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Relative roles of different-sized herbivores and plant-plant interactions in tall shrub tundra vegetation

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Tall shrubs play important roles in the ecology of Arctic tundra ecosystems, including support of high shrub-associated biodiversity and regulation of a range of ecosystem processes. Tall shrub patches and herbaceous vegetation surrounding them often form a two-state vegetation mosaic. Such tall shrub tundra vegetation is an important locus for current vegetation changes in the Arctic. Both abiotic and biotic drivers are known to influence the shrub component. However, although expansion of the shrub state has received much focus lately, relative strengths of the multiple drivers of vegetation state are currently not fully understood. We investigated the role of herbivory relative to temperature and relative to plant-plant interactions, conducting a field survey and experimental studies at large spatial scales in riparian tall shrub tundra in Norway. We found both summer temperatures and summer grazing by reindeer (Rangifer tarandus) to affect tall shrub distribution and expansion potential. Furthermore, we found strong and rapid shrub growth change in response to abundance of key arctic herbivores; small rodents. Finally, we quantified the relative importance of neighboring plants and both herbivore types to recruiting tall shrubs. The previously unforeseen rate at which tall shrub tundra responded to altered herbivore pressures further exemplifies its central role in the tundra ecosystems, promoting tall shrub tundra as a bell-whether of change with respect to both abiotic and biotic drivers. While many of the results clearly relate to herbivory, neighboring plants or climate as drivers, some variation remains unexplained warranting future research focus on this highly dynamic part of the tundra ecosystem. Our results suggest that spatially variable biotic interactions are likely to modify forcing by climate, calling for an ecosystem approach when studying change in tundra ecosystems.