NCSR
Education for a Sustainable Future
www.ncsr.org

Anatomy of a Wildfire – the B&B Complex Fires

NCSR Fire Ecology and Management Series

Northwest Center for Sustainable Resources (NCSR)
Chemeketa Community College, Salem, Oregon
DUE # 0455446

Published 2008

Funding provided by the National Science Foundation
opinions expressed are those of the authors and not
necessarily those of the foundation

Fire Ecology and Management Series

This six-module series is designed to address both the general role of fire in ecosystems as well as specific wildfire management issues in forest ecosystems. The series includes the following modules:

- Ecological Role of Fire
- Historical Fire Regimes and their Application to Forest Management
- Anatomy of a Wildfire - the B&B Complex Fires
- Pre-Fire Intervention - Thinning and Prescribed Burning
- Post-Wildfire (Salvage) Logging – the Controversy
- An Evaluation of Media Coverage of Wildfire Issues

The *Ecological Role of Fire* introduces the role of wildfire to students in a broad range of disciplines. This introductory module forms the foundation for the next four modules in the series, each of which addresses a different aspect of wildfire management. *An Evaluation of Media Coverage of Wildfire Issues* is an adaptation of a previous NCSR module designed to provide students with the skills to objectively evaluate articles about wildfire-related issues. It can be used as a stand-alone module in a variety of natural resource offerings.

Please feel free to comment or provide input.

Wynn W. Cudmore, Ph.D., Principal Investigator
Northwest Center for Sustainable Resources
Chemeketa Community College
P.O. Box 14007
Salem, OR 97309
E-mail: ncsradm@chemeketa.edu
Website: www.ncsr.org
Phone: 503-399-5270

NCSR curriculum modules are designed as comprehensive instructions for students and supporting materials for faculty. The student instructions are designed to facilitate adaptation in a variety of settings. In addition to the instructional materials for students, the modules contain separate supporting information in the "Notes to Instructors" section. The modules also contain other sections which contain additional supporting information such as a “Glossary” and “Suggested Resources.”

Acknowledgements

We thank Steve Resh of Allegany College of Maryland, and Michelle Fulton of Feather River College in Quincy, California for their thoughtful reviews. Their comments and suggestions greatly improved the quality of this module.

TABLE OF CONTENTS

Anatomy of a Wildfire - Module Description

This module is the third in the *Fire Ecology and Management Series*. The module is designed for courses that support natural resource disciplines such as Forestry, Wildlife and Environmental Science. Although the module can be taught independently, faculty should consider teaching as part of the series. Specifically, the modules *The Ecological Role of Fire in Forest Ecosystems* and *Historical Fire Regimes and their Application to Forest Management* are designed to prepare students for the activities in this *Anatomy of a Wildfire – B&B Complex Fire* module. In this lecture-based module the B&B Complex Fire in central Oregon is examined as a case study to introduce the basics of wildfire behavior in the context of historical fire regimes. A *PowerPoint* presentation describes recent changes in fire frequency and intensity, how fire histories are determined, wildfire progression, methods for post-fire assessment and post-fire recovery and rehabilitation.

Anatomy of a Wildfire

Introduction

In 2003, the largest wildfire ever recorded on the Deschutes National Forest, burned over 90,000 acres of mixed conifer forest in Central Oregon. The fire impacted two national forests, a Native American reservation, and both state and private lands. The area is a significant source of timber production, an important recreational area and provides habitat for several threatened and endangered species. Starting as two separate fires (the Booth and Bear Butte fires) ignited by lightning strikes in mid-August, the two came together in early September and became known as the B&B Complex Fire. When they were finally extinguished in November, nearly $40 million had been spent in fire suppression.

In this lecture-based module, the B&B Complex Fire is used to introduce students to our current understanding of wildfire behavior in the context of historical fire regimes. The module is presented as a series of *PowerPoint* slides paired with a textual outline of the major points. Supplementary lecture notes for use by the instructor are included in the notes section for each slide. Citations of relevant print, video and web-based resources are also provided for the instructor as background, supplemental use in the classroom and for additional research.

The module is most appropriate for use as an introduction to fire behavior for courses such as *Fire Ecology*, *Wildfire Management*, *Environmental Science* and *Introduction to Natural Resources*.

Objective

Upon completion of this module students should be able to:

1. Describe wildfire behavior in an altered fire regime
2. Discuss the methods used to assess pre-fire conditions and post-fire effects
3. Describe the methods and expected outcomes of post-fire recovery efforts

Procedure

Fire behavior, fire history, fire effects and the various methods that are used in their analysis are important topics in any fire management curriculum. These topics may also be relevant in less specific forestry or natural resource programs. For example, the topic may be addressed in the context of ecological succession, forest ecology or forest management.

The accompanying *PowerPoint* presentation should be delivered to students at an appropriate time in the course or program. Alternatively, the presentation could be made available to students on-line, where they could review the material on their own.

Selections from the video resources cited at the end of the module may be used to supplement the *PowerPoint* presentation.

Additional text or titles may be added to the PowerPoint slides to match your particular instructional style

Assessment

Student learning of the material in this module is probably best assessed with essay questions on an exam. I suggest the following:

Use the specifics of the B&B Complex Fire to comment on the relationship between pre-fire conditions and fire behavior.

What are the goals of post-fire assessment and what tools are used?

What types of activities are typical of post-fire recovery and rehabilitation and what are the expected outcomes of each?

General Lecture Outline

I. Introduction
- Overview of B&B Complex Fire
- Central Oregon fire history

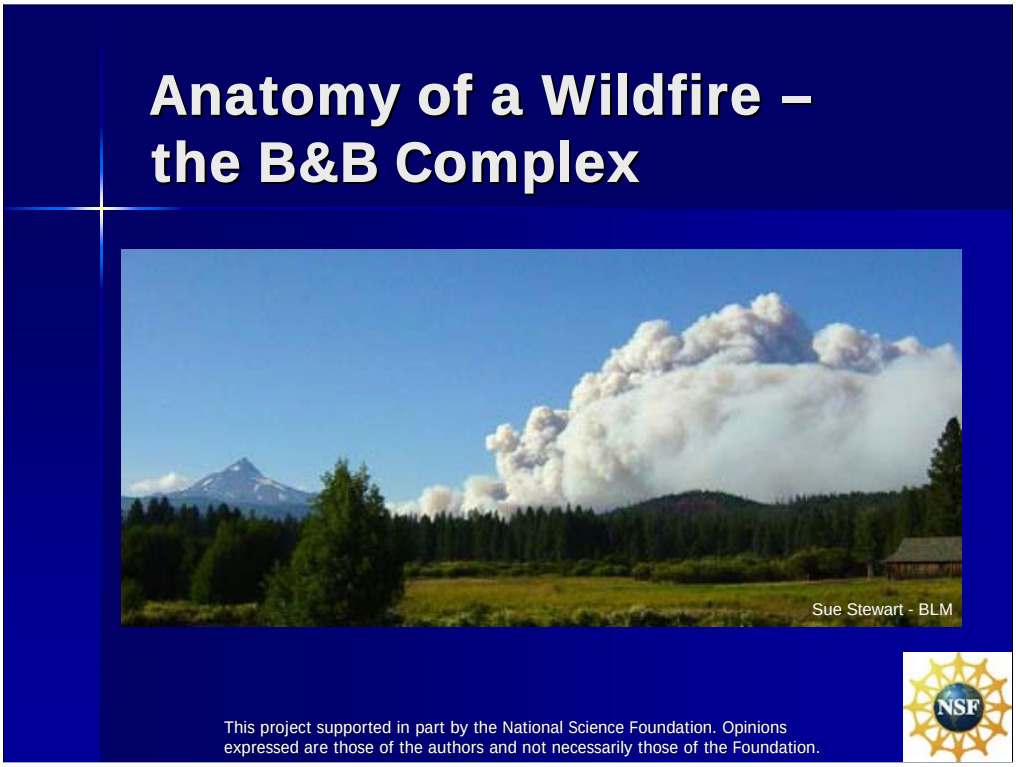
II. Analysis of fire behavior - the B&B Complex Fire
- Pre-fire conditions
- Ignition
- Fire progression
- Land ownerships

III. Post-fire assessment – the B&B Complex Fire
- Burned area emergency rehabilitation (BAER)
- Burned area reflectance classification (BARC)
- Burn intensity maps
- Severity vs. intensity

IV. Post-fire recovery and rehabilitation – the B&B Complex Fire
- Types of activities
- Wildfire research
- B&B Complex Fire statistics

See notes on *PowerPoint* slides for detailed lecture notes for *Anatomy of a Wildfire* presentation.

POWERPOINT SLIDES WITH INSTRUCTOR’S NOTES

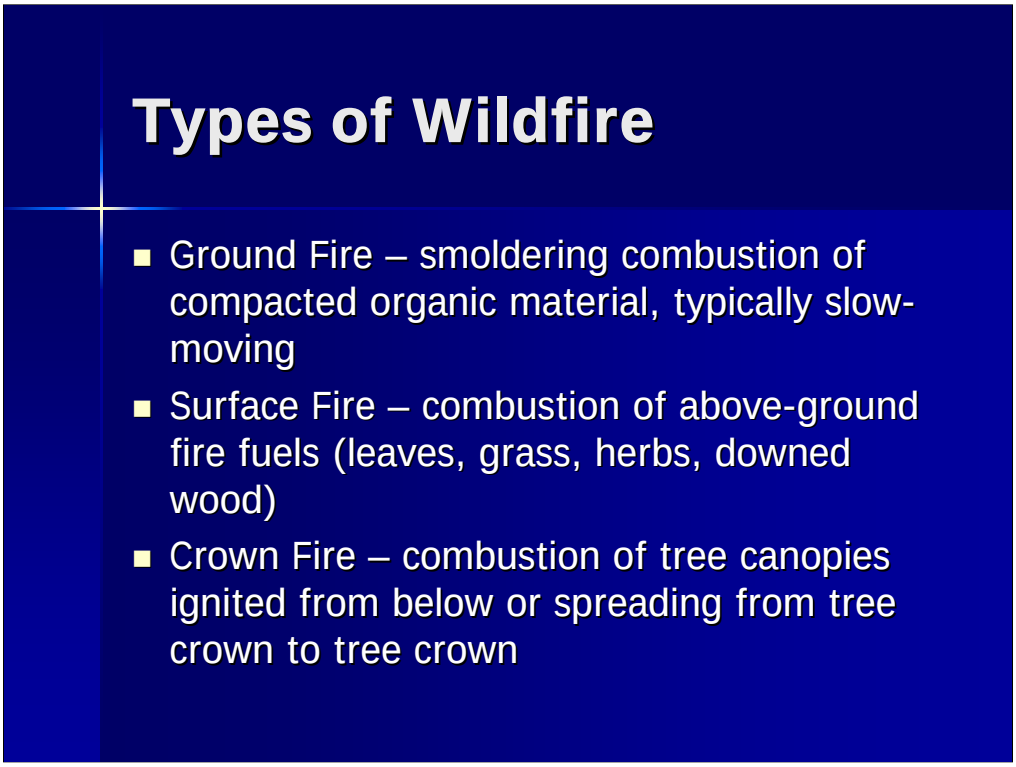


This presentation uses the 2003 B&B Complex Fires in central Oregon to illustrate some of our current thinking on wildfire behavior, wildfire regimes, and how wildfire impacts are assessed. Basic concepts are widely applicable to wildfires in other regions.

In 2003, the largest wildfire ever recorded on the Deschutes National Forest, burned over 90,000 acres of mixed conifer forest in Central Oregon. The fire impacted two national forests, a Native American reservation, and both state and private lands. The area is a significant source of timber production, an important recreational area and provides habitat for several threatened and endangered species. Starting as two separate fires in mid-August they joined in early September and became known as the B&B Complex Fire. When they were finally extinguished in November, nearly $40 million had been spent in fire suppression.

This image, taken from space by NASA's Earth Observatory Satellite, shows the B&B Complex Fire on 24 August 2003. At this point, the two individual fires had been burning for 5 days and a large smoke plume is apparent drifting to the east.

Central and western Oregon are shown here with the Columbia River near the top and the Willamette Valley as the light brown region on the left portion of the image. The Cascade Range occupies the middle of the image in dark green.

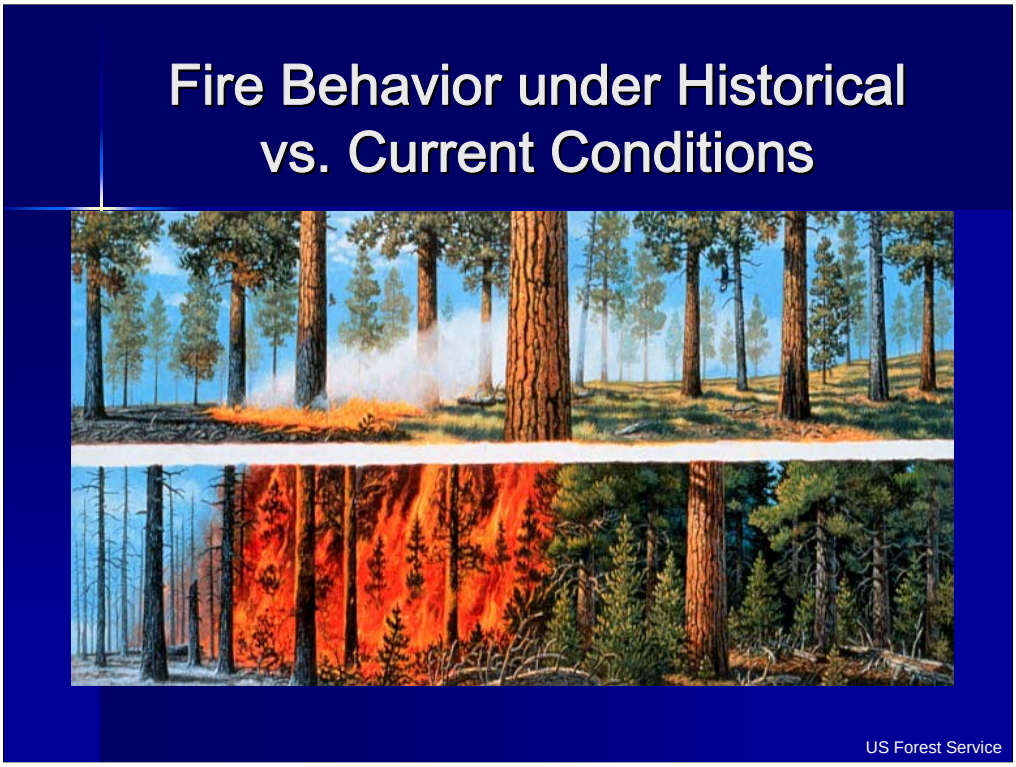


Fires are often categorized according to the location of fuel that primarily supports combustion.

Ground fires are characterized by smoldering combustion of compacted organic material such as peat or duff. They typically progress slowly with little flaming, perhaps moving only a few feet per day.

Surface fires burn fine, above-ground organic material such as leaves, grasses, herbaceous plants, shrubs and downed wood (logs and branches). The intensity of surface fires varies from very low to very high depending on conditions.

Crown fires spread through the forest canopy as the crowns of trees are either ignited from below or by spreading from tree crown to tree crown. When driven by strong winds or aided by steep slopes, crown fires can move through a forest very rapidly. Crown fires are typically of high intensity. (See Arno and Allison-Bunnell 2002, for details)



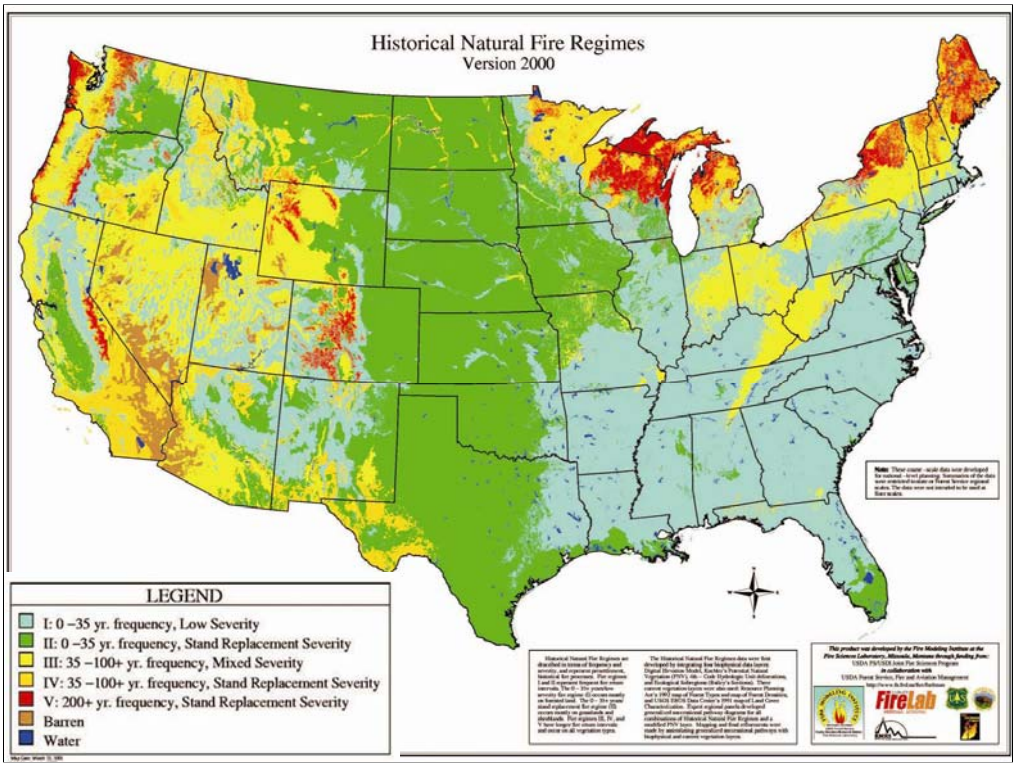
For many fire-dependent ecosystems, historical fire regimes were characterized by frequent, low intensity surface fires. These fires would burn dead wood, small shrubs and trees; but, in most fires, dominant trees would not be killed (top image). In contrast, as a result of fire protection, reforestation, and other factors, an altered fire regime exists. Current conditions promote less frequent, but highly intense crown fires that can be stand-replacing. Because the fire can be carried into canopy by burning the smaller trees and fuel, this can easily result in the death of a high percentage of dominant trees. (See NCSR module, *Ecological Role of Fire*, for details.) The B&B Complex Fire developed in such a context.

Fire History in Central Oregon 1900 - 2004

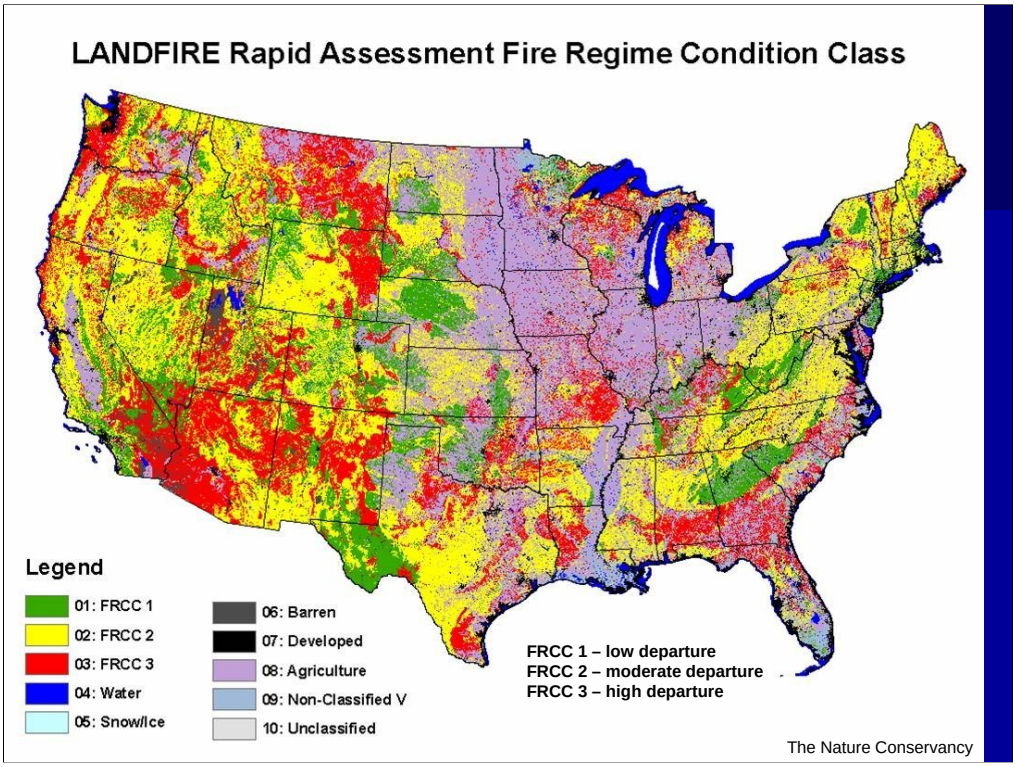
Decade	Acres burned	% of Total Area
1900-1909	11,913	5
1910-1919	45,564	18
1920-1929	5,491	2
1930-1939	699	0
1940-1949	13,761	5
1950-1959	1,123	0
1960-1969	10,640	4
1970-1979	5,605	2
1980-1989	5,932	2
1990-1999	25,519	10
2000-2004	128,817	51

The Oregonian

Fire history in Central Oregon, the region affected by the B&B Complex Fire, is shown in this table. Note the increase in the extent of fires since 1990. Since 2000, six major fires have burned in this region, including the B&B Complex in 2003.



This map illustrates the 5-class system of categorizing historical natural fire regimes. Much of the area impacted by the B&B Complex Fire in Central Oregon falls within Fire Regime I, represented in light blue on the map. Thus, historical fires were, for the most part, characterized by high frequency and low severity. They burned often, but rarely killed the large, established trees.



While the natural fire regime is a general classification of fire frequency and intensity in the absence of modern human activity, a fire regime condition class (FRCC) is a classification of the amount of departure from the historical natural regime. Three classes are identified based on the degree of departure:

FRCC 1 – low departure, within the natural (historical) range of variability and risk of losing key ecosystem components is low

FRCC 2 – moderate departure; risk of losing key ecosystem components is moderate

FRCC 3- high departure; risk of losing key ecosystem components is high

Note regions where departures are most severe include much of the western and southeastern United States. Large regions in southern California, Arizona and New Mexico, the Pacific Northwest, and the Greater Yellowstone ecosystem are particularly affected. Note that area affected by the B&B Complex (the vertical red band immediately east of the Cascade Range in Oregon) is included within a FRCC 3 classification, suggesting significant departure from historical conditions. Not coincidentally, these areas have all been affected by uncharacteristically intense and widespread fires in recent years.

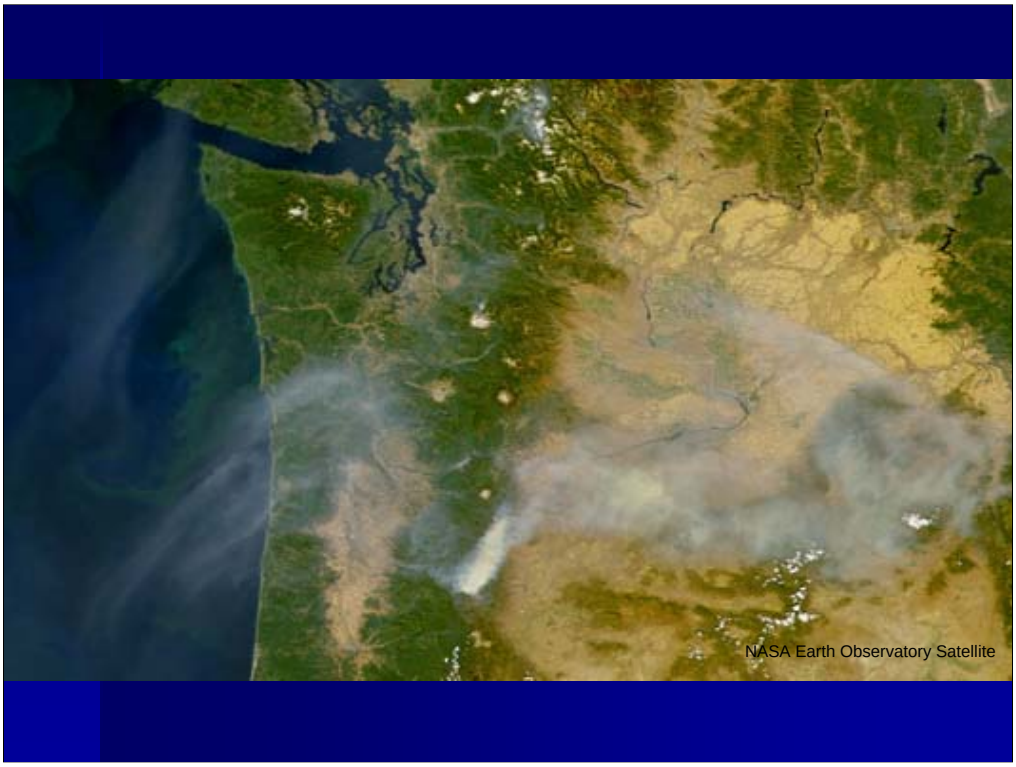
SOURCE: http://tncfire.org/images/RA_FRCC.jpg

The B & B Complex Fire in Central Oregon will be used as a case study to examine fire behavior, pre-and post-fire assessments and their relationship to wildfire management and restoration. This NASA Earth Observatory Satellite image shows the western half of Oregon with the Pacific coastline to the far left, the Columbia River near the top and the Willamette Valley as the light brown region near the center of the image. The Coast Range lies immediately to the west of the Willamette Valley; the Cascade Range to the east (both in dark green). The B&B Complex originated on the east slopes of the Cascade Range which are significantly drier than most other forests in the state due to the rainshadow effect.

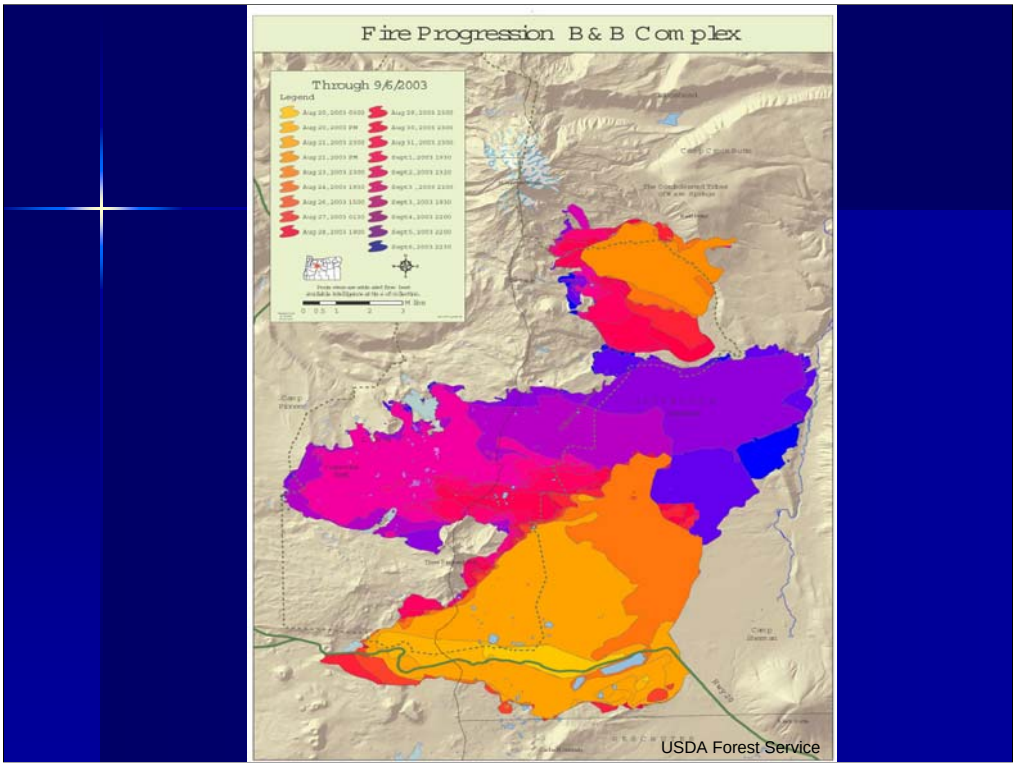
The Booth Fire and Bear Butte Fires started on Tuesday August 19, 2003 and were declared fully contained on Friday September 26. The cause of these fires was determined to be lightning strikes associated with thunderstorms in the area.

A view of the Bear Butte Fire on the day it was detected. Mt. Jefferson is seen in the left portion of the image. The forest type there is mixed conifer, lodgepole pine and in some areas, bug-killed timber. Insect outbreaks of bark beetle and spruce budworm during the 1990's resulted in large areas of bug-killed timber.

Aerial view of Booth Fire on day of detection as seen from Wickiup Reservoir. Three-fingered Jack is seen in the image.

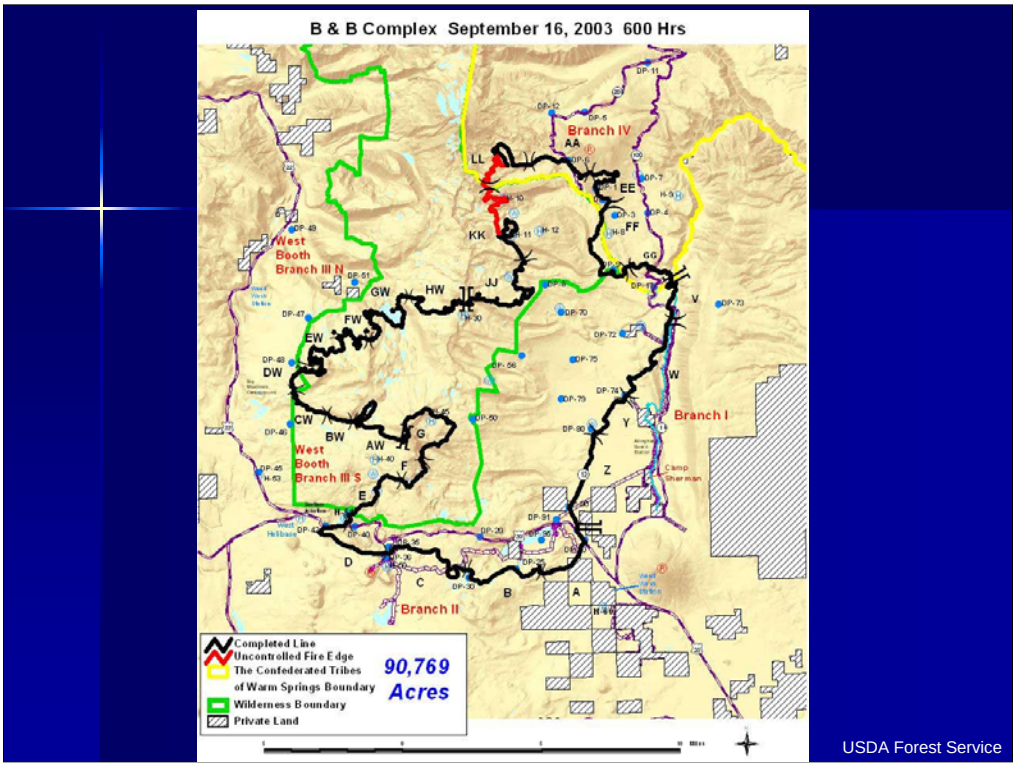


Satellite view on 2 September shows smoke extending all the way from Idaho to the Oregon Coast.

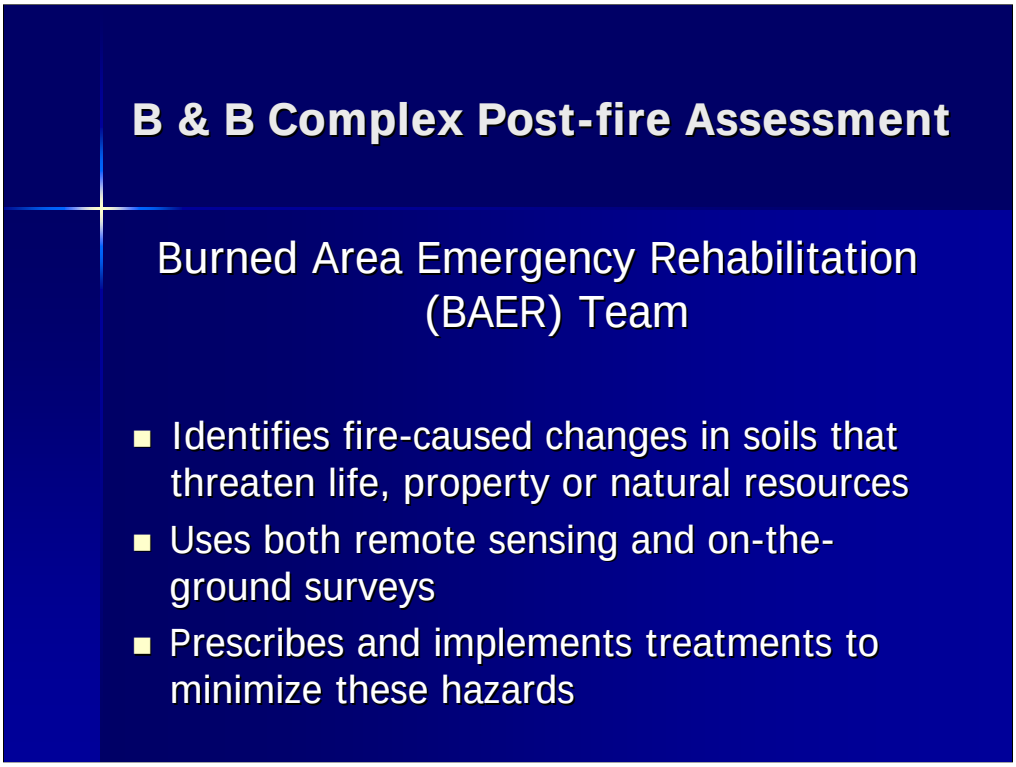


Booth Fire and Bear Butte fires started on Tuesday August 19, 2003 and were declared fully contained on Friday September 26. Causes were later determined to be lightning strikes associated with thunderstorms in the area.

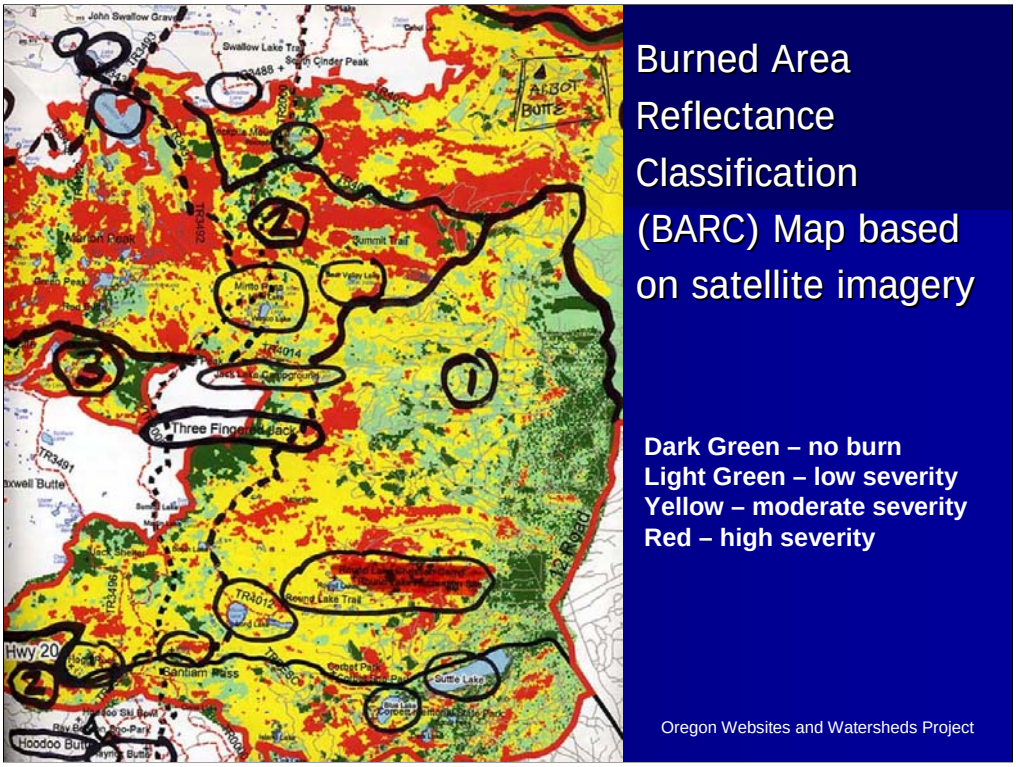
This figure illustrates the progression of the two fires which on September 4th joined to form a single complex of fires. The location of the fire on different dates is illustrated with different colors on the map – early dates in yellow and orange, later dates in purple and blue.



The fires were located on the Deschutes and Willamette National Forest approximately 30 miles NW of Bend, Oregon. A significant portion burned in the Mt. Jefferson Wilderness Area and a small area on the Warm Springs Indian Reservation. Smaller amounts of private and state land also burned. This complex of fires illustrates the challenge of multiple ownerships with different policies and management goals. In wilderness areas for example, natural wildfires may be allowed to burn. On privately-owned land where human structures are threatened, fire suppression is a priority.



Even before a wildfire is fully contained, natural resource specialists are evaluating the impact of the fire and how this will impact recovery and rehabilitation. A multidisciplinary team of scientists and natural resource managers called the Burned Area Emergency Rehabilitation (BAER) team has this responsibility. The primary responsibility of this group is to evaluate the burned area for threats to life, property and natural resources due to post-fire flooding and erosion. This evaluation uses both remote sensing imagery (usually satellite images) and on-the-ground surveys to generate maps that depict the impact of the fire on the hydrologic function of soils. For those areas that are identified as presenting a hazard, emergency stabilization treatments are prescribed and implemented.

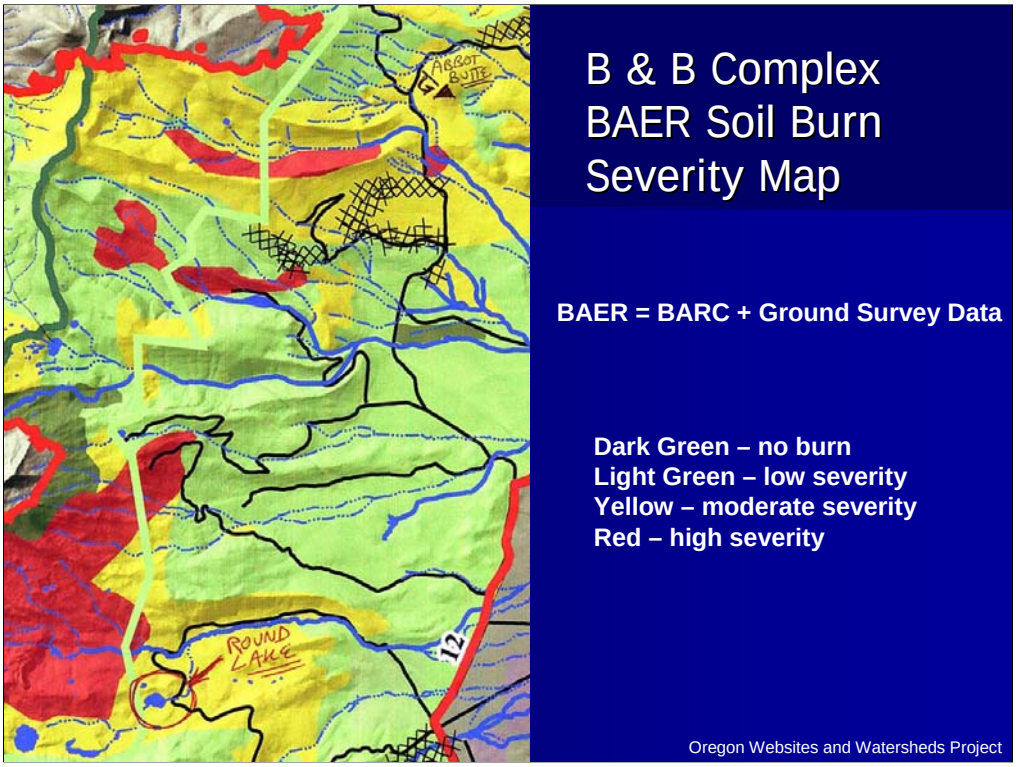


The initial evaluation is based on a Burned Area Reflectance Classification (BARC) map which is generated from satellite imagery. Ground surveys are later used to validate soil characteristics. Using these data the BARC map may then be modified to more correctly represent soil burn severity. After this process, each pixel in a soil burn severity map is usually assigned to one of four categories – “unburned” (dark green), “low severity” (light green), “moderate severity” (yellow), or “high severity” (red).

BAER Soil Burn Severity Class Criteria

Soil Burn Severity Class	Substrate	Understory and Shrub Vegetation	Overstory
Unburned	Not burned	Not burned	No fire-caused mortality
Low	Mineral soil unchanged; litter layer charred or partially consumed	Foliage and small twigs (<1/4 inch) consumed	Slight tree mortality (usually <10%)
Moderate	Moderate soil heating and ground char; litter mostly charred	Foliage, twigs and small stems consumed; shrub canopy consumed	Tree mortality highly variable
High	High soil heating; litter and duff consumed	All major plant parts consumed; few or no major stems of shrubs remain	Generally 80-90% tree mortality

Table shows criteria used to assign areas to soil burn severity classes and predicted impact on vegetation.



After the BARC (satellite-derived) maps are generated, ground surveys are conducted to evaluate the effects of the fire on soils. At this point the BARC maps may be modified by incorporating the data from these ground surveys. The result is a BAER Burn Severity Map (seen here). Thus, "BAER = BARC + ground survey data."

For a detailed discussion of the BARC/BAER Mapping Process, see:

Safford, H.D., et al. 2007. BAER soil burn severity maps do not measure fire effects to vegetation: a comment on Odion and Hanson (2006). Ecosystems (2008) 11: 1-11.

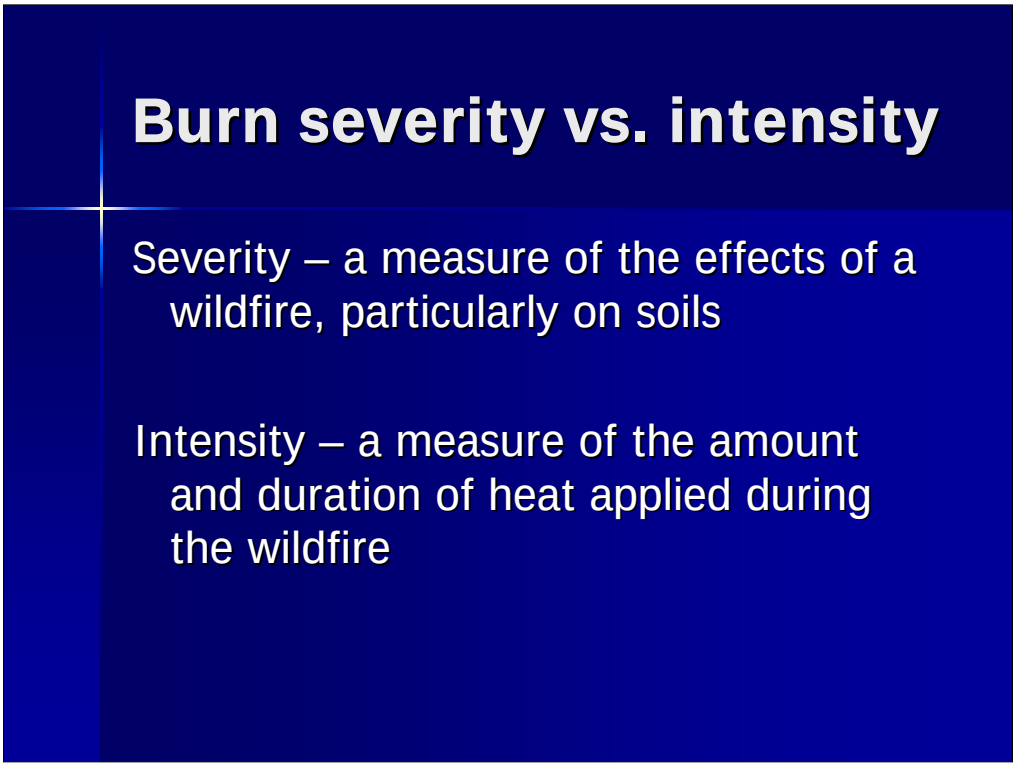
Like most wildfires, the B&B Complex illustrates a mosaic pattern of burn severity:

Did not burn (dark green)

Low severity (light green) – these two categories combined for 38% of the area (up to 25% mortality)

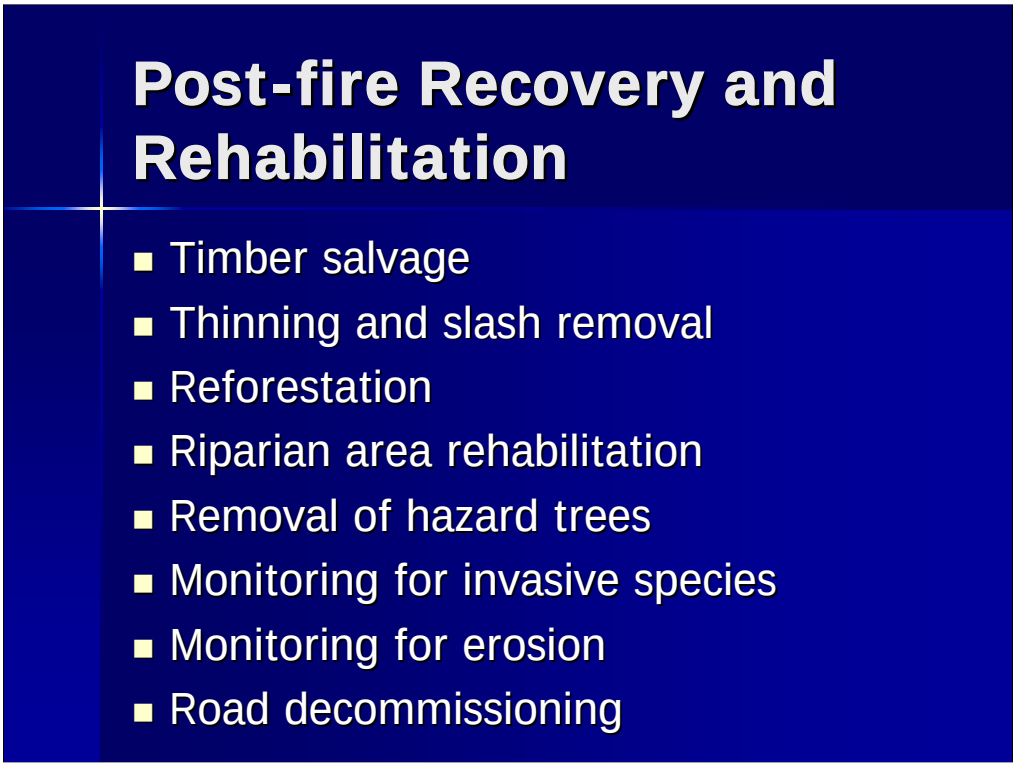
Moderately burned (yellow) – mixed mortality (25-75% living) – 18% of the area

Severely burned (red) – high mortality (>75% dead) – 44% of area



"Burn severity" maps are sometimes used for other purposes such as impact on vegetation, tree mortality or long-term ecosystem effects. However, it is important to note that their main purpose is to identify areas of impaired soil function. Although it would be reasonable to assume that there is a relationship between soil impact and other impacts, correlations between them may not be strong. Overlaying Geographic Information Systems (GIS) layers that depict pre-fire vegetation is often used to more properly evaluate fire effects other than soil.

Use of the term "fire intensity" on some post-fire assessment maps has led to confusion. Historically, the terms "intensity" and "severity" were sometimes used interchangeably. It is now recommended that "intensity" be used to refer to the "physical force of the event per area per time period". Note that both the *amount* of heat and the *duration* for which it was applied are used in the measurement of "intensity" (i.e., How hot did the fire burn and for how long in an area?). "Burn severity", on the other hand, should be used only to describe the *effects* of the fire. Although there is a strong correlation between the two, there are situations where that is not the case. A high intensity fire, for example, that spreads rapidly from crown to crown may result in low to moderate soil burn severity. In contrast, a low intensity fire (dominated by smoldering logs, for example), can produce intense heat over a long duration resulting in high soil burn severity.



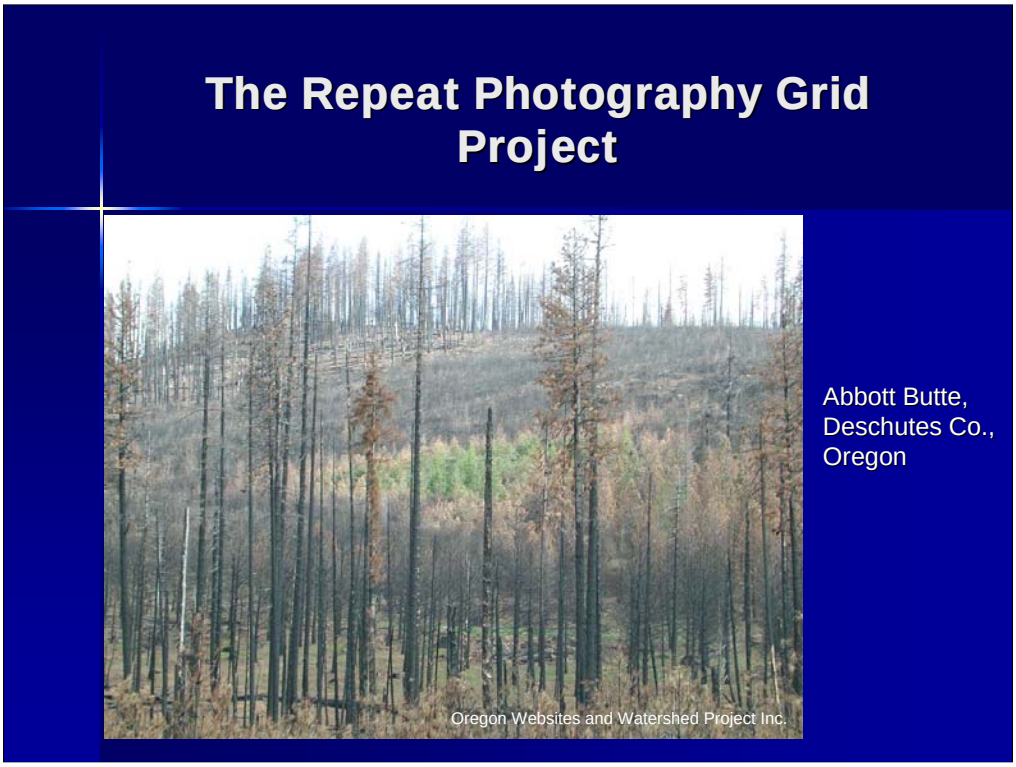
Post-fire recovery efforts within the area affected by the B&B Complex Fire are representative of fire-affected areas throughout the West. The overall goal is to restore a forest of fire-resistant mature trees that can withstand the 30 to 40-year fire return interval. Activities will include the following:

1. Timber salvage – planned harvest of dead and dying timber on approximately 10% of the affected area (10-14,000 acres). Revenue generated will be used to fund other restoration efforts
2. Thinning and slash removal to reduce fuel loads for future fires and to restore fire regime to within historical range of variability. This fire burned with uncharacteristic intensity due to heavy fuel loads.
3. Reforestation with trees that have been historically dominant in the region and better adapted to historical fires. These include especially ponderosa pine, but also western white pine (at higher elevations) and Douglas-fir, western larch and Engelmann spruce (on moist sites). Thus, a diversity of species is being planted and species selection is based on a match between site conditions and the ecological requirements of each species. By 2006, approximately 9000 acres had been planted (about 10% of the affected area); however, only those areas most severely affected will need to be planted)
4. Riparian area rehabilitation will include riparian plantings (vine maple, dogwood, rose, bitter cherry, elderberry, cottonwoods and aspen) and in some cases the construction of riparian exclosures to reduce grazing rates on recovering shrubs along streams
5. Removal of hazard trees (ie., trees that are likely to fall across roads, on structures or on people in the short term)
6. Monitoring for and removal of invasive species, which often occupy sites after a disturbance such as fire
7. Monitoring for erosion – removal of vegetation on steep slopes increases probability of erosion and landslides
8. Road decommissioning – removal of some roads including those that were installed to fight fire – return to original grade and establish native vegetation. Road removal reduces erosion and also reduces public access, which lowers future fire danger.

Post-fire rehabilitation

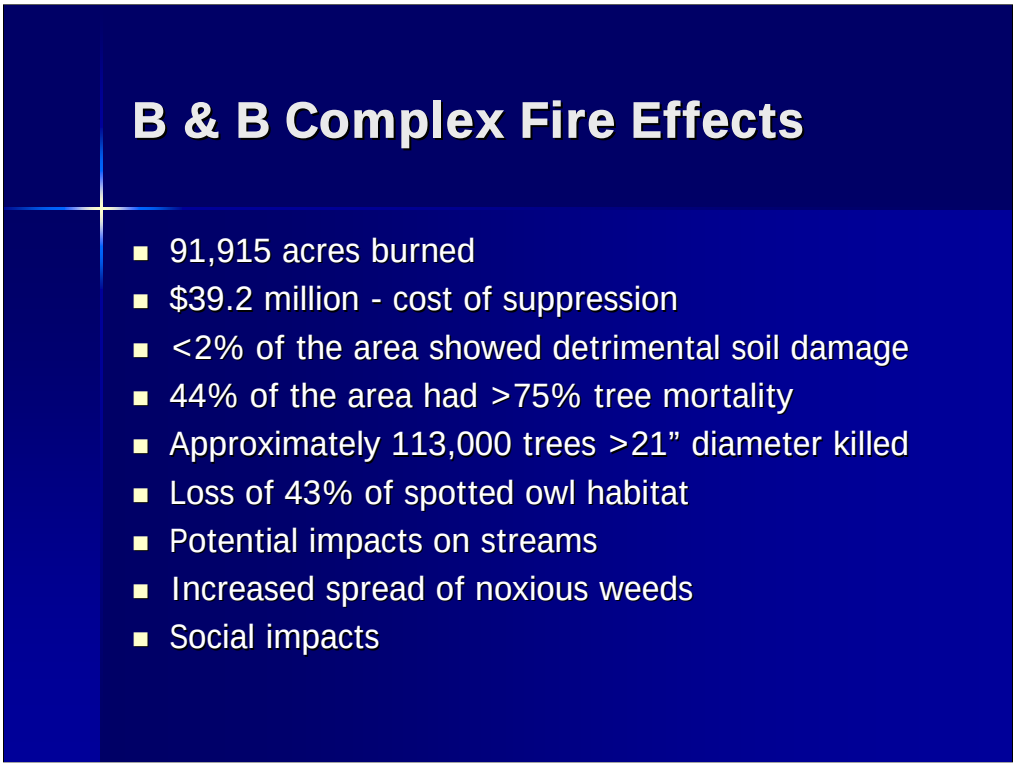
After the fire, much of the rehabilitation work is done by hand. Here we see the restoration of dozer lines put in to move equipment and to build fire breaks.

Some roads will be decommissioned including those that were installed to fight the fire.



As with many fires, the B&B Complex is being used as a natural laboratory for the study of fire behavior and recovery. This is consistent with the **adaptive management** approach to natural resource management, in which manipulations are seen as experiments with uncertain outcomes. Monitoring is required to see if the desired outcomes are met as a result of these manipulations. One of these studies (The Repeat Photography Grid Project) plans to conduct a systematic photographic inventory of the entire area affected by the B&B Complex Fire. First, grid points are established and identified by GPS coordinates. Each point is then photographed with a 360-degree panoramic digital sequence as well as individual photographs of plants, animals and unique site features. This photographic record is used to create a baseline dataset, which can be used to help monitor future environmental changes. The study is a joint project of Oregon State University, USDA Forest Service Pacific Northwest Research Station and Oregon Websites and Watersheds Project, Inc.

www.orww.org/B&B_Complex/Repeat_Photography_Grid/index.html



•This was a large fire that (at least at lower elevations) was uncharacteristic in size and intensity compared to historical fires. At higher elevations (within wilderness area) stand replacement fires were more common, but were probably not as large as this fire.

•At $39.2 million, cost of suppression was a significant expenditure of (mostly) public funds

•Although <2% of the area showed detrimental soil damage, until vegetation becomes re-established there will be increased risk for erosion and increased water flows.

•Fire severity measurements indicate high (>75%) tree mortality over 44% of affected area within the Sisters Ranger District.

•Approximately 113,000 trees >21” diameter were killed (17% of large trees in the Metolius River watershed). As a late successional species, spotted owls were among those species most seriously affected - loss of 43% of spotted owl habitat.

•With loss of vegetation there are several potential impacts on streams including increased flows (due to loss of evapotranspiration carried out by plants), increased nutrient input (due to erosion) and increased stream temperatures (due to loss of shading). Rivers and streams in this area are important habitat for several salmonid species – bull trout, redband trout, salmon.

•Increased spread of noxious weeds as a result of disturbance

•Social impacts – loss or change of scenic values due to fire and smoke, impacts on local businesses due to road closures during suppression efforts, loss of tourism and recreation income during and after fire (camping, fishing, hiking)

Natural recovery is well underway in the B&B burn area, even in the most intensely burned areas. Lodgepole pine seedlings, for example, are now abundant and growing rapidly around Round Lake, one of the most severely affected areas.

END – Another view of fire recovery at Round Lake

For many areas in the western U.S., the stage has been set for uncharacteristically intense fires such as the B&B Complex. Effective management of these forests will require an understanding of the role of fire in these ecosystems, historical fire regimes and the impacts of human activities. Management strategies that incorporate this understanding are more fully discussed in other NSCR Fire Modules (see *Historical Fire Regimes and their Application to Forest Management* and *Pre-fire Intervention: Thinning and Prescribed Fire*).

EXTRA PHOTOS

These photos were taken within the area affected by the B+B Complex in August 2007. The photo on the left was taken at Corbett Sno-Park and illustrates the mosaic nature of the fire and the degree of natural recovery approximately 4 years post-fire. Dominant trees are Ponderosa pine in a mixed conifer forest. The lone peak seen in the distance is Mt. Washington.

The photo on the right illustrates recovery 4 years post-fire in a Lodegpole pine dominated forest near Round Lake. The plant in the lower left is Pearly everlasting, a common early successional species.

Photo Credits

- NCSR – Wynn W. Cudmore PhD, Lester W. Reed PhD
- The Nature Conservancy www.tncfire.org
- US Forest Service: Deschutes & Ochoco National Forests, Sue Stewart and Pete Miles www.fs.fed.us
- Oregon Websites and Watershed Project www.orww.org

RESOURCES

Print and Web-based Resources:

Arno, S.F. and S. Allison-Bunnell. 2002. Flames in our forest - disaster or renewal. Island Press. Washington, D.C. 227 pp.

Arno, S.F. and C.E. Fiedler. 2005. Mimicking nature's fire: Restoring fire-prone forests in the West. Island Press. Washington, D.C. 242 pp.

Agee, J.K. 1993. Fire ecology of Pacific Northwest forests. Island Press. Washington, D.C. 493 pp.

B&B Complex Repeat Photography Grid Project
www.orww.org/B&B_Complex/Repeat_Photography_Grid/index.html

The Repeat Photography Grid Project is one of several studies designed to monitor post-fire recovery in the area affected by the B&B Complex Fires. The study is a joint effort of Oregon State University, USDA Forest Service Pacific Northwest Research Station and Oregon Websites and Watersheds Project, Inc. Researchers plan to conduct a systematic photographic inventory of the entire area affected by the B&B Complex Fire.

Grid points are established and identified by GPS coordinates and then each point is photographed with a 360-degree panoramic digital sequence. This photographic record is used to create a baseline dataset, which can be used to help monitor future environmental changes. All photos and a description of the study design are posted on the Oregon Websites and Watersheds website.

B&B Complex References
www.orww.org/B&B_Complex/References/

This site, maintained by Oregon Websites and Watersheds Project, Inc., posts citations and links to a variety of different resources pertinent to the B&B Complex Fire. Texts, journal articles, media accounts, multimedia presentations, maps and GIS layers are all included. Instructors will find this to be a useful resource for background on this fire.

Brown, J.K. and J.K. Smith (eds.). 2000. Wildland fire in ecosystems: effects of fire on flora. Gen. Tech. Rep. RMS-GTR-42-vol 2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 257 pp.

This comprehensive review of our state-of-knowledge on the effects of fire on ecosystems is the second in a five-part series entitled "The Rainbow Series". This volume emphasizes fire regimes, the effects of fire on plants and post-fire plant community development. Other volumes evaluate other ecosystem components such as animals, cultural resources, soil, water and air. Paper copies of these documents can be ordered from:

Fort Collins Service Center
Publications Distribution
Rocky Mountain Research Station
240 W. Prospect Rd.
Fort Collins, CO 80526-2098
970-498-1392
rschneider/rms@fs.fed.us
www.fs.fed.us/rm

The 5-part series is also available for download on-line at:

http://www.fs.fed.us/rm/pubs/rmrs_gtr042_1.html	Effects of Fire on Flora
http://www.fs.fed.us/rm/pubs/rmrs_gtr042_2.html	Effects of Fire on Fauna
http://www.fs.fed.us/rm/pubs/rmrs_gtr042_3.html	Effects of Fire on Cultural Resources
http://www.fs.fed.us/rm/pubs/rmrs_gtr042_4.html	Effects of Fire on Soil and Water
http://www.fs.fed.us/rm/pubs/rmrs_gtr042_5.html	Effects of Fire on Air

Carr, M. 2005. Wildland Waters USDA Forest Service. Summer 2005 FS-828. 22 pp.

This special issue on fire provides an excellent general introduction to the fire issue. Most aspects are briefly addressed including fire regimes, fuels management, restoration, fire responses, salvage logging, and rehabilitation. Links to additional resources are provided.

Noss, R.F., J.F. Franklin, et al. 2006. Managing fire-prone forests in the western United States. Front. Ecol. Environ 4(9):481-487.

This is an excellent review of the literature on the ecology and management of fire-prone forests in the western United States. The article and the references cited within should provide faculty with a comprehensive understanding of this complex issue. It has also been posted on-line by the Ecological Society of America at www.frontiersinecology.org.

Oregon Forest Resources Institute
www.oregonforests.org

The Oregon Legislature created the Oregon Forest Resources Institute (OFRI) in 1991 to improve public understanding of the state's forest resources and to encourage environmentally sound forest management through training and other educational programs for forest landowners. OFRI is funded by a dedicated harvest tax on forest products producers. Two OFRI documents are particularly relevant to this module:

OFRI. 2002. Fire in Oregon's forest. A Special Report form the Oregon Forest Resources Institute. Portland, Oregon. 16 pp.

OFRI. 2004. Forest fire risk and restoration. A Special Report form the Oregon Forest Resources Institute. Portland, Oregon. 17 pp.

Pyne, S.J. 2005. Tending fire. Island Press. Washington, D.C. 240 pp.

This book by a prominent wildfire researcher provides an in-depth evaluation of both fire suppression and "let burn" policies.

USDA Forest Service – Fire Effects Information System
www.fs.fed.us/database/feis

This Forest Service web site summarizes and synthesizes current research about living organisms' relationships to fire. If you are looking for species-specific information (photos, distribution, ecological characteristics, fire ecology, fire effects, management considerations) for plant and animal species in the U.S., this should be your first stop. Trees, shrubs, lichens, vertebrate animals and some arthropods are included. The site is easy to use and well-referenced for further research.

USDA Forest Service – Deschutes and Ochoco Forests – B&B Complex Fires
www.fs.fed.us/r6/centraloregon/fires/2003/b-b/index.shtml

This Forest Service web site summarizes all information specific to the 2003 B&B Complex Fires in Central Oregon. Historical information, fire progression, aerial photographs and satellite images are included.

Weisberg, P.J and F.J. Swanson. 2003. Regional synchroneity in fire regimes of western Oregon and Washington, USA. Forest Ecology and Management 172(2003):17-28.

This study is an example of how an analysis of fire scars can be used to reconstruct fire histories.

Video Resources:

Biscuit Fire. 2003. Oregon Field Guide. Oregon Public Broadcasting, Portland, Oregon. 30 min.

Oregon Public Broadcasting
714 SW Macadam Avenue
Portland, OR 97219-3009
www.opb.org/programs

This special production by Oregon Field Guide examines wildland fire issues related to the 2002 Biscuit Fire in southwest Oregon and northern California. Several perspectives are presented including those of the USDA Forest Service, the timber industry, fire ecologists and environmental groups. Although the details may differ, most of the issues associated with the Biscuit Fire also pertain to the B & B Complex Fire and wildfires in general.

Fighting Fire with Fire. 2005. The Nature of Things, Canadian Broadcasting Company.

Bullfrog Films
P.O. Box 149, Olney, PA 19547
800-543-3764
www.bullfrogfilms.com

This 45-minute production narrated by David Suzuki provides an excellent introduction to our current thinking on fire management. Although the emphasis is on fire issues in Banff National Park and Yellowstone National Park, the concepts discussed may be broadly applied across the West. The influence of past fire fighting policy, the current condition of western forests, thinning and prescribed fire, the ecological role of fire, and the implications of global climate change are all examined.

The Oregon Story: Rethinking the forests. 2005. Oregon Public Broadcasting, Portland, Oregon. 60 min.

Oregon Public Broadcasting
714 SW Macadam Avenue
Portland, OR 97219-3009
www.opb.org/programs/oregonstory

This video production, designed for a general audience, addresses forest-related issues in Oregon. The history of the logging industry, management of public vs. private forests, old growth forest and spotted owl issues, the Oregon Forest Practices Act and fire-related issues are all discussed. Those portions that address the role of fire in Oregon's forests are relevant to this module.

Prescribed Natural Fire. 2001. Oregon Field Guide. Oregon Public Broadcasting, Portland, Oregon. 15 min.

Prescribed Natural Fire - Update. 2002. Oregon Field Guide. Oregon Public Broadcasting, Portland, Oregon. 15 min.

While these two "Oregon Field Guide" videos emphasize prescribed fire as a management tool, the concepts introduced in this module are also covered.

BAER Soil Burn Severity Class Criteria

The table below summarizes the criteria that are used to assign areas to soil burn severity categories as well as predicted impacts on vegetation.

Soil Burn Severity Class	Substrate	Understory and Shrub Vegetation	Overstory
Unburned	Not burned	Not burned	No fire-caused mortality
Low	Mineral soil unchanged; litter layer charred or partially consumed; litter components charred but recognizable	Foliage and small twigs (<1/4 inch) consumed	Slight tree mortality, but usually less than 10%
Moderate	Moderate soil heating and ground char; litter mostly charred but not ashed; some areas of litter consumption; duff and wood partly consumed; burned roots still present	Foliage, twigs and small stems (1/4 – ¾ inch) consumed; shrub stems charred; shrub canopy consumed	Tree mortality highly variable; seedlings usually consumed; large trees often killed but retain some fine twigs, cones and leaves; area is not usually dominated by blackened trunks
High	High soil heating; litter and duff consumed, often leaving 1 to 2 inches of gray or white ash; surface soil visibly altered, often blackened and lacking structure; all surface organic matter and fine roots consumed; large fuels nearly completely consumed	All major plant parts consumed including fuels > ¾ inch; few or no major stems of shrubs remain	Generally 80-90% tree mortality; area dominated by blackened trunks; some pockets of live trees may remain