, there was a wild goat population of 60-70 in a limited area and that after the construction of the highway, the mentioned area was declared as a conservation area. Although, we conducted numerous observations in this area, we observed no wild goats. Thus, we concluded that the habitat split of the wild goats due to the construction of the highway may have caused the population extinct. The fact that there was no available data on the distribution area of the wild goat during the construction works of the highway and the fact that no passage was constructed have caused the habitat split of the wild goats.

No wild goats were observed in the observations performed in Beydilli for 2 years. Wild goats were known to be distributed in Beydilli. It was thought that since, it was very difficult to reach this are via the highway, there was no road network in some localities and thus, the conservation activities were carried out with difficulty lad to illegal hunting, which resulted in the disappearance of wild goats in this area.

Although, the data reported by Hus (1963, 1967), Turan (1987a, b), Demirsoy (2000), Canakcioglu and Mol (1996) was parallel with the findings on the morphological properties of wild goat. It was found that the colors of the kids changed one month after their birth and that the kids with darker color were male while, the ones with lighter color were female. Based on these data, making a more detailed classification in male individuals (the males between the ages of 2-4, 5-6, 7-9 and older than 10) morphological properties were defined.

Birth season was between May-June in the study are. It was observed that the earliest birth took place in 6 of May and the latest birth took place on the 10 of June. So, 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.

It was observed 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.

In the study, it was found that wild goats generally gave birth to 2 kids. Canakcioglu (1987) reported that wild goats generally gave birth to 1 kid.

In the study, the ratio of infertile females was found to be 6%. 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.

It was found that the largest wild goat ever hunted in the study area was 13 years old based on the analysis of its horn (Cetinkaya, 2005). The study in Turkey report that the lifespan of the wild goat is 15-20 years. 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. The researcher further indicated that under captivity, wind goats lived until, 14 years old. The data we obtained in the present study are consistent with the data of Korshunov (1994).

The increase in population size during the period of the present study (2002-2008) clearly indicates that the most important factor in mortality of wild goats is illegal hunting. During study period, the only factor that changed was the decrease of illegal hunting due to the training for protection and conservation activities.

As the large solitary males, which do not generally leave the forest daringly wander in the field during mating season, illegal hunters generally prefer mating season for hunting. In addition, 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.

The present study is the first and the most comprehensive study carried out in Turkey on the ecology of wild goats. It is thought that the data obtained in this study will give insight to further studies.

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