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

$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

Uden et al. 2020; Twidwell et al. 2021
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Uden et al. 2020; Twidwell et al. 2021
The Problem of the "Improvement *then* Restoration" Paradigm

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<tr>
<th>Practice</th>
<th>Proportion Implemented (by area)</th>
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<tbody>
<tr>
<td>Windbreak/Shelterbelt</td>
<td>1.00</td>
</tr>
<tr>
<td>Livestock Pipeline</td>
<td>0.75</td>
</tr>
<tr>
<td>Hedgerow Planting</td>
<td>0.50</td>
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<tr>
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1.14M NRCS practices; Cady et al. in prep

Map: Boundaries
- 2020 Biome Collapse
- 1990 Biome Collapse
- Historic Great Plains

Increasing practice applications funded
- Red: Ahead of Biome Collapse Boundary
- Orange: Behind Biome Collapse Boundary

Scale: 300 Km
The Problem of the "Improvement then Restoration" Paradigm

- Windbreak/Shelterbelt
- Livestock Pipeline
- Hedgerow Planting
- Range Planting
- Watering Facility
- Fence
- Prescribed Grazing
- Herbaceous Weed Control
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- Forest Stand Improvement
- Tree/Shrub Maintenance

Proportion of Practices Implemented (by area)

1.14M NRCS practices; Cady et al. in prep

Brush Management

Boundaries
- 2020 Biome Collapse
- 1990 Biome Collapse
- Historic Great Plains

Increasing practice applications funded

Km

Ahead of Biome Collapse Boundary
Behind Biome Collapse Boundary
The Problem of the "Improvement *then* Restoration" Paradigm

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Proportion of Practices Implemented (by area)

- Green: Ahead of Biome Collapse Boundary
- Red: Behind Biome Collapse Boundary

1.14M NRCS practices; Cady et al. in prep

Map showing distribution of practices across the Great Plains with shaded areas indicating increasing practice applications funded and boundaries showing 2020 and 1990 biome collapse.
The Problem of the "Improvement *then* Restoration" Paradigm

- Windbreak/Shelterbelt
- Livestock Pipeline
- Hedgerow Planting
- Range Planting
- Watering Facility
- Fence
- Prescribed Grazing
- Herbaceous Weed Control
- Forage and Biomass Planting
- Brush Management
- Firebreak
- Prescribed Burning
- Forest Stand Improvement
- Tree/Shrub Maintenance

Proportion of Practices Implemented (by area)

- Total Practice Applications Funded
  - Prescribed Grazing
  - Brush Management
  - Fence
  - Watering Facility
  - Livestock Pipeline
  - Forage and Biomass Planting
  - Herbaceous Weed Control
  - Range Planting
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1.14M NRCS practices; Cady et al. in prep

Green: Ahead of Biome Collapse Boundary
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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
Herbaceous production lost to tree encroachment in United States rangelands

Scott L. Morford | Brady W. Allred | Dirac Twidwell | Matthew O. Jones | Jeremy D. Maestas | Caleb P. Roberts | David E. Naugle

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 290.4 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.

NEW GUIDANCE FOR REVERSING AND PREVENTING WOODY ENCROACHMENT

Reactions 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-terains/woody-encroachment/
National Rangeland Statistics

Rangeland Productivity Lost to Woody Encroachment

Equivalent to 698K Round Bales

Nebraska

<table>
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<tr>
<th>Productivity lost to woody encroachment in 2019</th>
<th>Cumulative productivity lost to woody encroachment (1990-2019)</th>
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<tr>
<td>419,328 tons</td>
<td>3,881,756 tons</td>
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The productivity lost to woody encroachment in 2019 is equivalent to 698K round bales. Over the period 1990-2019, the cumulative productivity lost is 3,881,756 tons.
Knox County, Nebraska
Rangeland Production Lost to Tree Encroachment

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<td>29,814 tons</td>
<td>333,857 tons</td>
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Total rangeland productivity = 349,875 tons
Early Warnings for Woody Transitions – Knox County Area

1990

[Map illustration of Knox County Area showing early warning for woody transitions]
Early Warnings for Woody Transitions – Knox County Area

2020 – Similar to 2000 Riley County, KS
Cherry County, Nebraska

Rangeland Production Lost to Tree Encroachment

Total rangeland productivity = 2,797,753 tons

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<td>8,707 tons</td>
<td>79,814 tons</td>
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Losses following Early Warning
2020 – Similar to 2000 Knox County
No Losses...
...but are Early Warning Signals present?

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

Total rangeland productivity = 345,169 tons
Early Warnings for Woody Transitions – Arthur County Area

1990

Map Satellite Arthur, NE, USA

Rangeland Analysis Platform
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.

Slide from Jeff Nichols, NE NRCS State Range Specialist
A Better Science Strategy is Now Available

>20K Copies Distributed

Reducing Woody Encroachment in Grasslands

A Guide for Risk and Vulnerability

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**

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<tr>
<th>Encroachment stage</th>
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<tr>
<td><strong>Intact</strong></td>
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<td>10%</td>
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<td><strong>Dispersal &amp; Recruitment</strong></td>
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**Brush Management**

- $109K
What happens if we do not manage seed contaminated acres?

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Brush Management $189K
Reducing risk and vulnerability requires integrated management across multiple encroachment stages.

Seed dispersal drives risk and vulnerability.

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Defend the Core

Prescribed fire
(338.2; 338.4; 338.68)

Mechanical, Hand tools
(314.276)

Haying (?)

Browsing (?)

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Defend the Core → Grow the Core

Encroached acres

Seed contaminated acres

Intact acres

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 (?)
None to minimal

Defend the Core → Grow the Core

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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

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.

GREAT PLAINS GRASSLANDS BIOME

A FRAMEWORK FOR CONSERVATION ACTION 2021-2025

Woodland Expansion (7,900,000 acres)

Land Use Conversion (440,000 acres)
Great Plains Grassland Initiatives

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

RANCHER DRIVEN, SCIENCE INFORMED, AGENCY SUPPORTED

Transforming 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 bivariate.

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 (GPG). The initiative is part of the NRCS’s broader, multi-state (океан) framework calling to conserve the last remaining mosaic of grassland remnants in the Great Plains.

GPG 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, Osage Hills, and Smoky Hills regions of Kansas.

Treatment strategies will rely on an integrated pest management conservation system plan to manage avoid species encroachment or identify and select sites within the core grassland areas.
1st ever national policy in ag industry (2022)

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.
A Network of Regional Models of Success on Private Lands

Case Study 1:
The Loess Canyons Experimental Landscape

Success Spotlight

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 ecosystem to woodlands. Backed with support from NRCS, Pheasants Forever, and Nebraska Game & Parks Commission, the Loess Canyons grasslands have stabilized, benefiting livestock production and species like bobwhite quail and the imperiled American burying beetle.

“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-M Ranch Inc. and President of Loess Canyons Prescribed Burn Association, NE.
Loess Canyons Experimental Landscape

Loess Canyons PBAs land ownership

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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.
Thank You!

Reducing Woody Encroachment in Grasslands
A Guide for Risk and Vulnerability

E-1054

Oklahoma Cooperative Extension Service
Division of Agricultural Sciences and Natural Resources
Oklahoma State University

Additional links:
Rangeland Analysis Platform: http://rangelands.app
Eastern redcedar science literacy website: http://cedarliteracy.unl.edu