San Juan Fire
Fuel Treatment Effectiveness Report
Apache-Sitgreaves National Forest
Arizona

Incident Dates: June 26-July 2, 2014

"The prior fuel treatments allowed for safe firefighting."

Buck Wickham
Operations Section Chief

Contents

Figure 1

Figure 2

Photos show burnout operations on the San Juan Fire being conducted on June 30 (Figure 1) and on June 29 (Figure 2).

Overall, the fuel treatments that were encountered by this fire performed as designed by reducing fire intensities. This allowed firefighters to work in a safer environment where their suppression efforts could be successful.

1. Introduction

The San Juan Fire started June 26, 2014 on the White Mountain Apache Reservation and entered the Apache-Sitgreaves National Forest soon after detection. The fire is suspected to be person-caused.

Fire behavior on the incident's first two days was influenced by strong southwest winds of 15 mph with gusts to 25 mph and extremely dry fuel conditions resulting from long-term drought.

Evacuations were issued on the fire's first evening by Apache County for the subdivisions of Red Cabin Ranch, with seven homes, and Whiting Homestead, with 12 homes and a total of 27 structures.

The next day, the Carlock Ranch, with one home and several outbuildings, was also evacuated.

Figure 3 – The wind-driven San Juan Fire on its first day.

Containment efforts were largely successful with the last day of significant fire spread on July 1. Monsoon rains arrived on July 2 which prompted the lifting of evacuation orders. Final fire size was 6,975 acres.

Fuel Treatments Reduce Fire Intensities

Overall, the fuel treatments that were encountered by this fire performed as designed by reducing fire intensities. This allowed firefighters to work in a safer environment where their suppression efforts could be successful.

The fire's forward spread was largely halted by the end of the second day—despite continued high winds—in large part due to the success of burnout operations in areas where previous thinning and prescribed burning had occurred.

VIDEO

See Jeremy Human, Forest Fuels Specialist, Apache-Sitgreaves National Forest, describe the actions taken on the fire's first day. On the San Juan Fire, Human served as the Incident Commander on the Type 3 Incident Management Team and was the Operations Section Chief Trainee for the Type 2 Incident Management Team.

SJHumanDay1
(https://youtu.be/_lcr_st1Hzk)

The San Juan Fire's negative impacts on Forest resources were greatly reduced due to these previous fuel treatments—coupled with the conscientious efforts on the part of firefighters to conduct fire suppression activities aimed at reducing fire intensities.

The overall, cumulative outcome of these actions became a final fire footprint that experienced some high-severity fire, but with the majority of the fire burning at low to moderate severity that resulted in the protection of forest stand conditions.

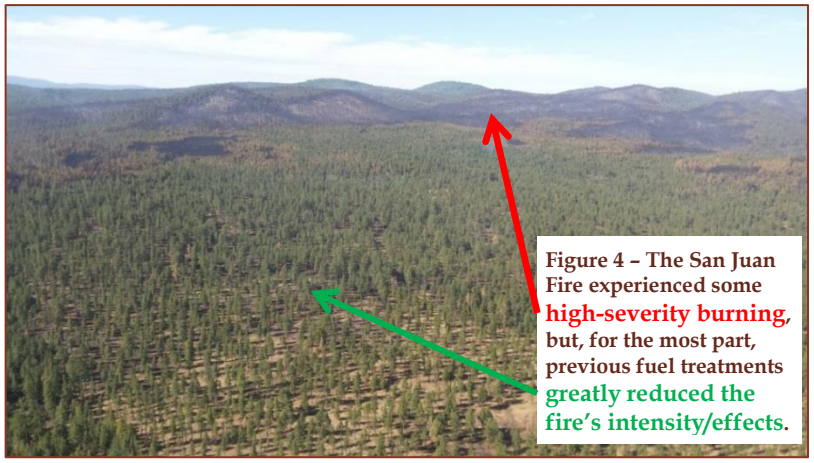

Figure 4 – The San Juan Fire experienced some high-severity burning, but, for the most part, previous fuel treatments greatly reduced the fire's intensity/effects.

VIDEO

See Jeremy Human, Forest Fuels Specialist, Apache-Sitgreaves National Forest, describe how fuel treatment areas helped suppression actions on the San Juan Fire. Human served as the fire's IMT3 IC and the IMT2 Operations Section Chief Trainee.

SJHumanTreatments

(http://youtu.be/7ykq2eII7mg)

The impacts of the San Juan Fire on the Forest resources were greatly reduced as a result of the previous fuel treatments, in addition to the conscientious effort on the part of firefighters to conduct fire suppression activities in a way that reduced fire intensities.

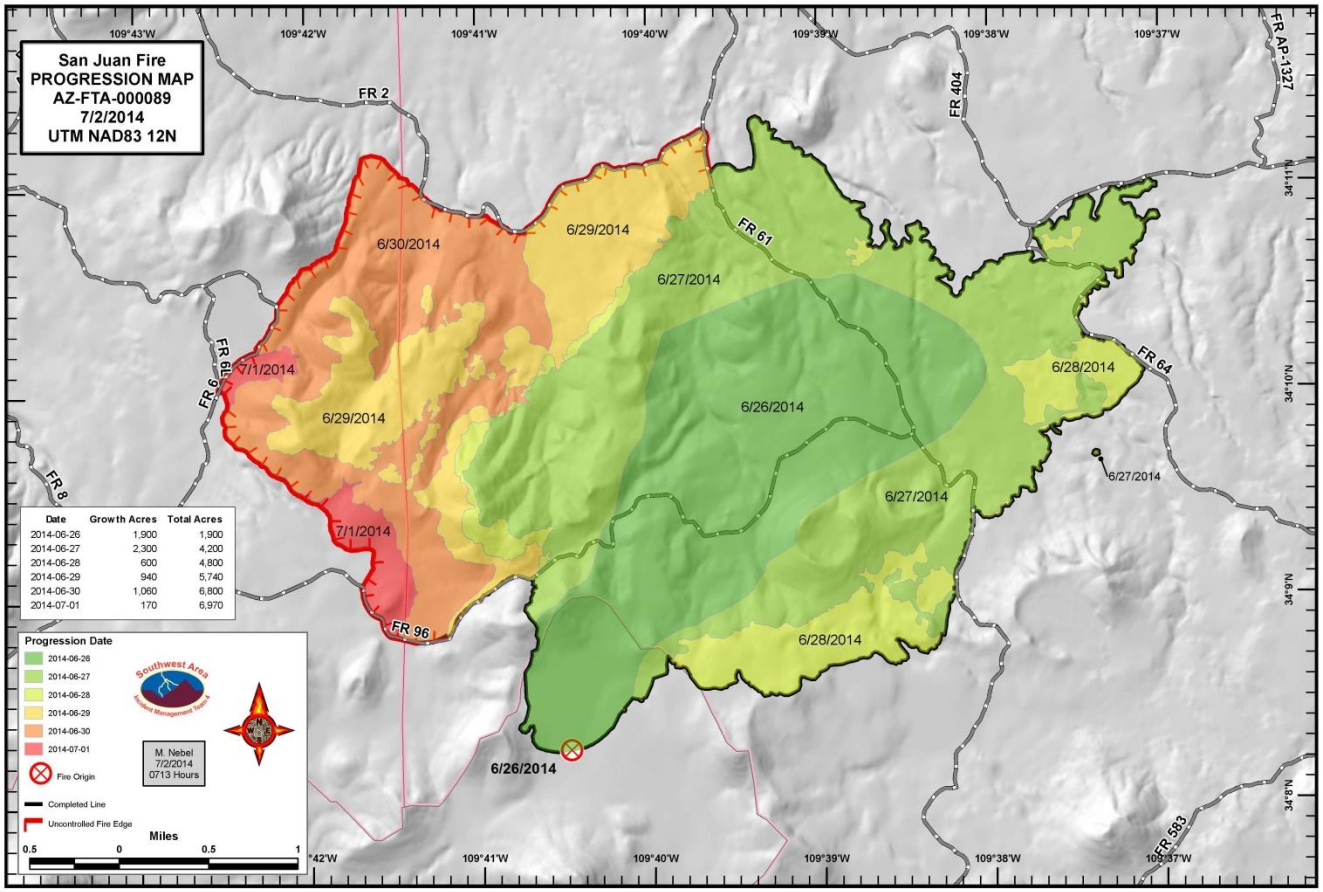

Figure 5 – Fire Progression Map of the San Juan Fire—from June 26 through July 1, 2014.

2. Fire Environment

A. Fire Weather

A low pressure system that dominated the weather pattern for the first two days of the San Juan Fire brought strong, gusty southwest winds on June 26-27. By June 28 an upper level ridge formed which reduced wind speeds but also brought warmer temperatures and drier relative humidity. Beginning on June 29, the fire's fourth day, the first signs of the annual monsoons were observed with increased cloud cover and higher relative humidity. Rainfall began on July 2 and continued for the next several weeks.

Observations taken from the Lakeside RAWS for June 26

(This RAWS is located approximately 15 miles east of the San Juan Fire.)

- Maximum Temperature: 85 degrees
- Minimum Relative Humidity: 6 percent
- Wind Speed and Direction: South-Southwest at 11 mph, with gusts to 23 mph

B. Fuel Conditions

Two primary vegetative communities were impacted by the San Juan Fire. First, the area immediately impacted at the higher elevations around Juan Garcia Mountain is generally a mixed-conifer community dominated by a mix of spruce, white fir, Douglas fir, and aspen. The remainder of the fire area below these higher elevations is primarily ponderosa pine with some oak and brush components. When looking at the fuel profile of the fire, multiple fire regimes are represented. The mixed conifer ecosystems are adapted to mixed-severity fire on a 35-100 year interval; while the ponderosa pine ecosystem is adapted to low-severity fire on a 0-35 year interval.

Live fuel moistures taken southeast of the fire's origin were 87 percent for ponderosa pine, which is typically dry for pre-monsoon conditions in this area. For the dead fuels, the Fire Behavior Analyst estimated the following: 1-hour fuel moisture: 2 percent; 10-hour fuel moisture: 3 percent; 100-hour fuel moisture: 5 percent; and 1000-hour fuel moisture: 6 percent. The computed National Fire Danger Rating System (NFDRS) 1000-hour fuels were also estimated below 7 percent which is in agreement with the Fire Behavior Analyst's estimates and indicates critically dry conditions. The Energy Release Component (ERC) from the Lakeside RAWS indicates 97th percentile conditions which approached all-time worst conditions for that station (Figure 6).

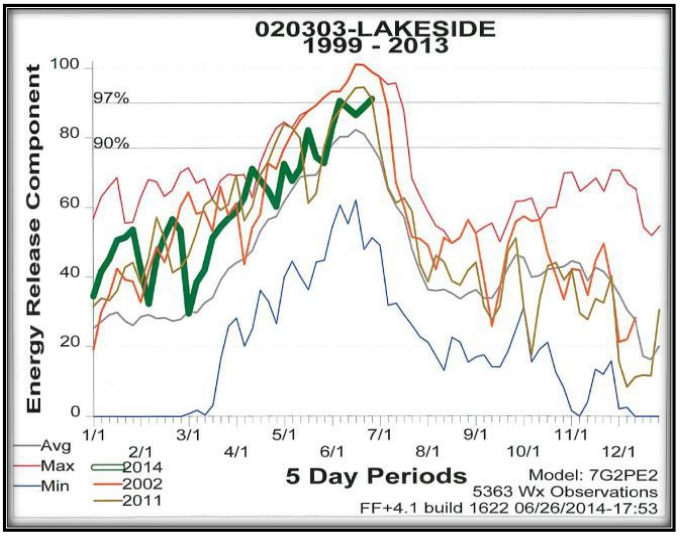

Figure 6 – ERC from Lakeside RAWS.

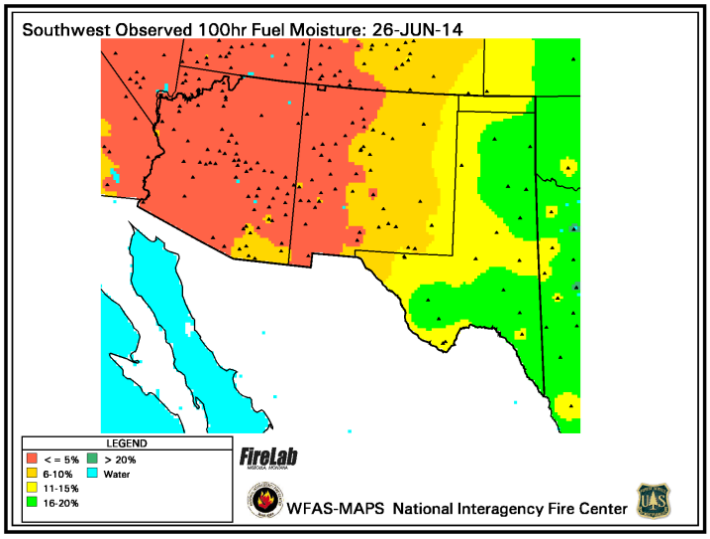

Figure 7 – Observed 100-hour fuel moisture for June 26, 2014.

Figure 8 – Ponderosa pine burnout operation on the San Juan Fire.

VIDEO

See Jerry Drury, Natural Resources Staff Officer, Apache-Sitgreaves National Forest, provide an overview of the White Mountain Stewardship Project:

http://bit.ly/SJDruryWhiteMt

Figure 9 – High-severity fire effects shown on the mixed conifer stands on the San Juan Fire.

Fuel treatments have occurred over a significant proportion of the area, primarily in ponderosa pine dominated stands to reduce the risk of damage or loss associated with wildfire and to restore the health and function of these fire-dependent ecosystems.

3. Narrative/Chronology

June 26

The San Juan Fire starts in grass on San Juan Flat at 1145 hours. In the afternoon, high temperatures range from the upper-70s to mid-80s. Relative humidity reaches 10-20 percent. The fire is being pushed to the northeast by southwest 20-25 mph winds, with gusts of 32 mph.

As the fire moves into ponderosa pine it starts to exhibit single/group tree torching and spotting. Once the fire burns into a mixed conifer stand it becomes a running crown fire burning northeast along Pulcifer Creek and the Forest Road 96 corridor until it crosses Forest Road 61 to the northeast. A Type 2 Incident Management Team is ordered. An in-brief is scheduled for the next morning at 0900.

June 27

The fire continues burning to the northeast, northwest and southeast as the strong southwest winds continue to affect fire behavior. In the afternoon, high temperatures range from the upper-70s to lower-80s. Relative humidity ranges from 15-20 percent.

Where the fire burns into established fuel treatments, fire behavior dramatically changes from a crown fire with spotting to a ground fire with 8- to 10-foot flame lengths. An in-briefing is conducted by the Fort Apache Bureau of Indian Affairs, White Mountain Apache Tribe, and Apache-Sitgreaves National Forest. Transition from the Type 3 Incident Management Team occurs at 2000. The fire is 5,000 acres and is 0 percent contained.

June 28

A ridge of high pressure begins to build from the southwest. Afternoon temperature ranges in the 80s, with lower relative humidity (12-20 percent). The wind event of the last two days has ended. The fire becomes more terrain and fuel driven. Fire behavior also moderates with the decrease in winds.

The fire burns to the south toward Gillespie Flat and east toward Mineral Creek. The fire is divided into six divisions: A,D,G,V, W, and Z. In addition, a Structure Protection Group is created to address the private inholdings at Red Ranch Cabin, Carlock Ranch, and Whiting Homestead.

> ***"Treatments allowed us to go direct versus indirect on the fire's first day, in part because we were able to hold easier and spots were easier to catch."***
>
> **Ben Plumb**
> **Division Z Supervisor**

Fuel Treatments Factored into Suppression Strategy

On June 28, the higher elevation and mixed conifer areas of the fire's containment lines do not hold through the burn period. This prompts a reassessment of that strategy in favor of a more indirect approach that uses existing roads and fuel treatments to support burnout operations in Divisions A and D.

Control features are located adjacent to vegetation treatments accomplished under White Mountain Stewardship and wildlife habitat improvement projects.

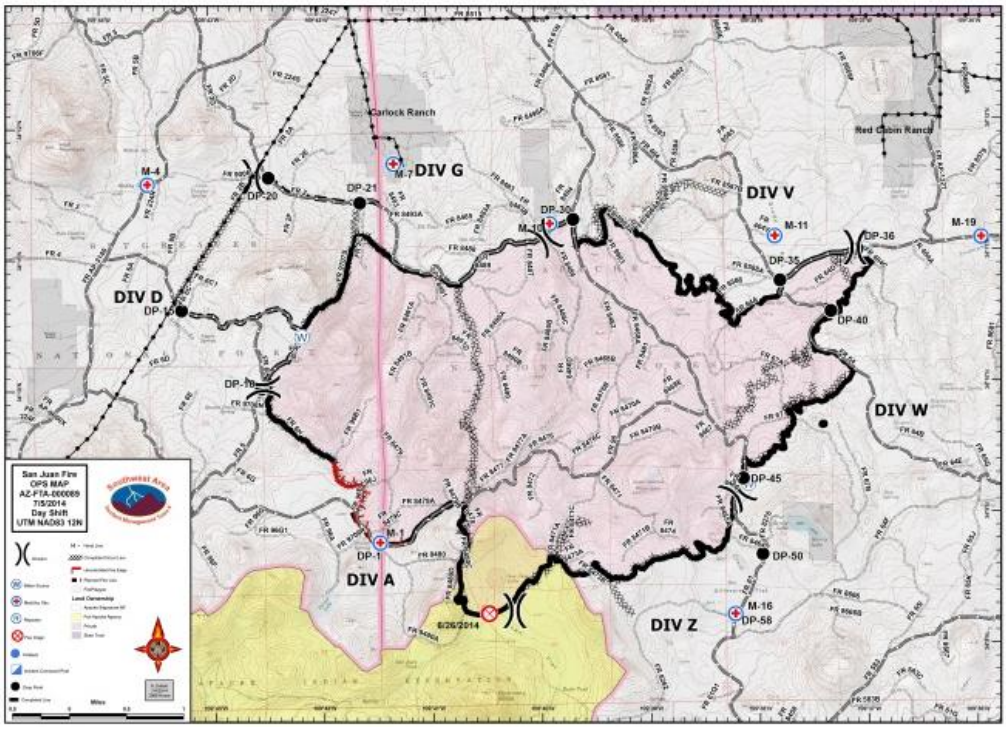

Figure 10 – July 5 operational map of the San Juan Fire.

These wildlife habitat projects were funded, in part, by the Rocky Mountain Elk Foundation.

From the Type 2 Incident Management Team's perspective, the treatments were strategic in aiding suppression efforts, thus providing for safe and effective control of the fire and minimizing undesirable effects to the natural resources. Most importantly, these treatment areas increased the margin of safety for firefighting personnel.

Night shift is established to hold and patrol burning operations.

From the Type 2 Incident Management Team's perspective, the treatments were strategic in aiding suppression efforts, thus minimizing fire size and undesirable effects to the natural resources. Most importantly, these treatment areas increased the margin of safety for firefighting personnel.

June 29

The first signs of monsoonal moisture are observed with scattered afternoon cumulus. Afternoon temperature is in the 80s, with relative humidity at 15-25 percent. Division G initiates a burnout operation along Forest Road 2, taking advantage of a favorable northwest wind.

In the late afternoon, an aerial ignition operation is initiated in the mixed conifer vegetation types on three knobs east of Drop Point 10 to allow the fire to back downslope toward Divisions A/D/G. The objective of this aerial ignition operation is to moderate fire behavior in these areas to reduce the fire's negative effects and aid suppression efforts.

Fire behavior on the other areas of the incident consists of smoldering and creeping in the duff and stump holes. The fire is now 5,700 acres and is 5 percent contained.

June 30

The afternoon cumulus field becomes more extensive as the monsoonal flow continues to increase—but no thunderstorms develop. Afternoon temperatures range from the mid-80s to lower-90s. Relative humidity is in the teens in the afternoon. Divisions A/D/G continue burnout operations—staying even with the backing fire from the previous night's aerial ignitions. The Structure Protection Group remains in place. The night shift is staffed. The fire is 6,300 acres and is 5 percent contained.

"Treatments allowed for buffer. We could go pick up spots. Without those treatments there would have been no way to hold our burnout."

David Raney
Division A Supervisor

July 1

This is the first day of monsoonal thunderstorm activity across the area, with temperatures ranging from the mid-80s to the low-90s and relative humidity in the low to mid-teens. The storm activity moved primarily south of the fire and did not impact the fire area. Division A and D completed burnout operations. Some single/group tree torching is observed in concentrations of ponderosa pine reproduction with mostly low-fire behavior activity. All other divisions are in mop-up phase. Today's night shift is the last one for this incident. Demobilization of resources begins. The fire is 6,975 acres and is 15 percent contained.

"Without the treatment, we wouldn't have been there."

Barry Green
Division V Supervisor

July 2

July 2 is the second day of the monsoonal push. The fire area is impacted with thunderstorms and showers. Any further fire behavior is minimal, consisting mostly of smoldering and creeping in the duff layers. There is no change in fire acreage. On July 2, containment is increased to 70 percent. (From July 3-6, fire behavior is minimal. All divisions are in the rehabilitation phase. On July 5, the fire is 95 percent contained. It is contained/controlled on July 17 and is pronounced officially out on July 31.)

VIDEO

HumanSJBurnouts

(http://youtu.be/hWOqDas_BUE)

Jeremy Human, Forest Fuels Specialist for the Apache-Sitgreaves National Forest, points out how prior fuel treatments helped suppression strategies and successful firefighting efforts on the San Juan Fire. Human served as the fire's IMT3 IC and the IMT2 Operations Section Chief Trainee.

Figure 11 – Burn-out operations on June 30 on the San Juan Fire.

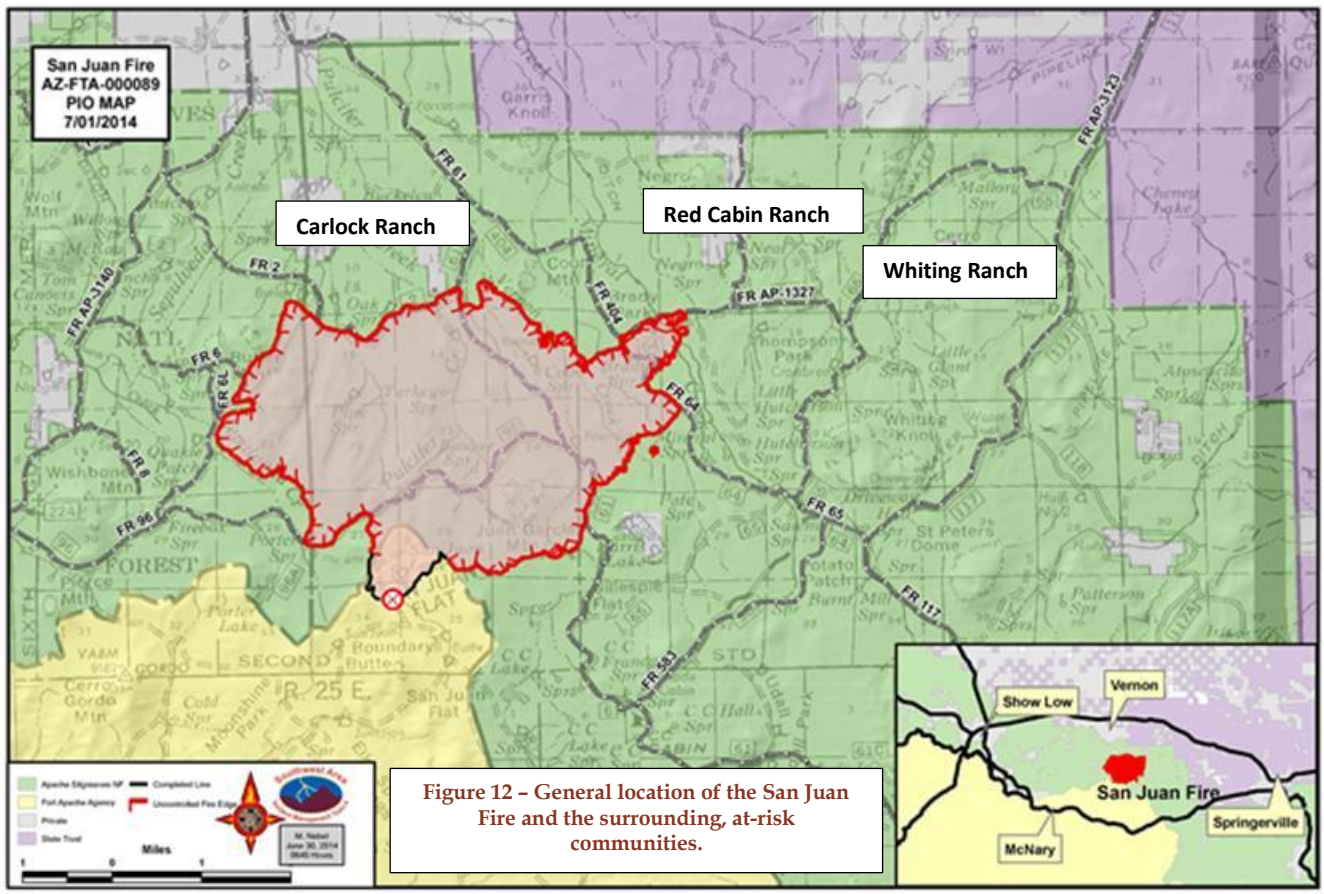

Figure 12 – General location of the San Juan Fire and the surrounding, at-risk communities.

4. Potential Consequences

The potential negative consequences that could have resulted from the further spread of the San Juan Fire are worth noting.

Several private ranches are located within one-day's perimeter growth of where the fire was eventually stopped. Moreover, if the fire's progression had not been stopped, it could have potentially impacted the community of Vernon (Figure 12) as well as the Red Cabin Ranch and Whiting Homestead subdivisions, and Carlock Ranch.

In addition, the negative impact to vegetative communities and wildlife habitat could have been substantially greater than what was actually experienced. Mexican Spotted Owl, Northern Goshawk and Apache (Arizona) Trout are some of the species of concern known to inhabit the area. In addition, a number of "highly desirable" game species inhabit the fire area, including deer, elk, and antelope.

Therefore, if the San Juan Fire had burned under higher severity over a larger portion of the landscape, its consequences could have been much more severe.

> *"Basically, the treatment areas helped stop the fire's spread so it didn't impact the Red Cabin Ranch private subdivision. It is super obvious that—without those treatments—the fire would have spread into Red Cabin."*
>
> **Barry Green**
> **Division V Supervisor**

5. Fuel Treatment Effectiveness

Generally speaking, the fuel treatments encountered by the San Juan Fire were effective at modifying fire behavior. Furthermore, these fuel treatment areas proved to be instrumental in providing fire managers with opportunities to contain the fire in a safe and effective manner while simultaneously limiting the fire's potential negative effects on natural resources, the surrounding communities and their infrastructure.

Fire behavior observed by firefighters at the scene—as well as estimates of fire severity taken after the fire (Figure 13; Table 1)—confirm that the treated areas performed as designed by not supporting sustained crown-fire even under extreme burning conditions.

As the San Juan Fire transitioned from untreated mixed conifer to treated ponderosa pine, fire behavior also transitioned from intermittent and sustained high-intensity crown fire in the untreated stands to a low-moderate intensity surface fire in the treated stands.

Thus, firefighters were able to utilize the road system within the treated stands to implement their burnouts. These burnout operations limited the forward progress at the head of the fire the day after the fire started.

VIDEO

See Tessa Nicolet, Regional Fire Ecologist with the U.S. Forest Service's Southwestern Region, explain what this map tells us about the San Juan Fire's behavior—and how this affected fire suppression actions:

http://bit.ly/SJTessaSeverityMap

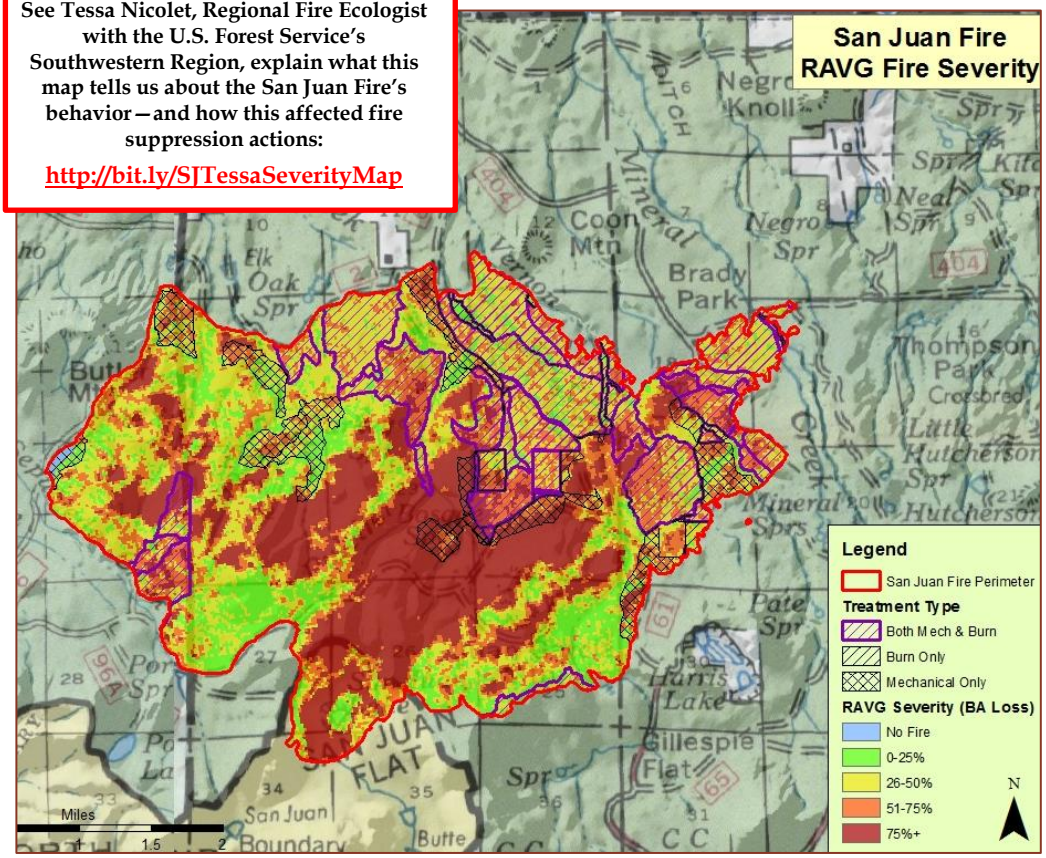

Figure 13 – Map of the San Juan Fire "Rapid Assessment of Vegetation Condition after Wildfire" (RAVG). RAVG products are generated to provide information that can assist post-fire vegetation management planning designed to address a number of management objectives.

Percent of San Juan Fire areas in each RAVG Severity Class			
RAVG (% BA Loss)	% of Entire Fire Area	% of San Juan Fire Perimeter with NO Treatments	% of San Juan Fire Perimeter with Treatments
Low 0-25%	14	16	11
Moderate 26-50%	35	29	45
Mod/High 51-75%	21	16	31
High >76%	29	38	13
Percent of Ponderosa Pine vegetation types in each RAVG Severity Class			
RAVG (% BA Loss)	% of all Ponderosa Pine	% of Ponderosa Pine Areas with NO Treatments	% of Ponderosa Pine Areas with Treatments
Low 0-25%	13	17	11
Moderate 26-50%	47	44	49
Mod/High 51-75%	28	22	31
High >76%	12	18	9

Table 1 – This table presents a comparison of preliminary RAVG (Rapid Assessment of Vegetation Condition after Wildfire) results for the entire San Juan Fire area by treatment type, as well as for the ponderosa pine-dominated vegetation types where the majority (82%) of all fuel treatments took place. Overall, much less of the areas that had received fuel treatments burned with high severity than those that did not receive fuel treatments.

A. Research Study Sites

One fortunate aspect of the San Juan Fire is that it burned through a series of experimental study sites established by the Ecological Restoration Institute (ERI) at Northern Arizona University.

As a result, we now have a much more precise side-by-side comparison of fuel treatment effectiveness of two different approaches to fuel treatments as compared to a control or untreated site. These study sites were initially established to facilitate long-term monitoring of these types of treatments. It is therefore especially informative to observe and study the impacts of an actual wildfire under peak burning conditions on such intensively monitored sites.

The key objectives of this long-term study are to:

- Quantify site-specific reference conditions using dendro-ecological reconstruction methods.
- Analyze effects of elevation on historical changes in forest structure and fire behavior.
- Compare the effects of alternative restoration treatments.

Known as the "A-S Mineral Study Site", the study design consists of:

- Four study blocks located in ponderosa pine dominated sites.
- Each block contains three side-by-side treatment units (each unit approximately 32 acres in size):
  - Control (no treatment) Unit
  - Burn Only (broadcast burn with no mechanical thinning) Unit
  - Full Restoration (mechanical thinning, piling, and burning) Unit
- Elevation gradient ranging from 7,800 to 8,200 feet.
- Initially measured in 2002.
- Treatments completed in fall 2008.
- Re-measured in 2009 and again in 2013.

Figure 14 – A-S Mineral Study Site's thin and burn treatment (aka "Full Restoration") shown after the passage of the San Juan Fire. This photo, taken within weeks of the fire, shows how very little overstory damage has occurred and ground cover vegetation is recovering. (Ecological Restoration Institute)

Figure 15 – A-S Mineral Study Site's burn-only treatment area after the passage of the San Juan Fire. Notice more tree stems in this photo than in the "Full Restoration" treatment photo above (Figure 14). While fire behavior was moderated here, it appears there was more mortality due to scorch than experienced on the "Full Restoration" treatment area. (Ecological Restoration Institute)

Figure 16 – A-S Mineral Study Site's control (no treatment) site after the passage of the San Juan Fire. Almost complete mortality occurred with most of the trees onsite being either consumed or completely scorched. (Ecological Restoration Institute)

VIDEO

http://bit.ly/SJGrecoRestoration

The ERI's
Three Side-By-Side Treatment Units

Standing on site in the aftermath of the San Juan Fire, Bruce Greco, Director of Outreach for the Ecological Research Institute, describes the significance of ERI's three "Long-Term Ecological Restoration Plots".

Bruce Greco

The Combination of Thinning and Burning Treatments Proved Most Effective

Inside one of the A-S Mineral Study Site study blocks, the San Juan Fire impacted all three treatments types (control; thin and burn; and burn only). From the visual indicators at this study site, it appears that the combination of thinning and burning was the most effective for reducing fire intensities and protecting forested tree cover (Figure 14).

The burn-only treatment moderated fire behavior as compared to the no treatment-control unit (Figure 16), but not as effectively as the mechanical and burn unit. Considerable tree mortality due to severe scorch is still evident in the burn-only treatment area (Figure 15).

ERI investigators speculate that the 2008 prescribed fire treatment was effective at scorching the lower portion of the trees and raising the base of the tree crowns. However, this treatment was not as effective at removing individual trees to reduce overall tree densities. Hence, the result of the burn-only treatment was a closed canopy stand with the canopy base height raised. Even so, this burn-only treatment area became a much denser stand than what was produced by the combination treatment of mechanical thinning and burning.

Both treatments were superior to the control (no treatment) unit in which high-severity fire prevailed, causing almost complete mortality throughout the stand.

For a more complete discussion of the A-S Mineral Study Site, see:

http://nau.edu/ERI/Research/Ecological-Research/Arizona/Apache-Sitgreaves/

Figure 17 – Nighttime burn-out operations on the San Juan Fire.

"The San Juan Fire provided lessons about how treated areas did what they were designed to do: slow a fire's advance and restore a forest's natural ability to self-regulate. How a wildfire behaves when it reaches a treatment area is a good test of how those treatments work. Fire crews and incident management teams reported that when the fire burned into areas that had been thinned, it burned with low severity and on the ground, not in treetops. The dry, frequent-fire forests of the West evolved with this type of fire, a slow-moving, low-severity surface fire that would remove young trees and revitalize understory grasses and forbs. Anecdotal evidence from the San Juan Fire also suggests that the previously treated areas allowed fire crews to safely conduct burn-out operations, thus enabling them to manage and control the fire."

Wally Covington, Director
Ecological Restoration Institute;
Regents' Professor of Forest Ecology,
Northern Arizona University

From his Aug. 22, 2014 article in *LiveScience's* "Expert Voices – Op-Ed and Insights"
http://www.livescience.com/47510-wildfire-prevention-is-science-not-art.html

6. Lessons Learned

Facilitated Learning Analysis

In September 2014—three months after the San Juan Fire—resource specialists and fire managers from the Apache-Sitgreaves National Forest along with researchers from the Ecological Restoration Institute at Northern Arizona University met for a Facilitated Learning Analysis.

Prior to this Facilitated Learning Analysis, all participants had visited the San Juan Fire site on numerous occasions. Thus, all participants had time to formulate opinions from their observations of how their resource area was affected by the San Juan Fire.

During the Facilitated Learning Analysis, each participant was asked what they learned from the San Juan Fire and associated fuel treatment projects, both in terms of actions and activities they would do again because they worked well, as well as actions and activities they would do differently because they believe there is room for improvement based on what they observed.

The following section highlights the observations and wisdom shared by these participants.

A. Fisheries

1. Lesson

No treatment also has consequences.

Don't think that by not treating something means it will not undergo change. Doing nothing is still a decision with its own consequences.

Across the country, resource managers often implement "Do Not Treat" buffers as a means of protecting streams and riparian areas from the impacts of treatments such as thinning or prescribed burning. But in a fire-prone landscape where an encounter with a wildfire is practically inevitable, these buffers can act like a fuel corridor, potentially putting aquatics at even *more* risk when wildfires eventually occur.

This negative effect was apparent on Arizona's 2011 Wallow Fire in which entire reaches of some streams and tributaries were lost as the buffered area burned with higher intensity and severity than the surrounding treated area.

VIDEO

http://bit.ly/SJStephStreams

Lessons Learned on Stream Buffers

Extending Treatments to Stream Banks can Improve Aquatic Habitat for the Long Term

Listen to and see, on site, Stephanie Coleman, Aquatics Program Manager for the Apache-Sitgreaves National Forest, describe how prior fuel treatments that extended to the banks of Mineral Creek reaped positive results when the San Juan Fire burned through this area.

Stephanie also discusses how the overall combination of thinning and prescribed fire benefited Mineral Creek's riparian areas.

Figure 18 – The Apache Trout, listed as a "Threatened" species under the Endangered Species Act, resides in Mineral Creek. Prior thinning and prescribed fire along Mineral Creek will benefit habitat for this species.

In contrast, on the San Juan Fire where slope and existing vegetation allowed treatments to extend to the banks of Mineral Creek (that hosts the Apache Trout, a "Threatened" species under the Endangered Species Act), low-severity fire resulted that actually invigorated riparian vegetation and left residual trees for shading and future large-woody debris. These conditions will now improve the habitat for aquatics in the long term.

2. Lesson

Implement treatments as close to streams as possible.

If riparian conditions and terrain/topography allow, managers should treat as close to the stream as possible to offer protection to aquatic and riparian habitats and break-up those fuel corridors that can threaten the entire stream if a wildfire occurs.

B. Wildlife

"Overall, the effects of the San Juan Fire will be a net energy gain back into the system. From a wildlife perspective, that's important."

Mike Godwin
Field Supervisor
Arizona Game and Fish Department

Lesson

Tilting the odds in our favor.

Treating the vegetation doesn't guarantee wildlife habitat will improve, but it sets the stage for improvement and tilts the odds in our favor. The amount and duration of moisture is the most critical component in the Southwest—and only Mother Nature controls this function.

VIDEO

http://bit.ly/SJMikeEffects

Lessons Learned on Wildlife Habitat Improvement

Mike Godwin, Field Supervisor with the Arizona Game and Fish Department, discusses how we are setting the stage for the key phases that will provide the recruitment of the vital browse, forbs, and grass species that will benefit wildlife habitat.

Godwin also points out the observed effects of the San Juan Fire, including the return of some browse species that have been absent here for several years.

C. Soils-Hydrology

Lesson

Design criteria for future projects.

Keeping a viable overstory canopy and reducing surface fuels to help ensure that a passing wildfire does not burn exceedingly hot should be design criteria for future projects.

VIDEO

http://bit.ly/SJEricSoils

Lessons Learned on Soils and Hydrology

Eric Robertson, Soil Scientist with the Apache-Sitgreaves National Forest, discusses how fire effects above the ground are important considerations for determining potential soil loss.

In this on-site interview, Robertson also points out the new grasses that are establishing post-fire, as well as the stands that received 100 percent mortality. He explains the ramifications of both of these conditions.

The treated areas that were intersected by the San Juan Fire were effective in reducing soil loss from the San Juan Fire because:

- There were still living trees left after the fire, and
- There was still some residual ground cover after the fire's passage, thus
- Both of these conditions help to intercept precipitation and minimize soil loss.

On the San Juan Fire, some treated sites favored low-severity wildfire which is favorable for long-term soil productivity. This is clearly illustrated in the Burned Area Reflectance Classification (BARC) maps (Figure 19) and Table 2 (both on next page).

From a soil productivity standpoint, when the San Juan Fire burned into the treated stands it returned nutrients to the soil *without* heating the soil in excess. This is a significant, positive outcome.

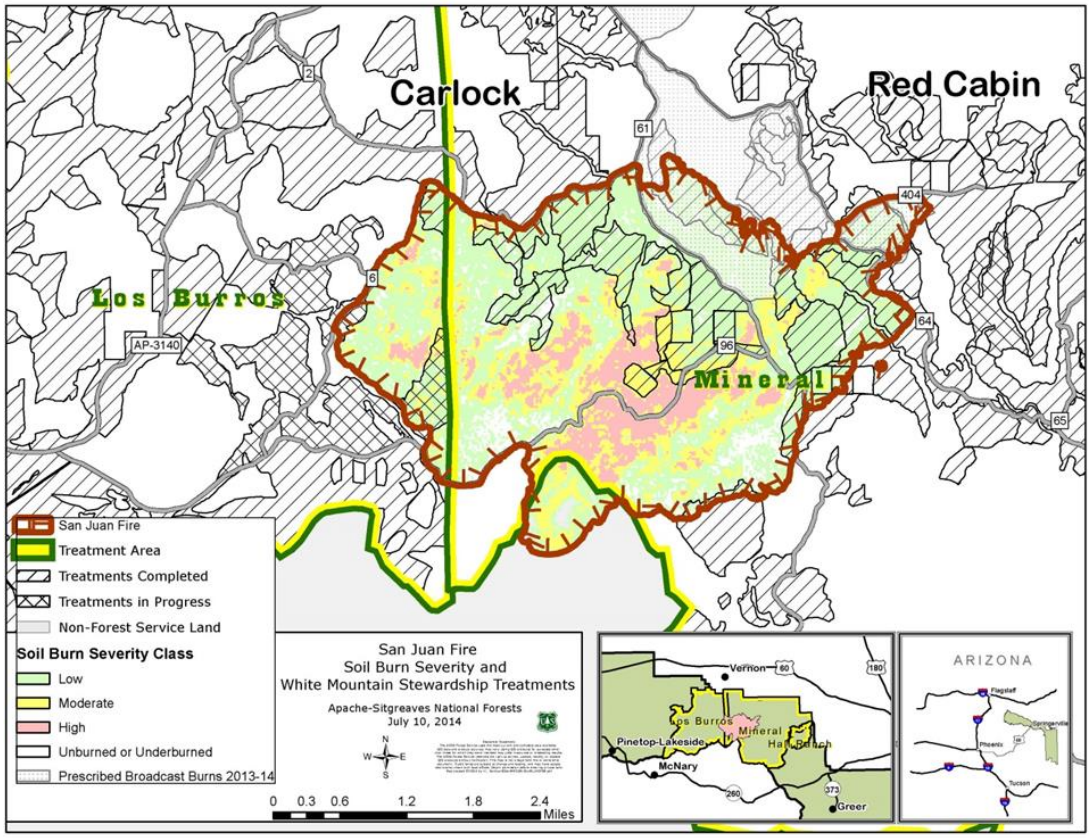

Figure 19 – Map of the San Juan Fire Burned Area Reflectance Classification (BARC). BARC is a satellite-derived data layer of post-fire vegetation condition. The BARC has four classes: High, Moderate, Low, and Unburned. A majority of the high-severity areas on the map are coincident with the areas that did not have a vegetation treatment applied. Conversely, in the areas in which vegetation treatments were applied, the burn severity is classed as Moderate, Low, or Unburned.

Percent of San Juan Fire Area in each BARC Fire Severity Type by Treatment Type			
BARC Severity	**% of Entire Fire Area**	**% of Areas with NO Treatment**	**% of Areas with Treatment**
Unburned	11	12	10
Low	61	48	83
Moderate	21	30	7
High	6	10	0

Table 2 – Comparison of preliminary BARC (Burned Area Reflectance Classification) results for the San Juan Fire. Burned area soil severity drops off significantly in treated areas. Less Fuel = Less residence time = Less negative soil effects.

D. Timber

1. Lesson

Plan on Possible Re-Mark after First Cut as You May Be Surprised How Much Material Needs to Come Out.

> *"There's no sense in trying to get it perfect the first time. Just factor in that you will need some practice to get the feel for marking. Therefore, plan to re-mark some units as needed—especially when you are first getting started."*
>
> **Raymond Rugg, Zone Timber Staff**
> **Apache-Sitgreaves National Forest**

Raymond Rugg, Zone Timber Staff, Apache-Sitgreaves National Forest, explains how when they started marking these treatment units, their first entries tended to not take out as much as needed. He said that when you paint each cut tree, the visual impact to the eye is that everything looks painted—and you therefore think that you've gone too far.

"But after the cut, a lot is still left," Rugg points out. "Often times it was way more than we wanted to be left."

2. Lesson

If a Higher Basal Area (More Trees) is Desired, a Groupy/Clumpy Prescription May Help Reduce Crown Fire Spread Better than a Uniform Prescription.

In some cases, the treatment called for more trees to be left than what was thought ideal to reduce the crown fire threat. Raymond Rugg, Zone Timber Staff, Apache-Sitgreaves National Forest, explained how they discovered that they could help mitigate this by using a groupy/clumpy prescription—leaving patches of tighter-spaced trees isolated by greater distances to neighboring groups or patches.

Many people believe this becomes a more aesthetically pleasing landscape than a more uniform forest cover. While effective, it can be more difficult to implement a groupy/clumpy prescription due to the higher training needed to layout these more complex arrangements.

3. Lesson

In these Forest Types, Diameter Caps Less than 12 Inches Make for Ineffective Fuel Treatments.

Raymond Rugg, Zone Timber Staff, Apache-Sitgreaves National Forest, said that 12-inch cap limits didn't take enough trees out. The result was often a mostly closed canopy with little space between trees. Besides stressing out the competing trees, this also reduced understory grass/forb production.

"By not taking out enough, these forested areas were less likely to burn in a low-intensity surface fire and more disposed to burn in a higher-intensity crown fire," Rugg explains.

While the intention of retaining the forested appearance of the landscape is the primary reason we impose these caps, Rugg cautions that we need to be careful in the future that we don't make the cap too small—less than 12 inches. This can place the entire stand at risk.

Rugg says that a larger cap and a more varied marking scheme can be the answer as there is significant value in creating diversity of age classes to perpetuate the stand over time while still creating separation between tree canopies to allow more light to reach the forest floor and improve understory conditions.

E. Fire Ecology

Prescribed Fire Treatments Need to Follow Mechanical Treatments

1. Lesson

Treatments that approximate historical conditions and include evidence-based thinning treatments plus repeated surface fire can be an effective way to restore ecosystem structure and function while reducing crown fire hazard.

Generally speaking, areas where we used prescribed fire as a follow-up treatment to thinning experienced less burn severity from the San Juan Fire than those areas where we only used thinning or only used prescribed fire.

When we only thinned, we didn't get rid of the fine fuels (needles/twigs) that make up so much of the fuel bed. Intensities, therefore, tended to be higher. When we only prescribe burned, the overgrown condition of the stand forced us to burn at very low burning conditions to avoid damaging the entire stand. Thus, we burned the small material but didn't really get rid of the excess trees in these overstocked stands. The San Juan Fire may have done some of that work for us.

Goal: Modify Ecosystem Function

The lesson here is that when we say the intent of our treatment is "Full Restoration" in dry-site ponderosa pine in the Southwest, we need to be clear that our goal is to modify not just the structure, but also the function of the ecosystem to accept wildfire events like the San Juan Fire.

Mechanical thinning can help us restore the structure sooner by removing excess vegetation. However, that system is not restored until it is maintained by regular, recurring fire episodes. On future projects, managers need to ensure that they factor this fire regime principle into their design. They need to realize that the desired end-state is not just getting the thinning done to change the structure, but also includes getting fire back into the landscape on a regular basis.

A forest that can accept fire on regular, recurring basis is really what defines the success of a restoration treatment in the ponderosa pine regions of the Southwest.

Correct Perspective: How Fire Affects Long-Term Ecosystem Health

2. Lesson

Don't let the immediate visual impact of the burned area trick you into believing that the impacts of a fire are worse than they really are. Focus on what the fire leaves behind—not what it takes.

If the desired condition for an area is to have 75 percent fewer trees and a fire comes through removing all but 25 percent of the trees, the immediate visual impact may lead you to believe that the results are negative because your initial impression is: *"everything is burned"*.

VIDEO

http://bit.ly/SJTessaHighSeverity

The Benefits of High-Severity Fire

Tessa Nicolet, Fire Ecologist for the U.S. Forest Service's Southwestern Region, discusses how high-severity fire can serve as a positive influence for long-term ecosystem health.

In the future, expect that once the shock wears off from seeing a lot of burned area and you realize there's still 25 percent of the trees that are going to survive, you might eventually conclude that the fire's outcome wasn't all that bad. In fact, this result may have been a positive influence for long-term ecosystem health.

F. NEPA Planning

Lesson

Each project is individual. Thus, the plan/prescription should be flexible enough to allow for selecting the appropriate "tool" for the site-specific conditions.

There are no "one-size-fits-all" treatment prescriptions.

That's why resource specialists need to utilize all the available "tools" and customize the treatment to the needs of each specific area. In doing so, resource specialists need to communicate with other specialists, discuss options related to equipment, contracting, timing constraints, fire effects, and various other considerations in conjunction with the project's objectives and priorities.

VIDEO

http://bit.ly/SJStephTool

The Most Important Message: Using the Flexibility in NEPA to Choose the Correct "Tool" from Your Toolbox

Stephanie Coleman, Aquatics Program Manager for the Apache-Sitgreaves National Forest, points out the importance of determining the appropriate treatment tool.

Above all, during their current planning, managers and resource specialists must be prepared to deviate from what has been done in the past, be diligent in monitoring as implementation occurs, and be flexible as the project is implemented to ensure adaptations can occur as necessary—according to the monitoring.

G. Collaborative Relationships and Communications

1. Lesson

Ensuring positive effects on the land requires common interests among many stakeholders, a source of funding, and—even more importantly—a willingness to take calculated risks for the benefit of the resource.

Treatment design begins with finding the intersection of common interests or goals among various collaborators.

Subsequently, and most importantly, there must be trust in the fire managers to implement the treatments in a manner that provides this collaboration with the most efficient and effective use of their resources that achieves those common goals.

VIDEO

http://bit.ly/SJMikePartners

Partnerships Help Accomplish Management Objectives on the Ground

Mike Godwin, Field Supervisor with the Arizona Game and Fish Department, discusses how his agency's "Habitat Partnership Committee Process" is helping to implement wildlife habitat improvement projects on the ground.

Godwin praises the Apache-Sitgreaves National Forest fire managers for their willingness to take calculated risks to ensure that wildlife habitat objectives are achieved.

2. Lesson

As line officers and program managers, we still have room to improve how we communicate the key messages regarding our fire management programs. We must continue to emphasize that: 1) wildfires can be beneficial as well as destructive; 2) cutting trees alone does not necessarily protect the forest from wildfire, it takes follow-up treatment with fire to complete the job; and 3) if we are to maintain the investment that we've made over the past decade, we must increase our prescribed burning program.

To garner support for our fire management programs, we must dispel these three commonly held myths:

1. All wildfires are bad.
2. Cutting trees alone restores landscapes and reduces fire potential, thus prescribed fire isn't necessary.
3. Safe prescribed burning can only happen in the early spring and late fall.

To counter these myths, our communications—both internally and externally—need to emphasize:

1. The positive effects that can result from wildfires, not just the negative effects.
2. The importance of prescribed fire in finishing the job after cutting to create the most effective fuel treatments possible.
3. The feasibility of conducting prescribed burning in late spring or even summer, especially in previously treated areas that have light fuel loadings and are less likely to cause control problems even with hotter/drier conditions (as was witnessed with fire behavior in treated areas on the San Juan Fire).

Beware of the Tendency to Emphasize Mechanical Thinning Over Prescribed Fire When Using Stewardship Contracting as a Funding Tool

Too often we hear our message repeated back to us that our goal on the Apache-Sitgreaves National Forest is removing trees.

In the future, we should emphasize that returning fire to the landscape is our goal and that removing trees is one way we can help make that happen.

Programs with heavy dependence on stewardship contracting—such as the program that we have—tend to focus our message on the mechanical thinning aspects of the program. However, there is a hazard in this. As a result, we tend to lose the prescribed burning message.

When stewardship contracting is your main vehicle for funding your projects, be aware that you need to spend more time communicating about your end-goal—creating forested areas that can and do regularly accept fire. Furthermore, always remember that stewardship contracting is simply a means for helping us use the value of the timber products to do this work in a more economical and cost effective way.

H. Prescribed Fire

1. Lesson

Fuel treatments that recently experienced broadcast prescribed fire were the most effective.

VIDEO

http://bit.ly/SJRobRxEffects

Rob Lever, District Fire Management Officer for the Apache-Sitgreaves National Forest, discusses how the head of the San Juan Fire burned into the site of the 2012 Coon Mountain Prescribed Fire.

Lever explains how areas treated by thinning, pile burning, and broadcast burning were the most effective in knocking down the San Juan Fire. This suite of treatments also helped the firefighters with their suppression tactics and strategies.

2012 Coon Mountain Prescribed Fire Enabled Immediate Containment of the San Juan Fire

One of the most notable outcomes of the San Juan Fire was the fact that—even under extreme burning conditions—because the head of the fire ran into an area that had been thinned and recently burned as part of a wildlife and fuel reduction project, the fire was able to be contained almost immediately. This specific fuel treatment project was the 2012 Coon Mountain Prescribed Fire that had reduced hazardous fuels and removed decadent brush.

While such a dramatic effect is highly unusual, it does illustrate the effectiveness of frequently recurring prescribed fire and the management of wildfires to encourage low- or moderate-intensity fire on a regular basis as opposed to a program of fire exclusion—which will eventually encourage high-intensity fire to occur.

Figure 20 – Final phase of treatment-broadcast burn in 2012 on the Coon Mountain Prescribed Fire.

2. Lesson

Broadcast burning is an effective means to mitigate control problems associated with pile burning.

Many of the treatment units associated with the San Juan Fire resulted in slash piles scattered throughout the unit. The traditional burning techniques were then implemented—to wait for snow or significant rain and then light these individual piles.

Often times, Apache-Sitgreaves National Forest managers found that considerable effort was invested trying to maintain control of these piles days or weeks after they were ignited as drier conditions sometimes caused these fires to creep into the areas between piles.

To mitigate this, they discovered that it was more effective to simply broadcast burn the area—including burning the fuels in-between the piles. By doing this, they reduced the amount of time and effort required to monitor and patrol the treatment area as piles could continue burning for weeks but the chance of escape was minimal. Furthermore, patrol and monitoring could be concentrated around a perimeter instead of throughout the entire unit—as they had previously been doing.

3. Lesson

Recently burned areas—whether by prescribed fire or other wildfires—present fire control opportunities.

The areas where prescribed fire had recently been implemented were very effective barriers to fire spread. Where the San Juan Fire entered the Coon Mountain Prescribed Fire area, the fire stopped on its own in many places and was very easy to control.

The lesson here is that we should think of recently burned areas—whether by prescribed fire or wildfire—as potential opportunities for anchor points for future prescribed fires or control features for wildfire response.

While fuel loads are recovering and will limit the risk of escape and increase the safety margin for firefighters, the San Juan Fire area presents a great opportunity for the initiation of prescribed fires for the next few years.

It also represents a great opportunity to possibly allow a naturally ignited fire to burn into the San Juan Fire area. This would remove excess fuel and perform fire's essential role in this ecosystem while also allowing for safe and effective fire control—even for a fire that is allowed to grow to achieve desirable resource benefits.

4. Lesson

The San Juan Fire taught us that that there might be opportunities to be successful at prescribed burning in mixed conifer fuels if we're willing to accept mixed severity results.

Tactics on the San Juan Fire were very similar to how a prescribed fire would be conducted. Ridge tops were ignited in the evening, or at night, allowing fire to back-down with lower intensity. In addition, the road system in surrounding open ponderosa pine was relied upon as the primary control feature. This allowed the fire in mixed conifer to back down to those more open stands where it was easier and safer to control.

The patchy nature of the San Juan Fire in those previously untreated mixed conifer stands was to be expected: both a few areas of high-severity crown fire along with areas of moderate to low-severity fire.

5. Lesson

The San Juan Fire also taught us that our window of opportunity for conducting prescribed fire may be larger than we previously thought.

Treated stands that do not have the kind of heavier fuel loadings that have traditionally caused problems will most likely burn under hotter and drier conditions.

The San Juan Fire burned during some of the most critical fire weather conditions this area has ever experienced, yet the fuel conditions allowed fire managers to control the fire using burnout techniques much the same way we would use if we were igniting this as a prescribed fire.

In addition, there is better smoke dispersion in the summer, so folks have yet to reconcile prescribed fire and restrictions occurring concurrently.

6. Lesson

It is vitally important to treat with prescribed fire soon after mechanical treatment and then continue frequent prescribed fire to maintain the investment you just made to thin the stand in the first place.

"It is far more economical to treat with fire early and often than to wait too long and find out you now have a fuel bed that is going to require another mechanical entry."

Rob Lever, District Fire Management Officer
Apache-Sitgreaves National Forest

VIDEO

http://bit.ly/SJRobMaintain

Rob Lever, District Fire Management Officer for the Apache-Sitgreaves National Forest, explains why it's important to maintain fuel treatments—especially fire— to preserve their effectiveness.

If implementing prescribed fire is postponed too long, it becomes increasingly difficult to remove the target trees.

Once these trees get to about head-height, a fire that is mostly fueled by grass and needle cast probably won't kill the trees.

Therefore, even though you may not have a critical wildfire condition for several more years, you already have a condition in which you will need to come back in with expensive mechanical treatment to remove the excess trees.

I. Wildfire Response

1. Lesson

The presence of numerous fuel treatment areas allowed fire managers to respond to the San Juan Fire in a way that resulted in lessening the severity of the effects on the land, a safe environment for firefighters, and proved to be—both in terms of potential damages and firefighting expenditures—far less costly.

Some of the specific outcomes observed on the San Juan Fire included:

1. Treatments allowed for increased firefighter and public safety. Firefighters engaged a fire that was at lower intensity than if treatment had not occurred. The fire was controlled before it encountered private property.
2. Due to the presence of thinned areas and the recent Coon Mountain Prescribed Fire, the head (or forward spread) of the San Juan Fire was caught before either the east or west flanks were contained.

VIDEO

http://bit.ly/SJLessons

Three Key Lessons

Tessa Nicolet, Fire Ecologist for the U.S. Forest Service's Southwestern Region, explains three key lessons we learned from the San Juan Fire's burn effects and how treatments enabled specific suppression actions.

Rob Lever, District Fire Manager Officer on the Apache-Sitgreaves National Forest, also discusses how the suite of prior fuel treatments allowed firefighters on the San Juan Fire to focus on controlling the fire—rather than having to also protect homes.

3. Because the firefighting ground forces and engines could hold the head of the San Juan Fire, less aerial-applied retardant was necessary on this incident.
4. Treatments allowed for both direct attack fire suppression tactics—in which suppression forces could safely engage the fire as necessary—as well the ability to utilize indirect tactics to stop the fire in pre-identified strategic locations. This allowed firefighters more options to go on the offensive and control the fire, rather than having to implement point protection strategies in a more defensive mode.
5. These prior treatment areas also made it easier for firefighters to find and pick up spots.

2. Lesson

While firefighters on the San Juan Fire had to employ more patience than "normal", the end result was well worth it.

Because of the condition of the treated areas, fire managers were not concerned with the fire making a substantial run. This allowed these managers time to plan and conduct a slow, methodical burn-out operation which brought the main fire out to control lines slowly, under moderate burning conditions, over the course of several days in order to fully contain the fire.

The temptation for firefighters is to fire-off the containment lines quickly to enable the fire to be controlled as soon as possible. If this tactic would have occurred on the San Juan Fire, the result would have been a far more damaging, higher-intensity fire.

In conclusion, if weather conditions and the situation allow for it, it is a good practice to manipulate the timing and techniques used during firing operations to improve fire outcomes rather than causing more damage because we were in a rush to suppress the fire as rapidly as possible.

To learn more
about the San Juan Fire or fuel treatments on the
Apache-Sitgreaves National Forest, please contact:

Jeremy Human, Forest Fuels Specialist,
Apache-Sitgreaves National Forest
Telephone – 928-333-6320

This fuel treatment effectiveness assessment was conducted by:

Tara Umphries
Fuels Specialist, Detailed
U.S. Forest Service, Southwestern Region; Albuquerque, New Mexico

Tessa Nicolet
Fire Ecologist
U.S. Forest Service, Southwestern Region; Payson, Arizona

Frankie Romero
Fire Use and Fuels Management Specialist
U.S. Forest Service, National Interagency Fire Center; Boise, Idaho

Report edited and designed by:
Paul Keller, Technical Writer-Editor, Wildland Fire Lessons Learned Center

Videos recorded and edited by:
Josh McDaniel, Fire Science Editor, Wildland Fire Lessons Learned Center
with support from the Southwest Fire Science Consortium – http://swfireconsortium.org/

We wish to thank the following people for their help and support in producing this assessment:

Apache-Sitgreaves National Forest
Paul Brown, Ed Collins, Stephanie Coleman, Jerry Drury, Mark Empey, Jeremy Human, Rob Lever, Marcia Pfleiderer, Eric Robertson, Raymond Rugg

Incident Responders
Ben Plumb, Dave Raney, Dave Reisner, Buck Wickham

Ecological Restoration Institute
Bruce Greco, John Paul Roccaforte

Arizona Game and Fish Department
Mike Godwin