A firefighter in a red helmet and jacket is seen from behind, looking towards a large wildfire in a forest. The fire is intense, with bright orange and yellow flames rising from the ground and trees. The scene is filled with smoke and the glow of the fire. Another firefighter is visible in the distance, also facing the fire.

Answering burning questions – using soil science to capture the benefits of forest fires without the danger of catastrophic wildfires

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Outline of Briefing

- The wildfire problem – the “new normal”
- Ecological role of fire in western forests
- Fire effects on soil and their ecosystem services
- One example of a success story of federally funded research on the impacts of fire and fire surrogates on soils
- The need for long-term fire-soil research

The wildfire problem – California burning



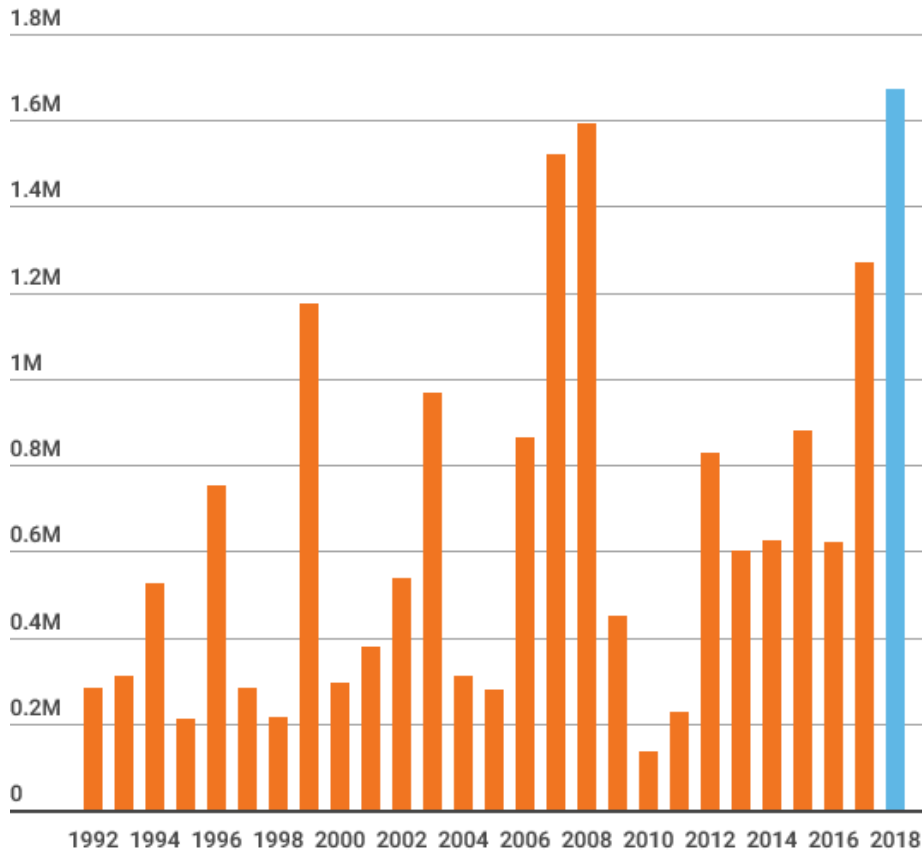
November 8, 2018



November 9, 2018

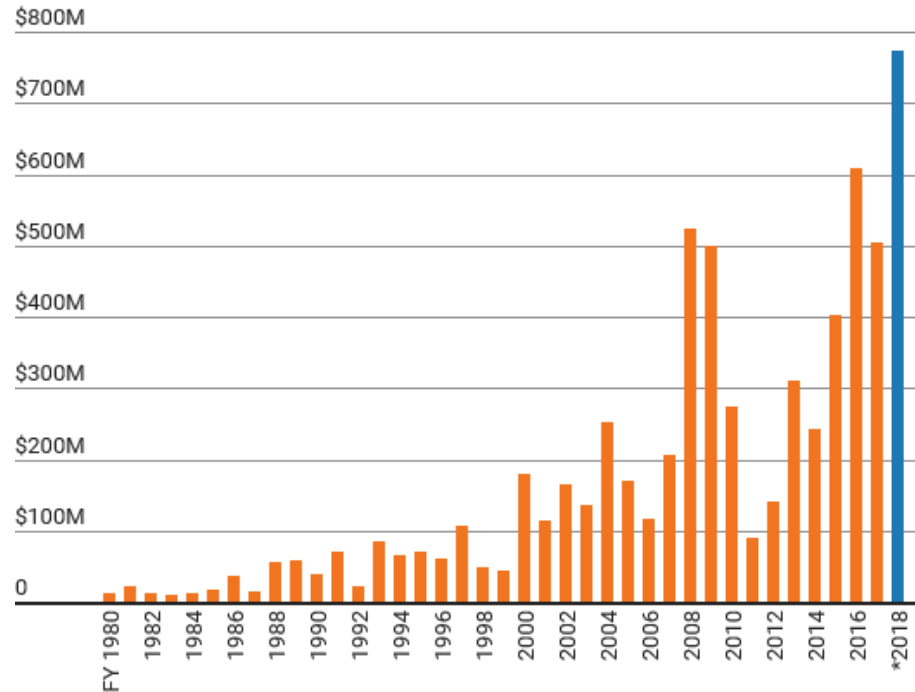
More area is burning with increasing suppression costs

Acres burned in California each year



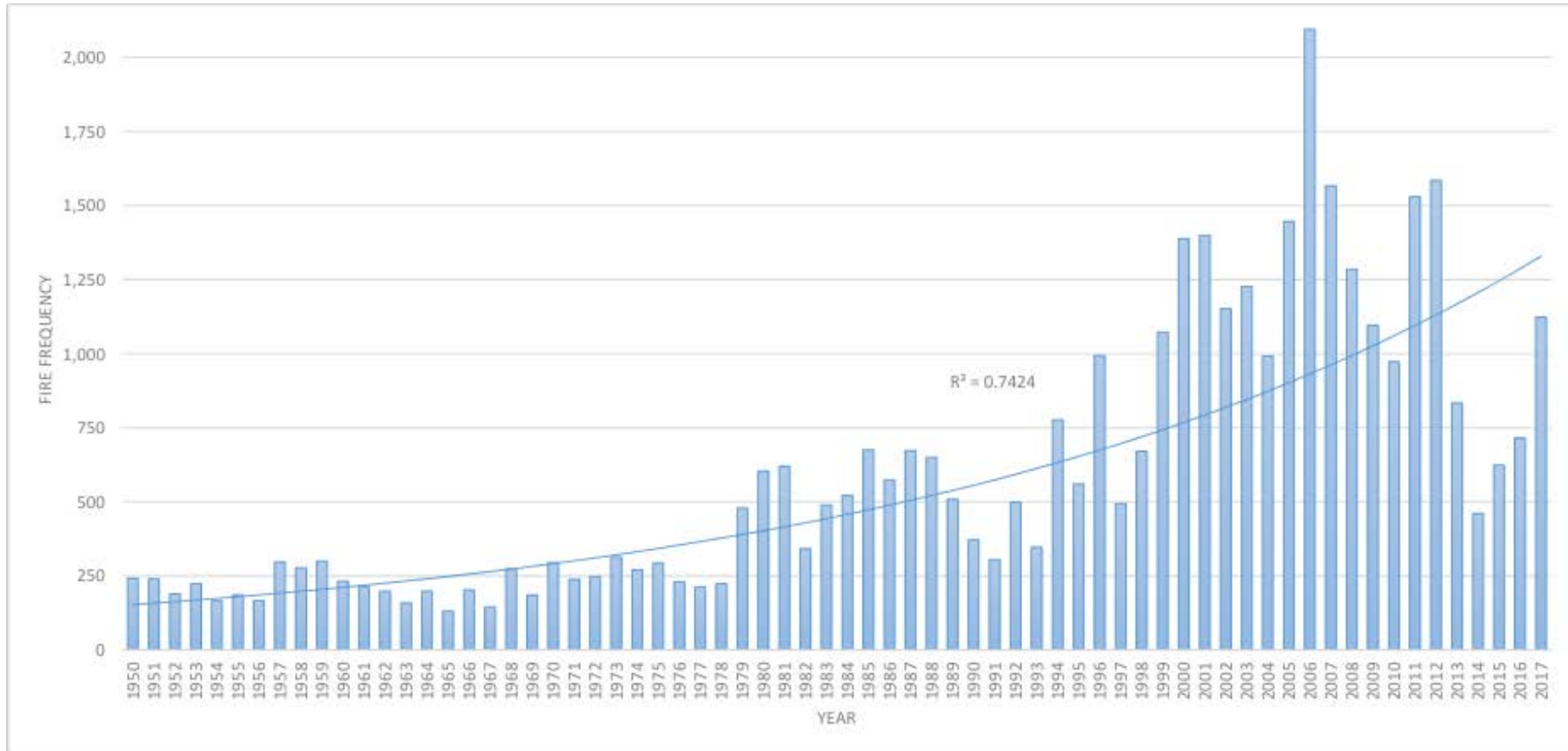
Source: Cal Fire

Soaring cost of wildfires



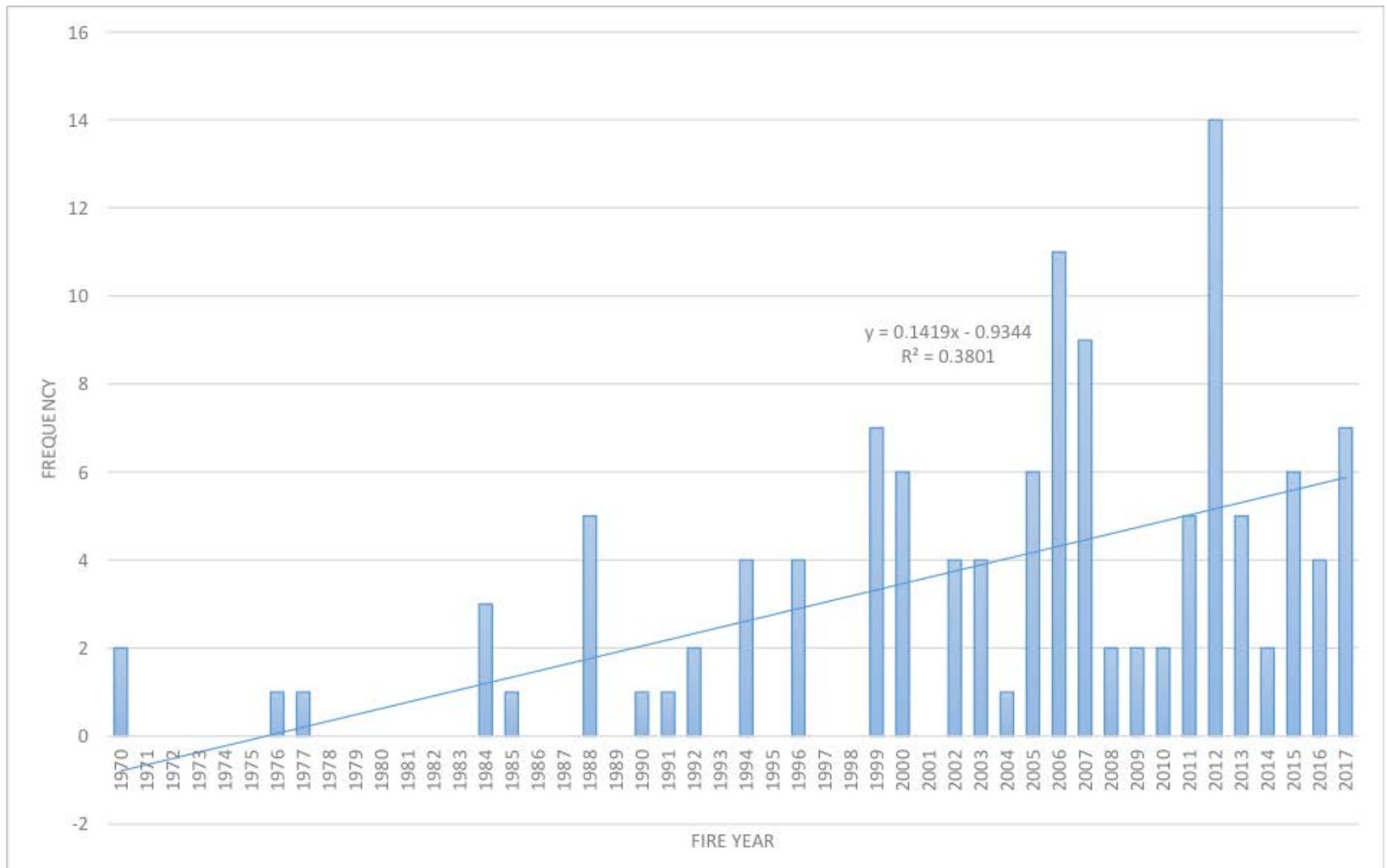
*Estimated spending July 2017-October 2018. All years fiscal years. Source: Cal Fire

Across the entire western U.S., fire frequency is increasing...



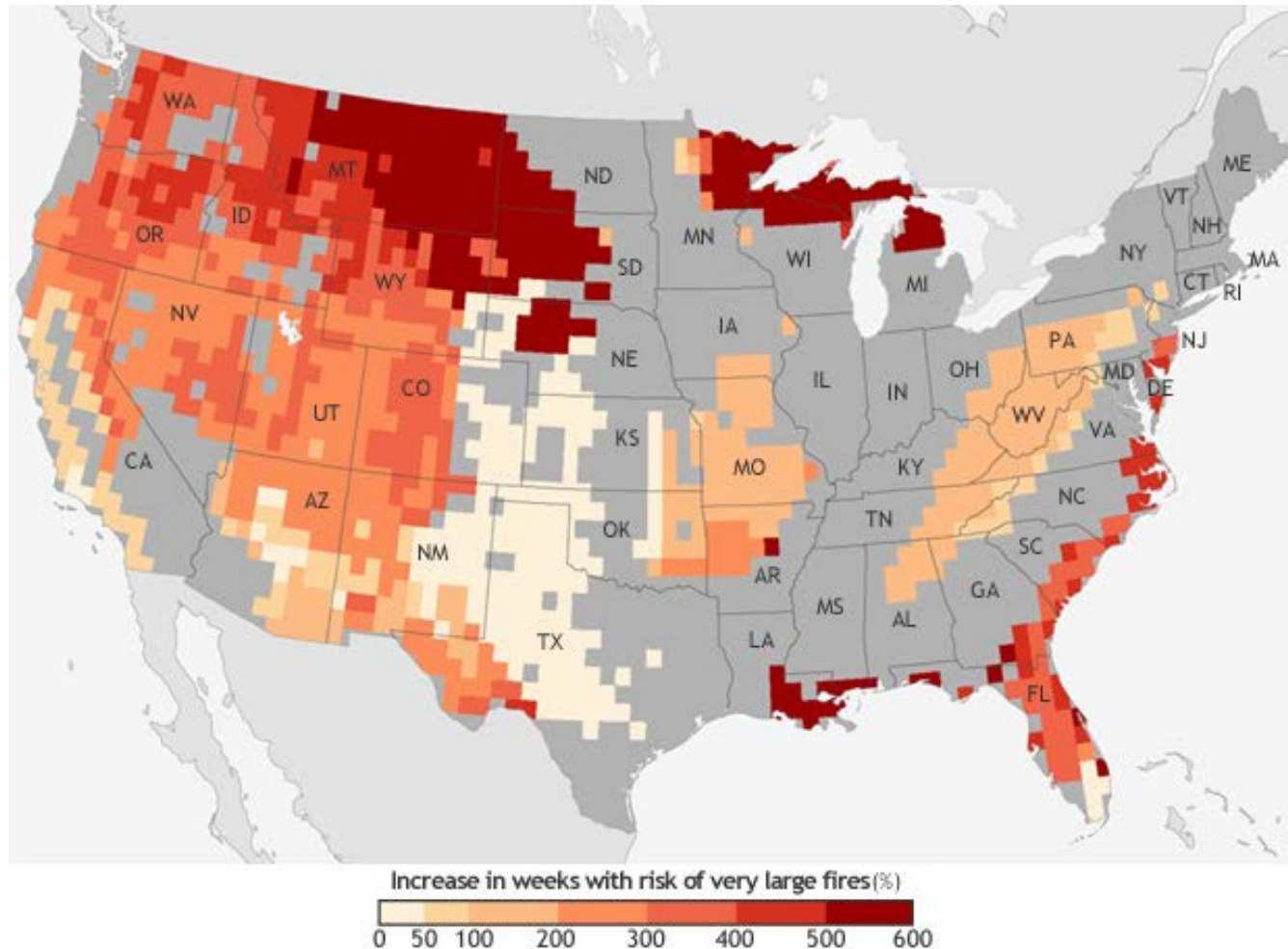
Source: NASA RECOVER/Keith Weber

And those fires are larger...



Source: NASA RECOVER/Keith Weber

Wildfires are going to have a big impact on our future...



Source: NOAA Climate.gov map, based on data from Barbera et al, 2015.

Ecological role of fire in western forests

- Before Euro-American settlement, coniferous forests of the Inland West burned on average once every few decades and were characterized by low-severity surface fires
- Overgrazing by livestock and active fire suppression drastically reduced the occurrence of fire

Fire plays an important role in many forests of western North America

Potential Climax Vegetation	Presettlement Fire Frequency (y)
Piñon pine and/or juniper	7 – 90
Ponderosa pine	2 – 38
Douglas-fir	20 – 60
Mixed conifer	6 – 150
Cedar-hemlock	60 - >400
Lodgepole pine	25 – 500
Subalpine-fir and/or spruce	50- 350

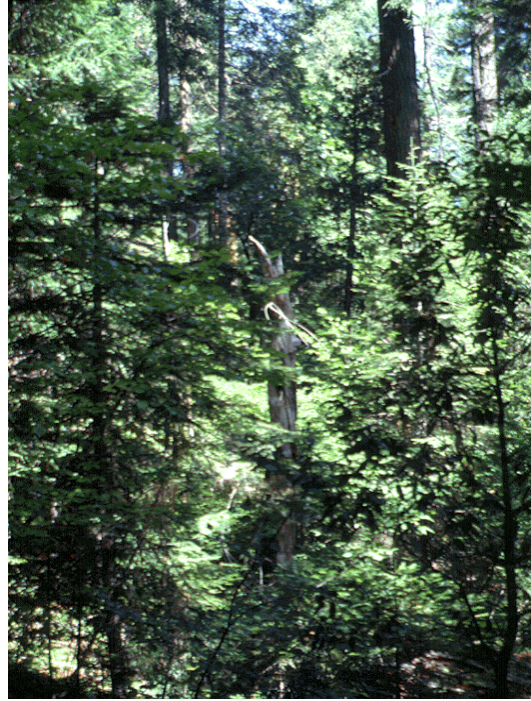
Gus Pearson Natural Area 1909



Gus Pearson Natural Area 1970s



The wildfire problem – the “new normal”



Resulting in:

- Current western forests have higher stand densities, with many more small trees and fewer large trees, and much greater quantities of fuels
- Deterioration of ecosystem integrity
- Increased probability of large, severe wildfires

The wildfire problem – the “new normal”

- Almost all western montane conifer forests have evolved with fire
- The size and severities of western U.S. wildfires are increasing
- Past land management and climate change are the causes for increased catastrophic wildfire threat
- Loss of soil and soil fertility are potentially the greatest long-term impacts on ecosystem services

Fire effects on soil and their ecosystem services

- Fire intensity governs fire effects
 - Low-severity fires increase soil fertility by releasing plant available nutrients
 - High-severity fires can result in excessive nutrient loss via combustion and enhanced soil erosion
- Fire also indirectly affects soils by managing vegetation, increasing soil temperature and water content post-fire, and affecting soil organisms

Soil Ecosystem Services

- An ecosystem service is a benefit to society derived from a healthy ecosystem property or process

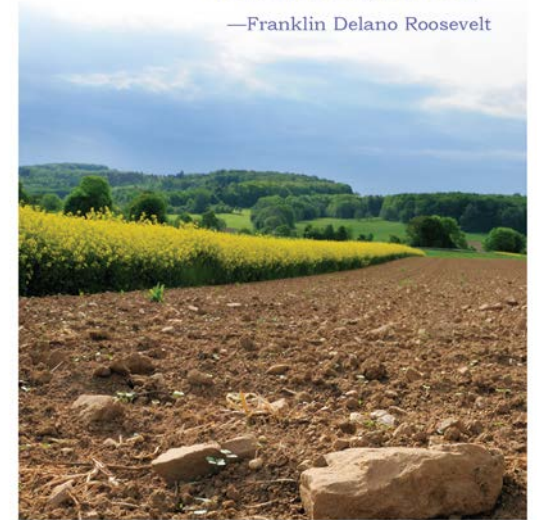


Economic Benefits of Soil Ecosystem Services

- Soil is priceless, yet calculated values of some ecosystem services are >\$17 trillion per year
- Biological nitrogen fixation by soil microorganisms contributes ~\$50 billion per year alone!

“The nation that destroys its soil, destroys itself.”

—Franklin Delano Roosevelt



Soil is THE fundamental resource and is non-renewable

- Robust soil quality leads to more water available for plant roots and cleaner water in streams and lakes
- Enhanced soil biological activity turns organic wastes into valuable nutrients and degrades toxic elements
- Carbon stored in soil regulates the climate by mitigating greenhouse gas emissions



Need for long-term research



JOINT FIRE SCIENCE PROGRAM

The JFSP provides funding and science delivery for scientific studies associated with managing wildland fire, fuels, and fire-impacted ecosystems to respond to emerging needs of managers, practitioners, and policymakers from local to national levels.

Research Supporting Sound Decisions

The Joint Fire Science Program (JFSP) provides leadership to the fire science community by identifying high-priority fire science research needs that will enhance the decision-making ability of fire and fuels managers, natural resource managers, and others to meet their management objectives. The program also meets the decision needs of those involved in developing and implementing fire-related policy.

The program's breadth of stakeholders has broadened over the years commensurate with its science mandate; however, the JFSP remains focused on actionable science and tangible outcomes that meet the needs of end users.

JFSP Values

The needs of managers and policymakers guide and frame research questions.

The JFSP emphasizes open solicitation and fair competition.

All research proposals receive an independent peer review to ensure scientific merit, applicability of outcomes, and feasibility of execution.

We share, synthesize, interpret, and demonstrate/validate results to maximize science adoption.

We perform regular self and external evaluations of program activities.

Opening Pathways to Active Science Delivery

The Fire Science Exchange Network involves active knowledge exchange. The objective is to foster a dialogue in which scientists and managers help frame questions and research needs to address during both planning and execution of research.

The exchange network uses various venues that are convenient for the applicable timeframe, circumstance, or context of the issue. The exchanges interact and communicate through the following methods:

- Field trips and tours
- Demonstration sites
- Workshops and conferences
- Networks of experts
- Webinars and training
- Research syntheses and briefs
- E-newsletters, websites, social media
- Regionally focused databases

Fifteen regional exchanges form the JFSP's Fire Science Exchange Network. The network is a national collaboration that provides the most relevant, current wildland fire science information to stakeholders. The exchanges bring together fire managers, practitioners, and scientists to address common needs and challenges.



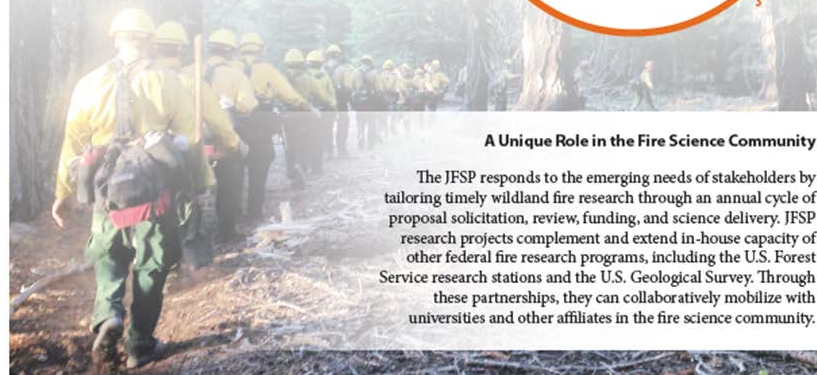
Partnering to Leverage Capacity and Educate the Next Generation

More than 150 colleges and universities have collaborated on and partnered with JFSP-sponsored research projects. For example, each year, the JFSP offers Graduate Research Innovation (GRIN) awards to masters and doctoral students conducting research in fire science. This helps shape the next generation of resource managers and scientists.

The JFSP's collaboration also extends to private and nonprofit organizations, federal agencies, and tribal, state, county, and local governments. In all, nearly 300 organizations have become partners in JFSP-sponsored research.

“What sets JFSP apart from other fire research funding entities is its emphasis on use-inspired science...The role that JFSP plays in the fire science arena is much larger than its direct funding.”

JFSP Program Review 2017



A Unique Role in the Fire Science Community

The JFSP responds to the emerging needs of stakeholders by tailoring timely wildland fire research through an annual cycle of proposal solicitation, review, funding, and science delivery. JFSP research projects complement and extend in-house capacity of other federal fire research programs, including the U.S. Forest Service research stations and the U.S. Geological Survey. Through these partnerships, they can collaboratively mobilize with universities and other affiliates in the fire science community.



JFSP Governance

The JFSP, through its Governing Board, is chartered by the Fire Executive Council (FEC). The JFSP is jointly funded by the Department of the Interior and the U.S. Forest Service. It is governed by 12 members who represent the above agencies.

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FIRESCIENCE.GOV
Research Supporting Sound Decisions

Fire-Fire Surrogate Study



United States
Department of
Agriculture

Forest Service

Pacific Northwest
Research Station

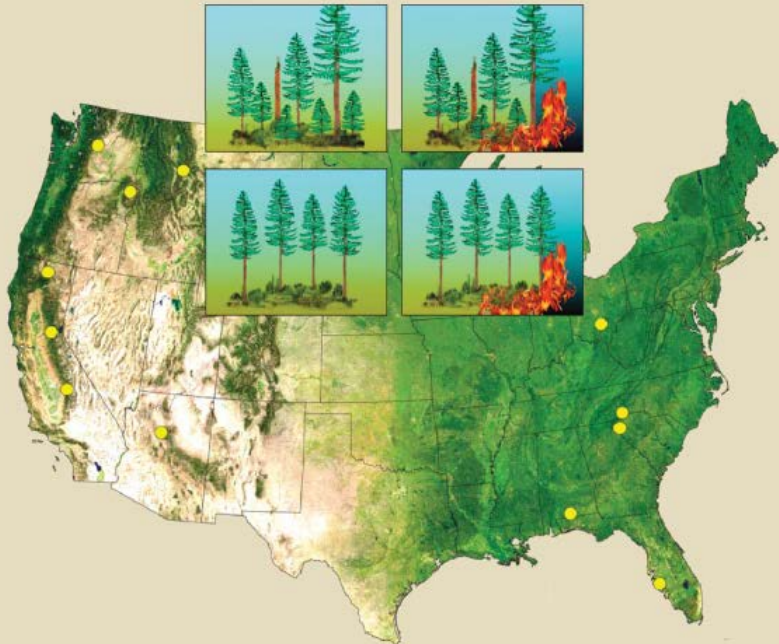
General Technical Report
PNW-GTR-860

April 2012



Principal Short-Term Findings of the National Fire and Fire Surrogate Study

James McIver, Karen Erickson, and Andrew Youngblood



- There is general agreement for the need of forest restorative treatments
- Less clear is the appropriate balance among mechanical fuels treatments, silvicultural cuttings, and prescribed fire

Critical finding of the Sierra Nevada Ecosystem Project (SNEP 1996)

"Although silvicultural treatments can mimic the effects of fire on the structural patterns of woody vegetation, virtually no data exist on the ability to mimic ecological functions of natural fire."



Mechanical Treatment Alone



Need to investigate the ecological consequences and tradeoffs of combinations of treatments

Prescribed Fire Alone

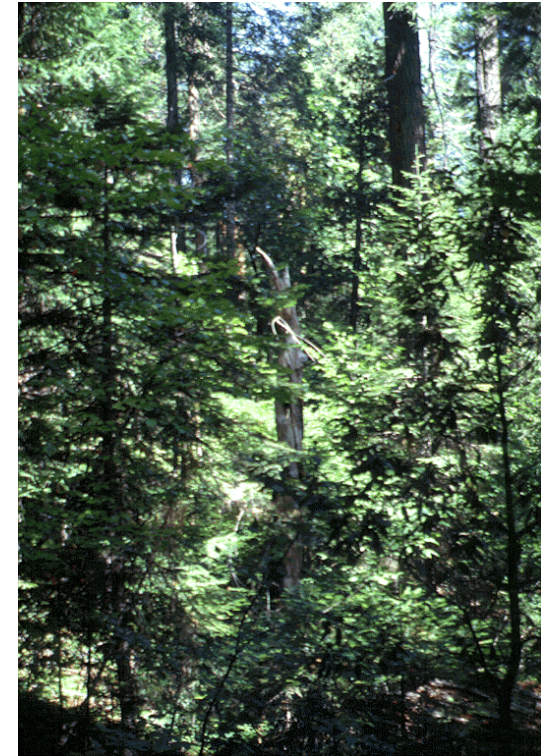


Combined Treatments





And consequences of continuing to do nothing...



Project Goal: Quantify the costs and the ecological consequences of alternative fire and fire surrogate restorative treatments in a number of forest types and conditions in the United States



- Forests with historical fire regimes characterized by frequent fires of low-moderate intensity





Core response variables

- Economics & wood product utilization
- Fire behavior, fuels, smoke
- Insects
- Pathogens
- Soil
- Vegetation
- Wildlife

Treatment Matrix

Prescribed Fire

C
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	NO	Yes
NO		
Yes		

Treatments designed to reduce wildfire risk

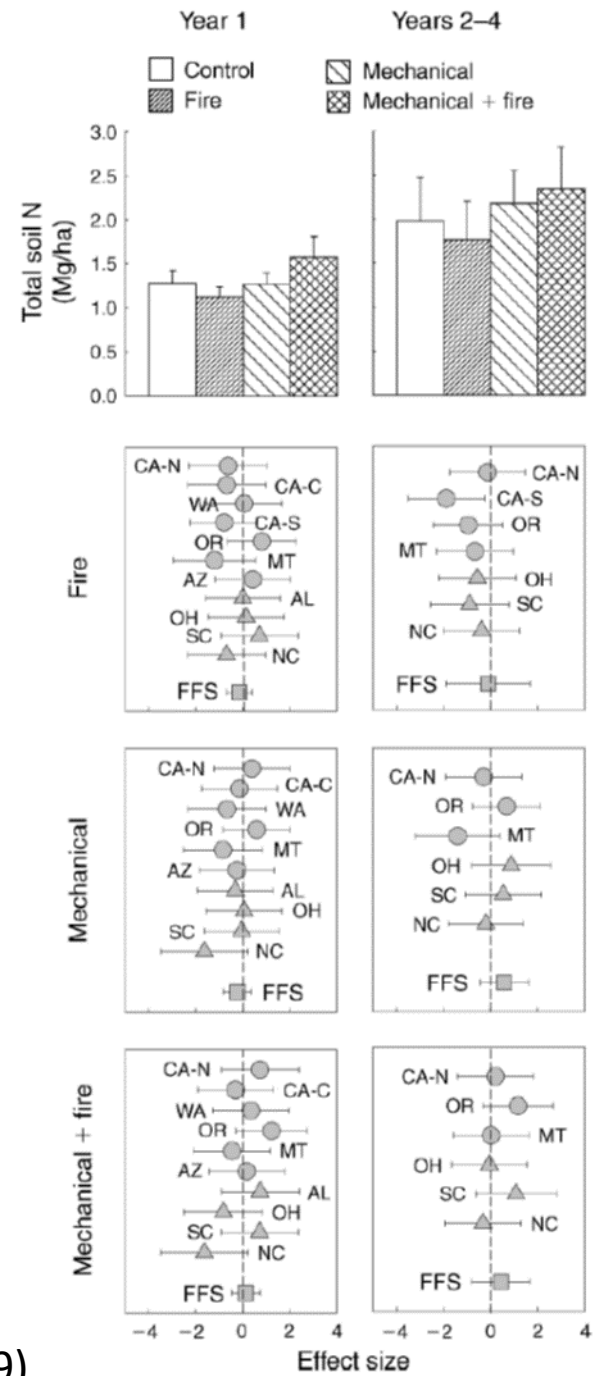
- Non-control FFS treatments guided by a specific Desired Future Condition (DFC)
- The DFC for each FFS research site defined by local participants, subject to a fire-related minimum standard
 - Each non-control treatment shall be designed to achieve stand and fuel conditions such that if impacted by a head fire under 80th percent weather conditions at least 80 percent of the basal area of overstory trees will survive



Site locations for the National Fire and Fire Surrogate Study

Summary of short-term soil results

- Treatments effects on soils were relatively modest and short-lived
- Mechanical + burn treatments tended to generate the highest fire severity and produce the greatest magnitude of effects
- Mechanical treatments alone did not serve as surrogates for fire in terms of soil





Conclusions

- The effects of fire on soils can be positive and negative depending on fire severity
- Active forest management can reduce the risk of wildfire
- Mechanical treatments alone cannot replace the ecological role of fire
- Funding for long-term research is necessary to improve our understanding of the impacts of forest treatments on ecosystem services