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## ***Interactive comment on “Nitrogen enrichment enhances the dominance of grasses over forbs in a temperate steppe ecosystem” by L. Song et al.***

**L. Song et al.**

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Reply to Nancy Dise’s Comments Page 5058, lines: 5. temperate, not temperature Response: Agreed and revised accordingly. 19. change to ‘deposition-induced’ Response: Agreed and revised accordingly. 20. N dynamics may be very important, but may not be ‘key’. Climate (and in some cases management) probably plays a more important role. Response: We replace “key to” by “closely related to”. Page 5059, lines: 3. I’m not sure if we can really say how ‘rapid’ or not these changes will be. Response: Here ‘rapid’ means the N-induced quick changing rate compared with ‘natural’ change rate in history. 4-6. ‘A decrease in biodiversity...community.’ This statement is very sweeping and in many case not justiiñÅed, unless we take a very broad deñÅition of ‘decrease in biodiversity’ (e.g. habitat destruction) Response:

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Replace “is the most serious threat to” by “is a serious threat to” (delete “the most”).

7. change ‘enlarge’ to ‘enhance’ Response: Agreed and revised accordingly. 9-13. I believe the largest effect shown on species richness, together with the largest decline in pH, was with  $(\text{NH}_4)_2\text{SO}_4$ , supporting the importance of pH Response: Yes, we agree with you. Both acidification and eutrophication contribute to decline in species richness under the treatment of ammonium sulfate. 11. delete ‘famous’, capitalise ‘Grass’ Response: Agreed and revised accordingly. 13. change ‘conñArmed’ to ‘showed’ Response: Agreed and revised accordingly. 14-15. You have to be careful here. Gradient studies such as these (1) describe long term patterns, and (2) cannot tell us unequivocally what the causal factors are. It is more correct to rephrase this as: ‘each additional increment in long-term N deposition of approximately 2.5 kg N/ha/y is associated with a reduction in species richness of one species.’ Response: Agreed and revised accordingly. 20. add ‘slowly’ or ‘partially’ before ‘reversible’, as I don’t think complete reversibility was shown. Response: A “partially” is added before “reversible”.

27. delete ‘supply’ after ‘nutrient’. Have these studies shown that N is limiting? Have they looked at the importance of P? Response: ‘N deposition’ is a “nutrient supply” or “nutrient input” rather than a ‘nutrient’. There are many studies that have shown N is limiting nutrient while P is not so limiting (i.e., soil Olsen-P is about 4-5 ppm in 0-10 cm soil layer in Inner Mongolian steppe) in major Chinese grasslands (see section of Materials and Methods). Page 5060, lines: 1. ‘Their results...’ Based on what? Response: Based on the 4 year N addition field experiment conducted by Bai et al. (2010). To avoid misunderstanding, we replace “Their results ...” by “The 4-yr results from Bai et al. (2010) ...”. 5. Does this mean that above 105 kg N/ha/y applied over 4 years, there was no significant change? How much higher were the doses above this? Response: It means there was no significant difference of aboveground biomass among treatments that with N additions rates higher than 105 kg N/ha/yr. Doses above 105 kg N/ha/yr include 175 kg N/ha/yr and 280 kg N/ha/yr in the study of Bai et al. (2010). 5-6. Delete ‘However’ from start of sentence. Change to ‘The effect of N deposition on communities is modiñAed by other factors...’ Response:

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Agreed and revised accordingly. 13. change 'reveal' to 'investigate' Response: Agreed and revised accordingly. 16-18. change to 'The objectives of this study were to (1) test how different functional..., and (2) elucidate the role of...' Response: Agreed and revised accordingly. Page 5061, lines: 19, change to 'to study the recovery from high N addition...' Response: Agreed and revised accordingly. 23-24. End the sentence after 'non-destructively.' Delete 'because: :N addition.' Response: Agreed and revised accordingly. 26. delete '(20-25 August)' Response: Agreed and revised accordingly. Page 5062, line: 5-8. Were mean values of cover and species richness then calculated from the 5 replicate quadrats? Response: Yes, mean values of cover and species richness were calculated from the 5 replicate quadrates. 18. 'oven-dried' Response: Agreed and revised accordingly. 25. 'within 12 h. ' This is not clear. Was this extraction made on a previously frozen sample? This is implied from the previous sentence. Response: Yes, we mean that the 'frozen' soil samples will be extracted and analyzed for Nmin within 12h under laboratory condition. This sentence is revised to "Under laboratory condition, the frozen soil samples were removed from refrigerator and within 12 h a 12 g moist subsample of soil...". Page 5063, lines: 6-8. were assumptions of normality checked? Response: Yes, the assumptions of normality were checked before the statistical analysis. We have added one sentence "All the data were tested for normal distribution before statistical analyses" to clarify this in the revision. 17. change 'stimulated' to 'increased' Response: Agreed and revised accordingly. 21. delete 'gradient' Response: Agreed and revised accordingly. 24. add 'experimental' after 'moderate'. These levels are not at all 'moderate' in nature. Response: Agreed and revised accordingly. Page 5064, lines: 11. add 'any' before 'further'. Response: Agreed and revised accordingly. 24. add 'partial' before 'recovery' Response: Agreed and revised accordingly. Page 5065, lines: 21. change 'herbage' to 'vegetation' Response: Agreed and revised accordingly. 25. change to 'functional groups' Response: Agreed and revised accordingly. Page 5066, lines: 4. start a new paragraph after 'treatments'. Response: Agreed and revised accordingly. 5. change 'enhanced by' to 'enhanced in' Response: Agreed and revised accordingly. 12. start

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a new paragraph at sentence beginning 'The amounts of N... Response: Agreed and revised accordingly. 15. add comma: 'N addition, in particular...' Response: Agreed and revised accordingly. Page 5067, line: 16. spelling: 'declined' Response: Agreed and revised accordingly. Page 5068, lines: 2. change to 'N-enriched' Response: Agreed and revised accordingly. 7-9. 'No further...of the study.' This sentence is unclear. Response: We change that sentence to "No further decline in forb species occurred at the highest N addition rate (480 kg N ha<sup>-1</sup> yr<sup>-1</sup>) in 2009 or 2010 compared with 240 kg N ha<sup>-1</sup> yr<sup>-1</sup> due to no N application in the 480 kg N ha<sup>-1</sup> yr<sup>-1</sup> treatment during the final two years of the study". 17,19. You are talking about a 'critical load' here. A critical level is a concentration. Response: The "critical level" is replaced by "critical load". 19-21. In general, newer research shows these loads to be lower – it would be better to refer to the 2010 'Review and Revision of Critical Loads' document (R. Bobbink and J-P Hettelingh eds.) Response: Agreed, we have replaced "critical level" by "critical load". We have changed the sentence "The critical level was..." to "The critical load was found to be 15-25 kg N ha<sup>-1</sup> yr<sup>-1</sup> for sub-atlantic semi-dry calcareous grassland, 10-20 kg N ha<sup>-1</sup> yr<sup>-1</sup> for heath meadows and humid swards, and 5-10 kg N ha<sup>-1</sup> yr<sup>-1</sup> for alpine and subalpine grassland (Bobbink et al. 2010)". Page 5069, lines: 9-11. did you measure any pH change? Response: We did not measure the change of soil pH value in this study. We believe soil pH decline may have occurred under higher N addition rates due to nitrate accumulation and leaching in the soil profile. 16. explain what Carroll et al. did. Response: We have inserted "who found regular applications of ammonium nitrate (35–140 kg N ha<sup>-1</sup> yr<sup>-1</sup>) resulted in significant decrease for individual forbs cover." after "Carroll et al. (2003)". 27-28. elaborate – what do you mean by the 'source' of N? Response: Yes, we mean by the "source" of N (which could be indicated by different delta 15N values). Page 5070, lines: 24. add 'incipient' before 'soil N saturation' Response: Agreed and revised accordingly. 27. change to 'N-saturated conditions' Response: Agreed and revised accordingly. Page 5071, lines: 1-3. So, is nutrient imbalance (rather than competition or pH) your explanation for the observed changes in your experiment? Have you

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looked at nutrient ratios in the vegetation to test this? Response: Nutrient imbalance in our situation could be one of reasons for the observed changes in our experiment. However, we did not test nutrient ratios in our experiment. According to Gong et al. (2011) (Gong XY, Chen Q, Dittert K, Taube F, and Lin S, 2011. Nitrogen, phosphorus and potassium nutritional status of semiarid steppe grassland in Inner Mongolia. *Plant and Soil* 340: 265-278), plant N, P and K concentrations and ratios of N:P or N:K at another N addition experimental site in Inner Mongolia can be largely affected by N addition rates and plant nutrient patterns were also associated with changes for community composition. 3. 'deposition-induced' Response: Agreed and revised accordingly. 10-11. How do you know that plants increased their N assimilation? Response: We mean "with increased N addition plant N assimilation increased ...". We have changed the sentence "As the plant increased..." to "With increased N addition, plants increased their N assimilation and the  $\delta^{15}\text{N}$  value increased in both grasses and forbs, indicating changes in plant N sources". 12. 'changes in soil N sources'. Can you be more specific? Response: "Soil N sources" here means "plant N sources including fertilizer N and soil N two parts". We have added "comprised fertilizer and soil two parts" after "N sources". Figure 4D: change y-axis label from 'Grasses' to 'Forbs' Response: Agreed and revised accordingly. Figure 5. These data would be better modelled as an asymptotic relationship rather than a straight line. Response: We found the linear regression is the best described relationship in our situation. The N480 treatment was not included in the regression because N addition was ceased in 2009 and 2010 in the treatment.

Please also note the supplement to this comment:

<http://www.biogeosciences-discuss.net/8/C2409/2011/bgd-8-C2409-2011-supplement.pdf>

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