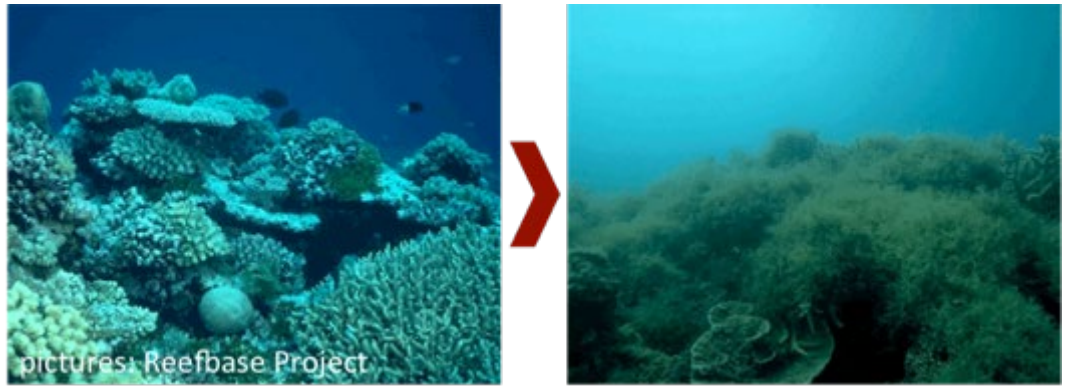
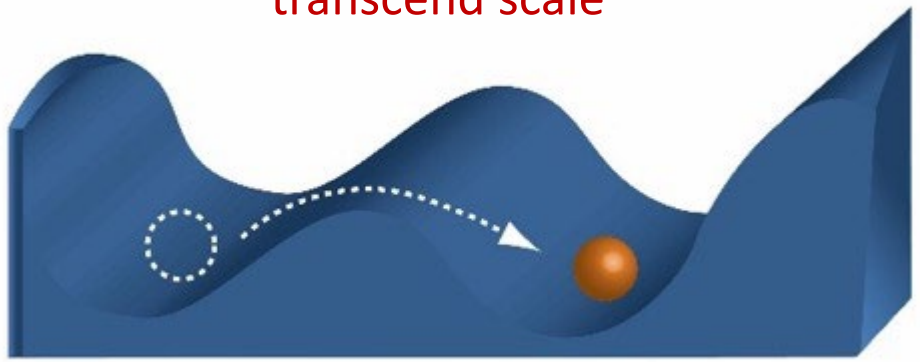
Reducing Woody Encroachment to Conserve Rangeland Production in the Great Plains

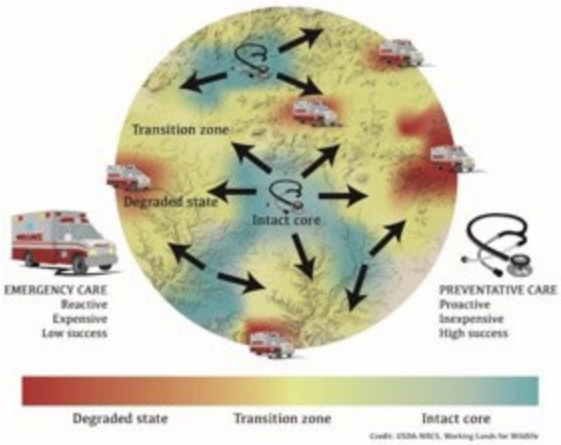
Dirac Twidwell
University of Nebraska

A grand challenge for the 21st century is to avoid transitions in nature that are so severe their consequences go beyond the traditions of any single discipline.

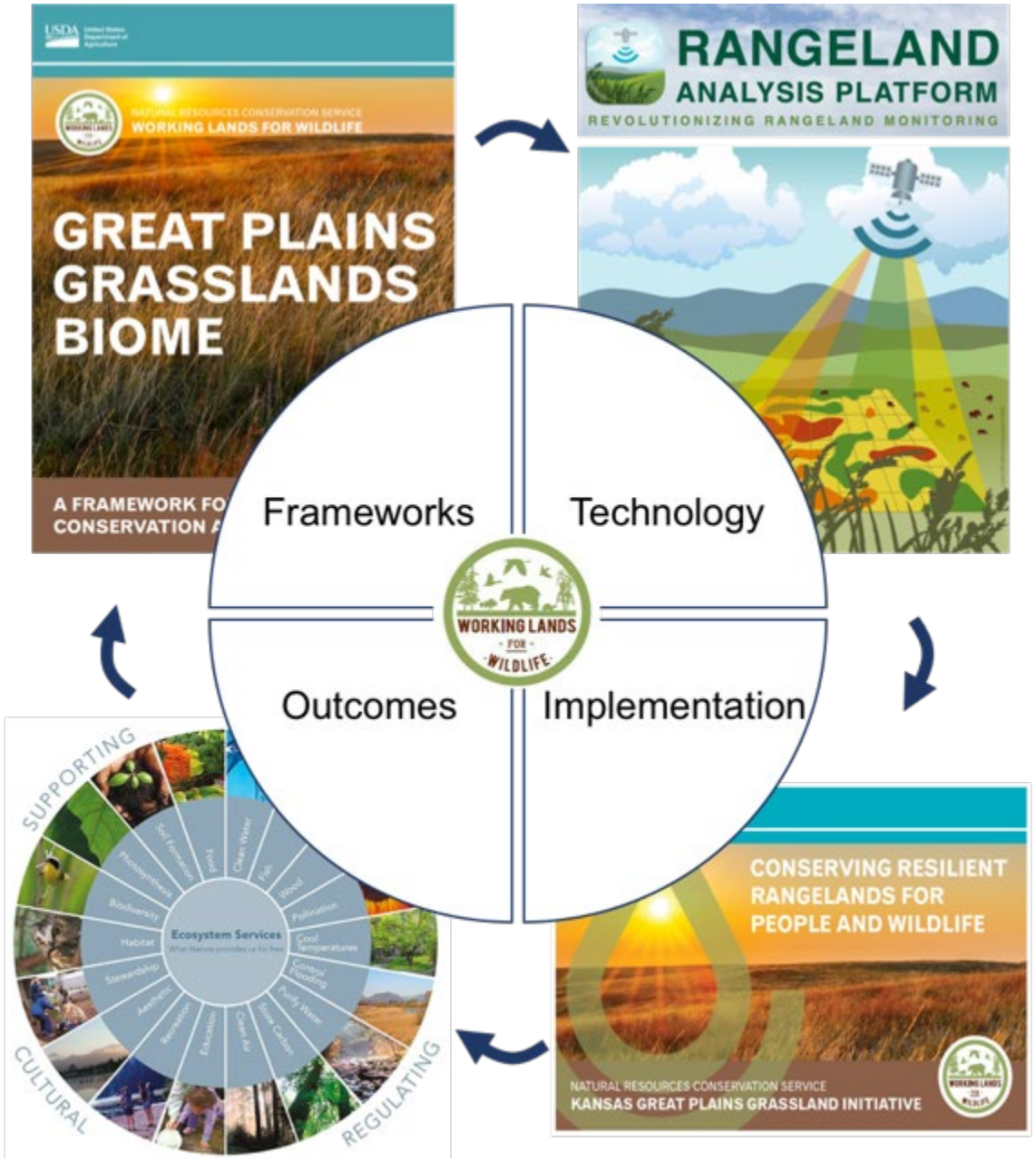


Scientists now hypothesize that the most catastrophic transitions are those that transcend scale

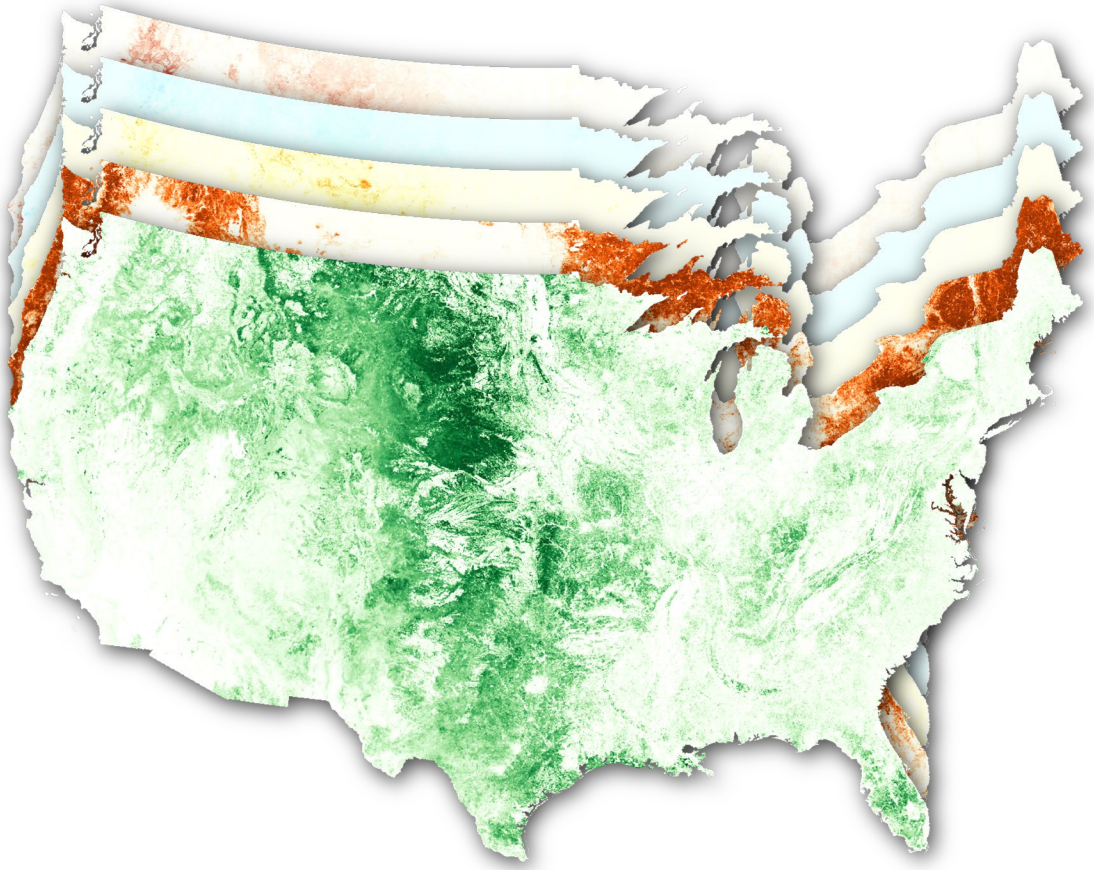




Science is well-positioned to support the scaling-up of conservation in the Great Plains

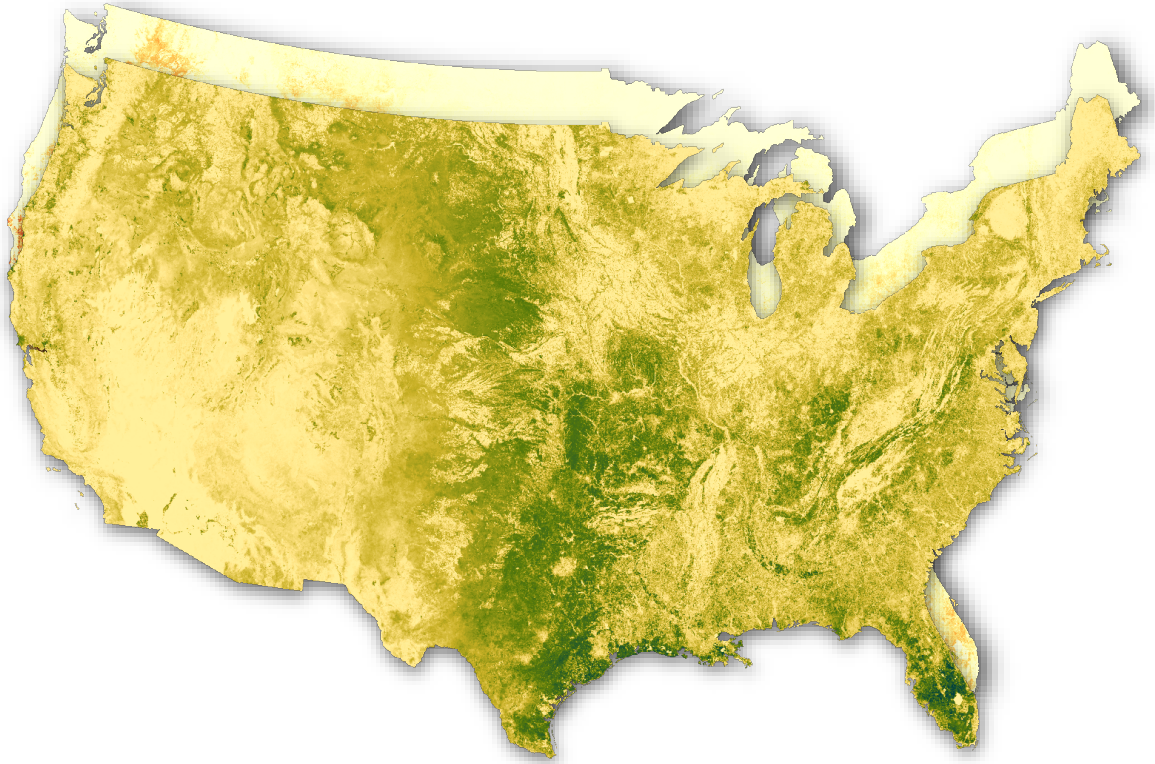


Rangeland Analysis Platform



Rangeland Cover

- 0-100% aerial cover
- 5 vegetation groups
- Annual time-step



Rangeland Production

- lbs/acre
- 2 vegetation groups
- Annual time-step
- 16-day time-step

The Great Plains Biome is Collapsing

1990

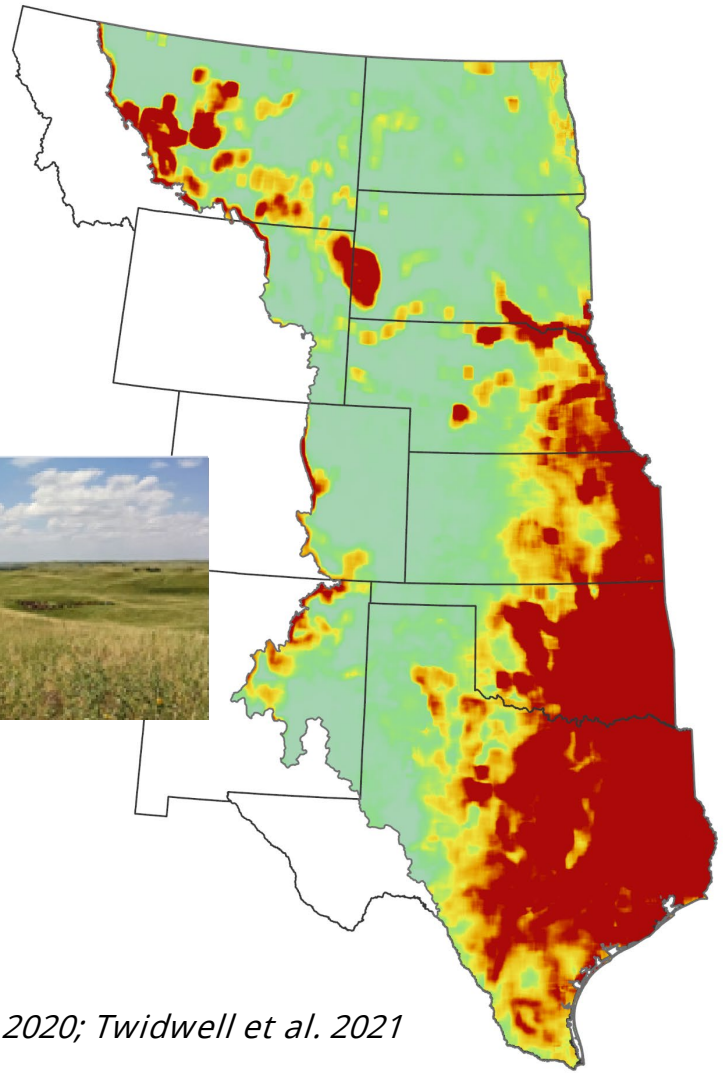
Uden et al. 2020; Twidwell et al. 2021

$177M spent in last Farm Bill

Southern Plains: $164.5 M
Southern Mountain: $59.6 M
Pacific: $25.9 M
Northern Plains: $12.5 M
Northern Mountain: $8.5 M

The Great Plains Biome is Collapsing

2020



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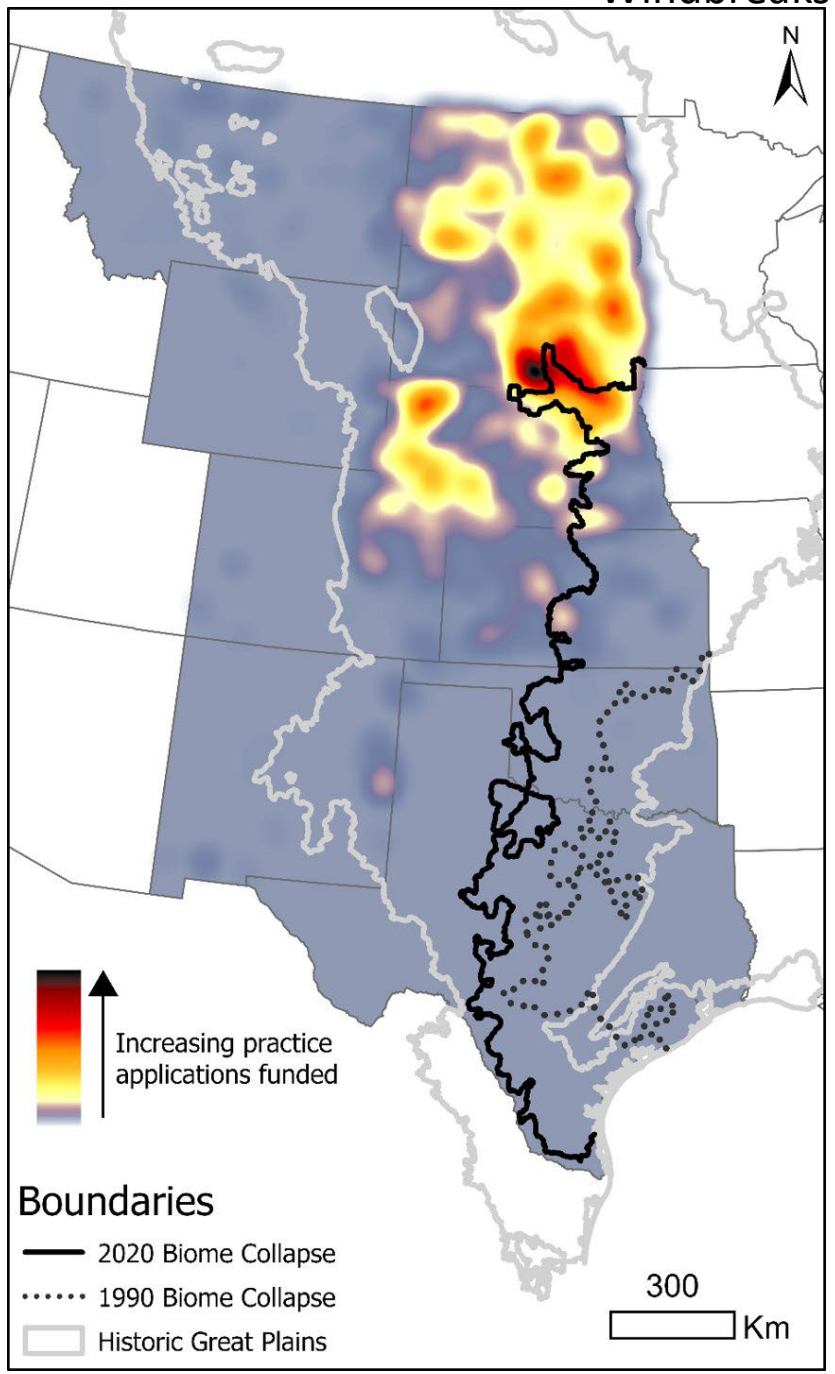
The Problem of the ”Improvement *then* Restoration” Paradigm

1.14M NRCS practices;
Cady et al. in prep

Windbreaks



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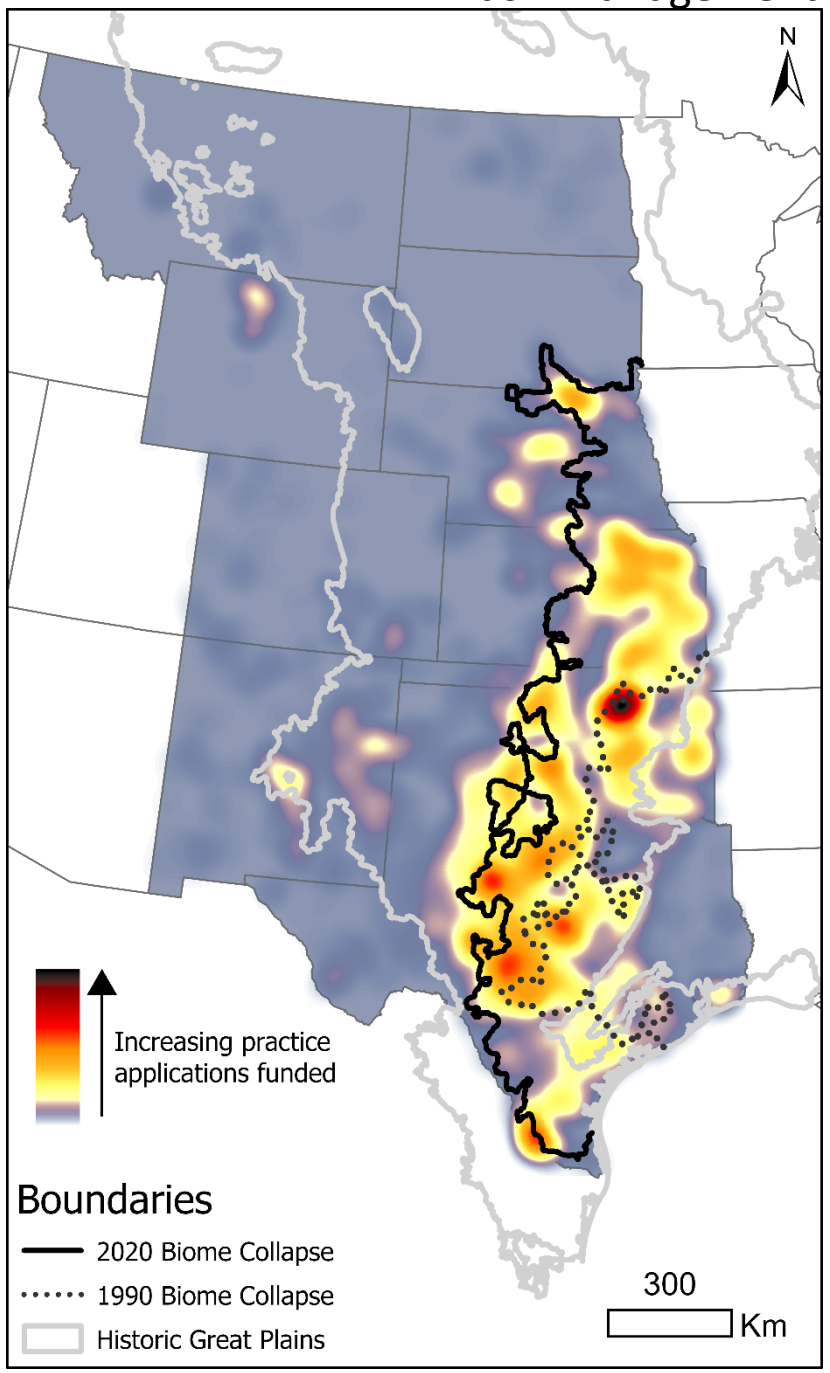

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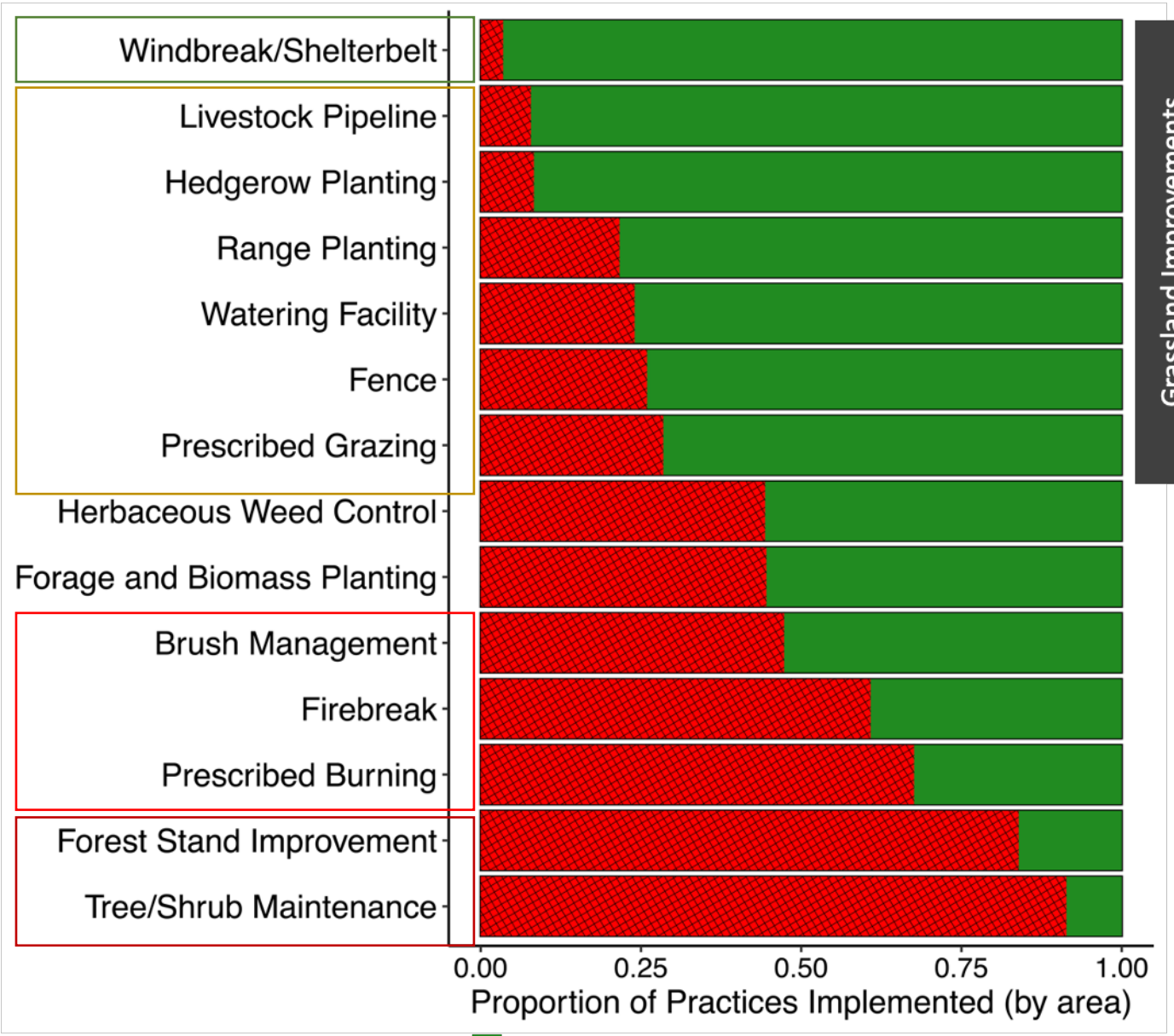

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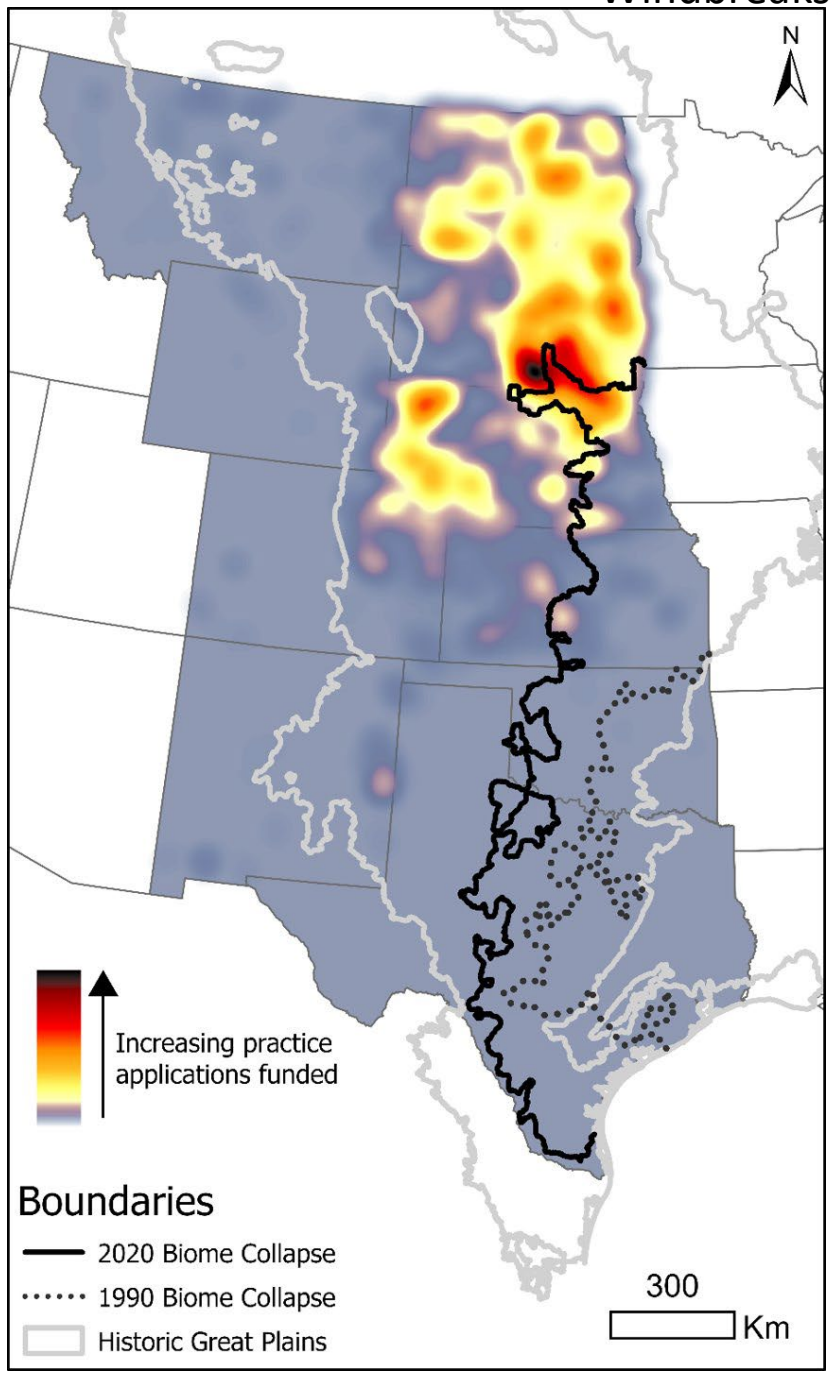

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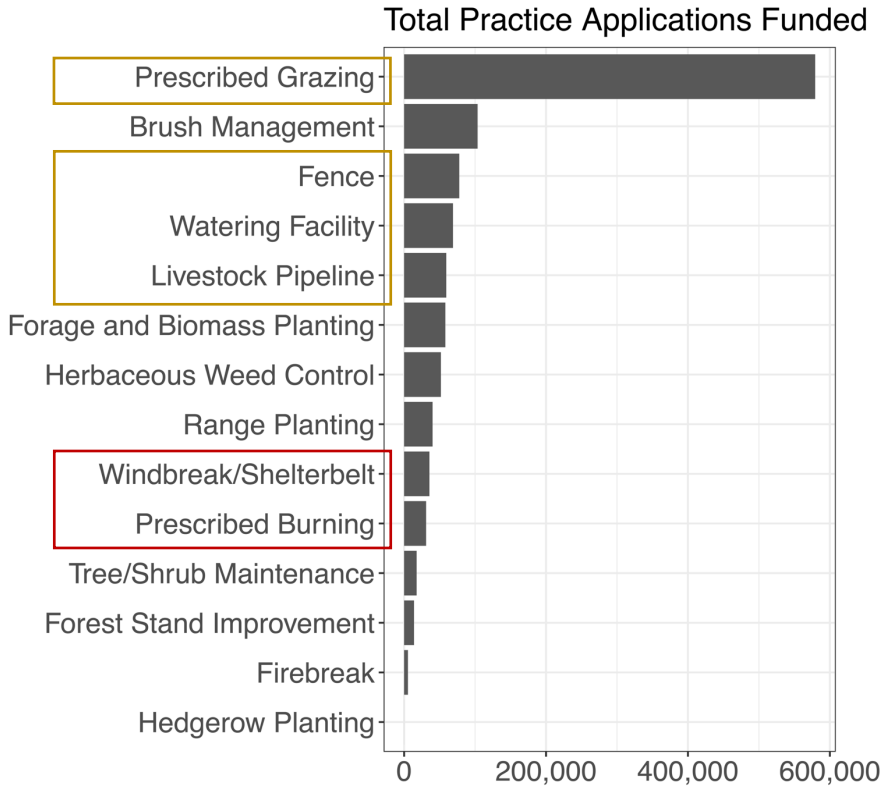

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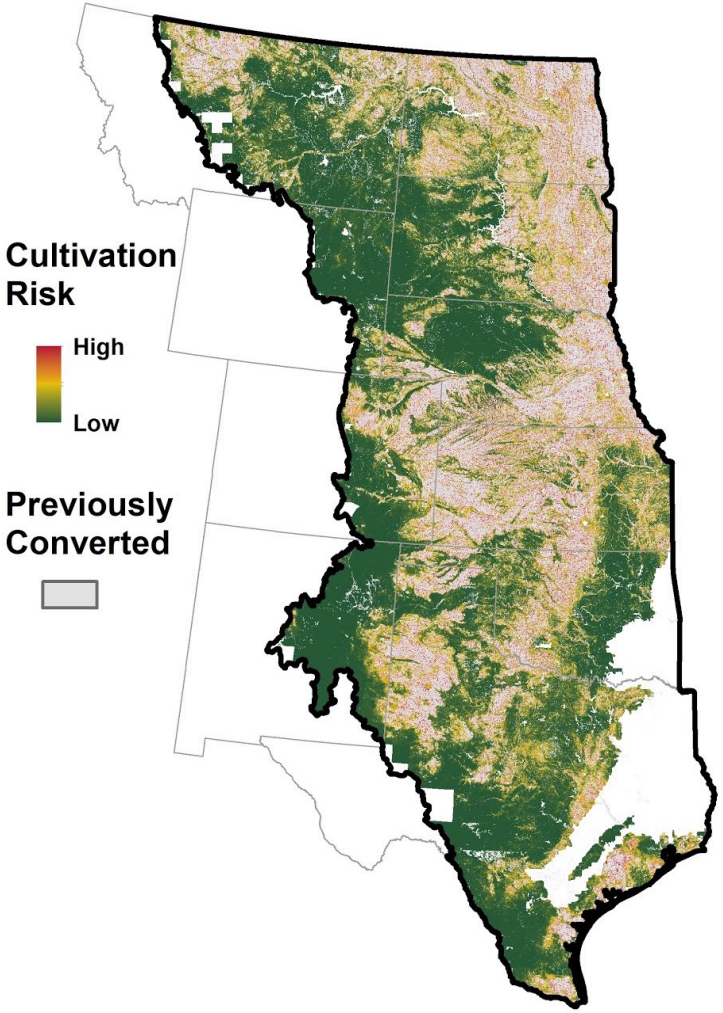
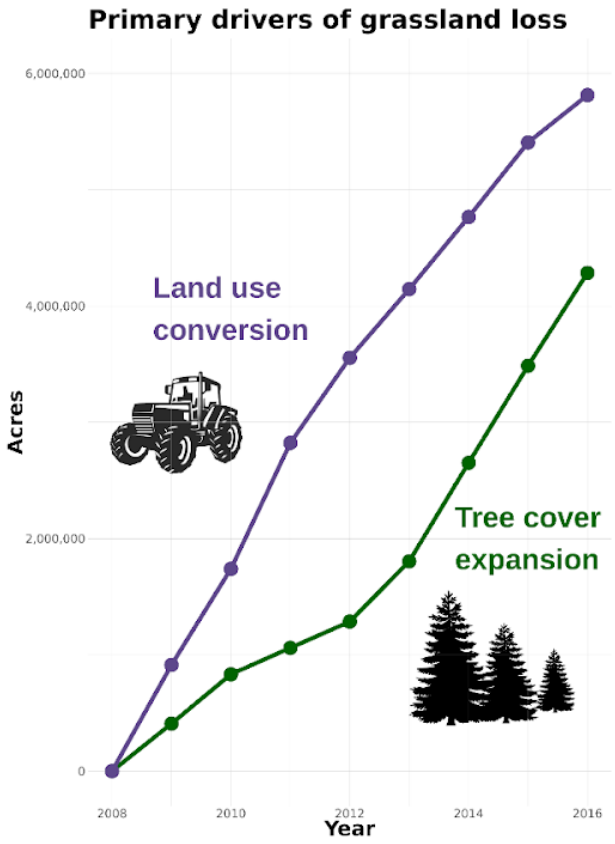
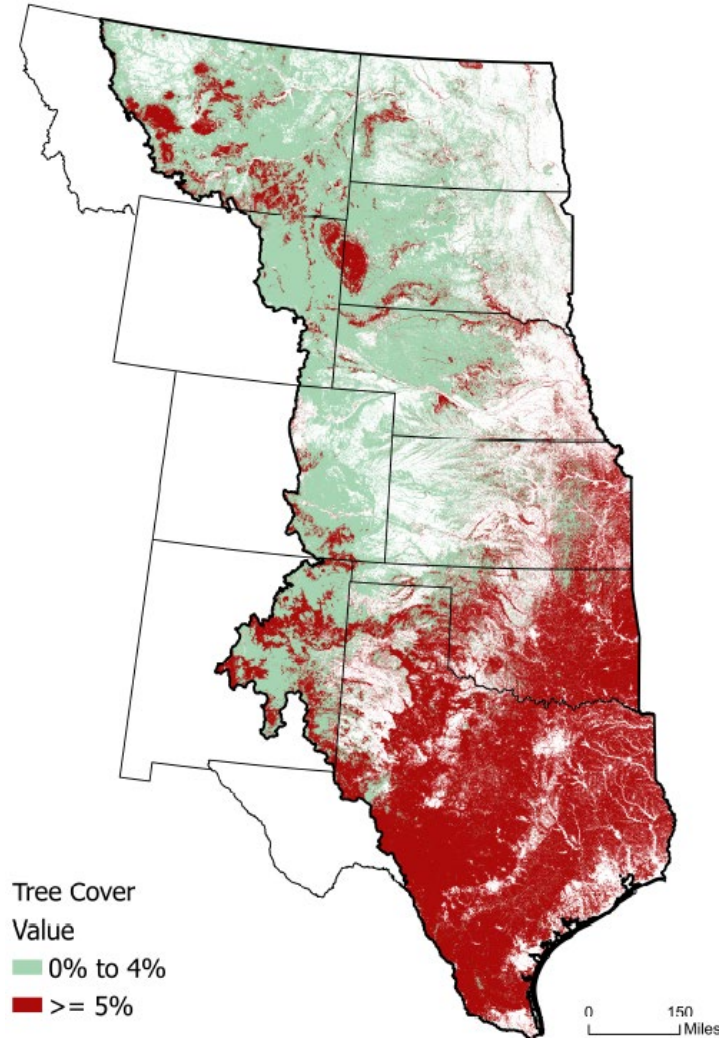
The Top Drivers of Grassland Loss in the Great Plains Biome:
Land Use Conversion & Woody Encroachment

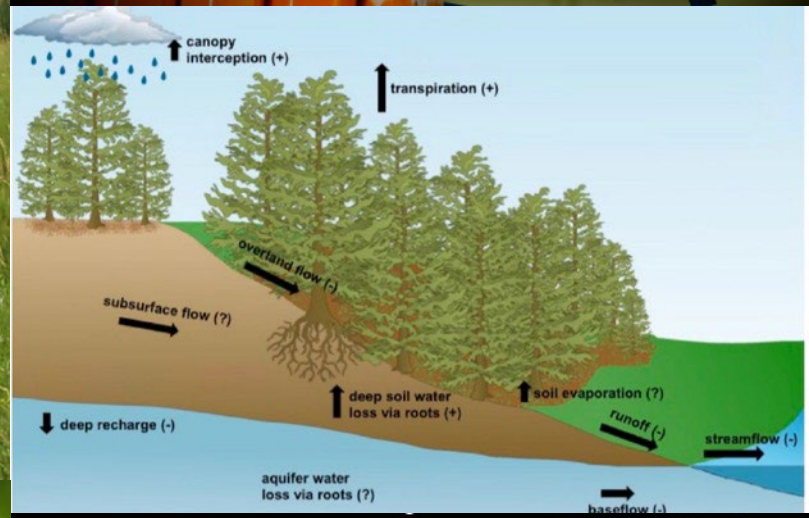


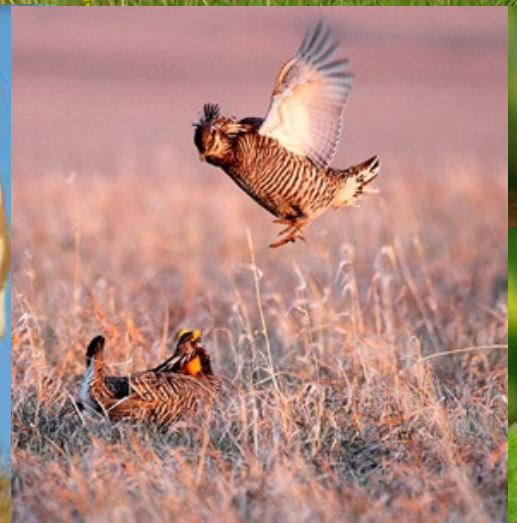


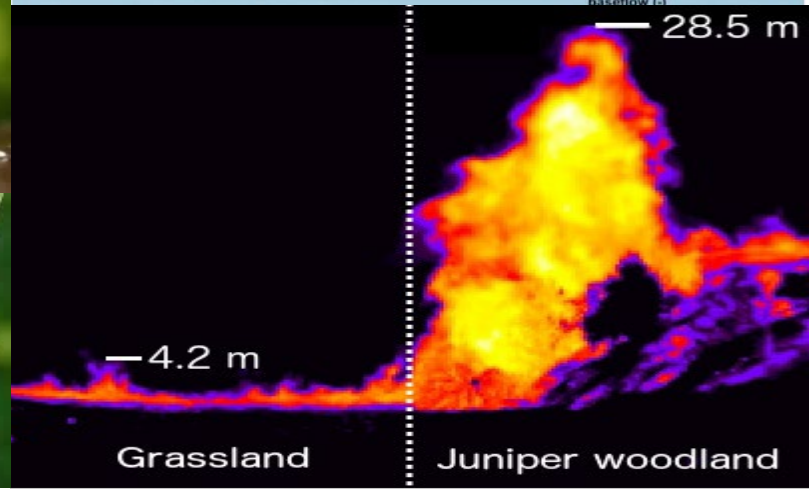


Morford et al. in 2022

Biome-level consequences: Rancher livelihoods, Wildfire danger, Human health, Water, Endangered species, School funding, Regulatory pressure







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RESEARCH ARTICLE

Herbaceous production lost to tree encroachment in United States rangelands

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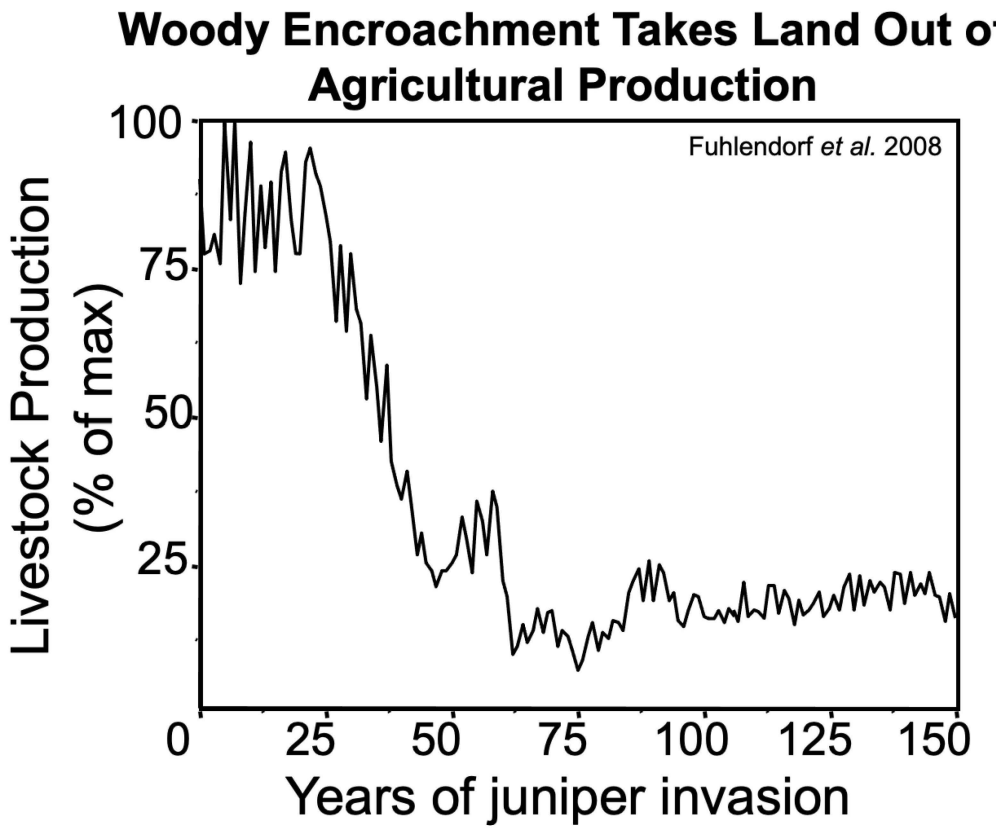


USDA United States Department of Agriculture

WORKING LANDS FOR WILDLIFE

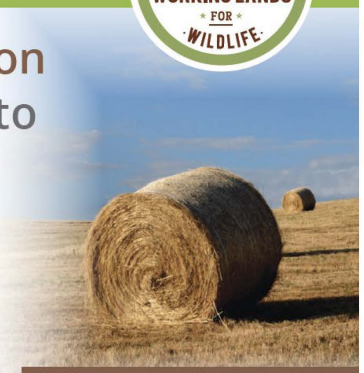
The Great Plains Lost 22.4 Million Tons of Rangeland Production to Woody Encroachment in 2019

Rangelands are the economic and cultural backbone of the Great Plains. Healthy, resilient rangelands power rural communities, host diverse wildlife, support recreation, and provide critical services like water and carbon storage.

Grazing is the common thread that sustains these rangelands for people and wildlife. In 2019, rangelands in the 10-state Great Plains region produced 292.4 million tons of forage.

Today, woody encroachment is one of the greatest threats facing rangelands in the Great Plains. Invading trees outcompete and displace grasses and forbs, reducing rangeland production by up to 75 percent. Scattered woody plants may look harmless, but their expansion in rangelands results in major consequences to livestock production and wildlife. When we lose healthy rangelands, we lose the cultural, economic, and life-sustaining resources they provide.

According to scientists working alongside the NRCS's Working Lands for Wildlife efforts, every state in the Great Plains lost rangeland production due to woody encroachment in 2019 – a loss of 22.4 million tons.



RANGELAND PRODUCTION LOST TO TREES EQUATES TO:

- $323+ million in lost forage[1]
- 37.3 million round bales[2] – enough to circle the globe 1.4 times!
- Forage for 4.8 million cows[3]

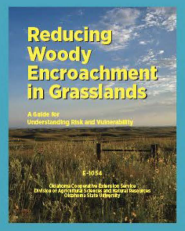
1. Calculation is based on cash rental rates
2. Calculation is based on a 1,200-lb round bale
3. Calculation is based on 780-lb of forage per AUM for a 12-month period

Production losses are derived from a 1990 baseline and are the result of increasing woody cover in 2019 versus 1990.

NEW GUIDANCE FOR REVERSING AND PREVENTING WOODY ENCROACHMENT

Reacting to woody encroachment after trees have taken over makes it impossible to avoid rangeland production losses, perpetuating the problem as trees simply keep expanding into formerly treeless grasslands.

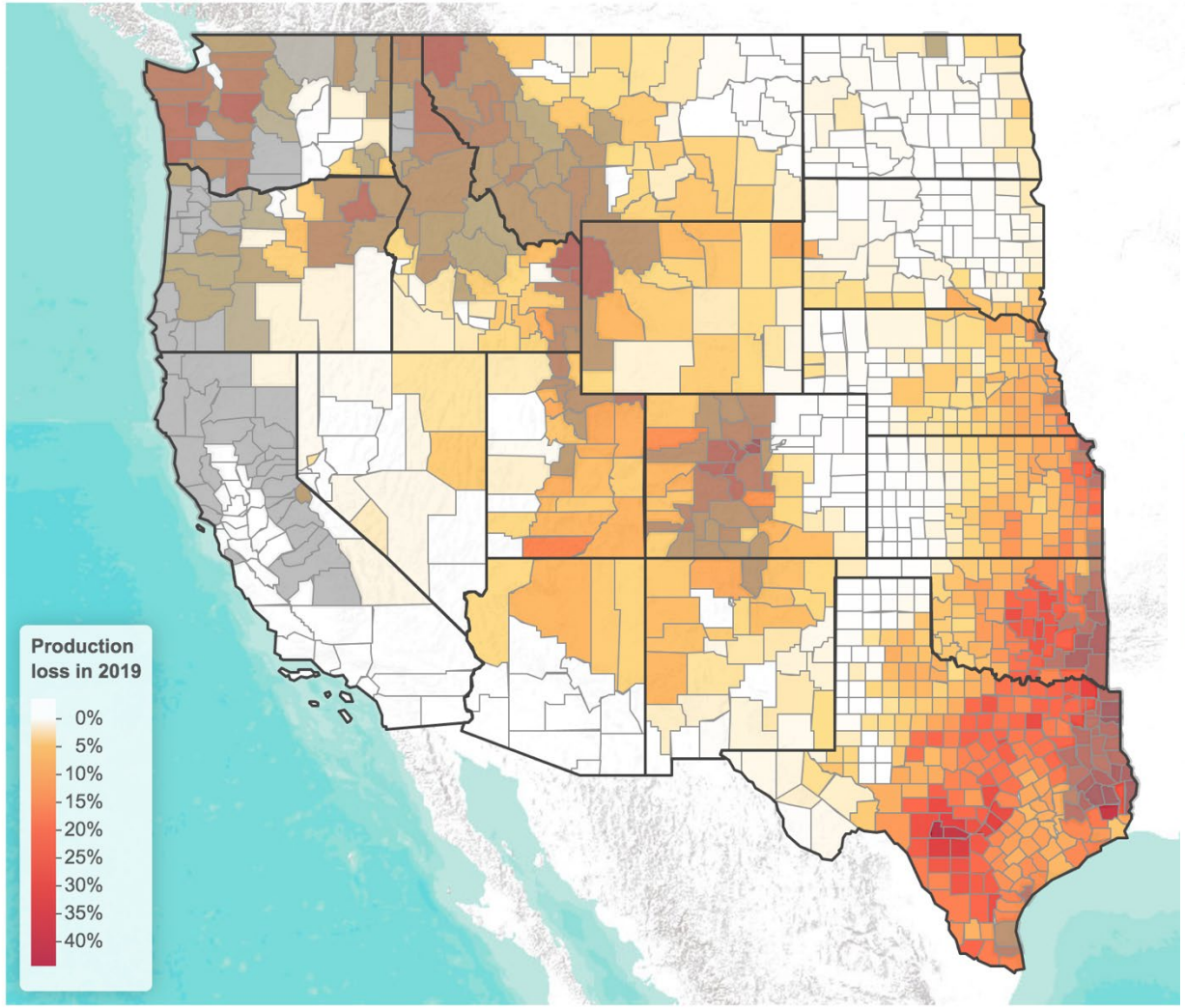
New guidance, developed as a collaborative effort among rangeland scientists in the Great Plains, outlines a more cost-efficient and proactive strategy to keep rangelands productive and reverse losses due to woody encroachment.



Learn more at: https://www.wlfw.org/great-plains/woodland-expansion/

National Rangeland Statistics

Rangeland Productivity Lost to Woody Encroachment



South Dakota

Productivity lost to woody encroachment in 2019	Cumulative productivity lost to woody encroachment (1990-2019)
145,352 tons	2,076,178 tons

Nebraska

Productivity lost to woody encroachment in 2019	Cumulative productivity lost to woody encroachment (1990-2019)
419,328 tons	3,881,756 tons

Kansas

Productivity lost to woody encroachment in 2019	Cumulative productivity lost to woody encroachment (1990-2019)
2,060,106 tons	28,902,217 tons

Oklahoma

Productivity lost to woody encroachment in 2019	Cumulative productivity lost to woody encroachment (1990-2019)
4,491,096 tons	76,529,801 tons

National Rangeland Statistics

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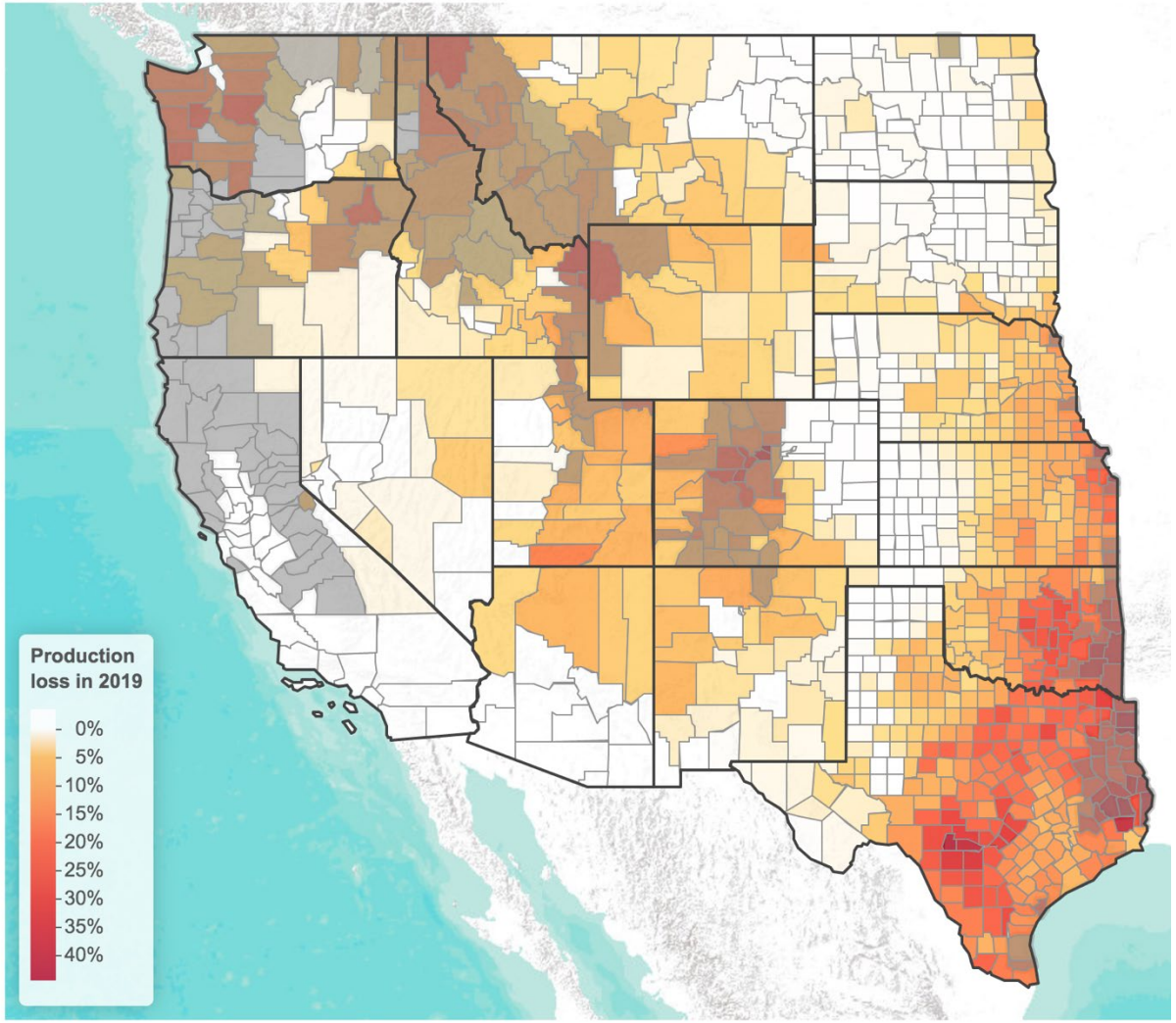

Equivalent to 698K Round Bales

Nebraska

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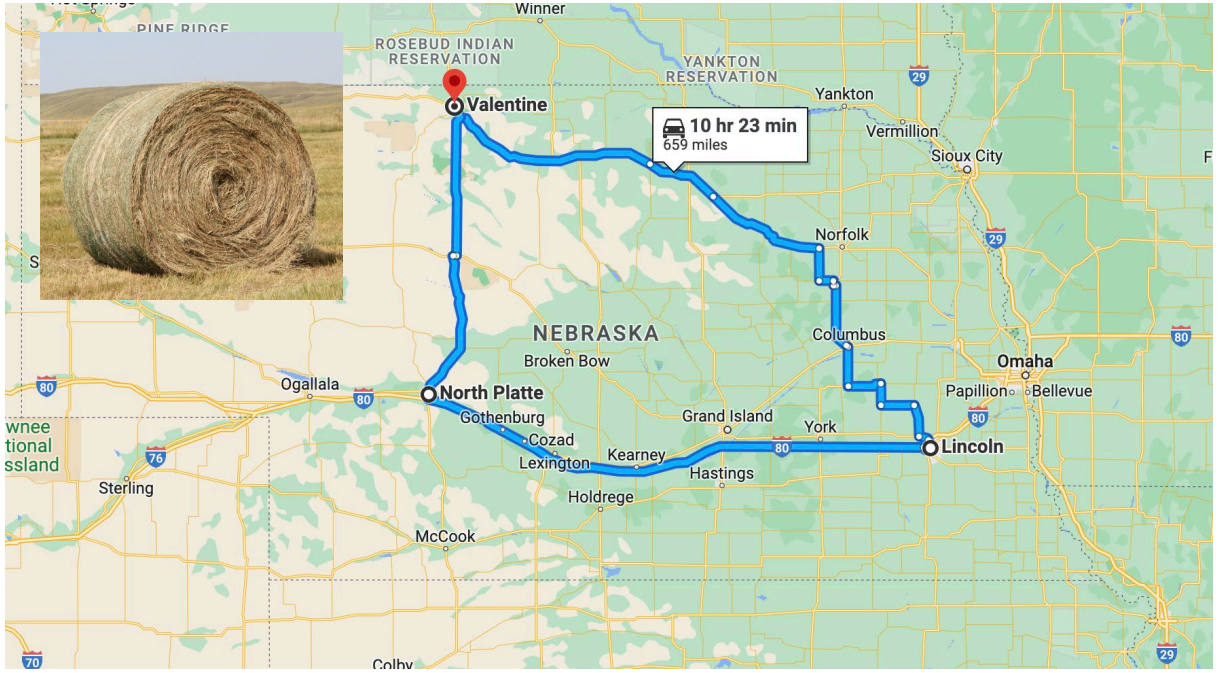
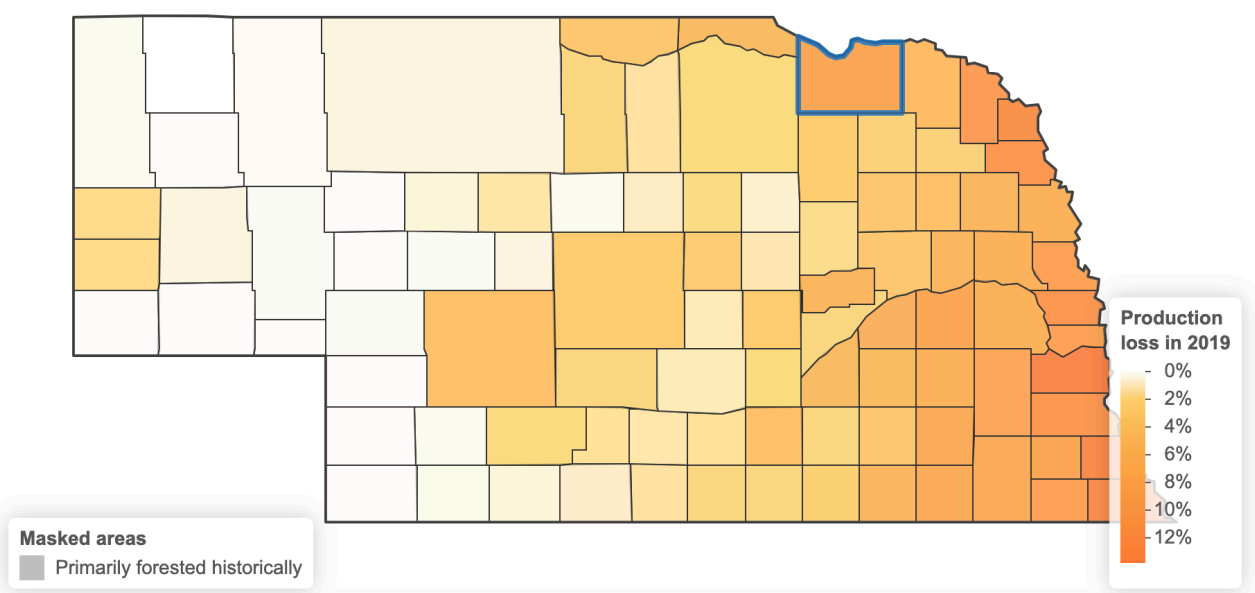


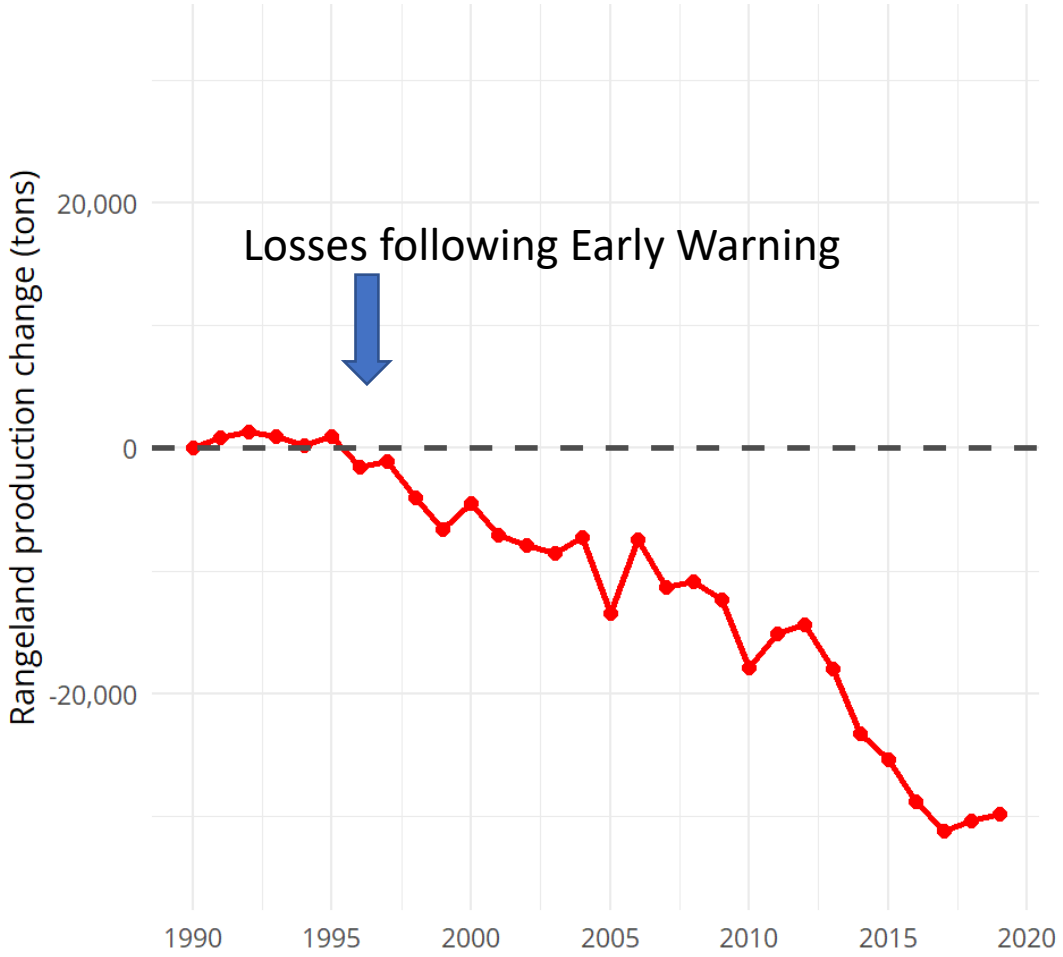
Knox County, Nebraska

Rangeland Production Lost to Tree Encroachment

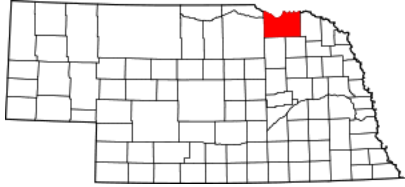


Production lost to tree encroachment in 2019	Cumulative production lost to tree encroachment (1990-2019)
29,814 tons	333,857 tons

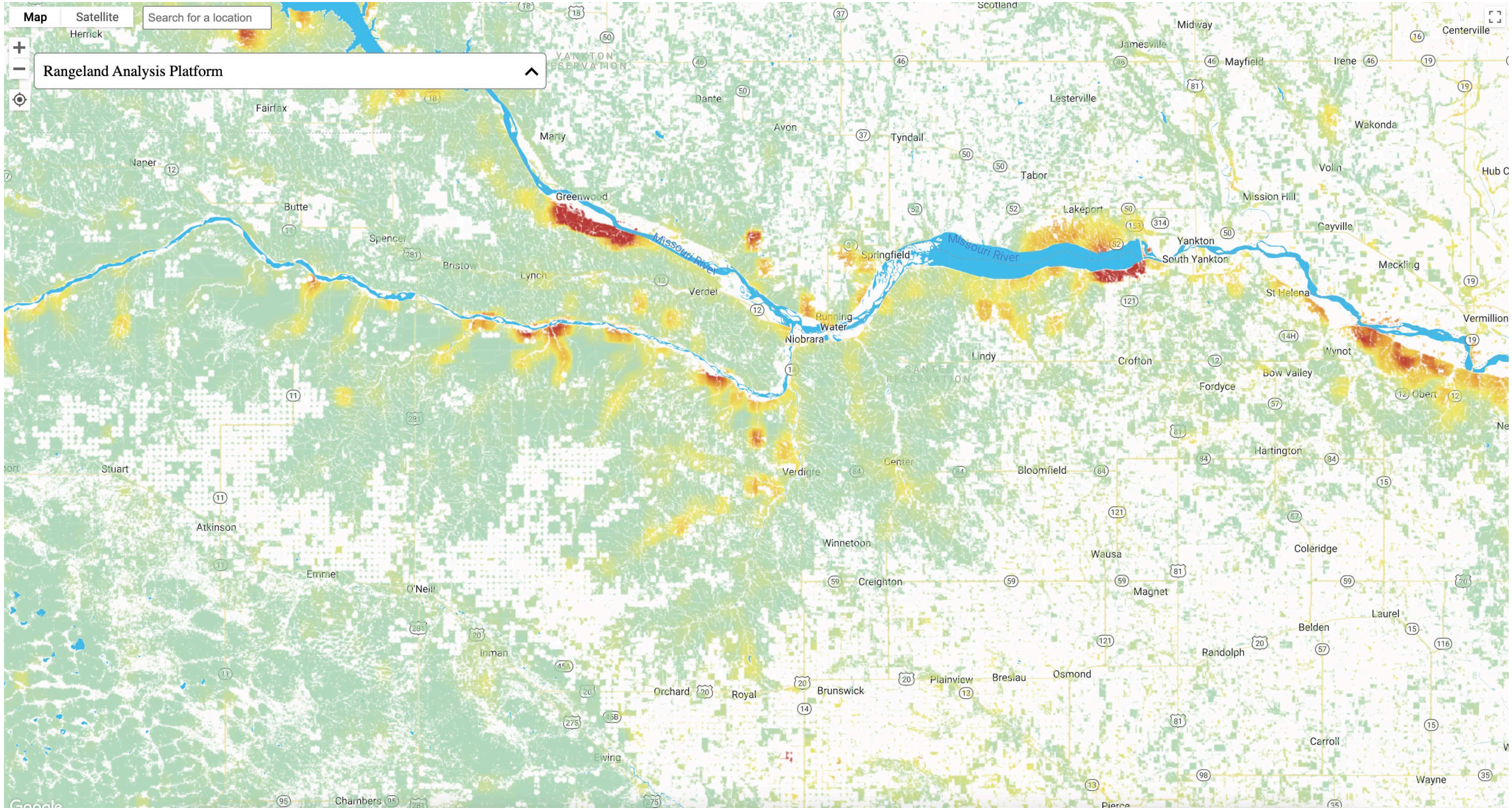
Total rangeland productivity = 349,875 tons



Early Warnings for Woody Transitions – Knox County Area



1990



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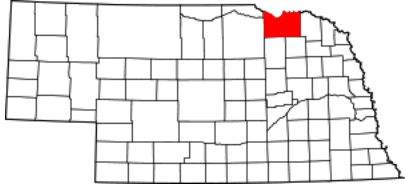
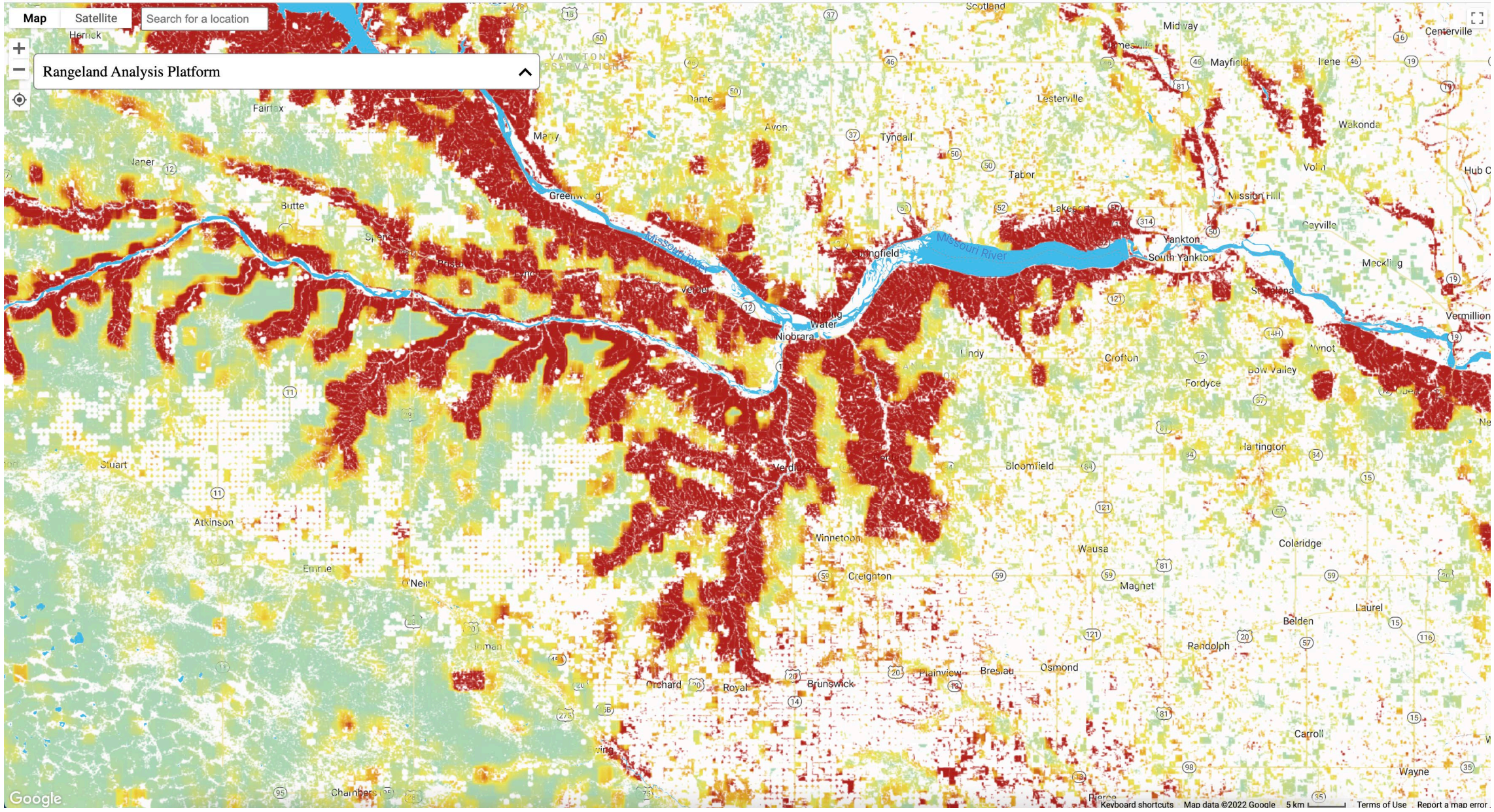
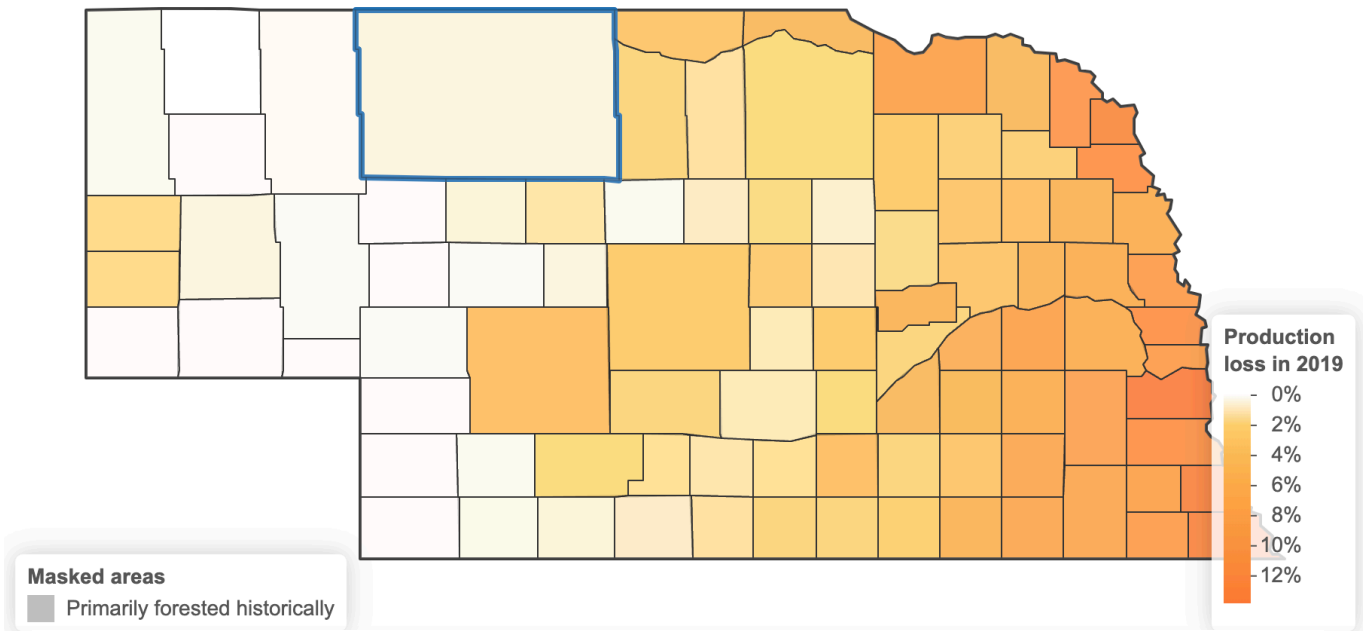


2020 – Similar to 2000 Riley County, KS



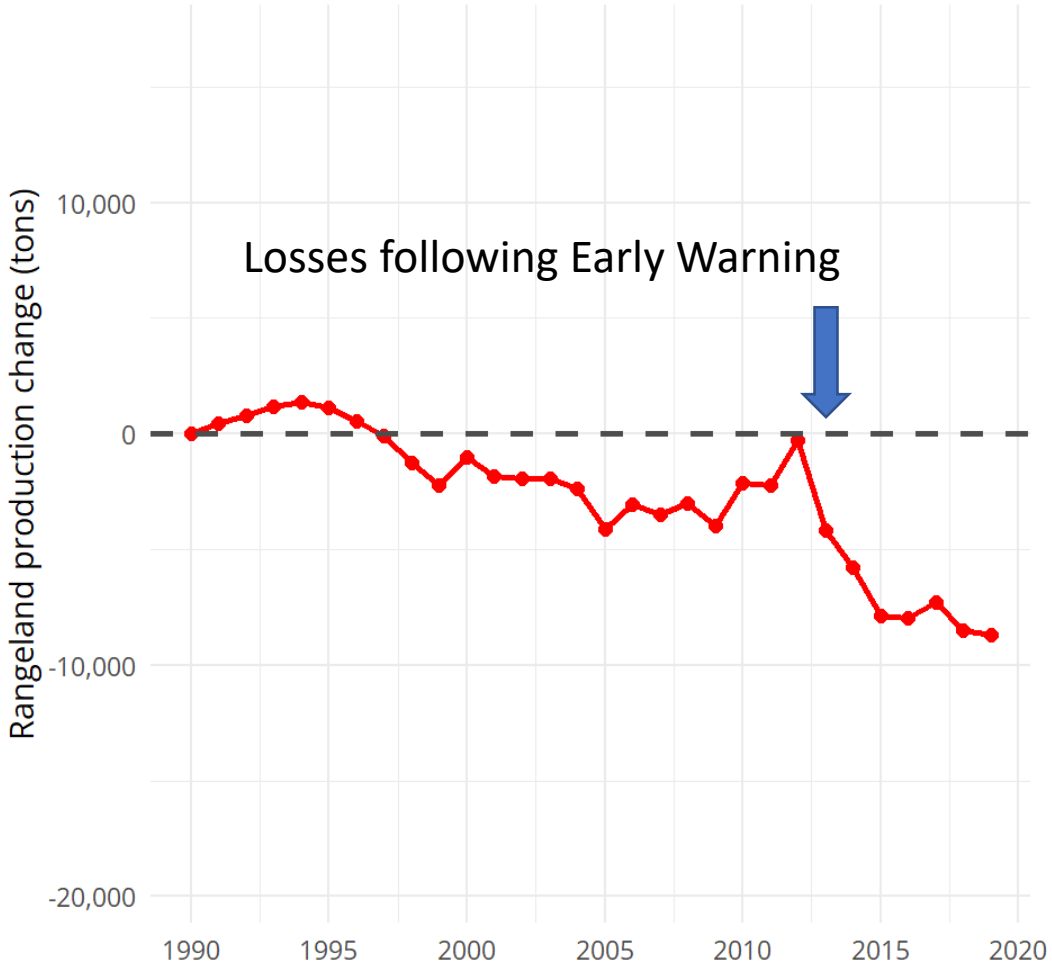
Cherry County, Nebraska

Rangeland Production Lost to Tree Encroachment

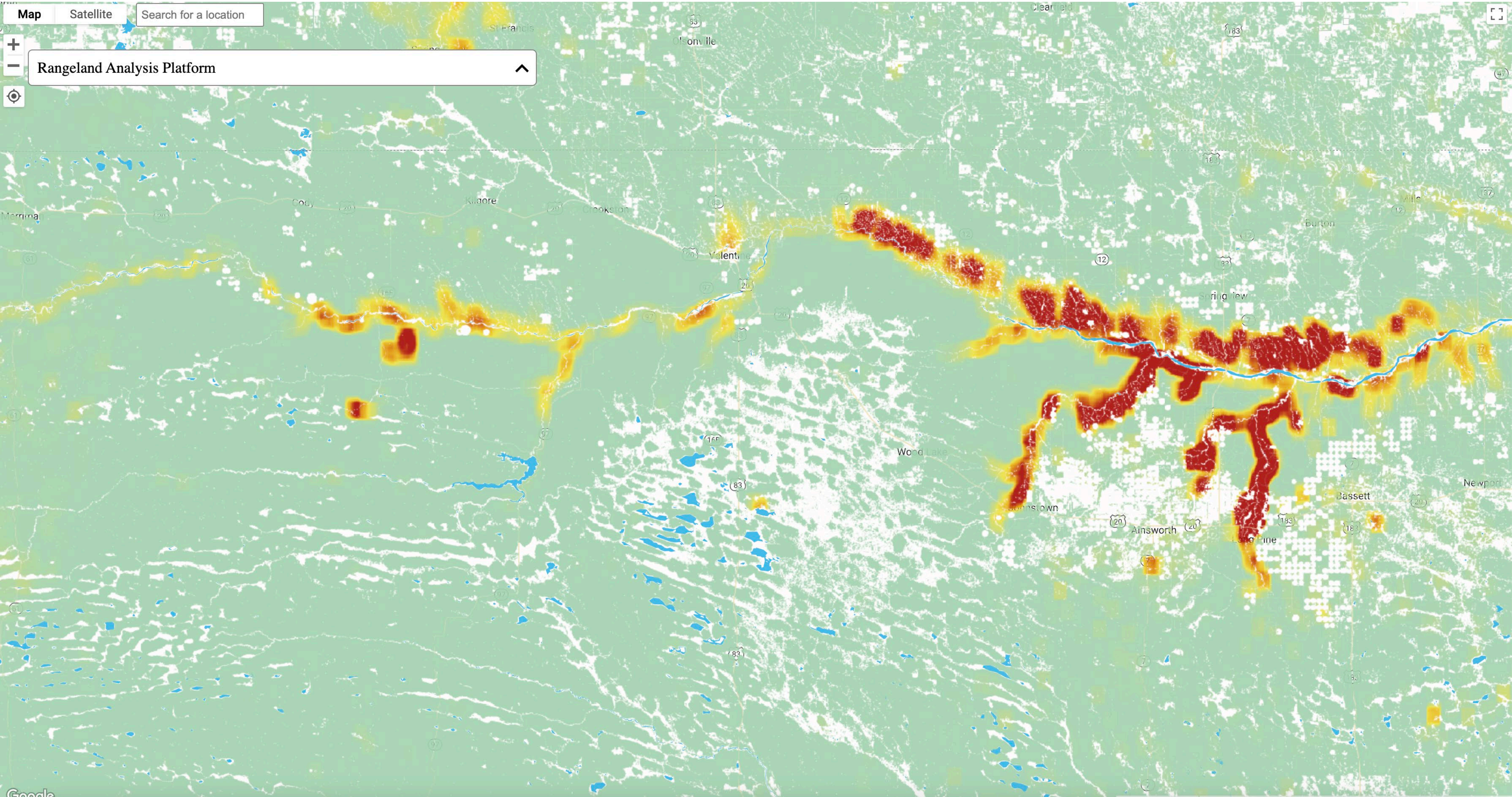


Production lost to tree encroachment in 2019	Cumulative production lost to tree encroachment (1990-2019)
8,707 tons	79,814 tons

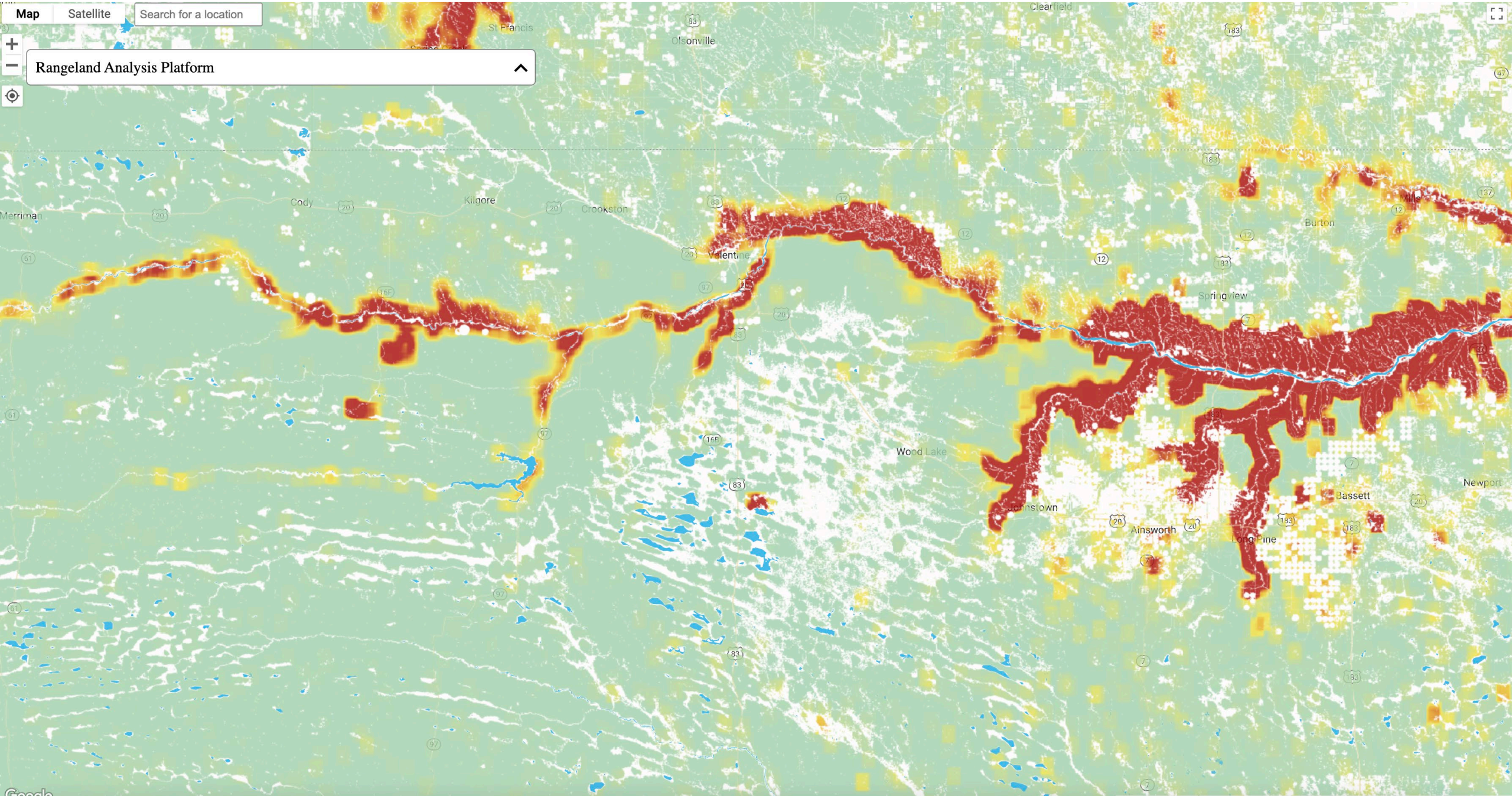
Total rangeland productivity = 2,797,753 tons



1990

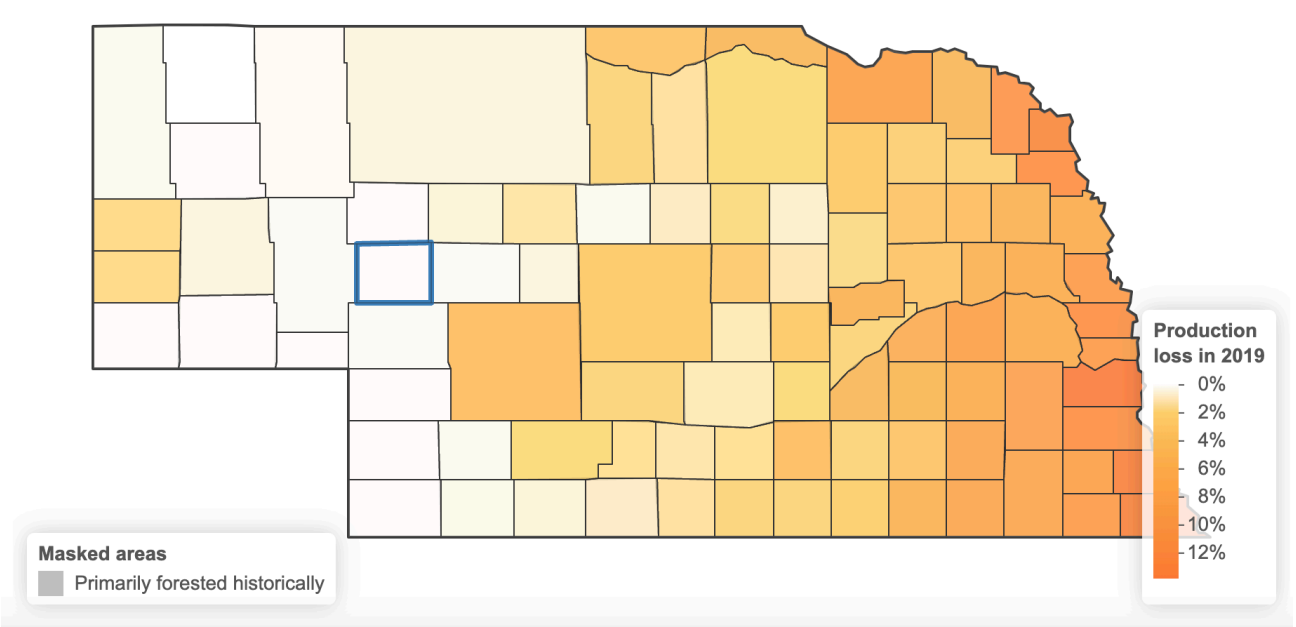

Map
Satellite
Search for a location
Rangeland Analysis Platform
Kilgore
Burton
Springview
Wood Lake
Newport
Bassett
Ainsworth
Google

2020 – Similar to 2000 Knox County



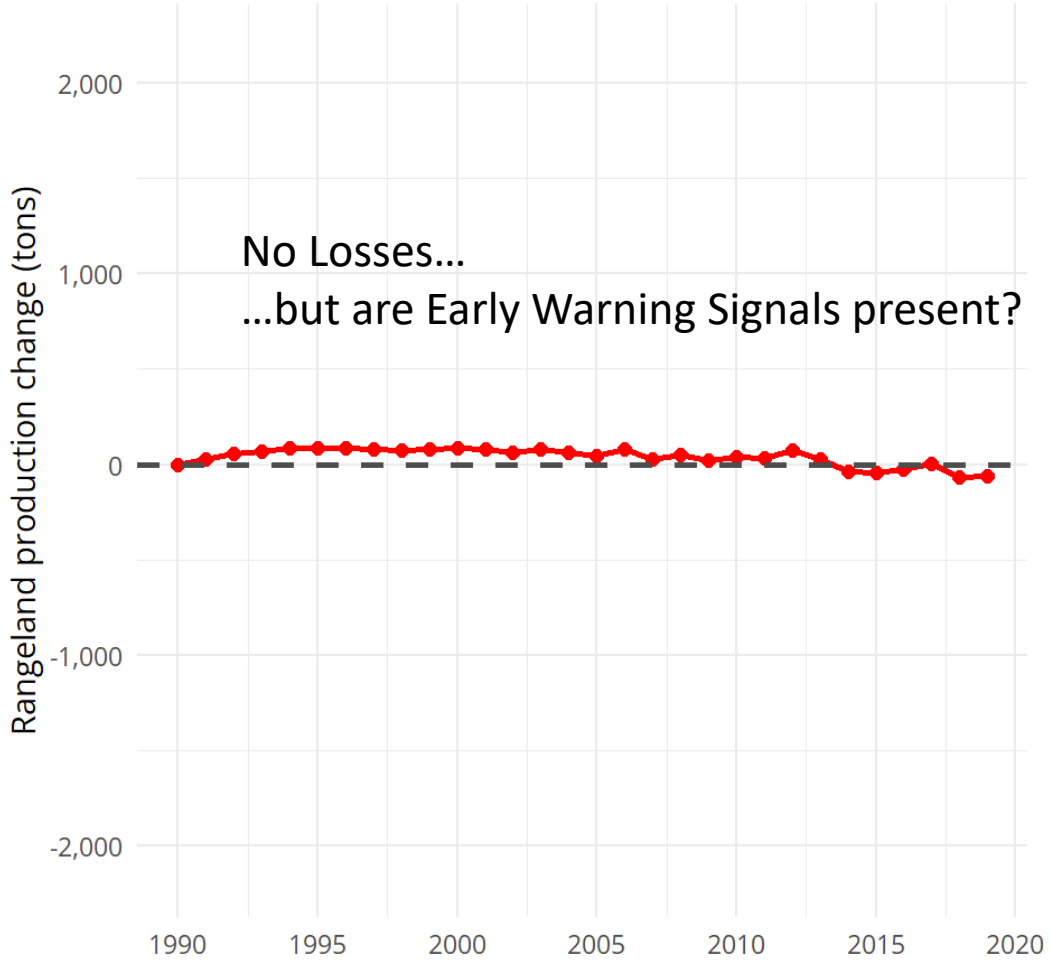
Arthur County, Nebraska

Rangeland Production Lost to Tree Encroachment



Production lost to tree encroachment in 2019	Cumulative production lost to tree encroachment (1990-2019)
64 tons	No losses

Total rangeland productivity = 345,169 tons

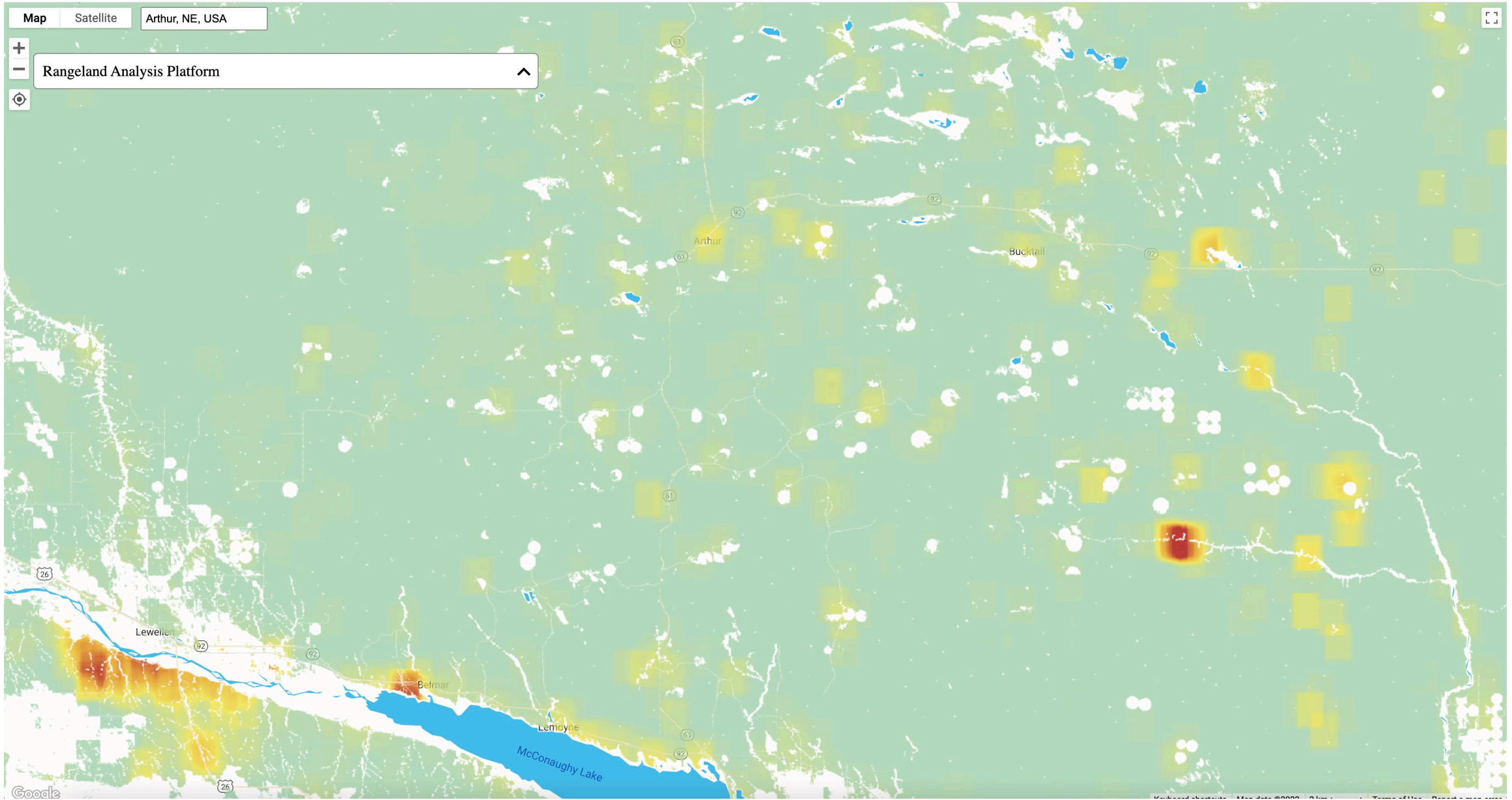


Early Warnings for Woody Transitions – Arthur County Area

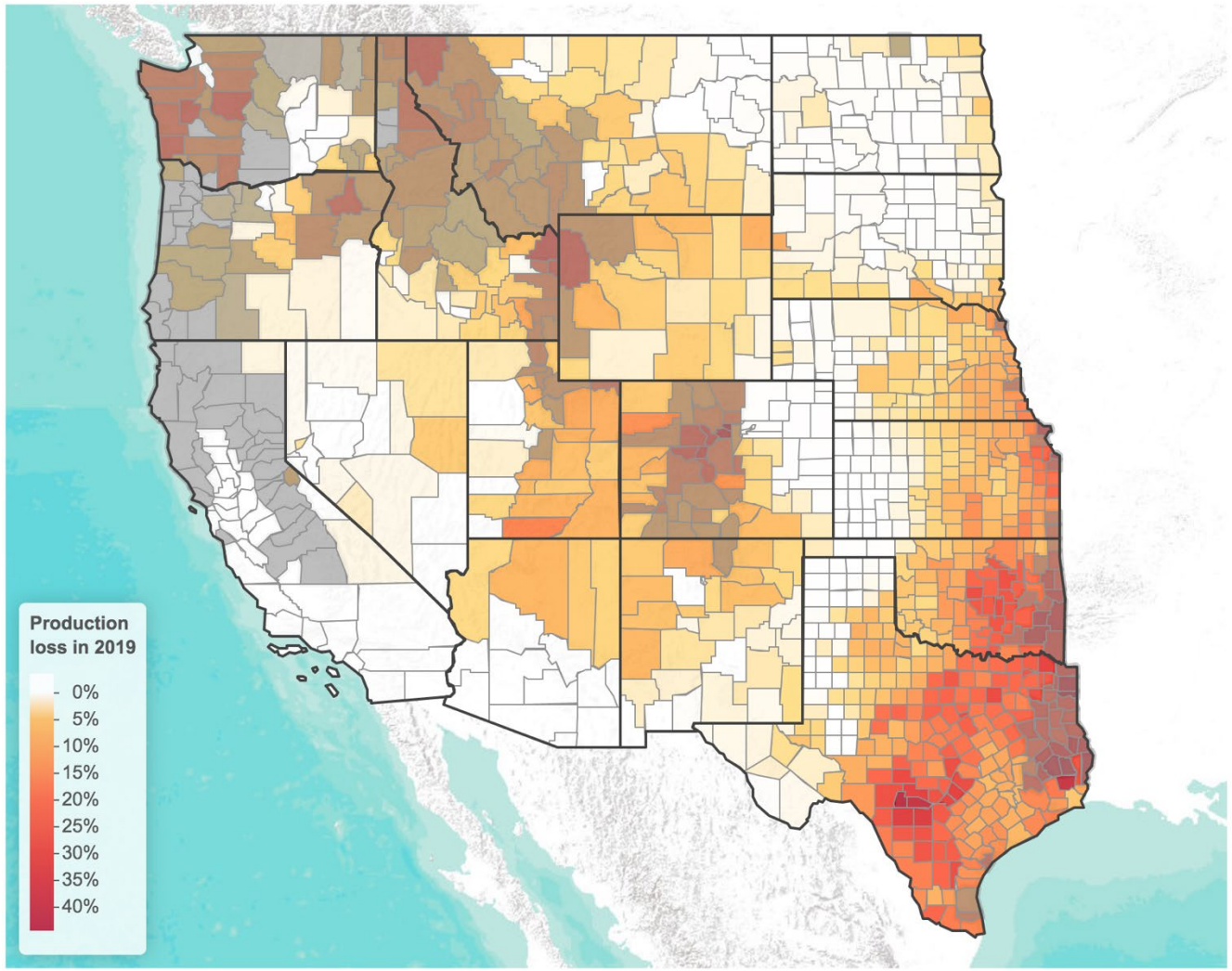
1990

Early Warnings for Woody Transitions – Arthur County Area

2020



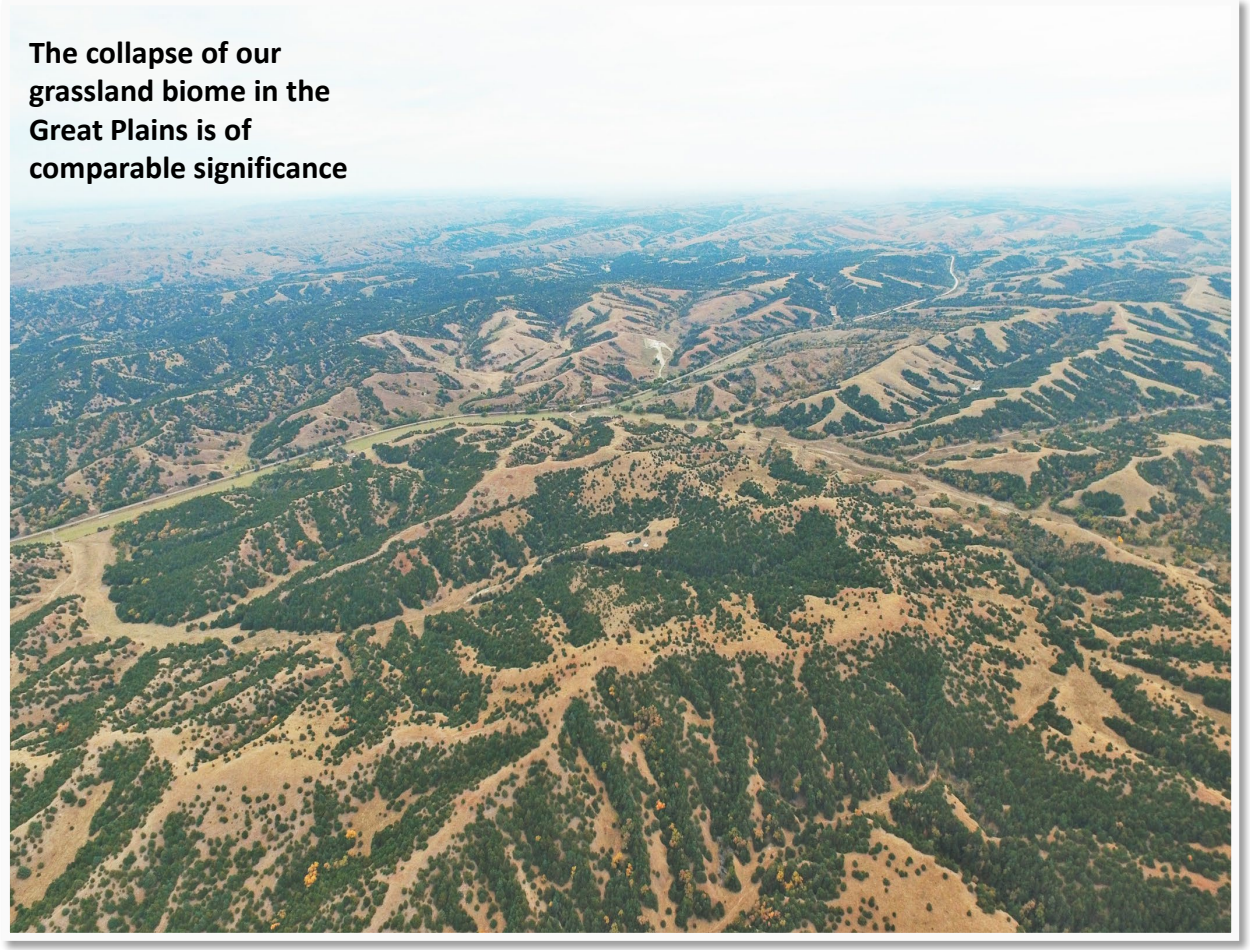
National Rangeland Statistics



Great Plains Facts

- ✓ **No county has restored lost yield after woody encroachment increases significantly**
- ✓ **No county has prevented woody encroachment from increasing**

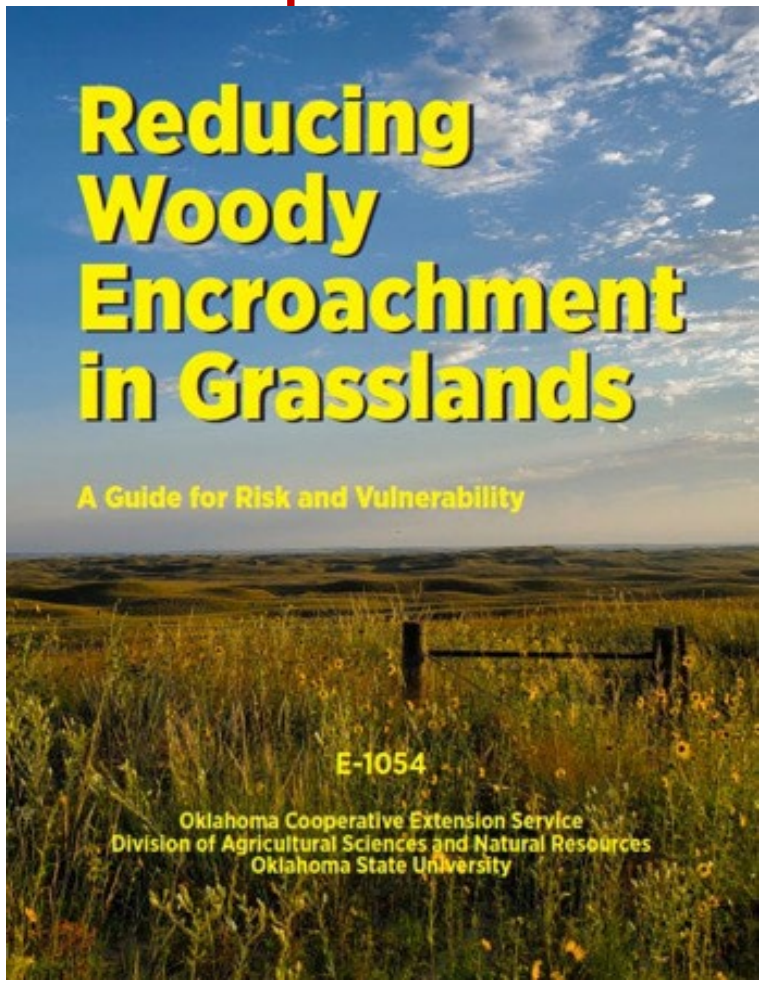
Ecological Transformations Require Bold Actions

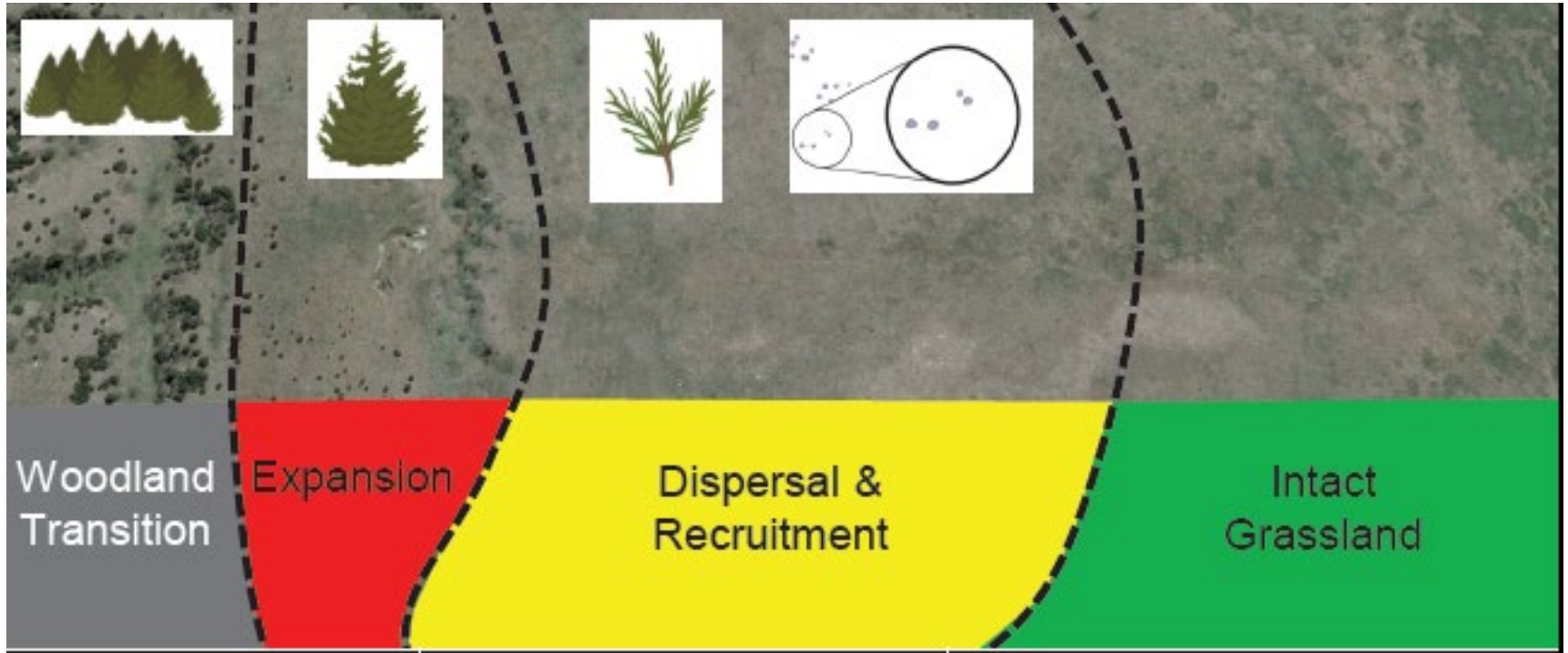


Slide from Jeff Nichols, NE NRCS State Range Specialist

A Better Science Strategy is Now Available

>20K Copies Distributed

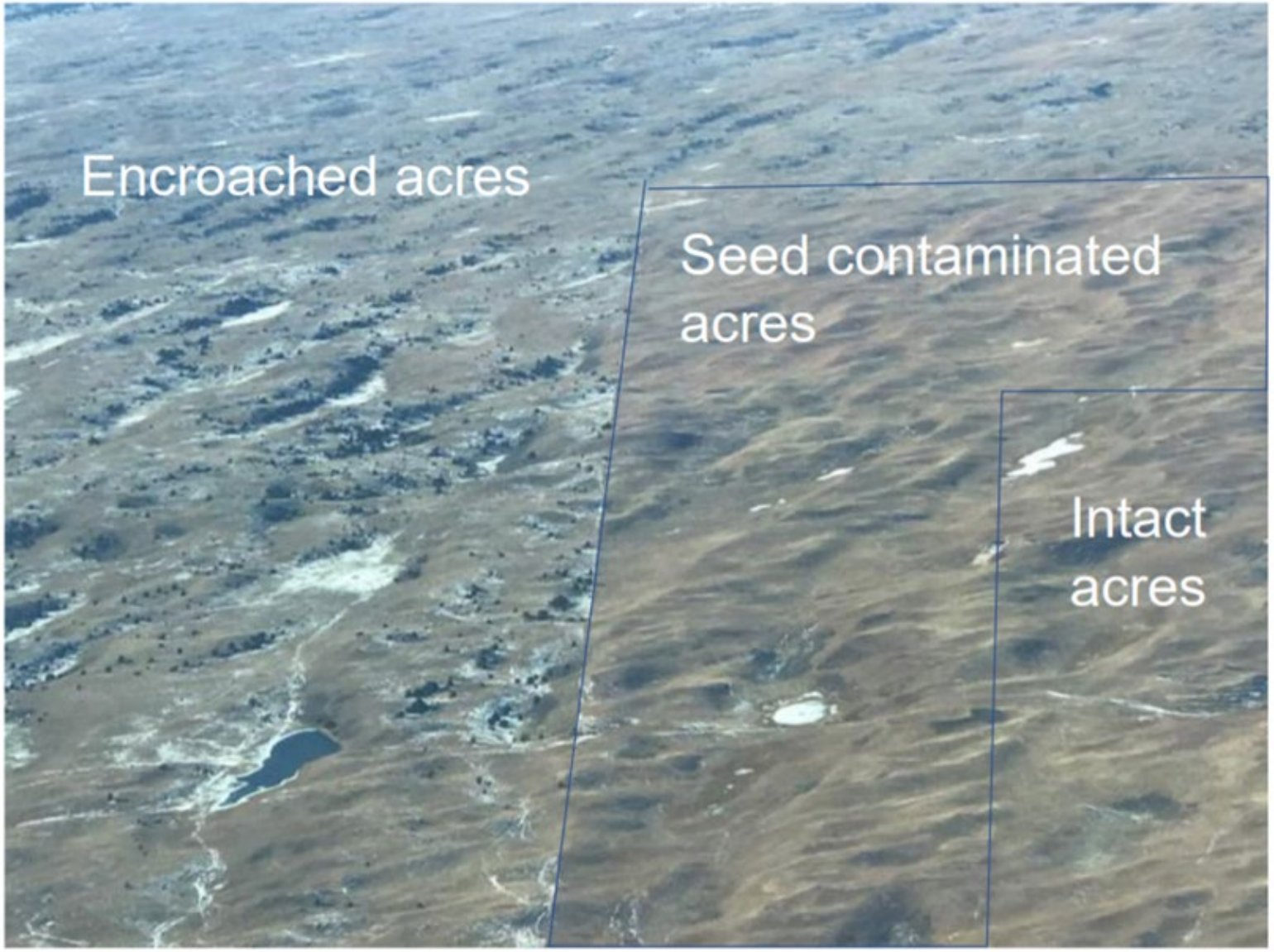


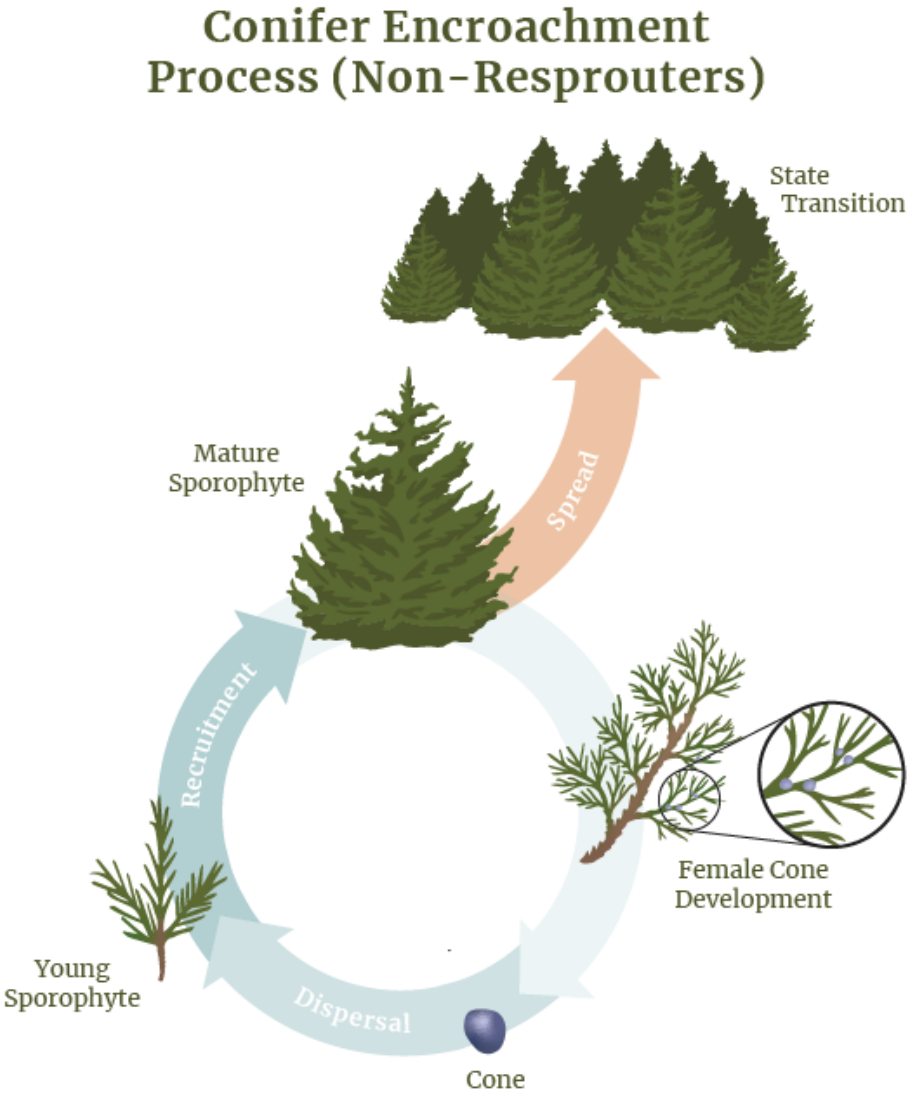


Stages	Description	Management
Woodland Transition	Woody plant dominance	Heavy machinery - mechanical removal, fire
Expansion	Scattered producing trees	Hand tools, heavy machinery - mechanical removal, fire
Dispersal & Recruitment	Intact with seedlings or incoming seed	Fire, hand cutting, haying, mechanical removal, browsers
Intact Grassland	Treeless with no seed	Avoid introducing seed

Twidwell et al. 2022

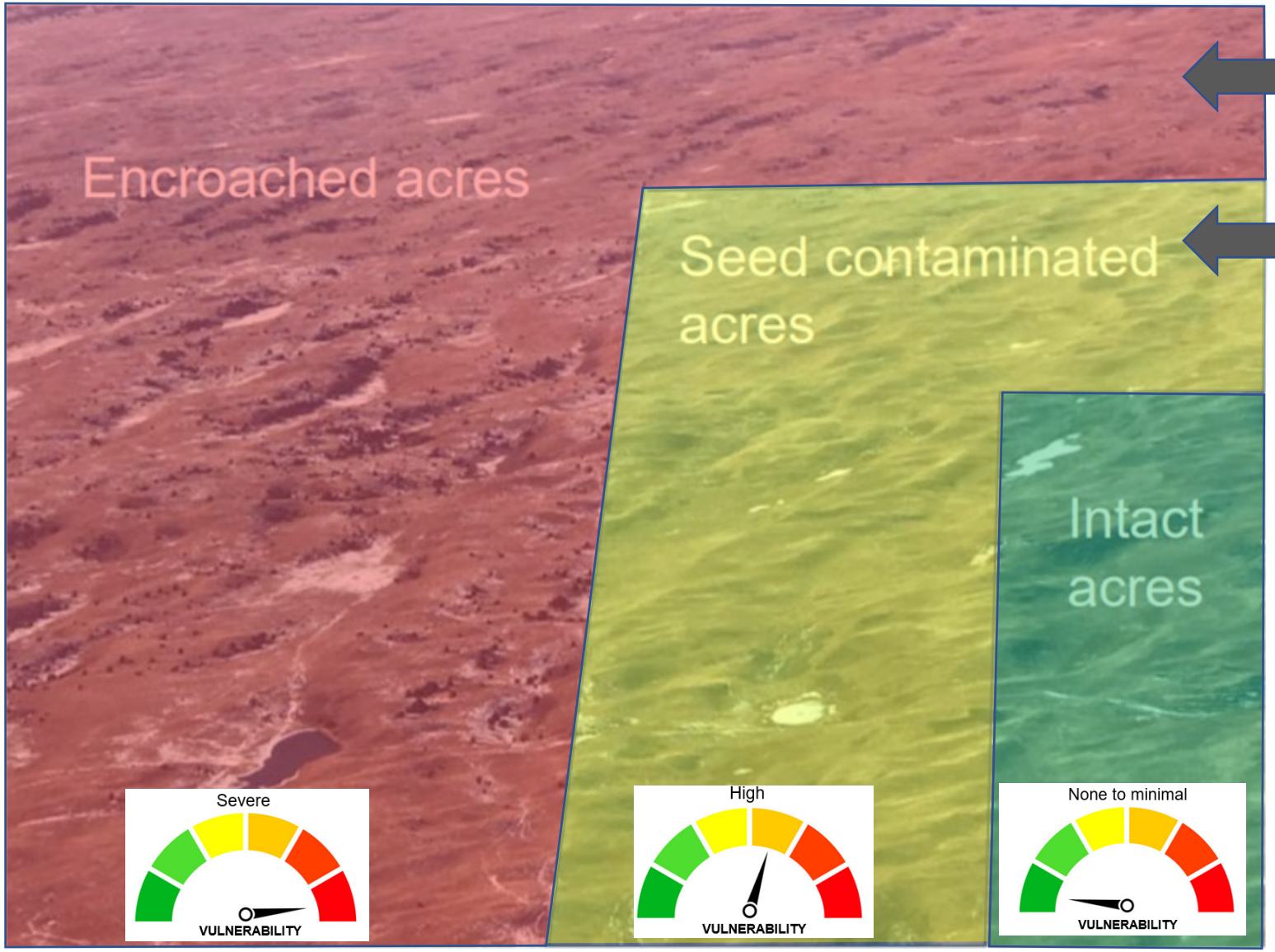
Reducing risk and vulnerability requires integrated management across multiple encroachment stages





What happens if we do not manage seed contaminated acres?

Traditional Approach on 3,000 acres



Brush Management
$109K

No management

Encroachment stage	Description	% of site
Intact	Treeless with no seed	10%
Dispersal & Recruitment	Intact with seedlings or incoming seed	20%
Encroachment	Scattered, seed producing trees	70%
State Transition	Woody plant dominance	0%

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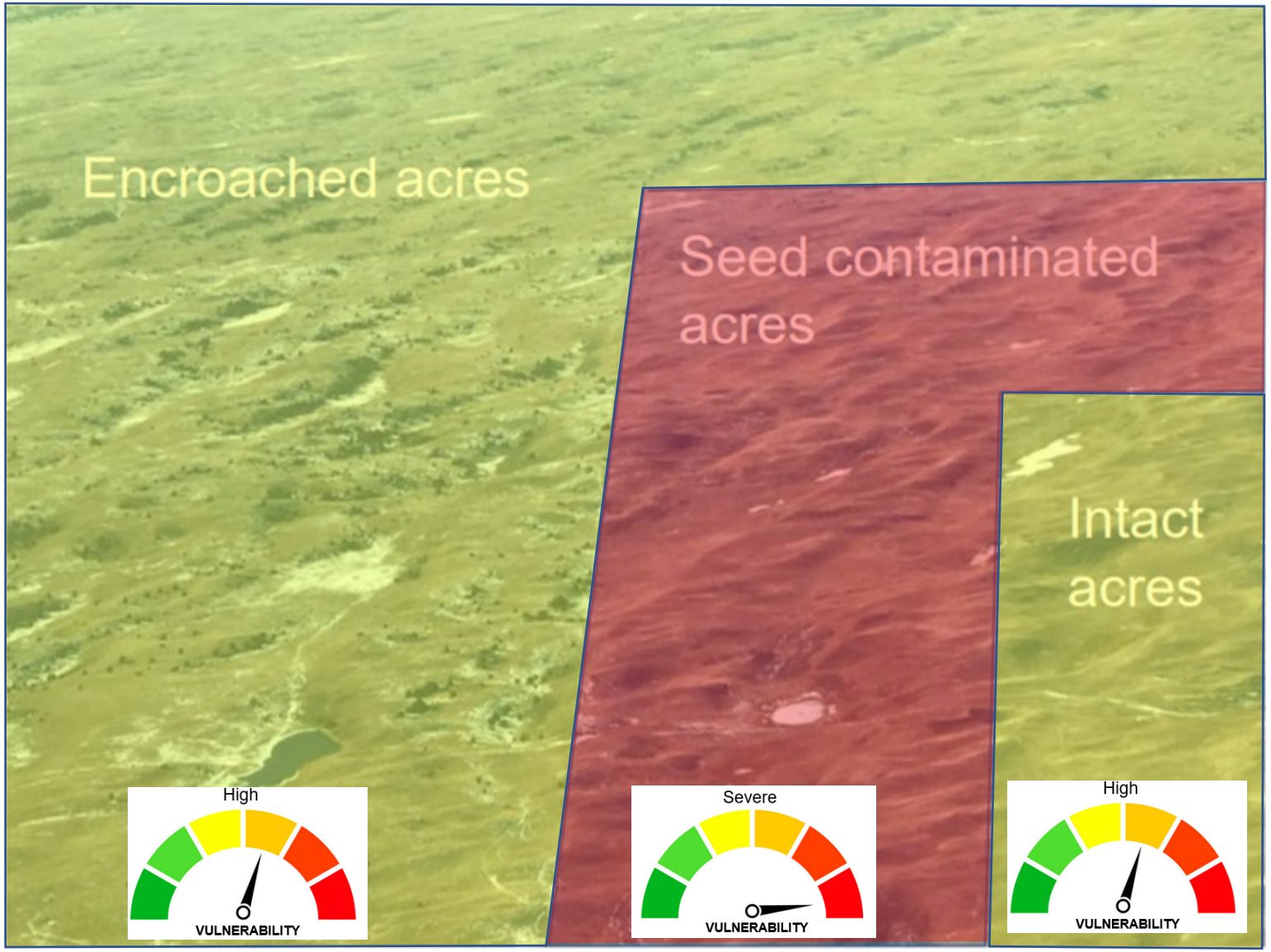
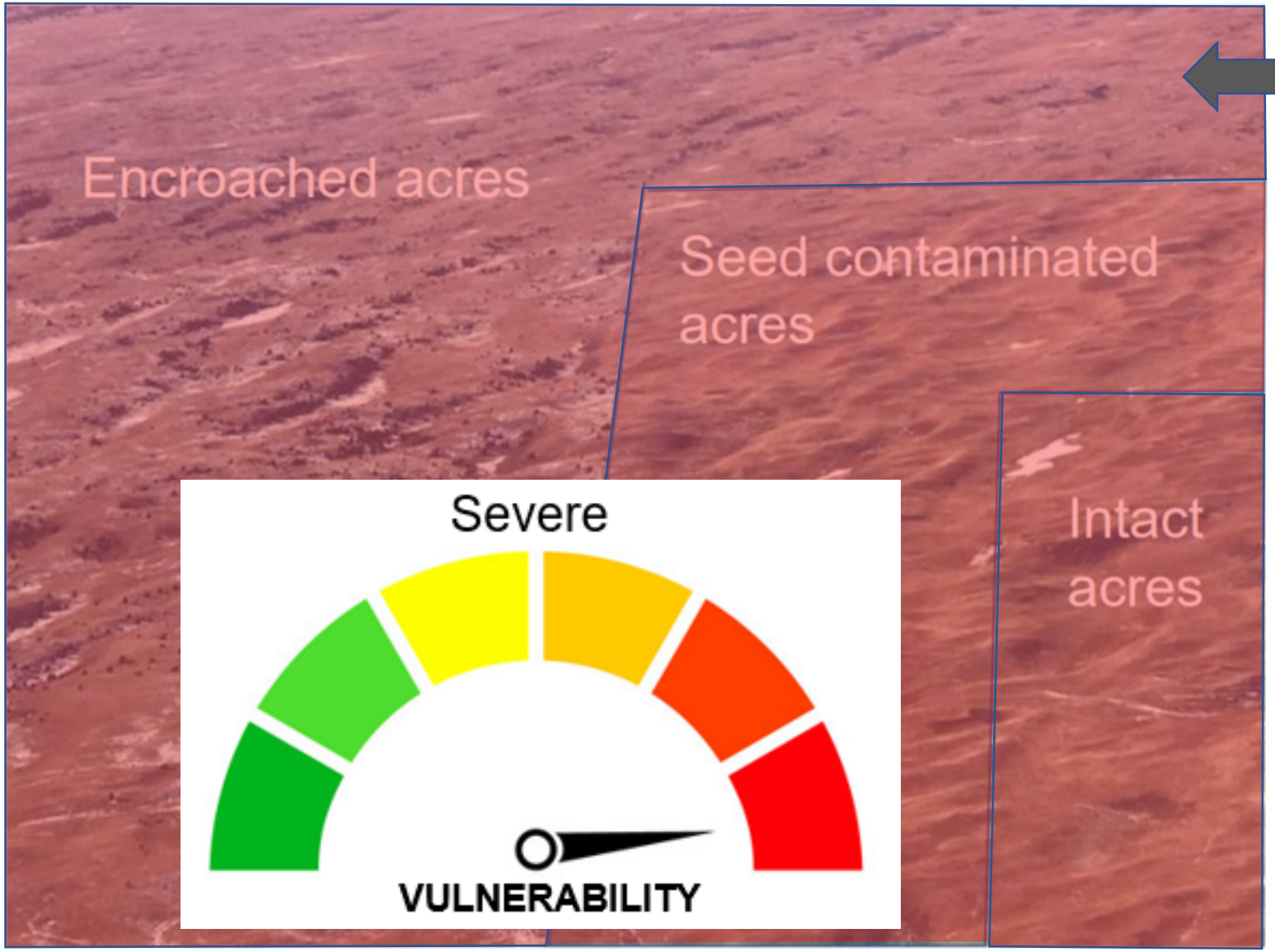
Traditional Approach on 3,000 acres



Encroachment stage	Description	% of site
Intact	Treeless with no seed	0%
Dispersal & Recruitment	Intact with seedlings or incoming seed	80%
Encroachment	Scattered, seed producing trees	20%
State Transition	Woody plant dominance	0%

What happens if we do not manage seed contaminated acres?

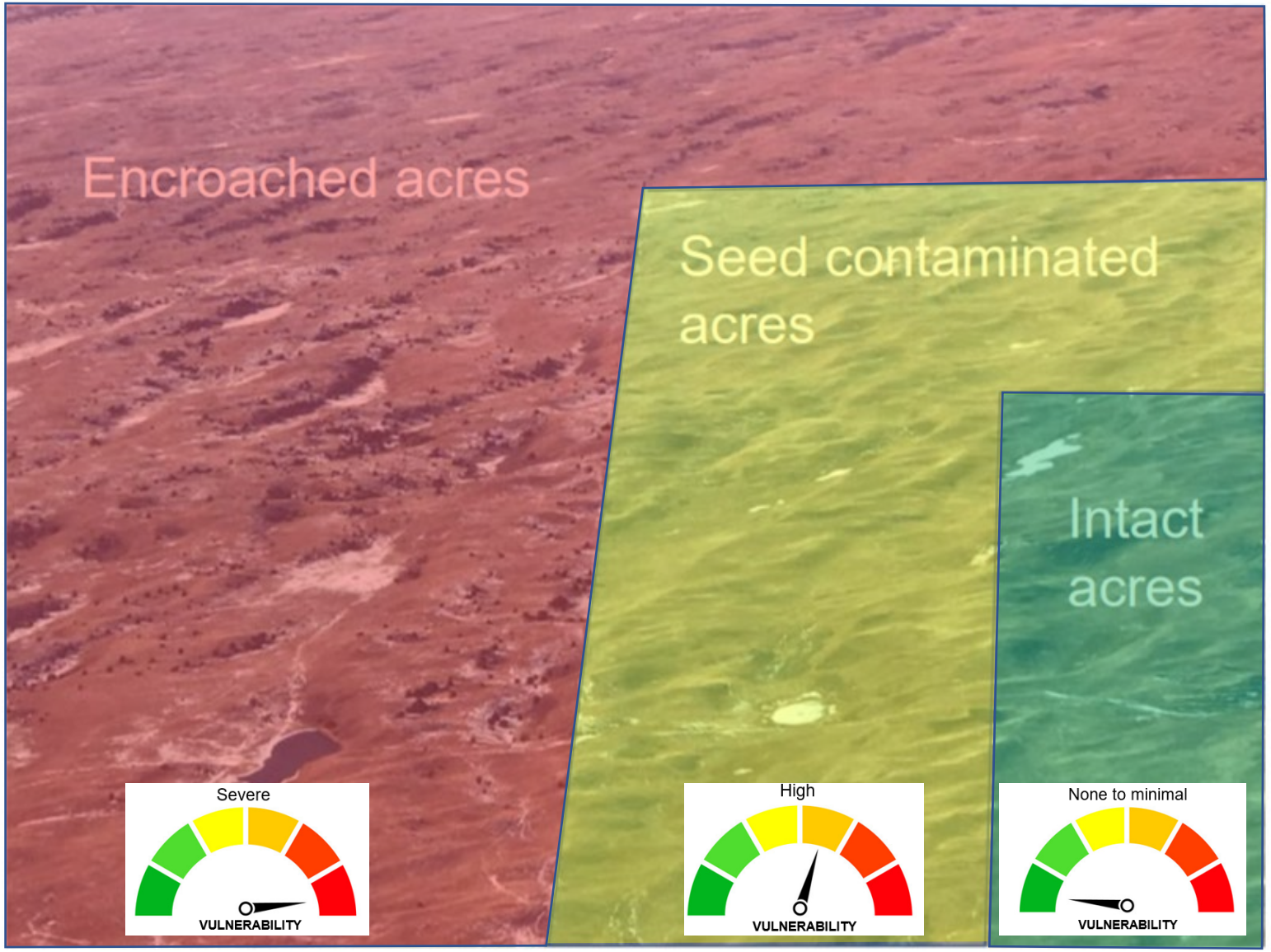
Traditional Approach on 3,000 acres



Brush Management
$189K

Encroachment stage	Description	% of site
Intact	Treeless with no seed	0%
Dispersal & Recruitment	Intact with seedlings or incoming seed	0%
Encroachment	Scattered, seed producing trees	100%
State Transition	Woody plant dominance	0%

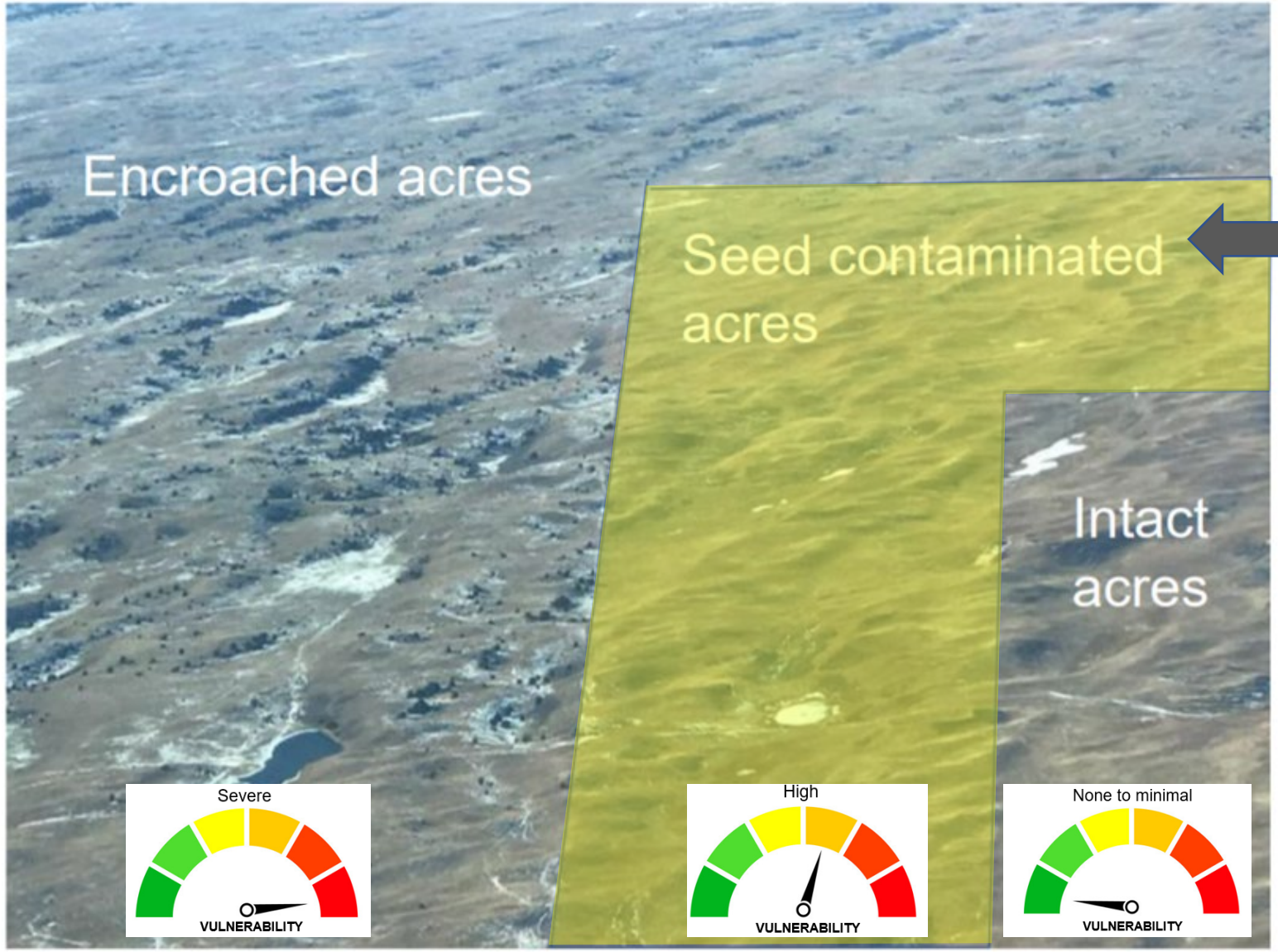
Reducing risk and vulnerability requires integrated management across multiple encroachment stages



Seed dispersal drives risk and vulnerability

Encroachment stage	Description	% of site
Intact	Treeless with no seed	10%
Dispersal & Recruitment	Intact with seedlings or incoming seed	20%
Encroachment	Scattered, seed producing trees	70%
State Transition	Woody plant dominance	0%

Defend the Core

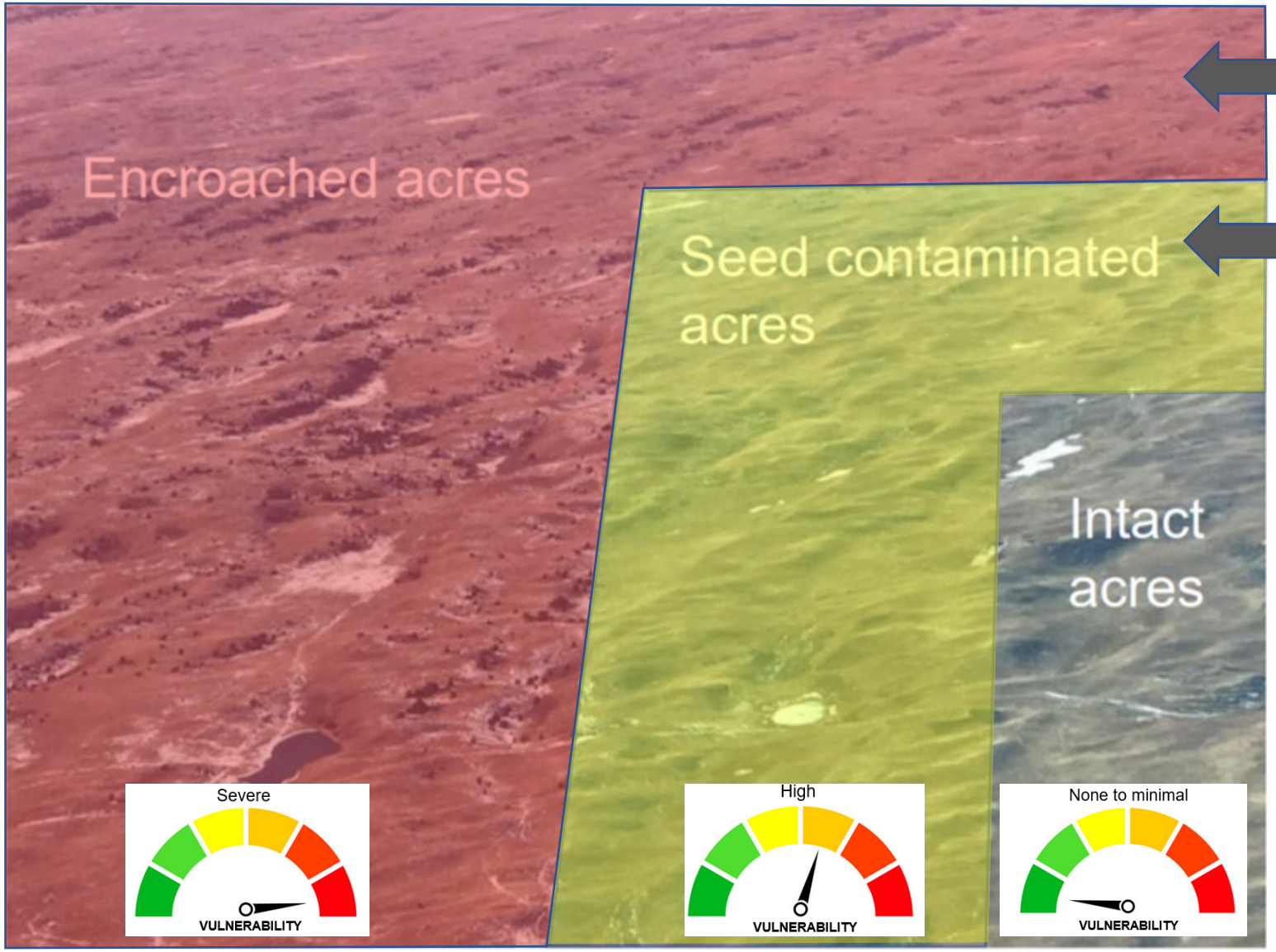


Prescribed fire
(338.2; 338.4; 338.68)
Mechanical, Hand tools
(314.276)
Haying (?)
Browsing (?)

<$6K

Encroachment stage	Description	% of site
Intact	Treeless with no seed	10%
Dispersal & Recruitment	Intact with seedlings or incoming seed	20%
Encroachment	Scattered, seed producing trees	70%
State Transition	Woody plant dominance	0%

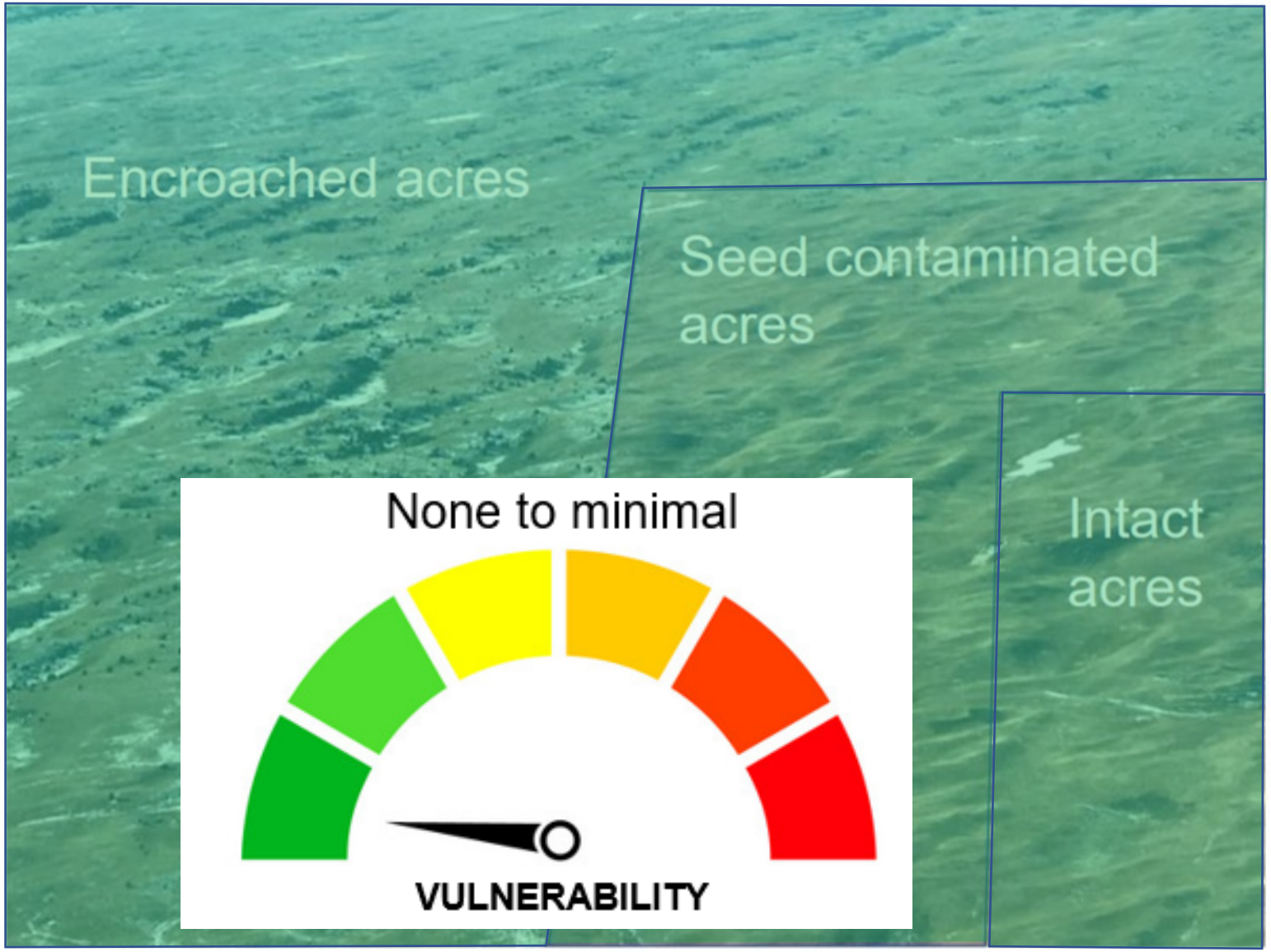
Defend the Core → Grow the Core

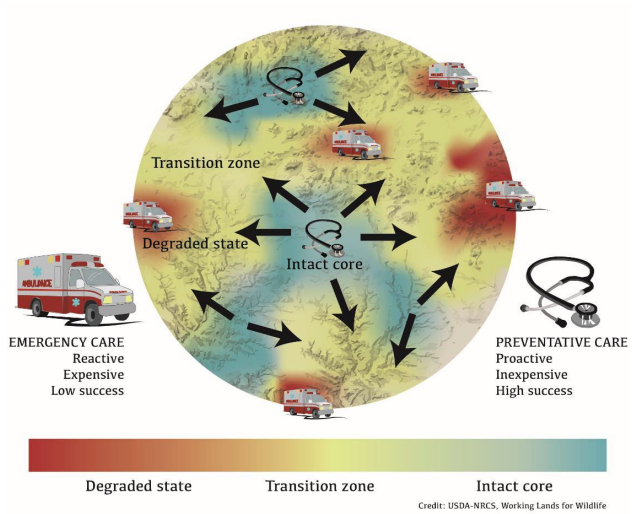


Prescribed fire
(338.4; 338.68)
Mechanical
(314.3; 314.38; 314.5)

Prescribed fire
(338.2; 338.4; 338.68)
Mechanical, Hand tools
(314.276)
Haying (?)
Browsing (?)

Defend the Core → Grow the Core

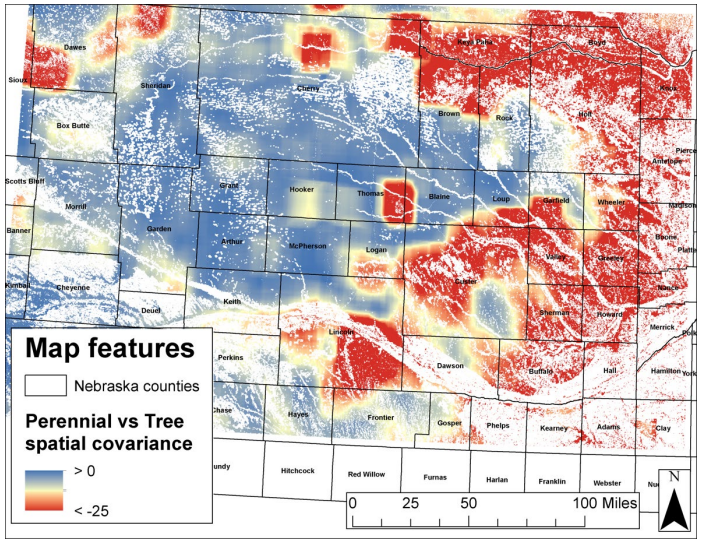




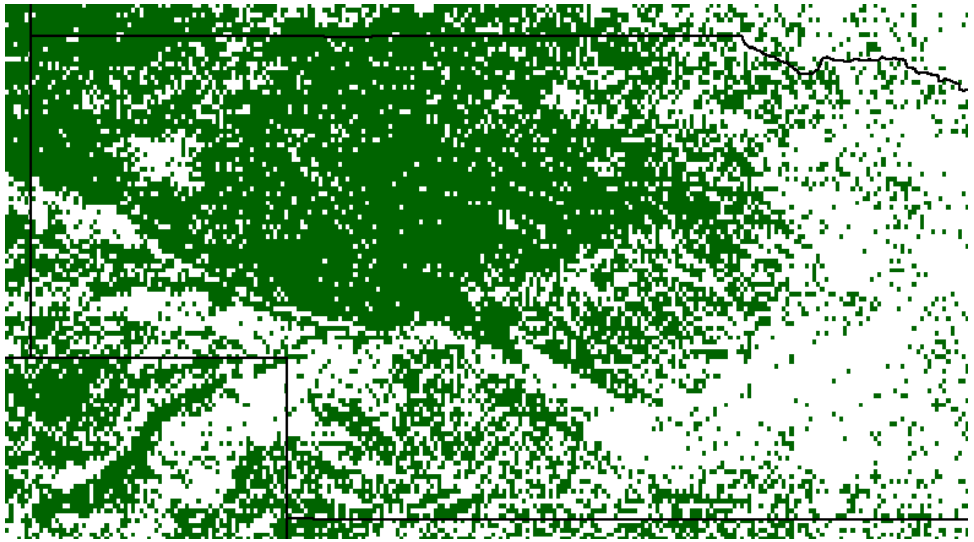
Encroachment stage	Description	% of site
Intact	Treeless with no seed	100%
Dispersal & Recruitment	Intact with seedlings or incoming seed	0%
Encroachment	Scattered, seed producing trees	0%
State Transition	Woody plant dominance	0%

Identifying Cores and Building Resilience in the Great Plains

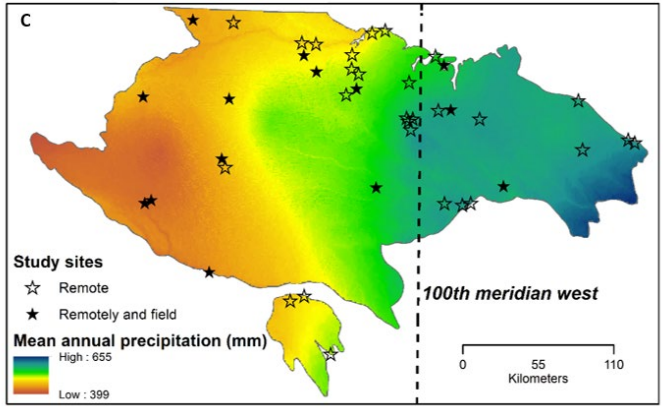
1. Identify the existing transition between grass-tree regional states



2. Locate intact areas to anchor conservation efforts (intact grasslands <5% cover)

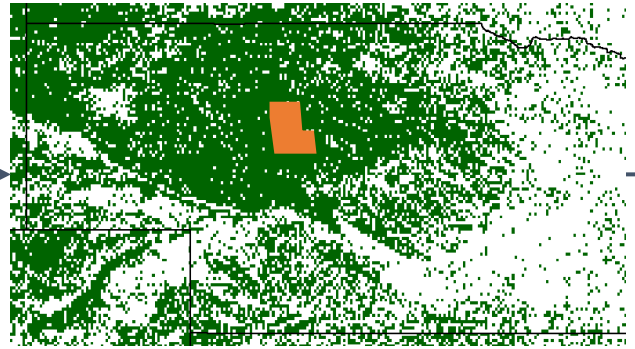


3. Refine core areas with field inventories and local knowledge to identify incipient invasion within the core that is undetectable by technology

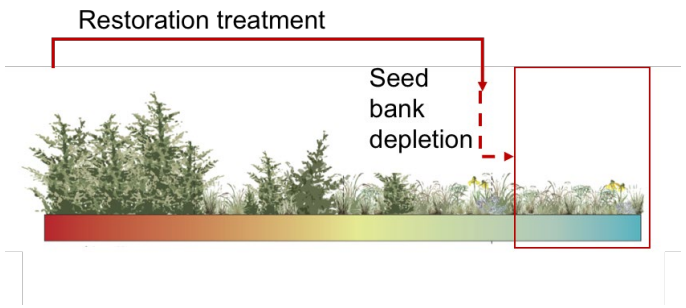


4. Overlay data and knowledge on wildlife priorities

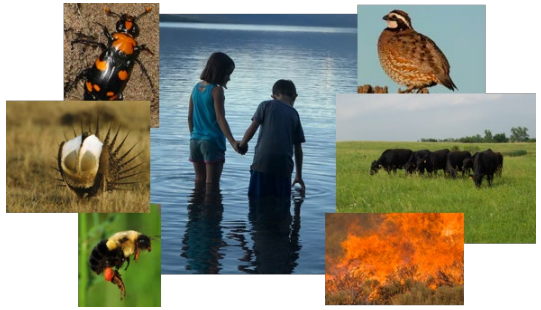
5. Identify landowner networks with the cultural will to act



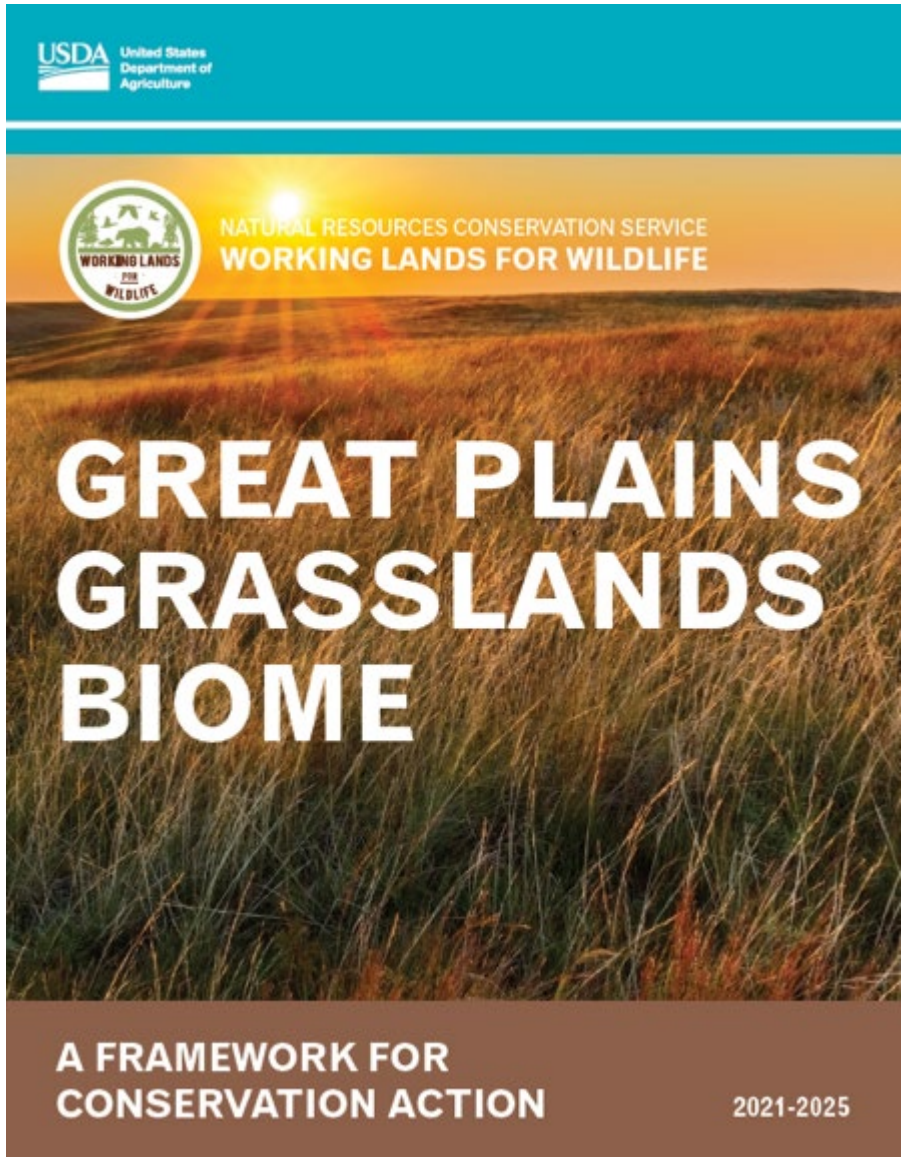
6. Co-produce scenarios for customized solutions

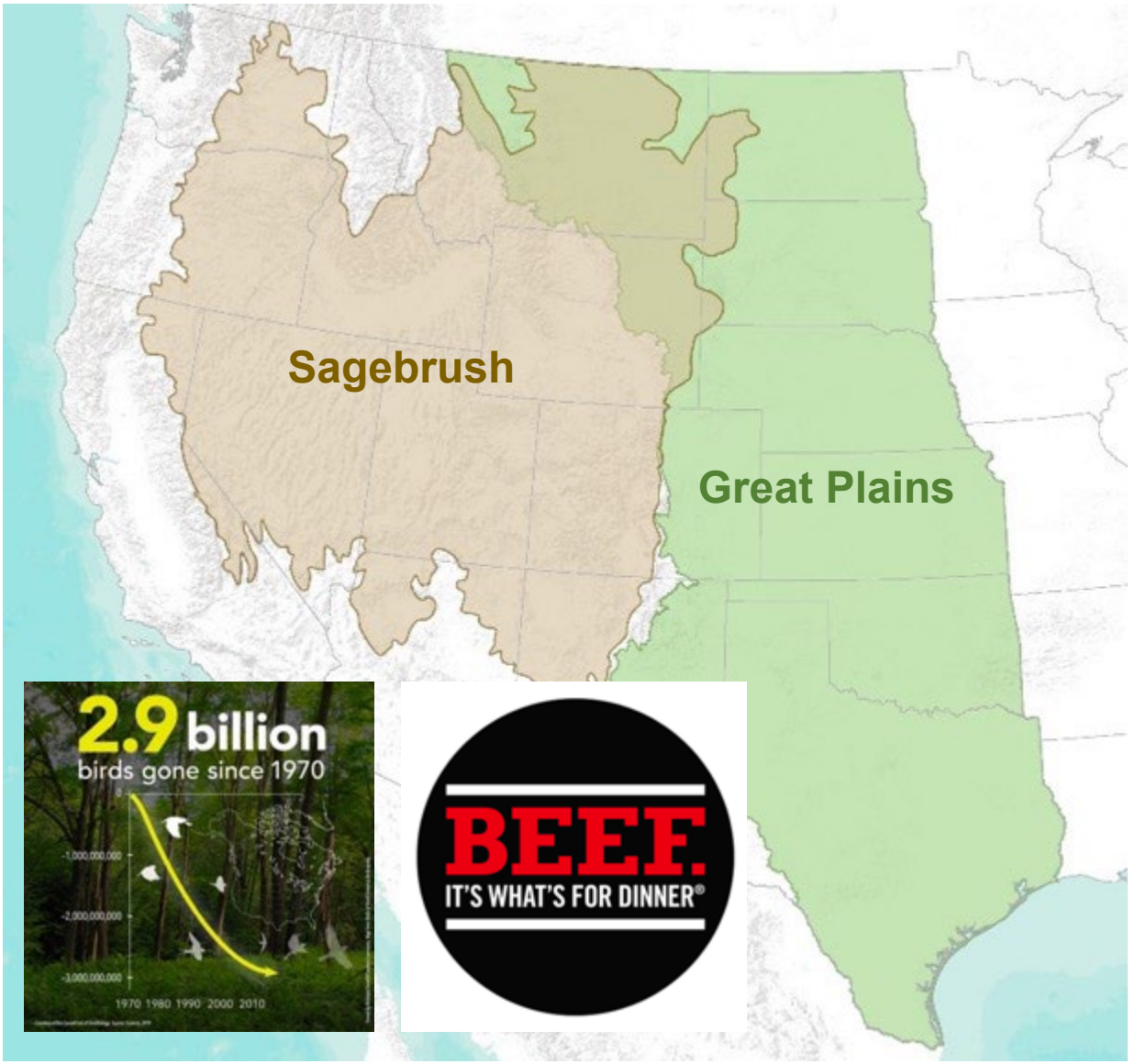


7. Track outcomes, adapt over time, and grow the core with success stories



NRCS Released their First Biome-Scale Framework for Conservation Action in America's Grasslands





NRCS State Leadership Responded Overnight to Insights from New Technology

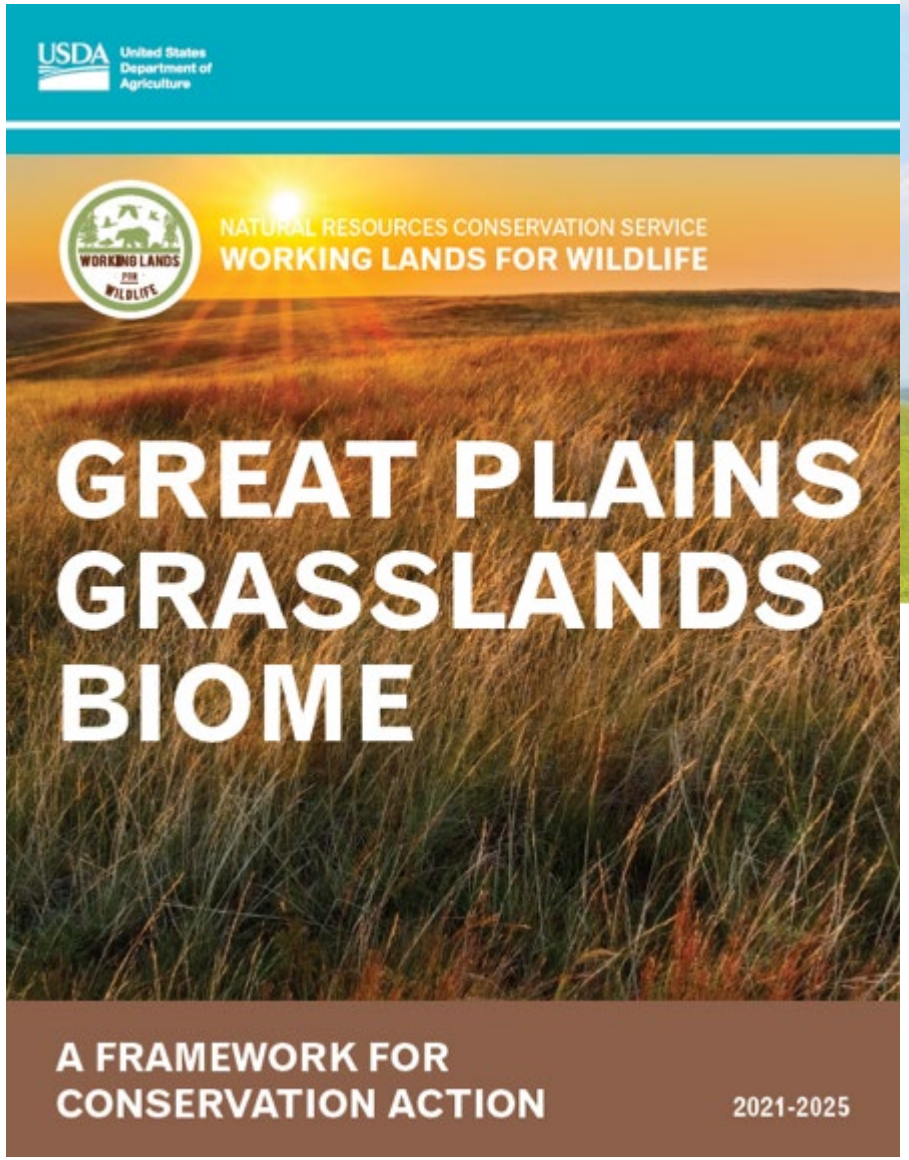
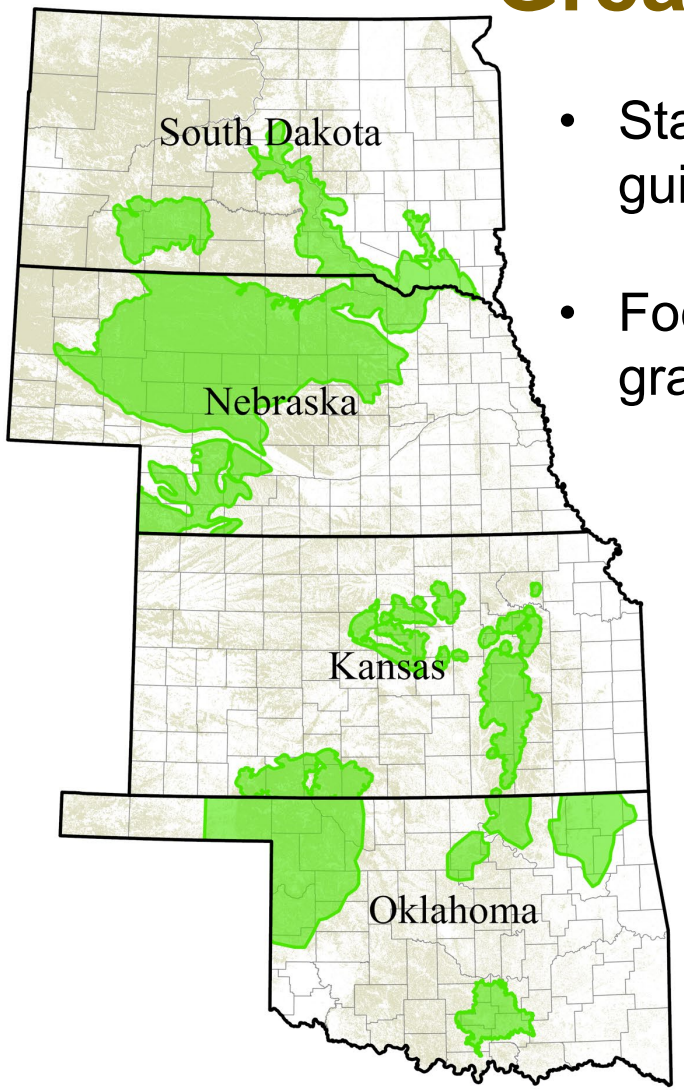


Photo: Shutterstock/Max Voran

Photo: Dirac Twidwell

Photo: Jeremy Roberts/Conservation Media

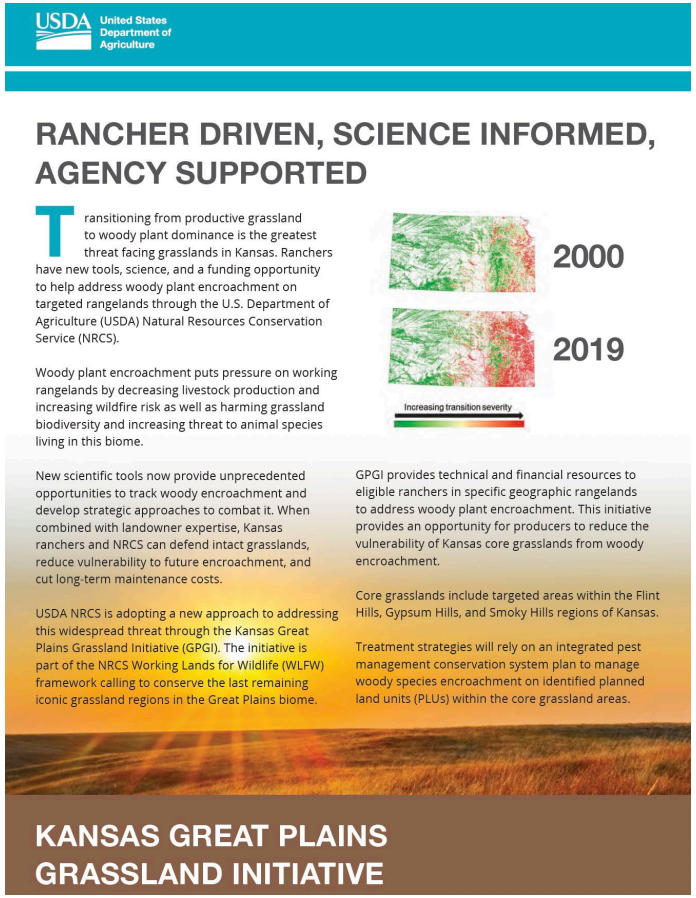
Great Plains Grassland Initiatives

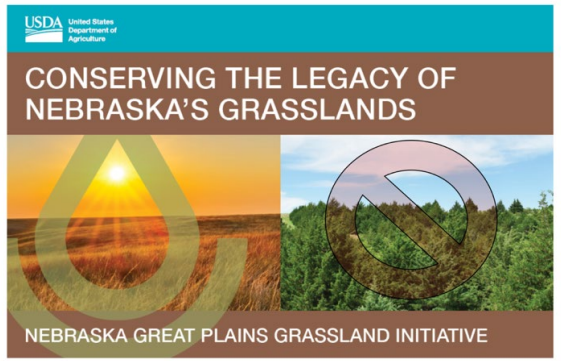


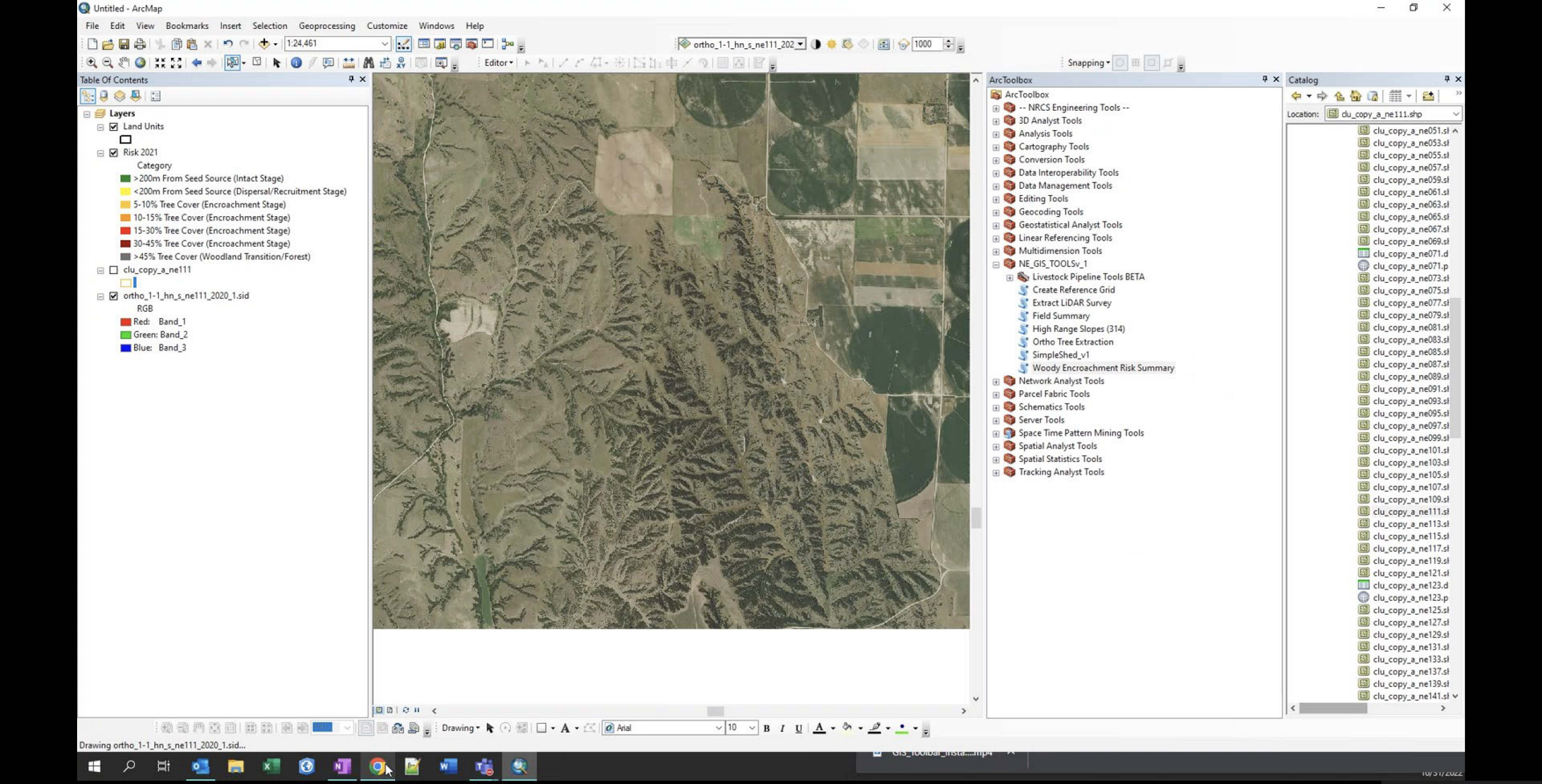
- State-based implementation of new national guidance for grassland conservation
- Focus is on addressing drivers of large-scale grassland loss

Great Plains Grassland Initiative (Phase 1 Implementation)

Grasslands (Phase 1 Technical Guidance; Future GPGI Candidates)






Untitled - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Table Of Contents
Layers
Land Units
Risk 2021
Category
>200m From Seed Source (Intact Stage)
<200m From Seed Source (Dispersal/Recruitment Stage)
5-10% Tree Cover (Encroachment Stage)
10-15% Tree Cover (Encroachment Stage)
15-30% Tree Cover (Encroachment Stage)
30-45% Tree Cover (Encroachment Stage)
>45% Tree Cover (Woodland Transition/Forest)
clu_copy_a_ne111
ortho_1-1_hn_s_ne111_2020_1.sid
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
ArcToolbox
ArcToolbox
-- NRCS Engineering Tools --
3D Analyst Tools
Analysis Tools
Cartography Tools
Conversion Tools
Data Interoperability Tools
Data Management Tools
Editing Tools
Geocoding Tools
Geostatistical Analyst Tools
Linear Referencing Tools
Multidimension Tools
NE_GIS_TOOLSv_1
Livestock Pipeline Tools BETA
Create Reference Grid
Extract LiDAR Survey
Field Summary
High Range Slopes (314)
Ortho Tree Extraction
SimpleShed_v1
Woody Encroachment Risk Summary
Network Analyst Tools
Parcel Fabric Tools
Schematics Tools
Server Tools
Space Time Pattern Mining Tools
Spatial Analyst Tools
Spatial Statistics Tools
Tracking Analyst Tools
Catalog
Location: clu_copy_a_ne111.shp
Drawing ortho_1-1_hn_s_ne111_2020_1.sid...

1st ever national policy in ag industry (2022)

NCBA National Cattlemen's Beef Association

PROPERTY RIGHTS & ENVIRONMENTAL MANAGEMENT COMMITTEE (PREM)

Grazing Land Conservation – Amended

WHEREAS, rangelands include a rich and varied landscape of grasslands, woodlands, vernal pools, riparian areas, and wetlands which support numerous imperiled and native plant and animal species, and

WHEREAS, many rangelands are today at significant risk of conversion to development and other uses, and

WHEREAS, these rangelands and the species that rely on these habitats largely persist today due to grazing and other land stewardship practices of the ranchers that have owned and managed these lands and committed to their health, and

WHEREAS, these rangelands are a critical foundation of the economic and social fabric of the U.S. ranching industry and rural communities and will only continue to provide these societal benefits if rangelands remain in ranching, and

WHEREAS, woody encroachment is quickly consuming rangelands,

THEREFORE BE IT RESOLVED, NCBA shall work aggressively to accomplish the following:

Educate the public regarding the environmental benefits associated with grazing and rangeland agriculture

Streamline processes regarding consultations and other regulatory requirements to eliminate current disincentives to voluntary conservation efforts

Provide tax incentives and other benefits to those ranchers actively working to benefit the environment

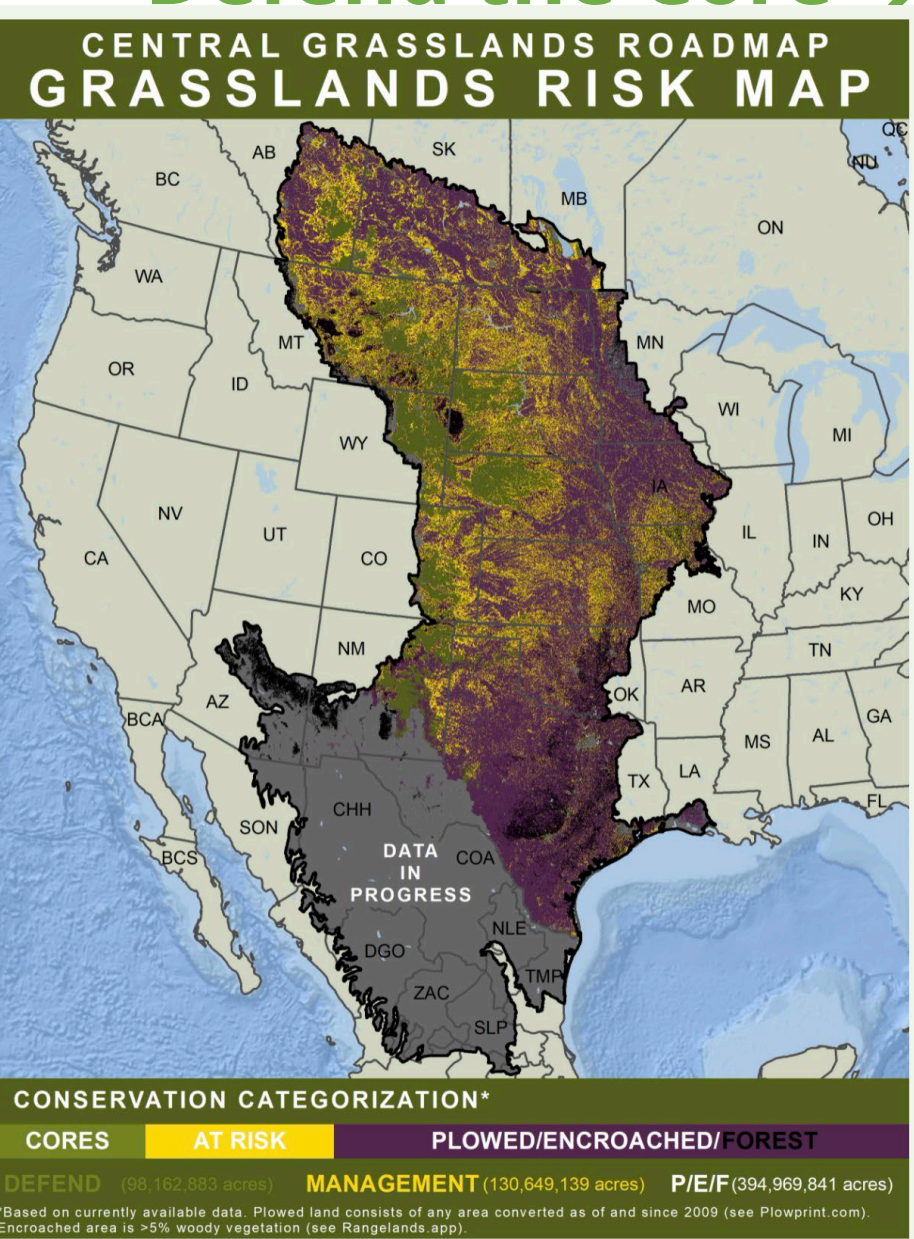
Pursue the expansion of the use of safe harbor agreements, exclusion of critical habitat, and use of the 4(d) rule for the listing of habitat and species

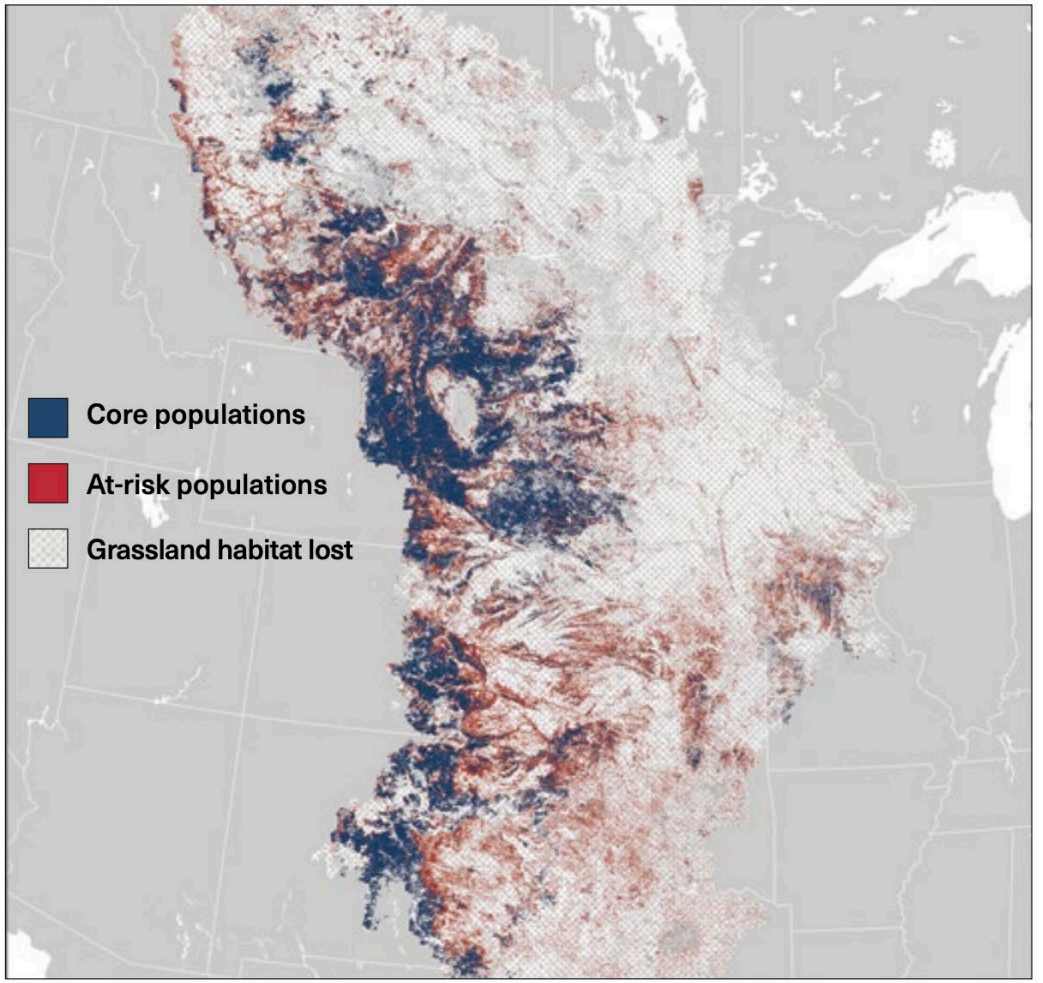
Seek more funding through willing partners for removal of invasive woody species and research for long term solutions

BE IT FURTHER RESOLVED, NCBA shall work on a national level to partner with state affiliates, conservation, and agricultural organizations to achieve these goals.

A New Mantra has Emerged:

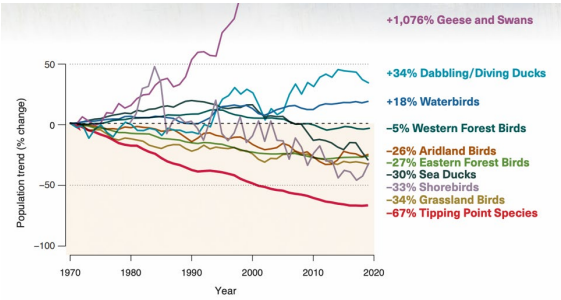
Defend the Core → Grow the Core → Mitigate Impacts



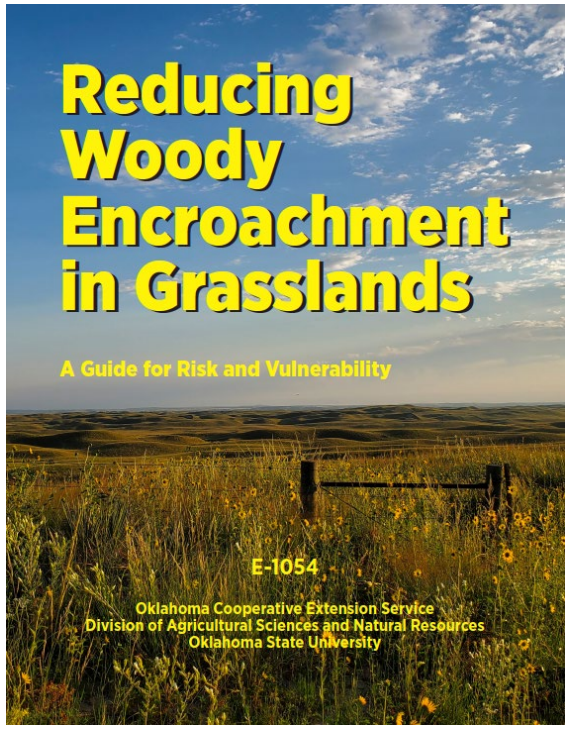


CORE AND AT-RISK GRASSLAND BIRD POPULATIONS

The Central Grassland Roadmap Initiative has identified core and at-risk grassland bird populations across the central Great Plains in order to focus conservation and restoration on the best remaining grassland habitat.
Source: Central Grassland Roadmap Initiative.



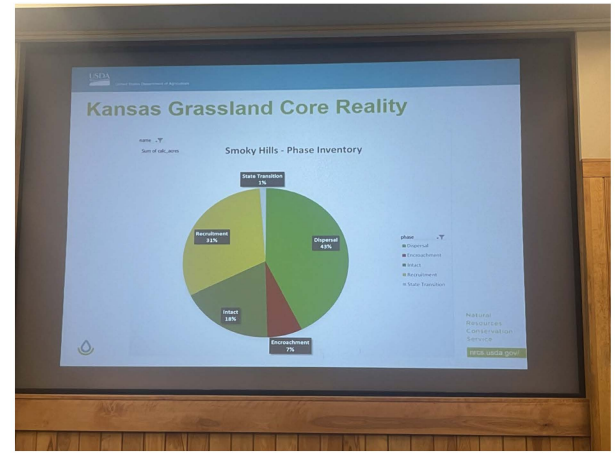
GREAT PLAINS GRASSLAND BIOME Extension Partnership

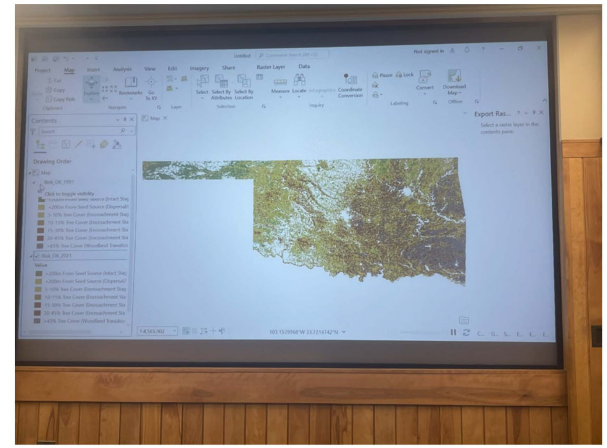


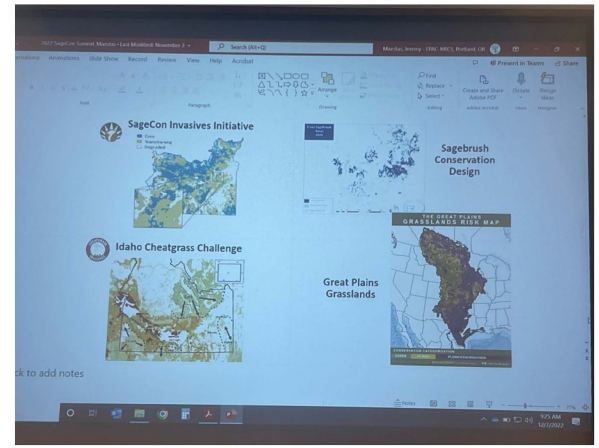
Field Training Handbook

[In Development]


THE VAST POSSIBILITIES OF OUR GREAT FUTURE WILL ONLY BECOME REALITIES
Spatial Presence
Grass
Tree Density
How we used to see it…
How we understand it now…
Succession
Disposal
Recruitment
Encroachment
State transition

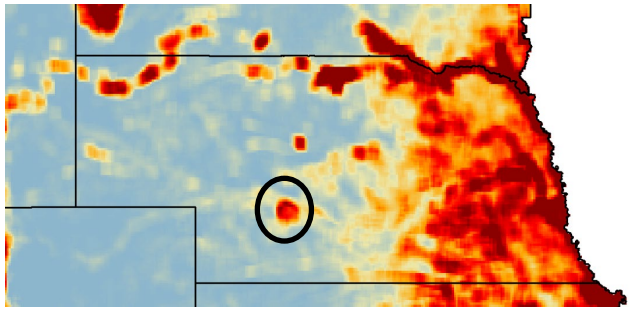

Kansas Grassland Core Reality
Smoky Hills - Phase Inventory
State Transition 1%
Dispersal 43%
Encroachment 7%
Intact 18%
Recruitment 31%
Natural Resources Conservation Service




SageCon Invasives Initiative
Sagebrush Conservation Design
Idaho Cheatgrass Challenge
Great Plains Grasslands
GRASSLANDS RISK MAP

A Network of Regional Models of Success on Private Lands

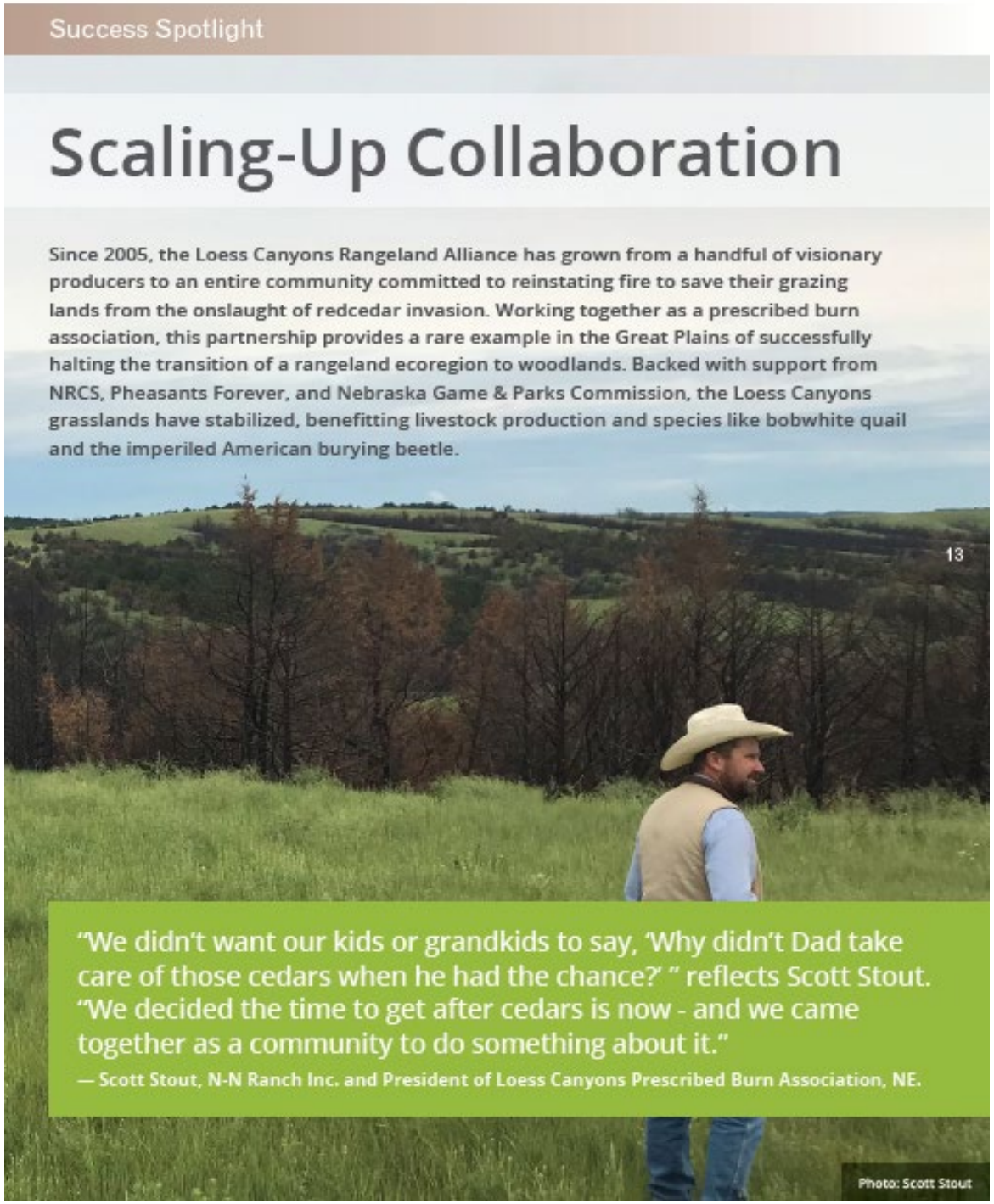
Case Study 1:
The Loess Canyons Experimental Landscape



NEBRASKA GAME PARKS

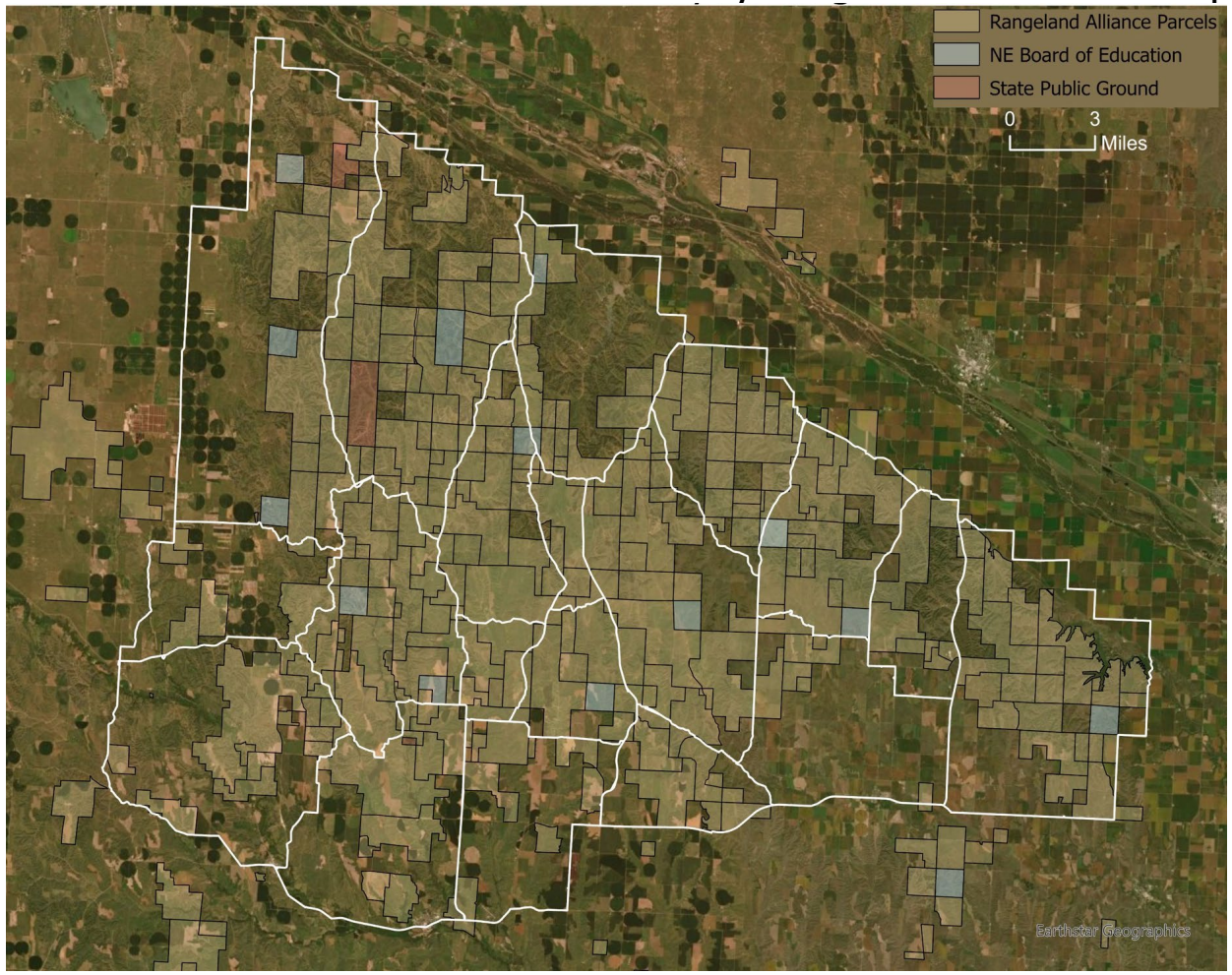
PHEASANTS forever The Habitat Organization

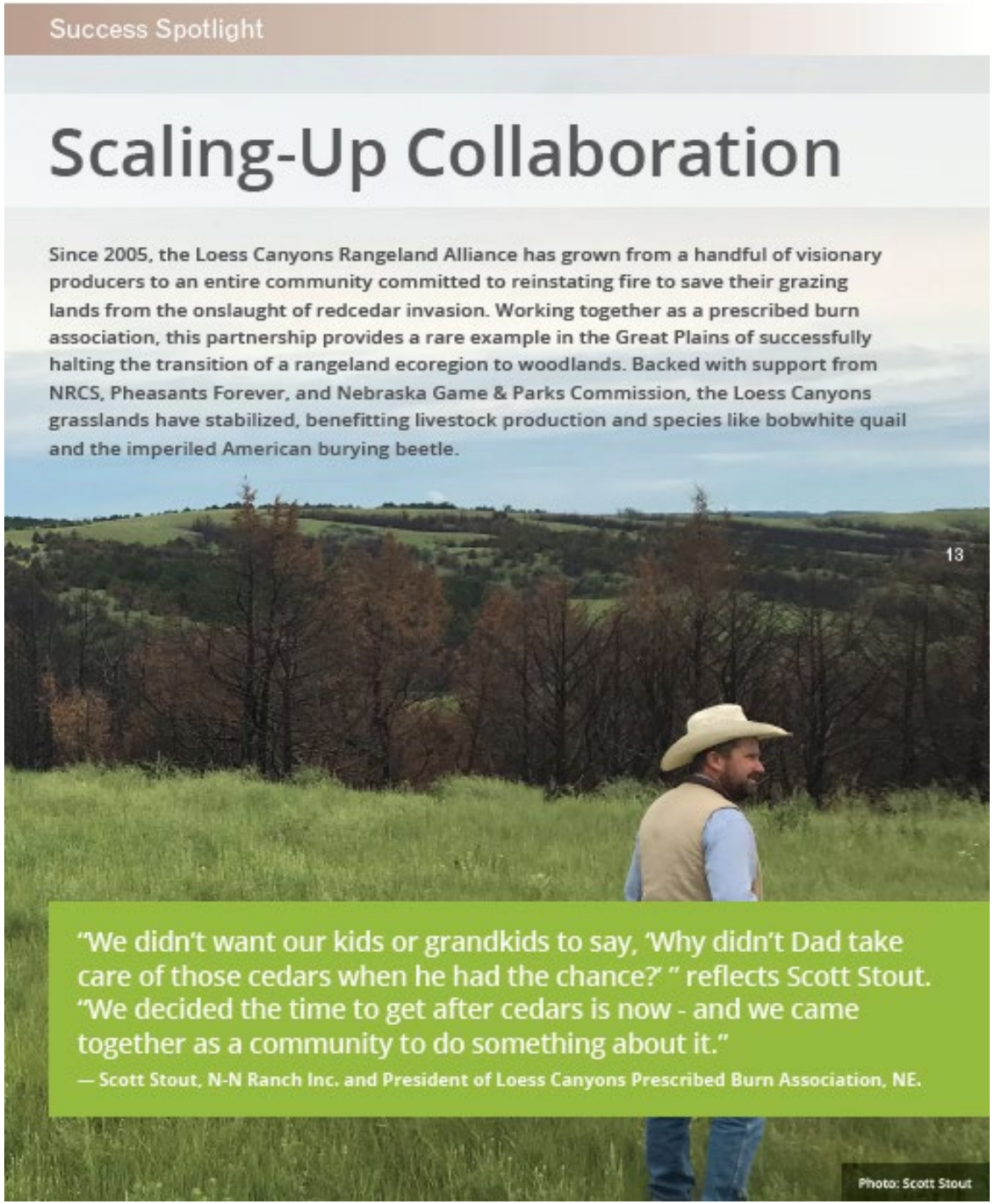
NRCS Natural Resources Conservation Service

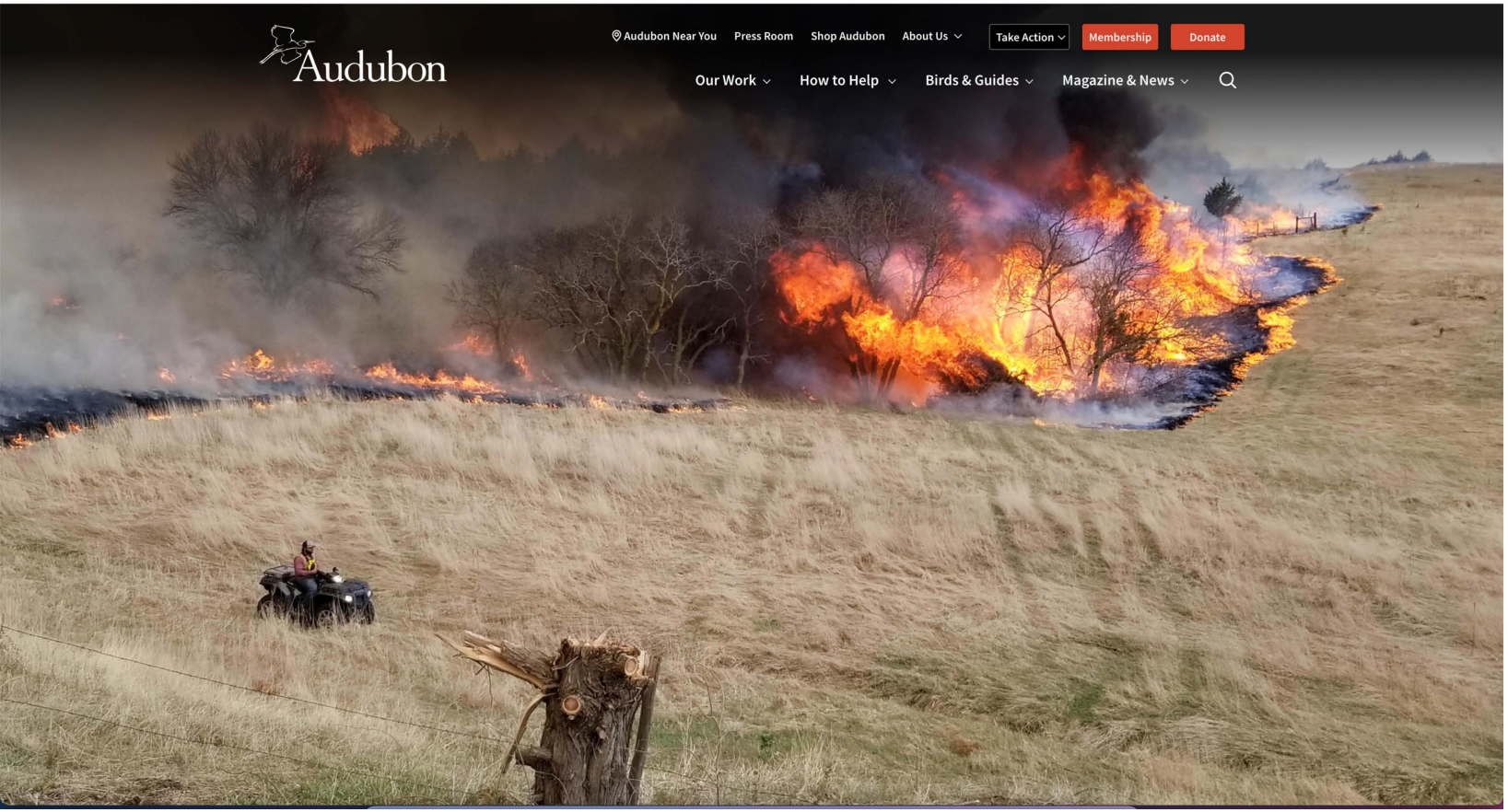


Loess Canyons Experimental Landscape

Loess Canyons PBAs land ownership







News

In Nebraska's Loess Canyons, Setting Trees Ablaze Gives Prairie Birds a Boost

For generations Great Plains ranchers saw fire as a foe. Now they're banding together and embracing it as a tool to restore grassland habitat.

THE SCIENCE BEHIND ERC INVASIONS

"Only one group in the Great Plains has demonstrated the capacity to stabilize a region following the onset of exponential growth of eastern redcedar. This is the result of unique partnership in the Loess Canyons of Nebraska, where landowners, scientists and agencies (Nebraska Game and Parks Commission, Pheasants Forever and Natural Resources Conservation Service) have leveraged resources in new ways to attempt to scale up ERC control, and this region provides the first scientific evidence for sustainable rangeland management in areas with higher amounts of eastern redcedar cover in the Great Plains." *—Dirac Twidwell*

LOESS CANYONS ADD TO SCIENCE LITERACY

The Eastern Redcedar Science Literacy Project is the most comprehensive resource on eastern redcedar invasion and its impacts to human well-being, and it represents science-landowner partnerships at their most effective.

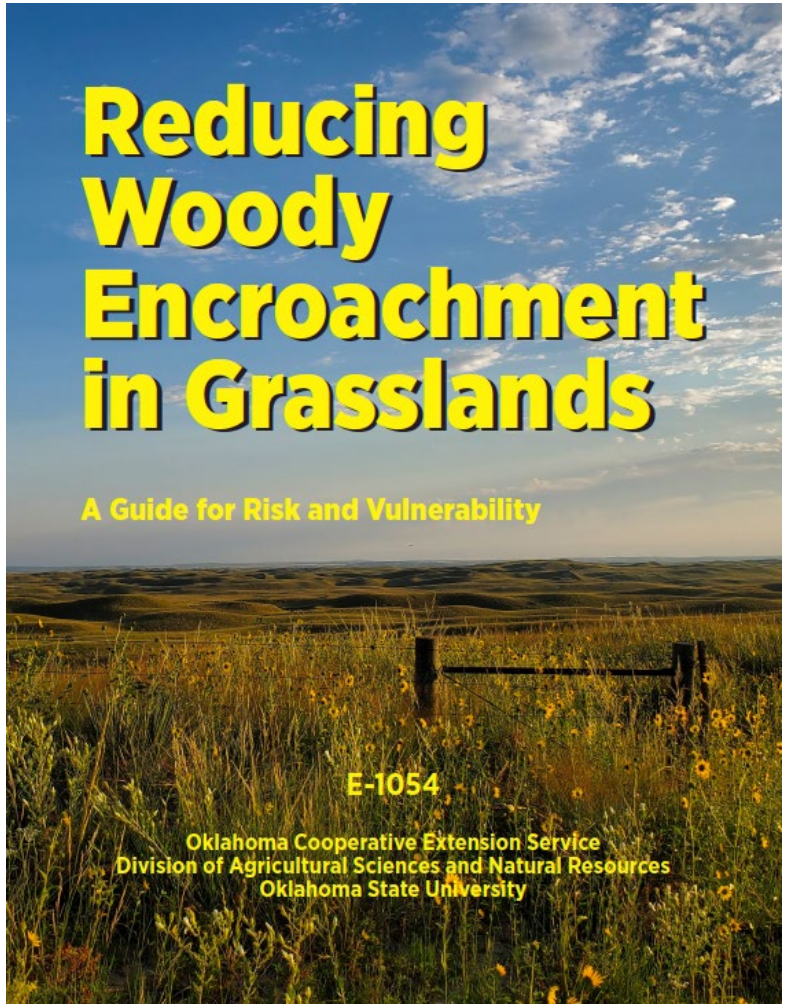
PRESCRIBED FIRE CHANGING NE LANDSCAPE

In the fight against cedar encroachment, no state is taking a more aggressive approach than Nebraska where Pheasants Forever, Nebraska Game and Parks Commission, United States Department of Agriculture, Nebraska Environmental Trust, USFWS-Partners for Fish and Wildlife, The Nature Conservancy, University of Nebraska-Lincoln and others are forming prescribed burn associations throughout the state to take back the prairie. And, it's working. Just ask the folks who have helped reclaim nearly 250,000 acres from invasive red cedars over the past 15 years.

THE GREAT PLAINS PRAIRIE NEEDS FIRE

The Great Plains prairie needs fire to survive. These ranchers are bringing it back.

Thank You!



Additional links:

Reducing Woody Encroachment in Rangelands: A Guide for Risk and Vulnerability https://wlfw.rangelands.app/great-plains/woodland-expansion/
Working Lands for Wildlife's Great Plains Grassland Biome Framework: https://wlfw.rangelands.app
Rangeland Analysis Platform: http://rangelands.app
Eastern redcedar science literacy website: http://cedarliteracy.unl.edu
Loess Canyons Science Report: https://www.lpcinitiative.org/wp-content/uploads/Loess-Canyons-Experimental-Landscape-Report-LOW-RES-FINAL-102121.pdf