Short Communication

Population Dynamics of *Ovis ammon gmelini* in Khan-Gormaz Protected Area in Iran

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ABSTRACT

In this paper, demography of the *Ovis ammon gmelini* colony inside the Khan-Gormaz protected area has been analyzed. Starting from 2003, *O. ammon gmelini* counts have been carried out, usually twice in year by the wardens. The population increased regularly from 65 animals in 2003 to 125 animals in 2008, with mean annual growth rate of 29%. The sex ratio showed a constant tendency to be balanced throughout the study period and ranged from 0.7 to 1.8. Mean yearly natality was 0.2, but there were great fluctuations, with a minimum value of 0.29 and maximum 0.64. Natality was inversely correlated with the total number of animals counted in the previous year. The relationships between, Mean temperature, Mean moisture, Density and Growth rate were nonlinear. © 2010 Friends Science Publishers

Key Words: *Ovis ammon gmelini;* Population dynamics

INTRODUCTION

Population growth and the resultant human activities have been viewed as generating pressures to the natural resource base and environments. Animal populations is influenced by extrinsic factors (e.g., weather) and intrinsic factors (e.g., population density) acting on birth and death rates (Mary *et al*., 2005). Therefore the study of how both weather and population density influence primary population parameters is a central focus of ecology. Density-dependent influences on fecundity have long been believed to have a regulatory effect on fluctuations in animal populations (Royma, 1992). Also ecologists are increasingly using data from long-term studies of animal populations to investigate the relative importance of intrinsic and extrinsic factors on population dynamics (Arcese *et al*., 1992; Mary *et al*., 2005). Population growth rate is the summary parameter of trends in population density or abundance. It tells us whether density and abundance are increasing, stable or decreasing and how fast they are changing. Understanding the effect of environmental conditions and density on individual heterogeneity in demographic rates is critically important, because any differential impact on individuals will affect population structure, with important consequences for population dynamics (Coulson *et al*., 2001; Benton *et al*., 2006). Thus there is evidence of intrinsic and extrinsic influences on reproductive performance.

Population growth rate is typically estimated using either census data over time or from demographic (fecundity & survival) data. Census data are analyzed by the linear regression of the natural logarithms of abundance over time and demographic data using the Euler–Lotka equation (Caughley, 1977; Hone and Clutton-Brock, 2007).

Population growth rate can also be seen as the key unifying concept in ecotoxicology (Walker *et al.,* 2001). Thus pollutants can be defined as environmental chemicals that exceed normal background levels and have the potential to adversely affect birth, growth or mortality rates with consequent reduction in population growth rate. There is growing concern over the impacts of climate change on animal species. The remarkable number of the world's ecological regions including variety of habitats in Iran of fauna and flora. *Ovis ammon gmelini* is a large mountain sheep inhabiting the mountains, steppecovered valleys and rocky outcrops of Iran and neighboring countries. However, *O. ammon gmelini* are rare and vulnerable to numerous human-related threats. *O. ammon gmelini* is categorized as vulnerable on the 2000 IUCN Red List (Hilton-Taylor, 2000).

In this paper, data available on the demography of the *O. ammon gmelini* inside the protected area have been analyzed to evaluate the effects of population density and weather on population dynamics.

MATERIALS AND METHODS

Study area: Khan-Gormaz Protected Area with 5000 hectares surface area is situated between 34º35′ and 34º40′ northern latitudes and 48º10′ and 48º15′ eastern longitudes, with an altitude ranging from 1580 to 2853 m on southern highlands of Hamadan Province. Because of high diversity

of wildlife and diverse habitats and landscapes, aimed at protecting Armenian sheep and wild goat, this region was designated protected area in 2001. Diverse topography, deep inaccessible valleys and vertical cliffs are among the fascinating landscapes and physical structures of the area. Formation of almost all of the high mountains of the area can be attributed geologically to Jurassic era. According to available data means annual precipitation and temperature of 400mm and 9ºC, respectively have resulted in a semi-arid climate in the area.

Starting from 2003, counts of sheep within the protected area have been carried out the area wardens. Counts are made at least once a year, usually twice: in spring and winter. During the censuses the size and the structure of the population were determined by direct observations (Observations were conducted using 8×40 binoculars). We analysed the dynamics of *O. ammon gmelini* populations using regression. We used the highest value of the yearly censuses for the abundance analysis. The mean annual growth (or decrease) rate between periods was calculated using the compound increase formula (Fre, 1989).

Growth rate= $(\sqrt{N_{i+n}/N_i}-1) \times 100$

Where N_i is the number of individuals counted in the year I and N_{i+n} is the number of the individuals counted after n years. The natality (lambs/females ratio) was evaluated using the data from the spring censuses, when the differences in body size between lambs and yearling reduced the possibility of error in the discrimination between the two age classes. Regression was computed to evaluate the influence of weather conditions on demography parameters. Data on weather were obtained from a meteorological station located at Touyserkan town.

RESULTS

The *O. ammon* population increased regularly from 65 animals in 2003 to 125 animals in 2008. During this 6 year period the overall growth rate was of about 45% with a mean annual growth rate of 8%. After 2004 the population showed a negative trend, with a rapid decrease, especially in 2005, in this year only 34 animals were counted. The mean decrease was of about 50% than in 2004. The sex ratio showed a constant tendency to be balanced throughout the study period and ranged from 0.7 to 1.8 (Fig. 1). Mean yearly natality was 0.2, but there were great fluctuations, with a minimum value of 0.29 and maximum 0.64 (Fig. 2). Natality was inversely correlated with the total number of animals counted in the previous year. The relationships between, Mean temperature, Mean moisture, Density and Growth rate were nonlinear (Figs. 3-8).

DISCUSSION

There is an increasing recognition that environmental effects and density have a differential impact on

Fig. 1: Sex-ratio of the *Ovis ammon gmelini* population in the Khangormaz protected area
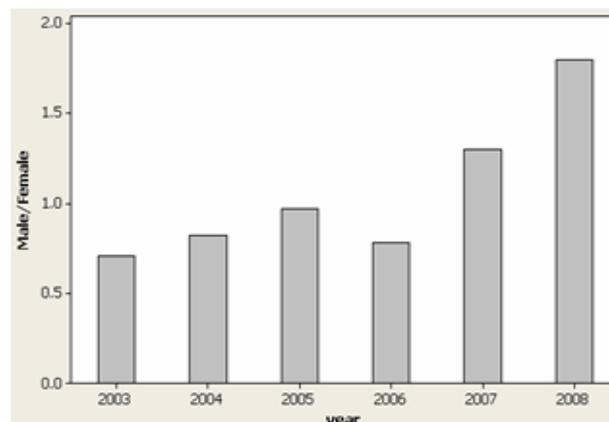

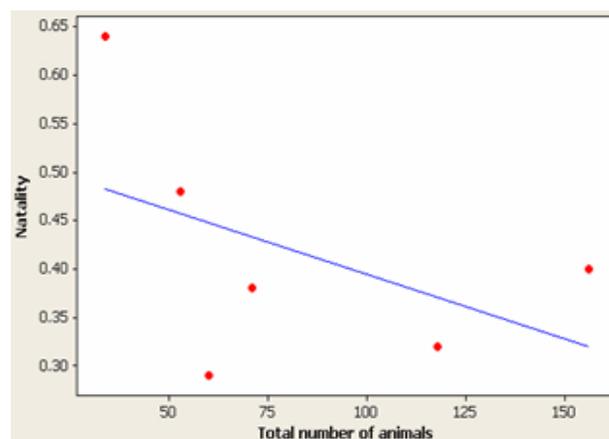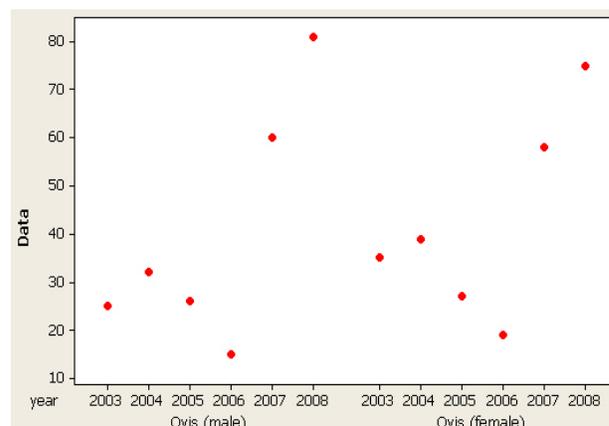**Fig. 2: Relation between natality (Lambs/Females ratio) and total number of animals**

Fig. 3: Male and female population trends in the Khangormaz protected area in 2003-2008

demographic rates of individuals of different ages, stages or qualities e.g., plants and animals.

Our central thesis is that population growth rate is the unifying variable linking the various facets of population

Fig. 4: The relationships between, Mean temperature, Mean moisture, Density and Growth rate in the Khangormaz
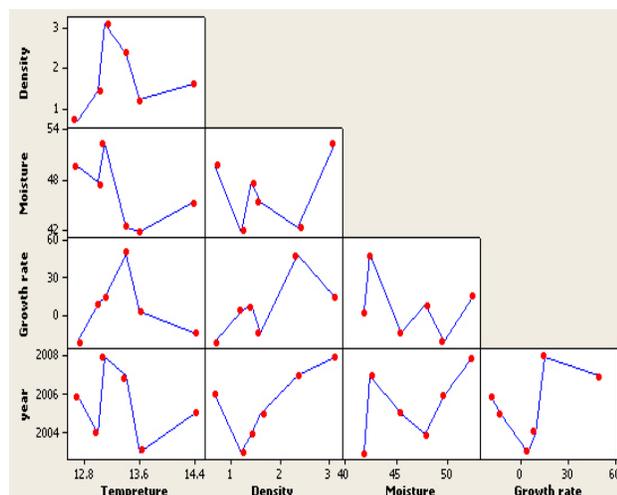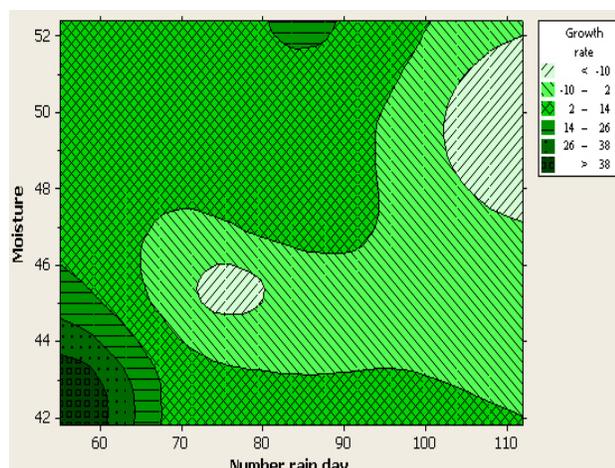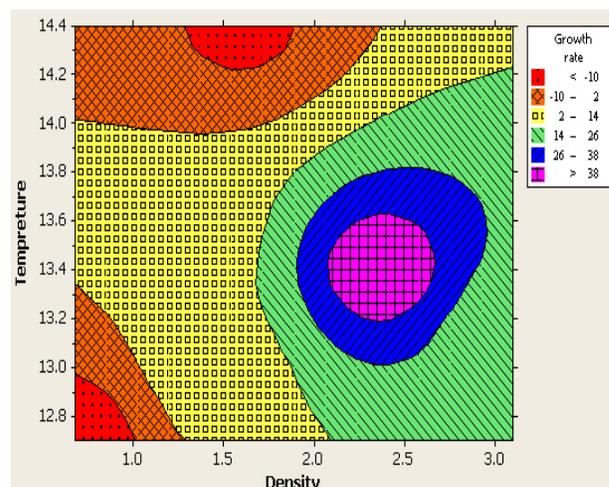

Fig. 5: The potential relationship between three variables moisture, number rain day and growth rate

Fig. 6: The potential relationship between three variables temperature, density and growth rate
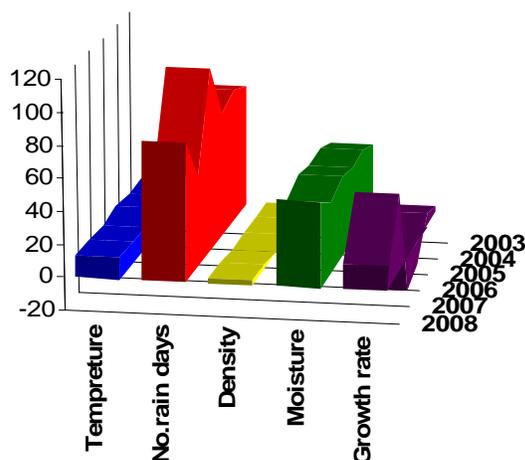

at that time to 25 animals a year. Although we did not found a significant correlation between the number of animals and weather conditions, we must point out that the influence of weather conditions on the demography of ungulates are probably evident only in situation with high density. The sex ration remained balanced thought the study period and did not change after the decrease phase. These results suggest that the decrease in the population was caused by a reduction in natality and lambs survival more than by adult mortality, in accordance with results found for other ungulates. Wolf predation and climatic factors may also be involved in the population dynamics of this species in the Khan-Gormaz protected area, but our data were probably not suitable to point out these effects. In order to completely understand the dynamics of this population, along term study on individually marked subjects would be required.

We conclude that population regulation, density dependence, resource and interference competition, the effects of environmental stress and the form of the ecological niche, are all best defined and analyzed in terms of population growth rate. Because so many factors affect population growth rate, it is never going to be easy to separate their effects when they operate simultaneously. Ecologists have used a variety of methods to study the combined and relative effects on population growth rate of determining factors. Without more active conservation management measures Khan-Gormaz risks further declines in species numbers and distribution including the imminent loss of several populations.

More active *O. ammon gmelini* conservation and management should be pursed. Perhaps the greatest challenges to conservation are poaching and competition with domestic livestock. Several authors have identified poaching as a major cause of *O. ammon gmelini* mortality even within protected area.

Some of the main plant species are nettle, sour cherry, mountain almond, astragal, thorn, barberry, thistle, *Ziziphora*,

ecology; thus analyses of population regulation, density dependence, resource and interference competition and the effects of environmental stress are all best undertaken with population growth rate as the response variable. During the 6 years period the *O. ammon gmelini* population in the Khan-Gormaz showed an opposite trend: an increase from 2003 to 2008 was followed by a rapid decrease. The demographic increasing occurred in the first phase, lead to an expansion of the area occupied by the spices. The seasonal pattern of space in the region population seems to be influenced by climatic factors and the seasonal distribution of feeding resources: animals migrated from the winter range located at the bottom of the valley, prevalently outside the protected area, to the summer range in the high altitude. A species population limitation plan, started by the Khan-Gormaz protected area in 2001, predicted a harvest equivalent to an annual increase (about 20%), corresponding

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Fig. 7: The relationship between five variables temperature, number rain day, density, moisture and growth rate
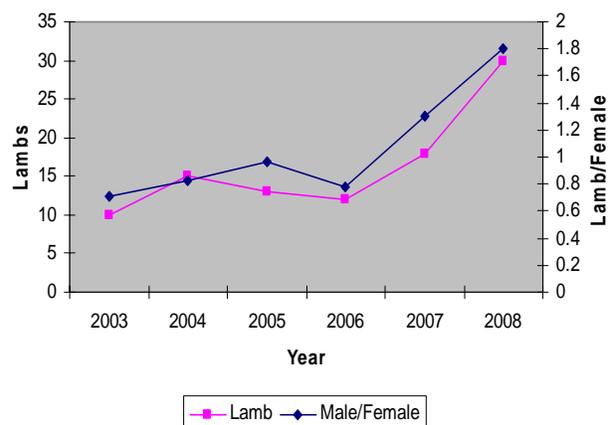

devils milk, carnation, sheep fescus, milfoil, dog rose, thyme, acanthofyllum and different species of Gramineae. The main animal species of the region include wild goat, Armenian sheep, wolf, striped, hyena, common fox, golden jackal, Indian crested porcupine, stone marten, golden, eagle, kestrel, sparrow hawk, hobby, black vulture, chukar partridge, see-see partridge, sandgrouse, stock dove, red-billed chough, bunting, rouck nuthatch, Mont-pellier snake, versicolored wood snake, agama, scorpion and tarantula. The presence of high biodiversity beautifule Bahrami and Lorestani caves and spring, eye-catching landscape of Takht sar cave and migratory birds, have encouraged research, educational and tourism activities in the region.

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Fig. 8: The relationship between number lambs to lamb/female ratio

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