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Original article

Effects of grazing forms on seasonal body weight changes of sheep and goats in north-central Mongolia: a comparison of nomadic and sedentary grazing

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Abstract

In order to evaluate the effects of concentration of livestock in villages in Mongolia, we compared the body weights of female sheep and goats of different management: a usual "nomadic herd" and an experimental "sedentary herd". The body weights of the sheep increased from June, peaked in November/December, and declined until March-May. During the decline, the sedentary herd lost more weight than the nomadic herd. In goats, the sedentary herd was heavier at the start in June, but was caught up by the nomadic herd in July. In March of the next year, the nomadic herd became heavier than the sedentary herd. The results showed apparent negative effects of sedentary grazing on body weight of sheep and goats, and suggest the validity of traditional nomadic grazing. It seems an example of traditional ecological knowledge to avoid deterioration of the steppe by overgrazing.

Key words: body weight, goat, Mongolia, nomadism, sedentary, sheep

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【Statement】

In October 2016, a paper bearing the authorship, title, and contents, respectively, completely or almost completely identical with those of the present paper was exposed at an internet site as an article of a different journal: for a few weeks it was kept open to public for free reference and downloading. The authors declare invalidity, and ethical and legal flaws of that act due to the complete absence of their consent or of their copyright waiver for the use of their work or any of its part in that way.

Introduction

The life style of Mongolian people is primarily grazing, which has been constant through the Middle age, during the period of socialism after the World War II, or after the regime change in the early 1990s. Through the long history, techniques and knowledge of grazing have been developed and accumulated. Fernandez-Gimenez (2000) termed it as traditional ecological knowledge (TEK). Some of TEK may be difficult to understand for those who are not familiar with the nature and history of Mongolia. It is not surprising that there are superstitions which should be improved. There are, however, misunderstanding of outsiders according to different values. For example, digging the land is primarily taboo for Mongolian,

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whereas it is no doubt the base of life for cultivation-based farmers. Thus old Chinese people sometimes thought Mongolian lazy because the latter do not cultivate their own land but "move" widely without staying at particular places. However, digging the land at arid environment often results in degradation. Therefore, the taboo not to dig lands by nomadic people is reasonable to avoid overuse of the land. It is therefore important to understand that "common senses" developed in a humid environment are not always adoptable in the arid environment. In order to avoid above-mentioned misunderstanding, it is necessary to test TEK by scientific approach. It is known that TEK is often ecologically appropriate and reasonable (Fernandez-Gimenez, 2000).

After the regime change in the early 1990s, long-distance nomadic grazing is becoming less common and many people concentrate to villages to stay and move livestock for shorter distances (Fernandez-Gimenez, 2002). Herders have become to feel reluctant to leave the high-quality camps, and they also prefer to camp close to district centers for trade commodities and social services (Fratkin and Means, 2003). This causes overgrazing and subsequent degradation of the steppe (Okayasu et al., 2007). Besides, together with climatic and social backgrounds, "dzuds" or severe winter disasters frequently occurred in the last decade (United Nations Office for the Coordination of Humanitarian Affairs, 2010). To minimize the damages of disasters, various approaches should be adopted including climatology, plant ecology, and livestock husbandry. In such approaches, scientific analyses of TEK seem useful and fruitful. For example, Fernandez-Gimenez (2000) surveyed TEK and perceptions of the herders in central Mongolia, and analyzed to conclude that an assessment of the ecological status and trends on the rangelands and a shared knowledge base including both scientific and traditional contributions should make a strong foundation for better pasture management.

We found that Mongolian nomadic pastoralists regard low-growing graminoids as "good forage plants", and tested this to find it reasonable because such graminoids are productive and contain high protein (Kakinuma et al., 2008). We also pointed out that the herders are often optimistic about overgrazing probably because they have not experienced such high density of livestock so far as is seen today. "Common senses" developed in a humid environment may recommend keeping livestock at a high stocking density in a limited place. This issue should be tested not only from the point of plant ecology but also from livestock condition. It is expected that nomadic grazing would afford good forages to livestock by keeping the grassland condition good and productive, while sedentary grazing would result in deterioration of the steppe and the livestock would be forced to utilize poor plants. Although it seems quite important to test this, no publish has been found so far. We report here two grazing options, the traditional nomadic herd and the experimental sedentary herd and its effect on the body weights of sheep and goats.

Materials and methods

1) Area studied

The study was done in Bulgan prefecture (Bulgan county, 48°48'N, 103°32'E) in northern Mongolia where the forest-steppe is prevailing (Fig. 1). The steppe are dominated by *Stipa krylovii*, *S. sibirica*, and *Elymus chinensis* while north-facing slopes are vegetated by larch woods. Bulgan county, a political and economic center, is populated by 12,010 people (2013, Mongol Statistic Office), but the population density in most of other areas is very low. People live in a "ger" or a yurt and often have summer and winter camping sites or more. The most abundant livestock are sheep, followed by goats. They are monitored by shepherds. Cattle and horses are also grazed near gers, but they are freely grazed.

Fig. 1. Location map of the study area, Bulgan.

2) Experimental design

By cooperation of local nomad families, we could choose herds of sheep and goats to graze widely in the steppe managed by shepherds ("nomadic" herd, hereafter) and those to stay at a low-growing grassland near a ger ("sedentary" herd, hereafter). The nomads chose 13 sheep and 10 goats as the nomadic herd, and 15 sheep and 14 goats as the sedentary

herd. Only adult female animals were used and young ones were excluded. All the animals were labeled, identified, and weighed on 15th of every month from June 2006 to December 2007 except for the nomadic sheep in May 2007. Animals were captured, four legs were tied by band, and put onto a balance to weigh. All the animals were freely grazed, and no supplementary feedings were afforded.

3) Statistical analysis

The body weights of the "nomadic" and "sedentary" herds of the sheep and the goats at the start (June 2006) were compared by Student's t-test. In order to show the effects of herding ("nomadic" or "sedentary"), the body weights at the start and those one year after the start (June 2007) were compared by the multiple t-test with Bonferroni correction.

Results

1) Sheep

The mean body weights of the sheep of nomadic and sedentary herds at the start were 34.9 kg and 36.8 kg, respectively, which were not different (P = 0.23, Fig. 2). Thereafter, both herds increased the body weights until November/December of 2006 and then declined. After December, the sheep lost body weight to decline to the bottom in March, 2007 and recovered from June (data were not available in May). After May, the sheep increased body weight. The mean body weight of the sedentary herd in June 2007 (35.5 kg), one year after the start, was not significantly different from that at the start (June 2006, 36.8 kg, P = 0.074). In contrast, the mean body weight of the nomadic herd in June of the second year (40.9 kg) was significantly heavier one year after the start (34.9 kg, P = 0.007). These results suggest that sedentary grazing of sheep negatively affects body weight.

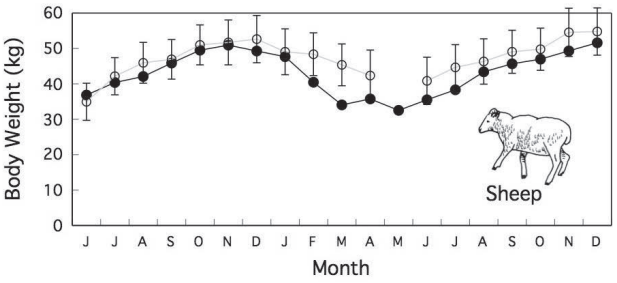

Fig. 2. Monthly changes (2006/2007) in sheep body weight of nomadic (open circle) and sedentary (solid circle) herds in northern Mongolia. Vertical lines stand for SD. Data of May 2007 of nomadic herd were not available.

2) Goats

In case of goats, the nomadic herd (28.3kg) was significantly lighter than the sedentary herd (30.6 kg, P = 0.007, Fig. 3) at the start. The nomadic herd caught up the sedentary herd as early as in July. Thereafter, the mean body weights of the two herds did not differ and increased to attain the maximum in October for the sedentary herd (39.5 kg) and in December for the nomadic herd (42.2 kg).

The mean body weight of the nomadic herd in June 2007 (32.0 kg), one year after the start, was significantly heavier (P = 0.016) than that at the start (28.3 kg), though that of the sedentary herd in June 2007 (28.8 kg) was not significantly different (P = 0.028) from that at the start (30.6 kg) in the sedentary herd.

These results also suggest that sedentary grazing negatively affects body weight for goats as well.

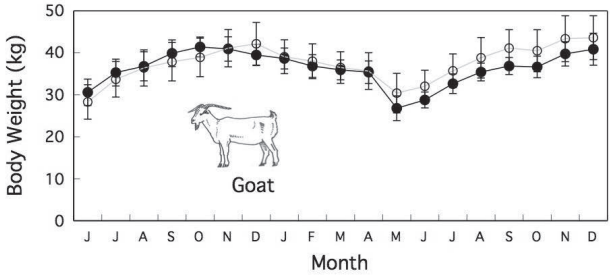

Fig. 3. Monthly changes (2006/2007) in goat body weight of nomadic (open circle) and sedentary (solid circle) herds in northern Mongolia. Vertical lines stand for SD.

Discussion

This "experiment" was not performed by a research organization but was carried out by cooperation of local nomad families living on livestock grazing. Because of this, there were inevitable restrictions. For example, we could not choose two goat herds of the same mean body weights at the start. Although the nomadic goat herd fortunately reached to and finally exceeded the body weights of the sedentary herd, it was better to calibrate the starting condition. Another restriction was the grazing method. We planned to "fix" the sedentary herd to a limited place. However, the nomadic people empirically judged the physical condition of the herd dangerous, and moved the herd to better swards. Therefore, the decline of the body weight of the sedentary herd was "moderated", and the evaluation of the differences is conservative.

Despite such noises, noteworthy results were obtained. One was the body weights of sheep

and goats continued to increase until November when plants withered. Although the mechanism is unknown, similar phenomena are known in wildlife (Riney, 1982), which is regarded as an adaptation for overwintering.

The nomadic sheep herd lost more weight during winter than the sedentary herd, but the loss was due to parturition, which was not directly related to nutritional condition. This should be confirmed by better calibration of the target animals. However, it is noteworthy that the nomadic herd was significantly heavier in at least three months in the second year. For goats, the nomadic herd was lighter at the start, but caught up the sedentary herd in July. The mean body weights were not different in winter. After May 2007, however, the nomadic herd was constantly heavier than the sedentary herd. It is likely that the difference in the second year would be greater if the sedentary herd was strictly fixed into the limited place. However, we did not ask the herder to do this strict grazing because it was expected that some livestock would die. The sedentary herd was significantly lighter during the recovering season from April, showing the negative effects of this grazing method.

Nomadic grazing functions to avoid overgrazing. Consequently it avoids reduction of biomass and floral diversity of the sward. After the plant growth season, however, it does not directly affect the plants, but removal of dead plants would affect the growth in the next growth season. Intensity of grazing would also affect plant growth through trampling and defecation which affect physically and chemically soils. Mongolian nomadic pastoralists often have both summer and winter ranges or even more for nomadic grazing (Fernandez-Gimenez, 2006). It is shown that the temperature during winter is less colder and wind is weaker at the winter range (Morinaga, unpubl.). Therefore, it is expected that such an environment would moderate heat loss of the livestock.

The results of the present study suggest that sedentary grazing contains some negative affect on livestock. This seems to be a good case study to test TEK of Mongolian nomad pastoralists by scientific approaches as Fernandez-Gimenez (2000) recommended.

Acknowledgments

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References

Fernandez-Gimenez, M.E. (2000) The role of Mongolian nomadic pastoralists' ecological knowledge in rangeland management. *Ecological Applications*, **10**, 1318–1326.

Fernandez-Gimenez, M.E. (2002) Spatial and Social boundaries and the paradox of pastoral land tenure: a case study from post socialist Mongolia. *Human Ecology*, **30**, 49–78.

Fernandez-Gimenez, M.E. (2006) Land use and land tenure in Mongolia: a brief history and current issues. *Rangelands of Central Asia: Proceedings of the Conference on Transformations, Issues, and Future Challenges*. Rocky Mountain Research Station Proceedings RMRS-P-39, USDA Forest Service, Fort Collins, Colorado, pp: 30–36.

Fratkin, E. and Means, R. (2003) Sustainability and pastoral livelihood: lessons from East African Maasai and Mongolia. *Human Organization*, **62**, 112–122.

Kakinuma, K., Ozaki, T., Takatsuki, S. and Chuluun, J. (2008) How pastoralists I Mongolia perceive vegetation changes caused by grazing. *Nomadic People*, **12**, 67–73.

Okayasu, T., Muto, T., Jamsran, U. and Takeuchi, K. (2007) Spatially heterogeneous impacts on rangeland after social system change in Mongolia. *Land Degradation and Development*, **18**, 555–566.

Riney, T. (1982) *Study and Management of Large Mammals*. John Wiley & Sons, Chichesterm, 552 p.

United Nations Office for the Coordination of Humanitarian Affairs (2010) *Mongolia Dzud Appeal 2010*. New York, 54 p.

モンゴル中北部のヒツジとヤギの体重におよぼす放牧法の影響－伝統的な遊牧と固定放牧の比較

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近年、モンゴルでは家畜の放牧密度が高くなったので、その影響を評価するために伝統的な放牧と実験的に家畜を固定する放牧がヒツジとヤギの体重におよぼす影響を評価した。ヒツジの体重は 6 月から増加を始め、11,12 月に最高値に達し、翌春にかけて減少した。この減少期に固定放牧のヒツジは遊牧のヒツジより軽くなった。ヤギは実験を開始した 6 月に固定群のほうがやや重かったが、7 月には遊牧群が固定群に追いつき、翌年の 3 月には固定群より重くなった。これらの結果は固定放牧がヒツジとヤギの体重増加に負の効果をもつことを示した。このことは伝統的な遊牧が有効であることを示唆する。これは草原が過放牧によって荒廃することを防ぐ伝統的な生態学的知識の一例と思われる。

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