

The Effects of Warming and Grazing on Flower Production and Phenology of Mongolian Plant Species

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Introduction

In the next century it is expected that biodiversity and other plant properties in terrestrial ecosystems will be most affected by land-use changes and climate change (Sala, 2000). There is evidence to suggest that climate change and grazing could affect plant phenology and flower production, although a plant's reaction is difficult to predict. Even less so is understood about the interaction of grazing and temperature on these two plant properties. Prior studies in northern latitudes and temperate regions have noted enhanced flower production and an earlier bloom peak due to warming and grazing, but it is predicted that warming and grazing effects will cause different responses in different ecosystems (Aerts, 2004; Kudo, 2003). A study was conducted in Dalbay Valley, Northern Mongolia, a grassland region experiencing accelerated temperature warming and increased grazing intensity in recent decades, during the summer of 2010 to determine the individual and combined effects of warming and grazing on the phenology and flower production of indigenous plant species.



Results

- There was a significant decrease in flower production in the OTC chamber for *Artemisia commutate*, *Aster alpinus*, *Carex pediformis*, *Festuca Lenensis*, and *Koeleria macrantha*
- There was a significant decrease in flower production in grazed areas for *Festuca lenensis*, and *Helictotrichon schellianum*
- When the treatment x grazing interaction was analyzed, control plots with grazing had significantly more flowers than any other plot for *Artemisia commutate* and *Sibbaldianthe adpressa*
- The only species that exhibited a significant difference in median flower date was *Koeleria macrantha*, which bloomed three days earlier (Julian date 187 vs. 190) in grazed areas

Results of ANOVA for flower production.

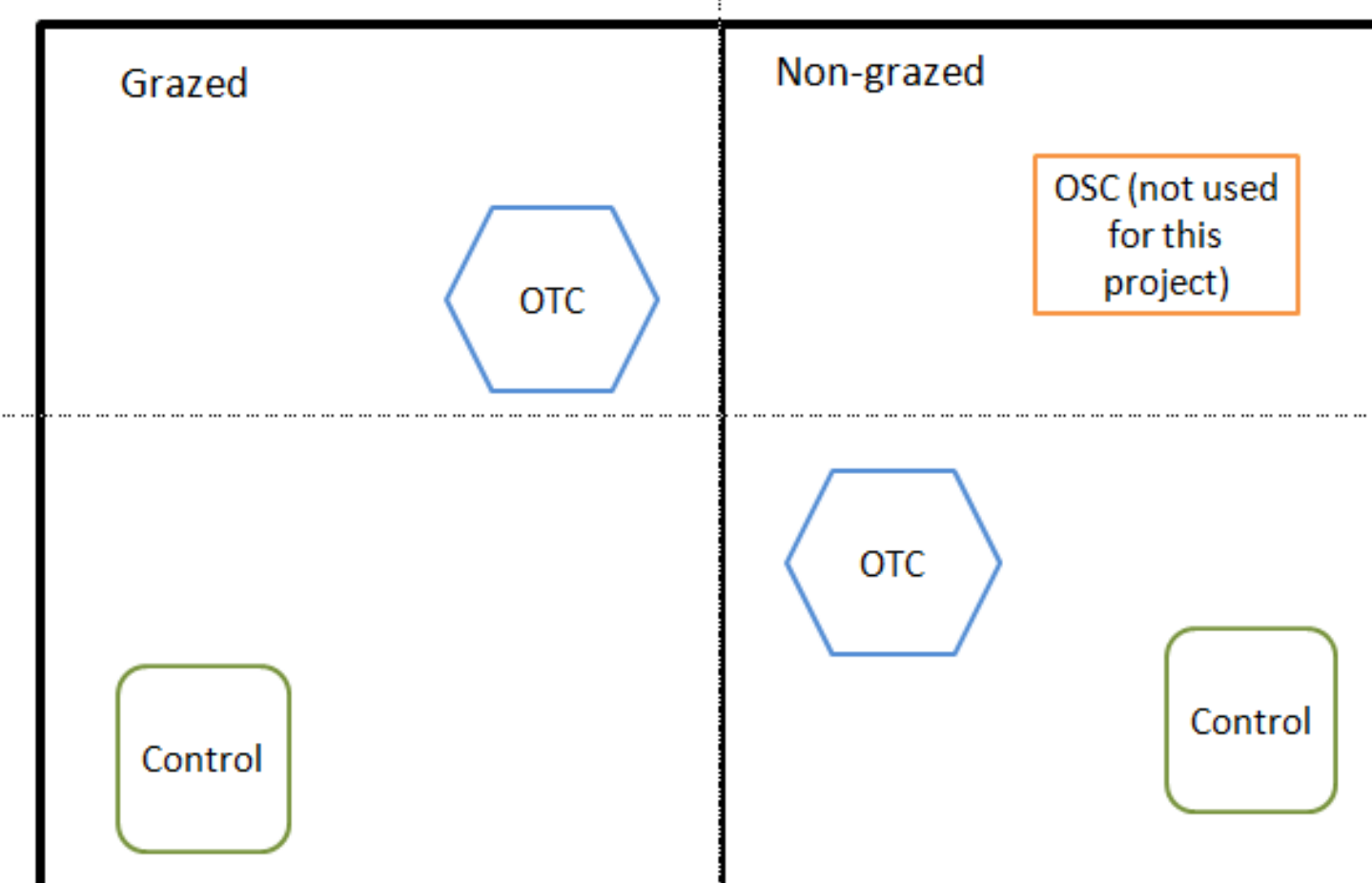
F-values for main effects and interactions are presented. For level of significance, *P<0.05

Effect	Are. Cap.	Art. Com.	Ast. Alp.	Bup. Bic.	Car. Ped.	Fes. Len.	Gen. Pse.	Hel. Sch.	Hie. Odo.	Koe. Mac.	Pot. Aca.	Pot. Bif.	Pot. Ser.	Sib. Adp.	Tha. Min.	Thy. Gob.	Ver. Inc.
Treatment	0.0001	7.562*	7.797*	1.705	10.554*	11.086*	0.670	0.933	0.714	9.113*	0.001	0.075	0.100	1.963	1.865	0.175	0.951
Grazing	2.113	3.516	0.479	0.432	0.829	19.965*	0.041	35.757*	0.629	1.159	5.070	0.018	0.480	3.333	1.611	0.908	0.599
Treatment x Grazing	0.223	10.773*	3.718	0.0003	0.105	2.810	2.184	0.017	1.110	0.094	1.621	0.199	0.237	7.192*	0.128	0.081	0.463

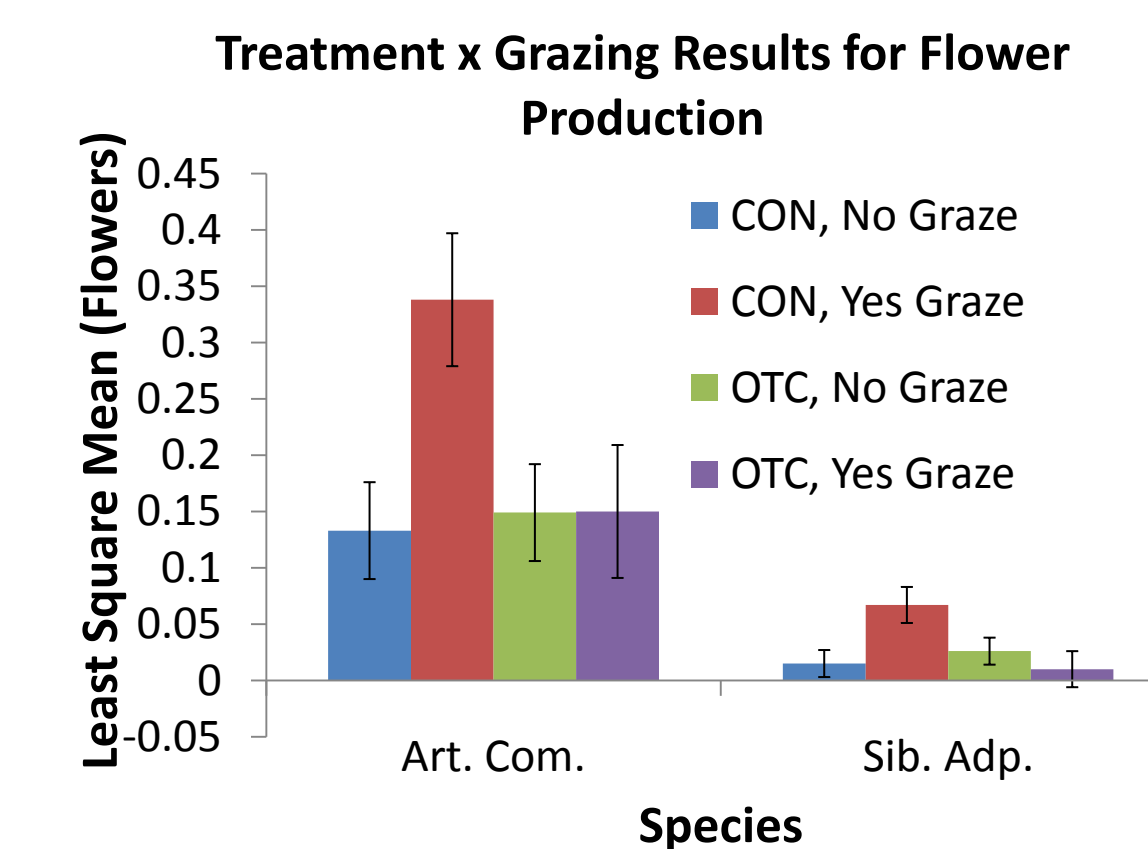
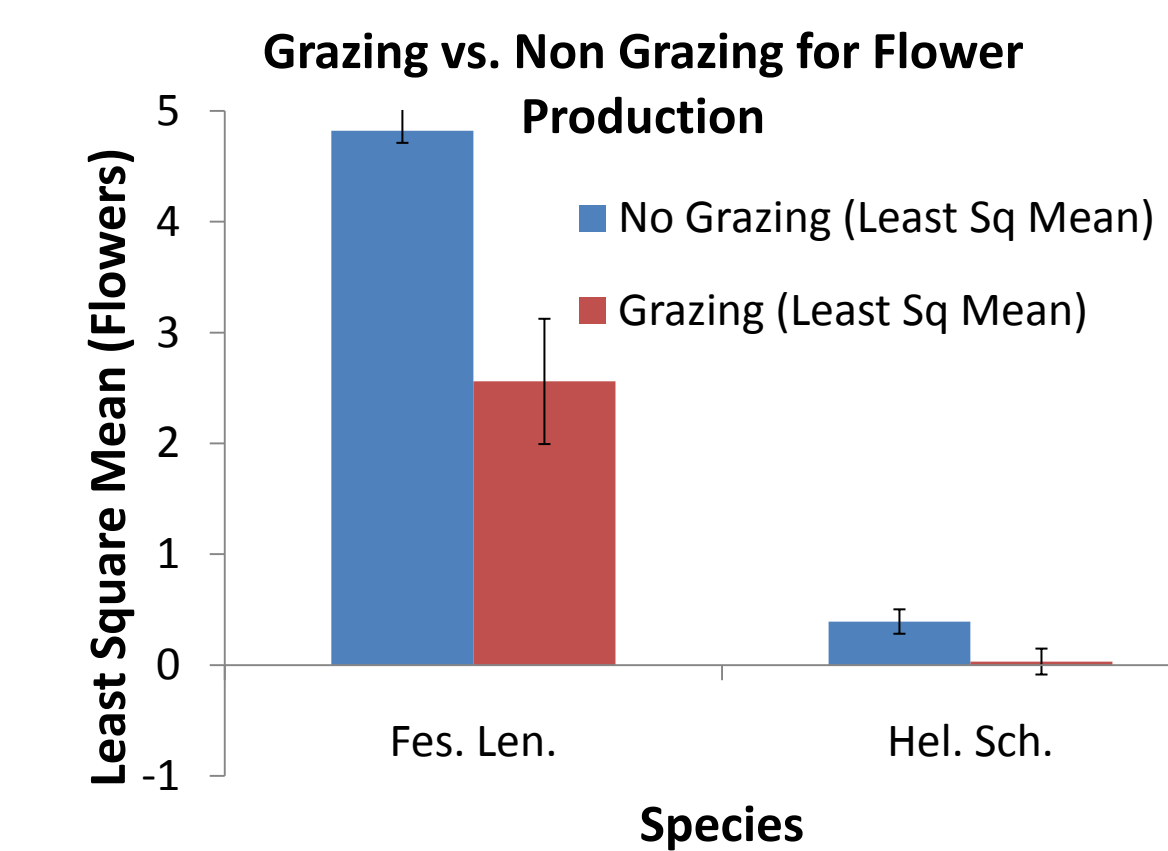
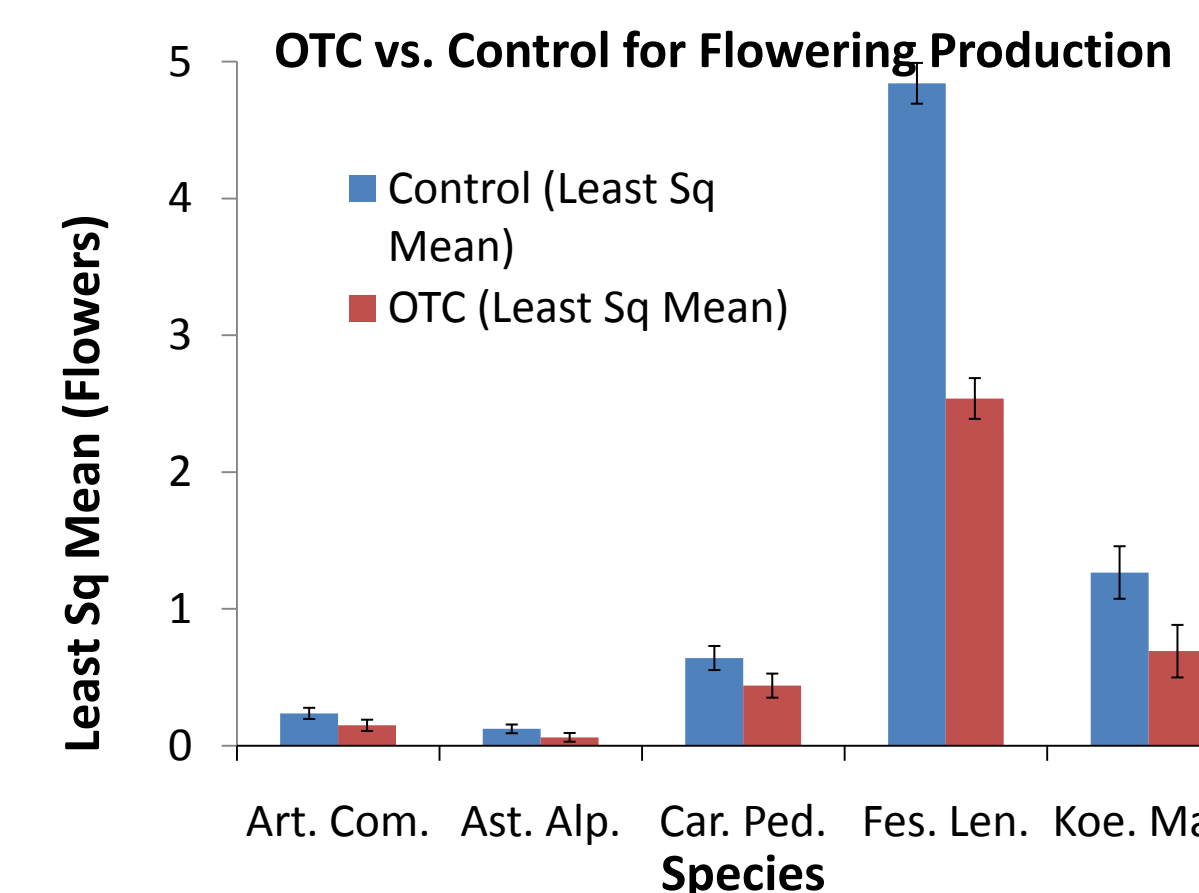
Methods

- Fifteen 9 x 9 m blocks were chosen on the south slope of the valley at random. Eight were located on the lower slope and seven were on the upper slope. The blocks on the upper slope did not experience grazing and were not utilized for this particular study.
- Blocks were divided into grazed and non-grazed sections (non-grazed sections were fenced in). Within both sections there was a control plot and a plot with a passive, open-top warming chamber.
- Presence and number of flowers for each species was observed once a week from June 4, 2010 – August 11, 2010. A 100cm x 50cm grid with 10 x 10cm cells was placed in the center of each experimental plot, and only flowers within this area that had not senesced were counted.
- Same areas were examined to determine % cover of each species in order to calculate weighted value of flowers over presence of species.
- ANOVA tests were used to determine effect of treatment, grazing, and their interaction on the total number of flowers for 17 species and median flower date for 6 species. The 17 species made up 84% of the total vegetation cover and were dominant species in the region.

Design of Each Block on the Lower Slope



Open top chambers (OTCs) in one of the blocks



Discussion

The plants that were affected by grazing and warming generally experienced a lower flower production. Two species did show a significant difference in flower production due to additive processes. Unlike in prior literature, very few species experienced a change in median flower date. This contrast with trends observed in other systems could be due to the fact that this area is very dry. Rather than advancing blooming, like in high latitude or temperate regions, a warming chamber could act as a stressor in this arid region. Responses may also be species specific because each plant reacts differently depending on many factors: the growth period of the plant, the type of plant (perennial vs. annual, shrub vs. forbs vs. grasses), and differing blooming time in the growing season. Plant reactions may also be influenced by the reactions of other plants. This study reveals the complexities of plant property reactions to global change.

Effect	Art. Com.	Bup. Bic.	Fes. Len.	Hel. Sch.	Koe. Mac.	Sib. Apr.
Treatment	0.8253	0.0257	1.8421	0.6626	5.8166*	1.1363
Grazing	0.9238	2.1689	0.7975	1.7528	3.6269	0.0648
Treatment x Grazing	0.9238	0.1638	0.0805	0.2038	0.4527	0.0768

Results of ANOVA on median flowering date. F-values for main effects and interactions are presented. For level of significance, *P<0.05

References

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