Grazing effects on genetic diversity of *Festuca campestris* Rydb. and *Stipa grandis* L. on the native grasslands in Canada and China, respectively

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Introduction Genetic drift or selectively neutral mutation in finite populations may result in genetic diversity within a natural population (Kimura, 1986). Genetic diversity influences the resilience of a species to survive perturbations or adapt to changes in its environment. Grazing by livestock may affect genetic diversity by exerting selection pressure on grazing sensitive species. In this study, we examine the effects of heavy sustained grazing pressure on the genetic diversity of *Festuca campestris* Rydb. and *Stipa grandis* L. These species are found on the Canadian Plains and the steppes of Inner Mongolia, respectively. Each is an important forage species that dominates their respective grasslands but decline readily when subjected to heavy grazing pressure.

Materials and methods Single natural grassland sites were subjected to heavy grazing pressure (~80% of ANPP) annually for more than 50 years in Canada (Fescue site, 50º 12' N, 113º 54' W) and Inner Mongolia (Stipa site, 43º 33' N, 116º 42' E) by cattle and sheep, respectively. Each site included contiguous grazing exclosures (> 1 ha) erected 1949 on the Fescue site and 1979 on the Stipa site to protect areas from livestock grazing. The Fescue and Stipa sites had thin Black Chernozemic and Typical Chestnut soils, respectively, and average annual precipitation of about 500 and 350 mm, respectively. Thirty four and 43 plants were collected from the protected and grazed areas, respectively, in the Fescue site and 30 and 30, respectively, in the Stipa sites. The collected leaves were prepared to extract genomic DNA and RAPD markers were used to detect the genetic diversity. welve and 18 arbitrary primers were used for the samples from the Fescue and Stipa sites, respectively. The data were analyzed using POPGENE 1.31 (Yeh *et al*., 1997).

Results Average genetic diversity (H_o) of both populations at each site was similar (Table 1) with most diversity within populations (H_s/H_t). Overall, the coefficient of gene differentiation (G_{st}) was relatively low. The number of migrants per generation (Nm) was large, suggesting high gene flow (Table 1). Nei's genetic identity was high for both sites suggesting that the grazed and protected populations were genetically similar. The gene flow and genetic identity were somewhat less in the Stipa population vs the Fescue population.

Table 1 Mean estimates of genetic diversity (H_0) produced by 12 or 18 primers for plants of two species that were either protected from grazing or heavily grazed for an extended period

Site	Years of protection	Primers	Population (H_o) Heavy	Population (H_o) Zero	H_t	H_s	H_s/H_t (%)	G_{st} (%)	N_m*	I**
Fescue	50	12	0.33	0.34	0.35	0.33	96.52	3.20	16.25	0.969
Stipa	26	18	0.32	0.31	0.38	0.35	92.10	4.50	11.61	0.924

*Gene flow: $N_m=0.5(1-G_{st})/G_{st}$, **Nei's genetic identity

Conclusion The 3.5 and 7.9 % inter-population variation observed for *F. campestris* and *S. grandis* is not clear evidence that grazing affected their genetic diversity. Reduced diversity might be expected if sensitive plants were killed and sensitivity had a genetic control. The lack of effect suggests either no genetic link between plant vulnerability to grazing or the masking of its expression with the replacement of killed genotypes. However, with over 30% of genetic diversity (H_o, Table 1), the populations of the two species contain a large amount of genetic potential to respond to selection pressure produced by grazing and other perturbations. The relatively small effect that grazing may have on genetic diversity and the apparent lack of genetic drift caused by grazing indicates that any loss of genetic diversity would recover if grazing pressure were relieved.

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