Grasslands Synthesis Project

Findings and Next Steps

NC CASC Webinar Series

May 11, 2023

North Central Climate Adaptation Science Center

Grasslands Synthesis Project

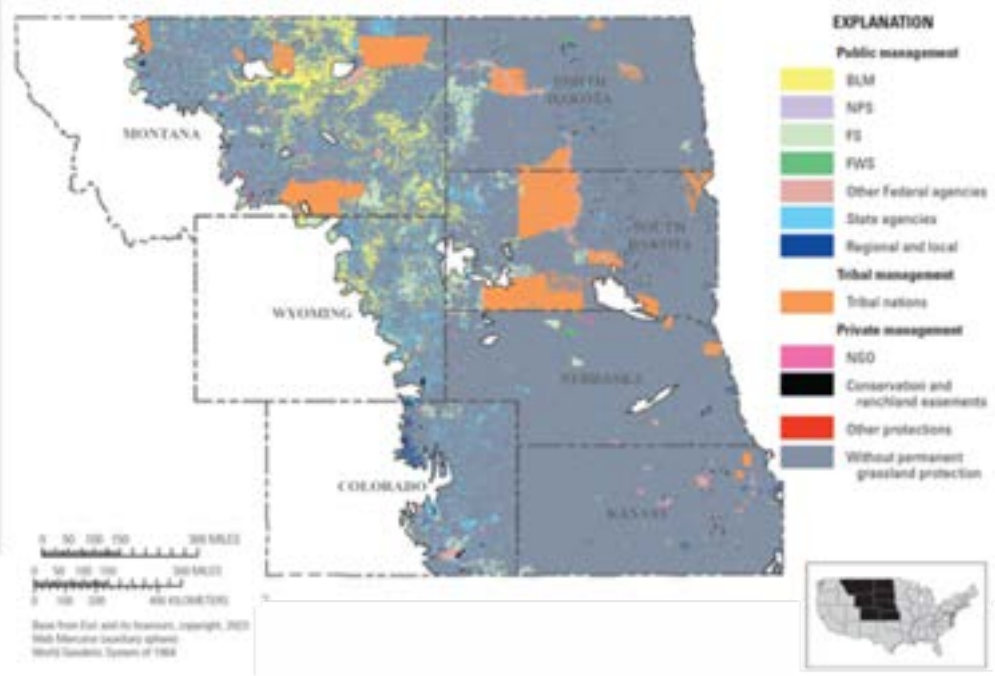
Presentation outline

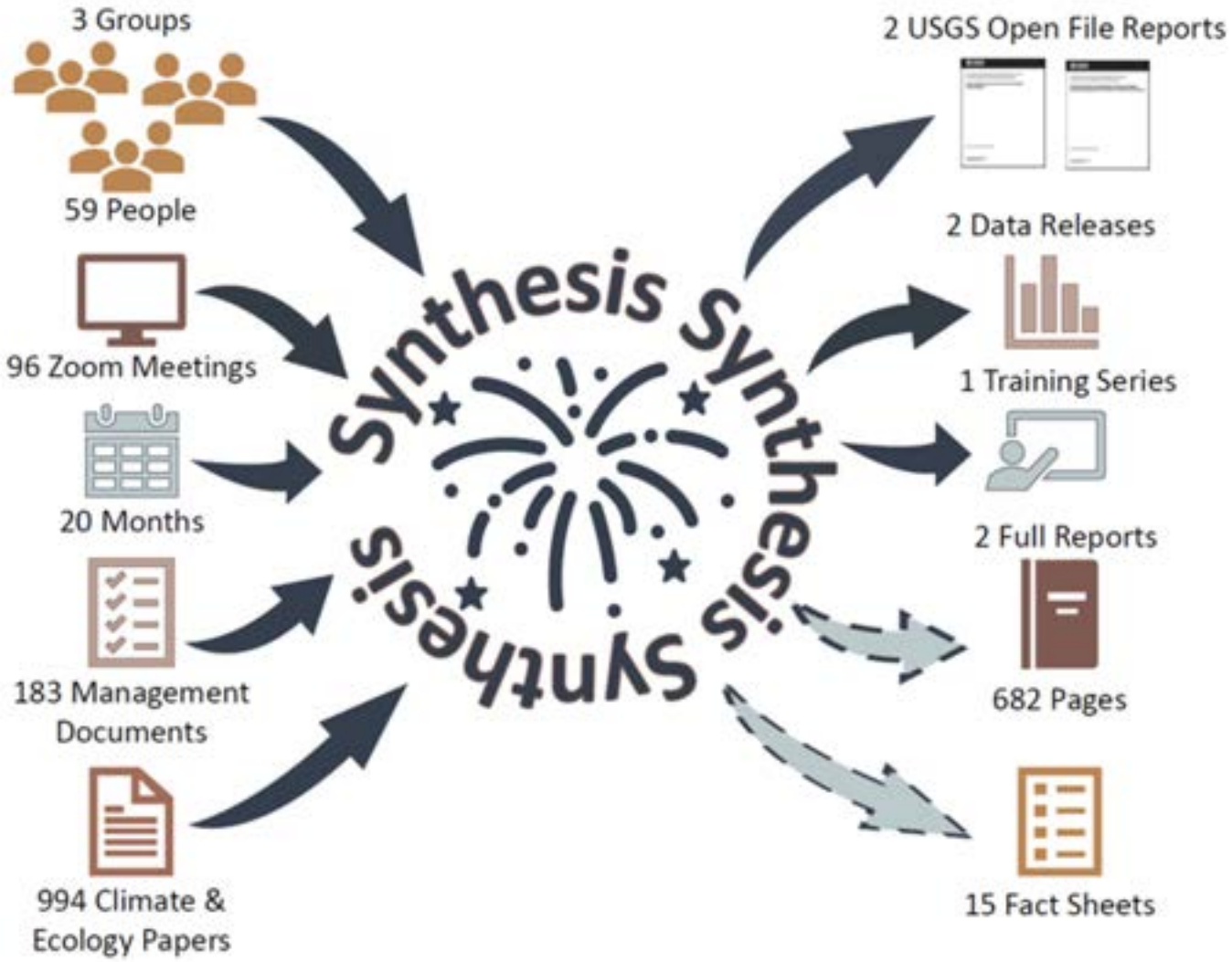
- Project impetus and design
- Methods and process
- Findings and outputs
- Next steps and future research

**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
Synthesis
2 USGS Open File Reports
2 Data Releases
1 Training Series
2 Full Reports
682 Pages
15 Fact Sheets

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

Grassland Management Priorities for the North Central Region

Open-File Report 2023–1037

U.S. Department of the Interior
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Synthesis of Climate and Ecological Science to Support Grassland Management Priorities in the North Central Region

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Grassland Management Priorities for the North Central Region

Identify Research Questions
Identify Key Partners & Stakeholders

Communicate Information Needs
Identify Agencies with Similar Goals

Open-File Report 2023–1037

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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

Open-File Report 2023–1036

U.S. Department of the Interior
U.S. Geological Survey

https://pubs.er.usgs.gov/publication/ofr20231037

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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]

Primary goals	BLM	FWS	NPS	FS	NRCS and FSA	Tribal nations	State agencies	NGOs	Private landowners
Conservation	X	X	X	X	X	X	X	X	X
Recreation	X	X	X	X	—	X	X	X	—
Productive grazing of livestock	X	—	—	X	X	X	—	—	X
Historic and cultural preservation	X	—	X	X	—	X	X	—	—
Energy development	X	—	—	—	—	X	X	—	—

15 Main Information Needs

Table C1. Organization of "Chapter C—Grassland Management Goals, Challenges, and Information Needs" sections by type of conservation challenge and information needed.

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

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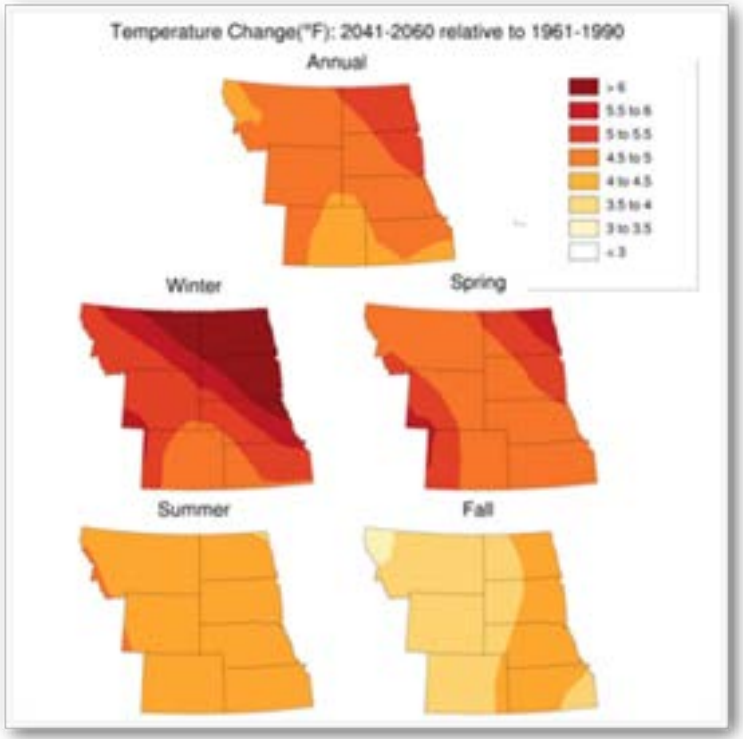
https://pubs.er.usgs.gov/publication/ofr20231036

Temperature, Precipitation, Water, & Fire

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

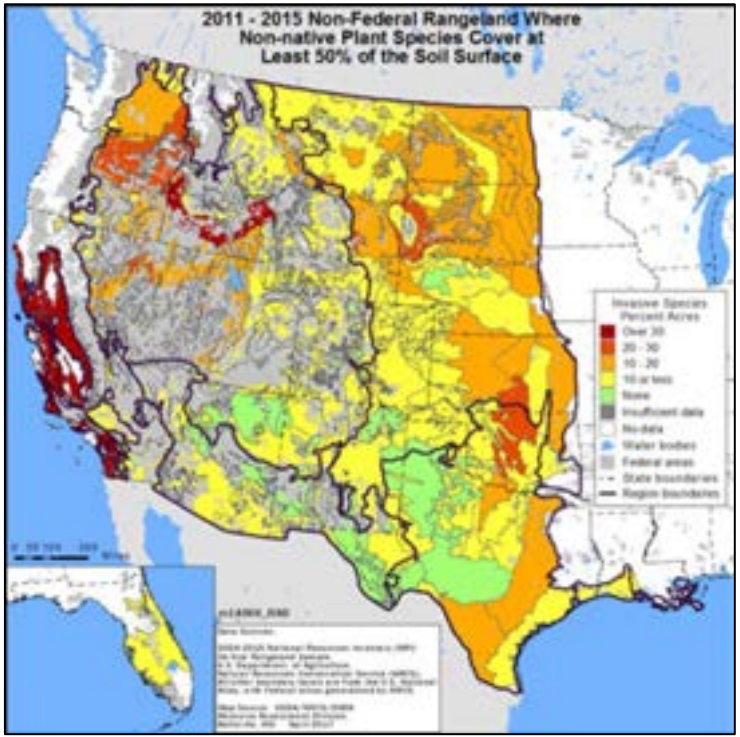
- **Temperatures** across the North Central region have increased by 1–2 degrees Fahrenheit (°F) since the early 1900s and they are projected to increase by 4–6 °F by the mid-21st century and 5–10 °F by the late-21st century, depending on future greenhouse gas emissions.
- **Precipitation** has increased 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.



From USDA-NRCS

Wildlife

By Kevin Ellison, Ana Davidson, Marissa Ahlering, Jim Giocomo, David Lightfoot, Alexander V. Zale, and Christine D. Miller Hesed

- 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**.

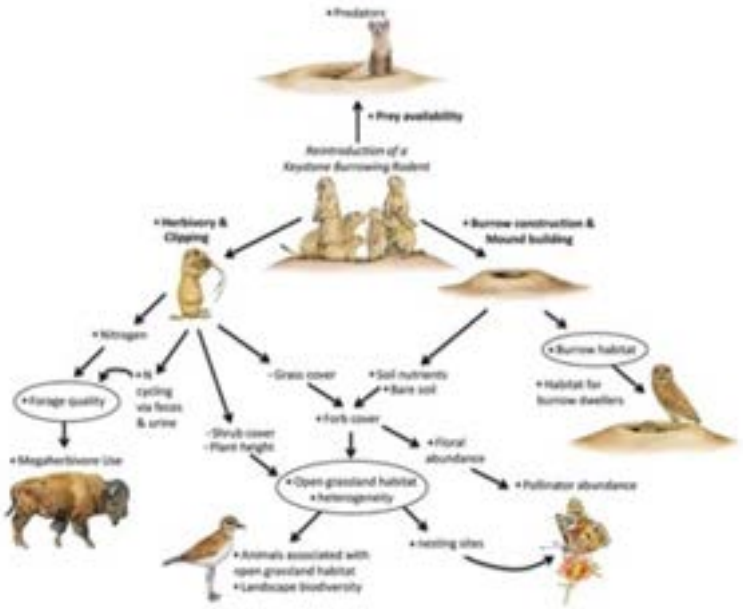


Figure is modified from Davidson et al., 2012 in *Frontier in Ecology and the Enviro.*; Drawings by S. N. Davidson

Large-Bodied Ruminants & Grazing

By Jeff M. Martin and Toni Klemm

- 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.

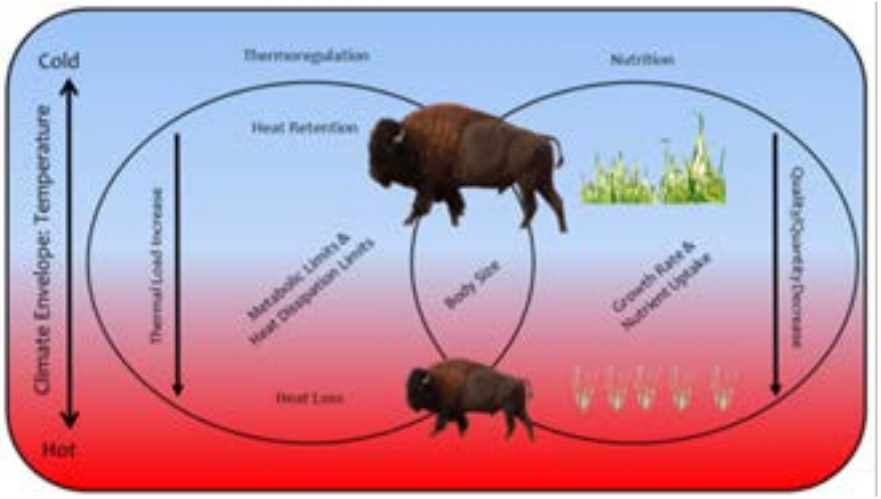
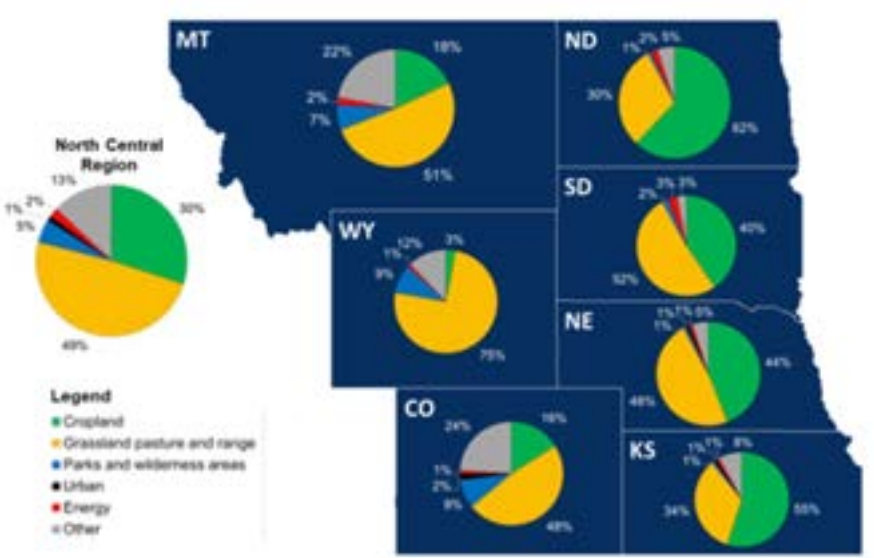


Figure from Martin et al., 2018 in *Ecology and Evolution*

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**.

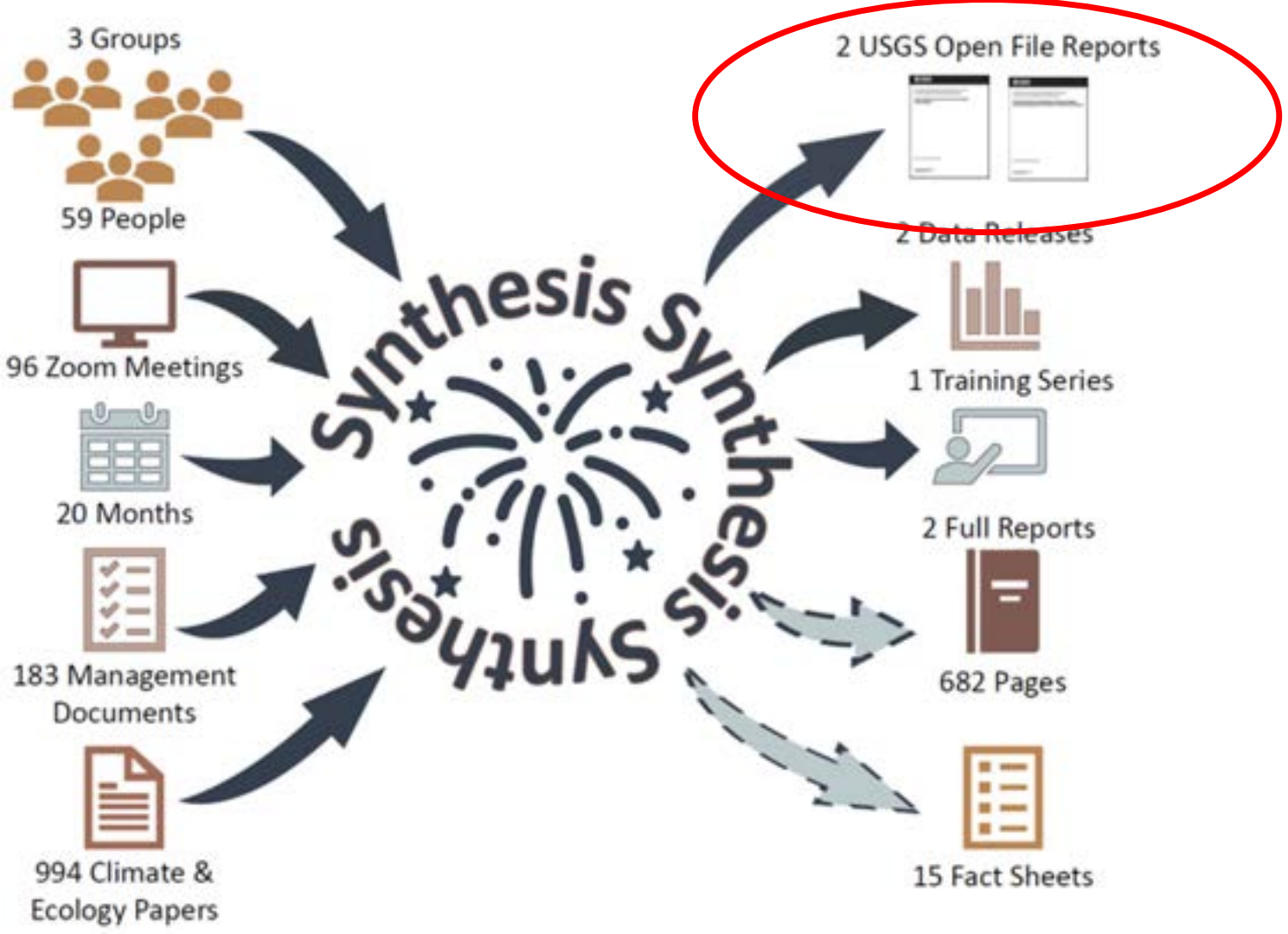


Land use in 2012. Figure created using data from USDA Economic Research Service and the National Renewable Energy Laboratory.

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.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Broadly Shared Information Needs Among Grassland Managers in the North Central Region

	Management Entity																
	Federal Agencies							State Fish and Wildlife									
Information Needed	Bureau of Land Management	US Fish and Wildlife Service	National Park Service	US Forest Service	Natural Resource Conservation Service	Farm Service Agency	Bureau of Indian Affairs	Rosebud Sioux Tribe*	Colorado Parks and Wildlife	Kansas Department of Wildlife and Parks	Montana Fish, Wildlife, and Parks	Nebraska Game and Parks Commission	North Dakota Game and Fish	South Dakota Game, Fish, and Parks	Wyoming Game and Fish Department	The Nature Conservancy^	Migratory Bird Joint Ventures+
1. Where are grasslands most likely to be lost to other land uses?	X	H	X	S	S	H	S	H	H	H	H	H	H	H	H	H	H
1.1 Where is cropland likely to expand and contract as the climate changes?	X	H	X	X	H	H	H	H	S	H	H	H	H	H	S	H	H
1.2 Where is ranchland likely to be sold and subdivided as the climate changes?	X	S	X	X	S	S	S	S	H	H	H	X	S	S	S	H	H
1.3 Where is urban and suburban development likely to occur as the climate changes?	X	S	X	S	S	H	S	H	H	S	S	S	S	S	S	S	S

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Species of Greatest Conservation Need in the North Central Region

				Species Listed As SGCN by State							
Scientific Name	Common Name	Taxonomic Gr	Federal Listing	CO	KS	MT	NE	ND	SD	WY	Total # of States
Charadrius melodus	Piping Plover	Birds	Threatened	x	x	x	x	x	x		6
Corynorhinus townsendii	mule-eared bat	Mammals	None		x	x	x	x	x	x	6
Falco peregrinus	Peregrine Falcon	Birds	None		x	x	x	x	x	x	6
Grus americana	Whooping Crane	Birds	Endangered	x	x	x	x	x	x		6
Haliaeetus leucocephalus	Bald Eagle	Birds	None	x	x		x	x	x	x	6
Lanius ludovicianus	Loggerhead Shrike	Birds	None	x	x	x	x	x		x	6
Macrhybopsis gelida	sturgeon chub	Fish	None		x	x	x	x	x	x	6
Mustela nigripes	Black-footed Ferret	Mammals	Endangered	x	x	x		x	x	x	6
Pelecanus erythrorhynchos	American White Pelican	Birds	None	x	x	x		x	x	x	6
Rhynchophanes mccownii	Thick-billed Longspur	Birds	None	x	x	x	x	x		x	6
Anthus spragueii	Sprague's Pipit	Birds	None		x	x	x	x	x		5
Asio flammeus	Short-eared Owl	Birds	None	x	x		x	x		x	5
Botaurus lentiginosus	American Bittern	Birds	None	x	x	x		x		x	5
Buteo swainsoni	Swainson's Hawk	Birds	None	x	x		x	x		x	5
Centrocercus urophasianus	Greater Sage Grouse	Birds	None	x		x		x	x	x	5
Charadrius montanus	Mountain Plover	Birds	None	x	x	x	x			x	5
Cycleptus elongatus	blue sucker	Fish	None		x	x	x	x	x		5
Cynomys ludovicianus	black-tailed prairie dog	Mammals	None	x	x	x		x		x	5
Dolichonyx oryzivorus	Bobolink	Birds	None	x	x	x		x		x	5
Hesperia ottoe	Ottoe Skipper	Insects	None	x	x	x	x		x		5

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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.

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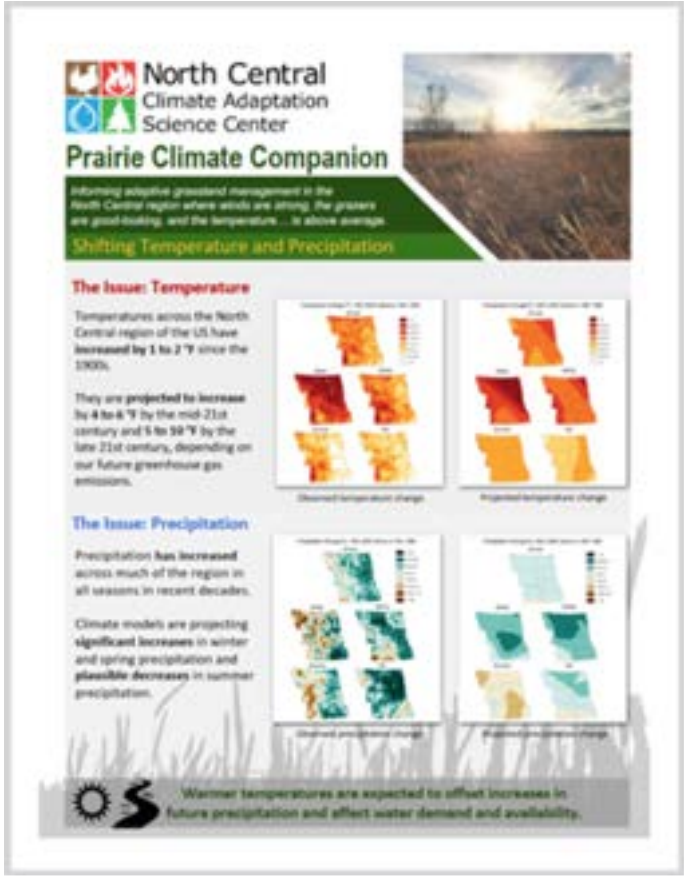

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Next Steps

SOCIAL SCIENCE

Synthesis Synthesis Synthesis

GRASSLAND MANAGERS

Links for reports and other resources

- Management Priorities OFR: https://pubs.er.usgs.gov/publication/ofr20231037
- 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

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