

# The Role of Fire in the Ecosystem



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# Introduction

- Fire is one of several natural disturbance events that shaped forests and rangelands historically.
- Periodic wildfires shaped much of the vegetation we appreciate in the west.
- Other disturbances that contribute to vegetation dynamics and patterns on the landscape are:
  - Insects (pine beetles, spruce beetles, etc.).
  - Diseases (dwarf mistletoes, root rots, etc.).
  - Winds (blowdown, micro-bursts, etc.).

# Introduction

- Local fire histories help us understand where fires burned historically, how severe they were, the extent of the particular fire, and how often fire visited a particular site.



# Introduction

- Sites are examined visually, and trees with fire scars (cat-faces) are either bored to remove a core that can be aged or a slice of the tree, including the scar, is removed with a chainsaw and examined for age and evidence of past fires in the rings.



# Outline

- General fire history of eastern Utah.
  - Explore the historical role fire played in the ecosystem.
  - Examine the role fire histories play in determining local fire occurrences.
  - Understand the effects of fire exclusion.
- Discuss fire ecology of pinyon/juniper and sagebrush/grassland ecosystems.
- Discuss fire ecology of ponderosa pine ecosystems.
- Discuss fire ecology of aspen communities.
- Questions and answers.

# Overview

- Understanding the natural processes that shaped forests and rangelands historically enables us to better define our management strategies for the future on public lands.
- Fire histories conducted locally help us to define the historical role fire played in different elevation and climatic zones and define the extent of those local fires.

# Overview

- Fire (and the absence of fire through suppression) has shaped vegetation patterns on the landscape as illustrated by the burn pattern in this photo.



# Overview

- The following photos show a ponderosa pine forest in Montana as it appeared in 1909 and again in 1948.

# Overview

- These photos illustrate the growth of younger age classes beneath the once open, park-like stand as a result of fire suppression.



# Overview

- Different species, elevations and climatic zones have different fire regimes and different fire return intervals.
- Different species of plants (trees, shrubs, grasses, etc.) Respond in different ways to fire.
- Some examples of fire-adapted tree species are:
  - Ponderosa pine
  - Lodgepole pine
  - Aspen
  - Gambel oak

# Vocabulary

- Wildfire – A fire, naturally caused or human-caused, that is not meeting land management objectives.
- Prescribed fire – A fire ignited under known conditions of fuel, weather, and topography to achieve specified objectives as documented in a formal, written prescription.
- Prescribed natural fire – A fire ignited by natural processes (usually lightning) and allowed to burn within specific parameters of fuels, weather, and topography to achieve specified (pre-identified) objectives.

# Vocabulary

- Succession – the process of change in plant communities. This process is measurable and predictable.
- Fire frequency – the return interval of fire or the average number of years between fire occurrences, based on a local fire history.

# Vocabulary

- Fire regime – the combination of fire frequency, predictability, intensity, seasonality, and extent characteristic of fire in an ecosystem (or in a particular ecosystem).
  - A generalized description of the role fire plays in an ecosystem.
  - Usually related and simply expressed in terms of the fire's severity or lethality:
    - Low, or non-lethal, generally a surface or understory fire.
    - Moderate or mixed, patches may crown out.
    - High, lethal, or stand-replacing, generally a crown fire, or very severe, slow-burning surface or understory fire.

# General Fire History of Eastern Utah

- John Wesley Powell's 1878 expedition documented forest vegetation and general conditions across most of the Utah Territory.
- An excerpt from his 1879 report gives some insight into the historic character of vegetation and the incidence of fire.

# General Fire History of Eastern Utah

- “Throughout the timber regions of all the arid lands, fires annually destroy larger or smaller districts of timber, now here, now there, and this destruction is on a scale so vast that the amount taken from the lands for industrial purposes sinks by comparison into insignificance. The conditions under which these fires rage are climatic.”

# General Fire History of Eastern Utah

- “Where the rainfall is great and extreme droughts are infrequent, forests grow without much interruption from fires; but between the degree of humidity necessary for their protection, and that smaller degree necessary to grow, all lands are swept bare by fire to an extent which steadily increases from the more humid to the more arid districts, until at last all forests are destroyed, though the humidity is still sufficient for their growth if immunity from fire were secured.”

# General Fire History of Eastern Utah

- Historically fires burned unchecked, many of them from midsummer to snowfall.
- Some were started by lightning.
- Others were started by native Americans to enhance grasslands for pasturing horses and big game habitat, reduce hiding cover for enemies, drive game for hunting, deprive enemies of resources, or to clear areas for travel, and for the growth of food resources.

# General Fire History of Eastern Utah



- During settlement by Europeans, fires may have been set in the grasslands and allowed to “escape” or “run free” into the foothills and mountains.

# General Fire History of Eastern Utah

- Settlers brought cattle and sheep into the territory and heavily grazed the foothills and nearby mountains, reducing fuels that historically carried frequent fires.



# General Fire History of Eastern Utah

- Logging for many different purposes and products also reduced the large tree component of the historic forests.
- Fire prevention efforts of the last century suppressed the naturally occurring fires, allowing more understory vegetation to become established.

# General Fire History of Eastern Utah

- Historic patterns of wildland fire varied from one place to another, depending on climate, type of vegetation, and human influence.
- Present fire patterns differ substantially from historic patterns.
- Fuels have built up under larger trees, providing “ladders” for fire to climb into the crowns, thus fires today burn more severely and in some cases more extensively than they did historically.

# General Fire History of Eastern Utah

- A common misconception about forests is that they stay the same.
- The truth is that forests and their vegetation are always changing – these ecosystems are dynamic.
- Wildlands are always changing, sometimes subtly and sometimes dramatically. Fire is one of the important natural (and dramatic) agents of change.

# General Fire History of Eastern Utah



- We've learned that the lack of periodic fire in many wild areas increases risks to society and the environment.

# General Fire History of Eastern Utah

- Valuable landscapes, private property, and natural resources are at risk.



# Fire History

- In order to understand fire history it is necessary to first understand how fires are categorized in terms of their severity.
- Fire regimes are generalized categories of severity.
- The categories extend from low to high.

# Fire Regimes

- Low, or non-lethal regime: fires in fire-adapted ecosystems such as dry ponderosa pine forests experienced a high frequency of these non-lethal fires. They burned on the surface, in fuels that were relatively light, doing little damage to the larger overstory trees. They limited the amount of small trees and shrubs that became established due to their frequency.

# Low, Non-lethal Fire Regime

- Frequent understory fires killed many tree seedlings, but generally did little damage to older trees with thicker bark.



# Fire Regimes

- Moderate, or mixed severity: these are fires that burned more severely in patches. More of the understory fuel was consumed with some lethal patches where crowns were consumed and trees killed. Generally, fires in this regime occurred in slightly higher elevation and moisture zones.

# Moderate, or Mixed Fire Regime



# Fire Regimes

- High, lethal, or stand-replacing: generally a crown fire, or very severe, slow burning surface or understory fire that consumed large amounts of the available fuels and killed the overstory trees. This regime is characteristic of higher elevations where lodgepole pine and subalpine fir forests are found.

# Lethal, or Stand Replacing Fire Regime



# Local Fire Histories

- Local fire histories help us determine how fires affected local ecosystems and the return frequency of fire in specific areas.



# Local Fire Histories

- When fire burns the bole of a fire-adapted species, such as Ponderosa pine, it leaves a record – if the tree survives.



# Local Fire Histories

- These records can be sampled, or collected, by removing an increment core or a slab of the tree, determining an age and number of fires recorded in the rings.

A "catfaced" stem of ponderosa pine records a story of fires.



# Local Fire Histories

- This record can be documented and preserved to interpret the actual occurrence and extent of local fires. It is useful in determining when to apply prescribed fire to local lands or to allow prescribed natural fire to burn.



Cross section of a pine stem reveals a record of 13 fires between 1815 and 1907. Fires burned around this tree an average of every 7 years during this 93-year period. (Lab of Tree-Ring Research, Univ. of Arizona.)

# Fire Exclusion

- Fire exclusion began about 1900 with the establishment of the National Forests and increased demands for wood products.



# Fire Exclusion

- Livestock grazing consumed grasses which historically allowed fires to spread rapidly.



# Fire Exclusion

- Improved technology allowed for more effective fire fighting and fire suppression.



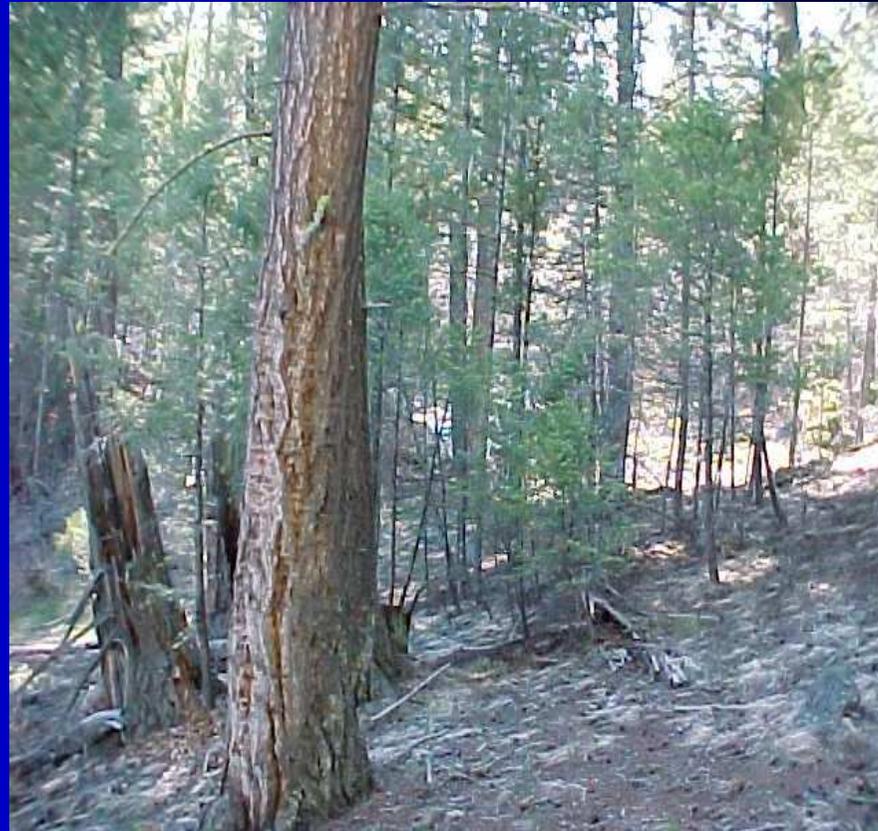
# Results of Fire Exclusion

- Shade-tolerant conifer seedlings became established under existing forest canopies, filling in open forests.



# Results of Fire Exclusion

- Conifer seedlings continue to fill in open forests today.



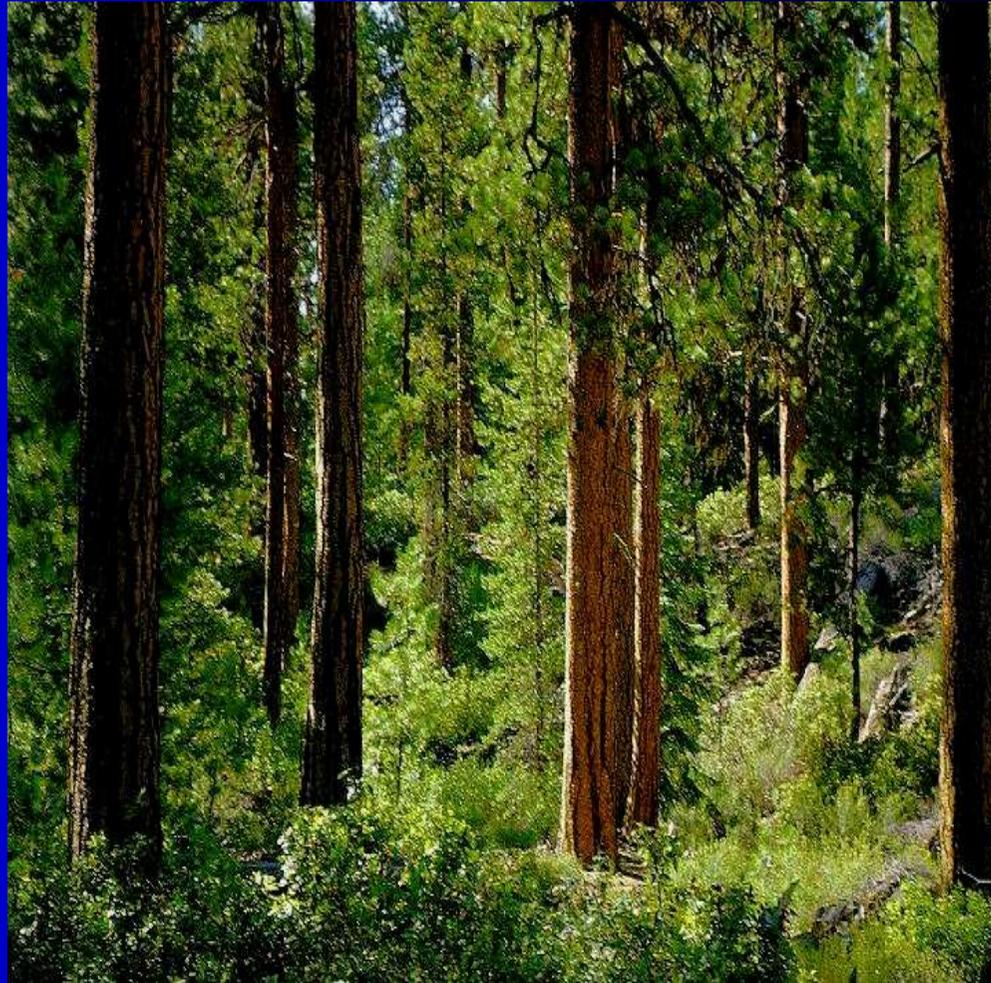
# Results of Fire Exclusion

- Evidence of old open forests can still be found in some landscapes.



# Results of Fire Exclusion

- Heavy understory stocking of trees was not common historically in dry forests.



# Results of Fire Exclusion

- Most of the current day Dry Forest ecosystems are at increased risk of crown fire due to increased ladder fuels.



# Results of Fire Exclusion

- Understory trees allow fire to climb (ladder) into the crowns of older trees.



# Results of Fire Exclusion

- In some stands it may be necessary to thin the understory (ladder fuels) before fire may be reintroduced.



# Results of Fire Exclusion

- Current Dry Forest ecosystems have larger and higher intensity crown fires than historically.



# Results of Fire Exclusion

- Generally crown fires have greater impacts on the ecosystems.



# Results of Fire Exclusion

“One of the most significant changes in land use in the 1900s was the suppression of wildfire. Fire suppression has led to changes in species composition and vegetation structure, and it has led to a significant buildup of fuels (Arno and Brown, 1989) and increased forest health problems (Mutch 1994).” (Wildland Fire in Ecosystems - Effects of Fire on Flora, RMRS-GTR-42-Volume 2, December 2000)

# pinyon/juniper Ecosystems

Areas that in the past have been maintained as open, primarily through natural fire, have reached a stage where pinyon/juniper (P/J) is the dominant vegetation type and grass/shrub types have been, or are being, reduced to a small component of the system.



# P/J Ecosystems

Fire has been called the most important natural disturbance before the introduction of livestock, particularly the large herds of the 19<sup>th</sup> century.

Unchecked by the frequent fires that once were common, P/J has expanded to cover what was once open grassy savannahs, encroached into former meadows, and is slowly encroaching on sage/grasslands.

# P/J Ecosystems



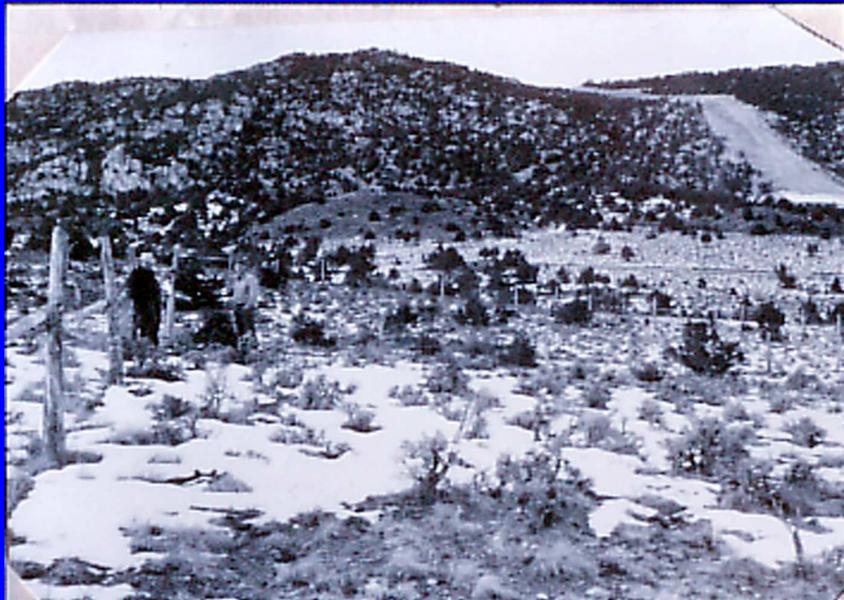
# P/J Ecosystems

Shrub communities have high value for a number of wildlife species, such as sage grouse, and pronghorn antelope. The open spaces of sage/grasslands are important to bighorn sheep.



# P/J Ecosystems

The rate of pinyon-juniper displacement of shrub communities is indicated by the 50-year span represented by these two slides, taken near Dutch John. The pipeline scar in the background provides a common reference for the two slides.



# P/J Ecosystems

Fire suppression of the past century is a factor in the increasing tree cover shown here. The advance of trees is slow enough that conifer dominance is a few decades away. However, without fire or other disturbance the trend towards conifer dominance is likely to continue.



# Ponderosa Pine Ecosystems

Ponderosa pine is a shade-intolerant, fire-adapted species. Historically, it was found in stands of well-spaced, older trees with sparse pockets of younger trees and abundant herbaceous vegetation.

# Ponderosa Pine



Frequent, regular occurrence of fire  
burned surface fuels  
– large, heavy fuel accumulations were uncommon.

# Ponderosa Pine

- Dwarf mistletoe is more common and widespread than historically. It was once held in check by frequent fire.
- Bark beetle outbreaks are more common in overstocked stands.
- There is an increase in “ladder” fuels.



# Ponderosa Pine

- There are heavier duff accumulations than historically, due to a lack of frequent fires that periodically burned needles and litter around the base of trees.
- Fuel conditions are ‘out of sync’ with natural (historic) conditions.
- The result can be large, uncontrollable wildfires that are uncharacteristic of the natural or historic condition.



# Aspen Communities

- “Fire has been a critical part in defining the spatial and temporal variability of western aspen landscapes.” (Bartos, 1998).
- “Ongoing fire history work in southern Utah (Chappell, 1997) indicates that during the 400 years prior to settlement fire-free cycles varied from 20 to 60 years.” (Bartos, 1998).
- The underlying importance of these statements is that we have ‘missed’ from 1 ½ to 5 fire cycles in areas of southern Utah in the last century.

# Aspen Communities

- Successional process and the reduction in fire's natural role are primary agents of the loss of aspen communities in western forest ecosystems.

# Aspen Communities



# Aspen Communities

The Rocky Mountain Research Station (RMRS) compiled data on aspen in the interior West during their Forest Inventory and Analysis Project (FIA). Findings show 2,930,684 acres of aspen historically.

Current data (~1998) indicates there are presently 1,427,973 acres of aspen in Utah. This represents a loss of 1,502,711 acres or a 51% decline in roughly that last century. (Bartos, 1998)

# Aspen Communities

12 minute video, “Fading Gold. The Decline of Aspen in the West”.

# Summary

- With nature, it's a “pay me now or pay me later” proposition.
- Nature will recycle our forests and rangelands, sooner or later.
- Fires helped create the scenic areas we all know and appreciate.
- We can learn from the historic record.
- We can mimic nature in many ways to help mitigate the effects of fire exclusion.

# Where to Get More Information

- [www.fs.fed.us/fire/operations/ecology](http://www.fs.fed.us/fire/operations/ecology)
- Local Forest Service and BLM offices.