Grasslands in a changing climate: How do we build resilient ecosystems?

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Abstract

To understand how grasslands may "keep up" with climate change, we need to understand the basis for their responses to changing environmental conditions. By planting material from a range of locations in the Great Plains, we have a setting to elucidate how different populations could potentially fill the expanding C3 niche in North Dakota. We planted 48 plots consisting of four treatments from regions across the great Plains and three cool-season grasses.

Figure 1. UND site near Turtle River State Park, Arvilla, ND. Picture taken June 21, 2017.

Introduction

The term assisted dispersal originally emerged in invasion biology, referring to the movement of non-native species both knowingly and unknowingly by humans. In recent years, the term has been co-opted to refer to the intentional movement of novel species or ecotypes to an ecosystem to fill an ecosystem function that has been altered due to climate change. This movement of ecotypes into new regions as the climate shifts has been one proposed way of creating resilient communities.

In North Dakota, the idea of assisted dispersal is even more pertinent because of our current dominant species—cool-season invasive grasses. Kentucky bluegrass (*Poa pratensis*) and smooth bromegrass (*Bromus inermis*) are currently the dominant species in what should be our most pristine prairies (Dekeyser et al, 2015). Both grasses green-up in the early spring and as the climate has started to shift toward longer growing seasons, there is a new climactic niche in the environment filled in by these invasive grasses with little to no competition from native species. Models predict more precipitation and longer growing seasons for the North Dakota climate (Shafer et al, 2014). Our aim is to test whether we can restore prairies that are potentially more resilient to invasive species by increasing the competition in that new climactic niche by introducing southern ecotypes of native cool-season grasses. Our hypothesis is that if we grow different ecotypes of grasses from southern latitudes, some of these grass ecotypes will green-up earlier and compete with invasive species within that niche.

Objectives

- Identify performance of local ecotypes compared to southern ecotypes in a common garden.
- Assess phenology of three species from four ecotypes.
- Determine community structure of plots from different regions to assess whether communities thrive with local ecotypes or more southern ecotypes.

Methods

We set up a total of 48 1 m x 1 m plots at the University of North Dakota research plot near Arvilla, North Dakota (Fig. 1). The species of interest were Prairie dropseed (*Sporobolus heterolepis*), Canada wildrye (*Elymus canadensis*), and Junegrass (*Koeleria macrantha*). The plots are in a randomized block design consisting of one control, three treatments, and 12 replicates of each plot type. The control plot is of a Western Minnesota origin. The three treatments are from reputable native ecotype producers in Minnesota (Prairie Restorations, Inc. and Shooting Star), Iowa (Prairie Moon), Nebraska (Prairie Legacy) and Missouri (Hamilton Seed Post). These regions consist of Iowa, Nebraska, Wisconsin, and Missouri which represent a range of current and future climate scenarios (Fig. 2).

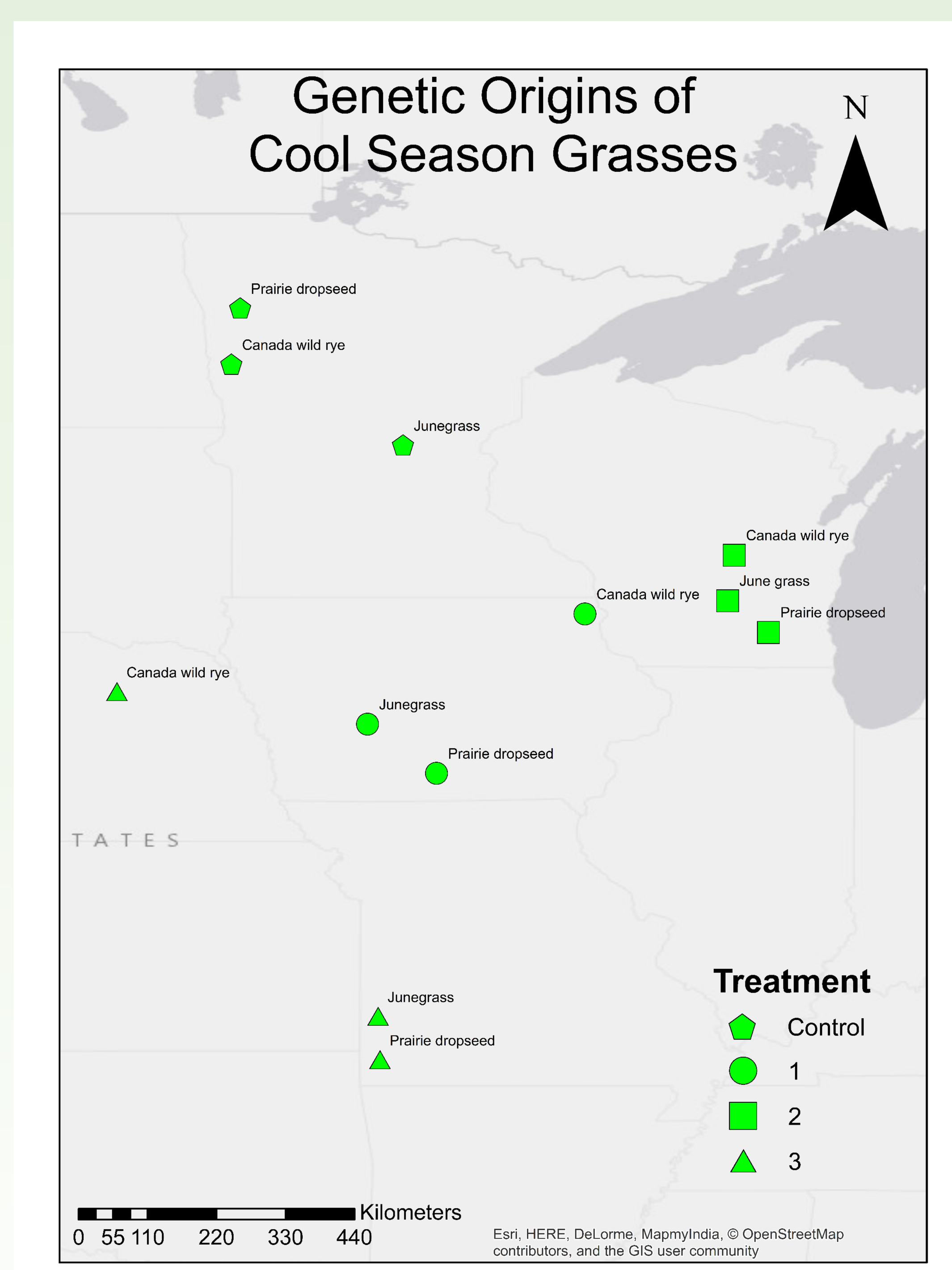

Figure 2. Origin locations for each ecotype of grass. Each location was a remnant prairie.

Methods (cont.)

Ecotype regions were chosen based on availability and representing future climate scenarios in North Dakota. Three species of cool-season grasses were planted at each plot along with three forbs and three warm-season grasses. In addition to the 48 plots, we also set up a monoculture of each of the cool-season grass ecotypes (12 plots) to better assess phenology.

Plots were originally planted in late May of 2017, but because of a late planting date and a focus on cool-season grasses we determined that emergence rates were too low (Fig. 2-4).

Plots were replanted in the Fall of 2017 after three Glyphosate treatments. The plots were tilled in October 2017. We marked each corner of the plots with PVC pipe and labeled each with a plot number.

Figure 3. (Top) Plot 48 seeded with, Elymus canadensis, Koeleria macrantha, and Sporobolus heterolepis, June 22, 2017. (Bottom) Plot 48 with new growth, July 5, 2017.

Methods (cont.)

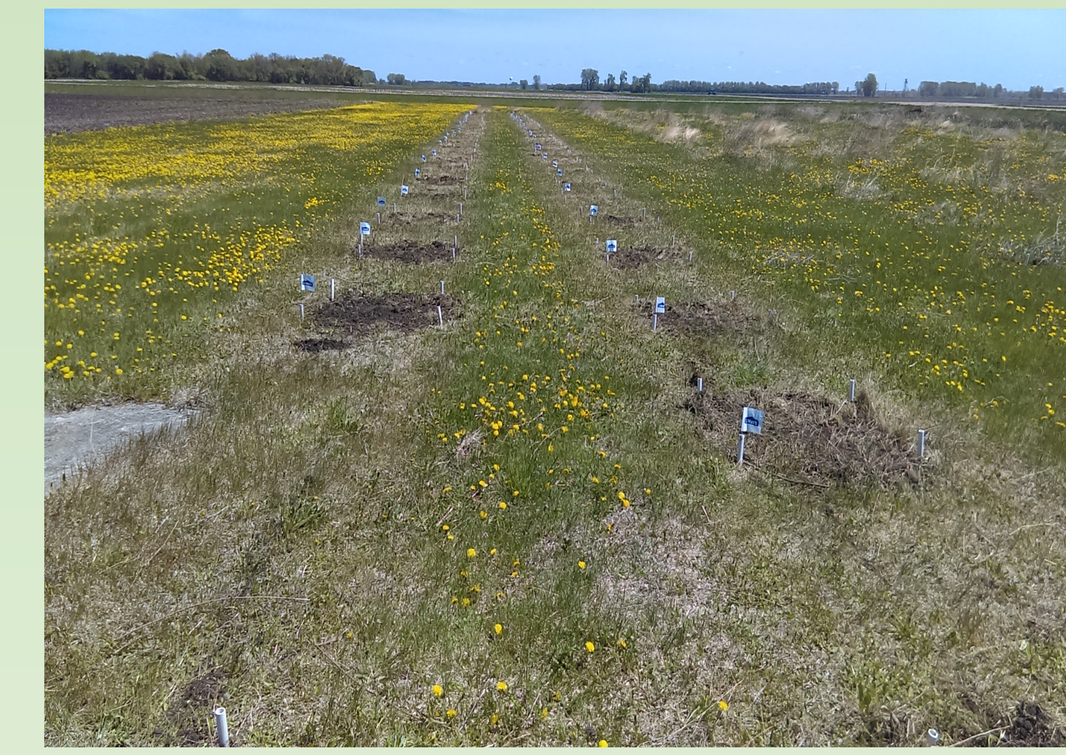

Figure 4. After seeding all 48 plots. Picture taken June 22, 2017.

Potential conclusions

We aim to assess whether communities may thrive with more southern ecotypes of grasses.

Hypothesis 1: Southern ecotypes result in a more even grassland community.

Accept if there is a significant difference in community structure between ecoregions.

Hypothesis 2: Southern ecotypes will out perform native ecotypes.

Supported if more biomass is produced in southern ecotype's monoculture plot.

Supported if seed counts are higher in southern ecotype monocultures.

Supported if southern ecotype phenology is earlier than native ecotypes.

References

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