RESEARCH BRIEF

SPRING 2026

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Management actions interact with climate change in restored prairies

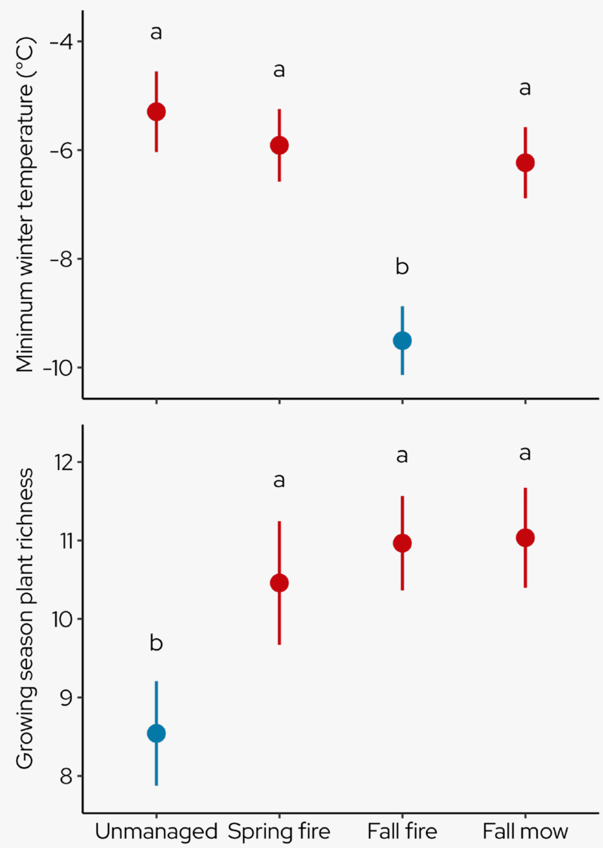
Fall fires can worsen extreme winter conditions caused by climate change in restored prairies, but plant communities showed minimal response to these changes over seven years of study.

The prairies of the Midwest provide crucial habitat for a wide variety of plants and animals, offer spaces for outdoor recreation, and contribute essential ecosystem services for both people and wildlife. Yet more than 99% of prairies in this region have been lost to land-use change. As agricultural land is increasingly abandoned, opportunities are emerging to restore these vital ecosystems. Restoration and land management practitioners are actively working to bring back prairies, but to ensure long-term success, these efforts must be designed with climate resilience in mind.

In the Midwest and other temperate regions, the effects of climate change are more pronounced in winter than in other seasons. Warmer winters often bring less snow, reducing insulation and leaving overwintering plants and animals more exposed to extreme cold. These conditions can worsen or improve depending on the timing and type of management activites. Prairies in this region are typically maintained by frequent, low-intensity disturbances such as spring or fall prescribed fire and mowing, which also influence insulation by altering plant litter. A key question for managers is how winter climate change might interact with management actions to affect restoration outcomes.

KEY RESEARCH FINDINGS FOR RESTORATION AND MANAGEMENT

- Experimental fall fire and reduced snow depth led to colder minimum winter soil temperatures
- Any experimental management action, including spring or fall fire and fall mowing, equally enhanced prairie plant richness and diversity
- Prairie plant communities remained remarkably resilient under experimentally altered winter condtions over seven years



Minimum winter soil temperature (top) and growing season plant richness (bottom) across management treatments, averaged over snow depth. Points show means and lines standard errors. Letters and colors mark significant differences among management treatments.

In collaboration with land management partners, our research team developed an experiment to test how prairie plant communities respond to different management actions applied at various times of year under simulated future winter conditions. Because many prairie plants are long-lived perennials, detecting change and disentangling the effects of management from those of climate change can take years to decades. To date, we have collected and analyzed seven years of data to identify when and which management practices best support prairie resilience to climate change.

We found that management actions interacted with winter climate to produce colder minimum winter soil temperatures when prescribed fire was applied in the fall and snow depth was reduced to simulate future winter conditions. This likely occurred because fall fires remove insulating plant litter without time for it to regrow and accumulate before winter, while experimentally reduced snow depth further limits insulation from extreme cold. Together, these changes can lower average winter soil temperatures, potentially affecting plant survival, growth, and long-term community composition.

However, we also found that while management actions significantly altered plant community composition, winter climate had no comparable effects over the past seven years. Regardless of management timing or type, all management actions increased plant richness and diversity compared to unmanaged areas, likely reflecting the positive role of disturbance in maintaining prairie structure. In contrast, reduced snow depth did not alter these metrics, suggesting that prairie plant communities can tolerate more extreme winter conditions than previously anticipated. Continued monitoring will be essential to determine whether additional management or climate change effects emerge over longer timescales.

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ABOUT THE RESEARCH TEAM

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Christopher R. Warneke is a Research Associate at the University of Wisconsin-Madison. Christopher has been the primary data manager for this project since 2022.

Ellen I. Damschen is a Professor and Associate Chair at the University of Wisconsin-Madison. She is the Principal Investigator on the current and former grants associated with this project.

For more information about this research, please see the associated academic papers published in *Ecosphere* (2022) and *American Journal of Botany* (2025) and visit the Damschen Lab website for biannual project updates.