

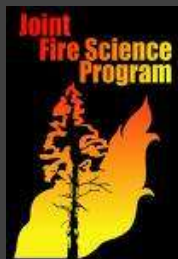
# Post-wildfire Seeding in Forests of the West: Effectiveness and Trends Over Time

Donna L. Peppin<sup>1,2</sup>, Peter Z. Fulè<sup>1,2</sup>, Jan L. Beyers<sup>3</sup>,  
Carolyn Hull Sieg<sup>4</sup>, Molly E. Hunter<sup>1</sup>

<sup>1,2</sup> Northern Arizona University, School of Forestry and Ecological Restoration Institute, Flagstaff, AZ

<sup>3</sup> USDA Forest Service, Pacific Southwest Research Station, Forest Fire Laboratory, Riverside, CA

<sup>4</sup> USDA Forest Service, Rocky Mountain Research Station, Flagstaff laboratory, Flagstaff, AZ



# Background

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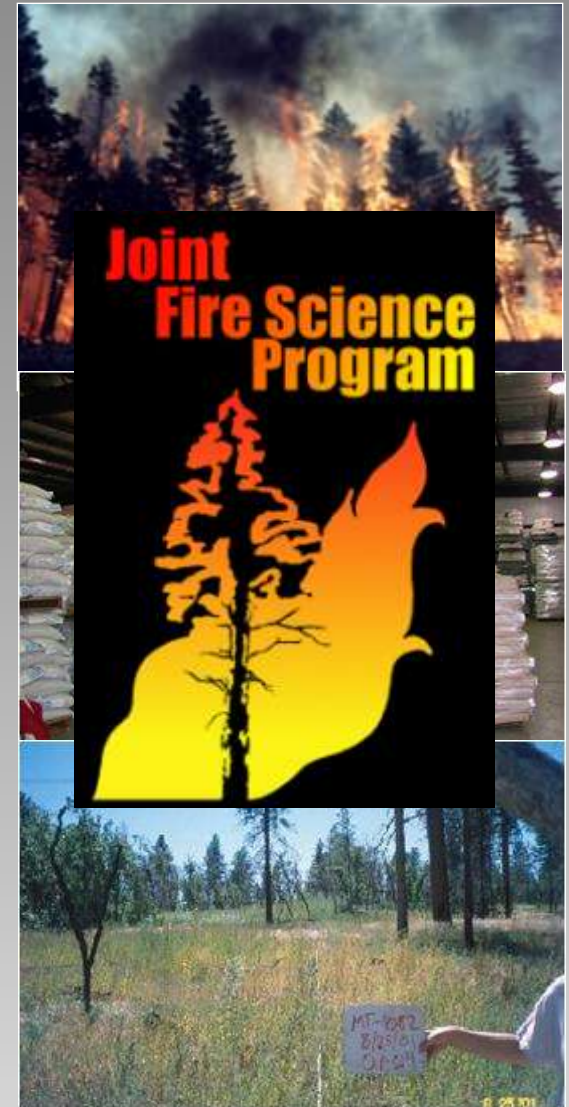
- Recent research shows:
  - Treatments often do not result in high vegetative cover
  - Negative impacts of seeding treatments on native plant communities by:
    - Suppressing native species' recovery
    - Persisting over time
    - Introducing non-natives
    - Changing fine fuels



# Background

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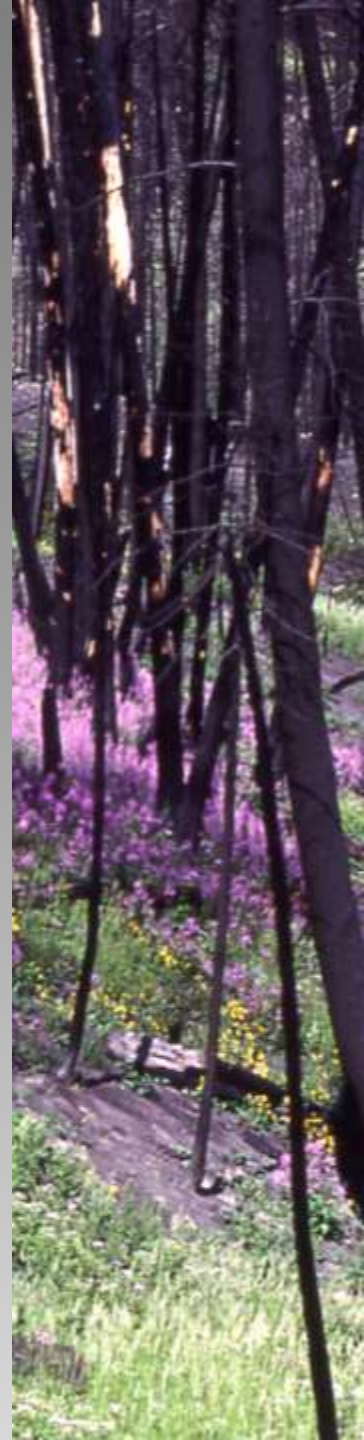
- Increased
  - Size and severity of wildfires
  - Allocation of funds for seeding
  - Use of native species
  - Research on the effects of seeding
- Need for re-assessment of post-fire seeding
  - Collaborative review
  - Joint Fire Science Program funding



# Review Topics

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- 1) Evidenced-Based Systematic Review
- 2) Analysis of USDA Forest Service Burned Area Reports





# Evidence-Based Systematic Review

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- Does seeding after severe forest fires reduce soil erosion?
- Is seeding effective at reducing non-native plant invasion into burned areas?
- Does post-fire seeding affect native plant community recovery?

# Systematic Review Methods

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- Evidence-based review approach
  - Follows a rigorous, predetermined protocol
  - Protocols submitted to the Centre for Evidence-Based Conservation



**CENTRE FOR EVIDENCE-BASED CONSERVATION**

# Systematic Review Methods

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- Search Strategy
  - 1) scientific journals
  - 2) “gray” literature
  - 3) unpublished theses
  - 4) management documents

# Systematic Review Methods

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- Search Strategy
- Inclusion Criteria
  - 1) Seeding in forested ecosystems
  - 2) 1970-Present
  - 3) Seeding after wildfires or prescribed burning
  - 4) Seeding alone or in combination with other rehab activities
  - 5) Seed applied aerially or ground-based
  - 6) Showed changes in plant community or soil stabilization variables
- Data Extraction

# Systematic Review Methods

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- Data Analysis
  - Quality of evidence criteria
    - **Highest** – replicated, controlled, statistically robust
    - **High** - unreplicated , controlled, observational (multiple sites), quantitative
    - **Medium** – unreplicated, controlled, observational (single location), quantitative
    - **Low** – unreplicated, uncontrolled, quantitative
    - **Lowest** – unreplicated, uncontrolled, qualitative

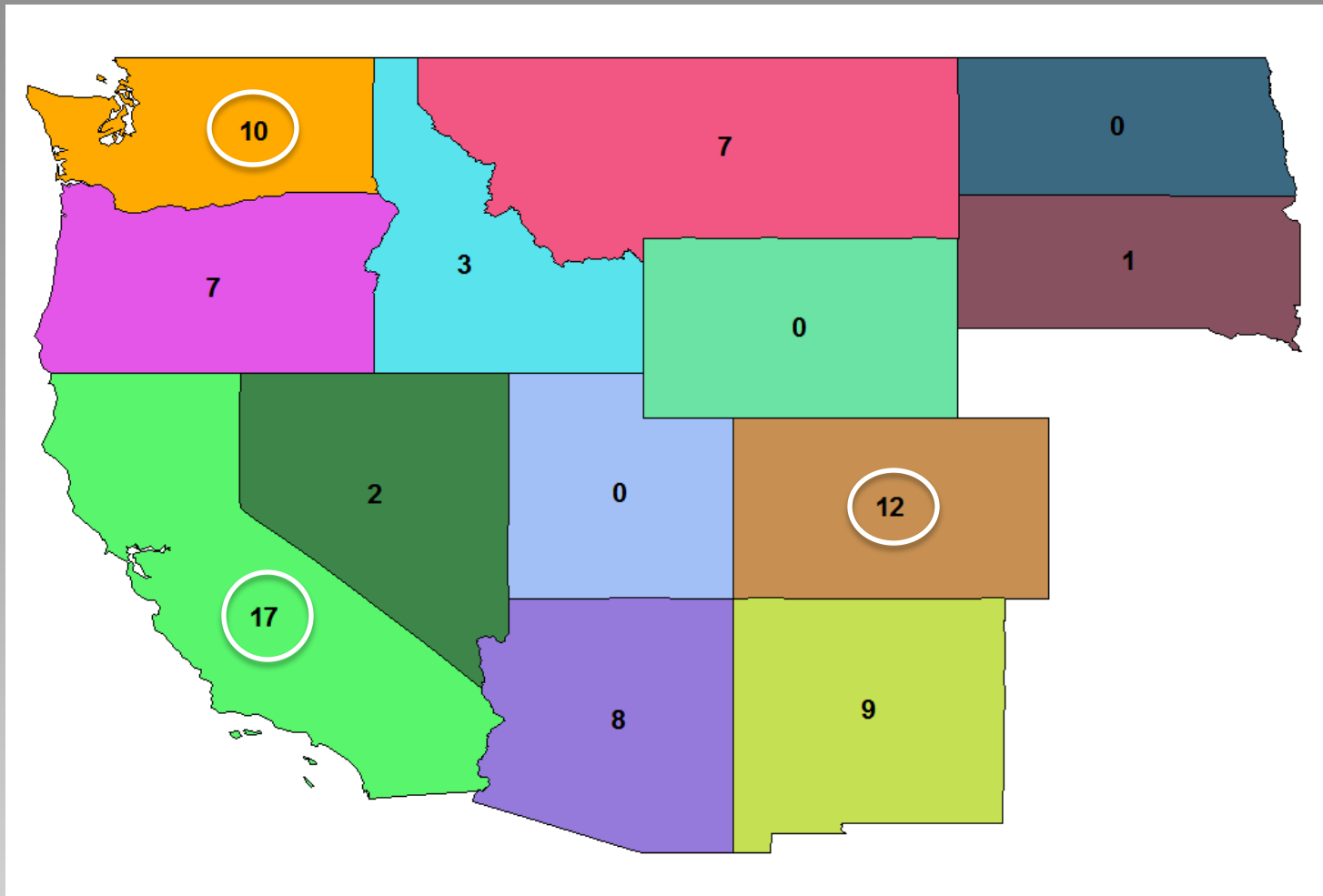
# Systematic Review Methods

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- Data Analysis
  - Effectiveness Ratings
    - **Effective** – statistically or quantitatively effective in mitigating negative effects on each review topic
    - **Minimal Effectiveness** – effective in mitigating some but not all negative effects on each review topic
    - **No difference in effectiveness** – seeded vs. unseeded treatments not statistically different in effectiveness
    - **Ineffective** – quantitatively or qualitatively ineffective in mitigating any negative effects on each review topic

# Systematic Review Results

- 94 papers reviewed



- Note: 20 review papers for entire western USA

# Systematic Review

## Results & Discussion

- **Result 1 - Soil Erosion:** based on 27 studies

	Number	% Effective	% Minimally Effective	% Ineffective	% No Difference
Effectiveness Ratings	27	33	26	26	15
Quality of Evidence *	12	8	16	58	16

\* Only based on papers of highest and high quality evidence

- Of highest and high quality papers, 92% (11/12) were published since 2000, none of which showed an effective result
- Before 2000
  - only 9% (1/11) of papers had highest or high quality evidence
  - All papers, 72% showed seeding to be effective

# Systematic Review Results & Discussion

## • Result 2 - Soil Erosion:

Sites Showing Cover Measure- ments	Those Showing Seeding Significantly Increased Cover	% of Sites Showing > 30% Cover (No. of Sites)		% of Sites Showing >60% Cover (No. of Sites)		Sites Showing Erosion Measure- ments	Those Showing Seeding Significantly Reduced Erosion
		Seeded	Unseeded	Seeded	Unseeded		
----- No. -----		----- Percent -----				----- No. -----	
<b>Post-fire Year One</b>							
<b>Total</b> <b>29</b>	12	55	31	<b>14</b>	0	<b>Total</b> 12	<b>0</b>
<b>Post-fire Year Two</b>							
<b>Total</b> <b>18</b>	7	83	50	<b>28</b>	6	<b>Total</b> 10	<b>1</b>

**Minimal support for > 60% cover threshold**

# Systematic Review Results & Discussion

- **Non-Native Species** (based on 11 papers)

	Number	% Effective	% Ineffective
Effectiveness Ratings	11	56	45
Quality of Evidence *	8	50	50

\* Only based on papers of highest and high quality evidence

- 83% of effective treatments incorporated annual non-native species
- 80% of ineffective treatments (5 papers) seeded non-native species
  - 60% seeded non-persistent species which persisted beyond the 1<sup>st</sup> year post-fire
  - 40% of seed mixes contaminated with undesirable species

# Systematic Review Results & Discussion

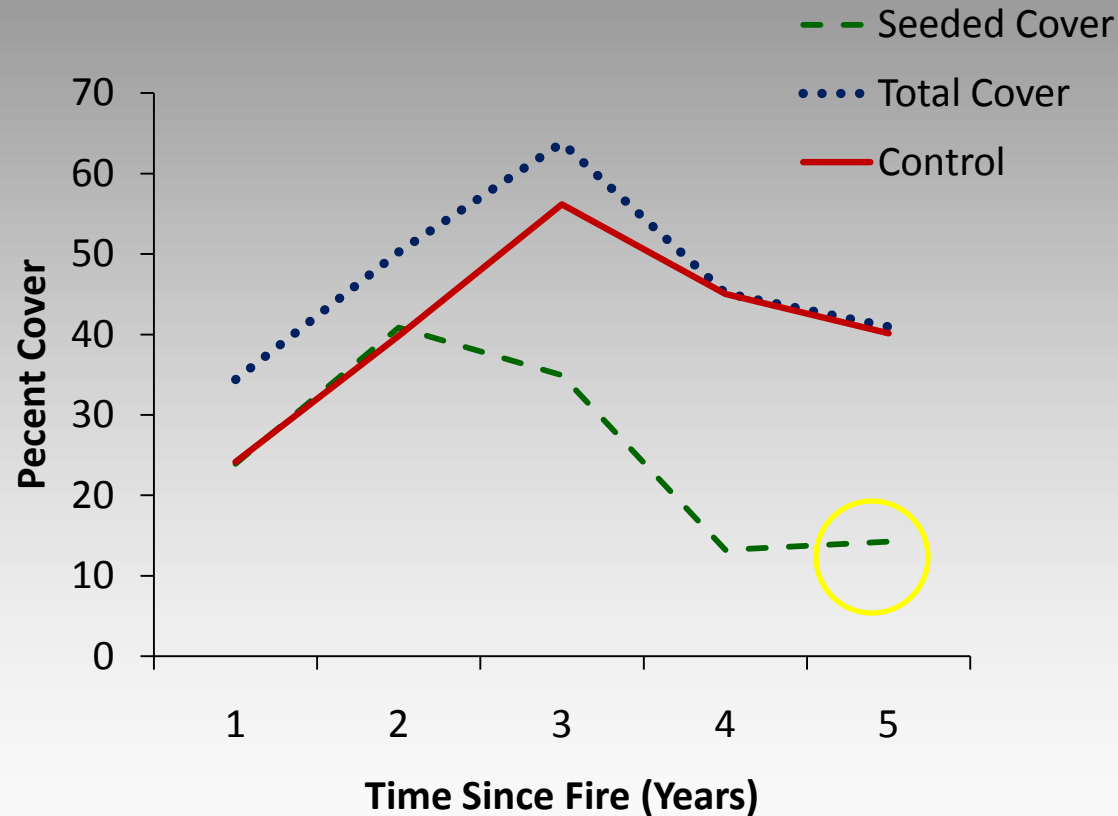
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- Why use annual non-native species?
- What about using native species?

# Systematic Review Results & Discussion



## Result 1 – Plant Cover (based on 57 study sites)

- **Trend 1:** Seeded sites support essentially no more total plant cover than control sites – by the 5<sup>th</sup> year post-fire
- **Trend 2:** Seeded cover increases in the first 2 years then declines to 10% in year 5

# Systematic Review Results & Discussion

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- **Result 2: Native Richness** (9 papers)
  - 78% found reduced native species richness
  - 56% found seeded species dominance coincident with reduced native species richness
- **Result 3: Woody Plant Establishment** (14 papers)
  - 79% found reduced establishment
  - Highest and High quality (4 papers) – 50% negatively affect tree seedlings and/or shrubs



# Systematic Review Conclusions

- **Soil Erosion:**

- Seeding is mildly effective in increasing plant cover, but shows no significant improvement in reducing erosion compared to unseeded treatments

***Recommendation:*** Use of alternative treatments (e.g. mulching) or no action



# Systematic Review Conclusions

- **Non-Native Species:**

- Seeding is only effective about 50% of the time
- Of those, the majority seeded with non-natives thus introducing additional negative impacts on native plant communities

***Recommendation:*** Early detection and rapid response methods



Cheatgrass (*Bromus tectorum*)

ipm.montana.edu



Diffuse knapweed (*Centaurea diffusa*)

forestandrange.org



Dalmatian toadflax (*Linaria dalmatica*)

ag.ndsu.edu

# Systematic Review Conclusions

- **Plant Communities:**

- Seeding increases plant cover in first several years post-fire, but long-term recovery is equal to that of unseeded sites
- Seeded species decline rapidly but have the ability to persist
- Rapid establishment of seeded non-natives often leads to suppression of native species and ineffective recovery

***Recommendation:*** Longer-term monitoring (greater than 5 years) needed to assess lasting impacts of seeded species





# Trends in Post-fire Seeding

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- 1) What are trends in seeding of specific species, especially the use of native species, over time?
- 2) How have other post-fire seeding trends, particularly those related to costs and area seeded, changed over time?

# Trends in Post-fire Seeding: Methods

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- **Literature Review**

- Reviewed a subset of systematic review papers containing information regarding trends in seeding
  - Area and amounts seeded
  - Seed sources and species selected
  - Total cost of seeding
  - Cost per hectare seeded

- **USFS Burned Area Reports**

- Obtained database containing summaries of 1164 USDA Burned Area Reports (2500-8 forms) – Pete R. Robichaud
- Forms included data from 1966-2007 for projects within the western U.S.
- Missing data in Regions 2, 4, 5, & 6, especially in 1970s and 1980s

# Trends in Post-fire Seeding: Methods

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- **Inclusion and Exclusion Criteria**
  - Seeding in forested ecosystems
  - Operationally seeded, with or without additional treatments
  - Excluded experimental seeding treatments in the context of research studies rather than landscape-scale treatments
  - Only species seeded on at least three fires
- Nativity was specified according to the USDA Natural Resource Conservation Service Plants Database ([plants.usda.gov/](http://plants.usda.gov/))
- All BAER spending adjusted to 2009 dollars

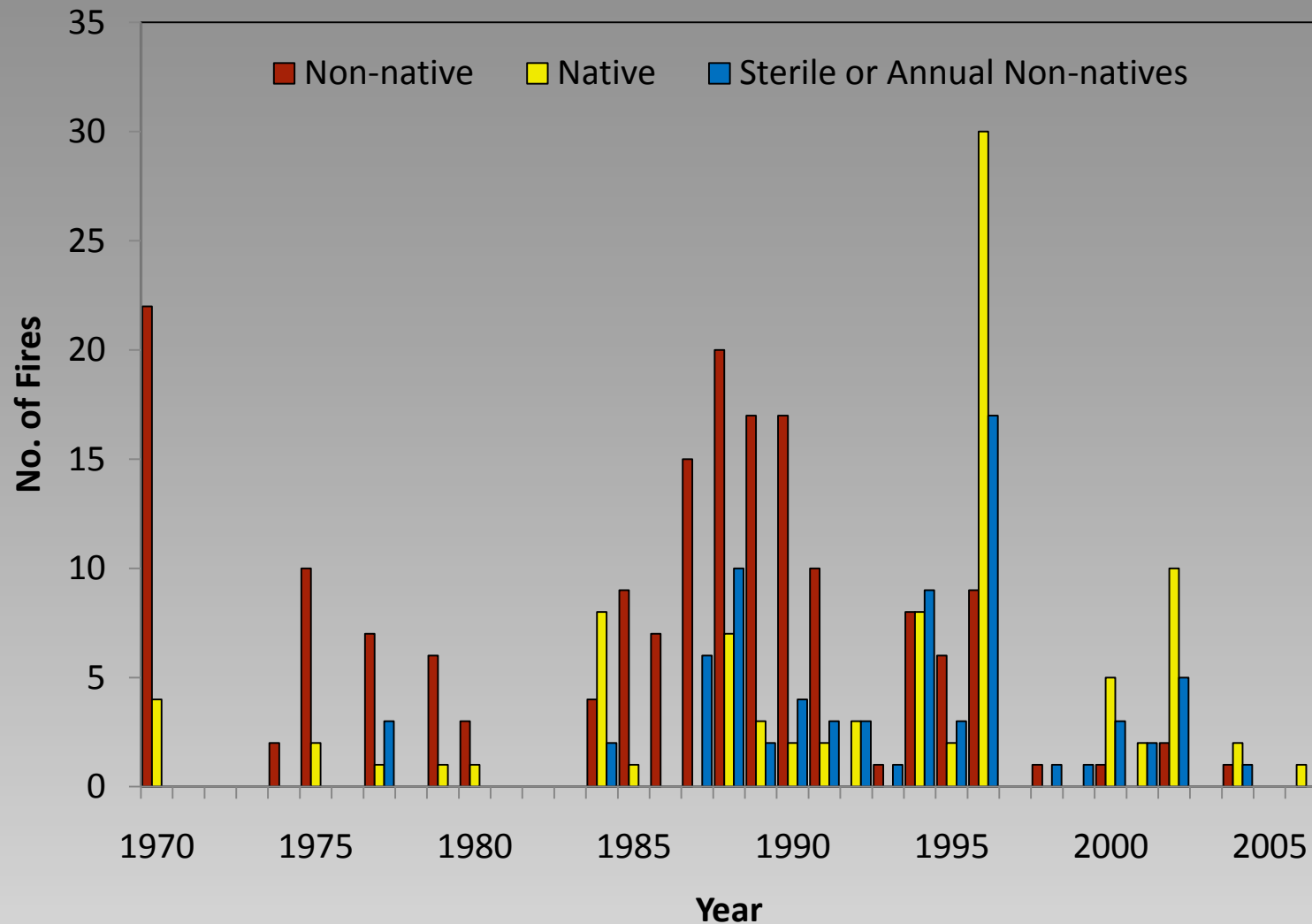
# Trends in Post-fire Seeding: Results and Discussion

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*What are trends in seeding of specific species, especially the use of native species, over time?*

- 40 reviewed papers
- 67 USFS Burned Area Reports
- 122 fires from 1970-2006

- Major shift to mixes containing native and non-native annual or cereal grains/sterile hybrids, with native dominate



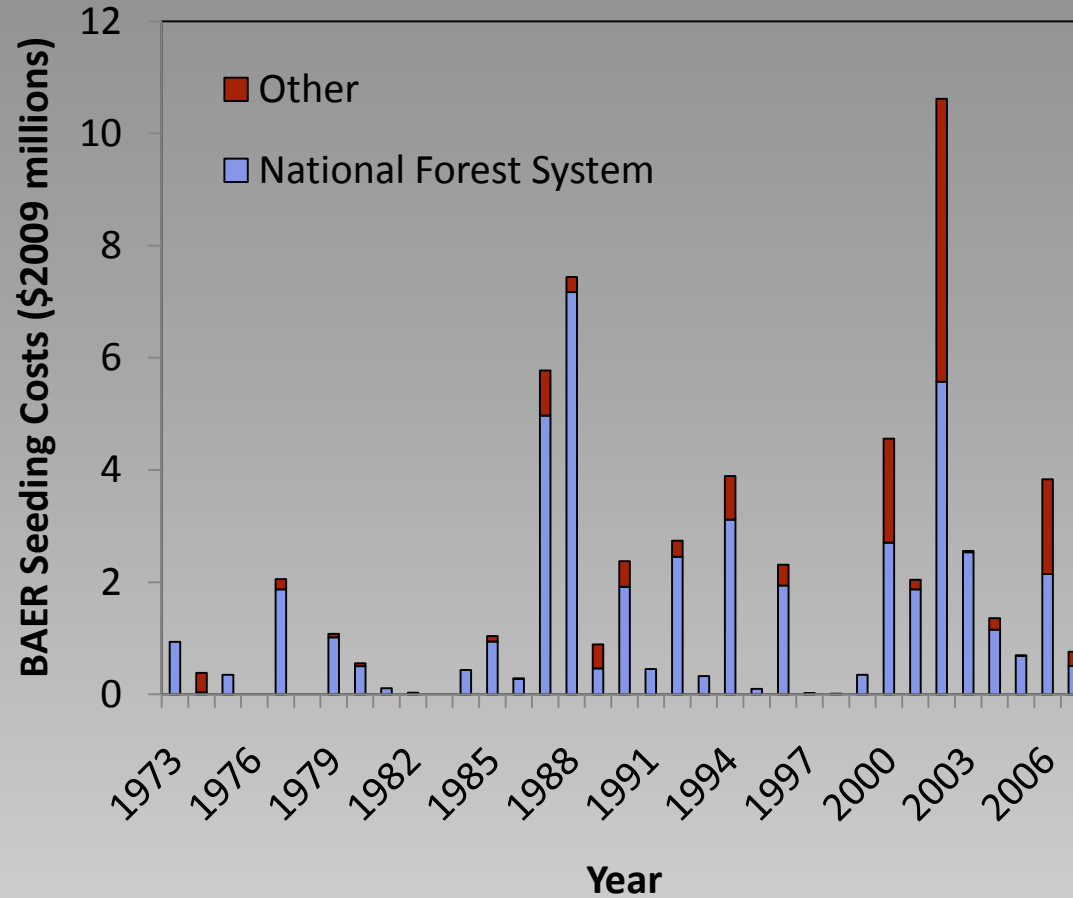
# Trends in Post-fire Seeding: Results and Discussion

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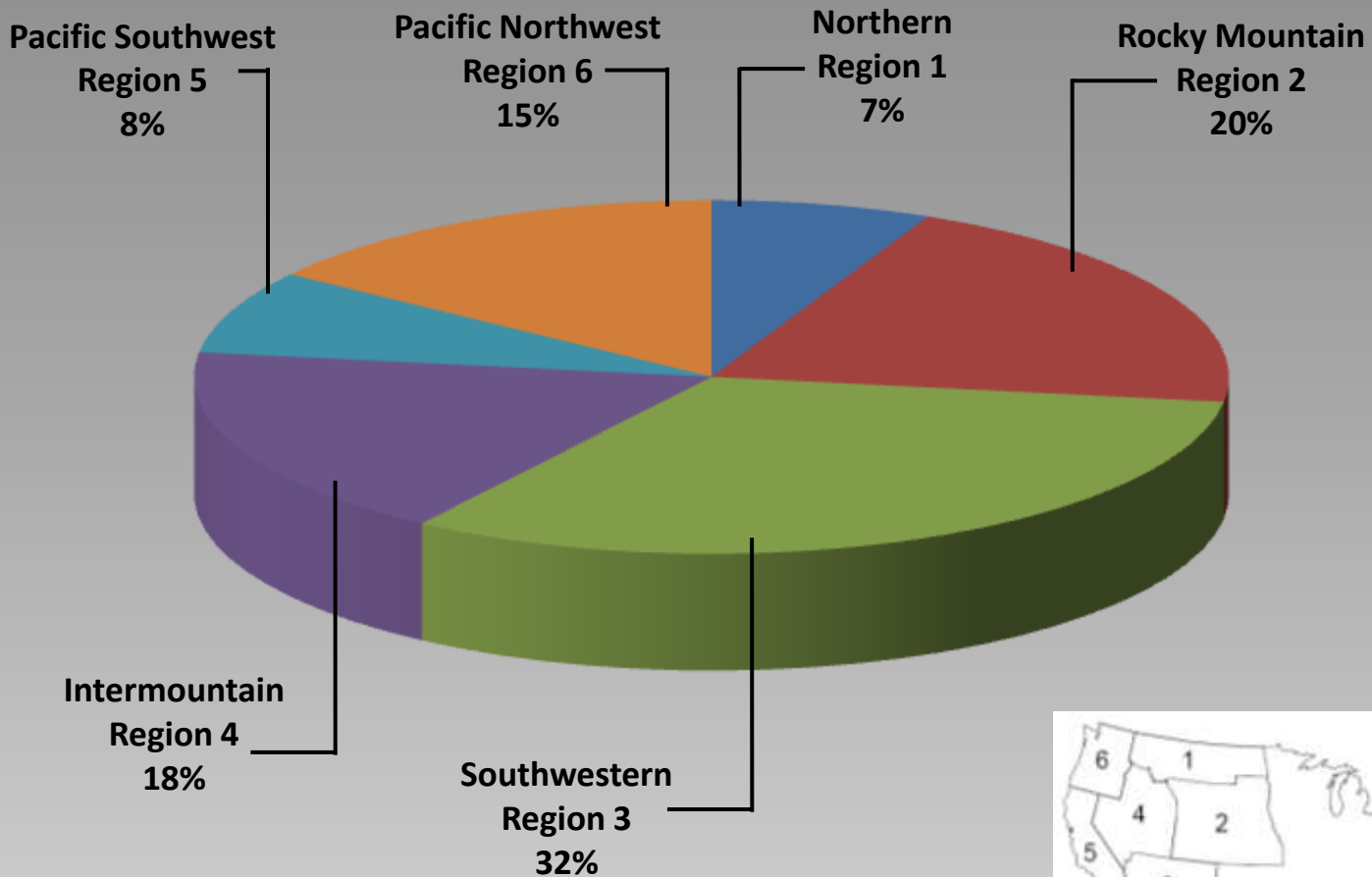
*How have other post-fire seeding trends, particularly those related to costs and area seeded changed over time?*

- 380 USFS Burned Area Reports
- 1973-2007

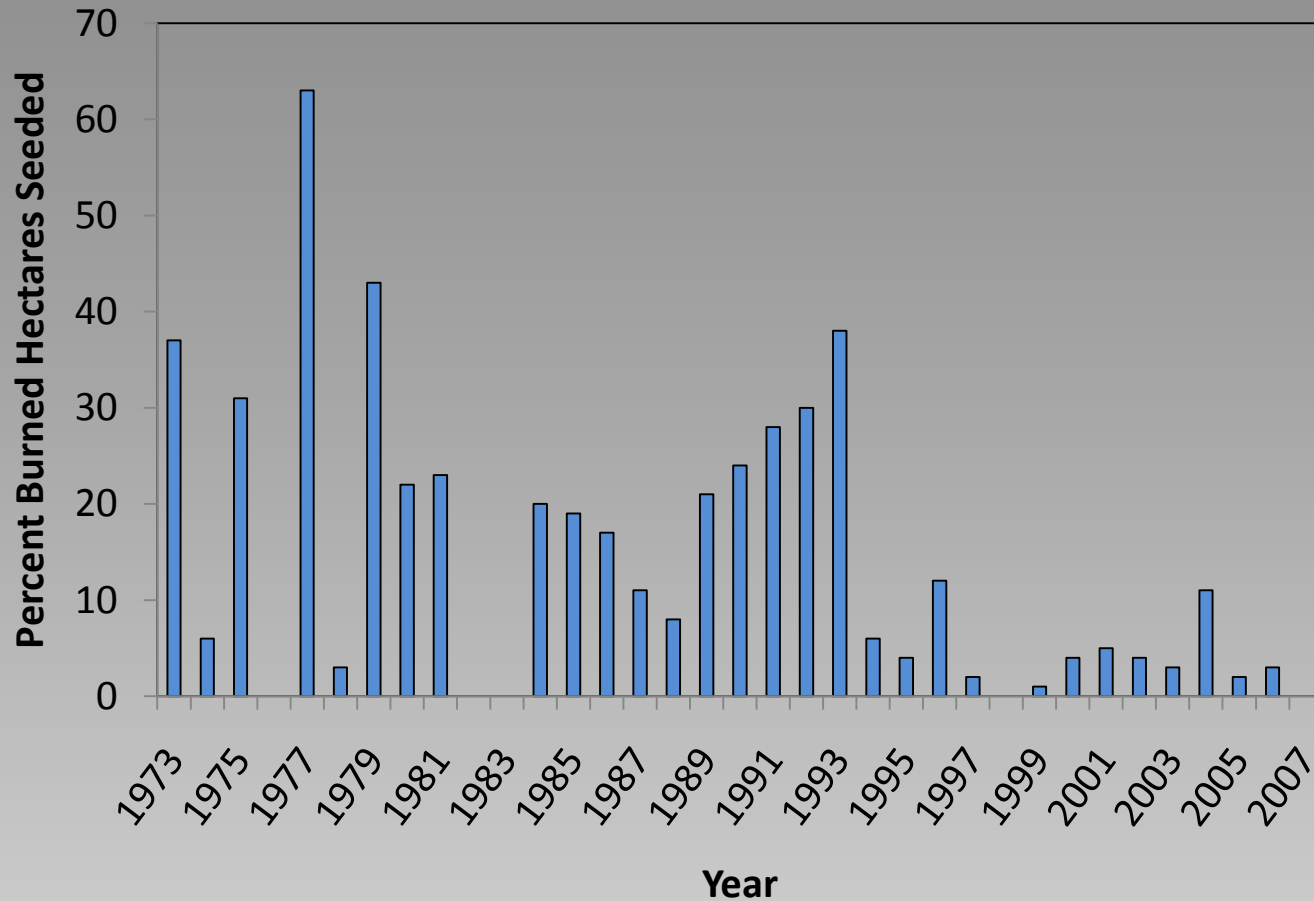
- Substantial increase in total BAER seeding expenditures



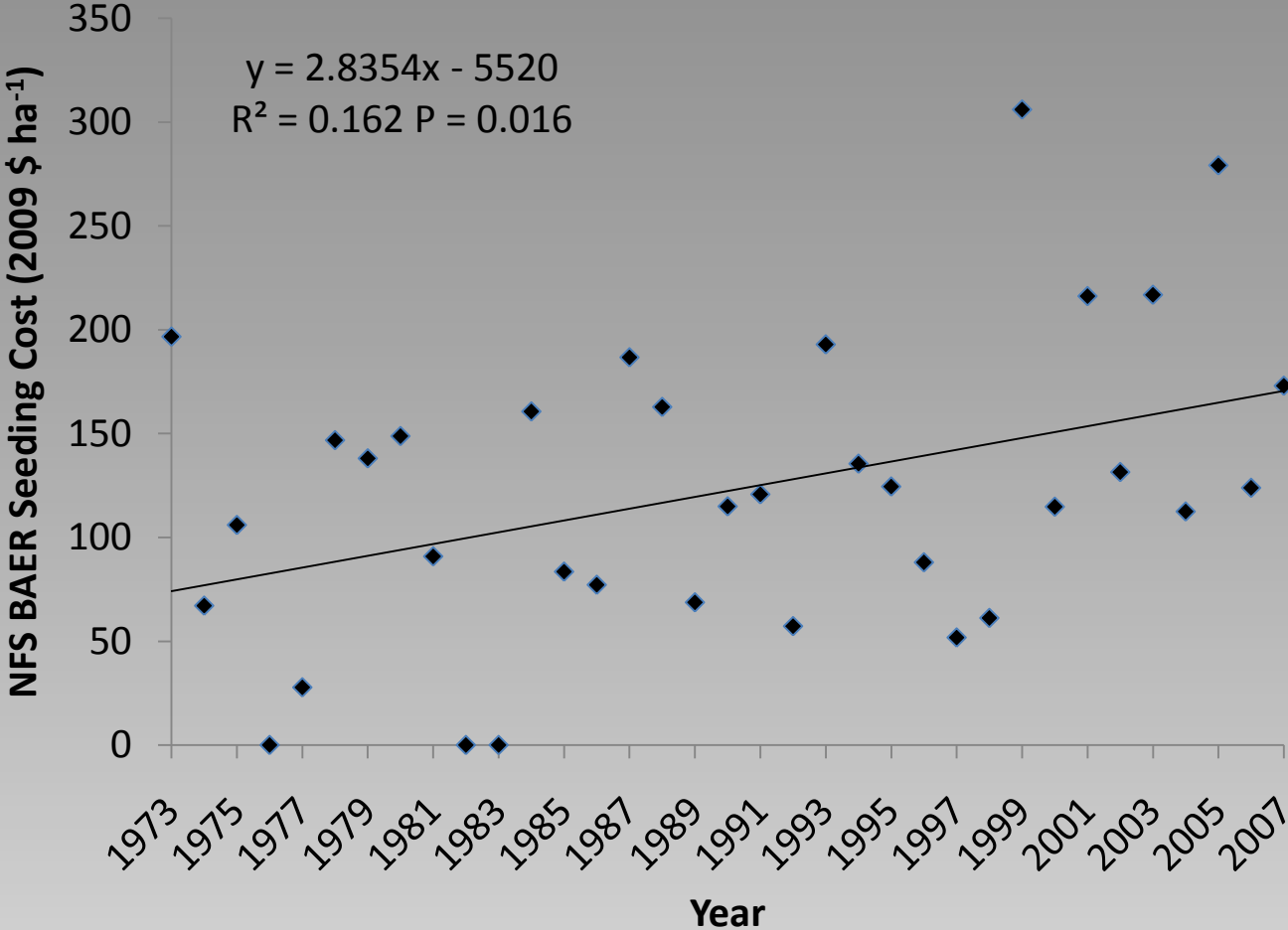
- Region 3 spent the majority on seeding between 2000 and 2007



- Percentage total burned area seeded has decreased



- Cost per hectare seeded has increased over time



# Trends in Post-fire Seeding: Conclusions and Implications

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- Trend of increasing use of native species and annual cereal grains/hybrids, with native species dominating seed mixes in recent years.
- Total Forest Service BAER seeding expenditures have increased substantially in the last decade
- Smaller proportions of burned areas have been seeded annually at higher cost per seeded hectare, likely due to increased use of additional treatments and costlier native species
- Potential negatives effects due to use of non-local genotypes and cereal grain/sterile-grass hybrids

# Future Research Needs

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- The long-term effects and effectiveness of post-fire seeding merit further study.
- More quantifiable research from well-design experiments and rigorous long-term monitoring are needed to address such issues.
- Priority should be given to research quantifying the effects of using native species, specifically those from distant sources, and cereal grains or cereal-grass hybrids on burned landscapes.
- What about use of native annuals?
- Land managers should weigh the cost/benefit of these treatments and consider using alternative rehabilitation methods shown to be more effective (e.g., mulching).

**Questions ?**

