Why is Sagebrush Country on Fire?
Altered Fire Regimes & Wildfire Management of Sagebrush Ecosystems

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Century-long History of Wildfire and Suppression on Forested Lands, “Forest Fires”

• History of fire suppression began in 1910.

• National fire policy started as full fire suppression to protect timber resources and rural communities (e.g. Smokey Bear Campaign).

• 1990’s to present, strike a balance between fire suppression to protect communities and bringing back the ecological role of fire.

• 2009, National Cohesive Wildland Fire Strategy (all stakeholders and land jurisdictions)
  - Fire-Adapted Communities
  - Restore and Maintain Resilient Landscapes
  - Safe and Effective Response to Fire
Recent Wildfire Trends across Federal Lands

Other Costs:

- State and Federal agencies pay suppression costs (9% of total wildfire costs).
- Total annualized cost approx. $71.1 to $347.8 billion.
  - Loss of infrastructure
  - Loss of private property
  - Constructions costs
  - Emergency Evacuation
  - Loss of Ecosystem Services
  - Post-fire Recovery
1. In just two decades, wildfire trends have changed significantly where shrublands/grasslands are now burning as much as forests.

2. 2000-2018: 47% of wildfires on federal lands occurred in shrubland and grassland types.

3. Across all ownerships, wildfires in shrubland and grassland types accounted for 56% of all fires.
Sagebrush Dominated Lands: Contemporary Wildfire Trends

2000-2018:
- Lost over 15 million acres of sagebrush, primarily in the Great Basin (portions of NV, OR, ID)
- Increase in annual area burned and larger fire sizes in some regions

2014-2018:
- ~9 million acres of Greater Sage-Grouse habitat burned
- ~80% of that area was within the Great Basin
- Large fire sizes (100,000 to over 400,000 acres) becoming common
- Increase in fire spread and extreme fire behavior

2018 Martin Fire, NV: started by fireworks, burned approx. 450,000 acres in 4-5 days.
Wildfire Trends Over Time for Sagebrush Ecosystems

Historical Fire Cycles: *highly variable across the sagebrush biome*

- Fire Return Intervals
  - Several decades in colder-moisture higher elevations
  - Hundreds of years in hotter-drier lower elevations
- Sagebrush Landscape Structure
  - Large expansive areas dominated by dense sagebrush

Contemporary Fire Cycles: *substantially changed from historic trends*

- Fire cycles in the hotter-drier lower elevations
  - Return intervals are shorter and don’t allow time for full recovery
  - Interaction with annual invasive grasses
    - Reburns occur on average every 7–15 years
    - Increase in area burned and large fire sizes
- Fire cycles in the colder-moister higher elevations
  - Shift towards smaller and less frequent fires
    - Successful fire suppression efforts
    - Other human activities
Invasive Annual Grasses and Wildfire Cycles: *Primary Threats to Western Sagebrush Lands*

Fire is major threat for sagebrush lands primarily due to increasing dominance of the “invasive grass-fire cycle” - especially in warmer and drier ecosystems that are less resistant to annual grass invasions and less resilient after disturbance.

Non-native fire prone grasses invade sagebrush ecosystems and dry out early before the fire season. These grasses provide contiguous fine fuels that ignite easily, increasing fire occurrence and spread.

After fire, *cheatgrass* rapidly recovers, out-competing natives. Native plant species like sagebrush don’t recover, and eventually disappear across the landscape – resulting in monocultures of cheatgrass.
Invasive Annual Grasses and Wildfire Cycles: *Primary Threats to Western Sagebrush Lands*

When Fire-prone, non-native, annual grasses (cheatgrass) invade less fire-tolerant sagebrush communities ...

**Results:**
- Eventual conversion of native sagebrush shrublands to non-native, annual grassland.
- Invaded areas promote very high fire frequencies and larger fires.
Role of the Invasive Cheatgrass (*Bromus Tectorum*) in Western Sagebrush Lands

**Wildfires Lead to Invasive Grass Growth in Great Basin**
More annual grasses, like cheatgrass, are growing in region previously dominated by sagebrush.

![Map showing growth of Cheatgrass](image)

**Annual Grasses 1990** vs **Annual Grasses 2018**
- **Low Cover**
- **High Cover**

Source: Matthew Jones and Brady Allred at the University of Montana and the Rangeland Analysis Platform, an app funded by USDA’s Natural Resources Conservation Service and Bureau of Land Management

![Graph showing energy flow](image)
Challenge: *High Probability (Risk) of Large Fires in Shrub/Grassland Areas Correlates with Nonnative Annual Grasses*

Great Basin - largest area with very high fire probability

- Large fire probability map: fuel models, landcover types, fire ignitions, weather patterns and climate (correlates with invasive annual grasses - see 2018 image)

- High fire probabilities in the Great Basin correlate with invasive annual grasses presence

- Brown = high fire probability
  Yellow = moderate burn prob.
  Teal = lower burn probability

Other Nonnative Annual Grasses Altering Fire Regimes and Native Plant Communities

A. Ventanata
(Ventanata dubia)
- Invaded Northwestern sagebrush & ponderosa pine forests

B. Medusahead
(Taeniatherum caput-medusae)
- Invaded sagebrush throughout the west

C. Red Brome
(Bromus madritensis subsp. rubens)
- Invaded Southwestern ecosystems & sagebrush ecosystems

D. Buffelgrass
(Pennisetum ciliare, Cenchrus ciliaris)
- Invaded Southwest warm desert ecosystems

E. South African Lehmann Lovegrass
(Eragrostis lehmanniana)
- Invaded Southwest warm desert ecosystems
## Impacts of Altered Sagebrush Fire Regimes

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<thead>
<tr>
<th>Non-market good or service</th>
<th>Potential impacts to people</th>
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<tbody>
<tr>
<td>Wildlife and plant communities</td>
<td>Threats to existence values of species and communities</td>
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<tr>
<td>Livestock forage</td>
<td>Changes in forage availability affecting ranchers</td>
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<td>Air quality</td>
<td>Induced illness from exposure to wildfire smoke</td>
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<tr>
<td>Carbon sequestration and storage</td>
<td>Release of stored carbon into atmosphere</td>
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<td>Sequestration of carbon through plant regrowth</td>
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<td>Soil erosion</td>
<td>Sedimentation of water resources</td>
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<td>Debris flows and associated downstream damages</td>
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<td>Recreation opportunities</td>
<td>Changes to aesthetics of recreation areas</td>
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<td>Closures of trails and recreation areas</td>
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<td>Changes to opportunities for hunting and wildlife viewing</td>
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<tr>
<td>Cultural heritage</td>
<td>Changes in fire's role in cultural traditions and practices</td>
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<td>Damage to culturally important artifacts and sites</td>
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- Increased risk to human life and property, high fire mgmt costs, and loss of cultural and economic resources
- Many wildlife population declines due to sagebrush loss & fragmentation
Wildland Fire Management Challenges

- Increasing duration and severity of fire seasons
- Decrease in firefighting workforce
- Reduced resilience of the landscape
- Increase in development in the wildland-urban interface
- Federal fire funding challenges
  - Funding largely focused on forest fires
  - Funding structure

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<tr>
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<th>Bur. Land Mgmt</th>
<th>U.S. Forest Service</th>
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<tr>
<td>Acres Managed</td>
<td>245 million acres</td>
<td>193 million acres</td>
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<tr>
<td>5-Year Avg Acres Burned</td>
<td>2.1 million</td>
<td>1.7 million</td>
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<tr>
<td>Fuels Mgmt Funding</td>
<td>$85 million</td>
<td>$400 million</td>
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<tr>
<td>Preparedness</td>
<td>$180 million</td>
<td>$1.3 BILLION</td>
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<tr>
<td>Post-Fire Rehabilitation</td>
<td>$35 million</td>
<td>$180 million*</td>
</tr>
<tr>
<td>Rural/Partner Support</td>
<td>$1 million</td>
<td>$94 million</td>
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Challenge: *Culture Mainly Focused on Forest Fires*

**Change in Policy Focus:** Current legislation does not address the unique aspects of fires occurring in shrub/grassland communities due to invasive annual grasses, especially on DOI Lands.

- Healthy Forest Restoration Act (2003):
- Forest and Landscape Restoration Act (Omnibus 2009)
- Omnibus (2018) – additional tools to the USFS for forest resiliency
- Farm Bill (2019) – promotes forest resilience and active forest management

**Change in Culture:**
- Public’s understanding of fire
- How media portrays fire

**Increase Research:**
- USFS: Specific wildfire research arm for forests & fire
- Dept. of Interior: Limited fire research funding
- Research gaps:
  - Effectiveness of Fuel Breaks in Reducing the Extent of Fire at Large Scales
  - Large-scale Effective Invasive Reduction Methods
Challenge: *Human-Caused Fires*

- Depending on area, human-caused fire ignitions range from 31-97%.

- Most common causes of human ignitions:
  - Powerlines
  - Vehicles
  - Target shooting
  - Campfires
  - Fireworks
Opportunity: Reducing Wildfire & Invasives Cycle

Integration between State and Federal Invasives Programs and Wildfire Management Programs.

• Increase coordination for targeted prevention, control and eradication of invasives annual grasses.
• Test strategically-placed fuel treatments and “invasive fuels” reduction strategies.
• Use new management strategies based on ecosystem resilience to fire and resistance to invasives.
• Coordinated Rural Fire Protection Areas: Increase fire-fighting capacity in remote areas
• Elevate issue of nonnative invasive annual grasses and wildfire

Stronger collaboration between State and Federal Wildfire Prevention Programs for reducing human-caused fires.

• Focus education and prevention programs in areas prone to human-caused fires
Opportunity: *Tools for Invasive Species and Wildfire Management at Multiple Scales*

**National Priorities**
- Science Framework (Part 1 and Part 2)
- Western Weed Action Plan
- WAFWA: Sagebrush Conservation Strategy
- WGA: Invasives Sub-committee
- DOI: National Invasive Species Council (NISC)

**Regional Priorities**
- NRCS: Idaho Cheatgrass Challenge
  - Research:
    - Post-Fire Recovery Prioritization Tools
    - Strategic and Effective Fuel Break Designs

**Local Priorities**
- Local Cooperative Weed Management Areas (CWMA)
  - Research:
    - Effective Post-fire Recovery Seeding & Cheatgrass Control
- States Invasives Mgmt Programs
Use Sagebrush Resilience & Resistance as a Prioritization Strategy:

- At a broad scale, distinguish between sagebrush communities at risk to fire and their capacity to recover from fire and resist annual grass invasions.
- Prioritize areas for wildfire management.
- Determine most appropriate types of wildfire management actions for:
  - Wildfire Suppression/Ops
  - Fire Prevention Strategies
  - Vegetation and Fuels Mgmt
  - Post-fire Recovery

Opportunity: Science Framework - Addressing Wildland Fire Risk Across the Sagebrush Biome
Wildfire Management - National Scale

• Highest priority is to protect communities
• Prioritize response to multiple fire ignitions across the entire U.S. for areas at high risk of loss.

Suppression Tactics – ‘On-the-Ground’ in Sagebrush Country

• Heavily degraded sites for pre-positioning fire suppression resources.
• Innovative fire suppression tactics:
  - Extinguish fire edges and hotspots within the burn perimeter
  - Retain unburned sagebrush islands within burn perimeters
  - Construct direct (rather than indirect) firelines, where/when it is safe
Opportunity: Proactive & Strategic Management at Large Scales

Overall goal of fuel management strategies:
• Protect intact and vulnerable sagebrush communities from loss to the invasive grass/wildfire cycle
• Strategically place invasive reduction projects to disrupt connected invasive grass fuels
• Strategically place fuel breaks for fire suppression efforts

Trade-offs to consider:
• Limited research on fuel invasives reduction and fuelbreak effectiveness/impacts
• Potential vector for spread of planted nonnatives and invasives
• Commitment to funding long-term maintenance
Opportunity: *Increased Effectiveness in Post-Fire Rehabilitation Efforts*

Rehabilitation efforts focus on creating resilience to fire and resistance to invasive grasses:

- Prioritizing native seeding strategies based on provisional seed zones
- Target rehabilitation efforts between sagebrush patch refugia in burned areas
- Establish patches of diverse native forbs, bunchgrasses, and other shrubs to mimic natural recovery succession of sagebrush communities after fire
Nonnative Invasive Annual Grass Management

Strategies to Prevent or Limit Invasions and Uncharacteristic Fire

Prevent New Invasions (levels 1-3):
- Maintain native communities
- Identify communities most at risk
- Commitment to Prevention
- Early Detection & Rapid Response

Reduce Existing Invasions (levels 4-5):
- Partnerships
- Identify highest priority need
- Strategic, place-based restoration
- Consistent long-term effort

Adapted from Mealor et al. 2013 (https://bit.ly/3cZSqii)
Zoning a Landscape for Invasive Plant Management

Cost of Impact in Managing Invasive Species
- Table depicts using prevention, eradication, control, and long-term management strategies
- Control of invasives is more effective and cost-efficient when done early (using proactive strategy), before infestation is widespread
- When management becomes reactive, success become more difficult
Important to Consider Current Landscape Context

Figures show that the landscape context of the invaded areas matter for management. Control is more effective over the long-term when strategies are informed by what’s going on in the surrounding landscape.

The figure in blue shows invaded areas surround by low invasion; whereas, the figure in red depicts low invasion areas surrounded by highly invaded areas.
Zoning a Landscape for Invasive Plant Management

- Combined with maps of percent cover of invasive plants and threat of spread of invasive plants (bottom figures), this type of information can be used to create spatial management zones to determine where prevention, eradication, and control strategies should be applied.

- Zone 1: Ecologically Intact Areas (No to Trace of Invasives Cover)
- Zone 2: Risk of Conversion Areas (Mild to Moderate Invasives Cover)
- Zone 3: Invasives Dominated (Moderate to Dominated)
Landscape Spatial Strategy for Managing Invasives

- Example of a zoned landscape where different invasive management strategies could be applied based on lower or higher invasive plant levels.

**Green-Yellow**: use proactive strategies for higher rates of success in reducing spread of invasive plants and extent of wildfires.

**Orange-Reddish Brown**: use reactive strategies. Prioritize fire prevention in areas that have high fire frequencies to help reduce spread of invasives.

**PRO-ACTIVE**: Prevention, eradication, suppression, restoration

**REACTIVE**: Prevent fire, fuels reduction, containment, post-fire rehabilitation
## Integrated Invasive Plant Management

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<thead>
<tr>
<th>Mgt Actions in Low to Mod R&amp;R</th>
<th>Land Uses</th>
<th>Wildfire &amp; Vegetation Mgmt</th>
<th>Invasives Plant Mgmt</th>
<th>Grazing</th>
<th>Climate Adaptation</th>
<th>Partnerships</th>
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<tbody>
<tr>
<td><strong>Prevention Zone</strong> (No - Trace)</td>
<td>Increase EDRR, Minimize frequency</td>
<td>Priority fire suppression efforts (pre-planning), Wildfire prevention strategies</td>
<td>High priority for EDRR for edges next to transition</td>
<td>Minimize or alternative strategies focused on native grasses and forbs</td>
<td>Identify new invaders, Scenario planning, Allow native species to move</td>
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<tr>
<td><strong>Intervention Zone</strong> (Mild - Moderate)</td>
<td>Minimize &amp; monitor, Use of EDRR &amp; herbicides</td>
<td>Focus fuel treatments next to prevention zone, Wildfire prevention strategies</td>
<td>Restoration: depends on magnitude &amp; context: herbicides, seedings, transplants</td>
<td>Alternative strategies, e.g. Outcome-based focused on native grasses &amp; forbs, Evaluate risk for operator</td>
<td>Allow native species to move Veg. treatments to maintain or facilitate state transitions,</td>
<td></td>
</tr>
<tr>
<td><strong>Containment Zone</strong> (Invasive Plant Dominated)</td>
<td>Maximize frequency &amp; extent</td>
<td>Focus fuel treatments, Wildfire prevention strategies, Suppression activities</td>
<td>Control along patch edges. Reduce fuels, Experiment control</td>
<td>Grass banks, Extended grazing, Reduce fuels</td>
<td>Veg. treatments to maintain or facilitate state transitions,</td>
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### Risk of Conversion
- **Invasives annual grass conversion**
- **Degraded State**
NRCS: ID’s Cheatgrass Challenge Strategy (Regional)

1. **Core**: Locate and defend relatively intact core from annual grass conversion
2. **Transitions**: Grow core over time
3. **Annual Grass Regions**: Mitigate severe impacts of the cheatgrass-fire cycle on life and property

(https://bit.ly/3cQwpTa)
Continue Collaboration and Promote Cooperative Weed Mgmt Areas (Local)

CWMAs: Local, stakeholder-driven collaborative invasive species mgmt. entities built on local knowledge, delivery & buy-in.

- Identify and eradicate small populations of non-native invasive species
- Post-fire seeding primarily with native species
- Monitor nonnative species’ responses to wildfire and prescribed fire
- Share knowledge about nonnative species and fire in specific ecosystems
- Consider impacts of other disturbances and management activities, in addition to fire, on nonnative species
Integration Between Research and Management

- USGS, forest service RS, and University researchers continue to work with managers and develop a wide variety of tools and systems
  - Effective management practices,
  - Strategic fuel reduction, restoration and post-fire rehabilitation
  - New fuel models for nonnative annual grasses

- Study the control of annual invasive grasses through the combined use of herbicides, soil bacteria, native seedings, and targeted grazing.

- Answer questions on the capacity of native plant communities to be resistant to invasions under a variety of environmental and management factors.
Wildfire and Invasives Management is very broad and complex. However, there is a strong need and many opportunities to focus on reduction of invasive plant species in management strategies in order to reduce fire where it is burning uncharacteristically.