North Central
Climate Adaptation
Science Center

Prairie Climate Companion

Informing adaptive grassland management in the North Central region where winds are strong, the grazers are good-looking, and the temperature… is above average.

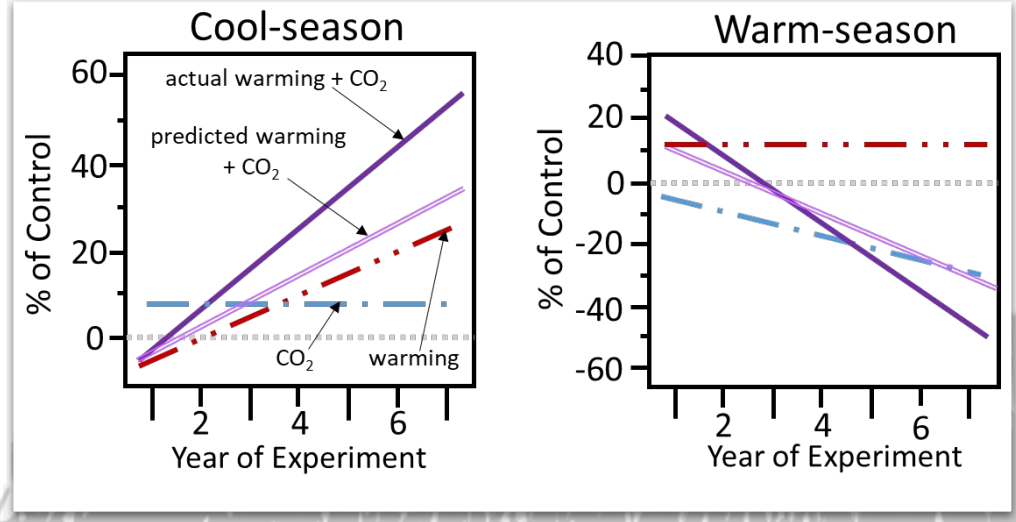
Native Plant Composition & Diversity

The Issue

Changing climate will expose plants to conditions changing at more than **20 times the rate** of recent evolutionary history. Great Plains **species will have to shift great distances** to keep pace with these changing climate conditions.

Climate change will have **different impacts on different species and groups of species**. Individual plant species have traits that make them more or less sensitive to shifts in temperature, precipitation, and carbon dioxide. Thus, shifts in overall community composition and species diversity are difficult to predict, but novel combinations of species are highly likely.

Of particular interest are cool-season and warm-season grasses, which often provide **complementary ecosystem services**. Relative abundances of cool-season and warm-season grasses are likely to shift with climate change. From a physiological perspective, cool-season grasses should benefit from increased carbon dioxide and warm-season grasses should benefit from warming, but **few studies have evaluated the combined effect of increases in carbon dioxide and warming temperatures**, particularly over long timescales.



Source: Image adapted from Mueller & others, *Ecology Letters*, 2016.

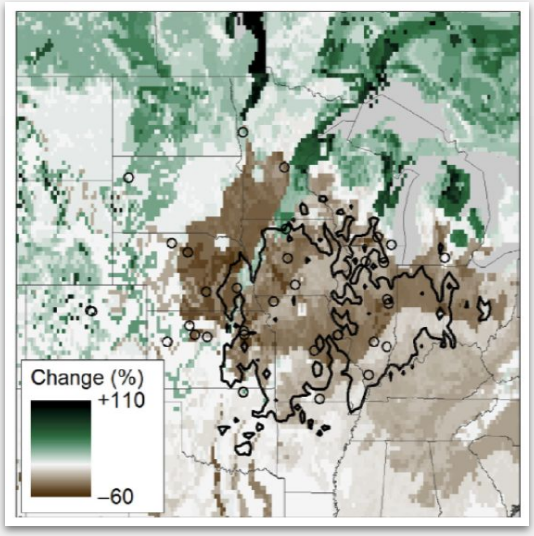
In a 7-year experiment in a Wyoming grassland, cool-season perennial grasses increased through time with warming alone and warming + elevated carbon dioxide [CO_2], but showed no trend with just elevated [CO_2]. Warm-season grasses showed more sensitivity to long-term elevated [CO_2] and switched from responding positively to responding negatively to warming + elevated [CO_2]. For both grass types, the actual effect of warming + elevated [CO_2] differed from the effect predicted by adding individual effects of warming + elevated [CO_2].

Implications for Grasslands Management

A shift in the ratio of cool-season to warm-season grasses could have major impacts on the timing and quality of **forage production**, the total amount of **plant biomass** produced each year, **wildlife habitat**, and other ecosystem services in Great Plains ecosystems.

Although paleoecological records show that many plant species naturally migrate in response to climate changes, various studies demonstrate the **inability of plant populations to track modern-day warming**.

In North Central grasslands, plant migration is hampered by the predominance of vegetative reproduction and highly fragmented landscapes. Consequently, **assisted migration** – the purposeful, human-mediated transfer of seeds or plants to new locations – may need to be carefully considered.



Projected change in big bluestem biomass by 2070 for the RCP8.5 greenhouse gas emission pathway. From Johnson and others, *Journal of Ecology*, 2021.

Selected Resources

Seeds of Success is the national native seed collection program, led by the Bureau of Land Management. The webpage has guidelines and strategies for collecting seeds for assisted migration, conservation, and restoration.

NatureServe Climate Change Vulnerability Index identifies plant and animal species that are particularly vulnerable to the effects of climate change. Managers can use the index to predict whether a plant may experience a range contraction due to climate change.

USDA Plants Database provides standardized information about the vascular plants, mosses, liverworts, hornworts, and lichens of the U.S. and its territories.

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Check out the synthesis report here!

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