Increasing Nitrogen Deposition and Grassland Productivity in Mongolia

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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/m^2 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℃ 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 (NH_4NO_3) 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 .

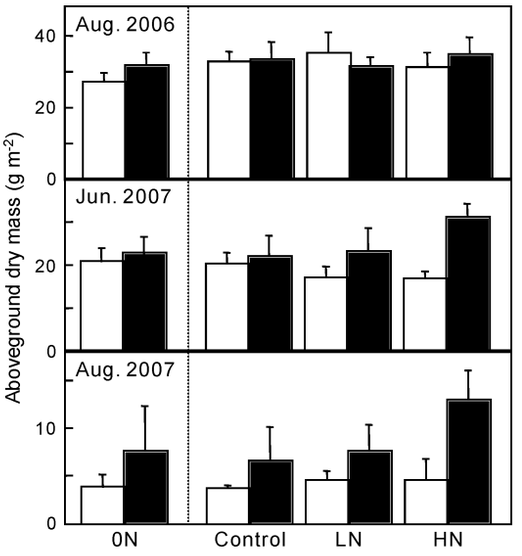

Figure 1 *Aboveground dry mass at August 2006 , June 2007 and August 2007 . 0N , Control ,LN ,HN show no treatment ,treatment with water application , low nitrogen application and high nitrogen application . Open and closed columns show grazing and non-grazing plots .Error bars represent* ± *1SE .*

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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