A novel approach to predicting species responses to climate change in Canadian prairies

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This is a summary of a progress report prepared for the Biodiversity Management and Climate Change Adaptation project that is currently in preparation for publication.

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Understanding the impacts of global change on vegetation is one of the largest challenges today, as shifts in vegetation will have implications for provision of important ecosystem services and conservation of various taxa. The aim of this project was to extend on and combine the logic of correlative species distribution models with mechanistic community processes captured by climate and grazing manipulation experiments across the Canadian prairies. In doing so, we aimed to make more accurate predictions for vegetation change at the community level in future climate and land-use scenarios.

We used ABMI records to map plant species occurrence and climatic niche distribution, subsequently categorizing them into functional groups of similar climatic type (Climatic Niche Groups) i.e. species found in drier/warmer or wetter/cooler regions. We followed the performance of these Climatic Niche Groups within a fully factorial experiment carried out across three sites in Saskatchewan, Alberta, and Manitoba, where climate (increased temperature, decreased precipitation) and grazing (simulated through clipping) treatments were applied.

We predicted that groups of species common in wetter/cooler regions would respond more negatively to reduced precipitation and increased temperature than groups of species frequently observed in drier/warmer regions. Additionally, we expected species common in drier and warmer regions to perform better under grazing as traits selected for under dry conditions are expected to be beneficial under grazing pressure.

Generally, the patterns in the groups' responses were in accordance with our predictions. Moreover, patterns were strongest and statistically more significant when treatments were applied simultaneously, as adding them potentially increased the aridity effect imposed. Differentiation in the groups' responses to the treatments was most pronounced at the wettest, coolest of the three experimental sites (Manitoba), and became weaker towards the driest, warmest site (Saskatchewan). Interestingly, over 5 years of manipulations at the Alberta site, trends with prediction towards an increase in relative abundance of dry/warm species – together with decreasing relative abundance of wet/cool species - were found in response to warming and reduced precipitation when plots were subjected to simulated grazing, while such trends were absent in unclipped plots.

Therefore, drawing some initial conclusions, our results suggest that prairie sites in drier/warmer regions may be less prone to predictable changes in community structure, where species may currently possess greater adaptations to aridity. Furthermore, our findings potentially indicate that a reduction in grazing intensity or frequency could be an effective management solution to minimize climate change impacts on community structure in the prairies, consequently supporting ecosystem functions and habitats for a variety of species.