Grasslands Synthesis Project

Findings and Next Steps

NC CASC Webinar Series
May 11, 2023

North Central Climate Adaptation Science Center
Grasslands Synthesis Project

Presentation outline

- Project impetus and design
- Methods and process
- Findings and outputs
- Next steps and future research

**All resources are linked at the end of this presentation**
Grasslands Synthesis Project – why and how?

- NC CASC had not done much work with grasslands managers or in the grassland ecosystems in the region.
- Designed a project that would provide a baseline of information needs and available science.
- Focused on available info to reduce stakeholder fatigue.
- 3 Groups
- 59 People
- 96 Zoom Meetings
- 20 Months
- 183 Management Documents
- 994 Climate & Ecology Papers

- 2 USGS Open File Reports
- 2 Data Releases
- 1 Training Series
- 2 Full Reports
- 682 Pages
- 15 Fact Sheets
Grassland Management Priorities for the North Central Region

Synthesis of Climate and Ecological Science to Support Grassland Management Priorities in the North Central Region

Open-File Report 2023–1037

Open-File Report 2023–1036
Identify Research Questions
Identify Key Partners & Stakeholders
Communicate Information Needs
Identify Agencies with Similar Goals

Synthesis of Climate and Ecological Science to Support Grassland Management Priorities in the North Central Region

Identify Research Questions
Ideas for Building Interdisciplinary Teams

Summaries of Climate Impacts on Grasslands
Grassland Management Priorities for the North Central Region

Open-File Report 2023–1037

USGS
Science for a Changing World

U.S. Geological Survey North Central Climate Adaptation Science Center
Prepared in cooperation with the University of Colorado Boulder

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## Goals for Grassland Management

### Table C2. Primary grassland management goals.

[Primary goals for each management entity were identified by the review of grassland-relevant management documents and by informal consultation with Tribal members (see “Chapter A—Background and Methods”). BLM, Bureau of Land Management; FWS, U.S. Fish and Wildlife Service; NPS, National Park Service; FS, U.S. Department of Agriculture, Forest Service; NRCS, U.S. Department of Agriculture, Natural Resources Conservation Service; FSA, U.S. Department of Agriculture, Farm Service Agency; U.S., United States; NGOs, nongovernmental organizations; —, not applicable]

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<th>NPS</th>
<th>FS</th>
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<td>Historic and cultural preservation</td>
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<td>Energy development</td>
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# 15 Main Information Needs

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<th>Section</th>
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<td>Grassland loss and fragmentation</td>
<td>1. Where are grasslands most likely to be lost to other land uses?</td>
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<tr>
<td>Grassland loss and fragmentation</td>
<td>2. What are best practices for grassland restoration in a changing climate?</td>
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<td>Disruption of historical disturbance regime</td>
<td>3. How will climate change affect disturbance regimes?</td>
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<td>Woody encroachment</td>
<td>4. How will climate change impact woody encroachment?</td>
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<tr>
<td>Herbaceous invasives</td>
<td>5. How will climate change impact herbaceous invasives?</td>
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<td>Unsustainable grazing</td>
<td>6. How will climate change impact grazing?</td>
</tr>
<tr>
<td>Change in water quality and quantity</td>
<td>7. How will climate change impact water quality, quantity, and availability?</td>
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<td>Wildlife population declines</td>
<td>8. How will climate change affect animal species of conservation concern?</td>
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<td>Conservation on private land</td>
<td>9. How can conservation on private grasslands be achieved?</td>
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<td>Public understanding of grasslands</td>
<td>10. How can public understanding of grasslands and their importance increase?</td>
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<tr>
<td>Legal and policy drivers</td>
<td>11. What legal and policy changes can support grassland resilience to climate change?</td>
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<tr>
<td>Economic incentives</td>
<td>12. How can grassland protection, enhancement, maintenance, and reconstruction be economically incentivized?</td>
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<tr>
<td>Coordination of actions across agencies, organizations, jurisdictions, and borders</td>
<td>13. How can grassland management be strategically coordinated across agencies, organizations, jurisdictions, and borders?</td>
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<tr>
<td>Availability of useable science and tools</td>
<td>14. How can the accessibility of relevant science and tools be improved?</td>
</tr>
<tr>
<td>Frameworks for conceptualizing problems and solutions</td>
<td>15. What novel ways of thinking are needed to successfully manage grasslands amidst climate change?</td>
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</table>
Synthesis of Climate and Ecological Science to Support Grassland Management Priorities in the North Central Region
Temperature, Precipitation, Water, & Fire

By Imtiaz Rangwala, Jilmarie Stephens, Katherine J. Chase, Owen P. McKenna, and David L. Hoover

- **Temperatures** across the North Central region have increased by 1–2 degrees Fahrenheit (°F) since the early 1900s and they are projected to increase by 4–6 °F by the mid-21st century and 5–10 °F by the late-21st century, depending on future greenhouse gas emissions.
- **Precipitation** has increased across much of the region in all seasons.
- Warmer temperatures are expected to offset increases in future precipitation and affect water demand and availability.
- Increased temperatures will result in more precipitation falling as rain rather than snow in the future, leading to more runoff and streamflow in winter and spring and decreased runoff and streamflow in late summer and fall, with some spatial variation.
- There is considerable uncertainty on how changes in temperature, precipitation, snow, and runoff will affect groundwater recharge.
- Observed and projected increases in wildfire frequency and size are expected from increases in temperature.
Vegetation

By Amy J. Symstad, David J. A. Wood, Shelly Crausbay, Jesse Nippert, Lauren Porensky, R. Chelsea Nagy, Brian W. Miller, Danika Mosher

- Climate change impacts grassland vegetation across the North Central region in a context of altered disturbance regimes and the introduction of novel species.
- The balance between cool season (C3) and warm season (C4) grasses is likely to shift with climate change, which has critical implications for biodiversity, productivity, livestock forage, and wildlife habitat.
- Interacting effects of land-use change and disturbance regimes have already facilitated an increase in woody plants in historically grass-dominated areas over the last 100 years.
- Predicting effects of climate change on invasive species in North Central grasslands would benefit from a clear understanding of the current extent, abundance, and composition of these grasslands.
- Climate change will affect the net primary productivity and timing of plant biomass production.
- Grassland ecosystems in the North Central region may undergo transformation to another ecological community; however, such transformations are notoriously difficult to predict.
Climate change will put additional stress on wildlife populations by synergistically interacting with other environmental disturbances to shift and fragment wildlife habitat and alter the timing of species lifecycles.

Little is known about how climate change will shift or fragment the prairie dog ecosystem; however, suitable habitat for black-tailed prairie dogs has been projected into the future under warm-and-wet and hot-and-dry climate scenarios.

Grassland birds that breed in the North Central region are of significant conservation concern because their populations have declined the most among all habitat-based groups in North America.

Climate change is expected to significantly affect the hydrology of grassland streams and the fish that occupy them.

Climate change will synergistically interact with other environmental disturbances to negatively impact many arthropod species.

Conservation must incorporate consideration of socioeconomic context and policy and relevant spatial scales.
The impacts of climate change through warming temperatures and changes in cold and hot extremes throughout the year will have direct effects on **energy budgets** of **large-bodied grazing species** across the North Central region throughout the 21st century.

Rising mean annual air temperature increases **energy use** for **thermoregulatory** and **metabolic functions** of large-bodied grazers, which results in **reduced body size**.

Potential decline in the **availability** and changes to the **nutritional quality** of **palatable forage** will indirectly affect grazing species’ growth, health, and performance.

Although **exposure** to various direct and indirect effects of climate change may be similar across the North Central grasslands, **sensitivity** and **adaptive capacity** will vary geographically.

There are several ways to reduce the impacts of climate change on grazing, including **converting marginal cropland** back to perennial grasslands, **increasing plant diversity**, and **planting nutritious forbs** in existing grasslands.
Land Use Change
By Heather M. Yocum, Christine D. Miller Hesed, Julie Elliott, and Jeremy Pittman

- Changes in land use are driven by complex interactions between the availability of biophysical resources and socio-economic factors, both of which will be impacted by climate change.
- Climate change will impact which areas are suitable for grazing or growing certain row crops, and which areas could be prioritized for restoration.
- Wind-energy development is an important contributor to the decarbonization of the energy sector, but it can fragment and degrade grassland habitats and lead to increased mortality for birds, bats, and other species.
- Urban, suburban, and exurban development has increased in the North Central region since the 1950s and continues to lead to grassland loss, fragmentation, and degradation.
- As climate-driven changes in precipitation and temperature impact agriculture, it may be possible to identify lands that are no longer optimal for row-crop agriculture and target them for restoration or conversion to sustainable grazing land, which can benefit grassland species and rural communities.
Remaining Research Needs

By Christine D. Miller Hesed, David J. A. Wood, Heather M. Yocum, Brian W. Miller, Imtiaz Rangwala, Lauren Porensky, Jeff M. Martin, Marissa Ahlering, & Amy J. Symstad

- Synthesizing research in the **social sciences** will be necessary to address grassland managers’ broadly shared information needs.
- **Collaboration with tribal members** and integration of scientific and **traditional knowledge** could help to inform successful grassland management in the face of climate change.
- There are **gaps** in the existing information, and that research is needed to, for example:
  - Refine **spatial** and **temporal** analyses for future changes and improve understanding of **extreme weather events**;
  - Improve **predictions** of changes in **hydrology**, **streamflow**, and **soil moisture**;
  - Study **interactions** among invasive species, fire, CO2, warming, drought, woody encroachment, grazing, and climate;
- Collaboration between **researchers** and **grassland managers** in developing future research projects will ensure that the information gained will be **relevant**, **accessible**, and **usable** for informing climate-smart management decisions.
3 Groups
59 People
96 Zoom Meetings
20 Months
183 Management Documents
994 Climate & Ecology Papers

Synthesis

2 USGS Open File Reports
2 Data Releases
1 Training Series
2 Full Reports
682 Pages
15 Fact Sheets
Broadly Shared Information Needs Among Grassland Managers in the North Central Region

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<th>Information Needed</th>
<th>Federal Agencies</th>
<th>State Fish and Wildlife</th>
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<td>X H X X H H H H H H H H</td>
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<td>X H H H H H H H H H H</td>
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<td>1.3 Where is urban and suburban development likely to occur as the climate changes?</td>
<td>X S S X X S S S S S</td>
<td>X S X X S S S S S S S</td>
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2 Data Releases, 1 Training Series, 2 Full Reports, 682 Pages, 15 Fact Sheets
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<th>Scientific Name</th>
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<th>MT</th>
<th>NE</th>
<th>ND</th>
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GRASSLANDS & CLIMATE
Training Series

VIRTUAL TRAININGS AND WEBINARS

- Introduction to the Basics of Climate Change
  Provided as an online course designed for grasslands managers May 16-27, 2022
  video recordings.
- Overview of Climate Change Impacts to Grasslands Ecology
  Webinar held June 13, 2022. Click here to access the recording.
- Understanding and Using Future Projections for Landcover Changes
  Webinar held July 20th 2022. Click here to access the recording.
- Understanding and Using Future Projections for Trust Species
  Webinar held August 31st 2022. Click here to access the recording.

IN-PERSON CLIMATE ADAPTATION WORKSHOP

This event was held in January 2023. A list of speakers’ bios can be found here.

https://southcentralclimate.org/resources/webinars-workshops/training-for-grasslands/
Management Priorities Full Report

- Differentiates threats and opportunities by grassland ecoregion (e.g. tallgrass, shortgrass, etc.)
- Provides “biographies” of grassland management agencies
- Discusses some of the many grassland management goals and challenges for tribal nations
- Organizes more specific information needs by grassland management entity

Climate & Ecological Science Synthesis Full Report

- Provides full chapters on the main topics briefly described in the Open File Report
- Provides a full chapter discussing future needed research and next steps
- Organizes synthesized information according to the list of 70 questions identified by the Management Priorities Working Group.
North Central Climate Adaptation Science Center

Prairie Climate Companion

The Issue: Temperature

Temperatures across the North Central region of the US have increased by 1 to 2°F since the 1980s. They are projected to increase by 4 to 6°F by the mid-21st century and 5 to 9°F by the late 21st century, depending on our future greenhouse gas emissions.

The Issue: Precipitation

Precipitation has increased across much of the region in all seasons in recent decades. Climate models are projecting significant increases in winter and spring precipitation and plausible decreases in summer precipitation.

Implications for Grasslands Management

Changing seasonal patterns of water availability, which could include wetter springs and drier late-somers and falls, will decrease windows for conducting prescribed burns. It could increase wildfire risk and may decrease availability of late-summer and fall forage for livestock and wildlife.

The projected increase in flash droughts and hotter droughts may result in direct mortality of wildlife and plant species in their current range. Improved habitat connectivity or translocation may be required to allow species to migrate to suitable conditions.

Incorporating greater flexibility in the timing and application of grassland-management practices will be important for responding to increased climate variability.

Selected Resources

- The Climate Tracker is a collection of web tools for visualizing past and projected climate and hydrology of the contiguous United States, including:
  - The Historical Climaterg shows monthly average climate for a location.
  - The Historical Climaterg Tracker which shows graphs and trend lines for historical climate variability for a location.
  - The Climate Mapper which maps historical and future climate information across multiple sectors.

The output from this tool is compatible with applications on GIS-type analytical platforms.

Contacts

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- Dr. Heather Yacso, Principal Investigator, NC CASC, heather.yacso@fws.gov
- Dr. Christy Miller Hood, Regional Climate Adaptation Scientists, NC CASC, miller.hood@fws.gov

Check out the synthesis report here!
Next Steps

SOCIAL SCIENCE

GRASSLAND MANAGERS
Links for reports and other resources

- Grasslands Roadmap: https://www.grasslandsroadmap.org/
- Climate & Ecology OFR: https://pubs.er.usgs.gov/publication/ofr20231036
- First Data Release: https://www.sciencebase.gov/catalog/item/6324ada1d34e71c6d67b58bc
- Second Data Release: https://www.sciencebase.gov/catalog/item/6324ac07d34e71c6d67b58b4
- Grasslands & Climate Training Series: https://southcentralclimate.org/resources/webinars-workshops/training-for-grasslands/
- Grassland website to access 2-pagers: https://nccasc.colorado.edu/grasslands
  - Email Dr. Miller Hesed if you’d like to be added to the mailing list to receive the 2-pagers as they are released: christine.hesed@colorado.edu
THANK YOU

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