

Reducing Woody Encroachment to Conserve Rangeland Production in the Great Plains



Dirac Twidwell
University of Nebraska

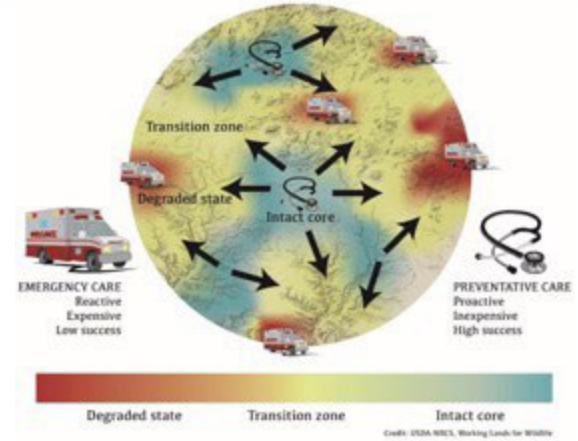
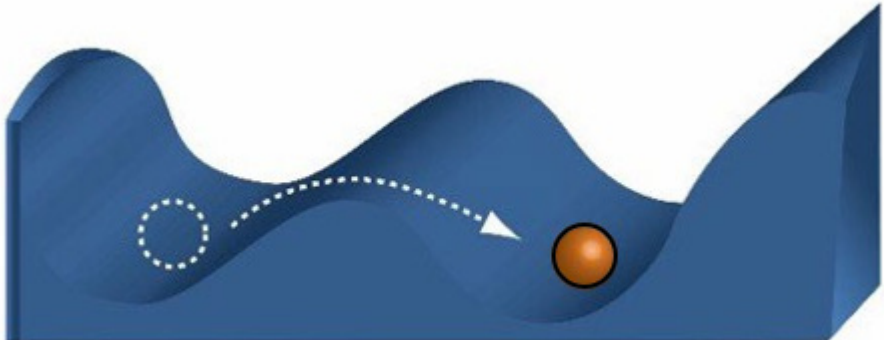
A grand challenge for the 21st century is to avoid transitions in nature that are so severe their consequences go beyond the traditions of any single discipline.



Pictures Reefbase project



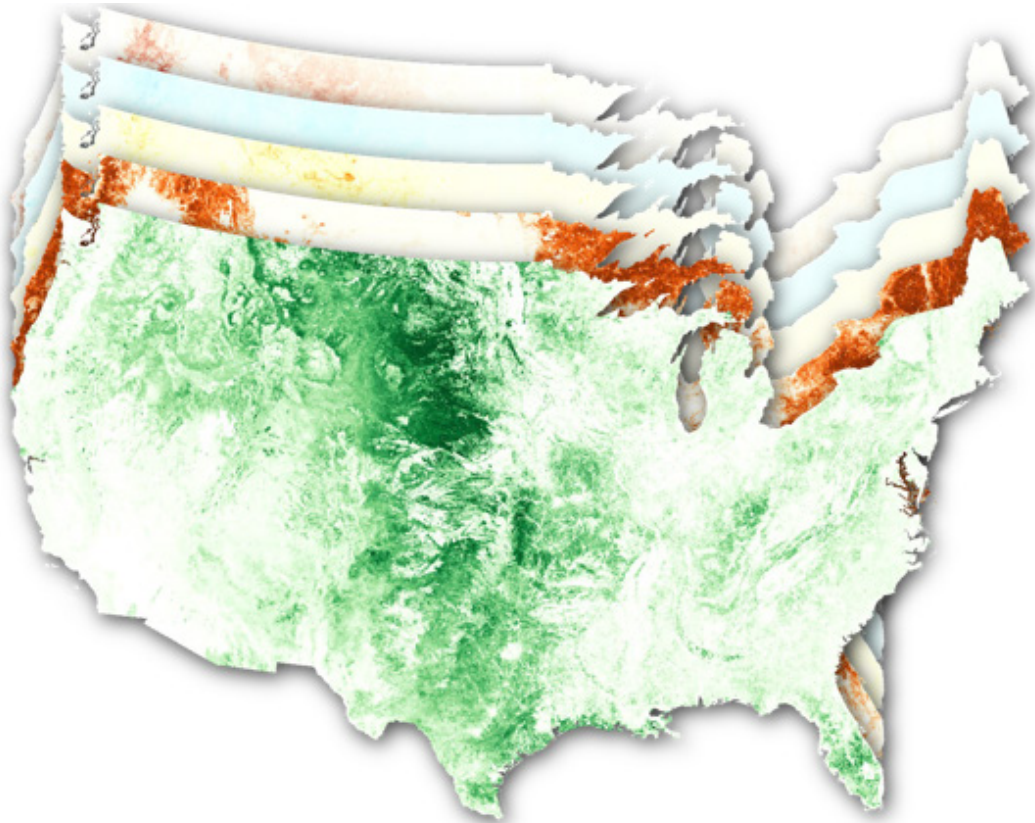
Scientists now hypothesize that the most catastrophic transitions are those that transcend scale



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

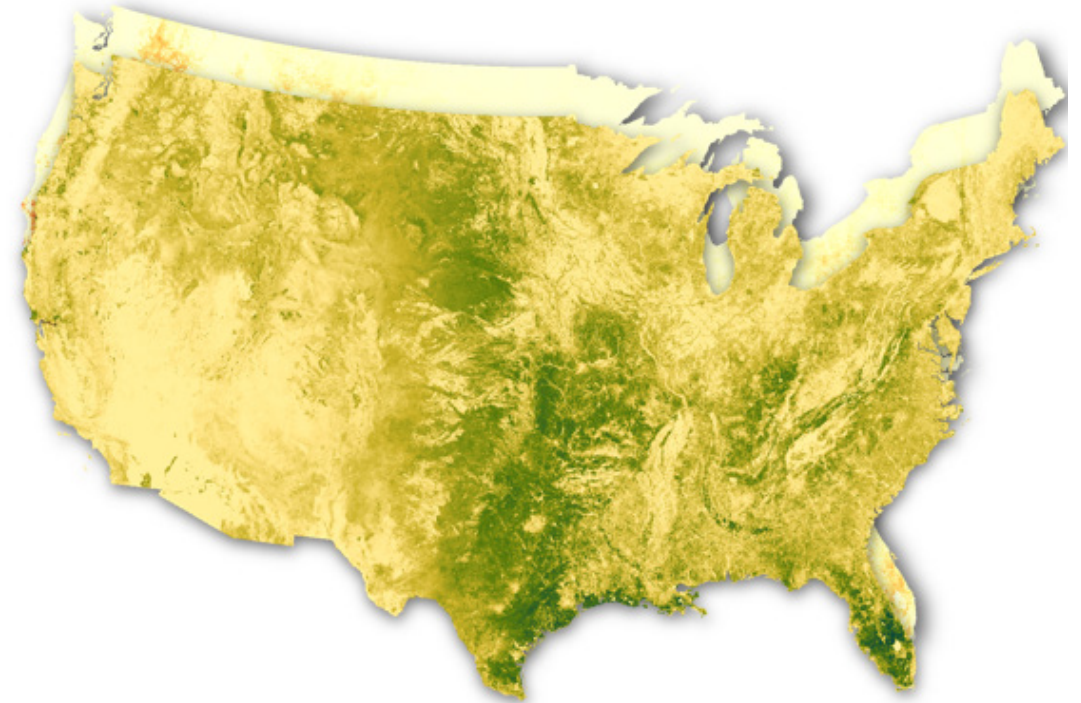


Rangeland Analysis Platform



Rangeland Cover

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

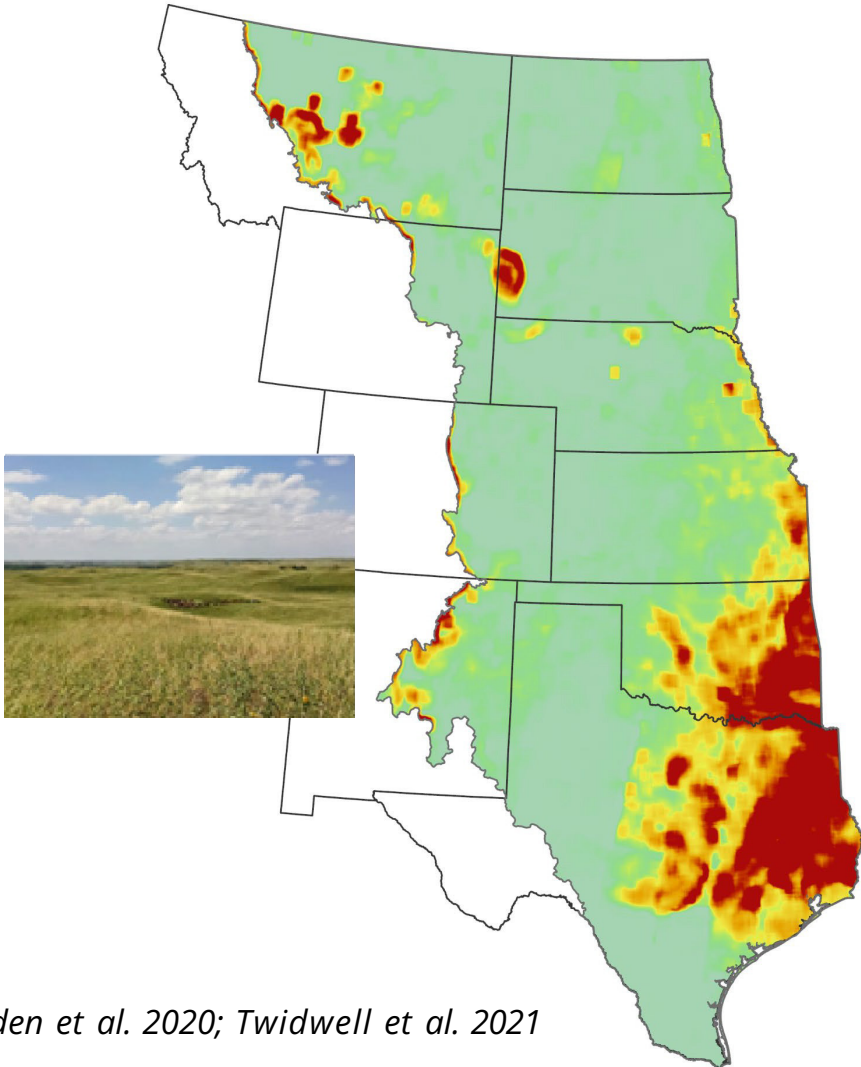


Rangeland Production

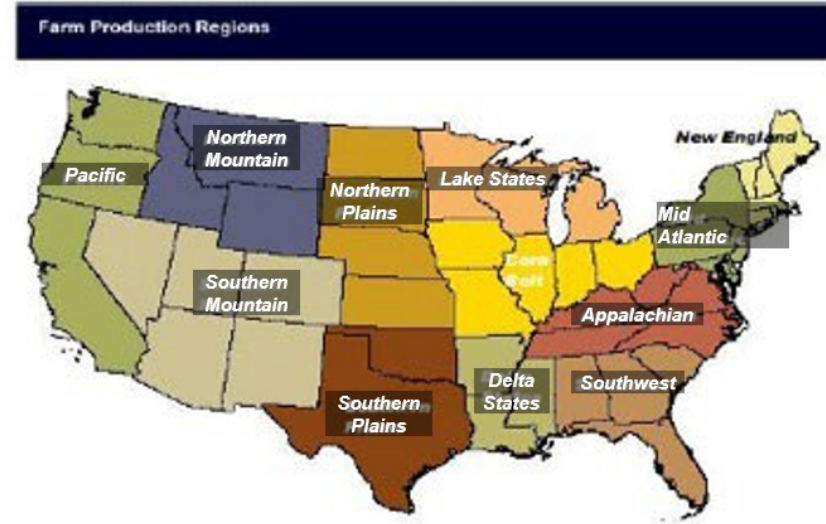
- lbs/acre
- 2 vegetation groups
- Annual time-step
- 16-day time-step

The Great Plains Biome is Collapsing

1990



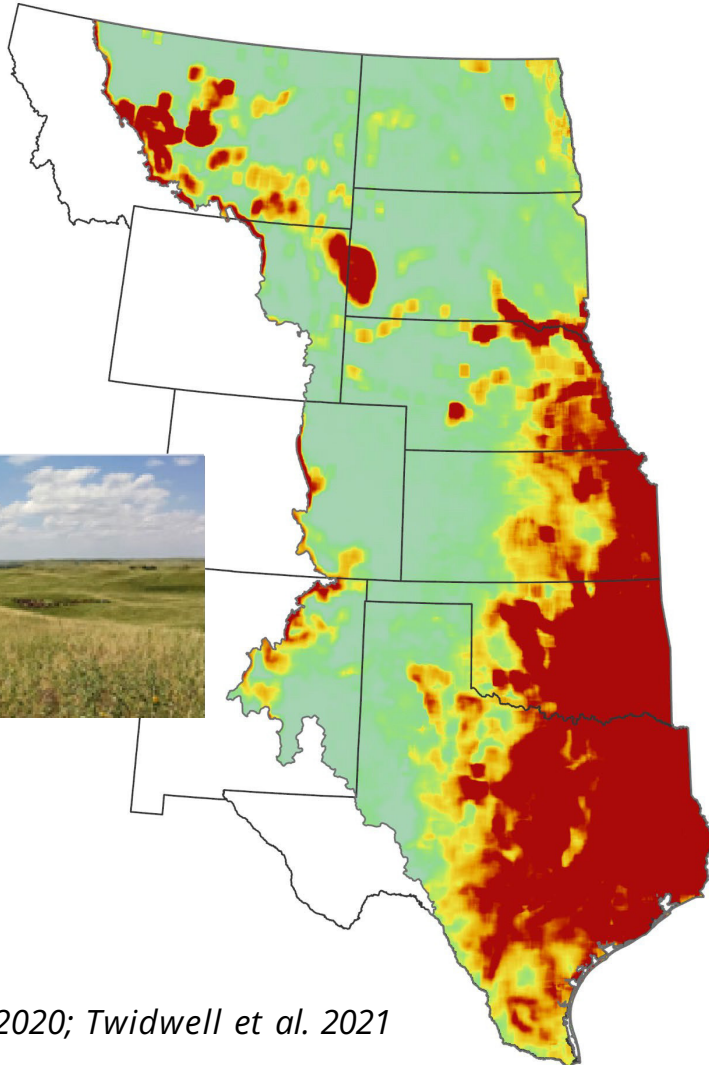
\$177M spent in last Farm Bill



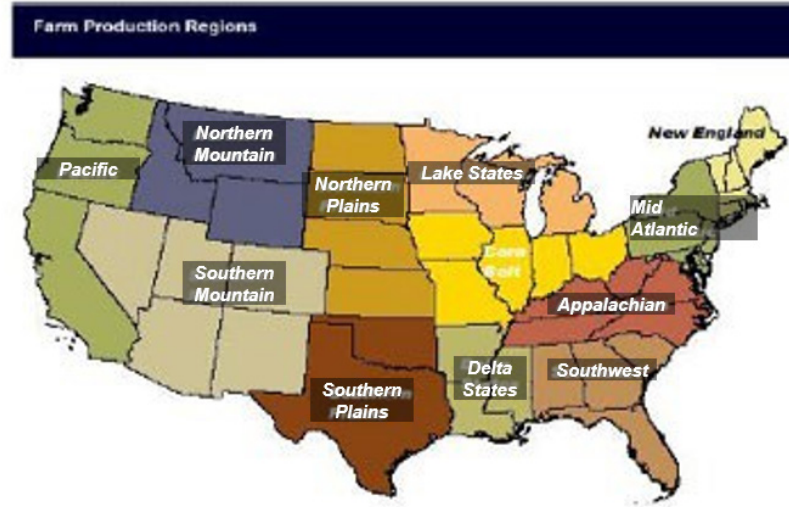
Southern Plains:	\$164.5 M
Southern Mountains:	\$59.6 M
Pacific:	\$25.9 M
Northern Plains:	\$12.5 M
Northern Mountain:	\$8.5M

The Great Plains Biome is Collapsing

2020



\$177M spent in last Farm Bill



Southern Plains:	\$164.5 M
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The Problem of the "Improvement *then* Restoration" Paradigm



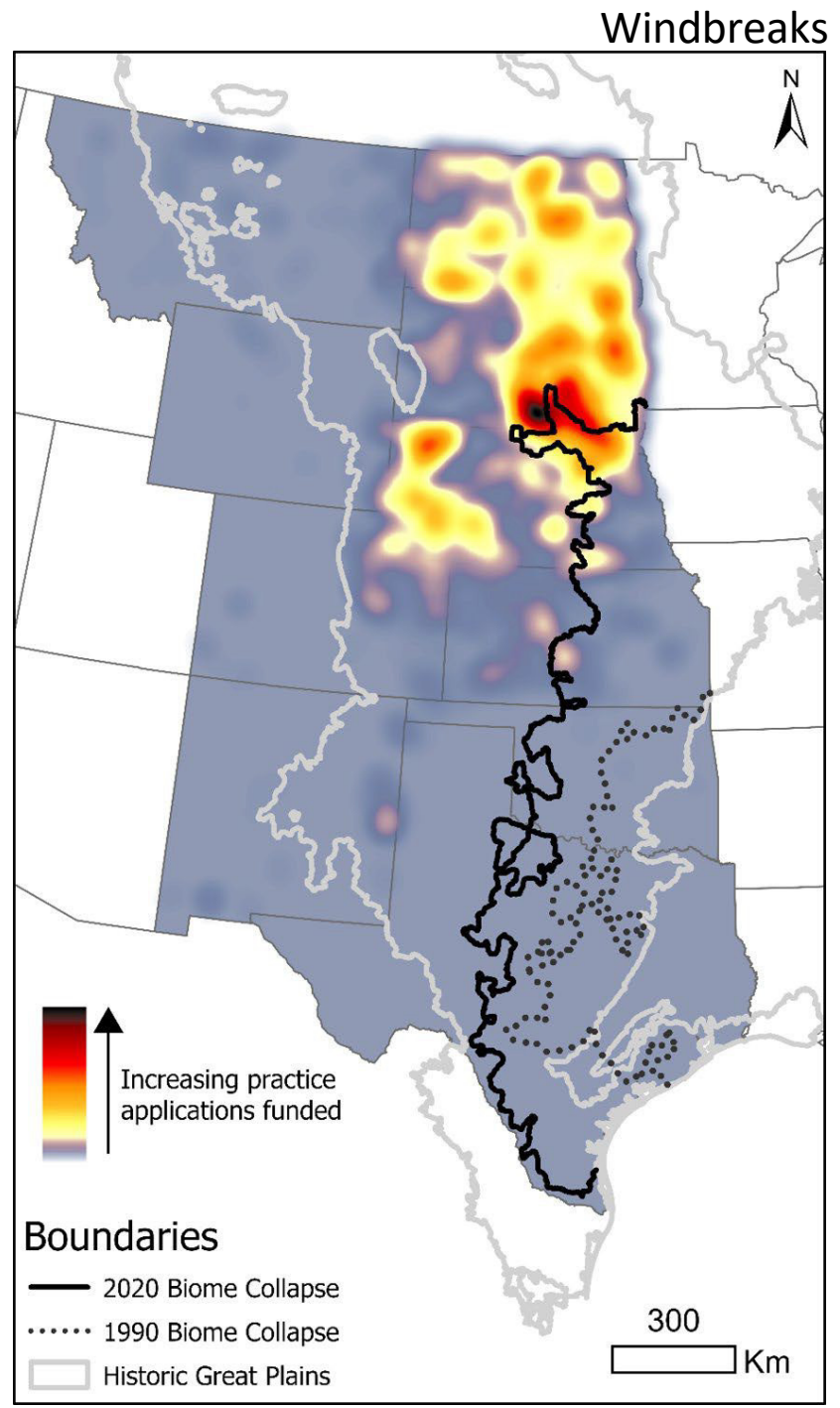
Grassland Improvements

Grassland Restoration

Forest Improv.

1.14M NRCS practices;
Cady et al. in prep

■ Ahead of Biome Collapse Boundary
■ Behind Biome Collapse Boundary



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



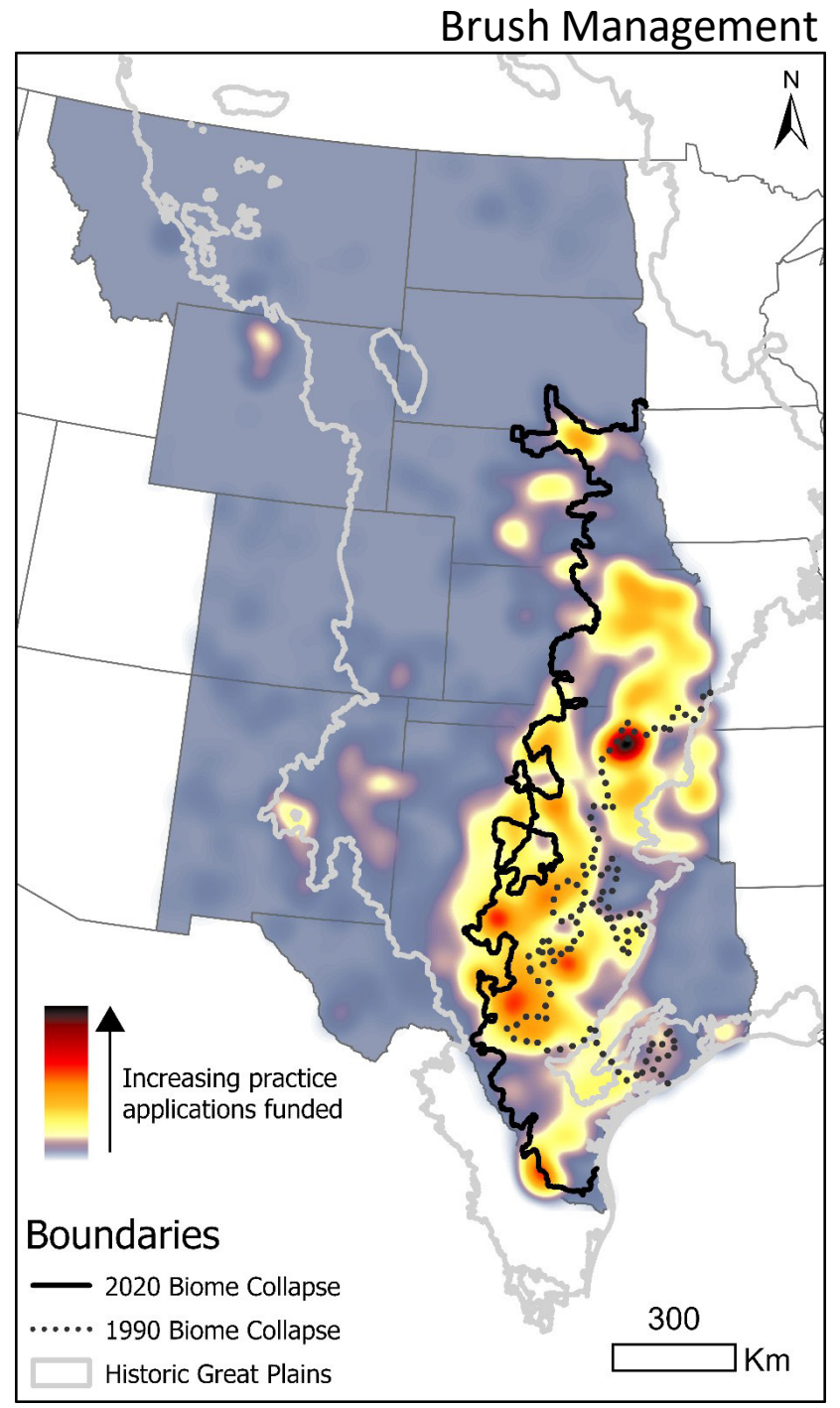
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■ Ahead of Biome Collapse Boundary
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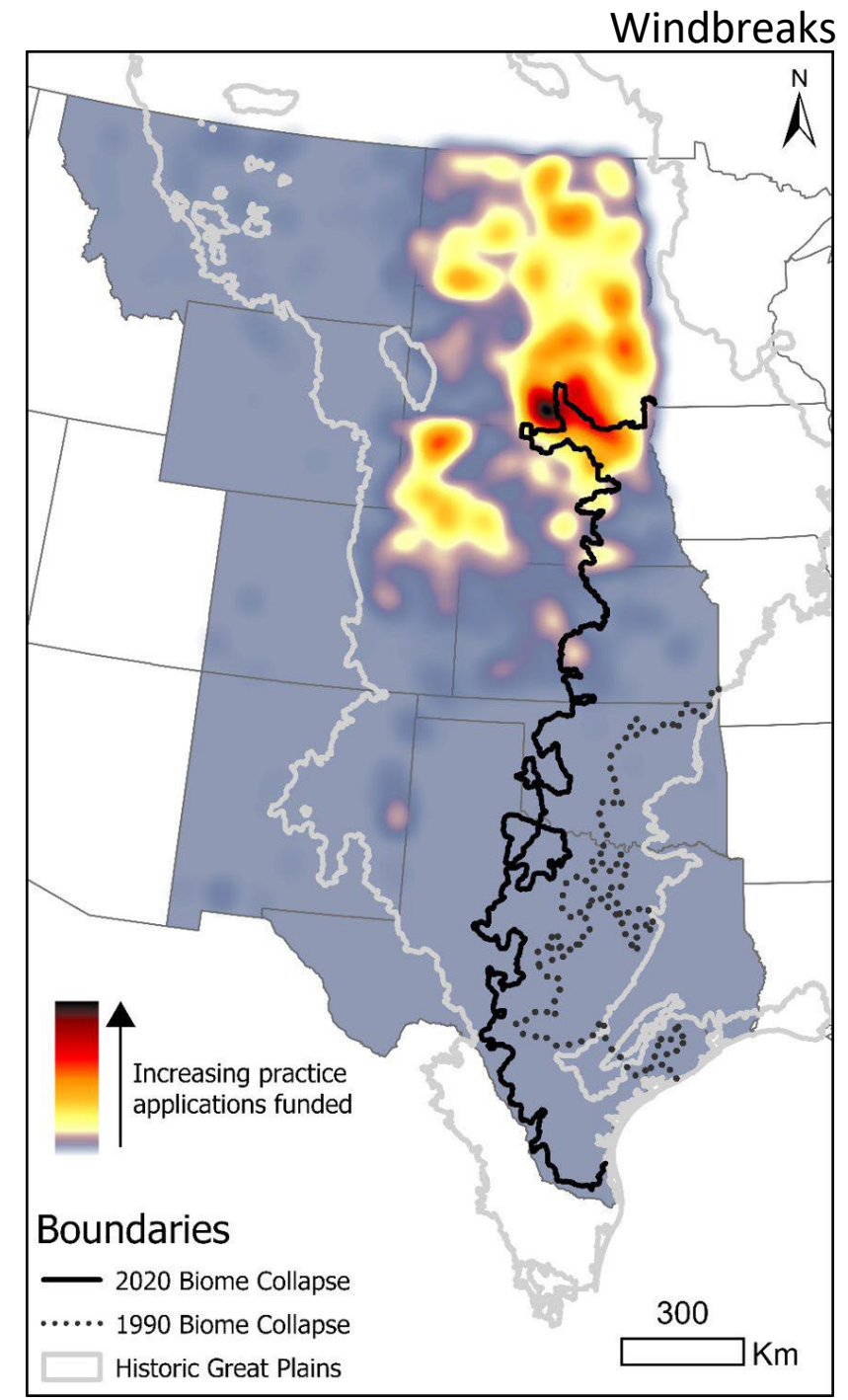
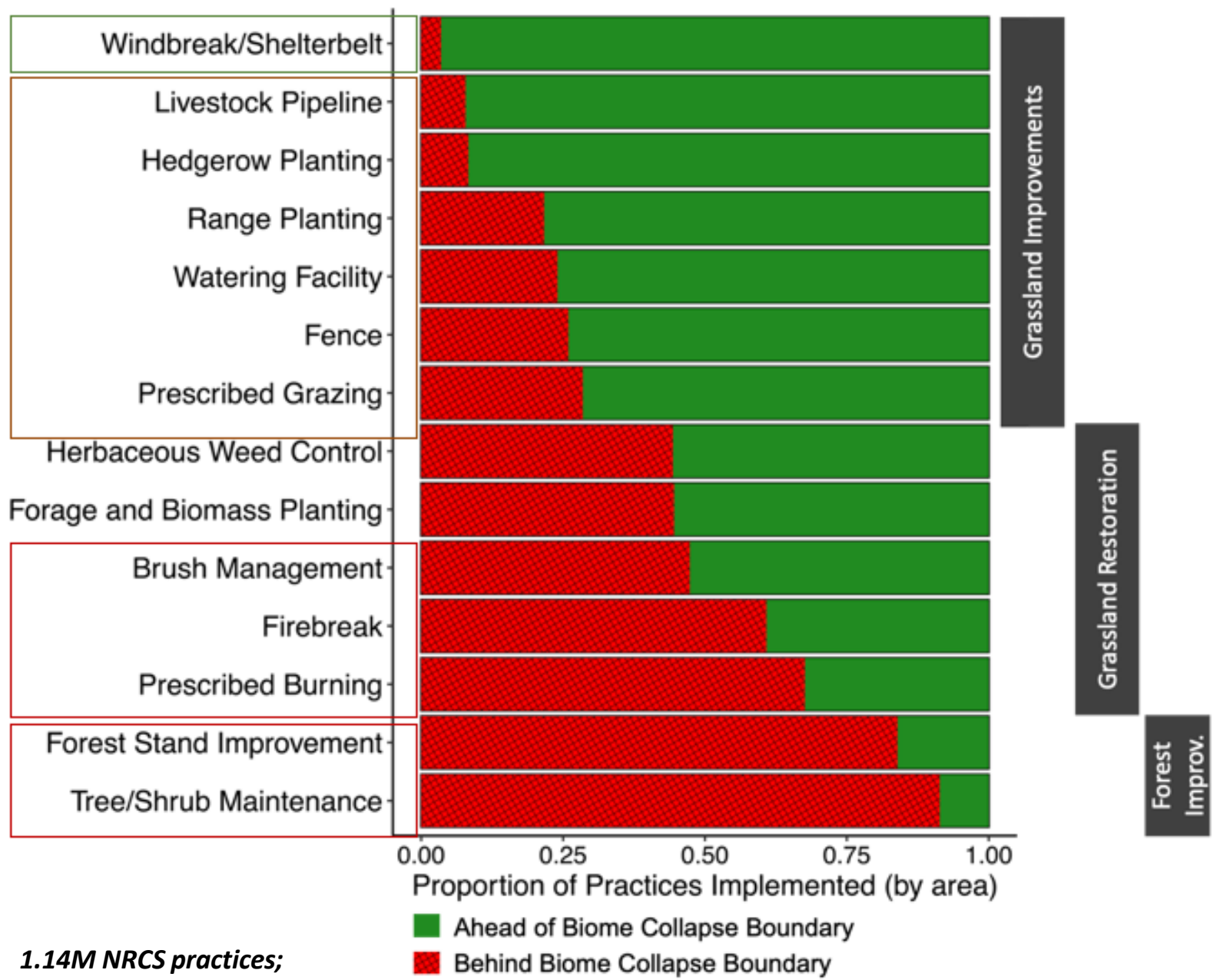
Grassland Improvements

Grassland Restoration

Forest Improv.



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

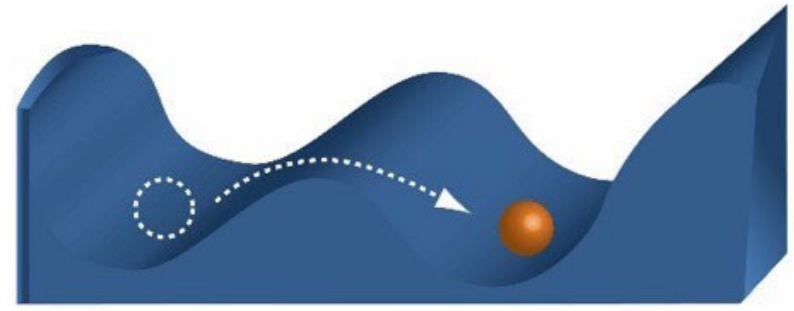
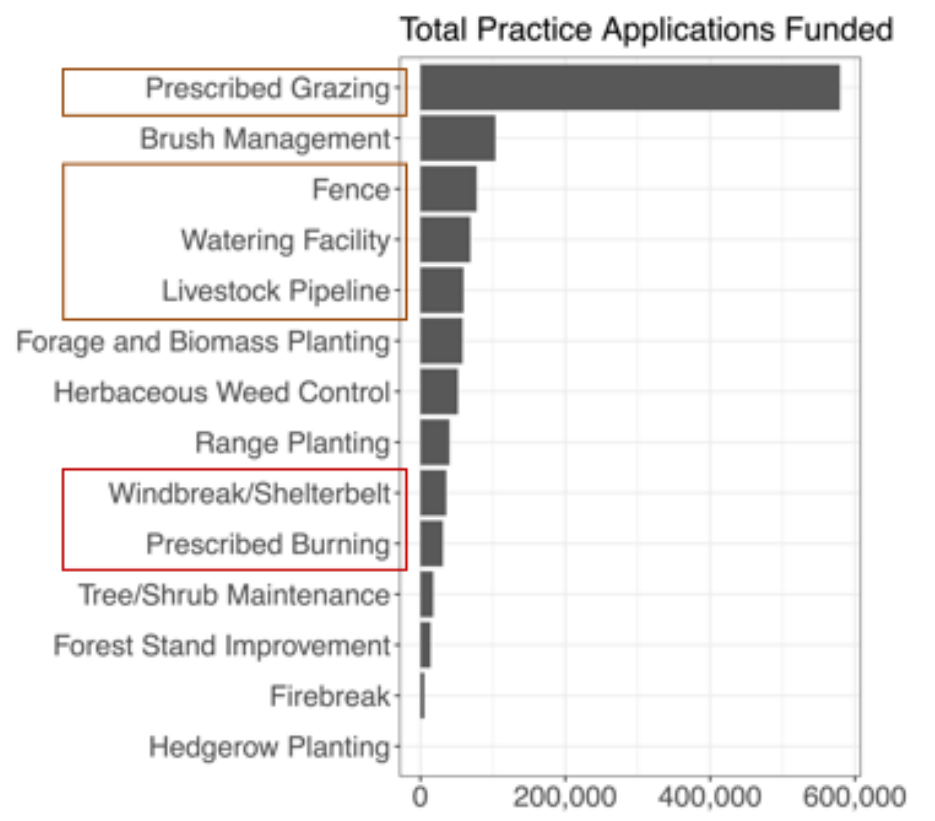


The Problem of the "Improvement *then* Restoration" Paradigm

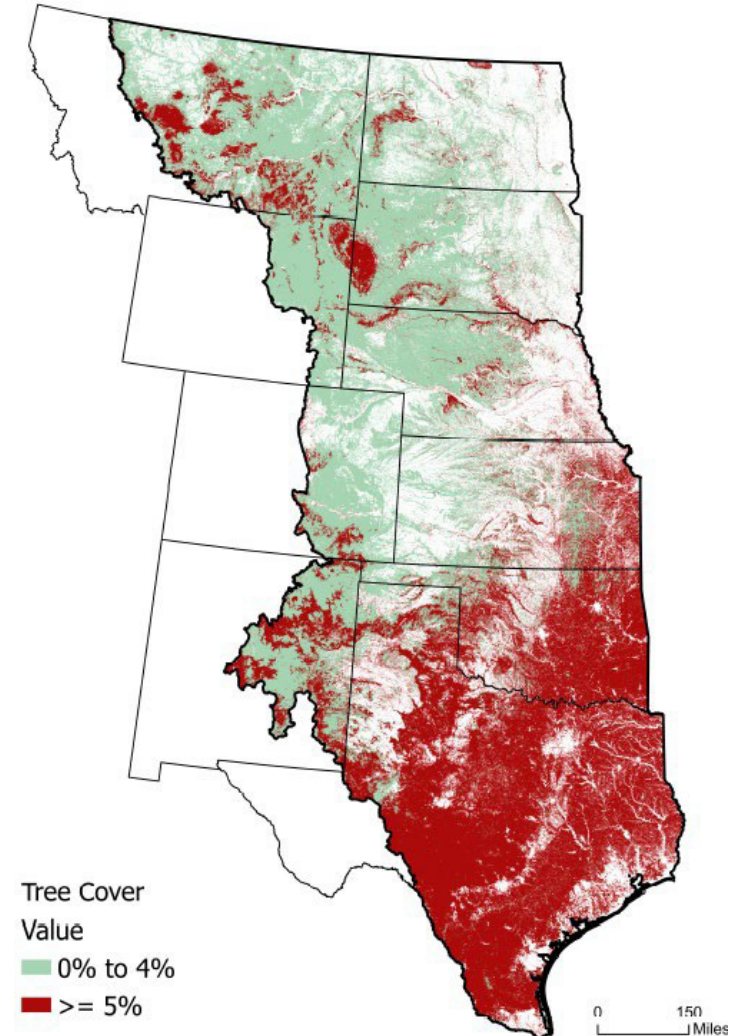
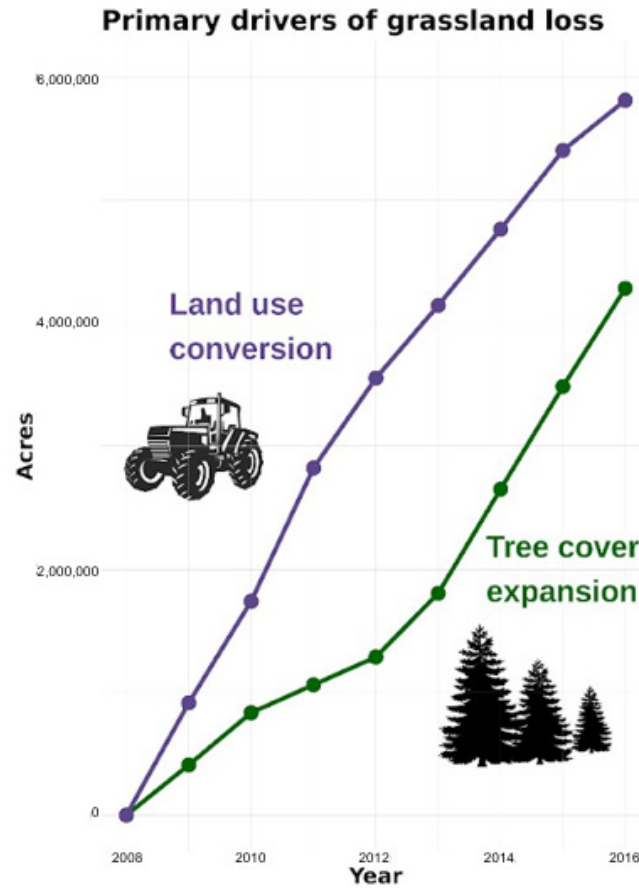
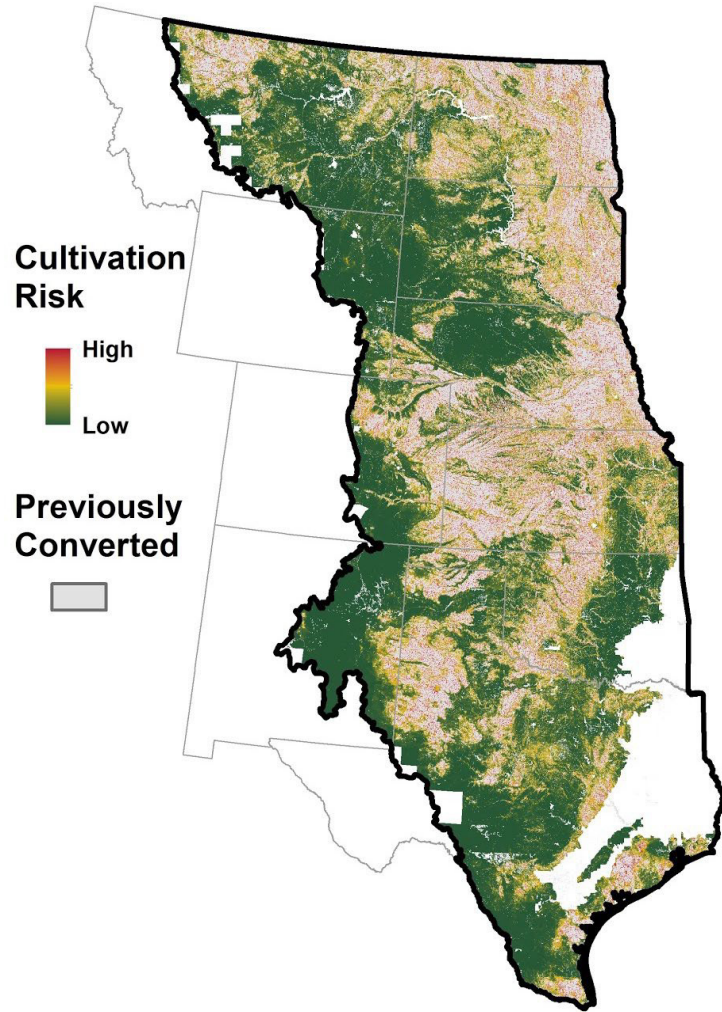


■ Ahead of Biome Collapse Boundary
■ Behind Biome Collapse Boundary

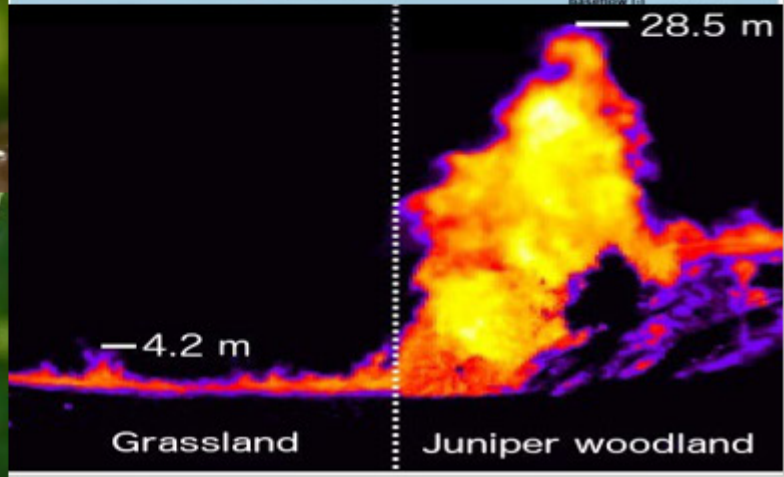
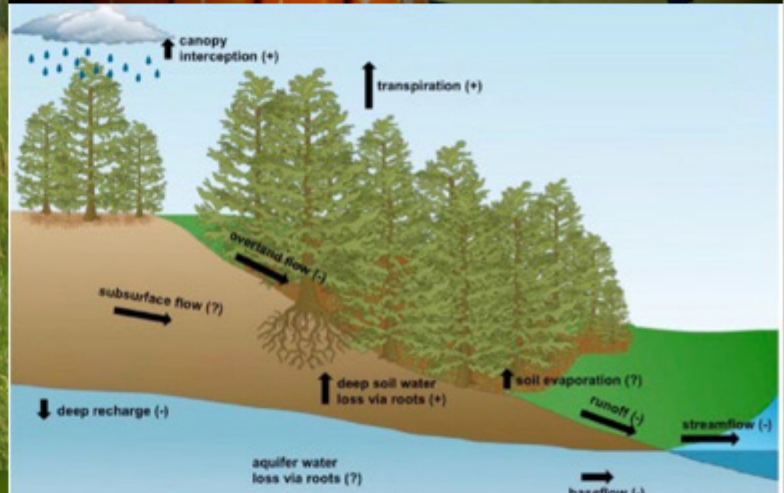
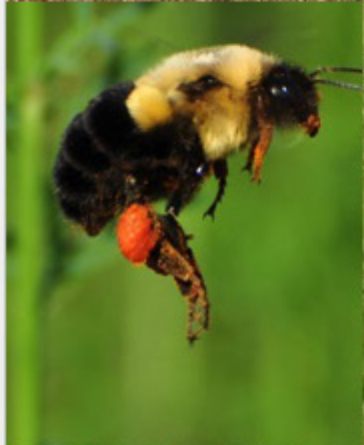
1.14M NRCS practices;
Cady et al. in prep



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



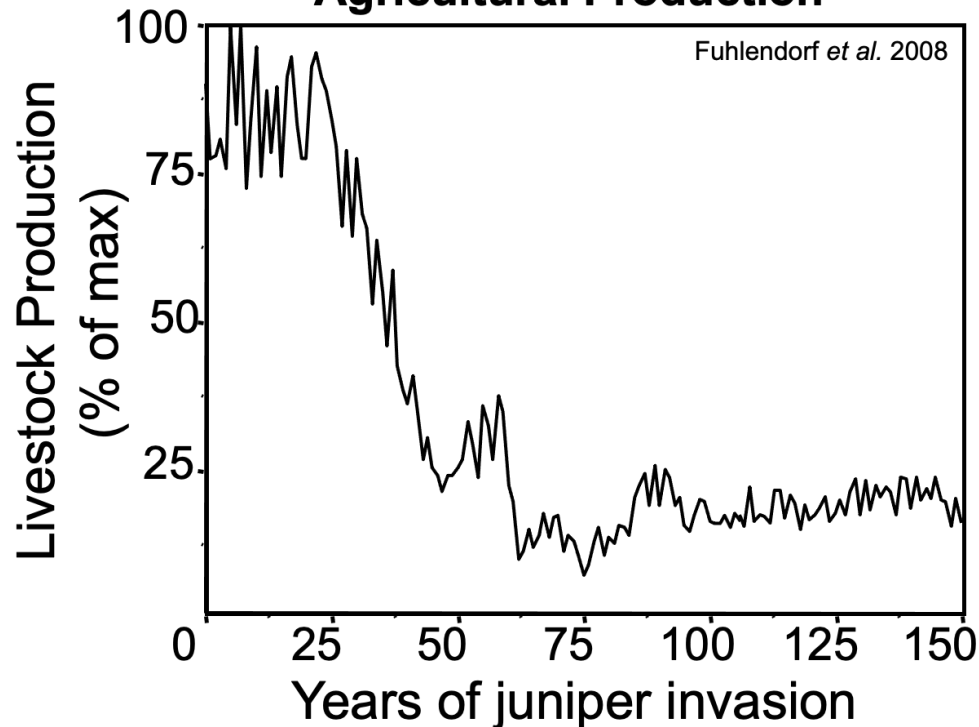
Biome-level consequences: Rancher livelihoods, Wildfire danger, Human health, Water, Endangered species, School funding, Regulatory pressure



Herbaceous production lost to tree encroachment in United States rangelands

Scott L. Morford¹  | Brady W. Allred^{1,2}  | Dirac Twidwell³  | Matthew O. Jones^{1,4}  |
Jeremy D. Maestas⁵  | Caleb P. Roberts⁶  | David E. Naugle^{1,2} 

Woody Encroachment Takes Land Out of Agricultural Production



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

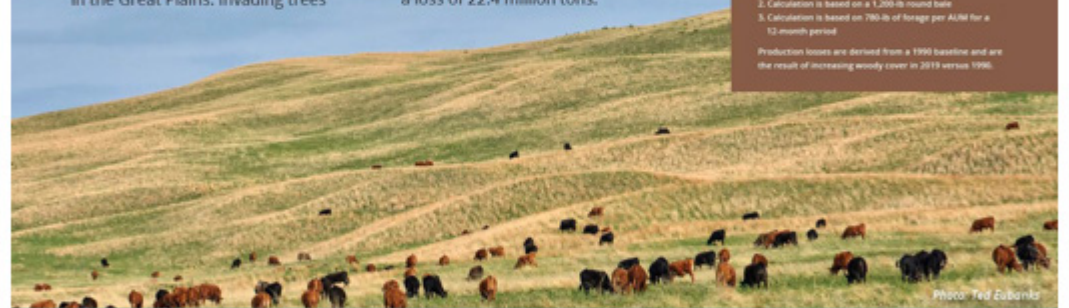
outcompete and displace grasses and forbs, reducing rangeland production by up to 75 percent. Scattered woody plants may look harmless, but their expansion in rangelands results in major consequences to livestock production and wildlife. When we lose healthy rangelands, we lose the cultural, economic, 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 forage¹
- 37.3 million round bales² – enough to circle the globe 1.4 times!
- Forage for 4.8 million cows³

1. Calculation is based on cash rental rates
2. Calculation is based on a 1,200-lb round bale
3. Calculation is based on 700-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.

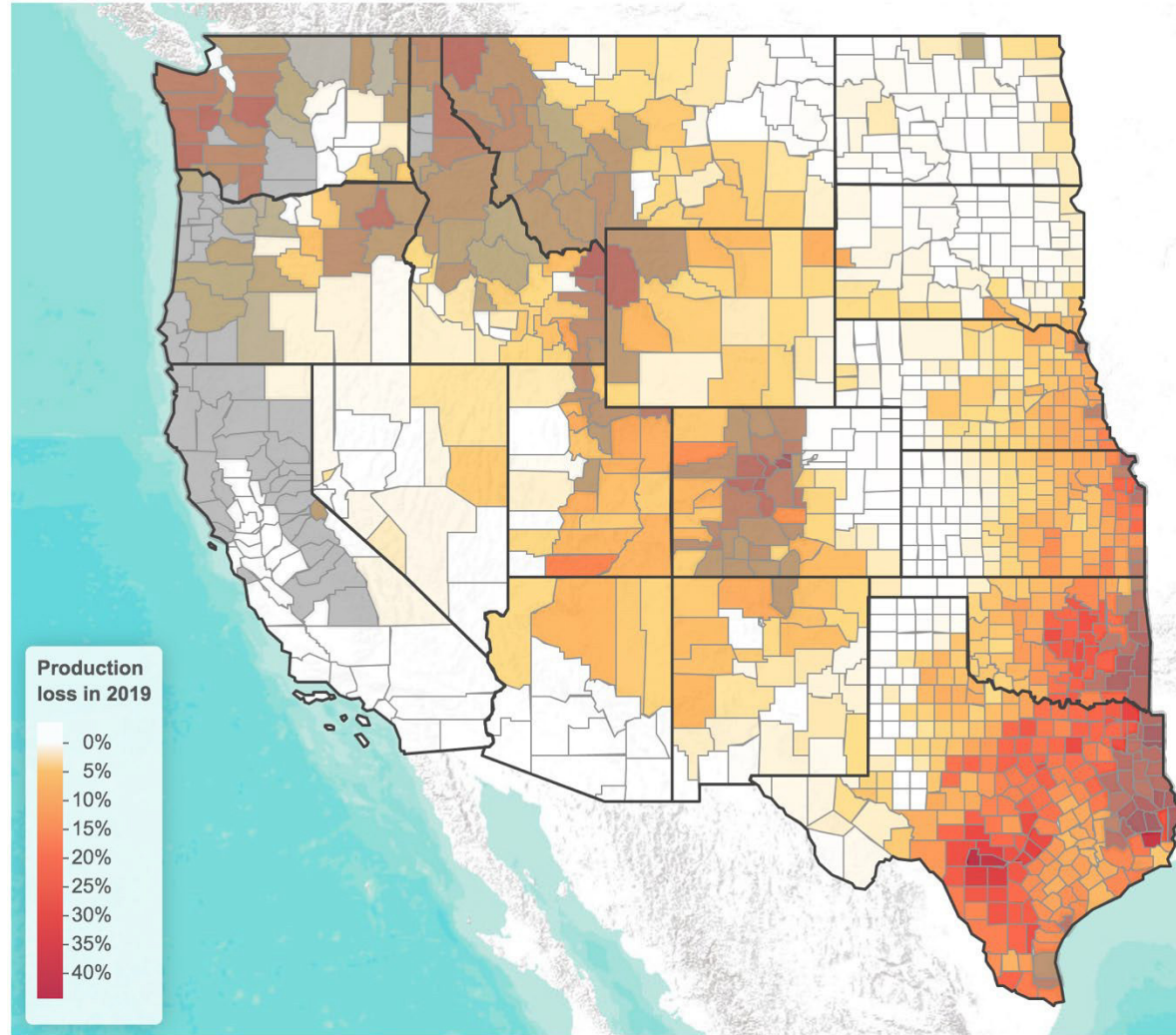
New guidance, developed as a collaborative effort among rangeland scientists in the Great Plains, outlines a more cost-efficient and proactive strategy to keep rangelands productive and reverse losses due to woody encroachment.

Reducing Woody Encroachment in Grasslands



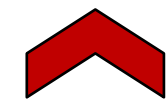
National Rangeland Statistics

Rangeland Productivity Lost to Woody Encroachment



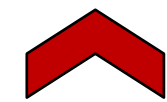
South Dakota

Productivity lost to woody encroachment in 2019	Productivity lost to woody encroachment in 2019
145,352 tons	145,352 tons



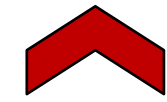
Nebraska

Productivity lost to woody encroachment in 2019	Productivity lost to woody encroachment in 2019
419,328 tons	3,881,756 tons



Kansas

Productivity lost to woody encroachment in 2019	Productivity lost to woody encroachment in 2019
2,060,106 tons	28,902,217 tons



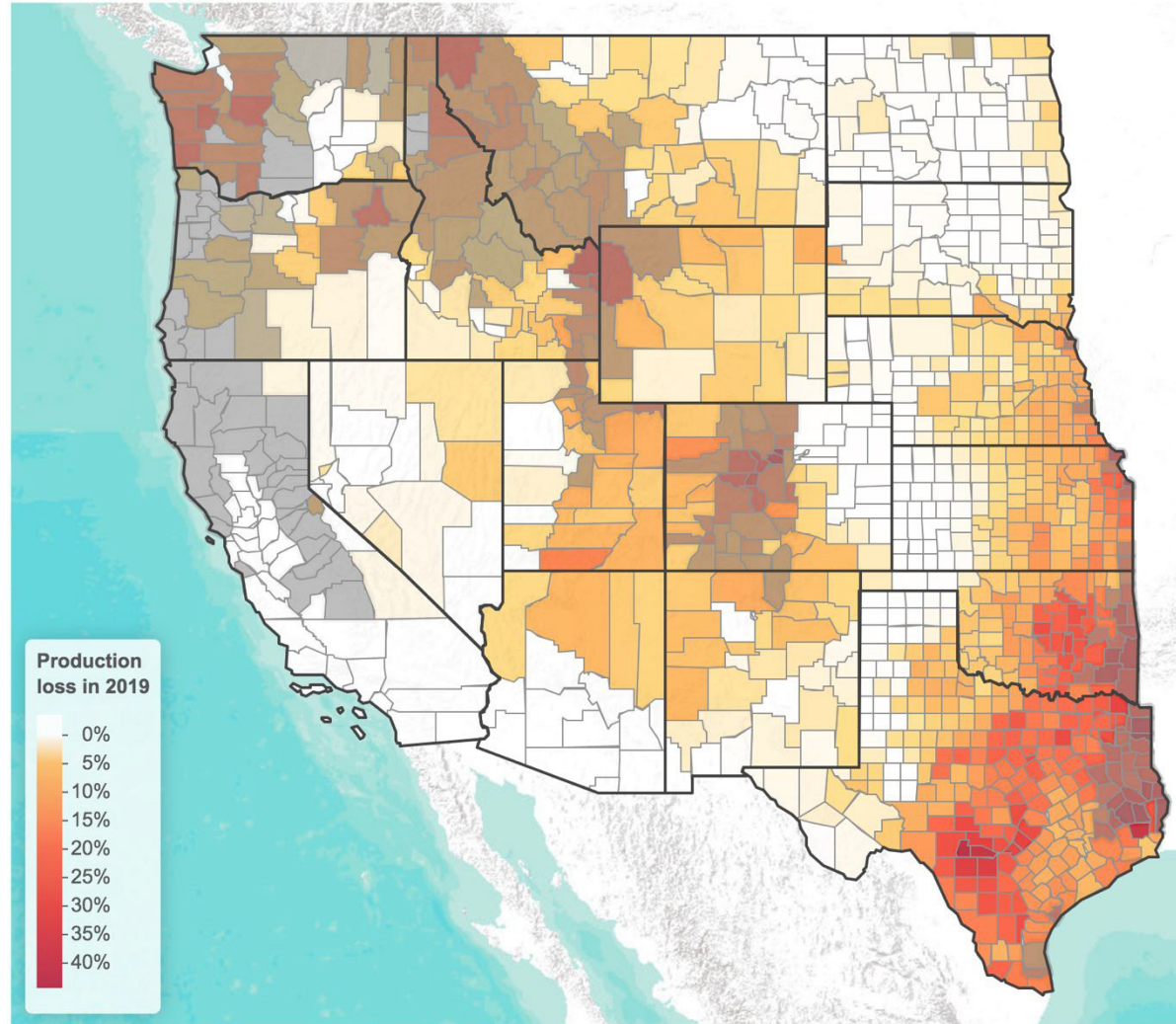
Oklahoma

Productivity lost to woody encroachment in 2019	Productivity lost to woody encroachment in 2019
4,491,096 tons	76,529,801 tons

The productivity loss is based on the 2019 National Rangeland Inventory (NRI) data. The productivity loss is based on the 2019 NRI data. The productivity loss is based on the 2019 NRI data.

National Rangeland Statistics

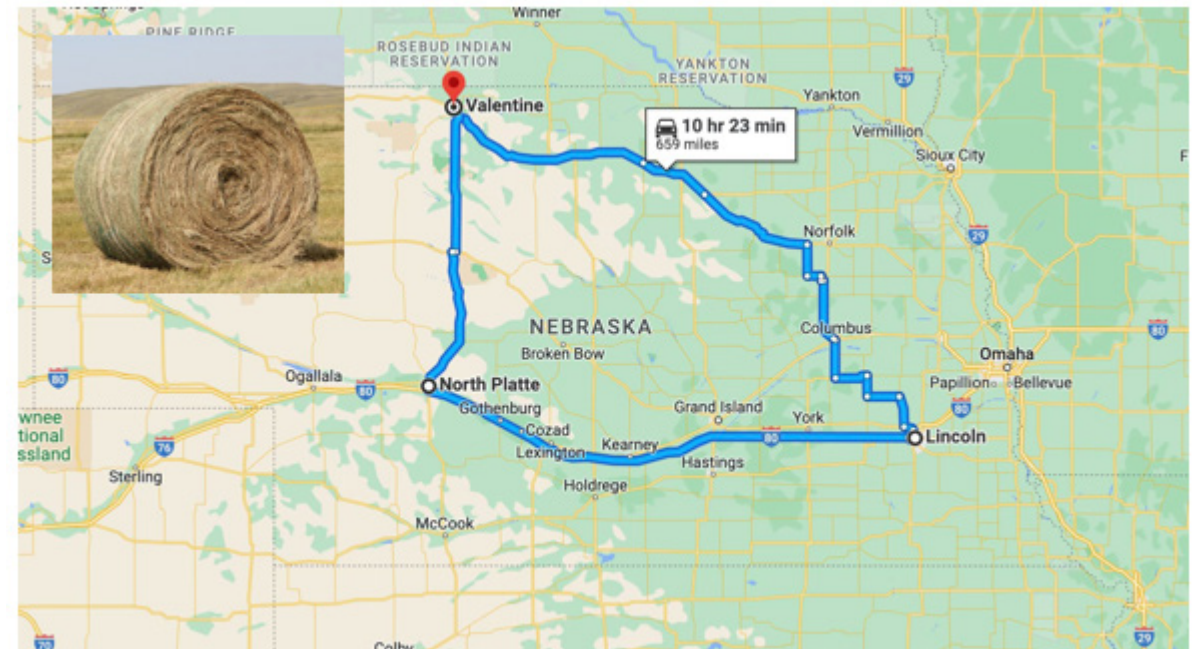
Rangeland Productivity Lost to Woody Encroachment



Equivalent to 698K Round Bales

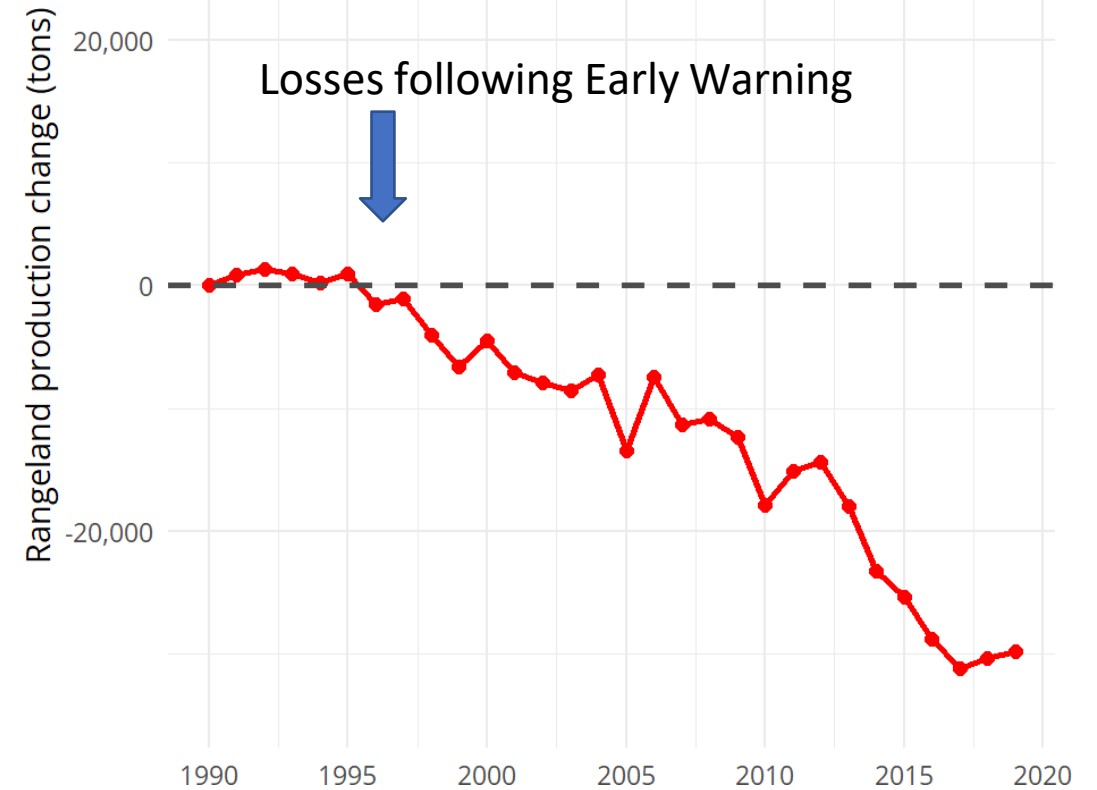
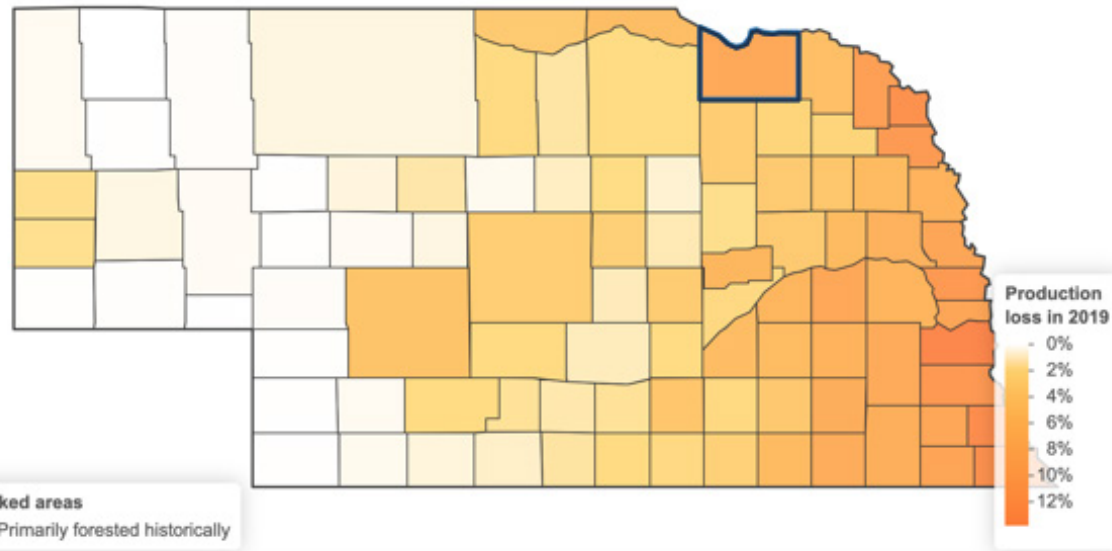
Nebraska

Productivity lost to woody encroachment in 2019	Productivity lost to woody encroachment in 2019
419,328 tons	3,881,756 tons



Knox County, Nebraska

Rangeland Production Lost to Tree Encroachment



Productivity lost to tree encroachment in 2019

29,814 tons

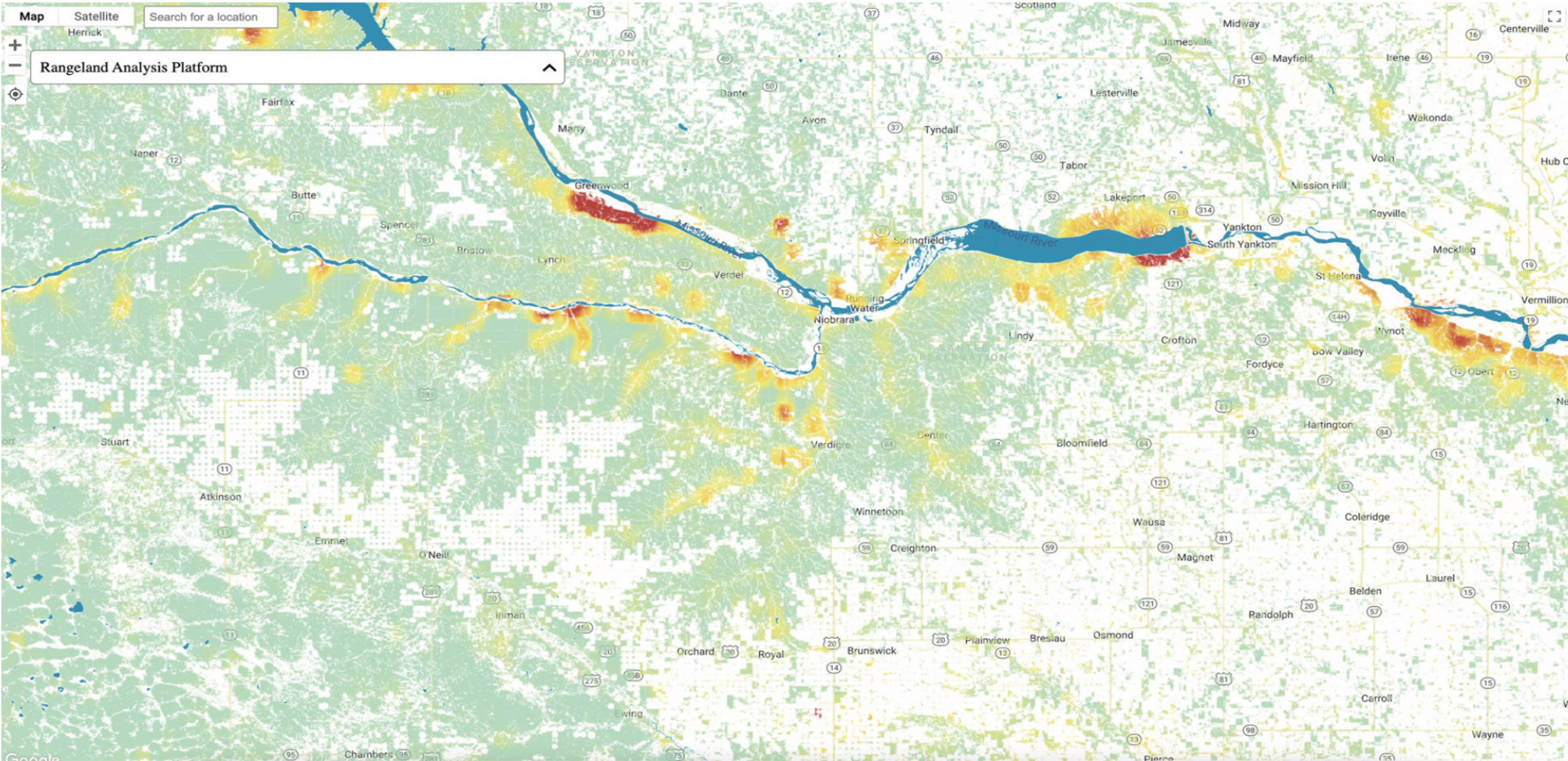
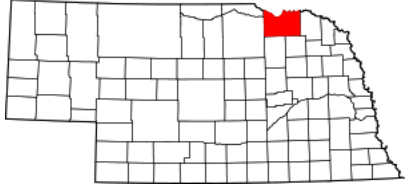
Cumulative production lost to tree encroachment (1990-2019)

333,857 tons

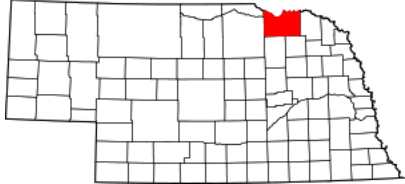
Total rangeland productivity = 349,875 tons

Early Warnings for Woody Transitions – Knox County Area

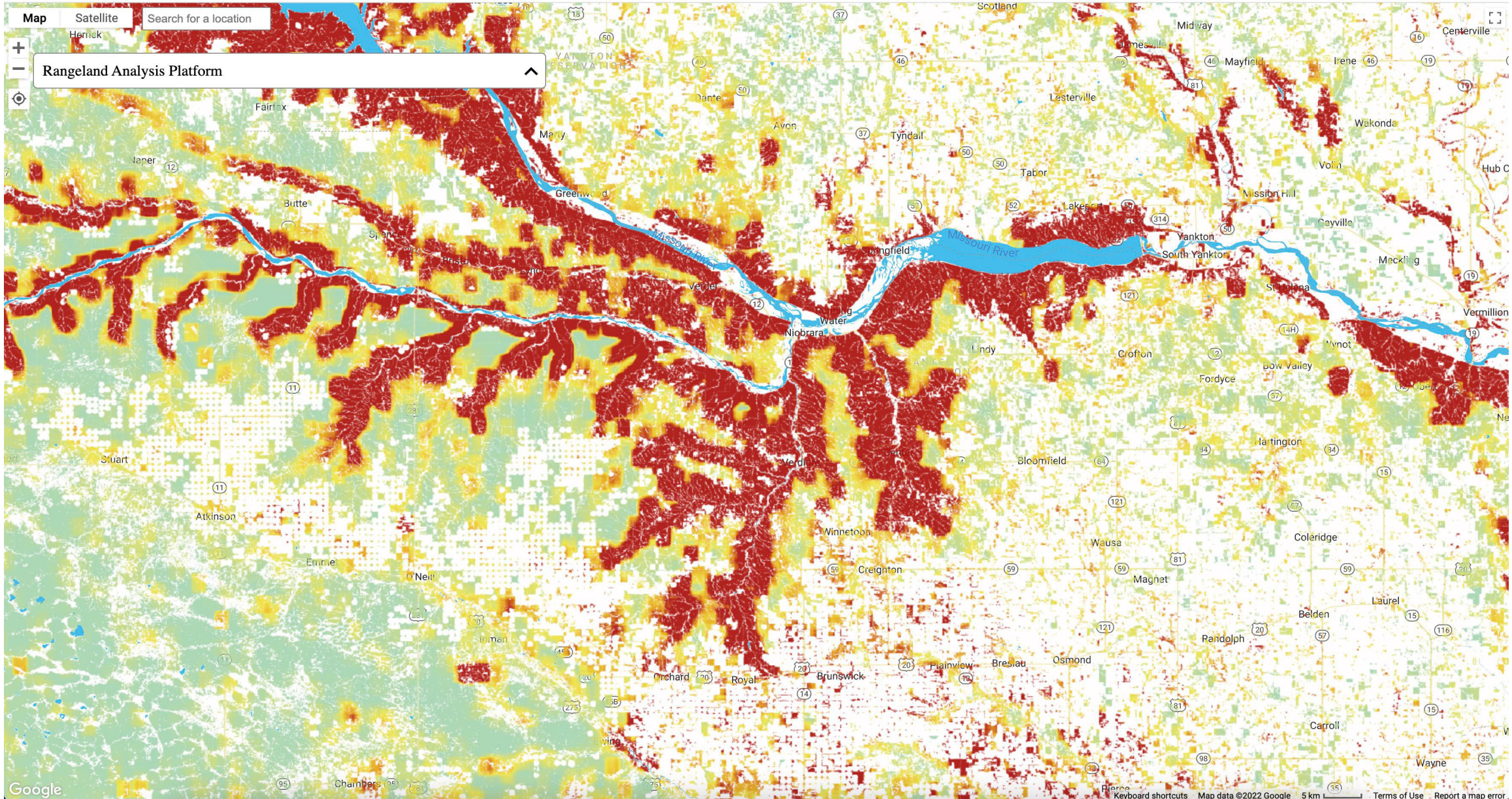
1990



Early Warnings for Woody Transitions – Knox County Area

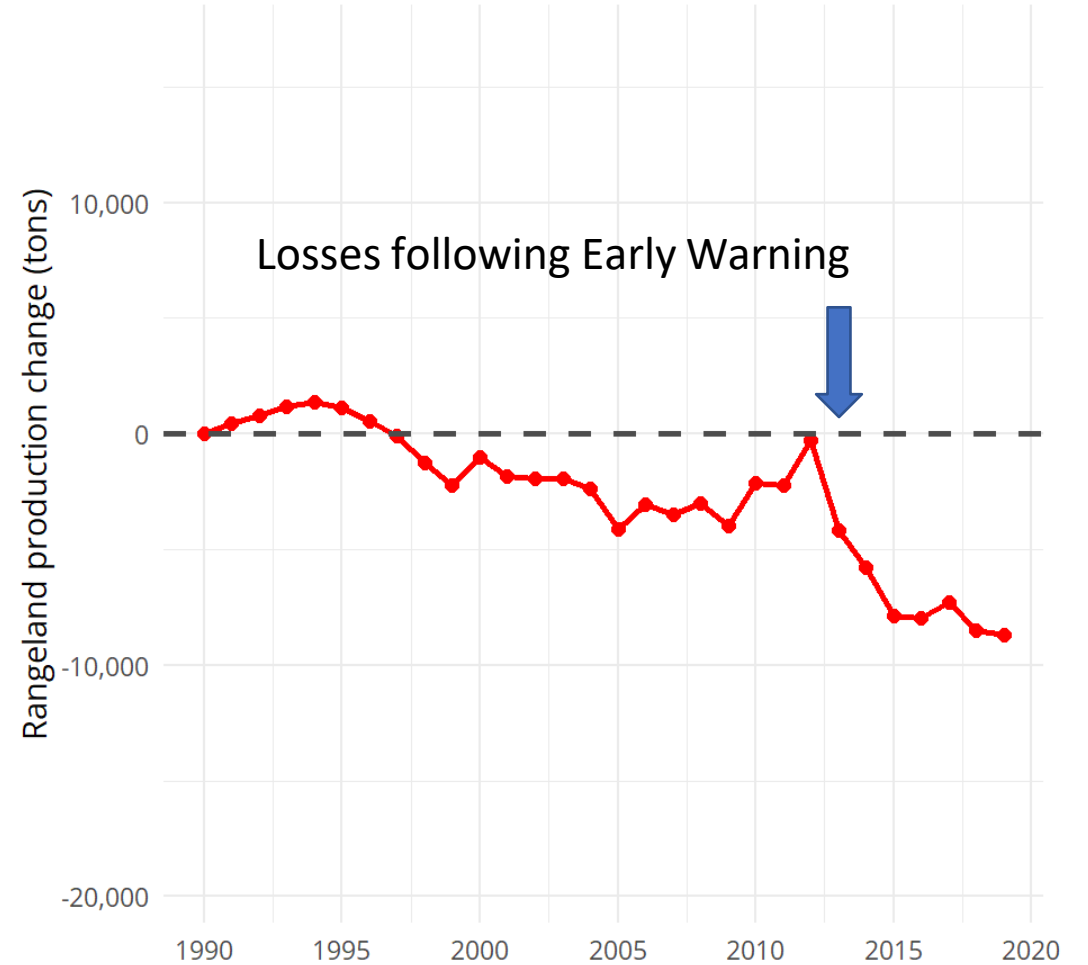
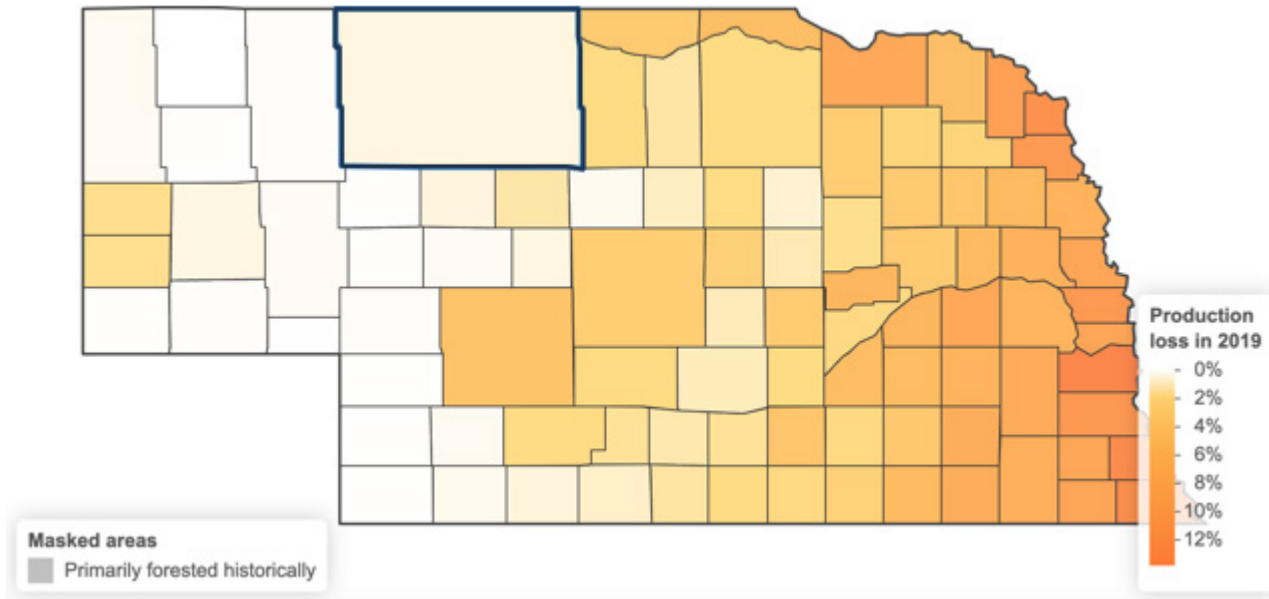


2020 – Similar to 2000 Riley County, KS



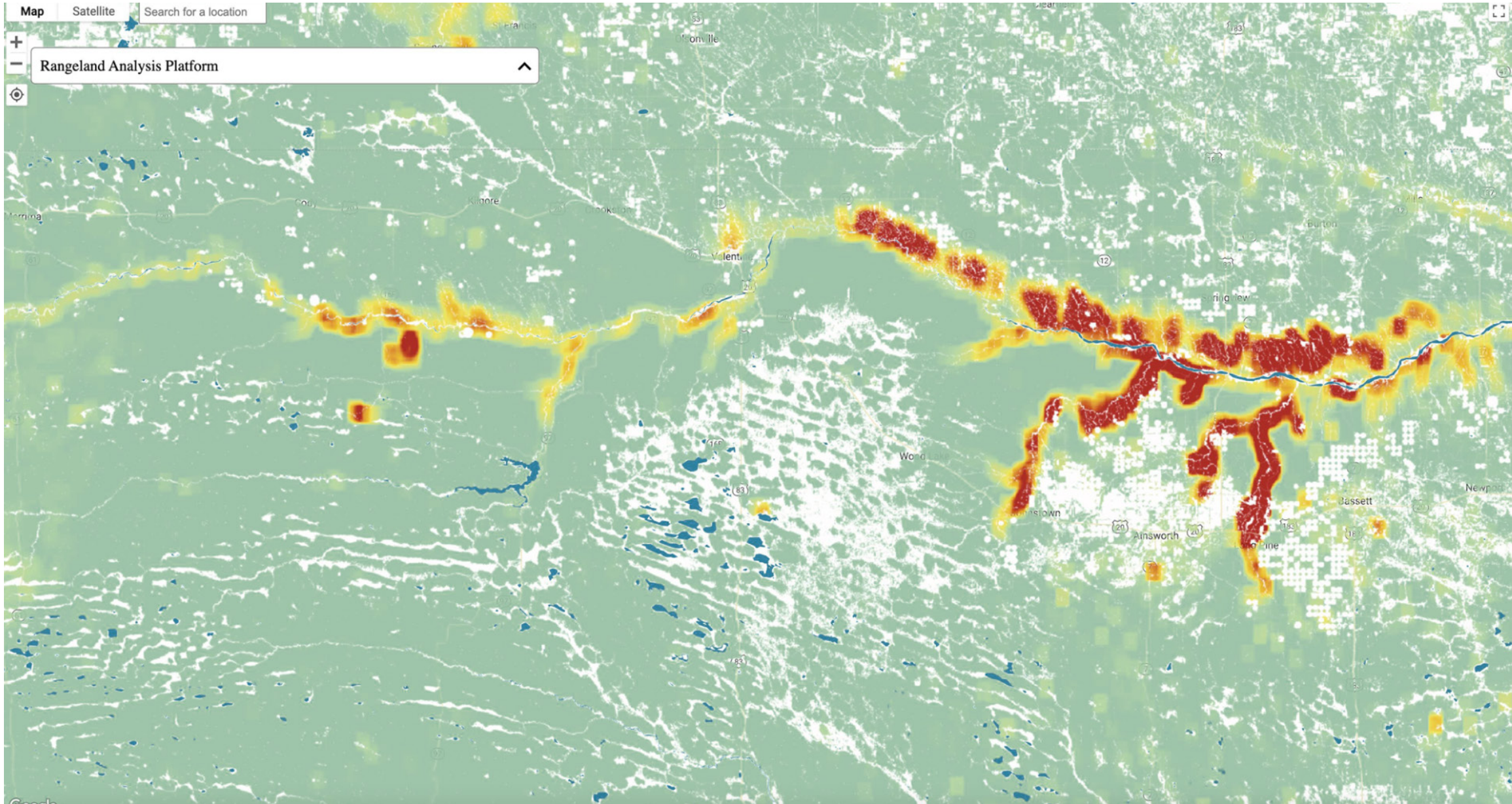
Cherry County, Nebraska

Rangeland Production Lost to Tree Encroachment

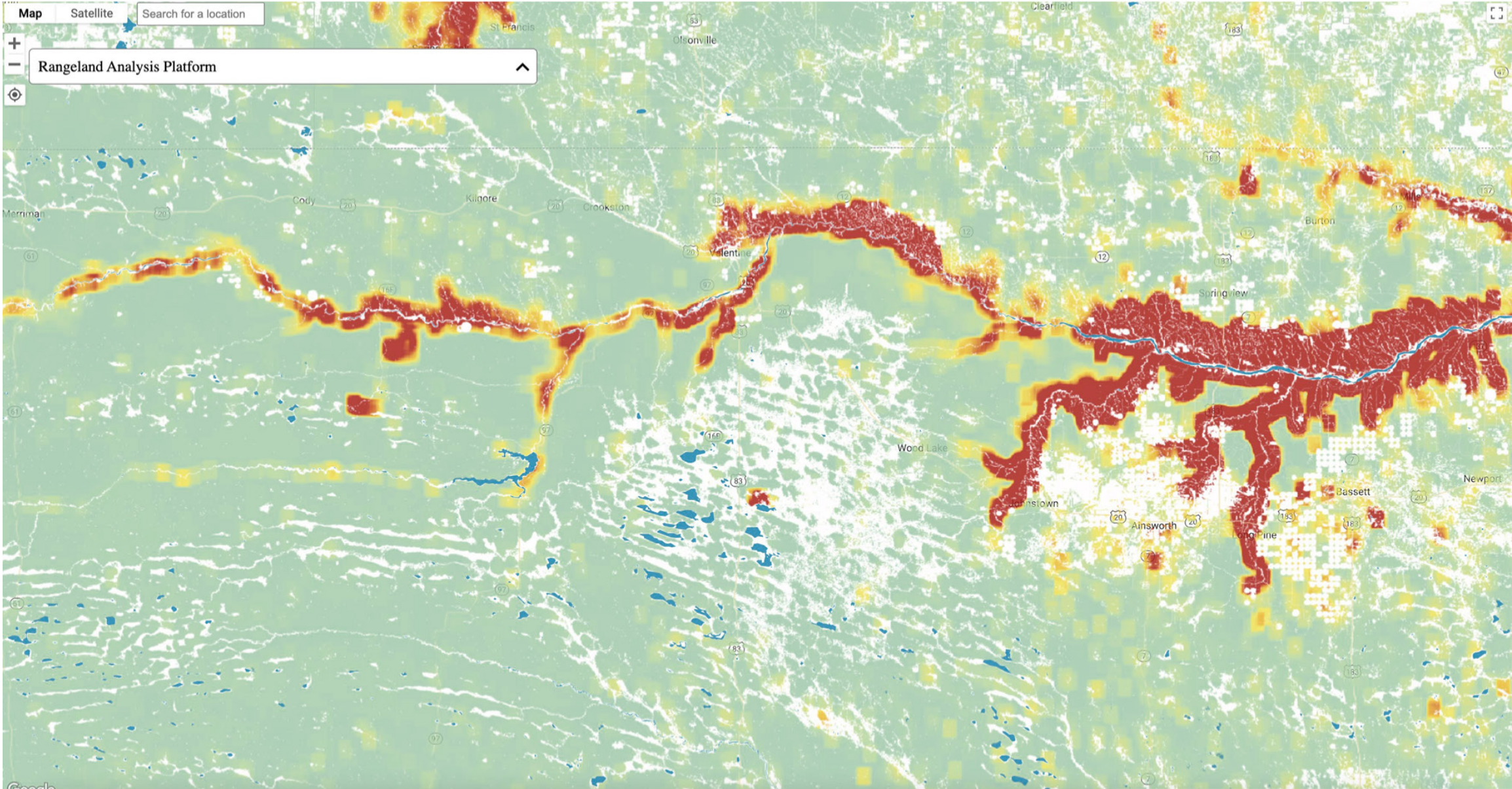


Productivity lost to tree encroachment in 2019	Cumulative production lost to tree encroachment (1990-2019)
8,707 tons	79,814 tons

Total rangeland productivity = 2,797,753 tons

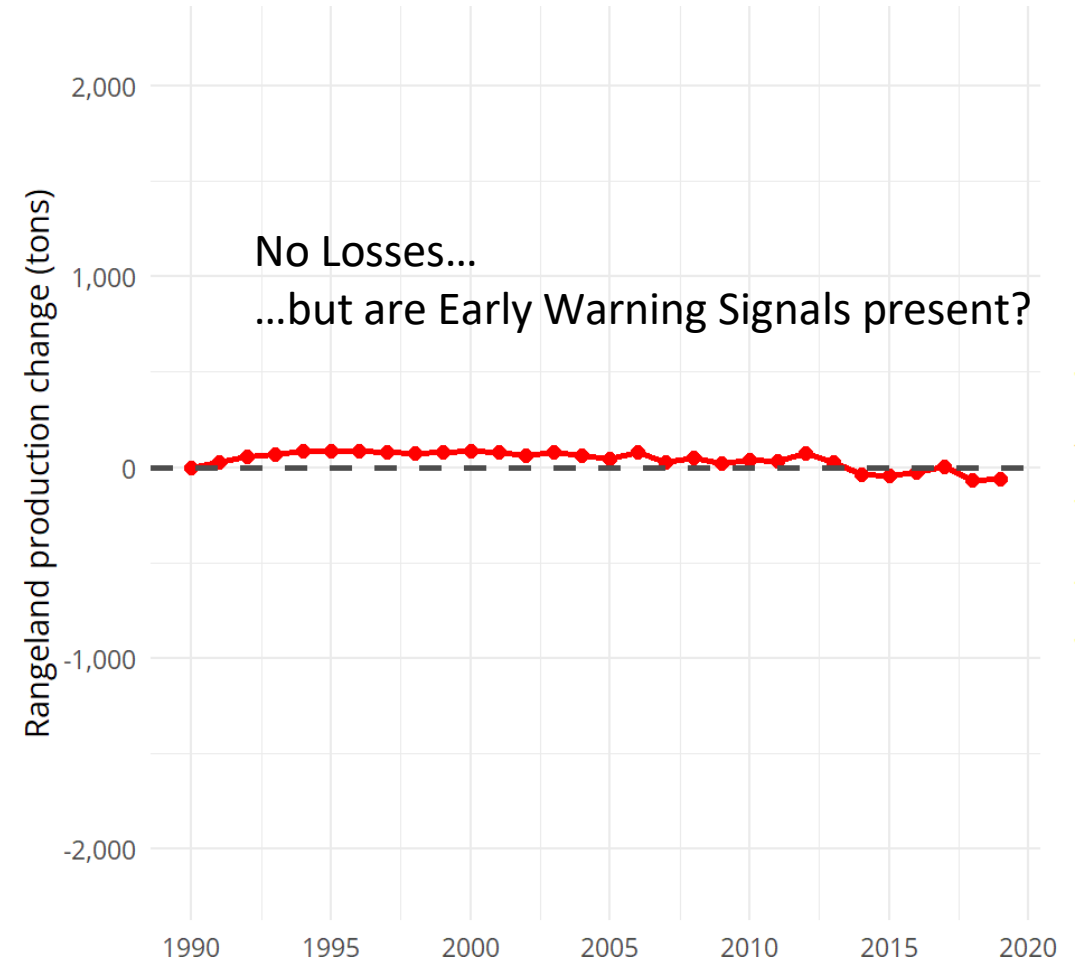
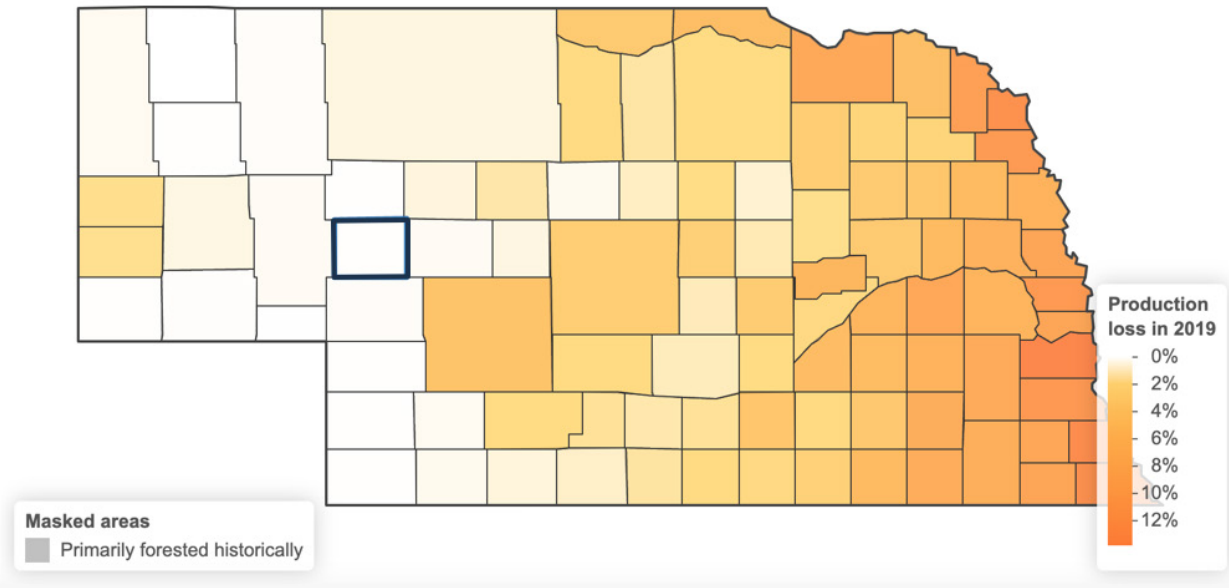


2020 – Similar to 2000 Knox County



Arthur County, Nebraska

Rangeland Production Lost to Tree Encroachment

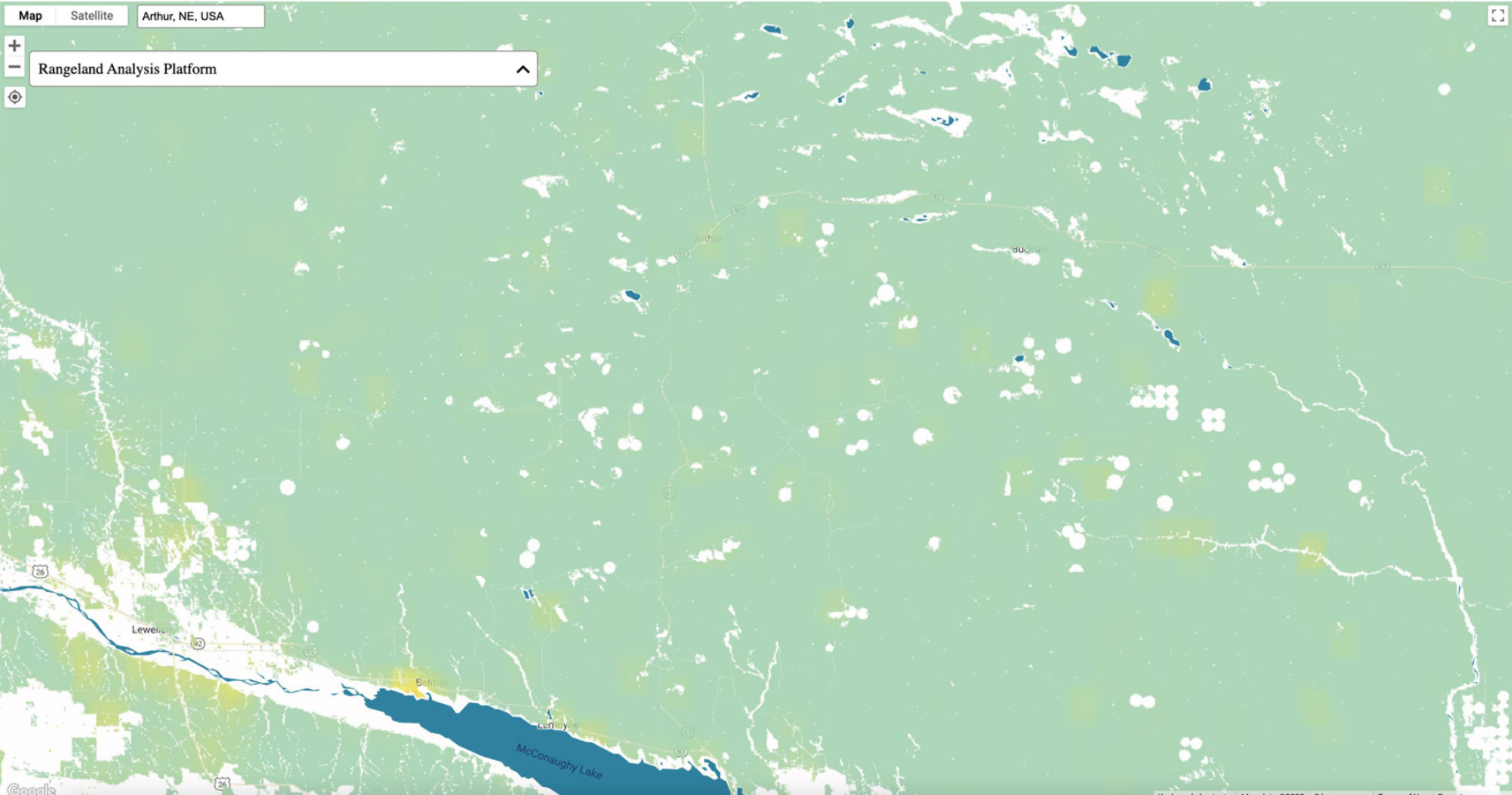


Productivity lost to tree encroachment in 2019	Cumulative production lost to tree encroachment (1990-2019)
64 tons	No losses

Total rangeland productivity = 345,169 tons

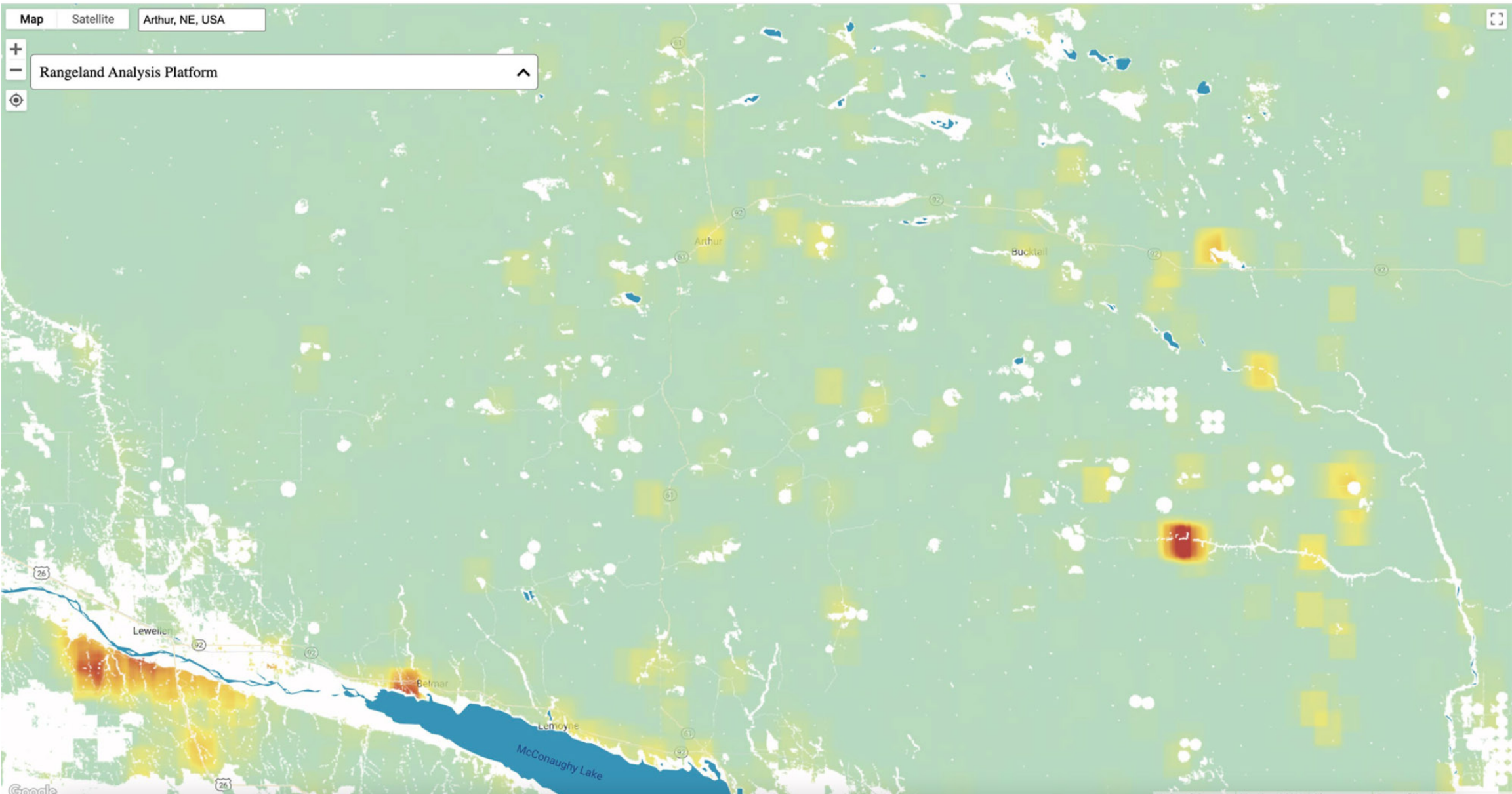
Early Warnings for Woody Transitions – Arthur County Area

1990



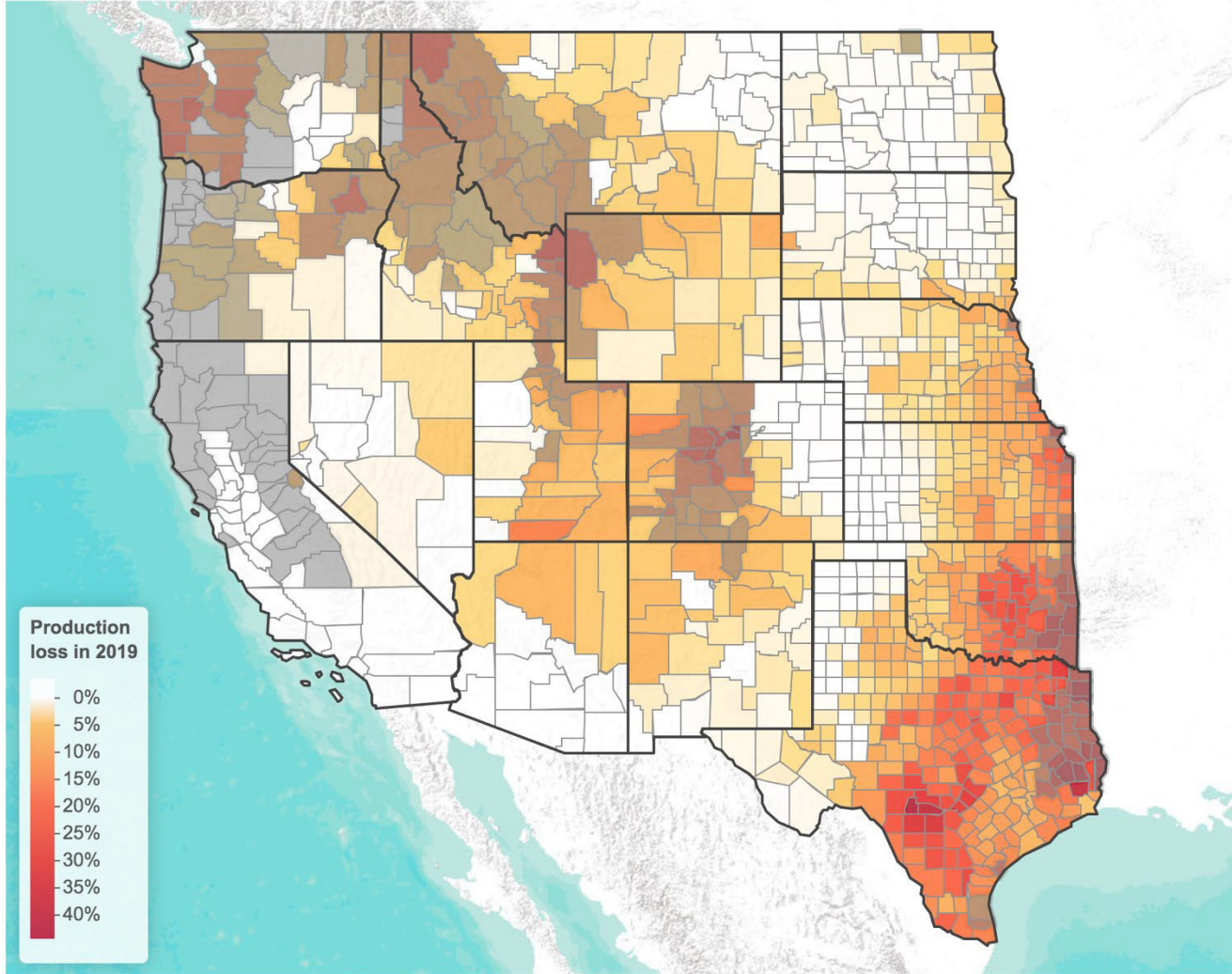
Early Warnings for Woody Transitions – Arthur County Area

2020



National Rangeland Statistics

Rangeland Productivity Lost to Woody Encroachment



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



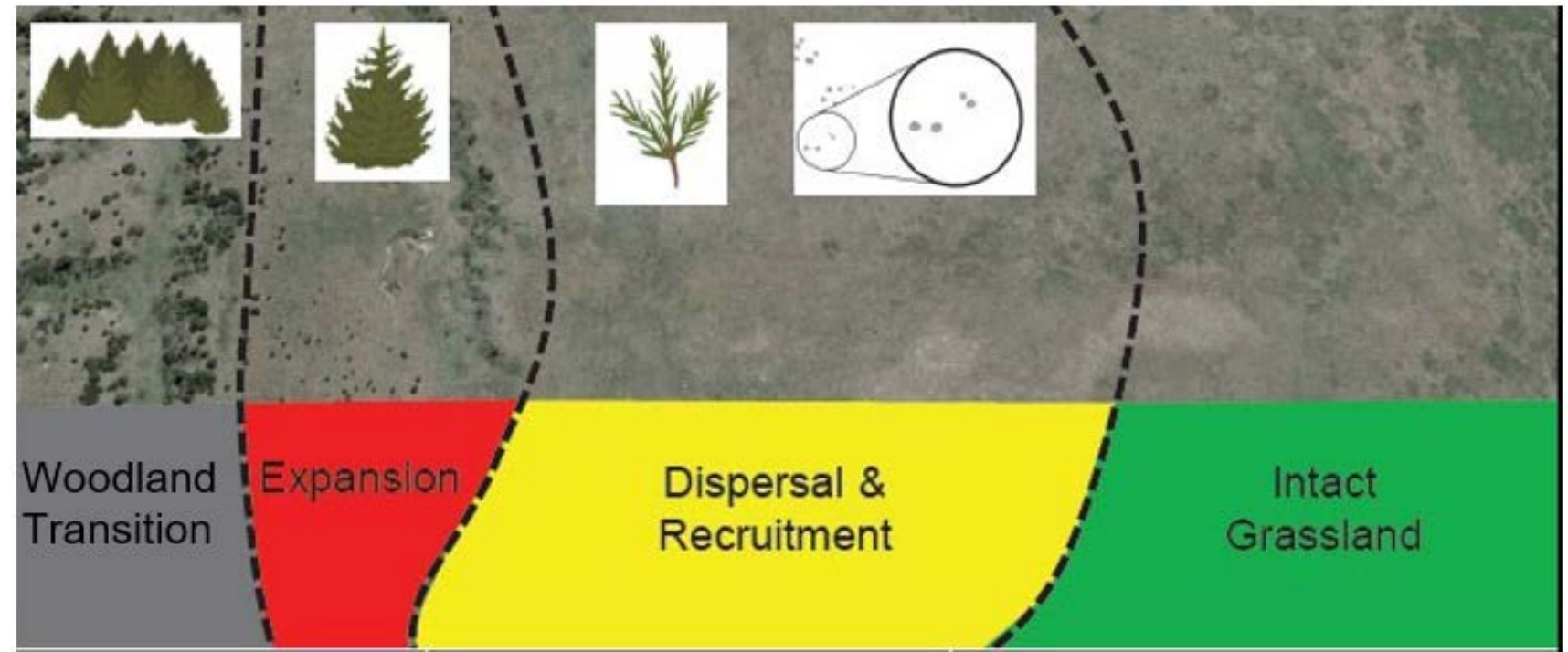
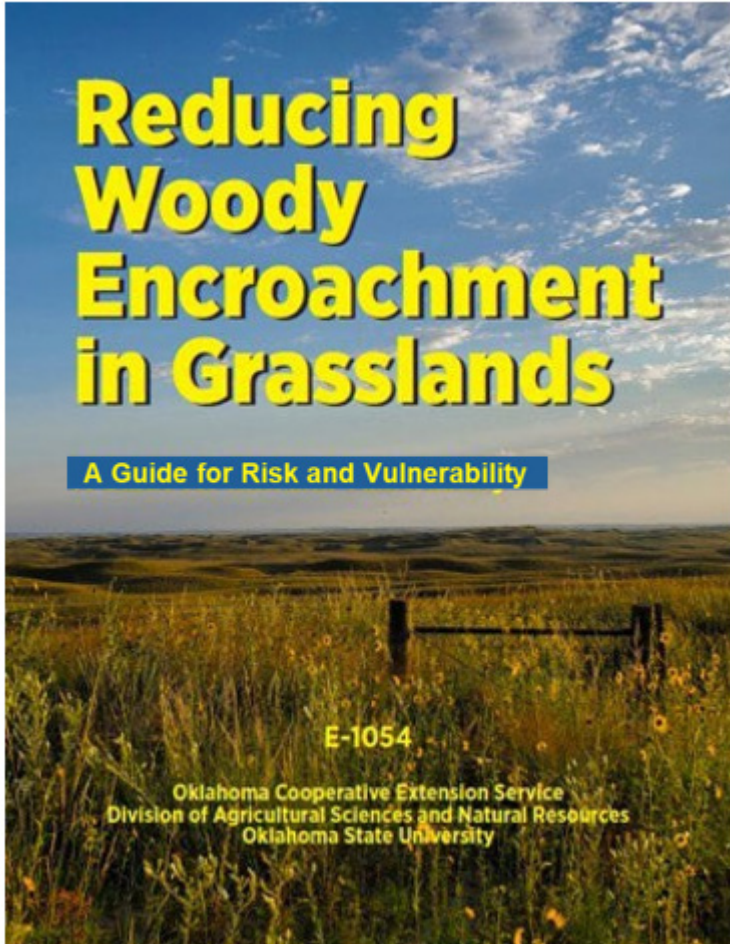
Hugh Hammond Bennett helped establish Conservation Districts and SCS/NRCS in the 1930's due to extensive soil erosion in the Great Plains



The collapse of our grassland biome in the Great Plains is of comparable significance.

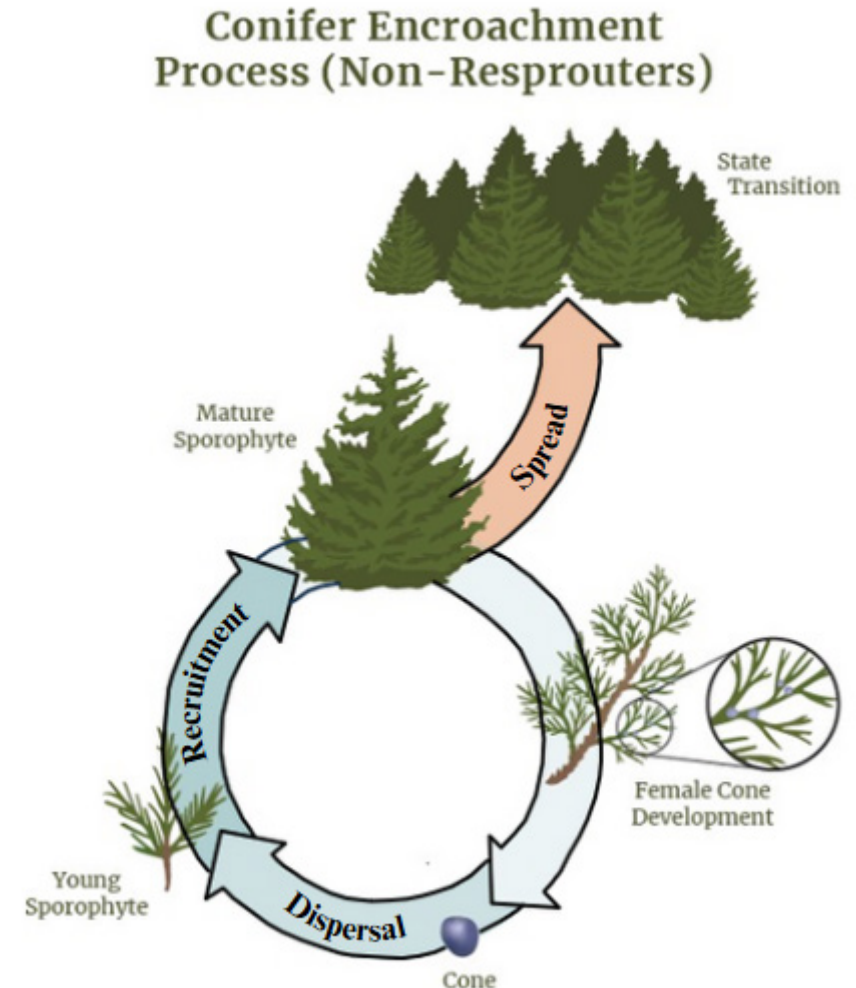
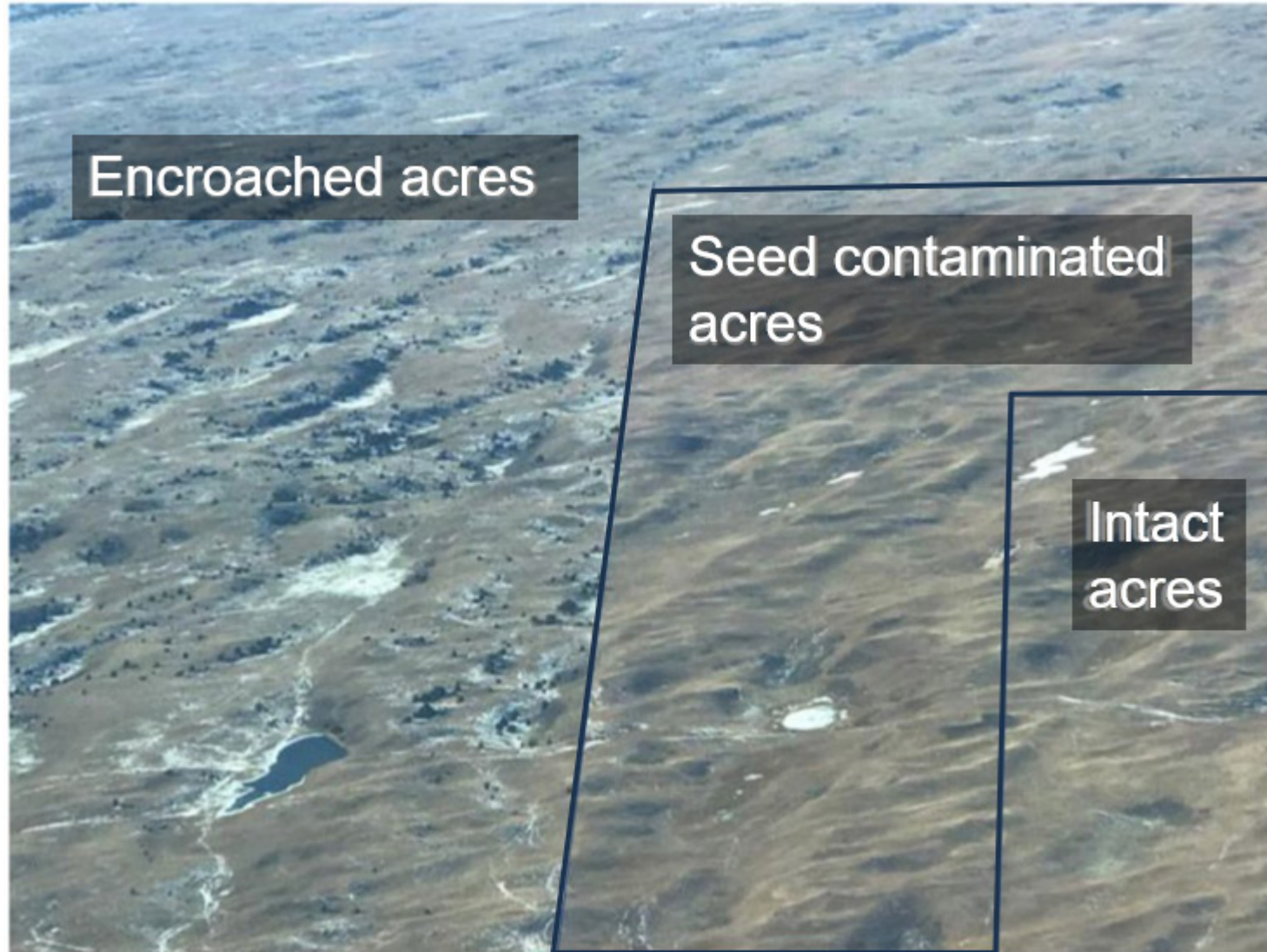
A Better Science Strategy is Now Available

>20K Copies Distributed



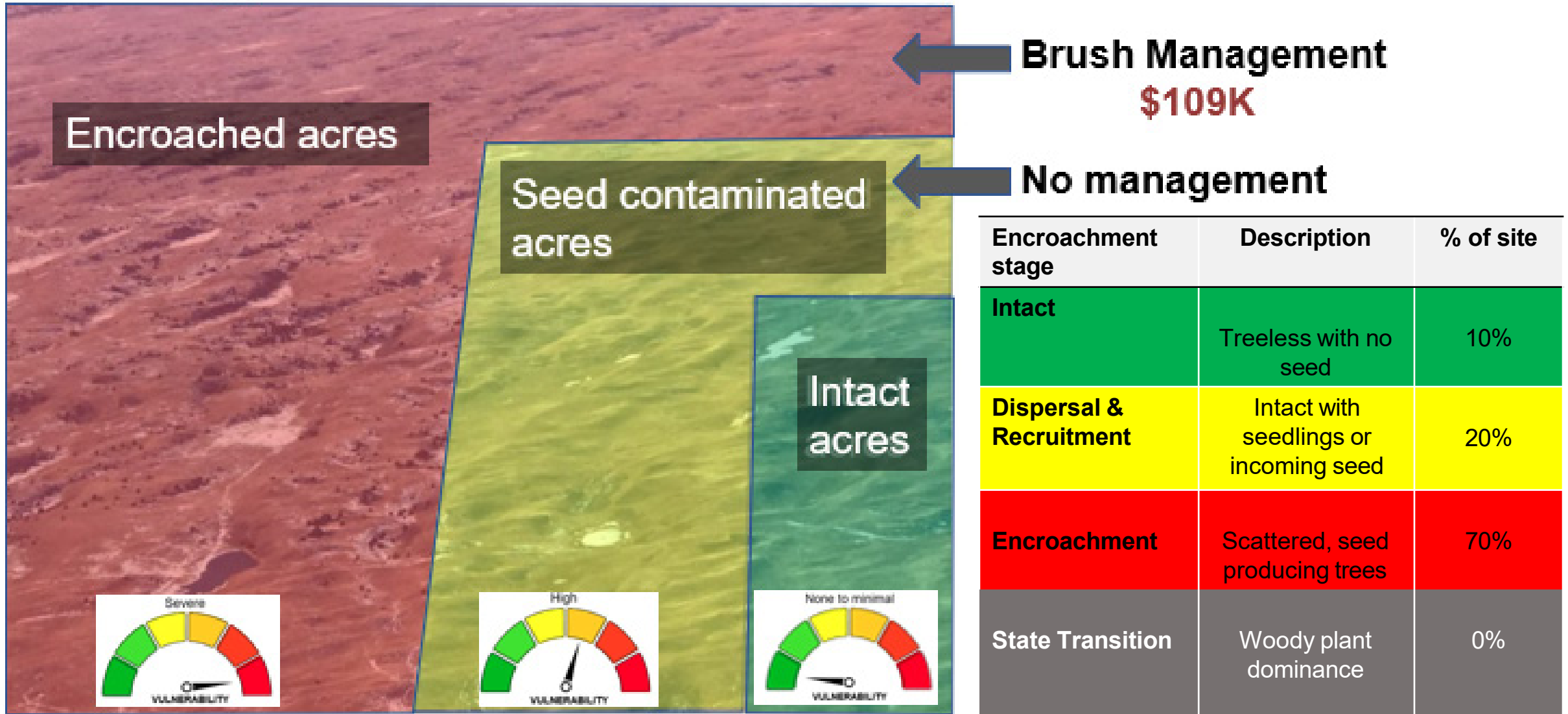
Stages	Description	Management
Woodland Transition	Woody plant dominance	Heavy machinery- Mechanical removal, fire
Expansion	Scattered producing trees	Hands tools, heavy machinery – mechanical removal, fire
Dispersal & Recruitment	Intact with seedlings and incoming seed	Fire, hand cutting, haying, mechanical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

Reducing risk and vulnerability requires integrated management across multiple encroachment stages



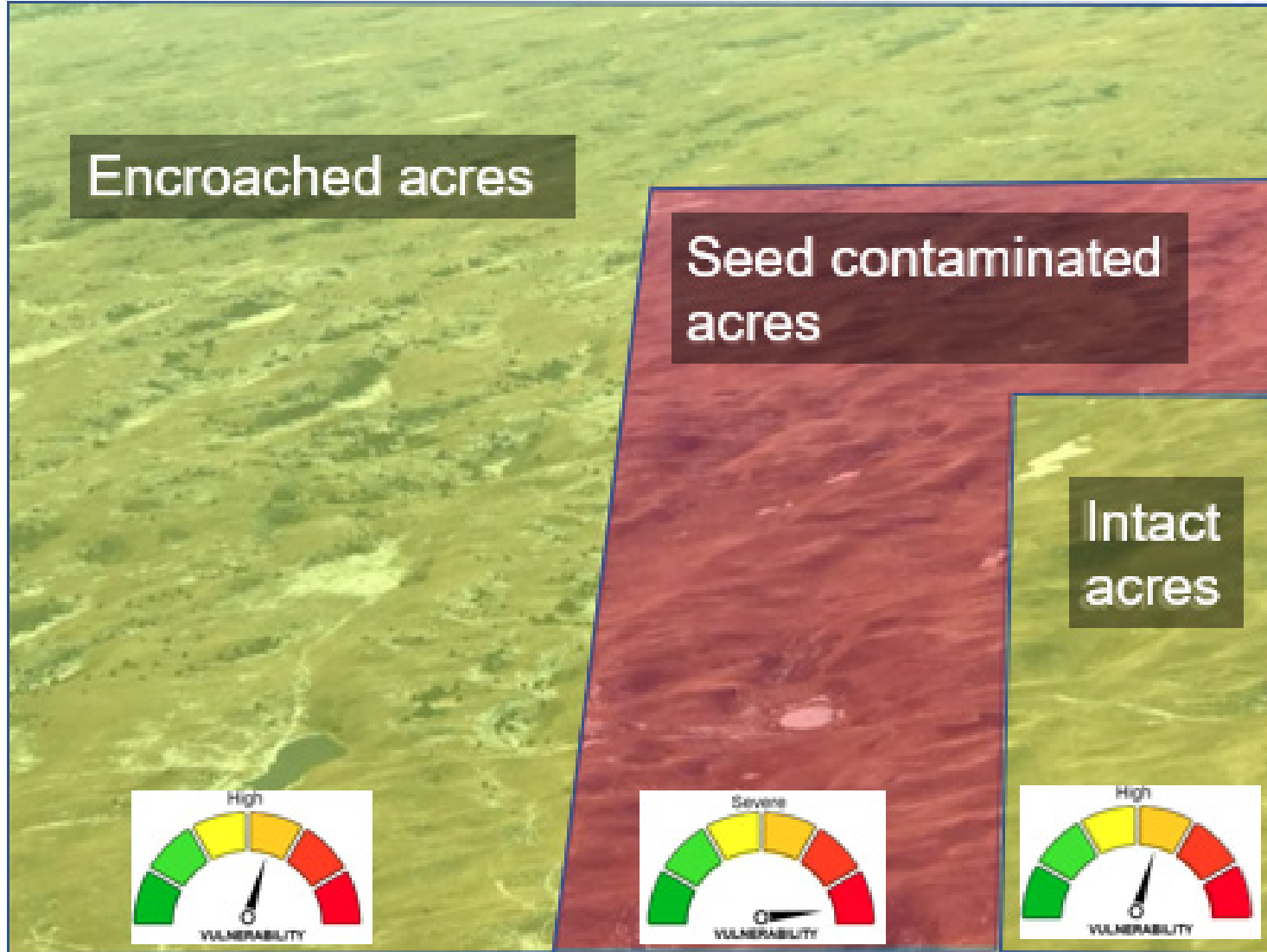
What happens if we do not manage seed contaminated acres?

Traditional Approach on 3,000 acres



What happens if we do not manage seed contaminated acres?

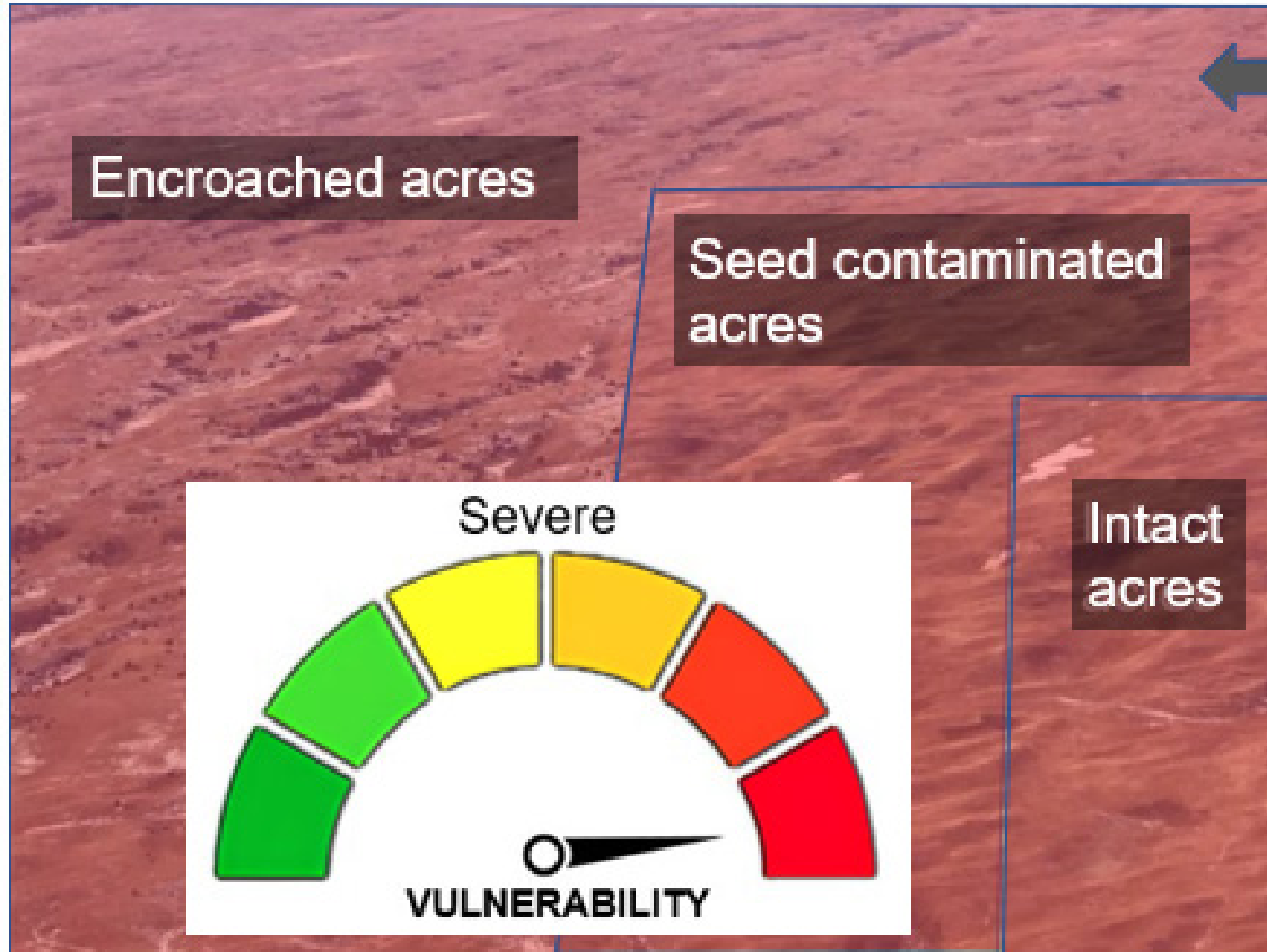
Traditional Approach on 3,000 acres



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?

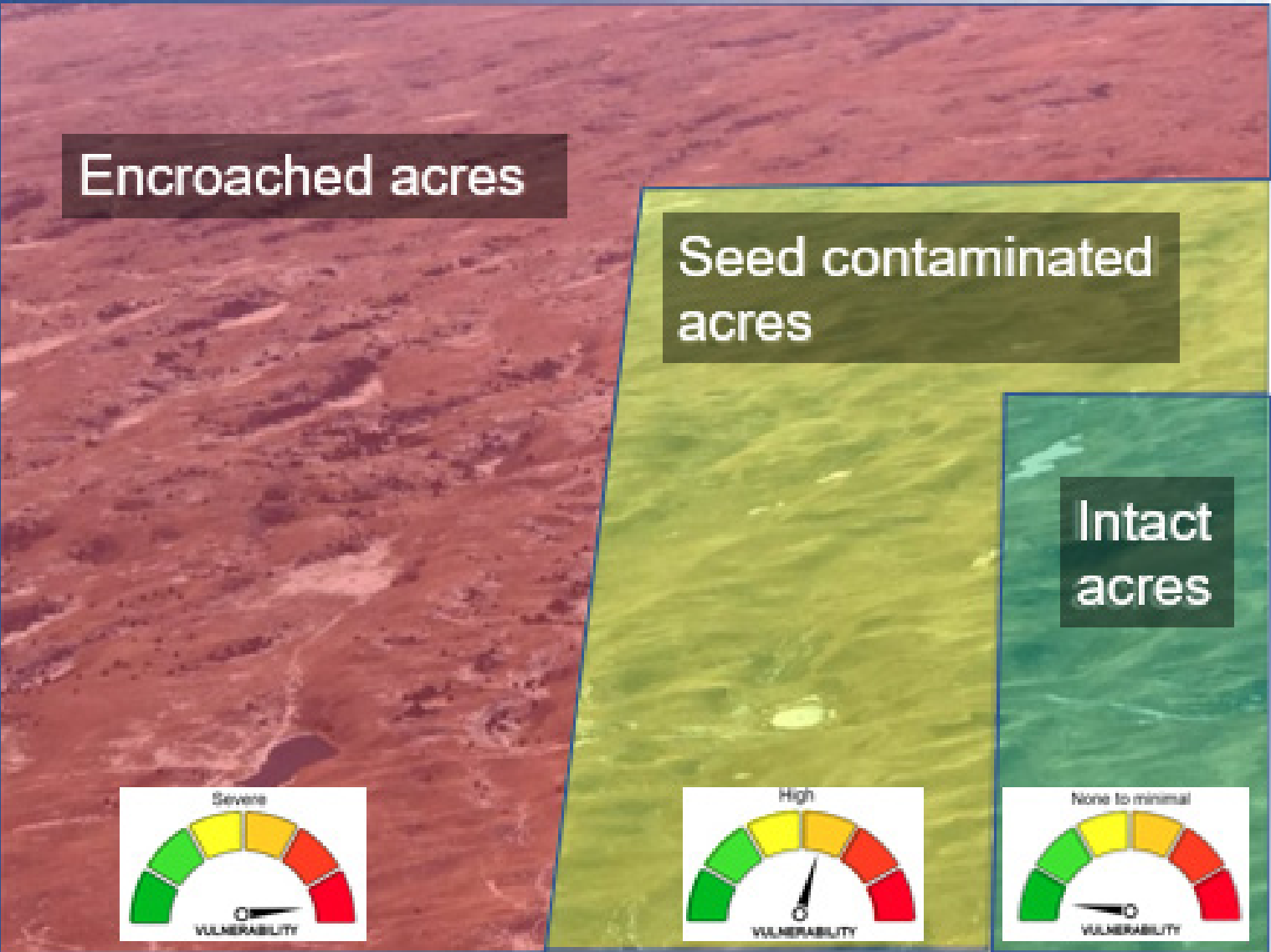
Traditional Approach on 3,000 acres



← **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%

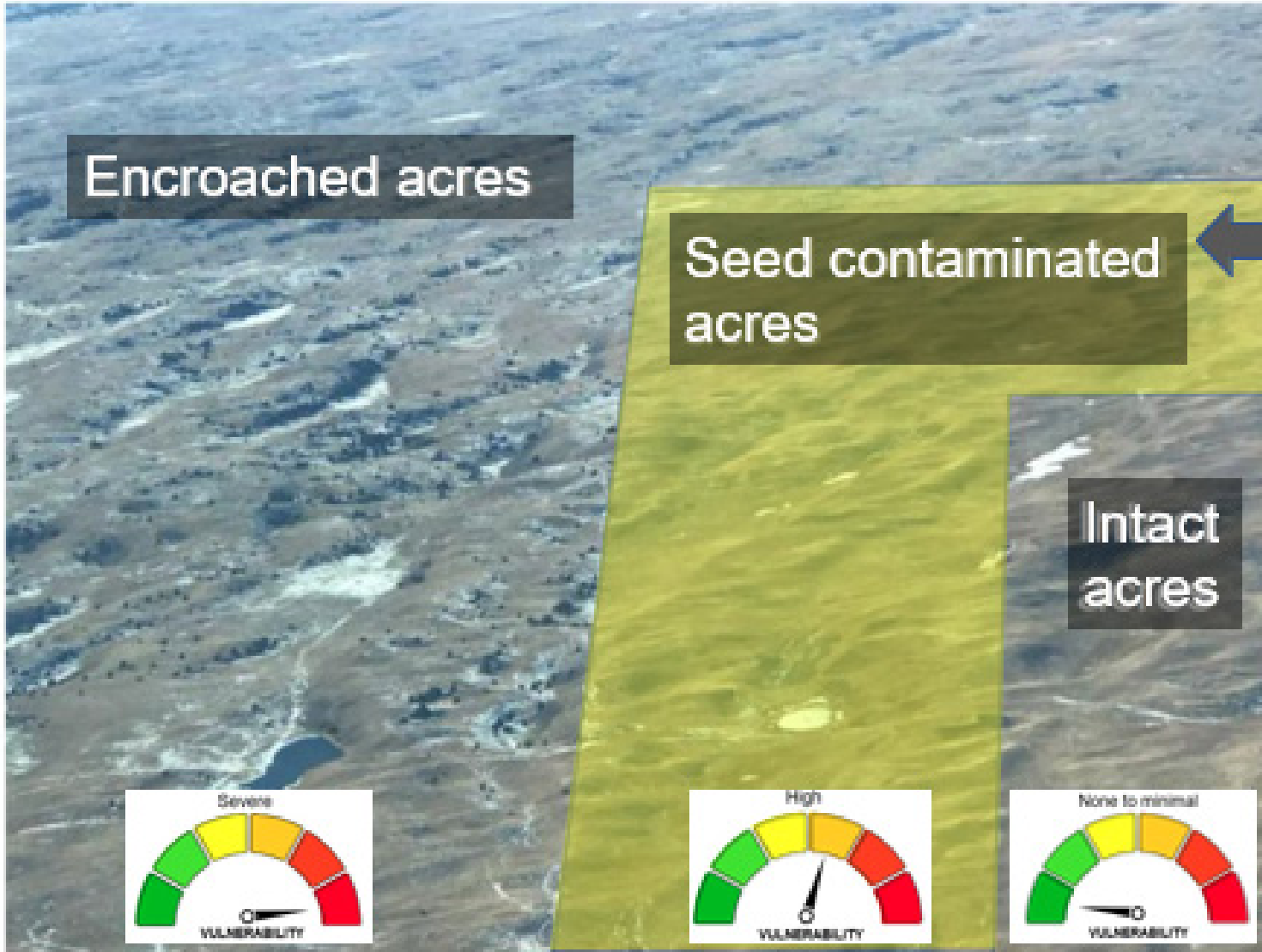
Reducing risk and vulnerability requires integrated management across multiple encroachment stages



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%

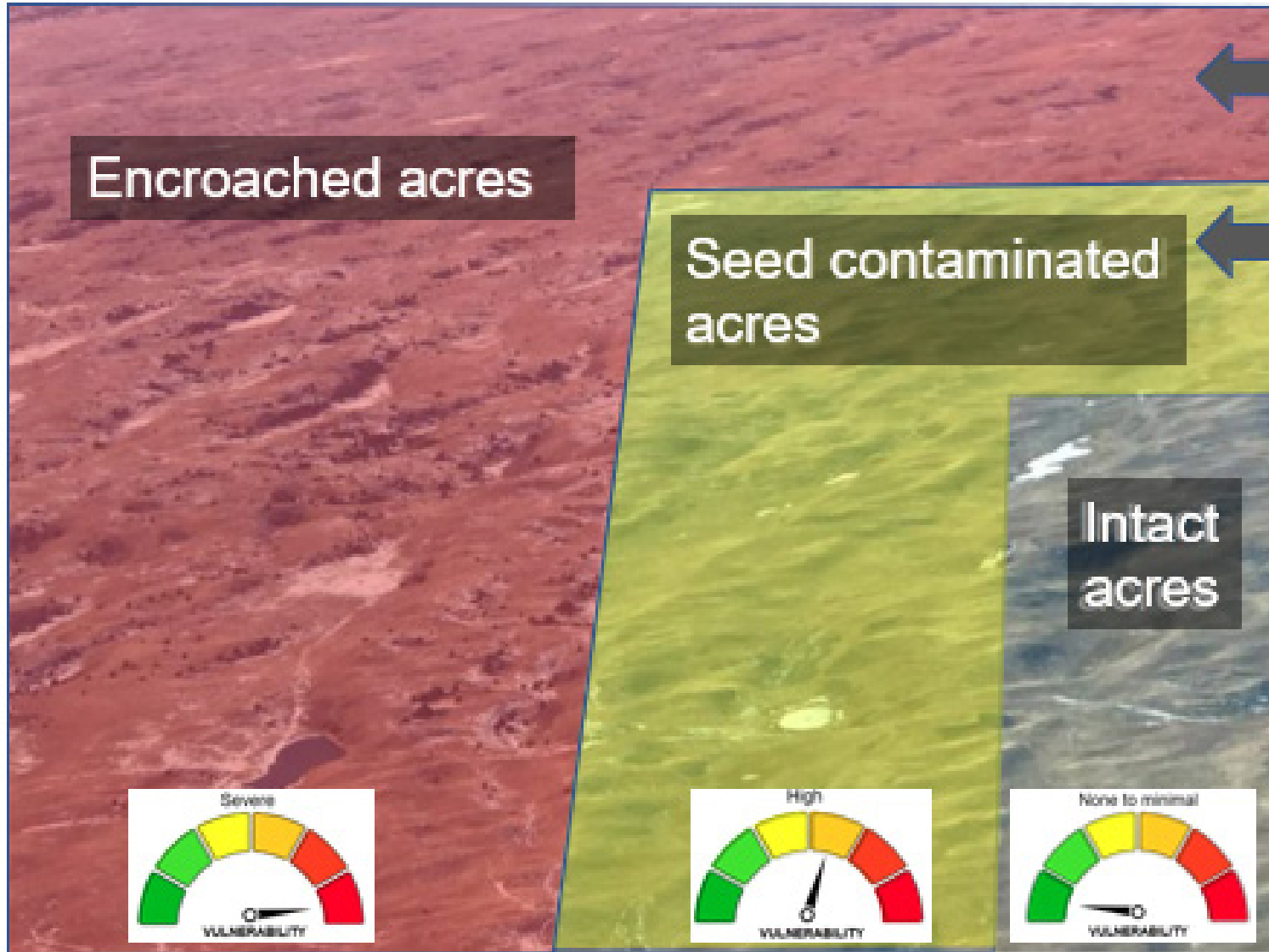
Defend the Core



Prescribed fire
 (338.2; 338.4; 338.68)
Mechanical, Hand tools <\$6K
 (314.276)
Haying (?)
Browsing (?)

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

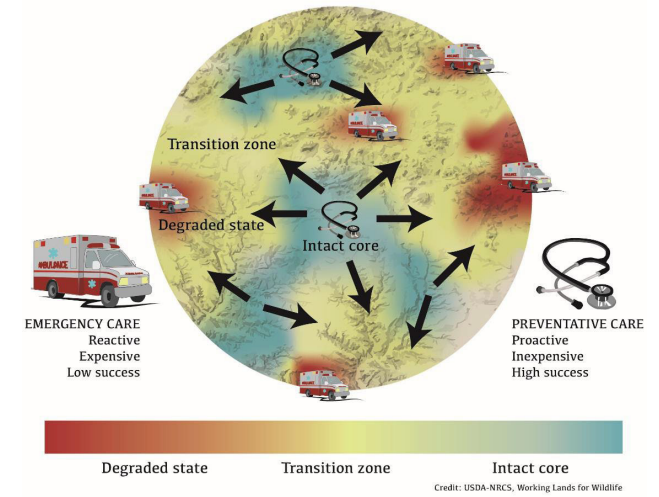
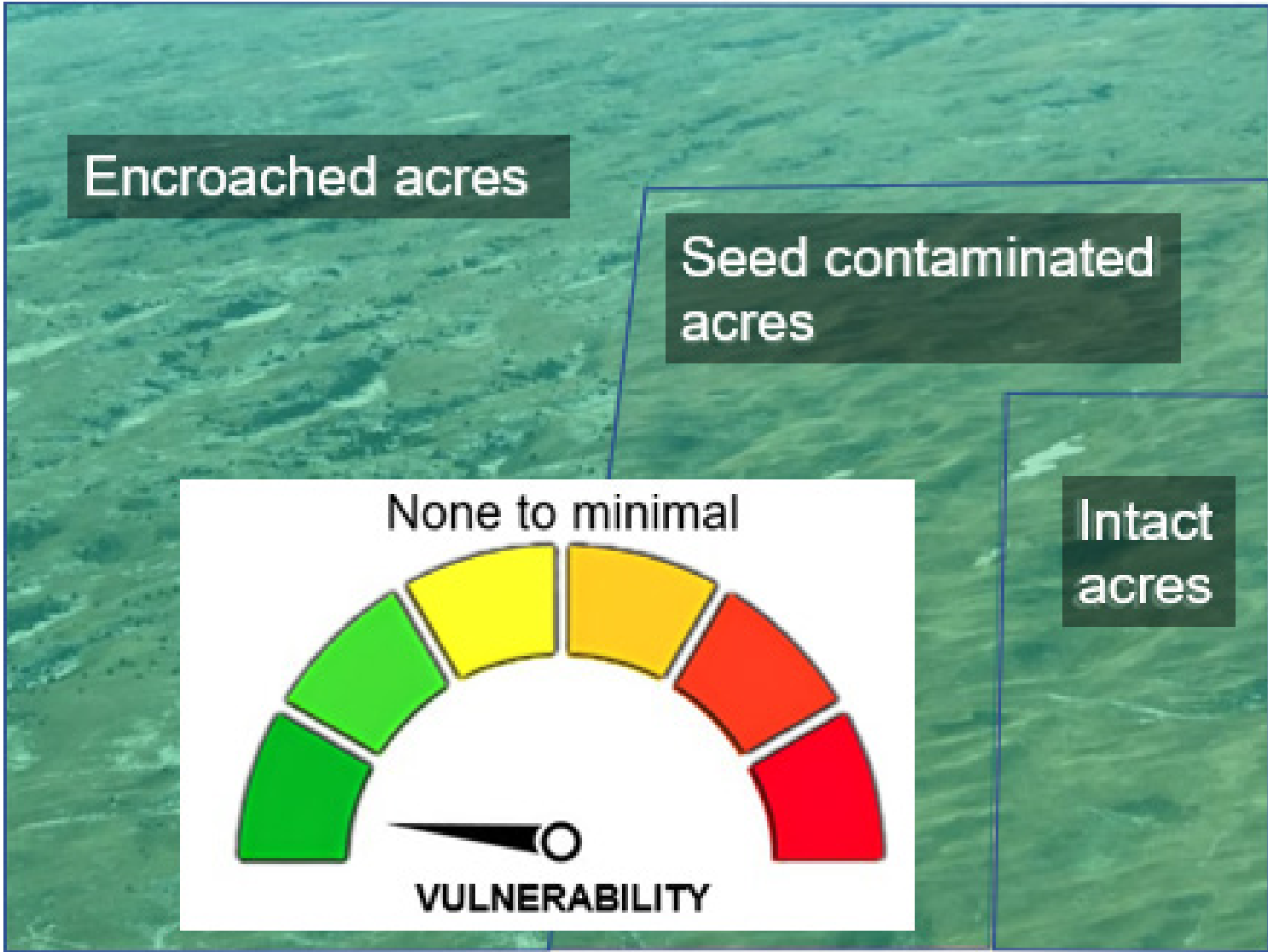


Prescribed fire
(338.4; 338.68)

Mechanical
(314.3; 314.38; 314.5)

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

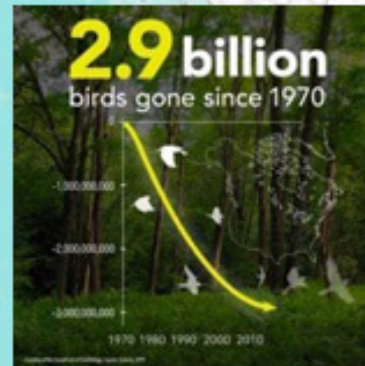
Defend the Core → Grow the Core



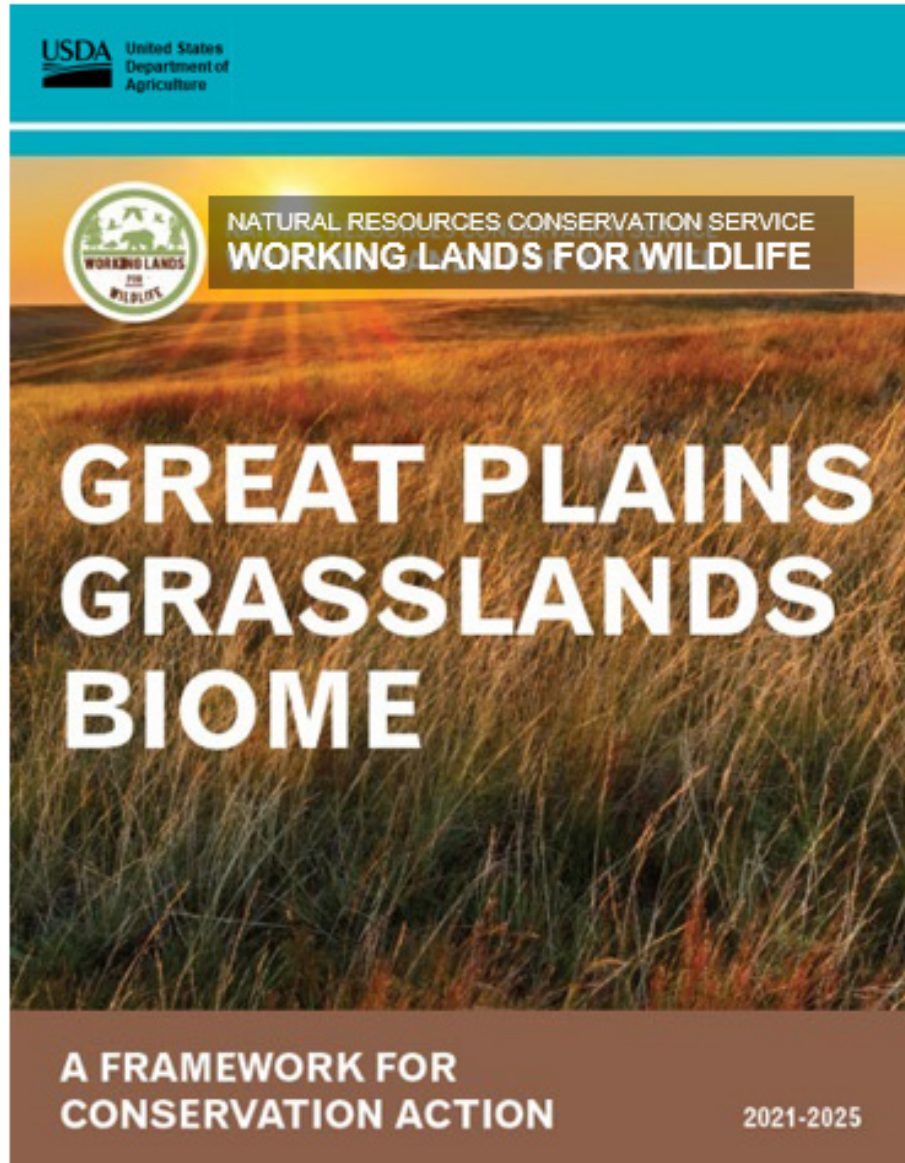
Encroachment stage	Description	% of site
Intact	Treeless with no seed	100%
Dispersal & Recruitment	Intact with seedlings or incoming seed	0%
Encroachment	Scattered, seed producing trees	0%
State Transition	Woody plant dominance	0%



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



NRCS State Leadership Responded Overnight to Insights from New Technology



9.8 Million Acres

Our top priority is conserving resilient and intact working rangelands. To achieve this outcome we must halt threats before they begin, reinstate fire back into the system, and work at scales that matter.

Photo: Shutterstock/Max Voran



Woodland Expansion
(7,900,000 acres)

Photo: Dirac Twidwell

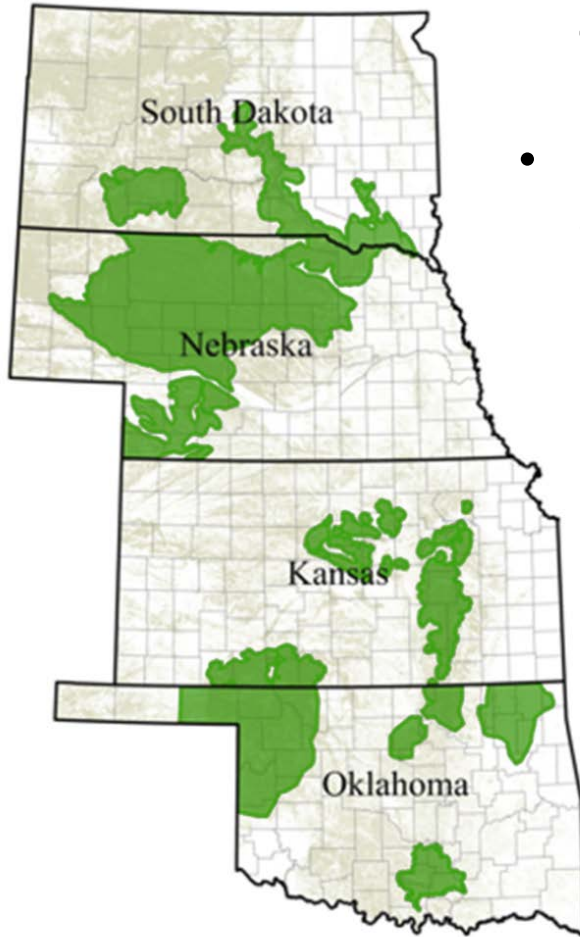


Land Use Conversion
(440,000 acres)

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)

USDA United States Department of Agriculture

RANCHER DRIVEN, SCIENCE INFORMED, AGENCY SUPPORTED

Transitioning from productive grassland to woody plant dominance is the greatest threat facing grasslands in Kansas. Ranchers have new tools, science, and a funding opportunity to help address woody plant encroachment on targeted rangelands through the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS).

Woody plant encroachment puts pressure on working rangelands by decreasing livestock production and increasing wildfire risk as well as harming grassland biodiversity and increasing threat to animal species living in this biome.

New scientific tools now provide unprecedented opportunities to track woody encroachment and develop strategic approaches to combat it. When combined with landowner expertise, Kansas ranchers and NRCS can defend intact grasslands, reduce vulnerability to future encroachment, and cut long-term maintenance costs.

USDA NRCS is adopting a new approach to addressing this widespread threat through the Kansas Great Plains Grassland Initiative (GPGI). The initiative is part of the NRCS Working Lands for Wildlife (WLFW) framework calling to conserve the last remaining iconic grassland regions in the Great Plains biome.

GPGI provides technical and financial resources to eligible ranchers in specific geographic rangelands to address woody plant encroachment. This initiative provides an opportunity for producers to reduce the vulnerability of Kansas core grasslands from woody encroachment.

Core grasslands include targeted areas within the Flint Hills, Gypsum Hills, and Smoky Hills regions of Kansas.

Treatment strategies will rely on an integrated pest management conservation system plan to manage woody species encroachment on identified planned land units (PLUs) within the core grassland areas.

2000

2019

KANSAS GREAT PLAINS GRASSLAND INITIATIVE

USDA United States Department of Agriculture

CONSERVING THE LAST GRASSLAND REGIONS OF OKLAHOMA

OKLAHOMA GREAT PLAINS GRASSLAND INITIATIVE

USDA United States Department of Agriculture

CONSERVING THE LEGACY OF NEBRASKA'S GRASSLANDS

NEBRASKA GREAT PLAINS GRASSLAND INITIATIVE

USDA United States Department of Agriculture

SOUTH DAKOTA LOST MORE THAN 145,000 TONS OF RANGE PRODUCTION TO WOODY ENCROACHMENT IN 2019

SOUTH DAKOTA GREAT PLAINS GRASSLAND INITIATIVE

Untitled - ArcMap

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Editor

Snapping

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)
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 - RGB
 - Red: Band_1
 - Green: Band_2
 - Blue: Band_3

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

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- clu_copy_a_ne071.p
- clu_copy_a_ne073.sl
- clu_copy_a_ne075.sl
- clu_copy_a_ne077.sl
- clu_copy_a_ne079.sl
- clu_copy_a_ne081.sl
- clu_copy_a_ne083.sl
- clu_copy_a_ne085.sl
- clu_copy_a_ne087.sl
- clu_copy_a_ne089.sl
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- clu_copy_a_ne117.sl
- clu_copy_a_ne119.sl
- clu_copy_a_ne121.sl
- clu_copy_a_ne123.d
- clu_copy_a_ne123.p
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1st ever national policy in ag industry (2022)



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

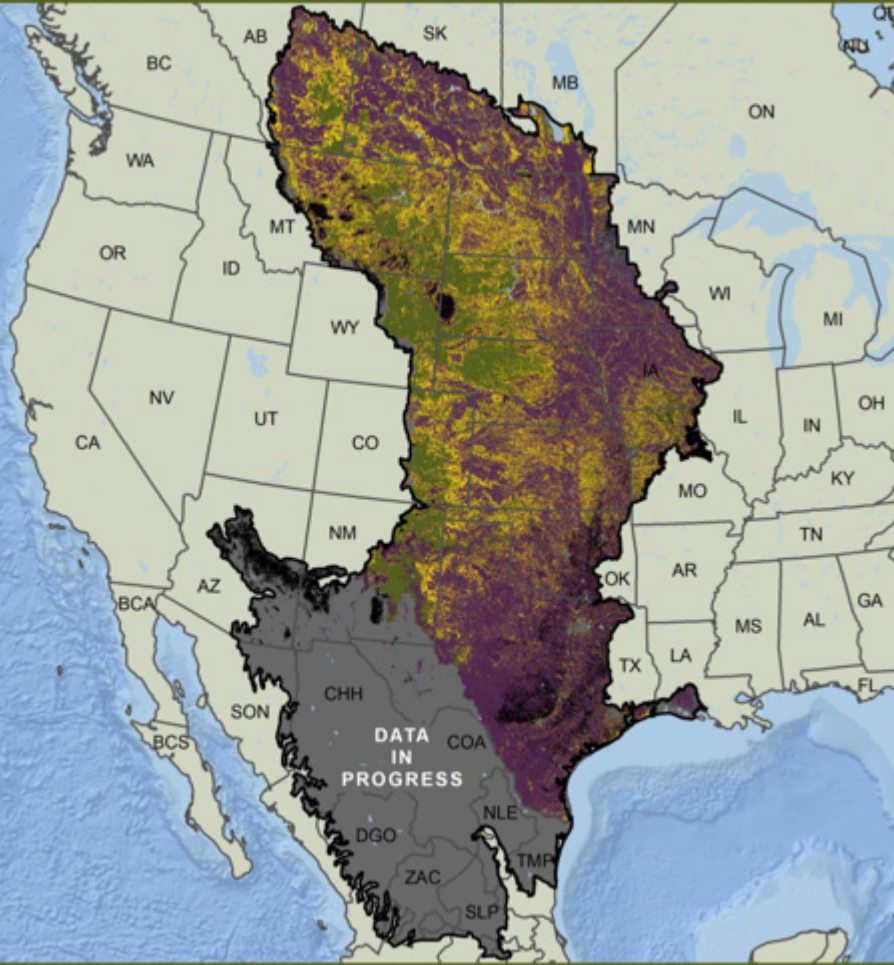
BE IT FURTHER RESOLVED, NCBA shall work on a national level to partner with state affiliates, conservation, and agricultural organizations to achieve these goals.



A New Mantra has Emerged:

Defend the Core → Grow the Core → Mitigate Impacts

CENTRAL GRASSLANDS ROADMAP GRASSLANDS RISK MAP

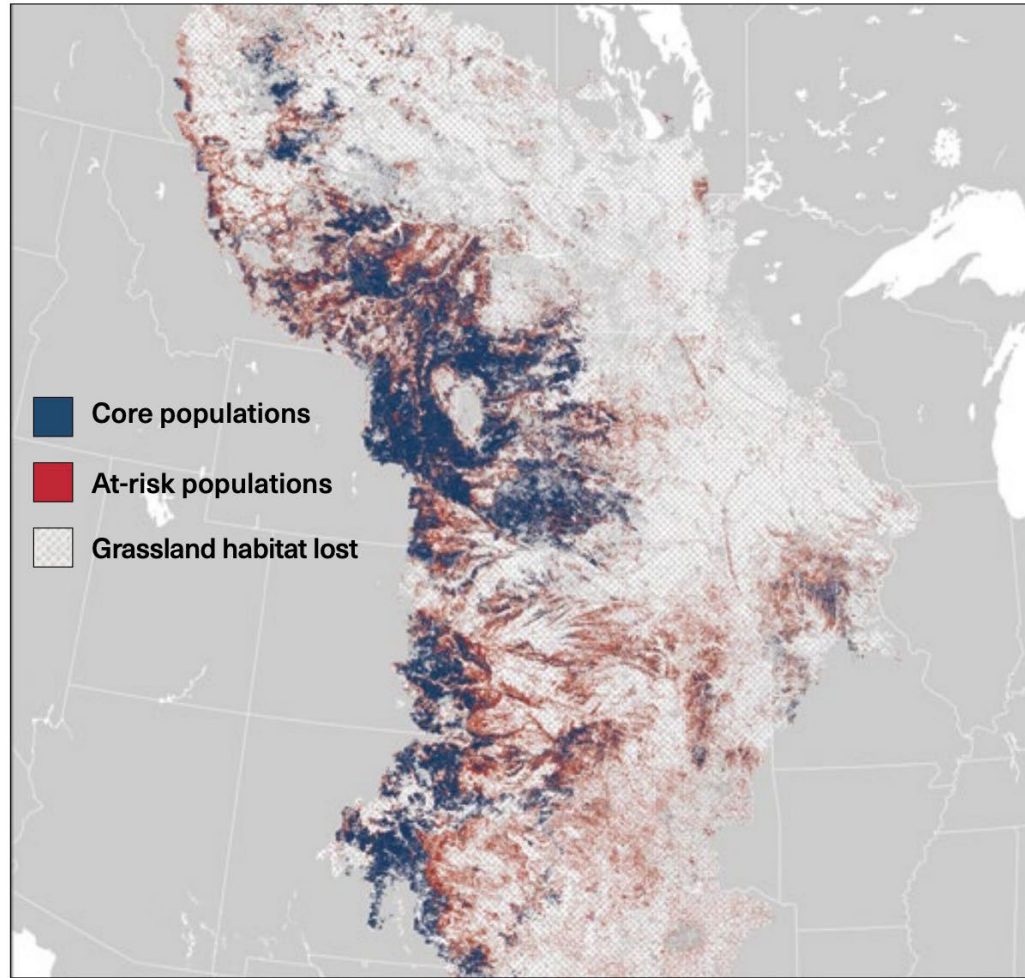


CONSERVATION CATEGORIZATION*

CORES **AT RISK** **PLOWED/ENCROACHED/FOREST**

DEFEND (98,162,883 acres) **MANAGEMENT** (130,649,139 acres) **P/E/F** (394,969,841 acres)

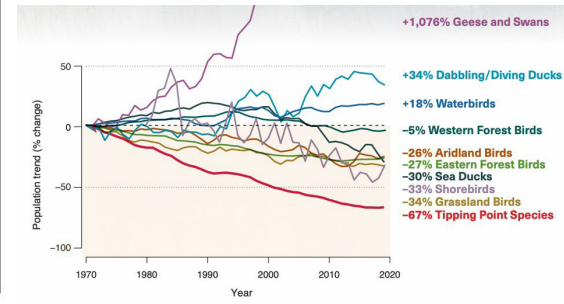
Based on currently available data. Plowed land consists of any area converted as of and since 2009 (see Plowprint.com). Encroached area is +5% woody vegetation (see Rangelands app).



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.

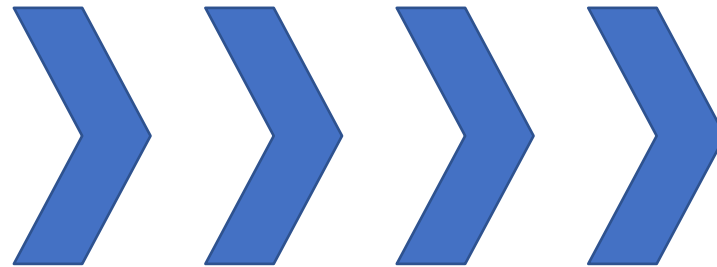
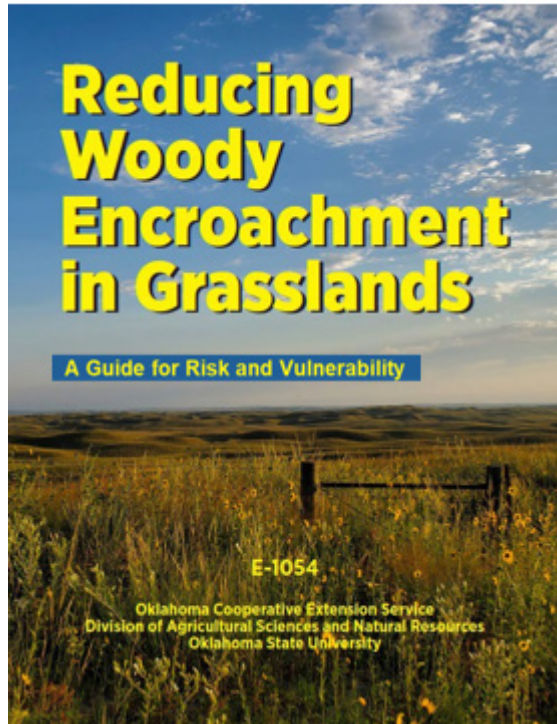
Source: Central Grassland Roadmap Initiative.



GREAT PLAINS GRASSLAND BIOME

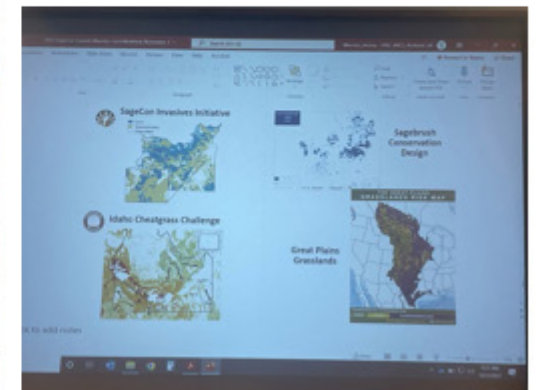
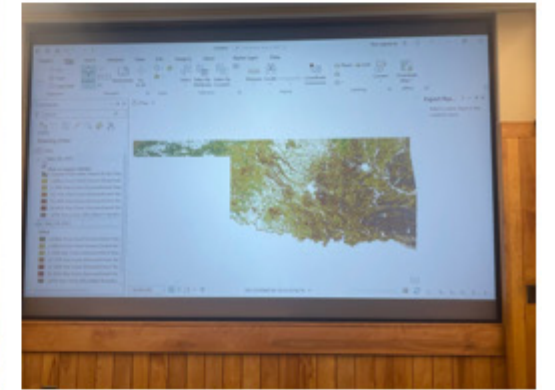
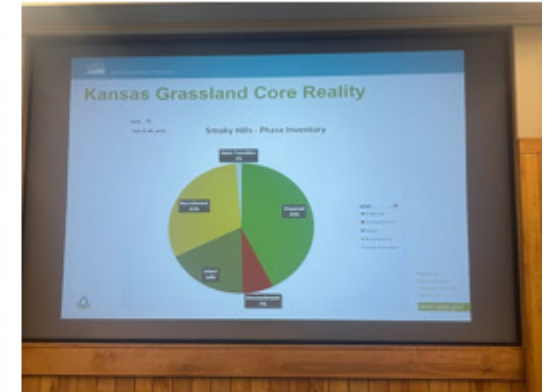


Extension Partnership



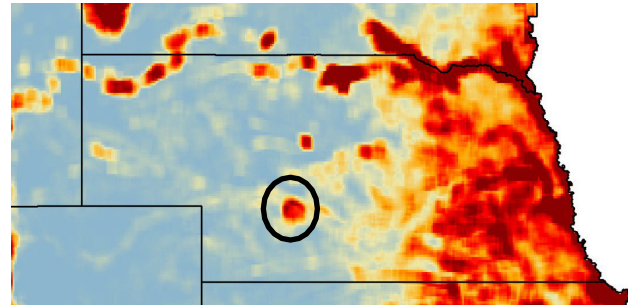
Field Training
Handbook

[In Development]



A Network of Regional Models of Success on Private Lands

Case Study 1: The Loess Canyons Experimental Landscape



Success Spotlight

Scaling-Up Collaboration

Since 2005, the Loess Canyons Rangeland Alliance has grown from a handful of visionary producers to an entire community committed to reinstating fire to save their grazing lands from the onslaught of redcedar invasion. Working together as a prescribed burn association, this partnership provides a rare example in the Great Plains of successfully halting the transition of a rangeland ecoregion to woodlands. Backed with support from NRCS, Pheasants Forever, and Nebraska Game & Parks Commission, the Loess Canyons grasslands have stabilized, benefitting livestock production and species like bobwhite quail and the imperiled American burying beetle.



13

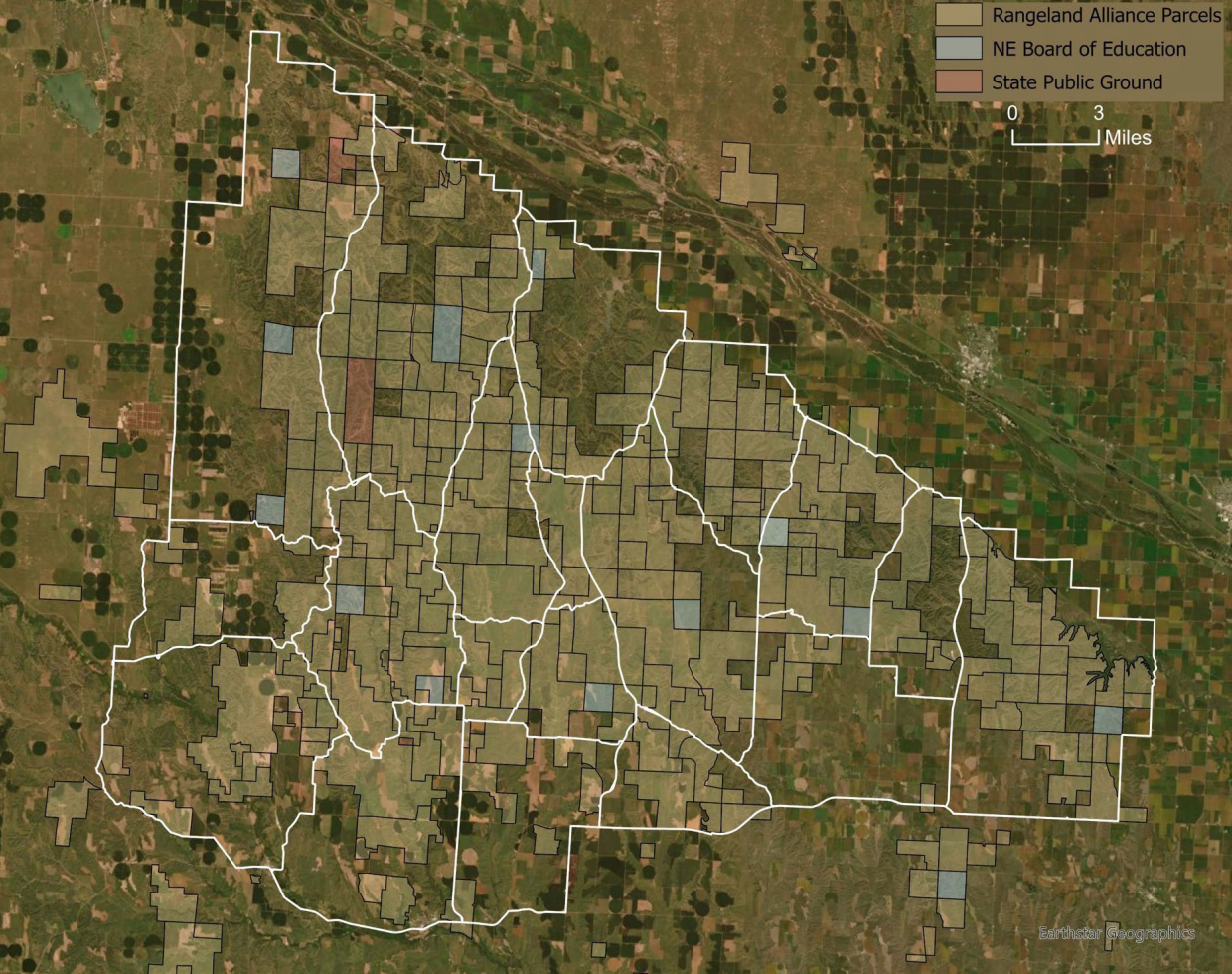
"We didn't want our kids or grandkids to say, 'Why didn't Dad take care of those cedars when he had the chance?'" reflects Scott Stout. "We decided the time to get after cedars is now – and we came together as a community to do something about it."

— Scott Stout, N-N Ranch Inc. and President of Loess Canyons Prescribed Burn Association, NE.

Photo: Scott Stout

Loess Canyons Experimental Landscape

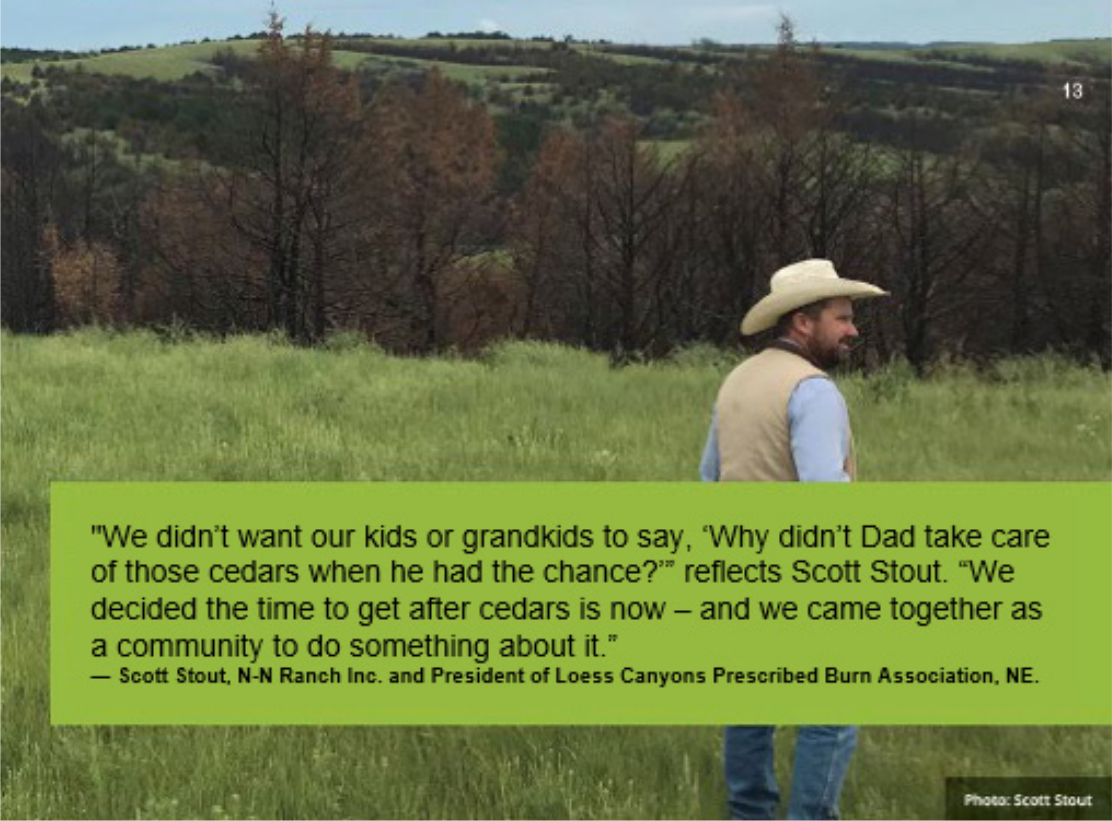
Loess Canyons PBAs land ownership



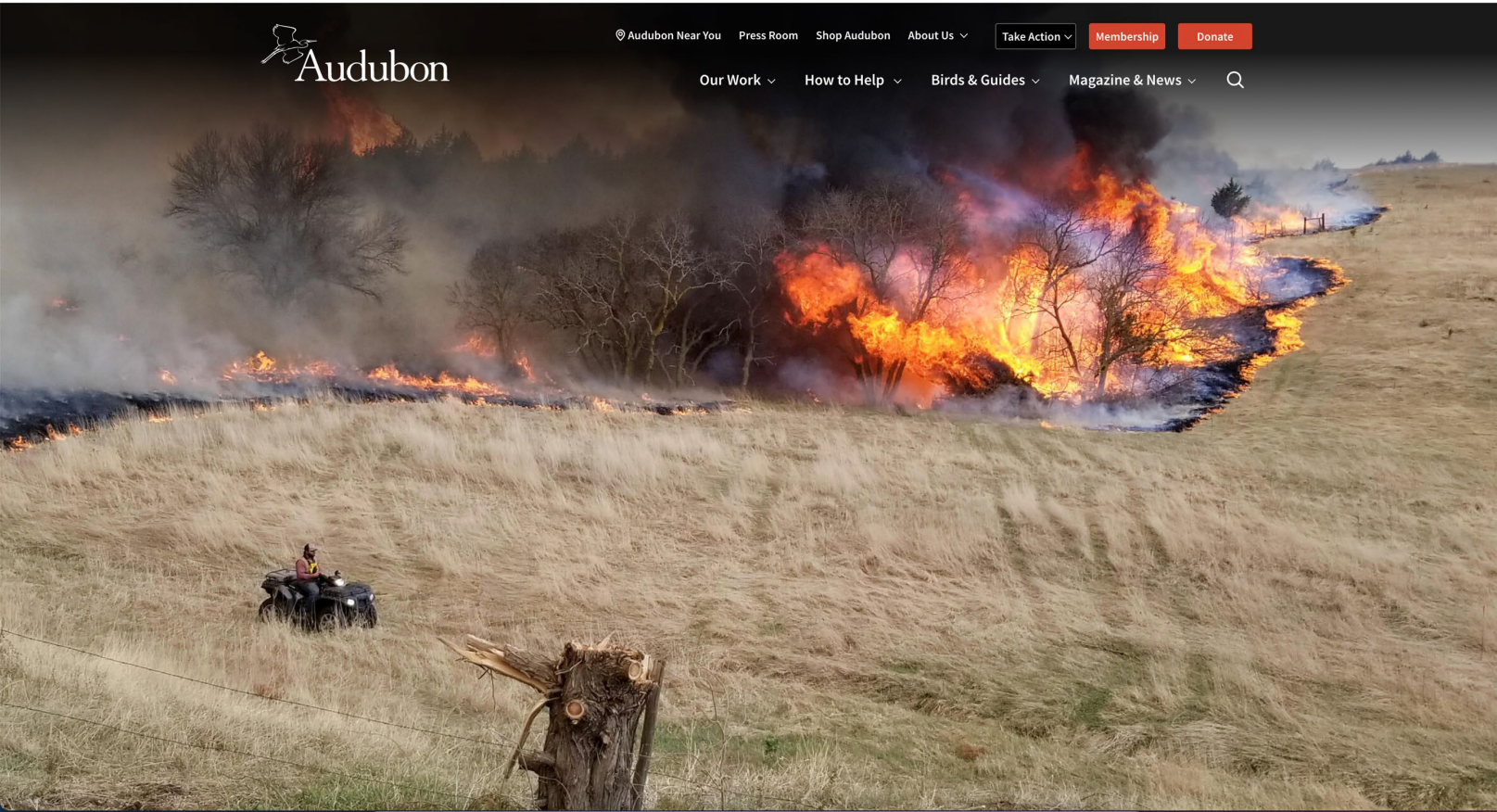
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News

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.

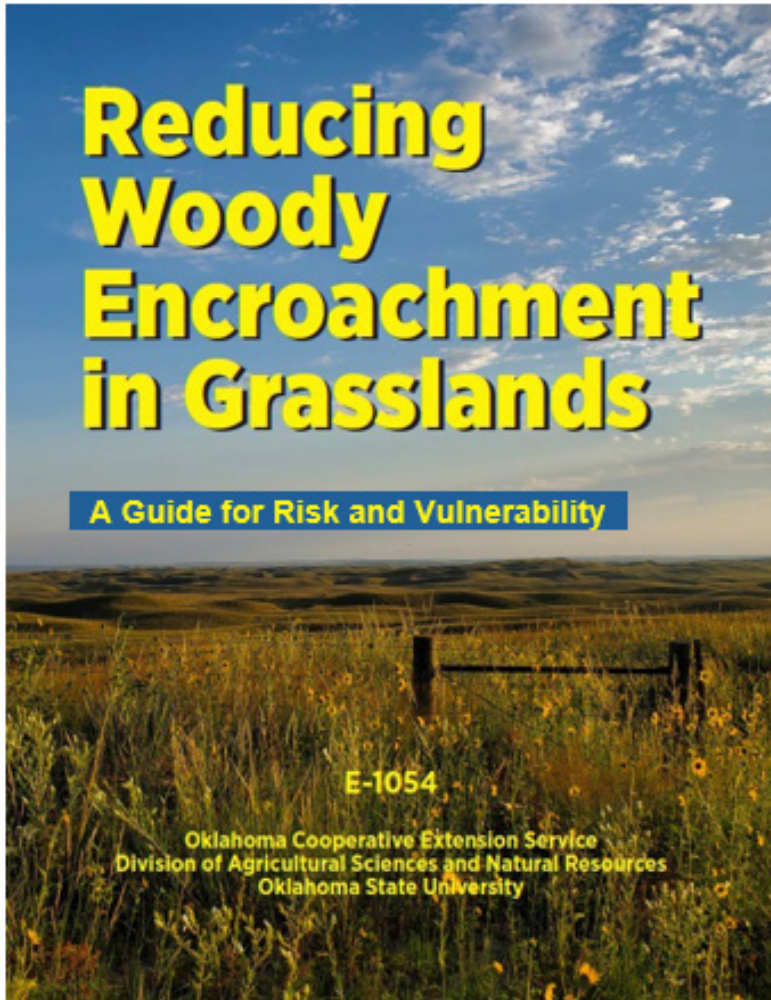


THE GREAT PLAINS PRAIRIE NEEDS FIRE

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
- Working Lands for Wildlife's Great Plains Grassland Biome Framework
- Rangeland Analysis Platform
- Eastern redcedar science literacy website
- Loess Canyons Science Report