Grazing Effects on the Seed Pool of *Stipa Krylovii* and Its Genetic Diversity in Relationship to the Plant Population on a Typical Steppe Community in Inner Mongolia

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Introduction *Stipa krylovii* is an important tufted forage species on the typical steppe in Inner Mongolia and is sensitive to heavy grazing pressure. Vegetative recovery of plant density is dependent on the seed bank, which is a genetic reservoir that supports the vegetative expression of the species thus enhancing its resilience (McCue and Holtsford 1998). The ability of the seed bank to support the *Stipa krylovii* population is dependent on its size and genetic diversity. Therefore, we conducted a study to determine the effects of heavy grazing pressure on its seed reserves and examine its genetic diversity in relation to surviving plants.

Materials and methods Thirty plants (spaced at least 10 m apart) of *Stipa krylovii* were randomly sampled from a site (41º 07' N, 115º 42' E, average annual precipitation = 368 mm, elevation = 1300 asl, soil = Typical Chestnut) that had been protected from grazing since 1984 and from a nearby community that had been heavily grazed for over 50 years. The plant cover of *Stipa krylovii* varied from 60 to 90% on the protected site and from 5 to 20% on the heavily grazed site. Nevertheless, plant composition was similar on each. The seed bank was sampled from 1, 50 x 50 x 5 cm plot associated with each sampled plant after seed rain. Seed numbers were determined using two methods: One was to screen the soil and count the seeds and the second was to germinate the seeds in trays and count the seedlings. Leaves were collected from each plant and from one seedling per plot (some plots produced no seedlings). The collected leaves were prepared to extract genomic DNA and RAPD markers that were used to detect the genetic diversity. Thirteen arbitrary primers were used and their markers analyzed using POPGENE 1.31 (Yeh *et al*., 1997).

Results Grazing severely depleted the number of *S. krylovii* seeds and frequency of occurrence in the seedbank (Table1). Of the total number of seeds founding in grazed plot, only 28% produced seedlings, while 60% did so in the protected area. The seedlings contained greater genetic diversity than the plants (Table 2). Of the total variation, 33% was found between the populations.

Table 1 Number and frequency of seeds and seedlings (germinated seeds) from grazed and protected sites in Inner Mongolia

Material	Grazed		Protected	
	No.	Fr. (%)	No.	Fr. (%)
Seeds	7	32	35	85
Seedling	2	7	21	50

Table 2 Genetic diversity (H_o) of *S. krylovii* plants and seed pool, as measured from germinated seeds, from protected sites in Inner Mongolia

Material	Sample (no.)	Loci		(H_o)	H_t	H_s	H_s/H_t (%)	G_{st}* (%)
		Total	Poly.					
Plants	30	111	85	0.194	0.260	0.173	66.73	33.27
Seeds	18	92	71	0.153				

*Coefficient of gene differentiation

Conclusion The seed pool is essential for imparting resilience to the plant population. Grazing affected the *S. krylovii* population not only by reducing its ground cover but also by nearly eliminating the seed pool. However, 27 years after removing grazing pressure, the ground cover and seed pool of the *S. krylovii* population had recovered. The seed pool contained a greater amount of genetic diversity and thus contributes to the recovery of the population following disturbances. Grasslands need to be managed to allow seed production to maintain the seed pool and the health of the grassland.

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