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The 21st International Grassland Congress / 8th International Rangeland Congress took place in Hohhot, China from June 29 through July 5, 2008.

Proceedings edited by Organizing Committee of 2008 IGC/IRC Conference

Published by Guangdong People's Publishing House

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Increasing nitrogen deposition and grassland productivity in Mongolia

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Key words : Grazing, Mongolia, Nitrogen deposition, Primary production, Steppe

Introduction The amount of nitrogen (N) fall-down from the atmosphere to the biosphere (nitrogen deposition) is increasing globally due to increased fossil fuel consumption and chemical fertilizer application (Galloway et al., 2004). As N is essential for plant growth, increased N deposition affects plant primary productivity (Vitousek et al., 1997). However, increased N deposition can also decrease plant diversity (Stevens et al., 2004).

Mongolian grassland is a steppe spread out in the north of central Asia and is utilized for grazing by nomads. Galloway et al. (2004) have estimated that the amount of annual N deposition in this region in 2050 is likely to increase by about 400mg/m² over that in the early 1990's. The increase in N deposition may influence the grazing potential of Mongolian grassland through changes in grassland productivity and species composition.

In the present study, N was artificially applied to Mongolian grassland to assess the effect of increased N deposition on grassland productivity. The study aims: (1) to analyze the effect of increased N deposition on the productivity of Mongolian grassland and (2) to evaluate the change in livestock carrying capacity of Mongolian grassland as a result of an increase in N deposition.

Materials and methods The study site, Bayan-Unjuul, is located in a typical dry steppe, about 150km south west of the capital Ulaanbaatar. Annual mean temperature and precipitation are 0.3°C and 165mm. Plant communities were dominated by the perennial grass *Cleistogenes squarrosa* and the perennial forb *Artemisia adamsii*.

Four experimental plots were established in August 2006. Each plot has two main treatments, grazing and non-grazing. In each main treatment, four nutrient sub-treatments were established: application of nutrient solution with low (LN, 300mgN m⁻² y⁻¹) and high (HN, 1500mgN m⁻² y⁻¹) N, application of nutrient solution without N (only water, Control) and no treatment (0N). A nutrient solution containing the required amount of ammonium nitrate (NH₄NO₃) was sprayed in June and August. The above-ground parts of plants were harvested two times each year (in late June and August) and were weighed after drying.

Results Aboveground dry mass just before the experimental manipulation did not differ among experimental plots (Figure 1). Water application did not affect dry mass. The effect of N application was found in non-grazing plots in HN treatment. More than 75% of increase in aboveground dry mass with HN treatment was attributed to *Artemisia adamsii* which is not palatable for livestock.

Conclusions The increase in N deposition expected by 2050 seems to have little effect on primary production of the Mongolian steppe. However, the primary production in this region potentially increases with more N deposition, and the increase may not be accompanied by an increase in grazing capacity of the grassland. Clearly, a longer experiment is needed to attain a more robust conclusion.

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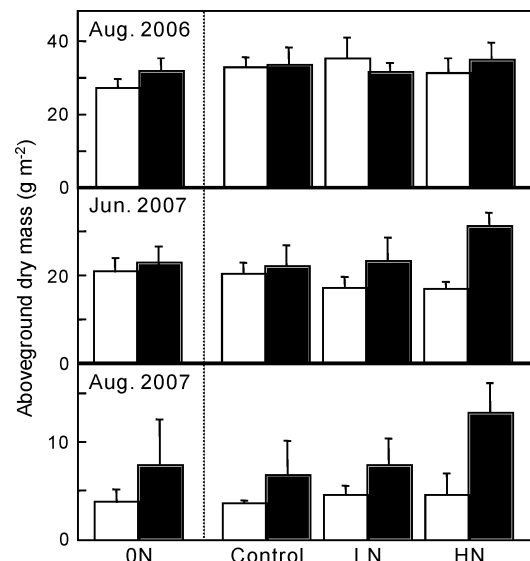


Figure 1 Aboveground dry mass at August 2006, June 2007 and August 2007. 0N, Control, LN, HN show no treatment, treatment with water application, low nitrogen application and high nitrogen application. Open and closed columns show grazing and non-grazing plots. Error bars represent +1 SE.