

# Sex-age structure of bovids in Ghameshlou, Central Iran

(Mammalia: Bovidae)

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**Abstract.** Ghameshlou National Park and Wildlife Refuge is home to three bovids, Goitered Gazelle, *Gazella subgutturosa* (Güldenstädt, 1780), Wild Sheep, *Ovis orientalis* (Gmelin, 1774), and Wild Goat, *Capra aegagrus* (Erzleben, 1777). These have been subject to predation by Grey Wolf, *Canis lupus* (Linnaeus, 1758), as well as to annual trophy hunting. In a demographic study between July 2007 and April 2009, we assessed the seasonal group size variation among the bovids and found that Goitered Gazelles have the largest groups in winter, while Wild Sheep form the largest groups in autumn. This difference is thought to be the result of patchily distributed, poor quality vegetation during the autumn and winter seasons, and the pursuit of different foraging strategies. Sex ratio was highly skewed toward females in Wild Sheep, but appears to be more balanced for the other two bovids. Twin lambs were encountered rarely in gazelles and Wild Sheep herds. Severe drought and wolf predation were considered to be the main causes of lower reproductive success in these two species compared to the Wild Goat. It is recommended that population parameters of the species should be monitored in order to predict potential demographic trends.

**Key words.** Population, Goitered Gazelle, Wild Sheep, Wild Goat, Iran, Middle East.

## Introduction

The Iranian plateau is home to four representatives of the family Bovidae (KARAMI et al. 2008), of which three occur in Ghameshlou Wildlife Refuge, central Iran: Goitered Gazelle *Gazella subgutturosa* (Güldenstädt, 1780), Isfahan Wild Sheep *Ovis orientalis isphahanica* (Nasonov, 1910) and Wild Goat *Capra aegagrus* (Erzleben, 1777). The latter two species represent the most numerous big game mammals in Iran (VALDEZ 1977). These species provide the main source of prey for predators, especially Persian Leopard *Panthera pardus saxicolor*, Asiatic Cheetah *Acinonyx jubatus venaticus*, and Grey Wolf *Canis lupus* (ZIAIE 2008, FARHADINIA & HEMAMI 2010). Meanwhile, these bovids are usually subject to legal exploitation in some habitats, including our study area, which is one of few reserves in the country where the hunting of Goitered Gazelles is sometimes permitted. Although they are still found within several reserves in Iran, little is currently known about their populations.

Detailed knowledge of local population dynamics is essential in the conservation and recovery of small wildlife populations (ENK et al. 2001). Estimating ungulates population parameters and determining causes of mortality are imperative for the proper management of preys and predators (ARYAL et al. 2010).

Meanwhile, Ghameshlou Wildlife Refuge where hosted this study has been receiving significant support from the government to promote wildlife conservation, particularly for game species, yet despite four decades of official protection, little scientific research has been conducted in the area.

The aim of this study has been to establish a scientific information baseline, for the three resident bovids, including Goitered Gazelle, Wild Sheep and Wild Goat in Ghameshlou National Park and Wildlife Refuge. We collected data on the ungulates to present a detailed perception of on their population parameters which can be used by managers and decision-makers for monitoring the game populations. Also, it is expected to provide a systematic perspective about some basic population parameters of abundant game species in Asia.

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## Study Area

With an area of 89,813 hectares, Ghameshlou National Park and Wildlife Refuge is located in north west of Isfahan (32°43'N, 50°52'E) near Najafabad, in Esfahan province. It is one of the oldest nature reserves in Iran designated as protected area in 1964, and promoted to National Park and Wildlife Refuge in 1975 (DARVISHSEFAT 2006). In 2009 the three core zones of the area were upgraded to national park. The altitude range from 1700 to 2700 meter a.s.l. and mean annual precipitation and temperature are 188 mm and 11.5°C respectively. The climate is temperate arid (DARVISHSEFAT 2006).

The vegetation comprises a number of bush species such as *Astragalus* spp. and *Artemisia sieberi* forming a bush-steppe habitat. Astragal and wormseed accompanied by pistache *Pistacia khinjuk*, almond *Amygdalus scoparia*, turk terebinth pistache *Pistacia alantica*, montpellier maple *Acer monspessulanum*, thistle *Cirsium* sp., camel's thorn *Alhaji persarum* and rhubarb *Rheum ribes* also are scattered in parts of the area.

Abundance of Esfahan Wild Sheep in the region is one of its characteristics. Other than Goitered Gazelle and Wild Goat, Ghameshlou National Park and Wildlife Refuge is inhabited by Hyaena *Hyaena hyaena*, Golden Jackal *Canis aureus* and Common Fox *Vulpes vulpes*. Moreover, Ghameshlou National Park and Wildlife Refuge is one of the best-known habitats of Grey Wolf in Iran with a rough estimate of 50-70 animals in the absence of other large hunting predators (ABDOLI et al., unpubl.).

## Methods

Field surveys were conducted between July 2007 and April 2009 in Ghameshlou Wildlife Refuge. Data for estimating population parameters were collected from direct sightings. Since existing trails in the area penetrate most mountainous terrain, it was not difficult to see Wild Sheep and Wild Goats from the vehicles. However, wherever possible, vantage points were climbed to get better sighting of the mountainous ungulates. The total length of 47 traversed transects was c. 259 km.

Transects were surveyed on vehicle or motorbike twice a month. Details of each sighted group were recorded name of species, herd size, sex/age structure, and location, normally using 12\*42 binoculars. Sex was determined based on presence/absence of horns for Goitered Gazelles and size and shape of horn for Wild Sheep and Wild Goat (ZIAIE 2008).

Twins predominate in all three bovids (Goitered Gazelle: KINGSWOOD & BLANK 1996; Wild Sheep: VALDEZ 1976; Wild Goat: ROBERTS 1966, ZIAIE 2008); therefore, in order to study animals' reproduction, we defined an index of female fecundity by counting the number of adult females and their accompanying lambs in each sighted herd. They are normally seen to give birth in May in the study area, so we comparatively recorded their lambs during their first summer in both 2007 and 2008. Since it is quite confusing to discern how many lambs are accompanying each ewe, only individuals within undisturbed groups were considered and since the bond between lambs and ewes is tight throughout the first months after lambing (as reported for mouflons by CIUCCI et al. 1988), any confusion over the lambs accompanying each mother was minimized. Moreover, we tried to capture most ungulate sightings using a digital zoom camera in order for later investigation on the computer and to determine single/twin lambs more accurately.

To assess if the sex ratio of either of the species is biased toward one sex chi-squared test was used. Group size variation between seasons was compared using ANOVA. Significance level was considered at 0.05 level in SPSS 17.0.

## Results

During field surveys, 7,467 bovids were sighted in Ghameshlou, of which Goitered Gazelles accounted for the largest proportion (69%), followed by Wild Sheep (29%), with a lower proportion of Wild Goats (less than 2%).

### Goitered Gazelle

A total of 5,170 Gazelles in 574 herds was recorded, of which 1,122 individuals were sexed. We counted 776 females and 346 males, giving a sex ratio of 31:69 for the Gazelles, which is significantly biased toward females ( $\chi^2=14.440$ ,  $df=1$ ,  $p\leq 0.001$ ).

The mean herd size of Gazelles was calculated as 9.1 (SE=0.57). Groups were smallest during spring ( $x=3.1$ , SE=0.28) largest in winter ( $x=15.51$ , SE=2.3); larger herds, even up to 150 animals, were also seen during winter (ANOVA=15.468,  $df=3$ ,  $p\leq 0.001$ ) (Fig. 1). During the first summer in 2 consecutive years, females in companion of lambs were recorded for a total of 170 times, mainly single lambs. Only 13% of sighted family groups consisted of twin lambs in 2007, but this figures decreased to zero for spring and summer 2008.

### Wild Sheep

During field surveys, 138 herds of Wild Sheep were recorded, consisting of 2,170 individuals. Out of 582 sexed individuals, 494 were ewes while the rest were to rams, and sex ratio was calculated as 15:85 ( $\chi^2=49.000$ ,  $df=1$ ,  $p=0.000$ ).

Mean herd size for Wild Sheep was 15.72 (SE=1.87), ranging from smallest in spring ( $x=5.64$ , SE=0.88) to largest in autumn ( $x=23.45$ , SE=5.05) (ANOVA=4.465,  $df=3$ ,  $p\leq 0.005$ ) (Fig. 2).

A majority of 66 family groups had only single lambs during their first summers (2007-2008) (90%,  $n=60$ ) and only 6 mothers were seen with twin lambs (4(2007) + 2(2008)).

### Wild Goat

Wild Goats comprised a small proportion of our observations, with no more than 127 sighted animals in 11 herds. Our small sample size included one large herd of 70 individuals; after exclusion of this exceptionally large herd, mean size of Wild Goat herds was calculated as 5.70 (SE=1.44). We successfully determined the sex of 66 animals, 26 males and 40 females, giving a sex ratio of 40:60, which no significant bias was seen ( $\chi^2=2.970$ ,  $df=1$ ,  $p=0.085$ ).

We sighted 22 mothers with their lamb(s) during summers, of which 73% ( $n=16$ ) had only one lamb, the rest twins. No lamb was seen in spring.

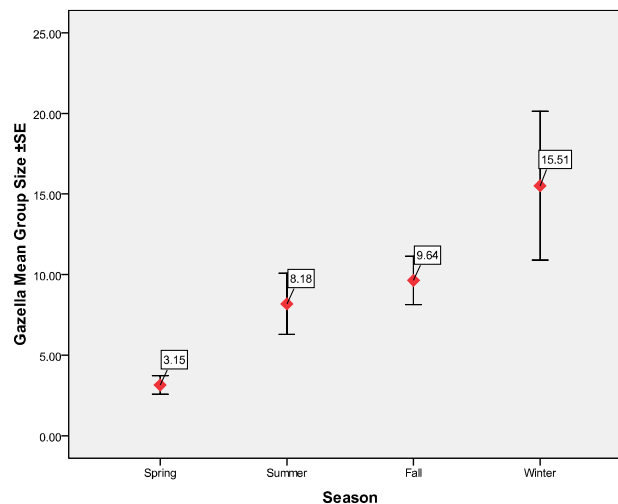


Fig. 1. Seasonal group size for Goitered Gazelles in Ghameshlou Wildlife Refuge.

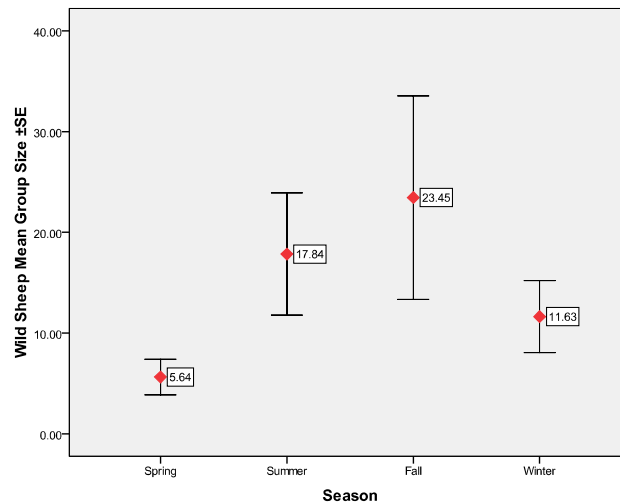


Fig. 2. Seasonal group size for Wild Sheep in Ghameshlou Wildlife Refuge.

## Discussion

The ungulates of Ghameshlou National Park and Wildlife Refuge show seasonal patterns of group size changes, from smallest in spring to large herds in late autumn and winter. The variation in group size may have been due to human presence, or to predation, or coinciding with the breeding season. In addition, group sizes may have been influenced by the distribution, quantity and quality of forage. It is shown that patchily distributed, poor quality vegetation cannot support large herds (WILSON 1981, EDGE & OLSON-EDGE 1990).

During ungulates parturition, which peaks from early May for Wild Sheep and Wild Goat to mid May for gazelles, females normally seek isolation in discrete areas for parturition in order to avoid any disturbance due to humans and predators (CIUCCI et al. 1998, BANGS et al. 2005, ZIAIE 2008). They may stay with their lambs in separation, and join the herd again after a few days (THORNE et al. 1979), a period which we find to be longer for the gazelles. Our results are in accordance with Watcher's aerial surveys of sand gazelles in Harrat al Harrah, Saudi Arabia, that large assemblies form during the winter months and small groups during the rest of the year (WATCHER, unpubl. report). The same seasonal variation in group size was reported for Wild Sheep and Wild Goat in Khojir National Park, Iran (SAFYAN-BOLDAJI 2001, TOHIDI 2001). Larger herds of Wild Sheep were mostly seen at lower elevations and even on the plains where most of water sources are located.

Unlike an earlier study, recording a predominance of twin lambs among Goitered Gazelles (KINGSWOOD & BLANK 1996), we witnessed only a small proportion of twins among the Gazelles decreasing to zero in the summer of 2008. In Miandasht Wildlife Refuge, northeastern Iran, 22% of mothers were seen to be accompanied by twins, while the rest had only one lamb based on a survey within four weeks of birth in 2010 (FARHADINIA et al., unpubl. report).

Little is known about the factors affecting litter size in Wild Sheep. In Esfahan Wild Sheep in Ghameshlou Wildlife Refuge, no more than 10% of ewes had twins accompanying them; it is naturally to be expected that since our sampling period for reproduction was 4 months after birth, a number of twin pairs would have been reduced to singles due to various mortality factors, given that lamb survival has been calculated to be only 55% for Punjab Urial *Ovis vignei punjabiensis* (AWAN et al. 2008), so a negative bias toward singles in our conclusion is highly probable. VALDEZ (1976) reported 40% twins

and one case of triplets; but his conclusion was based on examining fetuses after shooting pregnant ewes. In Punjab Urial, only 19% of births were of twins (AWAN et al. 2008). SCHALLER (1977) reported also twins in fewer than 10% of births at Pakistan.

The higher proportion of twins among Wild Goats compared to Wild Sheep and Goitered Gazelle could be an indication of high predation pressure on the latter two species. It has been reported that lambs of introduced mouflon in northern Italy appear to be particularly selected by wolves (CIUCCI 1994), and wolf scat analysis in the Ghameshlou National Park and Wildlife Refuge also indicates higher predation on Gazelle and Wild Sheep rather than Wild Goat (HOSSEINI-ZAVAREI et al., in prep.). However, it is highly probable that severe drought during our survey period, particularly in spring 2008 has been a cause of lower productivity of the bovids in our study area. It has been already discussed that meteorological factors correlate with breeding success in Goitered Gazelle (PERELADOVA et al. 1998) and Wild Goat (EDGE & OLSON-EDGE 1990).

Sex ratio is biased toward females in all species reaching to the highest level in the Wild Sheep. However, more investigation is needed to explore main reasons for considerable low proportion of females in the Wild Sheep population. For Marco Polo Sheep (*Ovis ammon polii*), Schaller and Aili (2008) recorded a male: female ratio of only 22:100 in China which this low number of males presumably indicated movement of males elsewhere. By contrast, the ratio was 55:100 in Tajikistan.

We recommend continued monitoring of population parameters in the game species in the Ghameshlou Wildlife Refuge, as these data can show population trends, which are of importance for effective conservation. Moreover, with respect to negative sex bias toward ewes in the Wild Sheeps, we recommend to revise hunting permits in Ghameshlou Wildlife Refuge. Meanwhile, if the population size of the Gazelles is monitored at least on a yearly basis, exploitation programs can perhaps be planned.

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## References

- ARYAL, A., S. GASTAUR, S. MENZEL, T. B. CHHETRI & J. B. HOPKINS (2010): Estimation of blue Sheep population parameters in the Dhorpatan Hunting Reserve, Nepal. – *International Journal of Biodiversity and Conservation* 2: 51-55.
- AWAN, G. A., M. FESTA-BIANCHET & J. M. GAILLARD (2008): Early survival of Punjab urial. – *Canadian Journal of Zoology* 86: 394-399.
- BANGS, P. D., K. E. KUNKEL & Z. D. PARSONS (2005): Habitat use by desert bighorn Sheep during lambing. – *European Journal Wildlife Research* 51: 178-184.
- BLANK, D. A. (1998): Mating behavior of the Goitered Gazelle (*Gazella subgutturosa*). – *Mammalia* 62: 499-519.
- CIUCCI, P. (1994): Movimenti, attività e risorse del lupo (*Canis lupus*) in due aree dell'Appennino centro-settentrionale [In Italian]. – Ph.D. thesis, University of Rome, Roma.
- CIUCCI, P., L. BOITANI & S. RICCI (1998): Social pattern of mouflon (*Ovis gmelini*) in the northern Apennines (Italy). – *Mammalia* 62: 442-446.
- DARVISHSEFAT, A. A. (2006): Atlas of Protected Areas of Iran. – Iranian Department of the Environment, Tehran.
- ENK, T., H. PICTON & J. S. WILLIAMS (2001): Factors limiting a Bighorn Sheep population in Montana following a dieoff. – *Northwest Science* 75: 280-291.

- FARHADINIA, M. S. & M. R. HEMAMI (2010): Prey selection by the critically endangered Asiatic cheetah in central Iran. – *Journal of Natural History* 44: 1239-1249.
- KARAMI, M., M. R. HEMAMI & C. GROVES (2002): Taxonomy, distribution & ecology of the Gazelles in Iran. – *Zoology in Middle East* 26: 29-36.
- KINGSWOOD, S. C. & D. A. BLANK (1996): *Gazella subgutturosa*. – Mammalian species No. 518. American Society of Mammalogists.
- PRELADOVA, O. B., K. BAHLOUL, A. J. SEMPÉRÉ, N. V. SOLDATOVA, U. M. SCHADILOV & V. E. PRISIADZNUK (1998): Influence of environmental factors on a population of goitred Gazelles (*Gazella subgutturosa subgutturosa* Gldenstaedt, 1780) in semi-wild conditions in an arid environment: a preliminary study. – *Journal of Arid Environments* 39: 577-591.
- SAFYAN-BOLDAJI, P. (2001): Population dynamic of Wild Sheep (*Ovis orientalis orientalis*) in Khojir national park. – Master thesis, Faculty of Natural Resources, University of Tehran.
- SCHALLER, G. B. (1977): Mountain monarchs-Wild Sheep and Goats of the Himalaya. – University of Chicago Press, Chicago.
- SCHALLER, G. B. & A. KANG (2008): Status of Marco Polo Sheep *Ovis ammon polii* in China and adjacent countries: conservation of a vulnerable subspecies. – *Oryx* 42: 100-106
- THORNE, E. T., G. BUTLER, T. VARCALLI, K. BECKER & S. HAYDEN-WING (1979): The status, mortality, and response to management of the bighorn Sheep of Whiskey Mountain. – Wildlife Technical Report No. 7, Wyoming Game and Fish Department, Cheyenne.
- TOHIDI, M. (2001): Population dynamics of Wild Goat (*Capra aegagrus*) in Khojir National Park. – Master thesis, Faculty of Natural Resources, University of Tehran.
- VALDEZ, R. (1977): Weights and measurements of Wild Sheep and Wild Goats. – *Journal of Wildlife Management* 41: 592-594.
- WILSON, P. N. (1981): Ecology and habitat utilization of blue Sheep (*Pseudois nayaur*) in Nepal. – *Biological Conservation* 21: 55-74.
- ZIAIE, H. (2008): A field guide to the mammals of Iran, Iranian Department of the Environment.

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