

# Observations on Behavior of Wild Goat (*Capra aegagrus*, Erxleben 1777)

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## Article Info

### Article history:

Received  
December 3, 2008

Received in revised form  
December 25, 2008

Accepted  
December 26, 2008

Available online  
March 21, 2009

## Key Words

*Capra aegagrus*,

Ecology,

Habitat,

Wild goat.

## Abstract

Wild (bezoar) goat (*Capra aegagrus*, Erxleben 1777) was studied in Köprülü Canyon Area and Termessos-Düzlerçamı Area in Antalya-TURKEY. Based on questionnaire survey and observations from June 2003 to August 2004, wild goats used eight different vegetations – maquis, Turkish pine (*Pinus brutia*), juniper (*Juniperus excelsa*), juniper mixed cedar (*Cedrus libani*), black pine (*Pinus nigra*), fir (*Abies cilicica* subsp. *isaurica*), cedar and sub-alpine – from 200 m to 2500 m. Wild goats preferred escape terrains with more than 30° angle within these habitats. Any food preferences were not observed except hyacinth (*Muscari* spp). Rutting season started in the middle of December in Köprülü Canyon Area and in the beginning of December in Termessos-Düzlerçamı Area. Rutting season lasted for 30-40 days and pregnancy period took 5-5.5 months. The first births occurred in the middle of May in Köprülü Canyon Area and in the beginning of May in Termessos-Düzlerçamı Area. Ratios of males associate with females were 0.47:1 in Köprülü Canyon Area and 0.57:1 in Termessos-Düzlerçamı Area. Bias in the sex ratios was a result of anthropogenic pressure.

## INTRODUCTION

Wild (bezoar) goat (*Capra aegagrus*, Erxleben 1777) is a very important game animal with valuable meat, hides, and horns [1]. It was announced as “Vulnerable” (VU A2cde) in the 1996 IUCN Red List of Threatened Animals [2], because of over hunting. In Turkey, hunting of wild goat is banned except special permissions [3].

Wild goat is a member of subfamily *Caprinae* which includes bovids adapted to extreme climates and difficult terrains [4]. Wild goat has distributed along

a very wide mountainous area from Afghanistan and Pakistan to Anatolian mountains, Aegean islands and Crete. Since it is the strongest candidate for being matriarchal ancestor of domestic goat (*Capra hircus*) [5], genetic structure of wild goat is very important and has been well studied [5-9]. In contrast to these studies, there are only few studies concerning their ecology. Wild goat was domesticated in Fertile Crescent about 10,000 years ago [10,11]. Despite being a part of Fertile Crescent in Turkey, where includes variety of zoogeographic and climatic characteristics; biology, ecology and behavior of wild goat still remain unclear. Information about biology of wild goat is important for hunting tourism, ecological tourism and wildlife management.

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The aim of this study was to provide some clear information about biology, ecology and behaviour of wild goat which are needed to establish reliable wild goat management and protection plans.

## MATERIALS AND METHODS

This study was carried out in mountainous regions of Antalya located in the south of Turkey from June 2003 to August 2004. Wild goat populations were observed during the whole year but most of the observations performed in rutting and birth seasons due to higher activity of wild goat populations. Total duration of field studies was 80 days. Two study areas with different characteristics were selected in order to obtain more information about wild goat: Köprülü Canyon Area and Termessos-Düzlerçamı Area (Figure 1).

Köprülü Canyon Area is located in high areas of Bozburun Mountain (2510 m) in Köprülü Canyon National Park and high habitat diversity including maquis, Turkish pine (*Pinus brutia*), juniper (*Juniperus excelsa*), juniper mixed cedar (*Cedrus libani*), black pine (*Pinus nigra*), fir (*Abies cilicica* subsp. *isaurica*), cedar and sub-alpine vegetations [12,13]. In Bozburun Mountain wild goat population is under risk of extinction due to anthropogenic pressure and lack of protection.

Termessos-Düzlerçamı Area located at relatively low altitudes comparing with first area (Güllük Mountain 1210 m), and includes maquis and pine vegetation, and contains Güllük Mountain National Park and Düzlerçamı Wildlife Protection Area. Although Termessos N.P. has been well protected and has remained untouched by means of vegetation and wildlife, Düzlerçamı W.P.A. has not been well

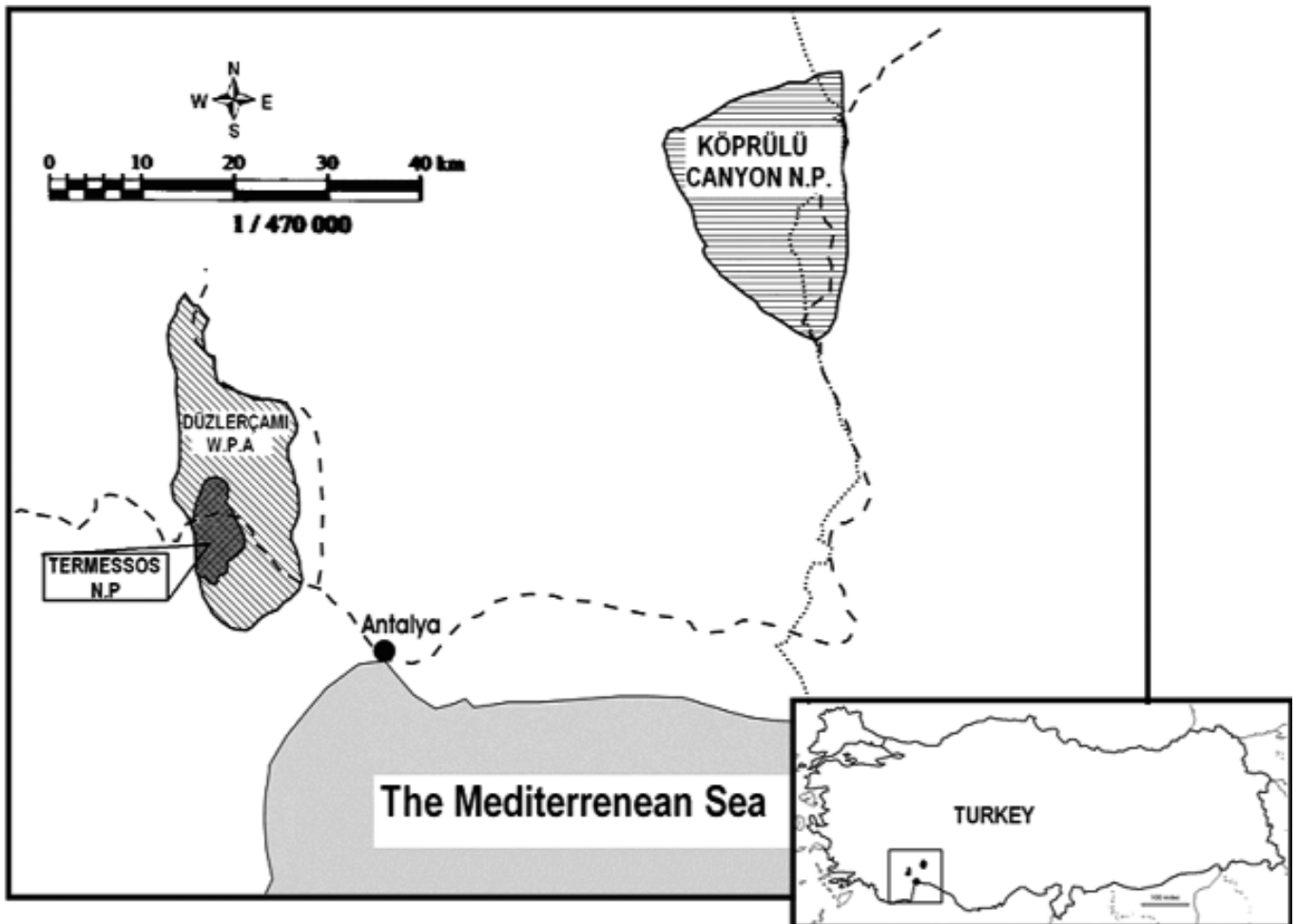


Figure 1. Location of study areas: Köprülü Canyon Area and Termessos-Düzlerçamı Area.

protected and vegetation and wildlife is under anthropogenic pressure.

Annual mean temperature of Köprülü Canyon Area is 16°C with mean maximum 26°C from July to August and mean minimum 8°C in December. Mean annual precipitation was 1100 mm with maximum mean precipitation 240 mm in December. Bozburun Mountain has more severe of weather conditions at high altitudes in winter seasons. Temperatures usually drop -10°C and snow cover stays more than two months at above 1500 m [14]. Mean annual temperature of Termessos-Düzlerçamı Area is 16.5°C with mean maximum 27°C in July and mean minimum 8°C in February. Mean annual precipitation was 800 mm with maximum mean precipitation 190 mm in December and January [14].

Prior to the a questionnaire survey conducted to get some information about wildlife and wild goats in study area over villagers native villagers, hunters and National Park officers to decide place of study areas and study plan.

The method of direct observations at fixed points which are mostly high locations was mainly used. With this method valuable data such as behavior, sex and age can be obtained [15,16]. 8x40 Nikon Action binocular and Nikon Fieldscope II telescope were used during observations. If close observations were possible, age, sex, and individual differences (horn anomalies, wounds etc.) which help the identification of wild goats have been recorded. Feeding, rutting and all other behaviors were also recorded. Composition and location of herds recorded which help individual identification of wild goats.

Because of steep and rocky ecosystems in study areas, using pellet counts and footprint for census were not possible. But pellets and footprints were used as support data to understand distribution and

habitat selection of wild goats.

Classifications and locations of habitats were taken from Çetinkaya [13] for Köprülü Canyon Area & Balkız [17] and Alçıtepe [18] for Termessos-Düzlerçamı Area in this study.

## RESULTS

### Population Size and Sex Ratio

Since the population of wild goat in Köprülü Canyon Area was relatively small; all individuals found in the population could be counted. It is founded that the population in the Köprülü Canyon Area consists of 29 wild goats (9 males, 19 females and one yearling). Ratio of males' associates with females was 0.47:1.

The population of Termessos-Düzlerçamı Area was relatively bigger than population of Köprülü Canyon Area and the number of observation was high. Although, more 155 individuals (officers predict that whole area has approximately 300 individuals), only wild goats whose sex could be determined certainly were used for sex ratio calculation. In Termessos-Düzlerçamı Area, sex and age of 57 wild goats (16 male, 28 female and 13 yearlings) of total 155 individuals observed. Ratio of males associate with females was 0.57:1.

Sex ratios of Termessos-Düzlerçamı Area and Köprülü Canyon Area were close to each other ( $\chi^2=2.00$ , d.f. = 1,  $P=0.157$ ) and different than 1:1. (Respectively,  $\chi^2=11.277$ , d.f.= 2,  $P=0.001$  and  $\chi^2=6.695$ , d.f.= 2,  $P=0.01$ ). Achieved sex ratios of Köprülü Canyon Area (0.47:1) and Termessos-Düzlerçamı Area (0.57:1) are similar with the results of the wild goat census in Düzlerçamı W.P.A in June 2004 (0.53:1) conducted by Ministry of Forestry ( $\chi^2=0.150$ , d.f.=2,  $P=0.928$ ).

In the present study, four group pattern as adult male group (may include young males), young male group, female group (may include young males) and mix group containing adult animals with both sexes were observed in both study areas. Mixed groups only form in rutting season and others form during whole year.

### Habitat Use

During the observation period, it was determined that wild goats used maquis, Turkish pine (*Pinus brutia*), juniper (*Juniperus excelsa*), juniper mixed cedar (*Cedrus libani*), black pine (*Pinus nigra*), fir (*Abies cilicica* subsp. *isaurica*), cedar and sub-alpine vegetations where varying from 200 m to 2500 m (Table 1). In addition to direct observations, pellets and footprints of wild goats were fairly found in these areas. Since wild goats used all these habitats throughout the year, any seasonal difference of vegetation preference was not observed. It was determined that wild goats used all of the eight habitat types and they spend most of their time on rocky steep places. 90 % of pellets and footprints were found at the slopes with more than 30° angle.

Table 1. Vegetations where wild goats were observed.

Habitat	Area	Altitude (m)
Maquis	Termessos-Düzlerçamı and Köprülü Canyon	200-1265
Turkish pine	Köprülü Canyon and Termessos-Düzlerçamı	400-1200
Juniper	Köprülü Canyon	600-1500
Juniper mixed cedar	Köprülü Canyon	600-1500
Black pine	Köprülü Canyon	1100-1500
Fir	Köprülü Canyon	1300-2000
Cedar	Köprülü Canyon	1400-1800
Sub-alpine	Köprülü Canyon	1700-2500

### Feeding Preference and Feeding Behavior

Wild goats were observed while they were feeding within those eight habitat types. Wild goats were not very selective about food; they preferred green

herbs and fresh buds of trees and bushes which contain more water. However local hunters stated that under harsh conditions like hot summers and cold winters when food resources are limited, wild goats fed on leaves of coniferous trees and barks of green trees as well. National park officers, local hunters and villagers stated that wild goats especially search for hyacinth (*Muscari* spp.), a geophyte with narcotic feature.

Feeding behavior of wild goats in eight different habitats was similar. Most of wild goats (89% of observations) preferred to browse before 11:00 a.m. and after 4:00 p.m. in summer, but after 13:00 p.m. until sunset in winters. Rest of the day observations are rare (11% of observations). Wild goat individuals usually fed with their herds and kept a distance that they can see each other. One of the adult goats in herd acted as "watcher" when others feed. Watchers did not feed and watched the area for any possible threat in higher places such as top of hills or big rocks. The watchers changed in every few hours. It was observed that one of watchers were the dominant male of the herds. Local hunters and villagers stated that some of the old males fed alone at nights except rutting season.

### Interactions of Wild Goat with Other Wildlife Species

Both of the study areas did not contain any large carnivore mammal killing an adult wild goat. According to local hunters, only possible predators of yearlings were griffon vulture (*Gyps fulvus*) and eagle (*Aquila heliaca*)

Wild boar and red deer were only wild herbivores which could compete with wild goat for food or habitats. Wild boar (*Sus scrofa*) lived in Köprülü Canyon Area and Termessos-Düzlerçamı Area and their tracks found abundantly. But there was no census record. There is a small Red deer (*Cervus elaphus*) population in Termessos-Düzlerçamı Area

with less than forty individual. Both species were not observed with wild goat in the same location and time during the study.

There is huge domestic goat population (22.000 individual) in Köprülü Canyon Area [13]. It is observed that wild goats evade close encounters with domestic goats.

### Reproduction and Demography

The youngest females with at least a kid observed in this study were two-years old. The oldest observed female was more than ten-years old and had two kids. Most of the females had twins. Young males which were older than two years were not observed with their mothers. Although young males usually formed bachelor groups after leaving their mothers, females generally preferred to stay with female groups after reaching their maturity. These female groups possibly assembled by mothers, daughter and sisters.

Adult males observed lonely or in a bachelor group with other males until rutting season. They observed

with females at rutting season. In the rutting season, beards of males had more distinctive colors and hides are longer. At the beginning of rutting season, fights between males for females were observed. During these fights older males with bigger body and bigger horns had a great advantage and they could establish bigger herds. In this study the youngest male that can form a mating herd was four years old. When males lost fights against stronger males, two common behaviors were observed. First, he accepted a passive position in the herd. Passive males stayed with herd of stronger male but did not copulate with females. Second, he wandered alone or with other males who could not find female. In this study longest path travelled by a wanderer male was more than 20 km from Karadağ Mountain to Köprülü Canyon. It was observed that winner males had to protect their herds from other males.

Rutting season started in the middle of December in Köprülü Canyon Area and in the beginning of December in Termessos-Düzlerçamı Area. Most of the copulations occurred in the first two week of rutting season. Rutting season lasted for 30-40

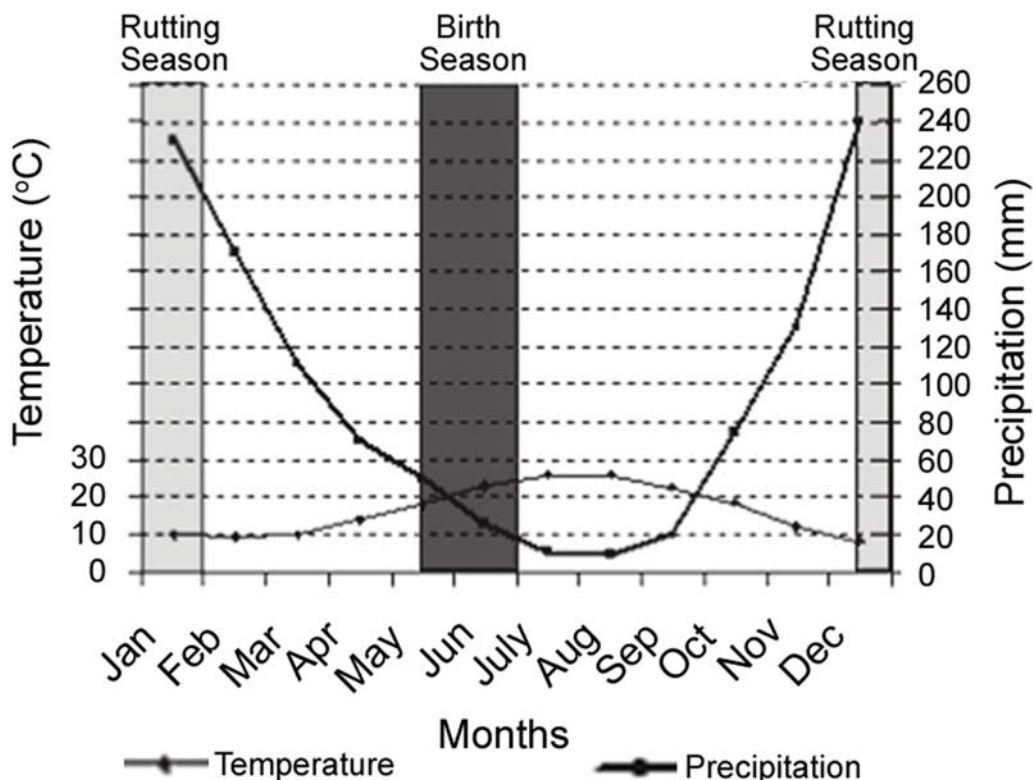


Figure 2. Rutting and birth seasons of wild goats in Köprülü Canyon Area and their relation with climate.



days, and ended when males left females. Pregnancy period took 5-5.5 months. The first births occurred in the middle of May in Köprülü Canyon and in the beginning of May in Termessos-Düzlerçamı. Because mothers hide their newborns in caves and under tick bushes, newborns could not be observed after births. Local hunters stated that two weeks old kids could move as well as their mothers and follow them to everywhere. The youngest kid observed in this study was three or four weeks old.

## DISCUSSION

Both sex ratios of populations in Köprülü Canyon Area and Termessos-Düzlerçamı Area were different than 1:1. Since Weinberg [19] stated that sex ratios of natural and un-harvested Caprinae populations are close to 1:1. Difference in sex ratio may mean anthropogenic disturbance. Hunters prefer to hunt adult male with more meat and bigger horns. This unequal hunting pressure decreases male number and results as biased sex ratio.

Four group patterns observed in the present study has already mentioned by Weinberg [19]. All groups are temporary and flexible, and they can combine with other groups or divide quickly. But forming of groups is not random; it is just beneficial [20]. Because of this flexible grouping, group size data are not valid in long term and not mentioned in this study. Mixed groups only form in rutting season and others form whole year. Males did not stay with females after rutting season, because they have to spend too much energy to protect their herds and rutting. According to the local hunters adult males lost one third of their body weights after rutting season but females do not. Males have to apart from females to gain their energy and weight before next rutting season.

It has been generally thought that the habitat of wild goat is steep mountainous regions [21] whereas wild goats were detected in eight different habitats with different altitudes in this study (Table 1). This result is not contrary with previous data about wild goat. But it emphasizes a different reason for habitat selection rather than altitude or food type which habitats can supply. All the areas where wild goats

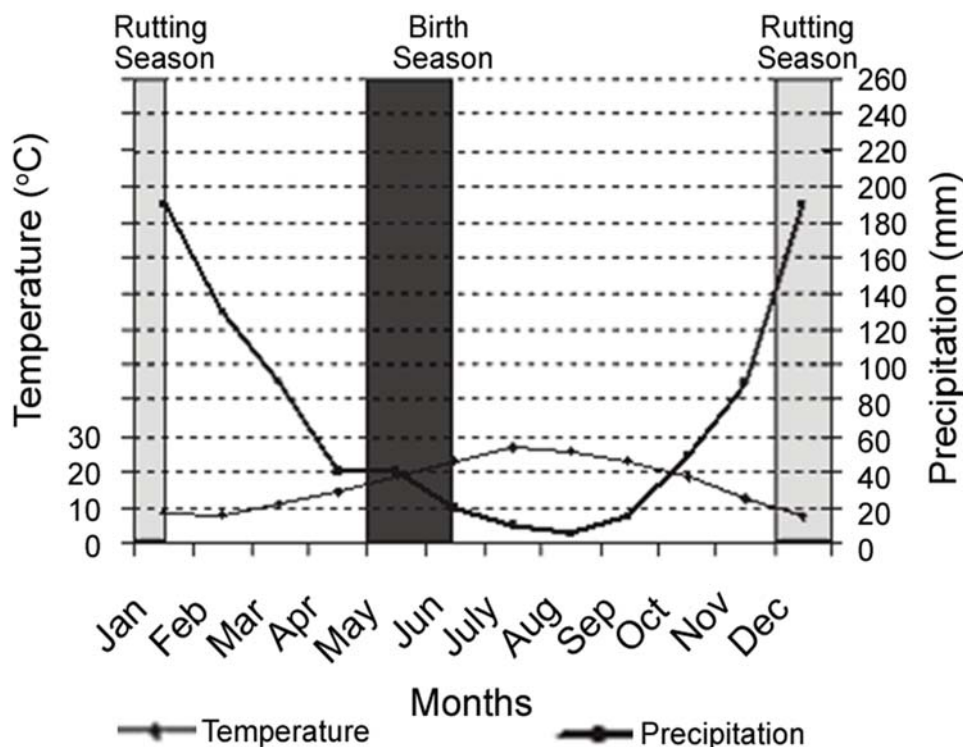


Figure 3. Rutting and birth seasons of wild goats in Termessos-Düzlerçamı Area and their relation with climate.

were detected are slopes more than 30 degree. The main factor that determines the choice of wild goats seems to be steepness. Wild goat morphology is very adapted for steep rock surface. They have rubber like hooves and very muscular legs. A wild goat prefers sloping and rocky areas where they can escape from their enemies. Singer J. Francis [22] called these areas as "escape terrain" and pointed that bighorn sheep need slopes from 27° to 85°. Watcher behavior during feeding is also a behavioral adaptation for sloping areas.

According to the observations of the present study wild goats are not completely restricted on a habitat for feeding. Wild goats can eat almost every possible plant even leaves of coniferous trees and barks of young trees. This wide range of food is probably one of the major reasons how wild goats can distribute in such a large extent in the world.

Feeding behavior of wild goats is a part of their adaptation to harsh environments. Although wild goats feed before 11:00 a.m. and after 4:00 pm. in summers to avoid hot weather, they delayed it to 13:00 p.m. until sunset in winter because of cold weather Wild goats ruminated rest of the day in shadows and hiding places. The short time of feeding and watcher behavior give more protection from predators also. There is not any official record about feeding preference of wild goat about hyacinth in Turkey. But hunters confirmed that this is a common behavior in many regions other than Antalya also.

Harrison [1] stated that wild goat has many natural enemies including leopards, bears, lynx, and wolves, and kids can be taken by eagles, jackals and foxes. In Turkey, there is not any record about leopard (*Panthera pardus tulliana*) for thirty years. In Antalya region, most of the local peoples in forest villages breed domestic goats and consider bears and wolves as danger for their domestic goats. Bear

and wolf populations are disappeared in study area because of hunting for more than twenty years. Lynx can hunt newborns and kids but their number was not enough to effect wild goat population. Jackal and caracal still exist in study area and Antalya but there is no information about their status. Foxes are abundant in study area. Jackal, caracal and fox are not big enough to hunt an adult wild goat. Any event or information can not find that this relatively little carnivores can hunt newborns or kids. Griffon vulture and eagles are possible hunters for newborns and kids but not adults. Weinberg [19] mentioned golden eagle and bearded vulture can attack yearlings too.

Due to National Park officers Red deer population in Termessos-Düzlerçamı Area was less than forty individuals and prefer plain areas to live, and wild boars have diurnal behavior and different feeding preferences, competition between red deer or wild boar and wild goat may not be expected.

Because of giving birth to twins from two years old to the end of their life, female wild goats have high reproductive ability. This ability was also recorded by other researchers [19,23]. Weinberg [19] noted that giving birth to singletons or twins is related to climate and vegetation. Harsh environments and cold winters are promoting singletons. Although in harsh winters twins have less chance to survive because they are smaller at birth and grow slower [19], mild Mediterranean winters of Antalya region with mean minimum 8°C allow twins to survive in winters.

Birth and rutting seasons of wild goat show difference all over the world (Table 2). There is two week difference in rutting and birth season between Köprülü Canyon Area and Termessos-Düzlerçamı Area. This difference is very significant, because two areas are very close to each other. Termessos-Düzlerçamı Area is relatively at lower altitude and

Table 2. Different rutting and birth seasons of wild goat all over the world.

Region	Rutting season	Birth season	References
Köprülü Canyon Area (Turkey)	Mid-Dec /Beginning of Feb.	Mid-June/July	This Study
Termessos-Düzlerçamı Area (Turkey)	Dec/Mid-Jan	May/Mid-July	This Study
Daghestan	Nov./Dec. Mid-Dec./Jan.	May./June, Mid-June/mid-July	Dinnik, 1910 [24], Weinberg, 2001 [19]
Chechnya	Mid-Dec./Beginning of Jan	-	Batkfflyev, 1989 [25]
Tushetia (Georgian part of Andi Koisu riverbasin)	Mid-Nov./Mid-Jan. (variable)	Mid-April/End of June (variable)	Ekvtimishvili, 1984 [26]
Caucasus Minor (Armenia and Azarbaijan)	Nov./Dec.	End of Apr/May	Dahl, 1984, [27] Kuliev, 1981 [28]
Koper-Dagh (Turkmenistan)	Nov./mid-Dec.	End of Mar. /Early May.	Korshunov, 1984 [29]
Sind (Pakistan)	Aug./Oct.	Jan./Apr.	Schaller, 1977 [30]

climate gets warmer earlier than Köprülü Canyon Area. Closeness and climatic difference between two areas shows that difference in birth and rutting seasons effected by climate not latitude or longitude. This difference is an adaptation for giving birth before drought season when food resources are limited, but after rainy season which is not suitable for newborns.

All ecological, morphological and behavioral characteristics of wild goat are merely adaptations for extreme climates and harsh conditions.

Although with the help of these adaptations wild goat has a very large distribution; anthropogenic pressure decreases population size and distribution area of wild goat in study areas and world. Sex ratios of wild goat in this study indicate that anthropogenic pressure effected population dynamics also. In order to evaluate exact results of human impact on wild goats and protect them, more study about their biology is necessary.

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