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Pasture Management Relevant Behaviour of Yaks (*Bosgrunniens*)

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Key words: yaks; habitat behaviour, locomotion, grazing

Abstract

After a decline in yak populations in Central Asia, efforts have been made for several years to rebuild them. In that context, the ecological demands of the alpine landscape must be taken into account. The aim of the studies was to analyse the behaviour of yak cows in short time intervals and to deduce which sub-areas the yaks prefer more or less strongly, which altitudes in the mountains the animals visit in the course of a year, which distances they cover in summer and winter and which factors influence their grazing behaviour. The investigations were carried out on yaks in eastern Kyrgyzstan, Tian Shan Mountains. In three experimental years, 12 Yak cows were equipped with GPS receivers. The positions of the animals on the pastureland were recorded in an interval of 15 minutes. On this basis the home range as well as the walked distances, whereabouts and times (preferences) could be determined. The behaviour of the yaks depends on various factors, which are mainly related to the large grazing area: the variation in the yield of pasture, the different geographical conditions and the seasonal weather conditions. The investigations showed that the behaviour of the animals is strongly influenced by the seasons. This refers to the use of areas and altitudes as well as to movement behaviour. It was found that certain pastures are permanently more frequented than others are. The locomotion of the yaks is more pronounced in winter than in summer. This is because in winter the animals have to go long distances in search of food. Detailed knowledge of yak behaviour can help to improve pasture management in the high alpine region in order to use natural resources sustainably.

Introduction

Domesticated yaks are very well adapted to the environmental conditions of the high mountains and have been a part of this ecosystem for centuries. During the transition process in Central Asian countries, the number of yaks in the high mountains has been reduced. Government support is intended to increase the population again. In doing so, the ecological demands of the alpine landscape have to be taken into account. The aim of our research was to analyse the behaviour of yaks (*Bosgrunniens*) in herds in close temporal succession in order to learn how the animals use the grazing areas at different altitudes in the course of the year. We also determined what distances the animals cover in summer and winter. Furthermore, we investigated which factors influence the grazing process.

Methods and Study Site

The studies were conducted on yaks in eastern Kyrgyzstan; Tian Shan Mountains, Chon - Taldy Suu, 42°05'46.20 "N; 79°00'27.09 "E. A herd of 230 adult female yaks was available for habitat behaviour analysis and evaluation. We equipped 12 focal animals with GPS receivers in three experimental years. In the first and second year of the experiment, the animals were only equipped with GPS receivers in summer. In the third year, the yaks also wore the GPS receivers in winter. The selection of focal animals resulted both from the limited number of GPS - collars and from the fact that various authors have found in their studies that yaks graze close to each other (Belyaev 1980, Sambraus 1999, Wiener et al. 2003/06). This made it possible to describe the location of the herd with only a few animals equipped with GPS systems. The system recorded the positions of the animals at intervals of 15 min. The data processing and visualisation was done in the geographic information system (GIS) with the software ArcGIS 10.2 (ESRI). The tool Base map Service in ArcGIS served as the map basis. For the analysis and representation of the habitat behaviour, the home ranges of the yaks as well as the variance of the intensity of use of partial areas (kernel density estimation, Silverman 1986) within the grazing area were calculated. We recorded the grazing behaviour by manual and video-based observation. To determine the seasonal influence (weather and vegetation) on the behaviour of the yaks, we divided summer and winter into the following periods: S1: June 1 to 30; S2: July 1 to August 4; S3: August 5 to September 30; W1: October 1 to November 30; December 1 to March 31; W3: April 1 to May 31.

Results

Those yaks that were equipped with GPS receivers represented the respective location of the entire herd very well. We determined the home ranges of three focal animals on seven consecutive days and the inter-individual distances between them at 3 pm. The three yak cows formed average daily home ranges of 2.4 ha (0.6 - 9.6 ha) during this period. The mean inter - individual distance was 180 m (49 - 546 m).

The habitat behaviour of the yaks depends on several factors, mainly related to the large heterogeneous grazing area. The home ranges in summer, which were generated by the GPS data of the focus animals in the three study years, are almost congruent. They mark used grazing areas of 2329 ha in the first, 2123 ha in the second and 2078 ha in the third year. The home range following this year in winter had a size of 2166 ha. Within this large area, forage supply, geographical conditions and seasonal and local weather vary. The intensity of use of sub-areas determined with the help of the kernel density function shows that certain pasture areas are permanently more frequented than others are. The most heavily used pasture areas in the three summers had a size of 281 ha, 394 ha and 256 ha, respectively. Thus, their share of the total grazing area was 12%, 18% and 12%, respectively. In winter, yaks used about 8% (180ha) of the home range identified for this period most intensively. The main reason for the different intensity in land use is the local variance in vegetation due to soil quality, water supply and exposure of the different sub-areas. This results in considerable differences in the availability of pasture forage within the grazing area. Particularly heavy use of frequently visited areas can lead to soil degradation and erosion.

The yaks' preferences for altitude in the mountains change with the seasons. From the beginning to the middle of summer, the animals preferred to stay on pastures that are 3000 to 3400 m above sea level. This indicates that the animals prefer the higher and cooler areas when temperatures rise. At the end of the summer period, they again prefer the somewhat lower pastures (around 3000 m above sea level). The trend towards using lower-lying areas continues in winter. In the deepest winter (middle phase), they searched for food on areas near the herder's family home (2600 m above sealevel), where they are protected from predators at night in a yak corral.

We analysed the locomotion behaviour of the yaks based on the distances covered. The comparison of the distances covered in the winter and summer period's shows that the yak cows moved a total of 2334 km through the mountains between 1 October and 27 May of the following year. That are about 10 km per day. For the summer, we measured 540 km. That are 5.3 km per day. The differentiated consideration of the individual seasonal phases shows for the summer that in the early phase, the animals walk the least and later the distances continuously increase. A different picture emerges when looking at the distances travelled in the winter period. Here, the animals cover significantly longer distances. The middle phase from December to March is particularly noticeable because of the longer distances.

The grazing behaviour of the Yak cows was analysed in the summer periods by direct observations (7.00 a.m. - 7.00 p.m.). The duration of grazing was calculated as a proportion of time per hour of observation. In the early phase of the summer period, the animals grazed for an average of 42 min per hour during the observation. In the middle phase it was 33 min and at the end of the summer period 38 min. The diurnal distribution of the intensity of grazing is similar in the early and late phase. There are no pronounced minima and maxima. In total, the animals grazed for 9 h in the early phase and 8.2 h in the late phase. In contrast, in the middle phase there are different grazing activities evident in the diurnal cycle. Here, the animals alternate between shorter and longer periods when grazing. In the middle summer phase, the yaks were busy grazing for an average of 6.4 hours per day.

Discussion

The assumption that the yaks graze rest and move relatively close to each other in the herd was confirmed. In accordance with the results of other authors (Belayev 1980, Sambraus 1999, Wiener 2003/06), the animals remained in close contact with each other. Thus, it is possible to analyse the behaviour of the herd on the pasture with a few focus animals equipped with GPS - receivers. The yaks carrying GPS receivers marked the home ranges of the herd. The areas used in summer (2078 ha) and winter (2166 ha) were about the same size. The preference of sub-areas determined with the help of the kernel density function showed a large variance. The preference of plots varies during the year and it is mainly influenced by the plant yield. When calculating the grazing area requirements for a yak herd, the plot-specific variability of the forage supply must be taken into account. In our studies, the yak cows predominantly used only 12% to 18% of the total grazing area to cover their nutrient requirements in summer. In relatively warm weather, the animals prefer

areas near glaciers. Here it is cooler and there are no stinging insects. Kellner (1996) made similar findings. In winter, yaks prefer grazing areas on southern slopes. More intense sunlight and a thinner snow cover make it easier for the animals to find forage. In our investigations, we have found that the yaks cover significantly longer distances in winter than in summer. This is mainly due to the time-consuming search for food. For grazing in the vegetation period, the yaks spent about 53 - 70% of the duration of a light day. Buzzart et al. (2014) found in their studies that female wild yaks spent 68% of the observation time grazing. According to Wiener et al. (2003/06), grazing time varies between 34 and 80% of the time of a light day. In the summer period the yaks realised longer grazing times in the early and late phases than in the middle of the summer. Due to the restrictive nutrient supply in winter, the animals have lost body mass and there is a considerable nutrient demand for compensation and growth. Therefore, they eat long and intensively during the day. Later on (mid-summer phase), when the animals have met their compensation needs, they feed less and spend less time grazing. The lengthening of grazing times in the late summer phase is because food supply becomes scarcer again. These relationships have also been found by Luming et al. (2008), Wang et al. (2011), Ding et al. (2014). The studies should contribute to the knowledge about the site- and time-related behaviour of yak herds.

This research is a contribution to the development of pasture management systems that draw on information from remote sensing data, among other things. Moreover, this with the aim of using the existing natural resources of the high mountain pastures in an environmentally friendly and sustainable way.

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