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2013 Wildfire Season: An Overview

Southwestern U.S.

February 2014

NORTHERN ARIZONA UNIVERSITY
Ecological Restoration Institute

SOUTHWEST FIRE SCIENCE CONSORTIUM

Intermountain West Frequent-Fire Forest Restoration

Ecological restoration is a practice that seeks to heal degraded ecosystems by reestablishing native species, structural characteristics, and ecological processes. The Society for Ecological Restoration International defines ecological restoration as "an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability….Restoration attempts to return an ecosystem to its historic trajectory" (Society for Ecological Restoration International Science & Policy Working Group 2004).

Most frequent-fire forests throughout the Intermountain West have been degraded during the last 150 years. Many of these forests are now dominated by unnaturally dense thickets of small trees, and lack their once diverse understory of grasses, sedges, and forbs. Forests in this condition are highly susceptible to damaging, stand-replacing fires and increased insect and disease epidemics. Restoration of these forests centers on reintroducing frequent, low-severity surface fires—often after thinning dense stands—and reestablishing productive understory plant communities.

The Ecological Restoration Institute at Northern Arizona University is a pioneer in researching, implementing, and monitoring ecological restoration of frequent-fire forests of the Intermountain West. By allowing natural processes, such as low-severity fire, to resume self-sustaining patterns, we hope to reestablish healthy forests that provide ecosystem services, wildlife habitat, and recreational opportunities.

The Southwest Fire Science Consortium (SWFSC) is a way for managers, scientists, and policy makers to interact and share science. SWFSC's goal is to see the best science used to make management decisions and scientists working on the questions managers need answered. The SWFSC tries to bring together localized efforts to develop scientific information and to disseminate that to practitioners on the ground through an inclusive and open process.

This publication would not have been possible without funding from the USDA Forest Service and the Southwest Fire Science Consortium. The views and conclusions contained in this document are those of the author(s) and should not be interpreted as representing the opinions or policies of the United States Government. Mention of trade names or commercial products does not constitute their endorsement by the United States Government or the ERI.

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Cover Photo: The Doce (pronounced "Dough-see") Fire burned approximately 8 miles northwest of Prescott, Arizona near Granite Mountain. The western edge of the fire threatened American Ranch and other nearby developments but was contained before reaching any structures. *Photo courtesy of the U.S. Department of Agriculture*, www.creativecommons.org/licenses/by/2.0

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Introduction

Each year numerous fires burn through the Southwest, and even for fire managers and researchers it can be difficult to keep the details of each fire straight. The public hears a great deal about fires as they burn, but rarely do they see follow up information on burn severity or comparisons between fires. This report is an attempt to fill the need for a concise, timely publication that summarizes the season's fire details in the Southwest. The goal of this overview is to provide a single source for information on the 2013 fire season for quick reference and to move the conversation beyond the simplistic "acres burned." More specifically, this report describes the vegetation impacted by each fire and the degree to which fires affect resources including soils, vegetation and structures.

This overview includes the four largest fires from New Mexico and Arizona: Jaroso, Silver, Thompson Ridge, and Tres Lagunas in New Mexico and Dean Peak, Doce, Soldier Basin, and Yarnell Hill in Arizona (Figure 1). These fires represent less than 1% of all fires in the Southwest, but make up 68% of the area burned by wildfire in 2013. The conclusion compares these fires and illustrates regional trends from the season.

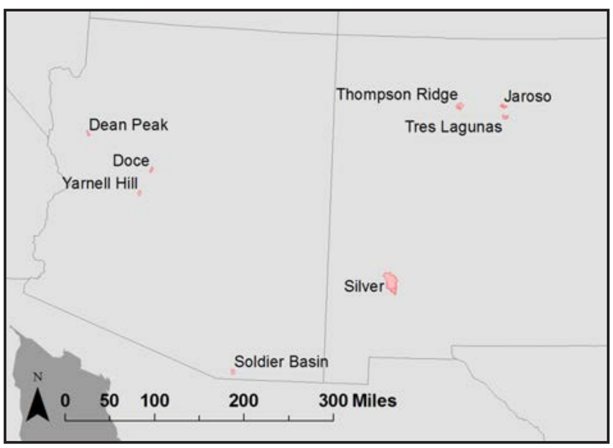

Figure 1. The eight large fires from 2013 analyzed in this report.

The analysis for this report was completed using only publicly available datasets, described in the Data Sources section. Each of these datasets provides some key information for each of these fires, including:

- Area burned by forest type,
- Soil burn severity,
- Canopy cover mortality,
- Area burned in the wildland-urban interface (WUI), and
- Pervious burn scars in the area.

While some of this information is preliminary and much of it is based on remote sensing rather than field measurements, to date, it provides the best available overview of the large fires in the Southwest in 2013.

Regional Context

Each year wildfires burn thousands of acres in the Southwest, and 2013 was no exception. Since 2002, an average of nearly 700,000 acres have burned in a wildfire each year and in 2013 wildfires burned about 317,000 acres (Figure 2). There was a severe and long term drought across much of the region as the 2013 fire season started. The continuing drought reduced the quantity of fine fuels in New Mexico, while in Arizona the 2012 monsoon and wetter winter allowed for about normal availability of fine fuels. Temperatures were a little higher than the historic average during the spring for the region, but were closer to normal for the rest of the season. The significant precipitation brought by the summer monsoons helped improve drought conditions across the region.

Data Sources

Most details on the 2013 fires were drawn from the Inciweb website. Inciweb (*www.inciweb.org/*) is an interagency information management system designed to provide the public with a single source of incident related information. Boundaries for each fire were taken from the Geospatial Multi-Agency Coordination (GeoMAC) archive of fire perimeter maps (*rmgsc.cr.usgs.gov/outgoing/GeoMAC/*). GeoMAC also provides the perimeters of fires back to 2000, which provided a historic context for this year's fires.

LANDFIRE: Vegetation

Basic information about the vegetation and topography of the area burned is available from the LANDFIRE project (*www.landfire.gov*). LANDFIRE provides nationally consistent, scientifically based maps of existing vegetation as well as vegetation condition class (VCC). VCC was formerly referred to as Fire Regime Condition Class or FRCC. VCC is a map of how the existing vegetation has departed from an estimated natural or historic condition. In the Southwest, this departure is generally due to a lack of fire, past logging, and grazing and results in greater density of trees and less healthy conditions. VCC is a particularly useful metric because it integrates information on existing vegetation, historic vegetation, and fire regimes into one variable and has been used to help determine where to focus restoration efforts.

Wildland-Urban Interface (WUI)

Another geospatial dataset that helps put fires in context is the location and density of housing, often referred to as the WUI. The Silvis Lab at University of Wisconsin developed a nationwide map of WUI based on U.S. Census data (*silvis.forest.wisc.edu/maps/wui/2010/download*). The Silvis map uses fairly standard definitions of the two main WUI conditions: intermix (one or more structures per 40 acres) and interface (three or more structures per acre, with shared municipal services). This report tallies the area that burned in the WUI during each fire.

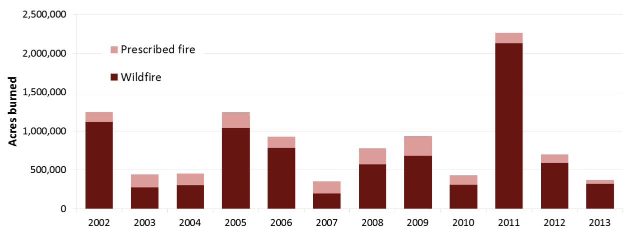

Figure 2. Wildfires and prescribed fires in Arizona and New Mexico based on National Interagency Fire Center data.

Soil Burn Severity

Soil burn severity maps provide Burned Area Emergency Response (BAER) teams a method to quantify soil impacts and the potential for post-fire erosion (activefiremaps.fs.fed.us/baer/download.php). In the immediate aftermath of a fire, BAER teams perform an emergency assessment of post-fire soil conditions based on a combination of field observations and remote sensing change detection products derived from the Differenced Normalized Burn Ratio (dNBR). The dNBR measures the change in the ratio of the near infrared reflected by healthy green vegetation to the shortwave infrared reflected by bare soil and rock. Soil burn severity maps typically have four classes: high, moderate, low, and unburned while others combine the last two categories into a "low/unchanged" category.

Rapid Assessment of Vegetation Condition after Wildfire (RAVG)

The RAVG map is also a map of burn severity, but instead of soil burn severity RAVG estimates canopy mortality (*www.fs.fed.us/postfirevegcondition*). The U.S. Forest Service Remote Sensing Applications Center provides the RAVG analysis as a first approximation of areas that may require reforestation treatments because of canopy killed by high severity fire. RAVG maps are created for fires greater than 1,000 acres on U.S. Forest Service lands or fires where it is requested. The maps are produced by measuring the change between a satellite image before and immediately after a wildfire using an algorithm called Relative Differenced Normalized Burn Ratio (RdNBR), which is sensitive to vegetation mortality resulting from the wildfire event. The RdNBR is derived directly from the dNBR but is more sensitive to vegetation mortality than the dNBR.

While soil severity maps and RAVG canopy mortality maps use satellite change detection methods, they measure fundamentally different forest attributes. In many areas of the 2013 fires, canopy mortality and soil burn severity patterns are similar. However, in some vegetation types such as chaparral or grass it is possible for a fire to cause complete canopy mortality with little effect on soils.

Caveats

There are important caveats for all the data used in this summary. First, the fire information presented here was taken from official sources in September 2013 and so may not include updates or revisions. Second, the geospatial data used to generate the maps and tables is also based on the best available information, but these data have errors and uncertainties. For example, the remote sensing data used in all these datasets can include errors introduced during collection, processing, and interpretation. Management decisions should be based on more detailed observations on the ground.

Jaroso Fire

The Jaroso Fire started in the Pecos Wilderness of the Santa Fe National Forest in New Mexico on the afternoon of June 10 and burned a total of 11,149 acres. The fire burned through heavy fuels including 1,300 acres of dead trees that had been blown over by a wind event six years ago.[1]

Vegetation, Past Fires, and Wildland-Urban Interface

The majority of the Jaroso Fire burned in the spruce/fir forest type (78%) with a much smaller percentage in the mixed conifer type (20%). Historically, spruce/fir experienced an infrequent, stand replacing fire regime. The remaining vegetation types in the Jaroso Fire perimeter included mixed conifer, made up of ponderosa pine, Douglas-fir, true firs, and aspen, which historically burned more frequently than spruce/fir types, but still often experienced patches of complete canopy mortality. The range of fire return interval in southwestern mixed conifer forests was wide (from 1 to almost 80 years between fires), but 14 years between fires was more common.[2] The majority of the Jaroso Fire area was categorized in LANDFIRE as moderately departed from historic conditions. In other words, composition and structure of vegetation and fuel were only moderately different from estimates of natural conditions. Most of the area coded as highly departed from historic conditions within the Jaroso Fire perimeter were mixed-conifer forests. Since spruce/fir forests burn less frequently and therefore have probably not missed many fire entries, they tended to be mapped as only moderately different from estimates of natural conditions.

Vegetation Departure (VCC)	Percent within Fire Perimeter
Low	0%
Moderate	86%
High	13%

Though no fires burned within the Jaroso Fire perimeter since 2000, three fire scars were nearby, including the Pacheco Fire from 2011. Though the Jaroso Fire burned entirely within the Pecos Wilderness of the Santa Fe National Forest, the WUI maps coded almost all of the area very low density development (91%) and a small portion as uninhabited (9%).

[1] Data from Inciweb http://inciweb.nwcg.gov/incident/3416/

[2] Evans, A. M., R. Everett, S. Stephens, and J. Youtz. 2011. A Comprehensive Guide to Fuels Treatment Practices for Mixed Conifer Forests: California, Central and Southern Rockies, and the Southwest. The Forest Guild, Santa Fe, NM. http://www.firescience.gov/projects/09-2-01-7/project/09-2-01-7_final_report.pdf

Fire Severity

Based on the soil burn severity map, most of the Jaroso Fire burned with high to moderate soil effects.

Soil Burn Severity	Percent within Fire Perimeter
Low	55%
Moderate	11%
High	34%

As should be expected for these vegetation types, the RAVG data presents a similar picture of fire severity with the majority of the burn perimeter experiencing 75% and greater canopy mortality. However, nearly a third of the area had less than 25% canopy mortality.

Canopy Cover Mortality	Percent within Fire Perimeter
0% canopy cover mortality	17%
0% <= CC mort < 25%	15%
25% <= CC mort < 50%	5%
50% <= CC mort < 75%	4%
CC mort >= 75%	54%

The Jaroso Fire caused high soil burn severity in 66% of the blowdown area (as mapped in the LANDFIRE system) and 75% to complete canopy mortaility in 75% of the blowdown area (Figures 3 and 4). Perhaps more surprising, given the density of fuel, is that the fire had little or no effect on soils on 17% of the blowdown area and had little or no canopy mortality in 11% of the blowdown area. The distribution of soil burn severity and canopy mortality is similar across the forest types (Figures 5 and 6). The high severity effects observed in this fire appear to fit expectations for historic fire regimes in spruce/fir forests.

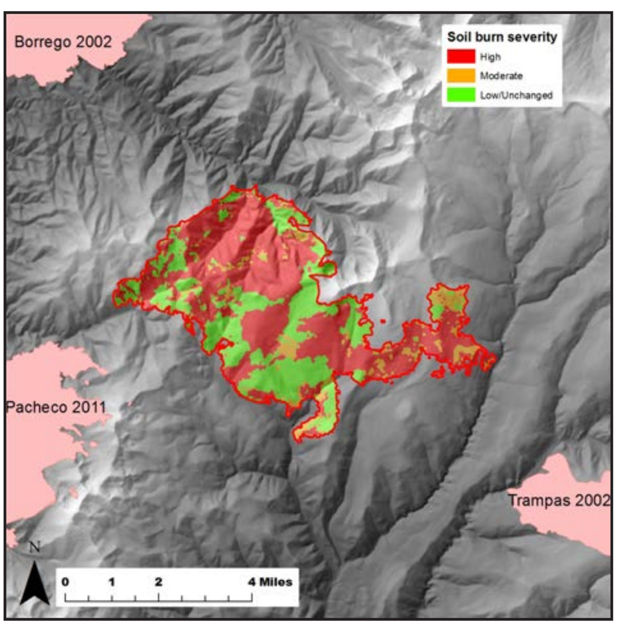

Figure 3. Soil burn severity map for the Jaroso Fire.

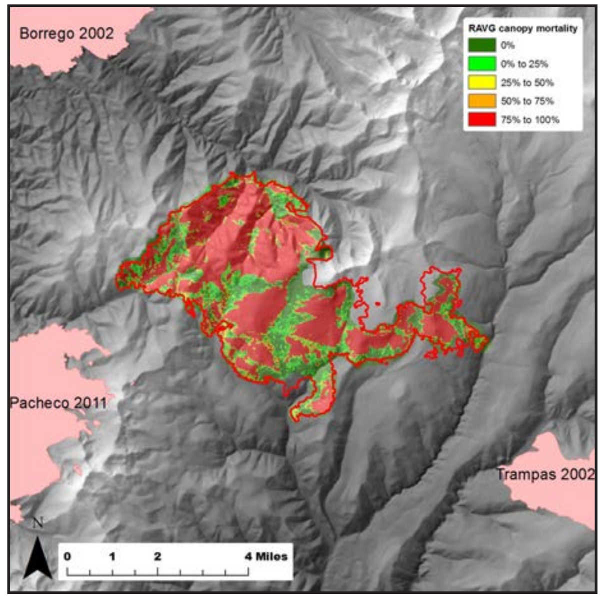

Figure 4. RAVG canopy mortality map for the Jaroso Fire.

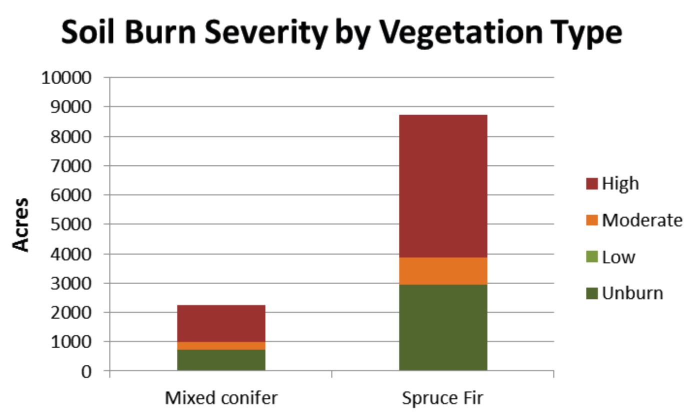

Figure 5. Soil burn severity by vegetation type for the Jaroso Fire.

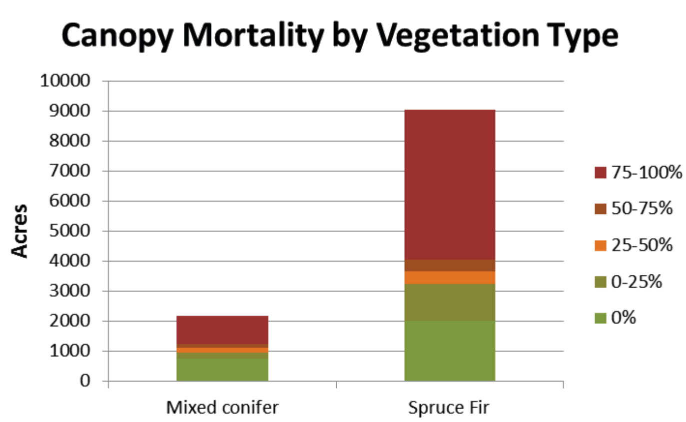

Figure 6. Canopy mortality by vegetation type for the Jaroso Fire.

Silver Fire

The Silver Fire was started by lightning on June 7. The fire burned on the Gila National Forest in southwestern New Mexico and caused the evacuation of the town of Kingston. Two weeks later, the fire had burned 138,705 acres, making it the largest fire in the Southwest in 2013.[3]

Fire Severity

Soil burn severity maps show that the majority of the Silver Fire had low impact on soils. In fact, only 15% of the fire burned with high severity effects on soil. However, because of the large size of the fire, 15% means more than 20,000 acres of high soil severity (Figure 7).

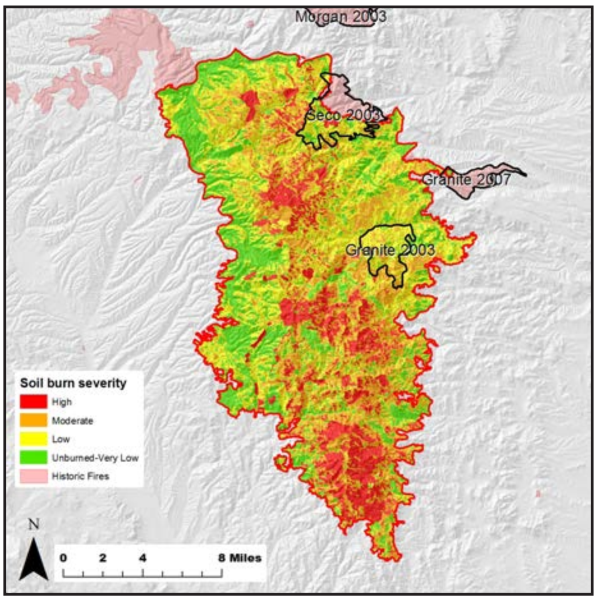

Figure 7. Soil burn severity map for the Silver Fire.

Soil Burn Severity	Percent within Fire Perimeter
High	15%
Moderate	27%
Low	32%
Very Low/Unburned	25%

The RAVG data suggest that there were significant areas where there was 75% or greater canopy mortality but soil impacts for the same location were still estimated to be less than high severity. Less than 25% of the canopy was killed in the majority of the Silver Fire (Figure 8).

Canopy Cover Mortality	Percent within Fire Perimeter
0% canopy cover mortality	29%
0% <= CC mort < 25%	24%
25% <= CC mort < 50%	12%
50% <= CC mort < 75%	11%
CC mort >= 75%	25%

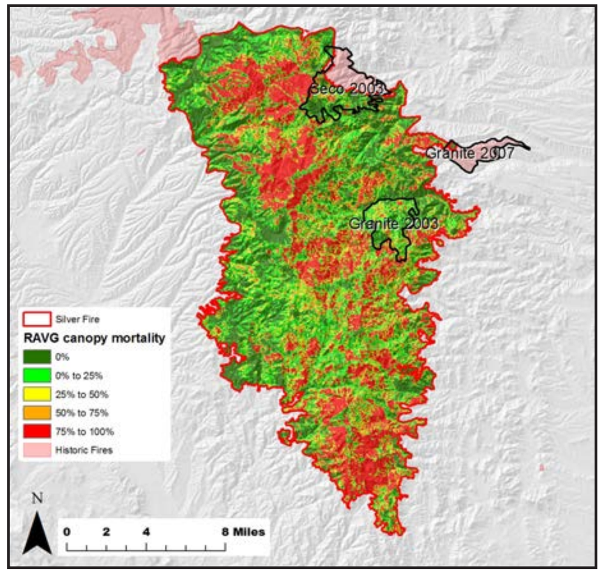

Figure 8. RAVG canopy mortality map for the Silver Fire.

Mixed-conifer forests had the highest precentage of high severity effects on soil and the highest precentage of high canopy mortality (Figures 9 and 10). In constrast, only a small precentage of ponderosa pine burned at high severity as measured by either soil severity or canopy mortality. The differences between the burn severity in these two forest types appear to line up with their respective historical fire regimes. Ponderosa pine historically burned with high frequency and low severity while mixed conifer historically experienced less frequent fire with mixed-severity effects.

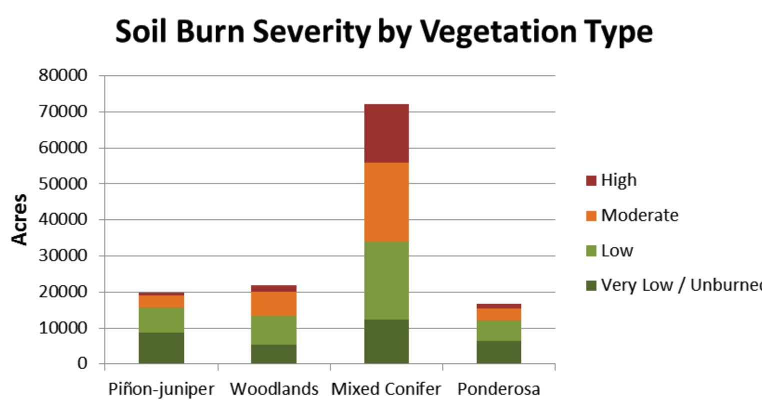

Figure 9. Soil burn severity by vegetation type for the Silver Fire.

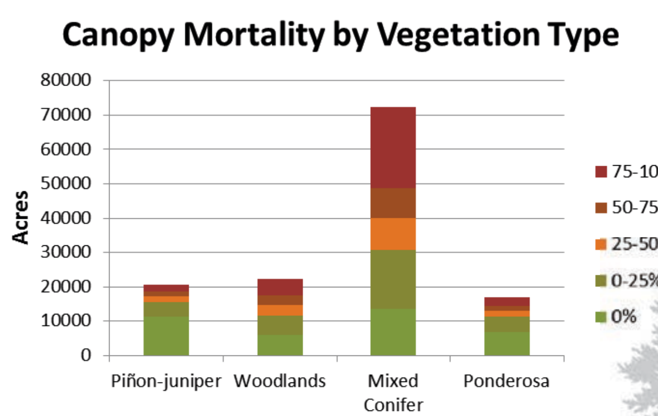

Figure 10. Canopy mortality by vegetation type for the Silver Fire.

[3] Data from Inciweb http://inciweb.nwcg.gov/incident/3414/

Thompson Ridge Fire

On May 31, a downed power line about 2 miles northeast of La Cueva, New Mexico started the Thompson Ridge Fire. By July 1, the fire was declared contained, but had burned 23,965 acres. The fire burned mainly in the Valles Caldera National Preserve.[4]

Vegetation, Past Fires, and Wildland-Urban Interface

Based on the LANDFIRE existing vegetation layer, the majority of the Thompson Ridge Fire was mixed-conifer forests with small portions of ponderosa pine, spruce/fir, and grasslands. Historically mixed conifer fire regimes were more frequent than fires in spruce/fir but less frequent than fires in ponderosa pine.

Vegetation Type	Percent within Fire Perimeter
Mixed conifer	81%
Ponderosa	6%
Spruce/Fir	4%
Grassland	4%

About 2% of the Thompson Ridge Fire burned within an area previously burned by the Las Conchas Fire of 2011. More importantly, a significant portion of the eastern perimeter of the Thompson Ridge Fire was coincident with the Las Conchas Fire perimeter. Based on the LANDFIRE maps, most of the Thompson Ridge Fire burned through areas that were moderately departed from historic conditions, but nearly 40% of the burn area had been highly departed from historic conditions.

Vegetation Departure (VCC)	Percent within Fire Perimeter
Low	2%
Moderate	60%
High	38%

The Thompson Ridge Fire burned within the Valles Caldera National Preserve, which contains historic cabins and some administrative buildings, but no private property. However, several nearby communities (Thompson Valley, Rancho de la Cueva and Elk Valley) were evacuated because of the Thompson Ridge Fire. Most of the area burned was classified as very low density development (63%) and 37% was classified at uninhabited.

Fire Severity

Very little of the Thompson Ridge Fire had severe effects on soil. In fact almost 75% of the fire had low to no effect on soils according to the soil burn severity map (Figure 11). No high soil burn severity was mapped within the Thompson Ridge Fire area that had previously burned in the Las Conchas Fire.

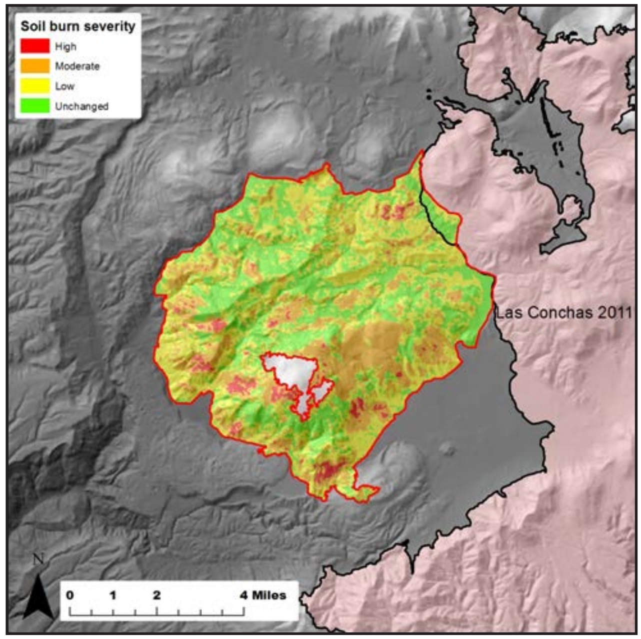

Figure 11. Soil burn severity map for the Thompson Ridge Fire.

Soil Burn Severity	Percent within Fire Perimeter
High	3%
Moderate	23%
Low	40%
Unburned	34%

In contrast to the soil burn severity map, the RAVG map of canopy mortality shows nearly a third of the burn area experienced 75% to complete canopy mortality (Figure 12). Most of the high canopy mortality occurred in the mixed conifer forest type.

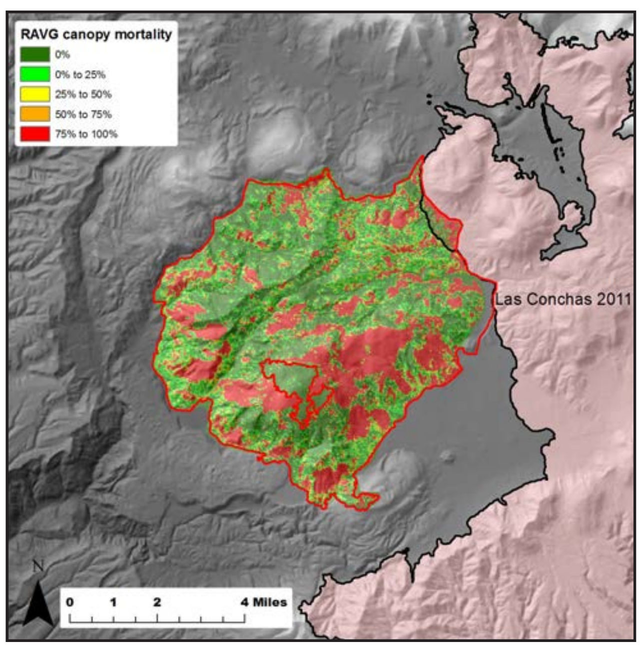

Figure 12. RAVG canopy mortality map for the Thompson Ridge Fire.

[4] Data from Inciweb http://inciweb.nwcg.gov/incident/3404/

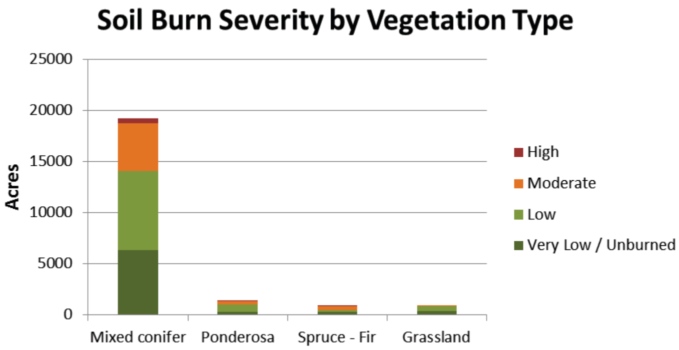

Figure 13. Soil burn severity by vegetation type for the Thompson Ridge Fire.

Canopy Cover Mortality	Percent within Fire Perimeter
0% canopy cover mortality	34%
0% <= CC mort < 25%	22%
25% <= CC mort < 50%	8%
50% <= CC mort < 75%	6%
CC mort >= 75%	29%

Since the area burned was dominated by mixed-conifer forests, the comparisons of burn severity by vegetation type largely reflect the overall burn severity percentages (Figures 14 and 15).

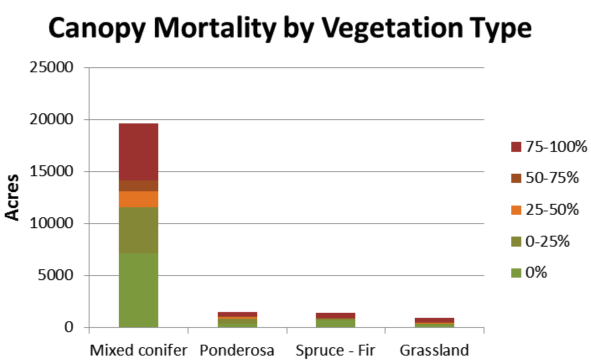

Figure 14. Canopy mortality by vegetation type for the Thompson Ridge Fire.

Tres Lagunas Fire

Like the Thompson Ridge Fire, the Tres Lagunas Fire was started by a downed power line. It is worth noting that the 2011 Las Conchas Fire was also started by a downed power line. The Tres Lagunas Fire started on May 30 about 10 miles north of Pecos, New Mexico. By the time the fire was contained on June 21, it had burned 10,219 acres.[5]

Vegetation, Past Fires, and Wildland-Urban Interface
Most of the vegetation that burned in the Tres Lagunas Fire was classified as mixed-conifer forests. As mentioned above, mixed-conifer forests have a variety of species including ponderosa pine, limber pine, Douglas-fir, true firs, and aspen. In the southwest before European settlement, mixed-conifer forests burned every 14 years on average but could have a fire-free period of 30 years.

Vegetation Type	Percent within Fire Perimeter
Mixed Conifer	80%
Ponderosa	7%
Spruce/Fir	7%
Grassland	2%

Since much of the area that burned in the Tres Lagunas Fire had not burned since 2000 (in fact the area had not burned for longer than 30 years), the majority was coded as highly departed from historic conditions. However, 40% (4,079 acres) of the Tres Lagunas Fire burned in the scar of the Vivash Fire of 2000. The area that burned in the Vivash Fire was coded as either moderate or low departure from historic conditions and almost all of the vegetation in the highly departed condition was outside the Vivash burn scar.

Vegetation Departure (VCC)	Percent within Fire Perimeter
Low	16%
Moderate	29%
High	55%

According to the WUI map, the Tres Lagunas Fire burned in very low density (33%) or uninhabited areas (67%). However, it did burn four and eight acres of intermix and interface WUI, respectively.

Fire Severity
The majority of the Tres Lagunas Fire was mapped as "low/unchanged" on the soil burn severity map (Figure 15). Only a small patch of the area that burned in the Vivash Fire was mapped with high soil burn severity and the vast majority was in the "low/unchanged" category.

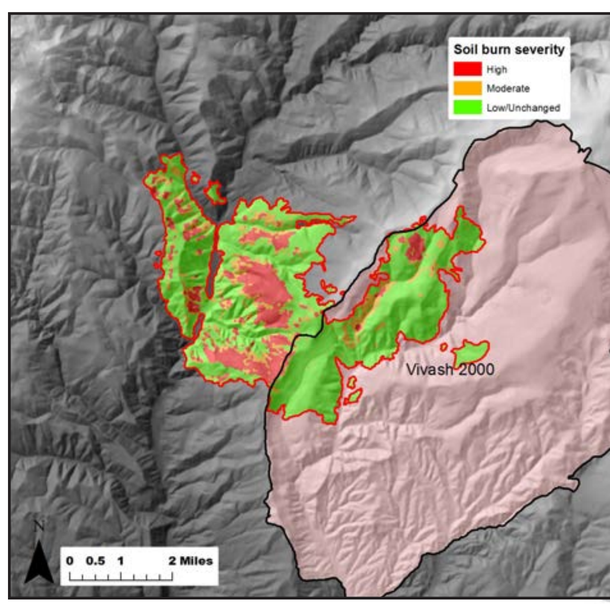

Figure 15. Soil burn severity map for the Tres Lagunas Fire.

[5] Data from Inciweb http://inciweb.nwcg.gov/incident/3401/

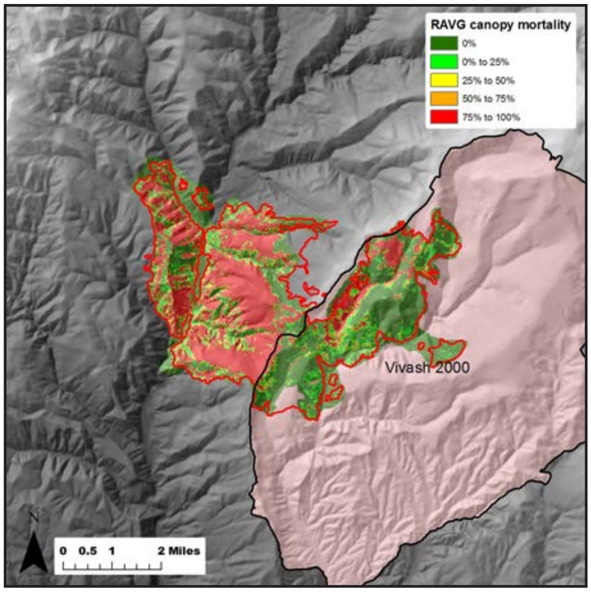

Figure 16. RAVG canopy mortality map for the Tres Lagunas Fire.

Canopy Cover Mortality	Percent within Fire Perimeter
0% canopy cover mortality	33%
0% <= CC mort < 25%	15%
25% <= CC mort < 50%	6%
50% <= CC mort < 75%	5%
CC mort >= 75%	38%

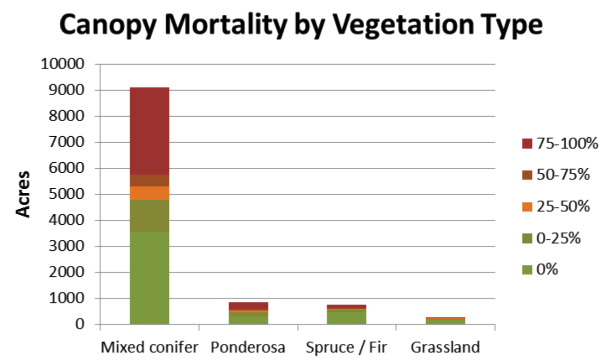

Figure 18. Canopy mortality by vegetation type for the Tres Lagunas Fire.

Soil Burn Severity	Percent within Fire Perimeter
High	15%
Moderate	13%
Low/Unchanged	72%

The RAVG canopy cover mortality map presents a different picture (Figure 16). Nearly 40% of the Tres Lagunas Fire had 75% to complete canopy mortality. Large portions of the Tres Lagunas Fire burned with little effect on soils but with significant changes to the canopy (Figures 18 and 19). The majority of the area with less than 25% canopy mortality was in the Vivash Fire burn scar. This highlights the complexity of measuring change or canopy mortality via satellite after an area reburns. It may be that many seedlings were killed by the Tres Lagunas Fire in the Vivash Fire scar, but because of their size, the satellite registered minimal change. This type of complexity in reburn areas calls for more research and detailed study.

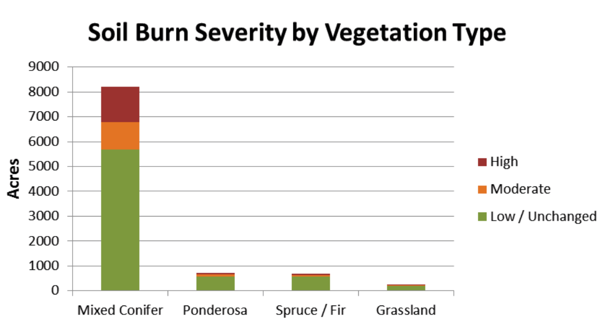

Figure 17. Soil burn severity by vegetation type for the Tres Lagunas Fire.

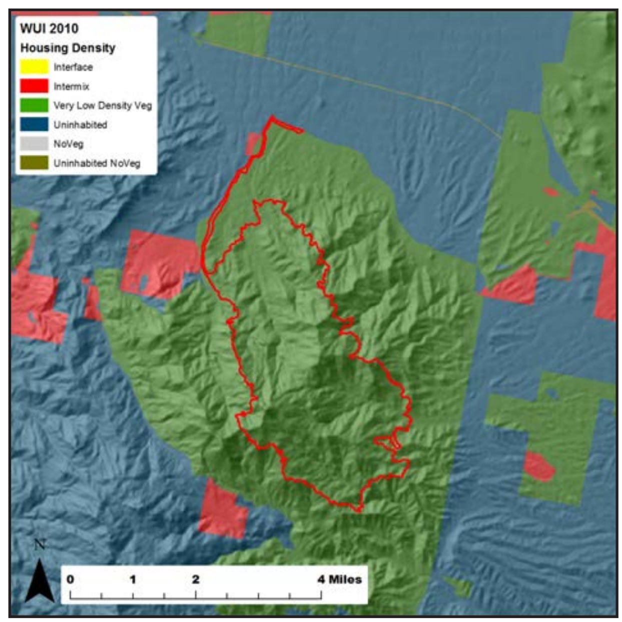

Figure 19. Map of land use near the Dean Peak Fire.

Dean Peak Fire

The Dean Peak Fire started June 29 in the afternoon about 10 miles southeast of Kingman, Arizona, in the Hualapai Mountains. There is less information about the Dean Peak Fire than most of the fires in this report. This is in part because it did not burn on land managed by the U.S. Forest Service. Some datasets, particularly burn severity, are not created for all fires. For example, RAVG data is not created for a fire unless it burns 1,000 acres of forested National Forest System lands. The fire burned on lands managed by the Bureau of Land Management, the state of Arizona, and private landowners. By the time crews were able to fully contain the fire it burned 5,400 acres.[6]

Vegetation, Past Fires, and Wildland-Urban Interface
The majority of the Dean Peak Fire burned in piñon-juniper woodlands with scattered areas of ponderosa on the higher elevations and chaparral on the lower elevations.

Vegetation Type	Percent within Fire Perimeter
Mixed conifer	82%
Ponderosa	7%
Spruce/Fir	2%
Grassland	9%

Vegetation Departure (VCC)	Percent within Fire Perimeter
Low	60%
Moderate	26%
High	14%

Since 2000, no fires burned in the area until the Dean Peak Fire. The fire return interval for piñon-juniper forests varies from frequent fire in juniper savannahs to very infrequent fire in persistent woodlands. Most of the area burned in the Dean Peak Fire was still relatively similar to estimates of historic conditions. The entire area of the Dean Peak Fire was classified as very low density development on the Silvis map of WUI. However, the fire did burn near houses on the northwest edge (Figure 19).

Fire Severity
Unfortunately, there was no information publicly available on the soil burn severity or canopy mortality for the Dean Peak Fire.

Doce Fire

The Doce Fire (pronounced "Dough-see") was approximately 8 miles northwest of Prescott, Arizona. It started on June 18, and was reported at 11:30 a.m. By June 23 it had reached 6,767 acres and was about 50% contained. The presumed cause of the fire was human activity.[7]

Vegetation, Past Fires, and Wildland-Urban Interface
Based on the LANDFIRE existing vegetation layer, much of the Doce Fire burned through chaparral or piñon-juniper woodland. A small portion burned in ponderosa pine forest.

Vegetation Type	Percent within Fire Perimeter
Piñon-Juniper	33%
Ponderosa	14%
Chaparral	49%

No fires had burned within the Doce Fire perimeter since 2000. Historically, all the vegetation types within the Doce Fire area would have burned occasionally, but with high variability. For example, ponderosa pine in the Southwest tended to burn at low severity every 3 to 7 years. Fire return intervals for piñon-juniper and chaparral systems are less certain and varied significantly across the Southwest. However, in the Prescott area regimes are thought to be toward the lower frequency and high severity end of the spectrum. Chaparral in the area burned on average every 35 to 40 years with high severity. Based on the LANDFIRE 2008 maps, the Doce Fire burned in vegetation similar to or moderately departed from historic conditions.

Vegetation Departure (VCC)	Percent within Fire Perimeter
Low	38%
Moderate	61%
High	1%

The Doce Fire burned in uninhabited areas, much of it in the Granite Mountain Wilderness. The western edge of the fire was contained just before it entered American Ranch and other nearby developments. The WUI data maps 81% as very low density development and 19% as uninhabited.

Fire Severity
Based on the soil burn severity maps, 80% of the Doce Fire had moderate to low soil effects (Figure 20).

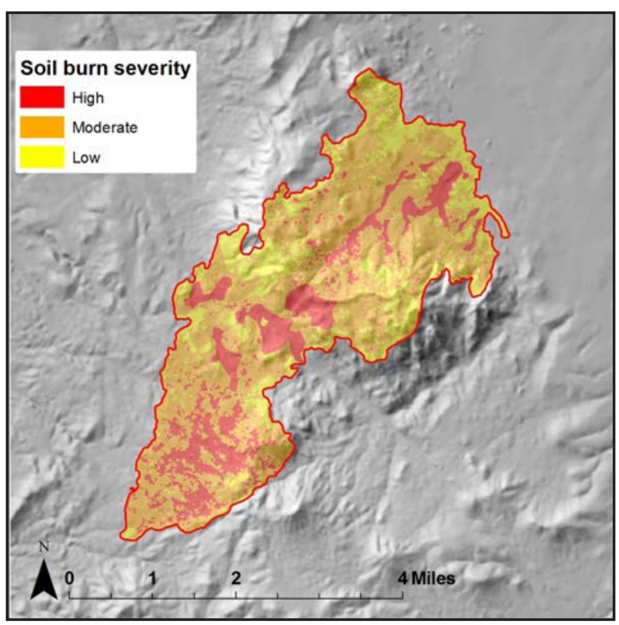

Figure 20. Soil burn severity map for the Doce Fire.

[6] Data from Inciweb http://inciweb.nwcg.gov/incident/3463/
[7] Data from Inciweb http://inciweb.nwcg.gov/incident/3437/

Soil Burn Severity	Percent within Fire Perimeter
High	20%
Moderate	57%
Low/Unchanged	23%

As would be expected for a predominantly chaparral dominated landscape, most of the burn area experienced high canopy mortality. RAVG estimates of canopy cover mortality were that 75% of the burn perimeter experienced greater than 75% canopy mortality (Figure 21).

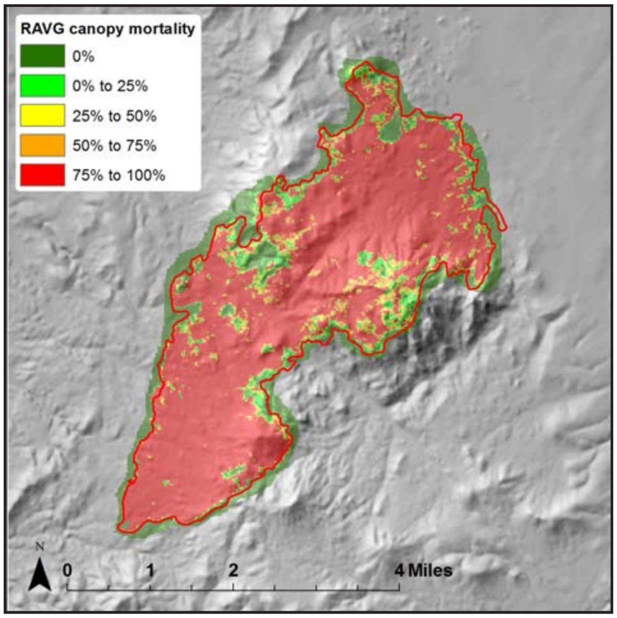

Figure 21. RAVG canopy mortality map for the Doce Fire.

Canopy Cover Mortality	Percent within Fire Perimeter
0% canopy cover mortality	6%
0% <= CC mort < 25%	6%
25% <= CC mort < 50%	5%
50% <= CC mort < 75%	7%
CC mort >= 75%	75%

As mentioned in the introduction, the soil burn severity (SBS) and RAVG maps measure different fire effects and a comparison between the two can highlight differences between soil and canopy effects (Figures 22 and 23). It is often reasonable to assume areas of standing trees that experience little canopy mortality would also have low soil burn severity. However, in the Doce Fire there are interesting differences between the SBS and the RAVG maps. About 90% of the moderate and 20% of the low or unburned on the SBS map were identified as near complete canopy mortality on the RAVG map. The difference between RAVG canopy mortality and the soil burn severity maps is evident in the contrast between the two measures of severity in the ponderosa pine type. According to the SBS map, only 21% of the ponderosa pine experienced high soil severity, while the RAVG map shows that 63% of ponderosa pine experienced 75% to 100% canopy mortality. This difference may be driven by the extensive coverage of chaparral and piñon-juniper, which is also intermingled with the ponderosa pine. In areas of chaparral or grass, fire can kill the entire canopy without causing severe effects on soil. Of course since the LANDFIRE, SBS, and RAVG maps are generated from remote sensing data and no model is perfect, there may be other data issues causing differences between the maps.

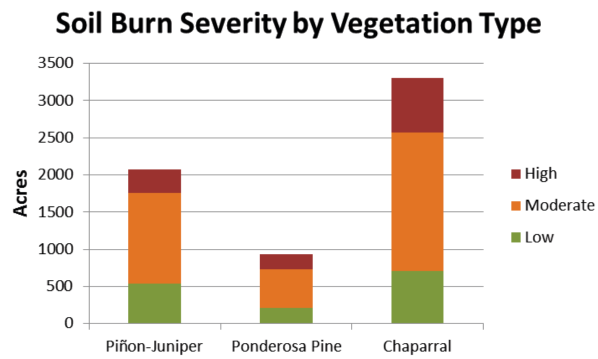

Figure 22. Soil burn severity by vegetation type for the Doce Fire.

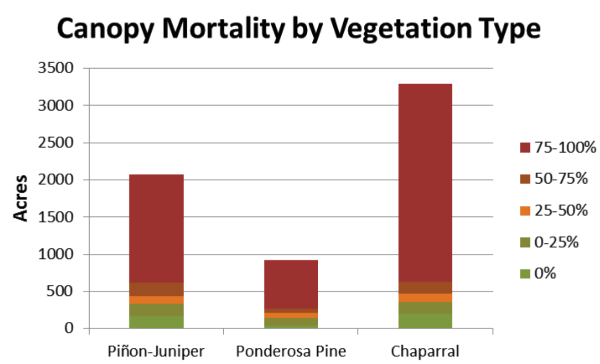

Figure 23. Canopy mortality by vegetation type for the Doce Fire.

Soldier Basin Fire

The Soldier Basin started in the Coronado National Forest south of Tucson, Arizona during the night of May 17 by human activity. The fire was fully contained on May 28 after burning 10,775 acres.[8]

Vegetation, Past Fires, and Wildland-Urban Interface

The Soldier Basin Fire burned through a mix of woodland and shrub vegetation types.

[8] Data from Inciweb http://inciweb.nwcg.gov/incident/3389/

Vegetation Type	Percent within Fire Perimeter
Juniper-oak	38%
Conifer-oak	5%
Piñon-juniper	23%
Chaparral	4%
Desert scrub	4%
Grassland	18%

Using the Silvis maps of WUI, nearly all of the Soldier Fire burned in uninhabited areas with a few small pockets of very low density development. About 9% of the Soldier Basin Fire burned in an area that had previously burned in the 2005 Aztec Fire. On the southern edge, the Soldier Basin Fire abutted the 2011 Duke Fire.

Fire Severity
The majority of the area within the Soldier Basin Fire had low soil burn severity and 16% was unburned (Figure 24).

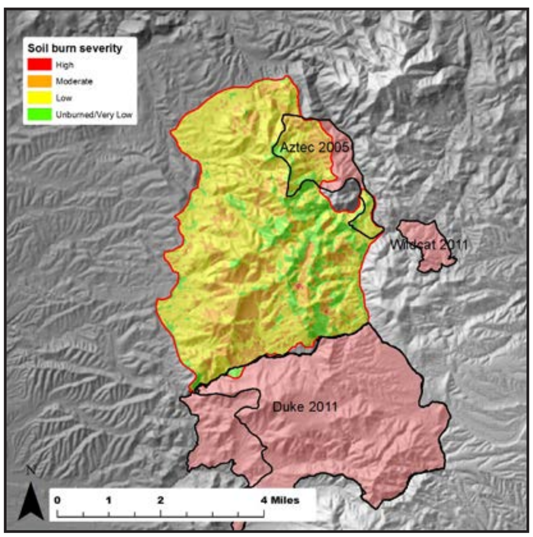

Figure 24. Soil burn severity map for the Soldier Basin Fire.

Soil Burn Severity	Percent within Fire Perimeter
High	0%
Moderate	23%
Low	61%
Unburned	16%

Based on RAVG data, about half of the area within the burn perimeter experienced greater than 75% canopy mortality (Figure 25).

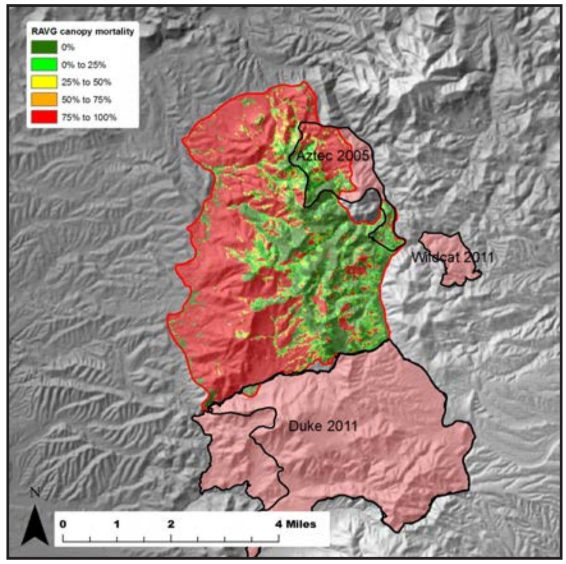

Figure 25. RAVG canopy mortality map for the Soldier Basin Fire.

Canopy Cover Mortality	Percent within Fire Perimeter
0% canopy cover mortality	23%
0% <= CC mort < 25%	12%
25% <= CC mort < 50%	6%
50% <= CC mort < 75%	5%
CC mort >= 75%	54%

As with the Doce Fire, the Soldier Fire burned through vegetation types where complete canopy mortality is not incompatible with moderate or low soil burn severity. For example, though 83% of the grassland experienced near complete canopy mortality, 79% had a low or unburned soil burn severity classification (Figures 26 and 27).

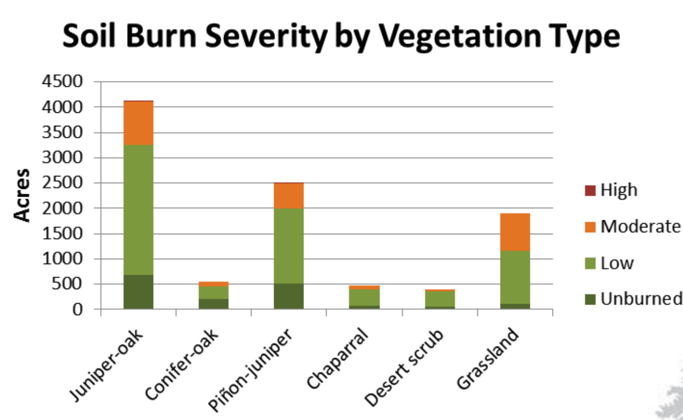

Figure 26. Soil burn severity by vegetation type for the Soldier Basin Fire.

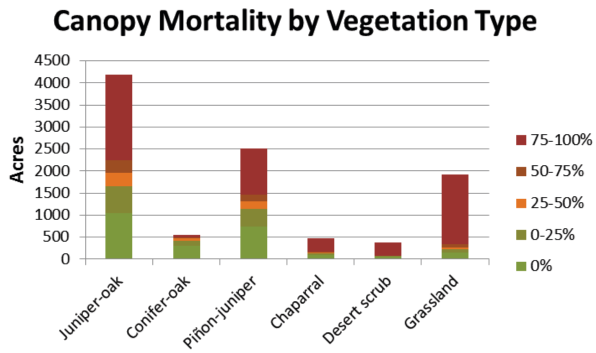

Figure 27. Canopy mortality by vegetation type for the Soldier Basin Fire.

Yarnell Hill Fire

The most important aspect of the Yarnell Hill Fire was the tragic loss of 19 wildland firefighters; however, there are other reports and sources that address the disaster. The discussion here will be confined to the ecological data presented for the other fires in this report.

The Yarnell Hill Fire started on the afternoon of June 28. Before it was contained, the Yarnell Hill Fire burned 8,374 acres between Yarnell and Peeples Valley, southwest of Prescott, Arizona.[9] As with the Dean Peak Fire, since the Yarnell Hill Fire did not burn on U.S. Forest Service land there is less information about fire severity.

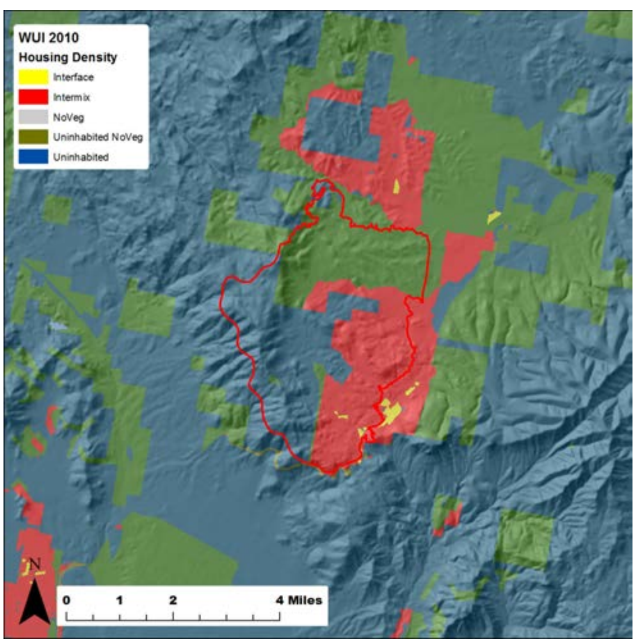

Figure 28. Map of land use near the Yarnell Hill Fire.

Vegetation, Past Fires, and Wildland-Urban Interface

The vegetation that burned in the Yarnell Hill Fire was 86% chaparral and 12% piñon-juniper. As discussed above, the fire return interval in these forest types is more difficult to determine than in ponderosa pine. Based on LANDFIRE data the mean fire return interval in the area was mainly in the range of 300 to 500 years, but Sneed and colleagues suggest average fire return intervals of 35 to 40 years with high severity for chaparral vegetation types in the area.[10]

Vegetation Departure (VCC)	Percent within Fire Perimeter
Low	73%
Moderate	21%
High	6%

No other fires had burned in the Yarnell Hill Fire perimeter since 2000. The Yarnell Hill Fire had a large portion of land classified as WUI in the Silvis map (32%) compared to the other fires in this report (Figure 28).

WUI Classification	Percent within Fire Perimeter
Interface	0%
Intermix	32%
Very Low Density	30%
Uninhabited	38%

[9] Data from Inciweb http://inciweb.nwcg.gov/incident/3461/

[10] Sneed, P., L. Floyd-Hanna, and D. Hanna. 2002. Prescott basin fire history project. Prescott College, Prescott, AZ.

Conclusion

This report covers about 68% of the area burned by wildfire in the Southwest in 2013 and shows some general patterns for this year's fires. For example, the majority of acres burned in these eight fires were in mixed-conifer forests (Figure 29). Comparing fires also highlights the importance of the largest fires because the majority of the mixed-conifer acres burned occur in just one fire, the Silver Fire.

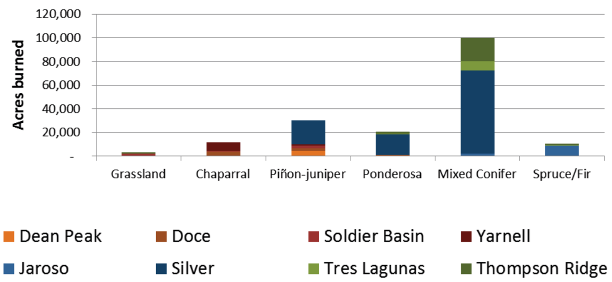

Figure 29. Summary of acres burned by major vegetation types.

Most of the acres within the six fire perimeters for which soil burn severity maps are available (about 60% of the acres burned in the southwest in 2013), burned with low soil severity (Figure 30). About 26% burned with high soil burn severity.

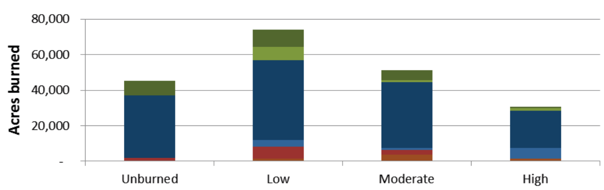

Figure 30. Summary of acres burned by soil burn severity class.

Similarly, of the six fires for which RAVG maps are available (about 60% of the acres burned in the Southwest in 2013), about 31% of the total burned area had greater than 75% of canopy mortality (Figure 31). Differences between the soil burn severity maps and the RAVG canopy cover mortality maps emphasize that these two maps measure different facets of fire severity and should not be used interchangeably. They are the product of distinct processing techniques for different purposes. In addition, disparities between the two metrics should be expected, particularly in areas where the vegetation can burn completely without significant effects on soil.

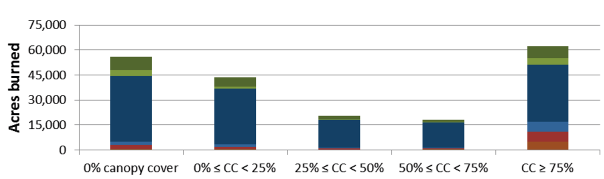

Figure 31. Summary of acres burned by RAVG canopy mortality classes.

Using the LANDFIRE vegetation condition class map, most (50%) of the area burned in all eight fires was moderately departed from historic conditions and nearly 30% burned in areas severely departed from historic conditions (Figure 32).

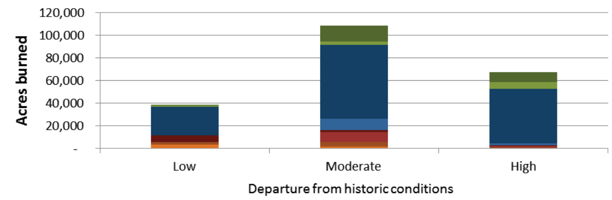

Figure 32. Summary of acres burned by LANDFIRE vegetation condition class.

Half of the fires examined here burned over previous fire scars. Significant portions of the perimeter of the Thompson Ridge and Soldier Basin Fires were coincident with fires from 2011. Only one fire, the Yarnell Hill Fire, burned significant acreage designated as WUI in the Silvis maps. However, other fires (Thompson Ridge, Tres Lagunas, Silver, and Doce) burned near communities and caused evacuations.

The Southwest is dominated by fire-adapted ecosystems that will continue to burn. Hopefully, this overview will add to other efforts to help residents of the Southwest better understand fire and create fire-adapted communities.

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