Livestock and Small Mammal Grazing in the Mountain Steppe of Gobi Gurvan Saikhan National Park, Mongolia

Vroni Retzer and Karin Nadrowski

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Philipps-University of Marburg, Germany
Faculty of Geography
Working Group Prof. Miehe
retzer@staff.uni-marburg.de and karin.nadrowski@staff.uni-marburg.de

Summary

Mountain steppe vegetation in the Gobi-Gurvan-Saikhan National Park in South Gobi Aimag and it's usage by two grazer types, the small mammal pika (*Ochotona pallasi*) and livestock was studied from autumn 2000 to summer 2001 including the winter months. Vegetation within exclosures was clipped, pika were life trapped and body condition of sheep and goats was scored. First results show that pikas consume a considerable amount of biomass and can be considered to be a competitor for livestock in areas of high pika density. The data also show the different feeding strategies of both groups of animals. Adult pika maintain constant weight all year round by feeding on hay supplies in winter. In contrast to this the condition of sheep and goats is changing with the availability of food.

Introduction

The area of the Gobi Gurvan Saikhan National Park – like almost all suitable pasture in Mongolia – has been inhabited by nomadic herders for an unknown period of time. The vegetation growing inside the Park is the basis for this usage and is parallel the food resource for wild herbivores such as Khulan (Wild Ass), Wild Sheep, Ibex, and two species of gazelle, small mammals such as pikas and hamsters, birds and insects e.g. grasshoppers. Depending on densities, biomass, distribution and food preferences, everyone of these wild herbivores will compete more or less intensively with livestock for food. In the mountain steppe areas of the park pikas are the most abundant small mammal. They are generalist herbivores weighing about 200g. They are active all year round during the day and collect, dry and store plants for winter in and on their burrows. There are two species of pika in the National Park, the Mongolian Pika (*Ochotona pallasi*) and the Daurian Pika (*O. daurica*). The most abundant species in the region is the Mongolian Pika (*O. pallasi*). The interaction between pika, livestock and vegetation is investigated by a joint project of the Universities of Marburg and Halle (both Germany) and the Mongolian State University in Ulaanbaatar.

Study Site

The study site is situated in the Gobi Gurvan Saikhan National Park (Three Beauties National Park) in the South-Gobi-Aimag of Mongolia, about 500km south of Ulaanbaatar. The Three Beauties are the easternmost outcrops of the Gobi-Altai and reach maximal heights of 2800m within the park. Mountain steppe covers significant area within the park and is dominated by feathergrass and Allium species. Our study site lies on 2330m asl on the southern slope of the Dund Saikhan Mountain (Middle Beauty) on the pediment. It is grazed by horses, camel, cattle and occasionally yak all year round while sheep and goat reach it only in summer. About five herders have their usual summerplaces within 3km radius around the research station. At the study site pika density is high, as it is typical for the elevations between 2300m and 2600m in the Three Beauties.

Methods

Standing crop, regrowth of vegetation and consumption of plant biomass was assessed by clipping vegetation on 1m^2 plots within different types of exclosures. The following four variants were realised. 1) Access for neither livestock nor pika possible (combination of two wires), 2) Access for livestock possible and for pika impossible (low, narrow wire fence), 3) Access for livestock impossible but for pika possible (high, wide wire fence); and 4) Access for livestock and pika possible (no fence at all). Clipping was done almost monthly as low as possible (in approximately 3mm height) and subsequently dried over the ger stove until no further reduction in weight could be measured. Areas, which have been clipped once were only clipped again for regrowth measurements. Clipping data from August and September 2000 (Fig. 1-3) were collected from an unreplicated exclosure experiment while the data from September 2000 to May2001 (Fig. 4) represent the first results of a four times replicated exclosure experiment.

The data collected from August to September were used to balance usage of vegetation by livestock and pikas respectively. Pika forage could be further divided using harvesting, life catching and observation data (Fig. 2,3). The reduction of plant biomass from end of August to end of September on the plots with access of both, livestock and pikas (Fig. 1a,e, Fig. 3) was divided according to the proportional usage derived from the reduction of plant biomass on the other plots. For this the sum of reduction of biomass a) without grazing (Fig. 1a,b), b) with only livestock grazing (Fig. 1a,c), c) with only pika grazing (Fig. 1a,d) was calculated. Then the proportions of the single influences could be derived (Fig. 3). To estimate pika hay collecting activity six above ground hay piles and two below ground hay stocks were evaluated in autumn 2000. A representative sample of about 10% of the collected biomass was taken and dried. Pika average weight was recorded by life trapping, density by direct observation on a 100x100 m2 area (see below). Pika food requirement was calculated based on average weight, density and a standard equation for metabolised energy.

In order to assess the fitness of animals, body condition of always the same ten female goats and ten female sheep of one herd near the research station was estimated from end of November 2000 to June 2001 (Fig. 5). Body Condition Scoring is a method to evaluate livestock's condition by feeling the level of fat and muscling deposition over and around the vertebrate of the loin region (Thompson & Meyer, 2000). Scoring took place in irregular intervals.

Pika data are recorded through irregular trapping and observation sessions on a 100m x 100m grid using 121 Sherman-traps. Weight and age were recorded (Fig. 6). Pikas were marked individually to enable identification. During observation the whole investigation area was scanned thoroughly with binoculars. This was done from within a van in the middle of the investigation area to ensure that pikas do not see the observer. To calculate the total biomass of pika per hectare the average weight of pika was multiplied with the number of observed pika (Fig. 6). This was done separately for adult and juvenile individuals and afterwards both numbers are summed up.

Results

The data from the exclosure experiment from end of August to end of September 2000 (Fig. 1) show a reduction of biomass on all plots, also on the not grazed one. Still there was regrowth measured on the plot clipped at the beginning of the experiment. At the end of September the area to which both groups had access to has the lowest amount of biomass (91 kg/ha, Fig. 1e) while the one which was protected from any grazing showed the highest (128 kg/ha, Fig. 1b). Reduction of biomass without the influence of both livestock and pika was 45 kg (Fig. 1b). Biomass on the only-pika-plot was reduced by 31 kg/ha (Fig. 1d), on the only-livestock-plot by 5 kg/ha (Fig. 1c). The sum derived from these two exclosures is 36 kg/ha. On the plot accessible to both grazers biomass was reduced by 38 kg/ha.

Consumption of biomass estimated based on haypile weight and pika metabolic requirements amounts to 34 kg/ha (Fig. 2). 8 kg are stored below ground, 4,5 kg are metabolised and 4,5 kg are stored above ground during September. The balance of the above data (Fig. 3) assumes that the highest reduction of biomass takes place without the influence of grazers (>50%). Pikas represent the second important influence, with part of their foraged plants still available to livestock.

Livestock itself represents the least important influence on biomass reduction. About 98 kg/ha biomass are accessible for livestock at the end of September as standing plant biomass or pika foraged hay piles above ground.

Averaged values from the longer term exclosure experiment from September 00 until June 01 (Fig. 4) show that standing biomass is decreasing on all plots from September to about May and then increasing again. The highest biomass is found in the fences, which exclude both groups, and the lowest in the ones giving access to both. The two groups show different use of the vegetation during winter: Within the fences, which allow access only for pika, the standing aboveground biomass drops at the beginning of winter to a low level of about 40 kg/ha. It stays at this low level until regrowth starts in spring. The fences allowing access only for livestock on the other hand show a more slowly but steady decline in biomass and reach the low level of 40 kg/ha only at the end of May 2001.

Body condition of both assessed kind of small livestock, sheep and goats, decreases significantly and constantly during winter and early spring. Sheep always reach a bit higher scores than goats do, but this difference is not always significant. In contrast to this pikas don't show changes in weight during the whole period of observation (Fig. 6, about 200 g). The same could be observed for the total biomass of pika on 1 hectare (Fig. 6, above). The total biomass is quite constant around 5,75 kg/ha.

Discussion

For the balance from end of August until end of September 2000 the results from the unreplicated fencing experiment and those from pika assessment match surprisingly well. Not only the data within the fencing experiment, but also the comparison of the fencing experiment and the calculations based on pika density data do not differ much. Since the data come from two different approaches and is not replicated, a bigger error would be expected. The good match of the data may thus be misleading. It may also indicate that both methods can be used to give a good estimate of the real situation. Further analysis of the replicated experiments will help to evaluate the methods.

The considerable regrowth under grazing on the plot harvested already in August and again in September is not in accordance with the reduction in biomass observed in all four variants in the same time. If this growth also had taken place on the four variants, the values given in the balance would underestimate the drying out and consumption of pika and/or livestock. At this late stage in the vegetation period when plants are senescent it is very likely that the regrowth was primarily induced by the clipping and no equal amount of growth on the other four plots can be expected. For this reason and because the proportions of eaten biomass versus dried out biomass of the possible regrowth cannot be assessed, it was assumed that no regrowth has taken place on the four variants to calculate the balance (Fig. 3).

This balance reveals that a strong competition between pika and livestock is possible with pika removing more than six times as much biomass in September than livestock. But there are several indicators showing that pika's influence on the forage availability for livestock is not as strong: First the data for September extrapolated for the whole year would clearly overestimate the consumption of pika because September is the time of intensive plant collecting for winter. The biomass removed in September is therefore not only the biomass they consume during this time (1/4 is consumed immediately) but helps them to survive up to three winter months (3/4 are stored). Second about 50% of the available biomass at the end of August has disappeared until the end of September - probably it dried out and was blown away. This shows that had the pikas not removed any biomass in the meantime, also 50% of this would have been blown away. For livestock searching for food in the end of September it doesn't make a difference where the biomass has gone. Would pikas satisfy their needs for energy on the spot without accumulating supplies they would reduce the amount of food available in winter further. By collecting supplies they also prevented these supplies from being blown away. Pikas thus use the vegetation more effectively than livestock. Although pikas consume considerable quantities of the available vegetation, the competition between Pikas and livestock therefore is much smaller as might be judged from the data of September 00 alone. In areas densely populated by pikas – in the Gobi Gurvan Saikhan this is the mountainous region between 2300m and 2600m asl – the consumption by pikas may be equal to the consumption by livestock. Pikas may also enhance pasture quality by their burrowing activity. Observations by the authors show that pika burrows are more productive and grow earlier than the surrounding vegetation. Further analysis of data will clarify this point.

The different feeding strategies of both animal groups are supported by the longer-term data from the fencing experiments (Fig. 4). Although this data have a high standard deviation and the differences between the single variants are often not significant (not included in the graph) do they show trends in accordance with the other findings on the body condition of livestock (Fig. 5) and on pika weight (Fig. 6): Adult pika can sustain their body weight all year round by collecting hay supplies and feeding on them in winter. Winter is neither critical for the single individual nor for the population. The number of pika and parallel to this also the total biomass of pika on the investigation area remained constant through the winter months. Mortality seems to be surprisingly low in winter. A possible reason for this is the territoriality and the resulting territorial fights of pikas which lead to a high mortality of those individuals which cannot gain a territory/burrow in the late summer and autumn months. Further analysis of behavioural and capture-recapture data will be used to validate these findings.

In contrast to pikas livestock has to live on the fat gained in the previous summer and on the vegetation remaining during winter. For this reason livestock shows a dramatic loss in weight in winter (Fig. 5) and condition is worst at the end of spring (not shown). Judging from observations and interviews with herders also mortality is highest during this time.

The fact that sheep always show slightly better body condition scores than goats may be a methodological bias since the method used was developed for sheep and not for goats. Differences in morphology and fat deposition may lead to different scores in the two species. Possibly the difference also reflects the fact that sheep are not used for milk production and though remain in better condition

Acknowledgement

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Literature

Thompson J. M. and Meyer H., 2000, The body condition scoring of sheep, www.orst.edu\dept\animal-sciences\bcs.html

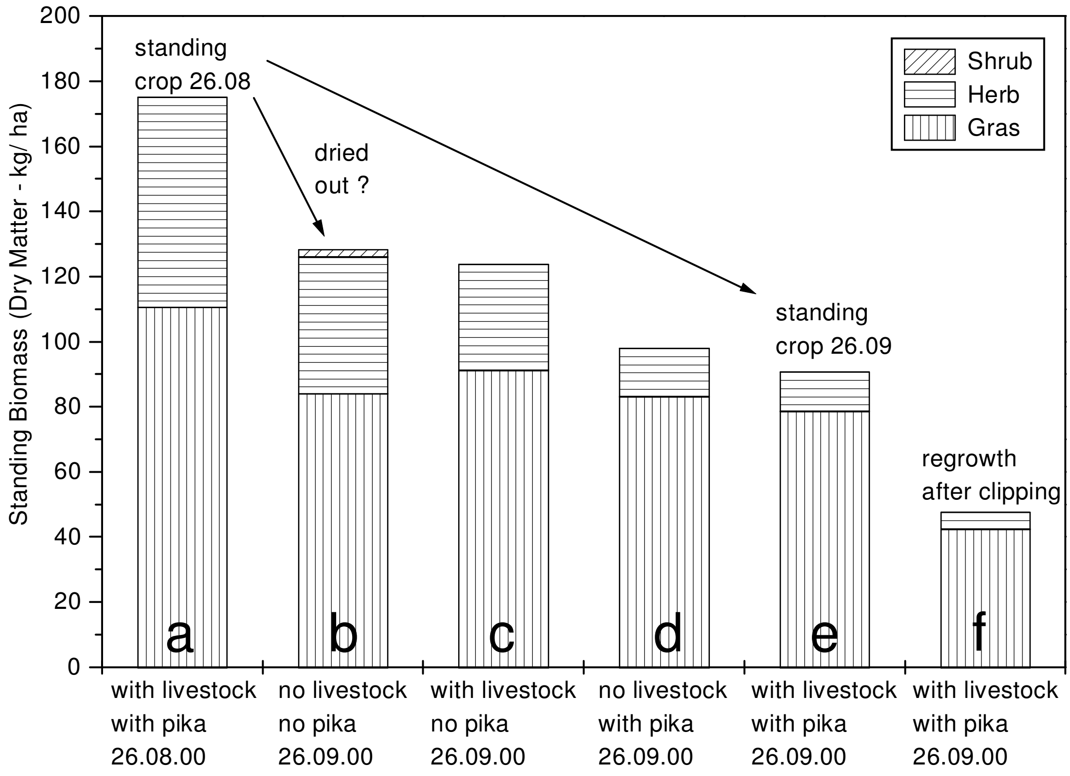

Figure 1: Use of vegetation by pikas and livestock respectively during September 2000. Pikas reduce biomass more than livestock in this month. Mark the difference between the situation of the end of August and the end of September in the not grazed plot, which cannot be explained by grazing. Biomass was probably reduced by wind and senescence.

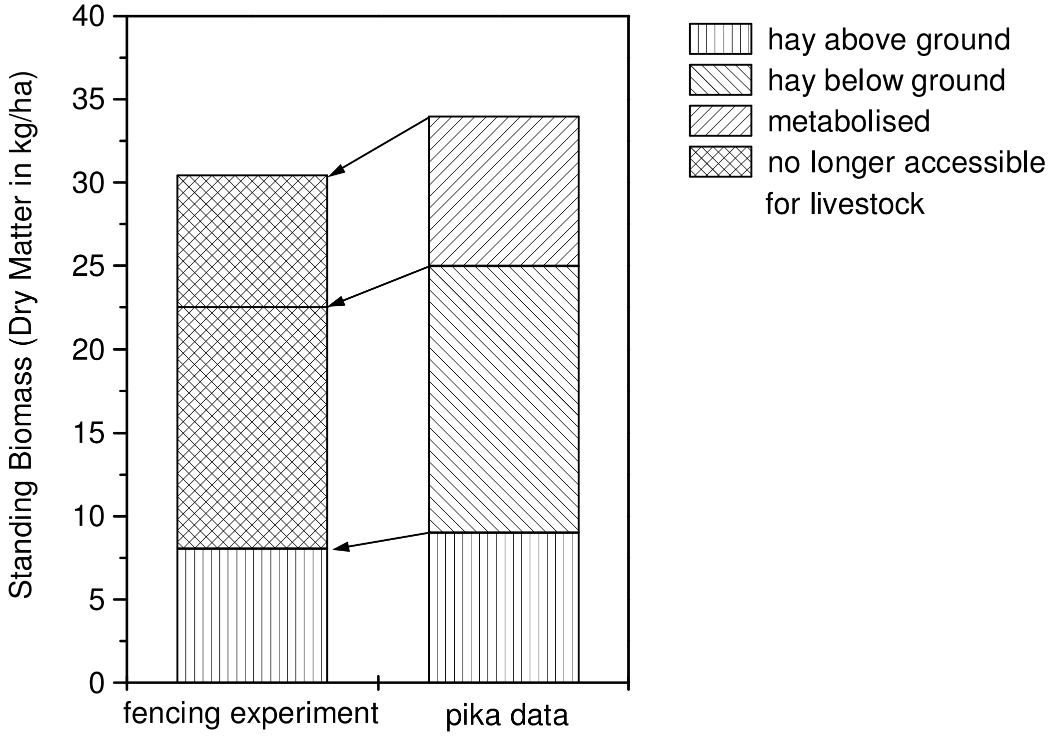

Figure 2: Amount of dry plant biomass collected by pikas measured in the fencing experiment compared to the collected biomass theoretically derived on the basis of haying activity and metabolised energy of pikas. Mark that both amounts do not differ much. The proportional usage of the collected plants was conferred to the experimental amount of collected plants. A small part of the biomass foraged by pikas is still accessible by livestock.

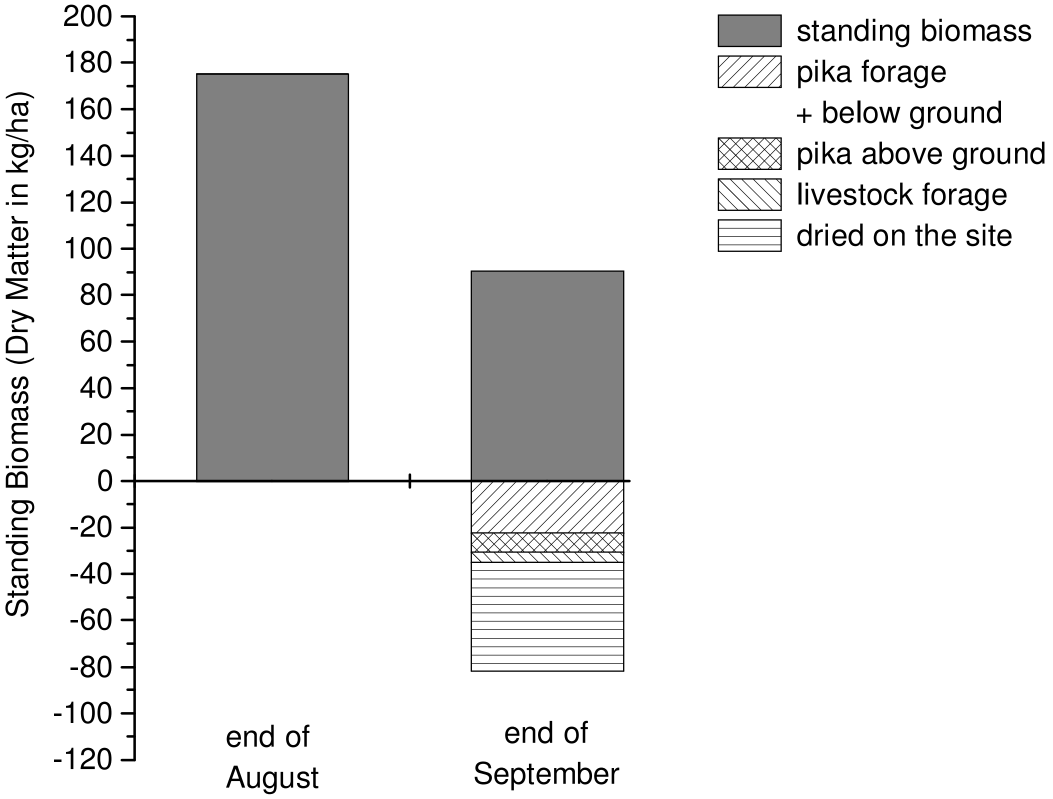

Figure 3: Balance for the period of time from end of August until end of September 2000. Available forage was reduced by about 50%, most of this was blown away, but the influence of pika is significant: they account for 1/3 of the removed biomass, which is still partially available for livestock in the form of above ground hay piles.

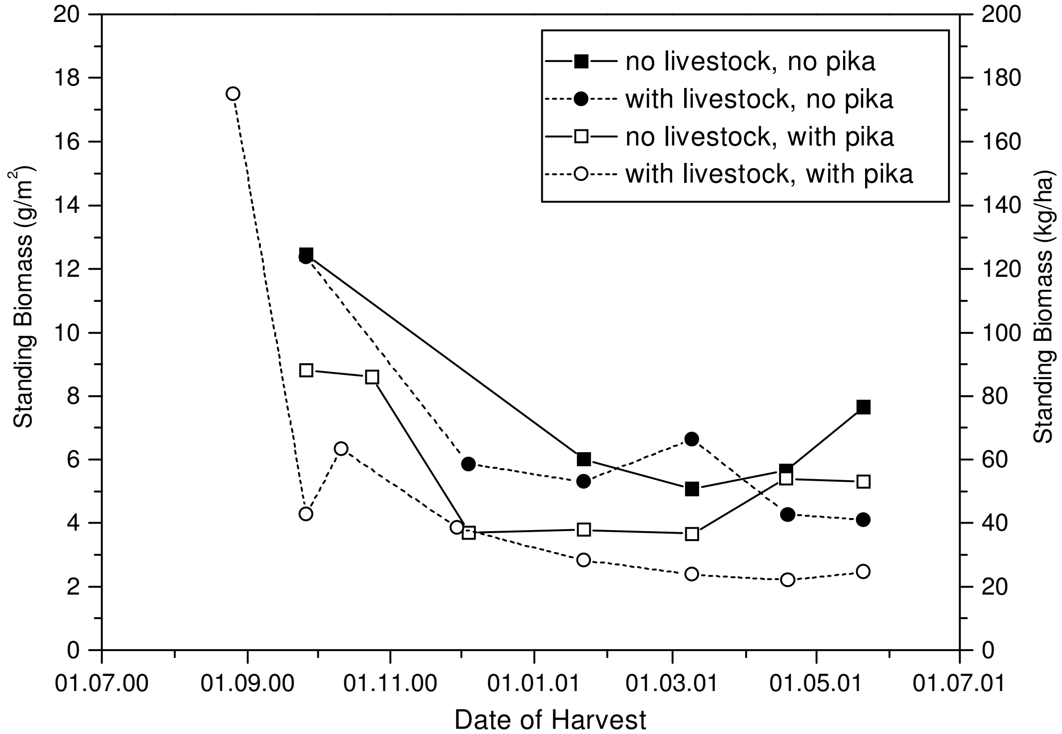

Figure 4: Standing aboveground biomass within the different variants of the fencing experiment from August 2000 until June 2001. The points are average values of 1 to 4 clipped square meters. Mark that the decrease of biomass on the pika plots is steeper in autumn than the decrease on the livestock plots. This reflects the different foraging strategies of the animals (see text).

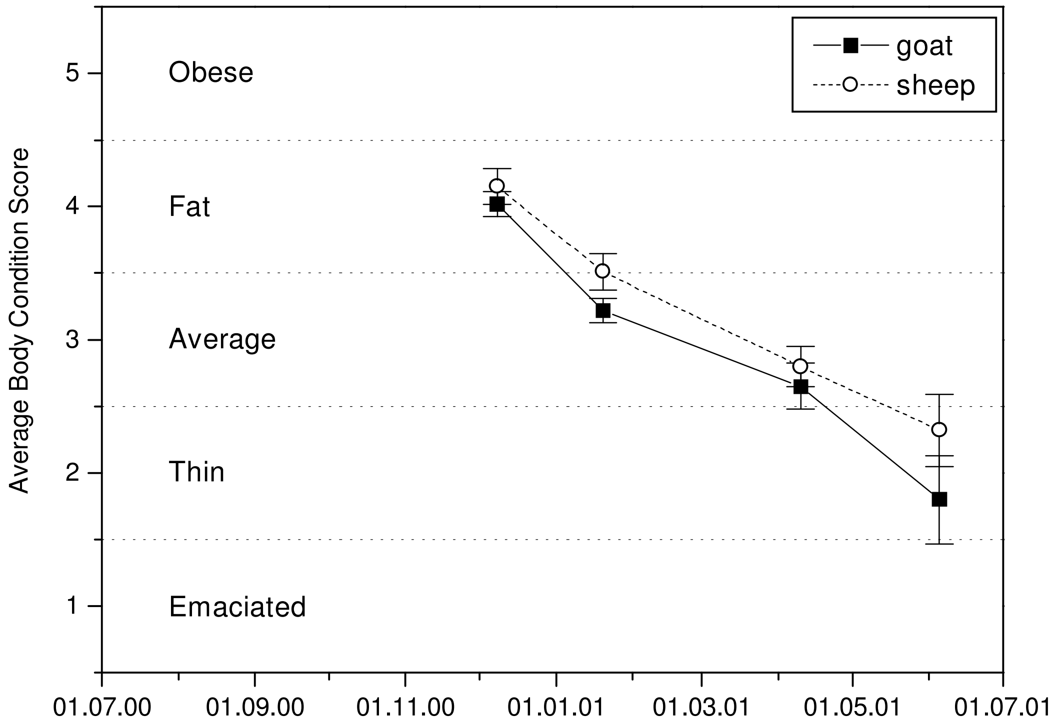

Figure 5: Average body condition score of ten sheep and ten goats near the research station. The average condition decreases from a fat condition at the beginning of December 2000 to thin condition at the beginning of June 2001.

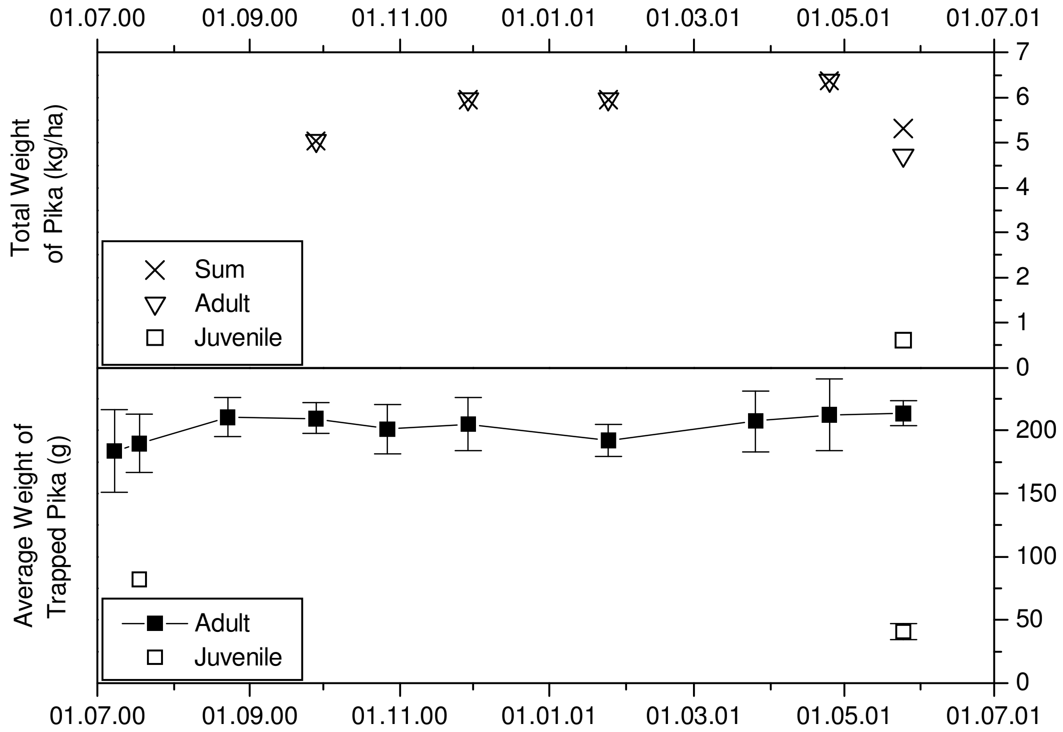

Figure 6: Biomass of pika on the 1ha investigation area (above) and their average weight (below). Data are given for juveniles, adults and total. Average weight as well as pika biomass per ha stays remarkably constant during winter.