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Grazing Impact on Plant Seed Production in Southern Mongolia

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Abstract

Nomadic livestock husbandry practices have a long history in Mongolia and still represent the main form of land use. Because of increasing livestock numbers, the danger of overgrazing and steppe degradation is on the rise. Nevertheless, studies on the influence of herbivores are rather rare in southern Mongolia and existing studies focus mainly on biomass production rather than on the consequences to reproduction of key steppe plants. We tested the effect of grazing by livestock and small mammals on the production and related seed abundance of three of the most dominant steppe plant species of the Mongolian desert steppes: *Agropyron cristatum*, *Stipa krylovii* and *Artemisia frigida*. The fieldwork took place in summer 2006 in the Gobi Gurvan Saykhan National Park, during which we estimated the extent of granivory and compared the abundance of inflorescences on grazed/ungrazed sites and the harvesting preferences of small mammals. Herbivory has a tremendous impact on flower and, subsequently, seed production of the three studied species. Flowers and fruits are browsed at levels of up to 100%. However, grazing pressure is plant-specific; both livestock and small mammals have feeding preferences, and pikas (*Ochotona pallasi*) prefer taxa such as *Stipa* spp. Granivory, in contrast does not seem to play any role for the three studied species growing in the southern Mongolian steppes.

Key words: *Agropyron cristatum*, *Artemisia frigida*, grazing, livestock, Mongolia, *Ochotona pallasi*, *Stipa krylovii*

Introduction

In natural grasslands herbivores play a key role because of their impact on the structural and functional elements of the ecosystem (McNaughton, 1985; Whicker & Detling, 1988). Large populations of livestock, such as bison in North America or zebras on the African savannas (Frank *et al.*, 1998), consume more than 50% of the aboveground phytomass. A second important mammal group in the world's drylands is the small mammals (Kinlaw, 1999). In Mongolia, rodents and lagomorphs (mainly *Ochotona* spp.) are widespread in all types of steppe. Their impact on the vegetation is pronounced, as their burrowing activity affects large areas (Zielinski, 1982; Samjaa *et al.*, 2000; Wesche *et al.*, 2007) making them important ecosystem engineers (Jones *et al.*, 1994). Small mammals have largely similar food requirements as larger ungulates and compete with livestock for fodder sources (Retzer, 2007).

In central Asia, some studies analyzed grazing effects by means of assessing the loss of biomass (Zhao *et al.*, 2004; van Staalduinen, 2005), the development of new plant communities (Li *et al.*, 2006), or the change of soil parameters (Su *et al.*, 2003; Schneider *et al.*, 2005; Stumpp *et al.*, 2005; Pei *et al.*, 2006). The impact of herbivores on plant reproductive cycles has hardly been studied, and effects on flowers and seeds are largely unknown. We analyzed the influence of livestock and small mammals on the three dominant desert steppe species, *Agropyron cristatum*, *Stipa krylovii* and *Artemisia frigida*. Specifically, we addressed the following questions:

- How is seed production influenced by grazing?
- Do small mammals favour certain plant species?
- Do herbivores harvest seeds of the three studied species as a fodder source?

Material and Methods

Study area and selected species. The field experiments were performed in the Gobi Gurvan Saykhan National Park in southern Mongolia in 2006. This park was designated in the 1990's,

but in spite of its protection status virtually all suitable sites are grazed by domestic livestock. In the study area (southern Dund Saykhan, 43°36.95' N, 103°46.45'E, 2300 m asl.), goats and sheep by far outnumber other livestock, and together with horses, they account for more than two-thirds of the grazing pressure exerted by larger mammals; other livestock species and wild ungulates are of minor importance (Retzer *et al.*, 2006). Semi-nomadic animal husbandry represents the major form of land-use in the Gobi and has been in place for centuries in the area, if not millennia (Miehe *et al.*, 2007).

Outside the few oases, the most productive pastures are found in and around the mountain ranges between 2000 and 2600 m a.s.l. Mean annual precipitation ranges between 100 - 150 mm on the piedmont regions and up to 200 mm in the summit regions. Rains are largely concentrated in the short warm-season, and are sufficient to support sparse, but continuous vegetation. However, the inter-annual variability of precipitation is high (coefficients of variation >30%, stations Bayandalay, 1570 m a.s.l, and Dalanzadgad, 1470 m a.s.l., National Meteorological Service Mongolia).

This study was performed in montane desert steppes, which form the most important pastures and cover some 20% of the park area (von Wehrden *et al.*, 2006). The dominant plant species are grasses, such as *Agropyron cristatum* and several *Stipa* species (*S. krylovii*, *S. glareosa)*, the onion *Allium polyrrhizum* and the dwarf shrub *Artemisia frigida* (Wesche *et al.*, 2005). Other shrubs (*Artemisia santolinifolia*, *Caragana leucophloea*) are restricted to disturbed sites or erosion gullies, while trees are rare and occur only at sites with permanent water surplus. Annual species are common on heavily disturbed sites, but are unimportant in terms of overall cover and biomass production.

We concentrated on the three abundant plant species, *Agropyron cristatum* (Poaceae, caryopses with small awn, hereafter called "seeds"), *Stipa krylovii* (Poaceae, seeds with small hook and long awn) and *Artemisia frigida* (Asteraceae, small achenes, hereafter called "seeds", without any appendages). Seeds for the granivory experiment were collected in 2005.

Methods. To estimate the grazing impact on seed production of *Agropyron cristatum*, *Stipa krylovii* and *Artemisia frigida* 20 grazing cages (A=0.25 m^2) were randomly placed on the desert steppes around the research camp in the Mt. Dund Saykhan. Cages were established in late 2005, and excluded both small mammals and larger livestock. They were compared with one plot each located in the vicinity of any given grazing-exclusion cage (block design). Since the seeds did not ripen due to the influence of drought in 2006, we chose to sum the number of inflorescences (i.e. the number of flowering culms/stems) as a substitute.

We excavated 11 burrows of *Ochotona pallasi* (one in 2005 and the others in 2006) to analyse the species composition of harvested plant material. We recorded our focus species as well as any other species present. The burrows were located at different altitudes to ensure that the main plant communities were represented. The retrieved plant samples were identified under a dissecting microscope with the help of herbarium material. We also performed some vegetation checks around the burrows to assess the relative importance of plant species in the burrows compared to the surrounding area. In the study region, the home range of *Ochotona pallasi* is around 900 m^2 around the animal's burrow (Monkhzul, 2003). Where the vegetation composition in the home range was relatively uniform, we only performed one vegetation check on a 9 m^2 plot. Otherwise, we increased the number, so that all distinct plant communities were included. Species cover was estimated as a percentage. Comparing the relative abundance of plants in the burrows and in the surrounding vegetation yielded an indication of food preferences and indicated any potential impact of pikas on the specific vegetation.

To test for granivory, we randomly placed 10 plastic dishes with 50 seeds from each *A. cristatum*, *S. krylovii* and *A. frigida* in the study site (1500 seeds in total). The dishes were covered with a plastic bowl to protect them from wind, and had an access hole (12 x 14 cm) to make sure that small mammals, birds or insects could reach the seeds. After 84 hours, exposure was terminated and the remaining diaspores were counted.

Results

Figure 1 illustrates the pronounced difference in the number of flowering stems between the grazed and ungrazed plots. The heavy impact of grazing on flower production was evident as there was not a single inflorescence on the grazed

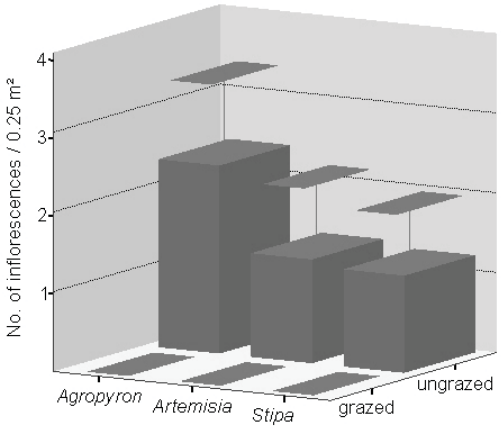

Figure 1. Number of flowering stems of *Stipa krylovii*, *Artemisia frigida* and *Agropyron cristatum* on grazed vs. ungrazed plots (0.25 m^2, mean + 1 standard deviation).

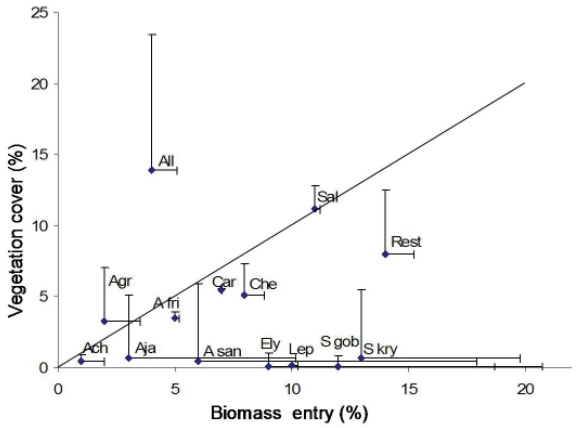

Figure 2. Relative abundance (%) of plant species in the vegetation and in the hay collected by *Ochotona pallasi*. The diagonal indicates the level of equal representation; given are means + 1 standard deviation (Abbreviations: Ach - *Achnaterum inebrians*, Agr - *Agropyron cristatum*, Aja - *Ajania fruticulosa*, All - *Allium* spec., A fri - *Artemisia frigida*, A san - *Artemisia santolinifolia*, Car - *Caragana leucophloea*, Che - *Chenopodium* spec., Ely - *Elymus* spec., Lep - *Lepidium densiflorum*, Sal - *Salsola collina*, S gob - *Stipa gobica*, S kry - *Stipa krylovii).*

plots.

Not surprisingly, the Split-Plot ANOVA analysis (Table 1) confirms these inferences. Differences between plant species were moderately pronounced (p=0.05). Effects of grazing were highly significant (p<0.0001), and species benefited from grazing protection at different intensities, as indicated by the significant grazing * species interaction (p=0.05).

In pika burrows we found a total of > 1.3 kg hay consisting from more than 13 different plant species (including the three studied species). There were also flowers and fruits from at least 7 species including *Agropyron cristatum* and *Stipa krylovii*. Figure 2 shows that the small mammals had feeding preferences. The relative abundance of the plant taxa, such as *Stipa* spp., *Artemisia santolinifolia* and *Ajania fruticulosa* was considerably higher in the burrows, than in the growing vegetation, while *Ochotona pallasi* apparently avoided *Allium* spp., *Agropyron cristatum* and *Artemisia frigida* were neither preferred nor avoided.

In the granivory experiment, after 84 hours, only 45 of the 1500 seeds offered (=3%) were not recovered (Table 2). This is certainly a rather minor effect, although the Wilcoxon-test showed a significant difference (p=0.017) between the numbers of diaspores in the beginning and in the end of the experiment.

Table 1 Split-Plot ANOVA to test for differences among grazed and ungrazed plots and between plant species

			Number of flowering stems		
		df	**mean sum of squares**	**F**	**p**
grazing	hypothesis	1	14520.00	38.000	<0.001
	error term	38	382.11		
grazing * block	hypothesis	38	382.11	0.926	0.594
	error term	76	412.56		
species	hypothesis	2	1284.01	3.112	0.050
	error term	76	412.56		
grazing * species	hypothesis	2	1284.01	3.112	0.050
	error term	76	412.56		
grazing * species * block	hypothesis		error term		

Table 2 Number of seeds at the beginning of the granivory experiment and after 84 hours, given are means +/- 1 standard deviation (n=10).

	Number of seeds	
	Beginning	After 84 hours
Agropyron cristatum	50 +/- 0	48.7 +/- 1.5
Stipa krylovii	50 +/- 0	48.0 +/- 1.9
Artemisia frigida	50 +/- 0	48.4 +/- 1.1

Discussion

Herbivory evidently has a negative influence on the plants' reproductive capacity in the southern Mongolian steppes as not a single flower of the three studied species was found on the grazed plots. The situation may differ from year to year, but grazing nonetheless must be regarded as an important factor for seed development and, consequently, the reproductive success of these species.

What is more difficult to assess is how much grazing a plant can tolerate. Staalduinen & Anten (2005) described that *Stipa krylovii*'s compensatory growth is less than 50% after simulated grazing. However, their plants were cultivated in a greenhouse and died-off when biomass was cut at levels <30 cm. Data have thus to be treated with care, as the species tolerates much more severe tissue removal in its native habitat. It has been described that *Artemisia frigida* can balance a loss of biomass in spring (Li *et al*., 2002), while summer grazing reduces seed production in the following year. For Syria, sheep were described to browse around two-thirds of the seeds grassland offers (Russi *et al*., 1992a). In China, Dexin *et al*. (1997) also found a decrease of seeds of *Stipa krylovii* with an increased grazing. In the Gobi Gurvan Saykhan region, we also found circumstantial evidence for these inferences, as flower production on plots that were regularly harvested in the course of biomass experiments tended to show lower flower production than that of the non-harvested plants growing on the fringes of the cages used in the experiments (pers. observation).

On the other hand, several authors report that grazing impact is not so important in the desert steppe. Fernandez-Gimenez and Allen-Diaz (1999) emphasise the influence of the tremendous inter-annual variability of the precipitation that renders effects of grazing on plant community composition negligible in the dry southern Mongolian steppes. Sternberg *et al*. (2000) also found a greater grazing impact in moist than in dry years, and exclosure studies of our group in the Gobi Gurvan Saykhan region underline the dominance of climate over grazing impact on plant biodiversity and biomass productivity (Wesche *et al.*, in revision). This is in line with the "non-equilibrium theory of rangeland science" (Ellis & Swift, 1988; Vetter, 2005): livestock's influence is limited in arid environments because the animals are limited by fodder availability and, ultimately, precipitation. In dry years, herbivore populations collapse keeping their populations low on average. However, the non-equilibrium theory does not consider effects on plant population biology, and indeed this may be one shortcoming where the theoretical framework of rangeland ecology needs improvement (Vetter, 2005).

In the pikas' burrows we found a total of > 1.3 kg hay belonging to more than 13 plant species (including *A. cristatum*, *S. krylovii* and *A. frigida*). There were also flowers and fruits of at least 7 species (including *A. cristatum* and *S. krylovii*). *Ochotona pallasi* is known to reduce biomass in burrow surroundings through grazing (Huntly, 1987). Retzer (2007) and Nadrowski (2006) even show for the study area that pikas need as much food as livestock (in terms of kg uptake/ha). Some plant species (e.g. *S. krylovii*) suffer heavily from *O. pallasi*'s fodder uptake, as shown in Fig. 2. Their impact on *Stipa* spp. seems to be disproportionally high, while they rather surprisingly show no preference for *A. cristatum*, which is regarded as a highly nutritious fodder grass by Mongolian herdsman (Jigjidsuren & Johnson, 2003).

Granivory was hardly detected in the study area, because only 3% of the offered seeds were not recovered; they probably fell out of the dish while pikas were examining the arrangement. Pikas were observed to enter the trays and we are therefore certain that we introduced no artefacts of human odour keeping the mammals from eating the seeds (Duncan *et al.*, 2002). Small mammals often only eat big seeds (Reader, 1993; Hulme, 1994; Perez *et al.*, 2006) because of the supposedly greater benefit of energy (Kelrick *et al*., 1986; Celis-Diez *et al*., 2004). The provided seeds were indeed relatively small, but there were no bigger ones in the study area. This may be one reason why granivorous animal species are apparently unimportant in the study region.

Conclusion

Our study provides clear evidence that direct browsing of inflorescences is the main impact of herbivores on seed production. Seed production has as yet not been a concern of herders, but grazing effects are pronounced and may reach an extent where hardly any seeds are produced on heavily grazed sites. Seed development represents an additional constraint on the plant level, and may be very limited under conditions of drought and/or nutrient shortage. These constraints add to the relatively harsh climatic conditions where successful establishment of perennial plants is rare and limited to occasional periods of beneficial conditions (Lavrenko & Karamysheva, 1993; Gunin *et al.*, 2003). Taken together, grazing impact plus climate effects may render successful sexual recruitment next to impossible in intensively grazed steppes. Genetic impoverishment of *Stipa spp.* populations under heavy grazing in northern Chinese steppes may hint at such a mechanism (Dan *et al.*, 2006; Zhao *et al.*, 2008), but the available data on Mongolia are not sufficient to come to any definite conclusion on this.

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References

Celis-Diez, J. L., Bustamante, R. O. & Vásquez, R. A. 2004. Assessing frequency-dependent seed size selection: a field experiment. *Biological Journal of the Linnean Society,* 81(2): 307-312.

Dan, S., Mengli, Z., Bing, H. & Guodong, H. 2006. Genetic diversity and population differentiation of the dominant species *Stipa krylovii* in the Inner Mongolia Steppe. *Biochemical Genetics,* 44: 513-526.

Duncan, R. S., Wenny, D. G., Spritzer, M. D. & Whelan C. J. 2002. Does human scent bias seed removal studies? *Ecology,* 83(9): 2630-2636.

Ellis, J. E. & Swift, D. M. 1988. Stability of African pastoral ecosystems: Alternate paradigms and implications for development. *Journal of Range Management,* 41: 450-459.

Fernandez-Gimenez, M. E. & Allen-Diaz, B. 1999. Testing a non-equilibrium model of rangeland vegetation dynamics in Mongolia. *Journal of Applied Ecology,* 36(6): 871-885.

Frank, D. A., McNaughton, S. J. & Tracy, B. F. 1998. The ecology of the earth's grazing ecosystems. *BioScience,* 48(7): 513-521.

Gunin, P. D., Slemnev, N. N. & Tsoog, S. 2003. Seed regeneration of dominant plants in ecosystems of the desert zone of Mongolia: dynamics of undergrowth populations. *Botaniceskij Zurnal,* 88: 1-17.

Hulme, P. E. 1994. Postdispersal seed predation in grassland - its magnitude and sources of variation. *Journal of Ecology,* 82(3): 645-652.

Huntly, N. J. 1987. Influence of refuging consumers (pikas: *Ochotona princeps*) on subalpine meadow vegetation. *Ecology,* 68(2): 274-283.

Jigjidsuren, S. & Johnson, D. A. (2003). Forage plants in Mongolia. Ulaanbaatar, Admon Publishing.

Jones, C. G., Lawton, J. H. & Shachak, M. 1994. Organisms as ecosystem engineers. *Oikos,* 69: 373-386.

Kelrick, M. I., MacMahon, J. A., Parmenter, R. R. & Sisson, D. V. 1986. Native seed preferences of shrub-steppe rodents, birds and ants: the relationships of seed attributes and seed use. *Oecologia,* 68(3): 327-337.

Kinlaw, A. 1999. A review of burrowing by semi-fossorial vertebrates in arid environments. *Journal of Arid Environments,* 41: 127-145.

Lavrenko, E. M. & Karamysheva, Z. V. (1993). Steppes of the former Soviet Union and Mongolia. Natural Grasslands. Ecosystems of the world 8b. Coupland R. T. Amsterdam, London, New York, Tokyo, Elsevier**:** 3-59.

Li, D., Bai, Y. & Xu, Z. 1997. Growth and reproduction of *Stipa krylovii* population under a grazing gradient. *Chinese Journal of Arid Land Research,* 10(1): 31-37.

Li, S. G., Tsujimura, M., Sugimoto, A., Davaa, G. & Sugita, M. 2006. Natural recovery of steppe vegetation on vehicle tracks in central Mongolia. *Journal of Biosciences,* 31(1): 85-93.

McNaughton, M. M. 1985. Ecology of a grazing ecosystem: the Serengeti. *Ecological Monographs,* 5: 259-294.

Miehe, G., Schlütz, F., Miehe, S., Opgenoorth, L., Cermak, J., Samiya, R., Jäger, E. J. & Wesche, K. 2007. Mountain forest islands and Holocene environmental changes in Central Asia: A case study from the southern Gobi Altay, Mongolia. *Palaeogeography, Palaeoclimatology, Palaeoecology,* 250: 150-166.

Munkhzul, T. 2003. Behaviour of *Ochotona pallasi* in the Gobi Gurvan Saykhan National Protected Park. Thesis submitted for the degree of M.Sc., National University of Mongolia.

Nadrowski, K. (2006). Life history strategy and forage of a dominant small mammal herbivore in a dry steppe. Faculty of Geography, Marburg, Philipps University.

Pei, S. F., Fu H., Wan C. G., Chen Y. M. & Sosebee R. E. 2006. Observations on changes in soil properties in grazed and nongrazed areas of Alxa desert steppe, Inner Mongolia. *Arid Land Research and Management,* 20(2): 161-175.

Perez, E. M., Weisz, M. D., Lau, P. & Bulla, L. 2006. Granivory, seed dynamics and suitability of the seed-dish technique for granivory estimations in a neotropical savanna. *Journal of Tropical Ecology,* 22: 255-265.

Reader, R. J. 1993. Control of seedling emergence by ground cover and seed predation in relation to seed size for some old-field species. *Journal of Ecology,* 81(1): 169-175.

Retzer, V. 2007. Forage competition between livestock and Mongolian pika (*Ochotona pallasi*) in Southern Mongolian mountain steppes. *Basic and Applied Ecology,* 8: 147-157.

Retzer, V., Nadrowski, K. & Miehe, G. 2006. Variation of precipitation and its effect on phytomass production and consumption by livestock and large wild herbivores along an altitudinal gradient during a drought, South Gobi, Mongolia. *Journal of Arid Environments,* 66: 135-150.

Samjaa, R., Zöphel, U. & Peterson, J. 2000. The impact of the vole *Microtus brandti* on Mongolian steppe ecosystems. *Marburger Geographische Schriften,* 135: 346-360.

Schneider, K., Archer, N., Breuer, L., Huisman, J. A. & Frede, H.-G. 2005. Effects of management practices and grazing intensities in a steppe environment on soil moisture (Xilin River Catchment, Inner Mongolia/China). *Geophysical Research Abstracts,* 7.

Sternberg, M., Gutman, M., Perevolotsky, A., Ungar, E. D. & Kigel, J. 2000. Vegetation response to grazing management in a Mediterranean herbaceous community: a functional group approach. *Journal of Applied Ecology,* 37(2): 224-237.

Stumpp, M., Wesche, K., Retzer, V. & Miehe, G. 2005. Impact of grazing livestock and distance from water sources on soil fertility in southern Mongolia. *Mountain Research and Development,* 25(3): 244-251.

Su, Y. Z., Zhao, H. L. & Zhang, T. H. 2003. Influences of grazing and exclosure on carbon sequestration in degraded sandy grassland, Inner Mongolia, North China. *New Zealand Journal of Agricultural Research,* 46(4): 321-328.

van Staalduinen, M. A. 2005. Impact of grazing by large and small mammalian herbivores in a Mongolian forest steppe. In: The impact of herbivores in a Mongolian forest steppe. Enschede, Febodruk BV.

van Staalduinen, M. A. & Anten, N. P. R. 2005. Differences in the compensatory growth of two co-occurring grass species in relation to water availability. *Oecologia,* 146(2): 190-199.

Vetter, S. 2005. Rangelands at equilibrium and non-equilibrium: recent developments in the debate. *Journal of Arid Environments,* 62: 321-341.

Von Wehrden, H., Wesche, K., Reudenbach, C. & Miehe, G. 2006. Vegetation mapping in Central Asian dry eco-systems using Landsat ETM+. A case study on the Gobi Gurvan Saykhan National Park. *Erdkunde,* 60: 261-272.

Wesche, K., Miehe, S. & Miehe, G. 2005. Plant communities of the Gobi Gurvan Sayhan National Park (South Gobi Aimak, Mongolia). *Candollea,* 60(1): 149-205.

Wesche, K., Nadrowski, K. & Retzer, V. 2007. Habitat engineering under dry conditions: The impact of pikas (*Ochotona pallasi*) on vegetation and site conditions in southern Mongolian steppes. *Journal of Vegetation Science,* 18: 665-674.

Wesche, K., Ronnenberg, K. & Retzer, V. in revision. Effects of herbivore exclusion in southern Mongolian desert steppes. *Acta Oecologica*.

Whicker, A. D. & Detling, J. K. (1988). Modification of vegetation structure and ecosystem processes by North American grassland mammals. In: Plant Form and Vegetation Structure. The

Hague, SPB Academic Publishing**:** 317-330.
Zhao, H., Zhang, T., Zhao, X. & Zhao, R. 2004. Effect of grazing on sandy grassland ecosystem in Inner Mongolia. *Ying Yong Sheng Tai Xue Bao* 15(3): 420-424.
Zhao, N.-X., Gao, Y.-B., Wang, J.-L. & Rhen, A.-Z. 2008. Population structure and genetic diversity of Stipa grandis P. Smirn, a dominant species in the typical steppe of northern China. *Biochemical Genetics,* 36: 1-10.
Zielinski, J. 1982. The effect of the Brandt vole (*Microtus brandtii* Radde, 1861) colonies upon vegetation in the Caragana steppe of central Asia. *Polish Ecological Studies,* 8: 41-56.

Хураангуй

Бэлчээрийн мал аж ахуй бол Монголын олон жилийн түүхтэй уламжлалт аж ахуй бөгөөд одоо ч гэсэн тус улсын газар ашиглалтынэ гол хэлбэр байсаар байна. Мал сүргийн тоо өсч байгаатай холбогдон бэлчээр нутгийн элэгдэл эвдрэл, талхагдлын аюул бий болж байна. Монголын өмнөд бүс нутагт өвсөн тэжээлт амьтдын бэлчээрт үзүүлэх нөлөө харьцангуй бага судлагчсан бөгөөд өмнө хийгдсэн судалгаанууд үндсэндээ биомассын бүтээмжийг үнэлж байснаас биш бэлчээрийн гол ургамлын нөхөн сэргэлтийн асуудлыг судалж байсангүй. Бид Монголын цөлөрхөг хээрийн бэлчээрийн зонхилогч 3 зүйлийн ургамлын (*Agropyron cristatum*, *Stipa krylovii*, *Artemisia frigida*) бүтээмж ба үрийн нөөцөд мал ба жижиг өвсөн тэжээлт жижиг хөхтөн амьтдын үзүүлэх нөлөөг судалсан юм. Хээрийн судалгааг 2006 онд Говь Гурван Сайханы Байгалийн Цогцолборт Газарт явуулж, дээрх амьтдын ургамлын үрээр хооллох байдал, мал амьтан бэлчээрлэдэг ба бэлчээрлэдэггүй талбайн ялгаа, жижиг хөхтөн амьтдын тэжээлийн сонголт зэргийг судлав. Өвсөн тэжээлт амьтад дээрх 3 ургамлын цэцэг ба үрийн боловсролтонд маш их нөлөөтэй болох нь тогтоогдов. Тэдгээр ургамлын цэцэг ба үрийг 100% хүртэл хэмжээгээр иддэг болох нь илрэв. Гэвч мал ба жижиг хөхтөн амьтдын ургамлын зүйл бүрд үзүүлэх нөлөө нь ялгаатай байв. Мал ба жижиг хөхтнүүд ижил төрлийн тэжээл сонголттой байсан ба огодой (*Ochotona pallasi*) *Stipa* төрлийн ургамлыг сонгож хооллох нь илүүтэй байв. Монголын өмнөд хэсгийн цөлөрхөг хээрт судалсан 3 зүйлийн ургамлын үрээр хооллох үзэгдэл ажиглагдсангүй.

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