Impacts of grazing intensity, grazing system, mowing and nitrogen fertilization on species dominance and coexistence in typical steppe of Inner Mongolia

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Overgrazing and poor management induced grassland degradation and desertification leads to severe ecological and environmental problems in Inner Mongolia and in China, for instance, the frequently occurred dust and sand storms. This may be partly due to the lack of sound scientific understandings on the processes and mechanisms of grassland degradation, which could be used for guiding grassland management practices. In order to get a further insight on the processes of grassland degradation in Inner Mongolia, a three-year mowing trial and a six-year grazing trial have been performed during 2004 to 2010. Here we compiled the species composition data from both trials, to explore the effects of multiple management practices on species dominance and species coexistence in typical steppe of Inner Mongolia. The major findings from this study are listed as following:

Grazing consistently reduced the species diversity through its negative effects on the palatable subordinate species. The severest diversity loss was observed at moderate grazing intensity. This indicates that the highest survival pressure for the palatable subordinate species was at moderate grazing intensity. A new concept has been proposed to interpret this phenomenon based on the results from the present study and synthesized knowledge from previous studies. Results from the grazing management system comparisons showed a clear mitigation effect of the mixed management system (with an annual shift between hay-making and grazing) on species shift. This indicates that the consistent negative effects of grazing on species diversity can be mitigated through this management system.

In contrast to the effects of grazing, we found that the uniform defoliation treatment of mowing had consistent positive effects on species diversity, and it could offset the negative effects of nitrogen enrichment on species diversity. We also found that nitrogen addition could offset most part of the reduction in aboveground biomass production caused by frequent mowing. Combined with the findings on the differential responses of the two dominant species (palatable *L. chinensis* and unpalatable *S. grandis*) to mowing and nitrogen addition, together it indicates the potential use of mowing and nitrogen fertilization for community structure improvement and diversity and productivity maintenance in typical steppe of Inner Mongolia.

In addition to the management practices effects, our results also clearly demonstrated the predominant role of precipitation in influencing the community structure and functioning of Inner Mongolia steppe ecosystem. Results from the correlations between species and plant functional group aboveground biomass with annual and seasonal precipitation amount in general showed that seasonal precipitation amount was more strongly correlated with the species and plant functional group aboveground biomass than annual precipitation amount. This finding indicates that the predominant roles of temporal distribution of precipitation rather than annual precipitation amount in shaping community structure in typical steppe of Inner Mongolia.