Lincoln National Forest
2011 Monitoring and Assessment Report

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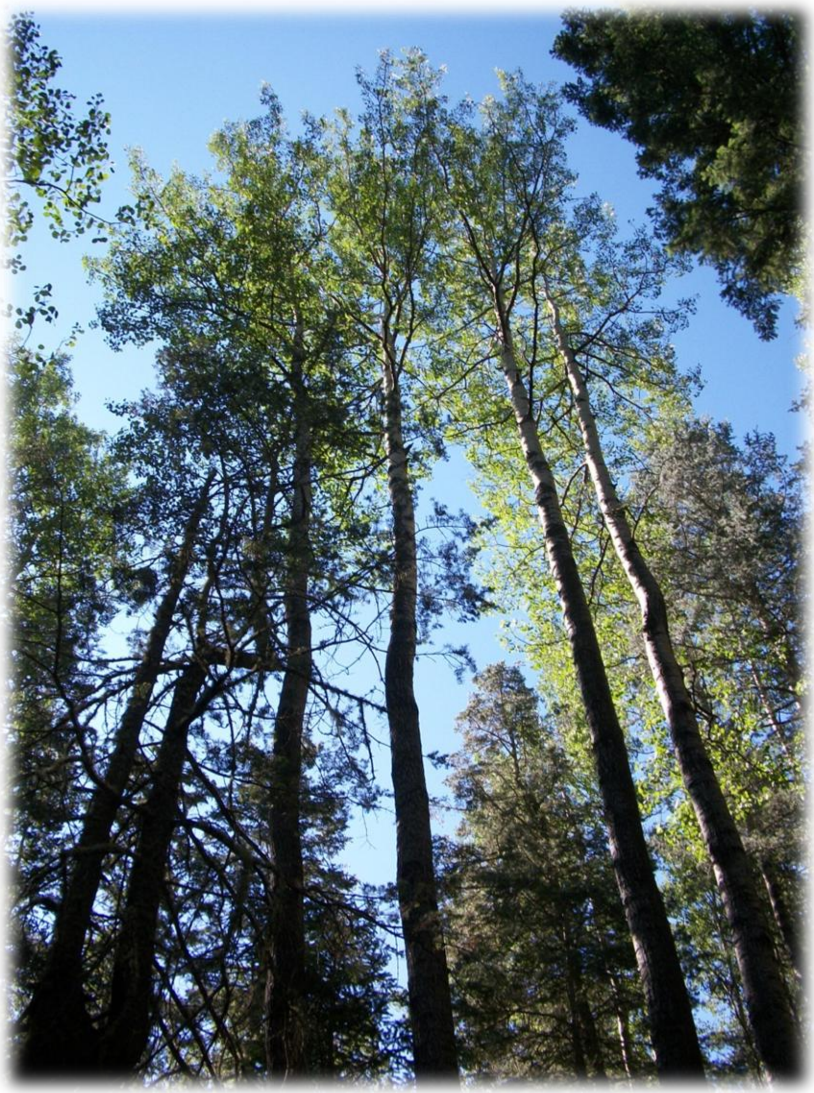

Caring for the Land
and Serving the People

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Executive Summary

This report contains data for field seasons 2010 and 2011 in a combination of force account and contract data collection. Data from 2010 comes from a completed CSE contract in the 335 acre Old Road Project where 56 plots were installed. Two non-forested (CNVSP) contracts were completed in 2011. 42 plots were installed on Smokey Bear and Sacramento Ranger Districts. Some data from the non-forested contracts is used to describe and support assessment of project areas.

During field season 2011 447 plots were installed through force account work. Approximately 55,000 acres of landscapes forest wide were assessed for effects of vegetation treatments, wildfire on treated and untreated landscapes. Plots consisted of Common Stand Exam (CSE), Common Non-Forested Vegetation sampling Methods (CNVSP), and photo points.

Key Findings:
Planning and implementation documents often overlap in Goals and Objectives. For example a project may be lopped and scattered to improve wildlife habitat, then burned to reduce hazardous fuels generated through the cutting. This can create confusion of how to interpret effectiveness of treatment.

Wildfire: Treatment Effectiveness, Vegetative Recovery, Fire Effects

- Terrain and extreme environmental conditions compromise treatment effectiveness.
- In extreme conditions type conversions, for example pinyon-juniper woodland to grassland delayed or stopped fire.
    - The addition of grazing to a treated area retarded spread of fire
    - In extreme conditions defensible space implemented by private landowners was successful at protecting property.
    - Hazardous fuels treatments have higher success when used as point protection, or in strategic placement with both manmade features such as roads and natural features such as large ridgelines.
    - Hazardous fuels treatment may be better described using objectives such as improving suppression capability and firefighter safety rather than altering fire behavior or restoring fire adapted ecosystems.
- ERC's have increased nearly doubling over the last 40 years due to periods of extreme drought over extended periods of time.
    - Treatments may not have been modeled for these conditions.
- Data shows areas with prior treatment have higher biodiversity than untreated areas during post wildfire vegetative recovery.
- BAER treatment which used seeding or seeding and mulching proved beneficial in fostering rapid growth of species to reduce potential erosion.
- In some wildfires both treated and untreated landscapes burned variably regardless of treatment, vegetation type, topographical characteristics or climactic conditions.
- Recognition of potential impacts of lop and scatter activity fuels during wildfire is important in terms of resistance to control, and effects to canopy and soil, where protection is a goal of the treatment.

Shifts in Vegetative Structure and Composition/Post Treatment Assessment
Vegetation manipulation, such as thinning from below, removal, and lop and scatter offer rapid change in stand structure to support diversity in both tree diameter size class and habitat.

Landscape level treatments, in particular prescribed burning provide the most efficient and wide scale shift in forest and surface vegetative structure, biodiversity and reduction in fuel loading.

Treatment of activity fuels needs to be considered. Some treatments increased fuel loadings, regardless of application of prescribed fire.

Assessment of vegetation needs to be consistent including using reliable methods that adequately describe tree density.
Treatments in Mexican Spotted Owl habitat create forest structures that do not meet recovery plan guidelines, however MSO PACs remain occupied.

Recommendations
Vegetation treatments where protection is the goal through treatment of hazardous fuels, should consider the following objectives, descriptions and treatments:

- Use improved suppression capability and firefighter safety as a primary objective of hazardous fuels treatments.
- Incorporate conditions such as reduction in resistance to control
- Implement treatments which support point protection of values at risk or combine with existing features to improve suppression capability.
- Utilize landscape level type conversions which support primarily grassland species. When grazing is incorporated treatment effectiveness improves.
- Re- focus the concept of restoring fire adapted ecosystems. Utilize specific components or parameters which are being altered to restore an ecosystem. Avoid the goal or objective of reduction in crown fire activity. Problem fire behavior, fire resistant to control can pose challenges if surface fire as well as crown fire. Some stand replacement (crown fire) may be desirable and normal function of a particular ecosystem. Clear understanding of values at risk and goal of project should be clear.
- Calibrate and validate fire behavior modeling. Models provide perspective on potential impacts of wildfire. They have limitations on adequately portraying landscape level fire spread and effects.

Restoration:

- Land Management Planning would better support implementation efforts with restoration principles unique to the Lincoln National Forest.
- Restoration principles should incorporate habitat enhancement, unique characteristics (stand structure, herbaceous composition, stream function), and other measurable characteristics. These can be used as metrics to measure and demonstrate change and effectiveness.

Landscape level changes are often difficult to quantify or prove as successful. Clearly defined desired conditions which are representative of the Lincoln will provide an avenue to demonstrate success in vegetative treatments.

Monitoring 2010-2011

Background:
This report contains data for field seasons 2010 and 2011 in a combination of force account and contract data collection. Data from 2010 comes from a completed CSE contract in the 335 acre Old Road Project where 56 plots were installed. Two non-forested (CNVSP) contracts were completed in 2011. 42 plots were installed on Smokey Bear and Sacramento ranger Districts. Some data from the non-forested contracts is used to describe and support assessment of project areas.

During field season 2011 force account work was accomplished on approximately 55,000 acres of landscapes forest wide to assess effects of vegetation treatments, wildfire on treated and untreated landscapes. 447 plots were installed forest wide. Plots consisted of Common Stand Exam (CSE), Common Non-Forested Vegetation sampling Methods (CNVSP), and photo points.

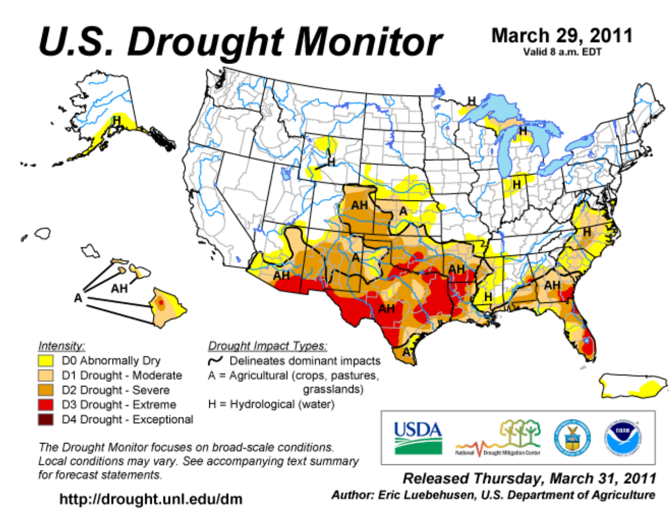
Table 1 below lists projects, acres, activities, plots and type of plot.

Table 1: Monitoring Projects

District	Project	Activities	Acres	CNVSP	CSE	Photo Point Some Veg Data
Smokey Bear	Poult	Thin/Rx	198		15	
Smokey Bear	Gobbler	Thin/Rx	52		7	
Smokey Bear	Lucas	Thin/Rx	225		12	
Smokey Bear	White Fire	Wildfire w/treatments	10,356			23
Smokey Bear	Donaldson Fire	Wildfire w/treatments	5,000 USFS (96,204)	4	101	
Smokey Bear	CNVSP Contract	Multiple	District Wide	17		17
Smokey Bear	Old Road, CSE Contract/fall 2010	Rx Fire, Lop & Scatter	335		56	
Sacramento	Benson Ridge/MSO	Timber Removal	642		58	
Sacramento	Pumphouse/MSO	Timber Removal	834		98	
Sacramento	Mayhill Fire	Wildfire w/treatments	31,941	1	63	6 (Sikes projects)
Sacramento	CNVSP Contract	Multiple	District Wide	25		25
Guadalupe	Bullis Rx	Rx Fire	2,500	2	50	
Guadalupe	Queen Fire	Wildfire w/treatments	4,200	1		5

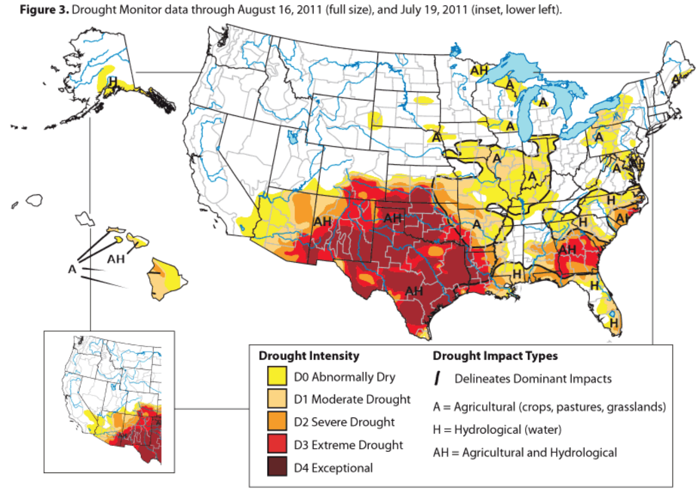
The Lincoln National Forest had 71 fires in 2011, totaling 77,175 acres burned on the Lincoln. Eight fires were ranged from 1,000 acres to over 50,000 acres. The combination of multiple wind events combined with climatic conditions for year 2011 had a direct effect leading to the high number of large fires occurring on the forest. La Niña contributed to dry conditions observed from winter through the monsoon season. Snowpack was 50% of normal with many areas characterized as being in severe drought. The entire calendar year for 2011 averaged 9 inches of rain forest wide. Comparatively 2008-2010 ranged from 15-26 inches of rain per calendar year forest wide. The combination of drought conditions combined with two to three years previous of abundant grass growth provided the conditions for multiple large fires.

The dry winter favored extreme drought conditions in Arizona and New Mexico. Above normal temperatures in March led to near complete melt of snow packs. The drought monitor graph below reflects March drought conditions across the US. Conditions continued into fall of 2011. Monsoon activity for 2011 was limited and scant in most areas. Average rainfall in 2011 from July to September was 5 inches. From 2008-2010, 10-23 inches of precipitation occurred from July to September forest wide. The US drought monitor below shows deepening of the drought in the US from March to August of 2011, reflecting scant precipitation.



March

Figure 3. Drought Monitor data through August 16, 2011 (full size), and July 19, 2011 (inset, lower left).



August

ERC /Fuel Moistures

In March of 2011 ERC's showed a steady increase, reaching 90th percentile conditions in late March and early April. Adding to extreme burn conditions was a late winter freeze, with temperatures 20-30 degrees below zero, which may have influenced fuel moisture in pinion, juniper and oak. The early freeze created fuel conditions more available to burn through reduction in moisture and possible mortality of leaf, stem and small branches of trees and leafing shrubs.

Live fuel moisture conditions were in dormant or nearly dormant conditions, while dead fuel moistures were within ranges conducive to extreme fire behavior as seen below in table 2:

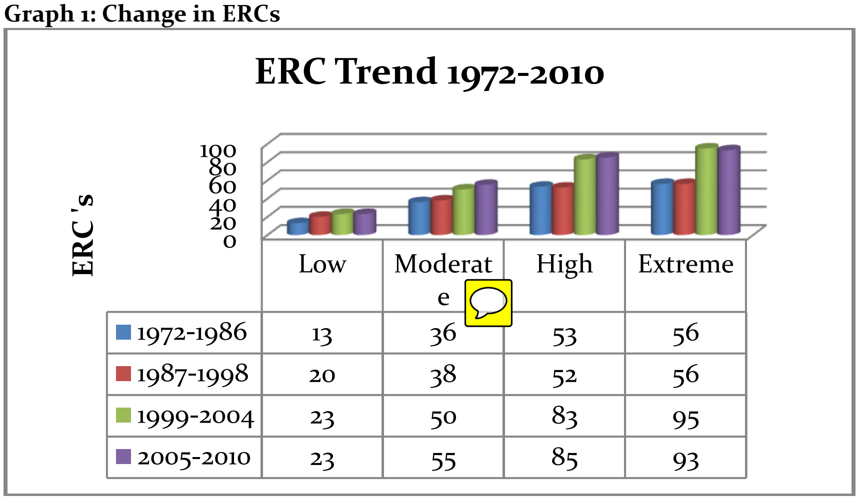
Table 2: Fuel Moistures

Source	1 hr	10 hr	100 hr	1000 hr	Woody	Herbaceous	Juniper	Ponderosa	Grass
RAWS	6	7	6	8	60	7			
Measured		5					81	106	7

Current climate trends have continued to show progressive drying and overall increase in fire danger over decades. The graph below shows change in ERC's from the 1970's to present. Rapid increase in ERC, and fire danger occurred in the late 1990's to present.

What was extreme 20 years ago is now moderate, and extreme has nearly doubled due to persistent drought that began in the 1990's. Fuels treatments are based on developing treatment prescriptions relative to 90-95th percentile weather; however those percentiles have shifted over several decades of increasingly warm weather trends. Graph 1 displays shifts in ERC over time.

Graph 1: Change in ERCs

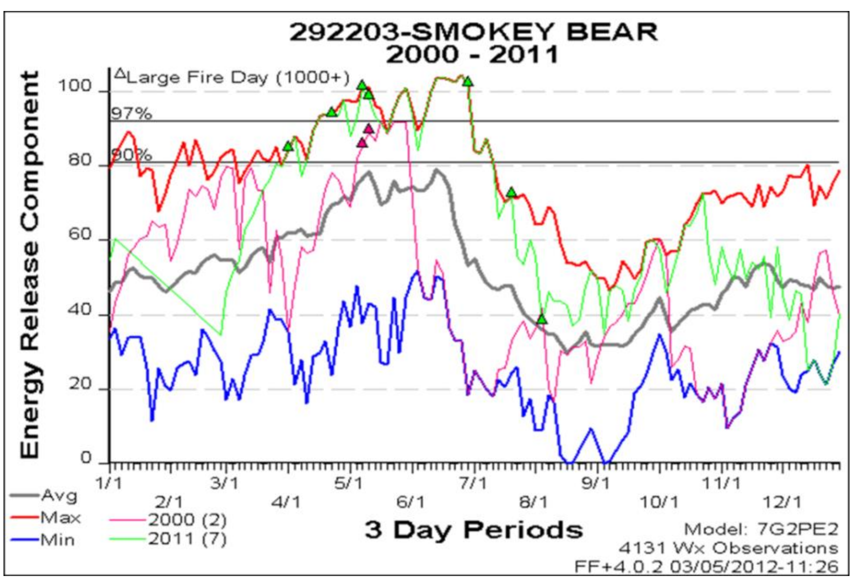


	Low	Moderate	High	Extreme
1972-1986	13	36	53	56
1987-1998	20	38	52	56
1999-2004	23	50	83	95
2005-2010	23	55	85	93

Graph 1a below displays an overlay of wildfires in 2011 and 2000. Triangles on the graph represent fires over 1000 acres for the year 2000 and the year 2011. The year 2000 is in pink while the year 2011 is in green.

Compare the ERC trend for both years. In 2000 ERC's trended in the high to extreme range from mid-May to mid-June, while in 2011 ERCs were in the high to extreme range from early April to mid-July.

Compare the number of fires over 1000 acres in both years. In 2000 there were two fires, while in 2011 there were five within the high to extreme range of ERC's. The number of fires over 1000 acres doubled, as did the length of time in which environmental conditions, represented by ERC's, were in the high to extreme range.



Monitoring

Four fires that burned in 2011, White, Donaldson, Mayhill and Queen, were monitored. Post fire monitoring effects to vegetation and impacts to vegetation treatments using a combination of CSE, CNVSP, and photo points.

Burned Area Reflectance Classification (BARC) maps, when available, were used to assist in determining location of plots. Other considerations such as treated and untreated landscapes, vegetation type, slop, aspect and other features were used to compare and contract effects of fires passage on the landscape.

Areas treated often had multiple objectives combining both hazardous fuels treatment with other objectives such as habitat or livestock forage improvement.

The following treatment observations were documented through monitoring:

- Landscape level type conversions had the greatest effect in slowing, delaying, or stopping fire. Typically conversions were either dozer pushes or masticated units which shifted landscapes from pinyon-juniper woodland to grassland. The addition of grazing which reduced fine fuels increased effectiveness of treatment through slowing/stopping spread of fire. (White Fire)
- Point protection in the form of fuel breaks around homes was successful in preventing crown fire. (White Fire)
- Landscape level prescribed fire may have mitigated overall severity, fostering low to moderate severity fire effects. (Queen Fire)
- Landscape level treatments and strategic placing of treatments improved suppression capability. (Donaldson Fire)
- Lop and scatter impacted both canopy and soils. (Mayhill and Donaldson Fire)
- Extreme conditions surpassed treatment's abilty to have any effect on fire behavior. (White Fire)
- Regardless of treatment fire effects were variable and inconclusive in determining treatment ability to alter fire behavior. (Donaldson and Mayhill Fires)

Several large fires dating to 1994 were monitored for post fire recovery and vegetative composition using CNVSP monitoring methods. Data was useful to demonstrate post fire vegetative species diversity and dominant vegetative cover over time. Table 3 lists fires which were monitored.

Table 3: Post Fire Recovery

Wildfire	Year	Acres	District
Patos	1994	5,133	Smokey Bear
Cree	2000	6,518	Smokey Bear
Scott Able	2000	16,034	Sacramento
Penasco	2002	16,020	Sacramento
Mayhill	2011	31.941	Sacramento
* Little Lewis-Scott Able	2011/2000	1,110	Sacramento
Queen	2011	4,200	Guadalupe
* The Little Lewis burned through the Scott Able fire of 2000			

White Fire

The White Fire was reported at 1330 on April 3, 2011. The fire occurred during Red Flag conditions with observed wind gusts estimated at 60 mph, and sustained winds 40-45 mph. The fire burned over 10,000 acres in approximately 6 hours. Photos 1 and 2 capture smoke, fire spread, winds, and fire behavior. Flame lengths were estimated up to 80 feet with short range spotting. Temperatures were in the 70's, with relative humidity in the single digits.

Photo 1: White Fire @ 1530

Photo 2: Fire/Smoke Column / Winds

Fuels

Vegetation within the fire is predominantly pinion-juniper woodlands with grass / oakbrush understory. Pockets of ponderosa pine occur in drainages and northerly aspects. Nine fuels treatments were interspersed within the perimeter of the White Fire. 1900 acres or 19% of the landscape had treatments mainly along ridges, bordering urban interface, riparian corridors and areas adjacent to in-holdings. Treatments were predominantly mastication with some dozer pushes, and habitat improvement projects focused on lop and scatter. Table 4 lists treatments, type and year treatment occurred.

Table 4: Fuels Treatments

Name	Type	Acres	Year of Treatment
Track 1	Mastication	95	2008
Track 2	Mastication	92	2009
Goat	Mastication	500	2007
Salisbury	Mastication	127	2009
Gravel Pit	Mastication	85	2008
West	Mastication	365	2007
Hale 2	Dozer Push / Rx	304	2006/2009
Lone Pine	Mastication	80	2007
Grindstone	Sikes Lop & Scatter	253	2001

Fuel treatments potentially extended time to evacuate populations, however fire spread and behavior were not altered, nor treatments used as holding lines due to rapidly spreading high intensity fire, burning under extreme conditions. Three treated areas, two on private lands did limit impacts of fire, protecting two homes. The Hale 2 dozer push, which was also grazed, slowed or stopped fire spread along the head or southeast portion of the fire.

Photos 3thru 6 document change in vegetation structure and post fire effects. Eight of the nine treated areas experienced moderate to high intensity fire, which resulted in 80-100% stand replacement. Ridgeline areas within the Gravel Pit mastication sustained low to moderate intensity fire. The Hale 2 dozer push and prescribed burn was the only treatment which stopped fire spread, and experienced low intensity fire or no fire.

Pre and post treatment effects within mastication units:

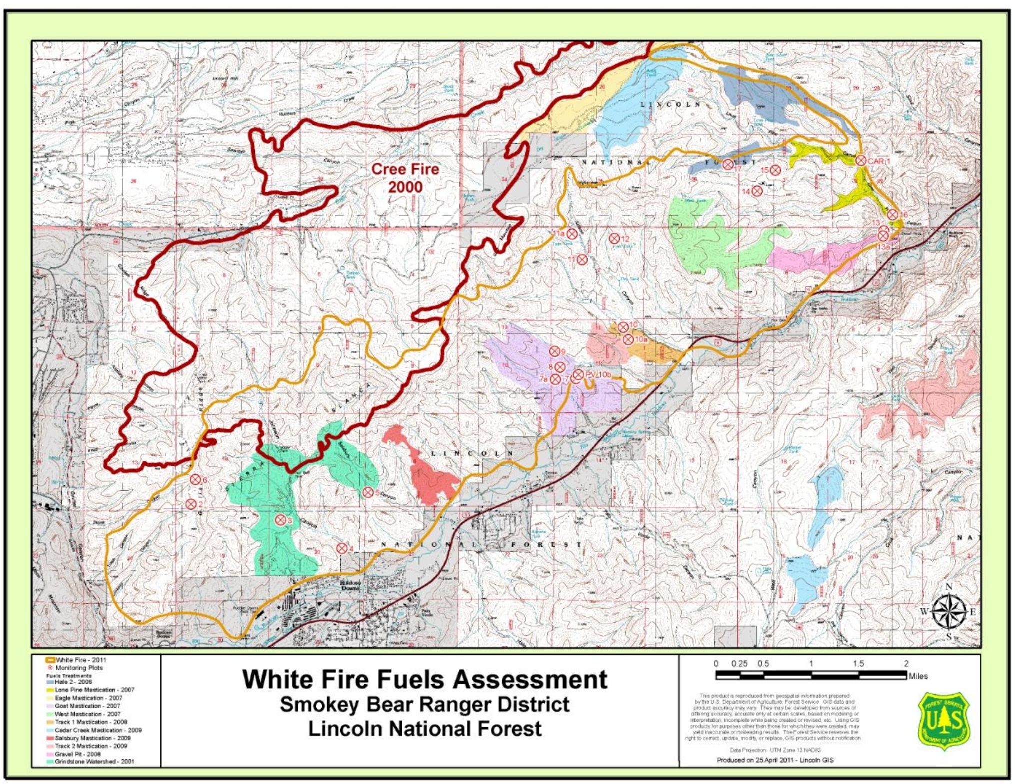
Photo 3: Goat Mastication – Pre-treatment

Photo 4: Goat Mastication (2007) – Post Treatment

Photo 5: Goat Mastication – Post Fire

Photo 6: Track 2 Mastication, Post Fire, east of Goat

Map 1 incorporates fire perimeter of White Fire with locations and distribution of fuels treatments and the 2000 Cree fire with adjacent treatments. The White Fire moved into the old burn scar of the Cree Fire which slowed or stopped the spread of the fire.



Map 1

Fuel breaks around homes and the Hale 2 Dozer push were able to alter fire behavior, bringing fire to the ground as seen in photo ow or stop the fire as seen in photo 8 of Hale 2 Dozer push. Note blackened landscape prior to dozer push, as well as past it where treatment ends on right side of photo.

Photo 7: Fuel break on private lands. Mitigated impact of fire on home further east, not seen in picture, no structures lost. A portion of Goat Mastication borders treatment. Track 2 borders private land to east.

Photo 8: Hale 2 Dozer Push, prescribed burned in 2009. Note openness, space between leave clumps.

Post Fire Rehabilitation:

Post fire seeding occurred on 5,900 acres within the White Fire. Within the 5,900 acres, mulching on 1,800 acres occurred combined with seeding. Twenty-one permanent plots were installed throughout the fire to document shifts in vegetative cover due to rehabilitation activities and natural regeneration of vegetation. Photo points were established immediately after the passage of the wildfire. Photo points were revisited after the onset of monsoon in the same year to assess vegetative response. Photo pairs 9 thru 11 characterize post fire vegetative recovery.

Photo 9: Plot 7, south, mastication, no seed/mulch, low severity, Seeping Springs Canyon

Photo 10: Plot 10a, south, mastication, no seed/mulch, moderate severity, Allison Canyon Area

Photo 11: Plot 7a, south, mastication, seed/mulch, moderate/high severity, Seeping Springs Canyon

Abundant oak brush sprouting occurred within plots 7 and 10a, photos 9 and 10, both mastication units. Photo 11, far right captures both success of seeding and mulching. Oak brush regeneration has also ensued within the same area. Inclusion of mulching was used in some areas to increase success of seeding.

Photo 12: Plot 5, south, lop/scatter, seed only, moderate/high severity, Salisbury Canyon

Photo 13: Plot 2, south, no fuels treatment, seed/mulch, high severity, Lookout Canyon

Photo 14: Plot 4, north, no fuels treatment, seed/mulch, high severity, Johnson Canyon

Photo 15: Plot 9, north, no fuels treatment, seed only, high severity, Big Box Canyon

Plots in photos 12 thru 14 produced sprouting of oak from seeding and some mulching, while photo 15 on far right had oak brush growth, with no application of seed or mulch. Photo pairs 16 and 17 experienced high severity wildfire, with seed applied.

Photo 18, far right had no seeding. Plot 17 is part of the Hale 2 dozer push at head of fire. Some low intensity fire occurred along the southern flank of the dozer push, while the interior of the unit had no fire.

Photo 16: Plot 14, south, no fuels treatment, seed only, high severity, no name canyon

Photo 17: Plot 15, east, no fuels treatment, seed only, high severity, Lone Pine Canyon

Photo 18: Plot 17, east, dozer push/rx fire, no seed/mulch, low/moderate severity, Lone Pine Canyon

Conclusions:
Conditions at the time of the White Fire were extreme based on seasonal trends and weather on the day of the fire. The overall orientation of the Rio Ruidoso river drainage is south, allowing for increased solar radiation, heating and drying of fuels, development of thermal belts, in addition to funneling of winds in a major river corridor. The river corridor further amplified wind flow due to its southwest to northeast alignment with prevailing winds. Radiant and convective heat combined with winds played as great a role as the flaming front itself in spreading the fire rapidly across a heavily dissected southerly oriented landscape.

Some treatments did mitigate wildfire spread. Fuel breaks at two homes and dozer push as discussed previously were successful in altering fire behavior limiting fire spread and fire behavior.

Photo evidence from post fire rehabilitation indicates successful vegetative recovery. Areas with no seeding or mulching also showed favorable post fire regeneration in the form of abundant oak brush sprouting. Newly sprouted oak brush is also a favorable browse species for ungulate populations.

Donaldson Fire

The Donaldson fire, caused by lightning, was detected on June 26. Major growth occurred from the 26 through the 30th of June, with a fire size of 96, 204 acres. Approximately 5,000 acres burned on USFS lands. The fire burned predominantly in grassland with pinyon-juniper woodland interspersed though out.

Terrain was rolling to rugged with heavily dissected drainages. Fire behavior was a combination of surface fire with pockets of intermittent torching in woodland. Weather trends at the time were hot with an increase in humidities due to time of year. Temperatures ranged in the high 70's to mid 80's with humidities 18-25%. Winds were average, 5-10 mph. Monsoonal flow was scant with little measurable precipitation. Fuel moistures as seen in the Table 5 were conducive to large fire growth.

Table 5: Fuel Moistures

1 hr	10 hr	100 hr	Herbaceous	Woody (shrubs)
2	2	3	30	60

Fuels Treatments

Multiple treatments occurred within the burned area. Mastication, lop and scatter, dozer push, and prescribed fire on approximately 2800 acres of land. Map 2 displays locations of treated areas within the fire perimeter, while table 5a displays treatment types and year of accomplishment. All treatments had the effect of opening up canopy and converting landscapes to grassland in varying extents from tens of acres, in lop and scatter projects to several hundred acres in mastication and dozer push units.

Table 5a: Treatments

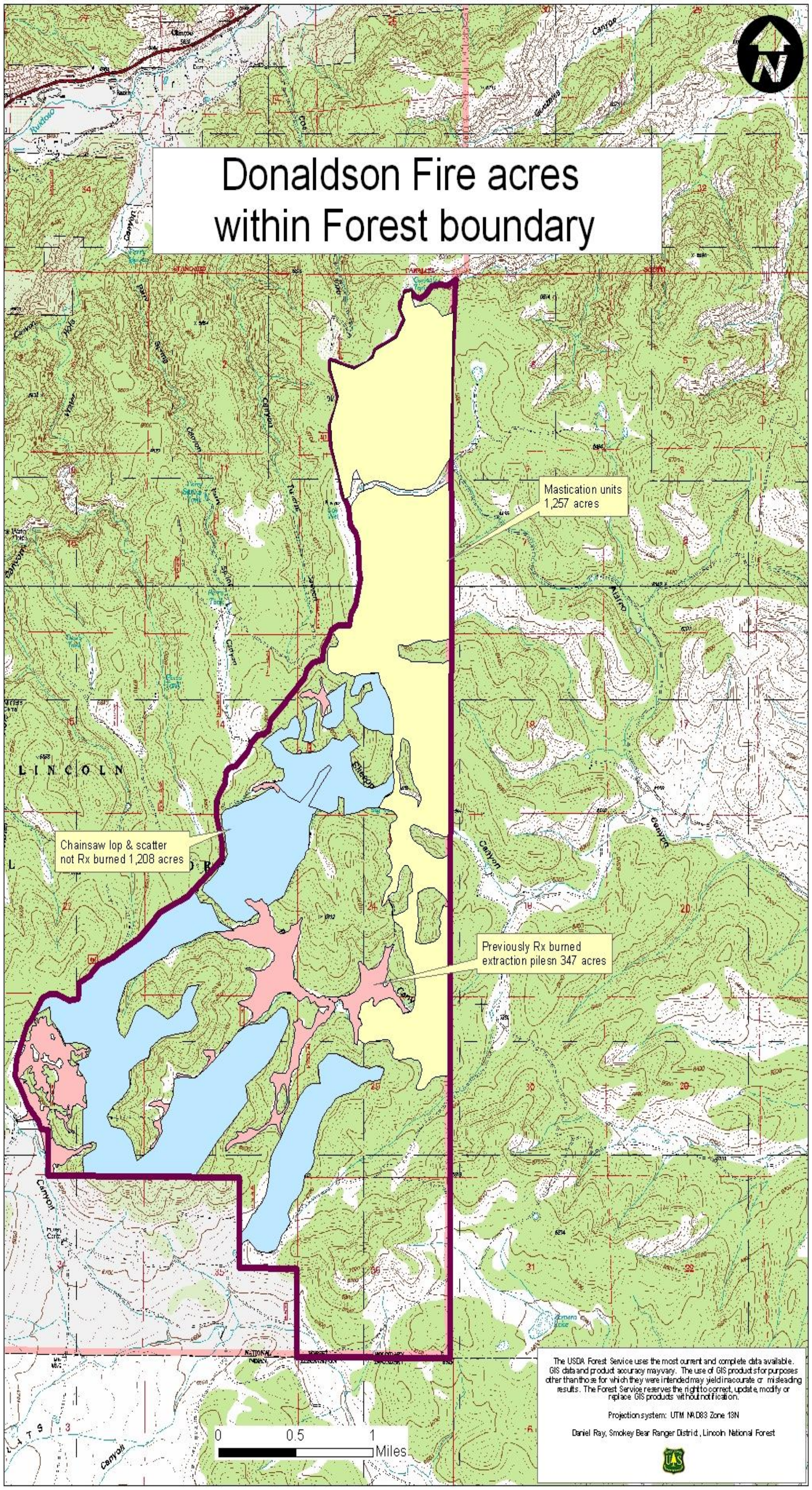
Name	Type	Year	Acres
Perry	Lop & Scatter/Rx	1998-2005	300
Dead Horse	Lop & Scatter	2005	308
Dog Town	Lop & Scatter	2007	600
Fox Water	Dozer Push / Rx	2009	347
Wapiti	Mastication	2006	800
Coe	Mastication	2006	457

Treatments allow for residual trees, left in small clumps to single trees. Openings generally left less than 10 percent forested cover. Photo 19 is a combination of lop and scatter adjacent to a dozer push, capturing treatment diversity within the project area. Lop and scatter treatments create openings in a corridor pattern. Dozer pushes create larger continuous landscapes typical of type conversions from woodland to grassland. Dark spots in dozer push are unburned piles.

Photo 19

Suppression capability was enhanced in the Donaldson fire. The west and southwest perimeter of the fire was contained along FR443 were multiple treatments were. Distribution of fuels treatments can be seen in Map 2. To the right of Map 2 is an aerial photo which shows the actual treatments which extend into the horizon of the photo. Furthest out are mastication treatments.

Vegetation treatment influence on fire behavior was inconclusive across the landscape. Overall effects of fuels treatments revealed variable intensities and severity; this was evident during post fire assessment of the wildfire. Fire burned at mixed intensities regardless of forest and surface vegetative structure and fuel loadings. Some areas experienced stand replacement, while others supported surface fire. Effects were not unique to treatments. Weather and topographical influences, similar to both the Mayhill and White fires appear to favor stand replacement rather than fuel continuity vertically or horizontally.



Map 2

Treatment placement was pivotal in holding operations during the Donaldson fire. Open areas allowed for defensible safe and improved safety in the implementation of holding actions.

Photo 20 below captures distribution of treatments. Area off wing tip of plane is southwest portion of area in map to left. Photo is looking north, showing multiple treatments within the fire area.

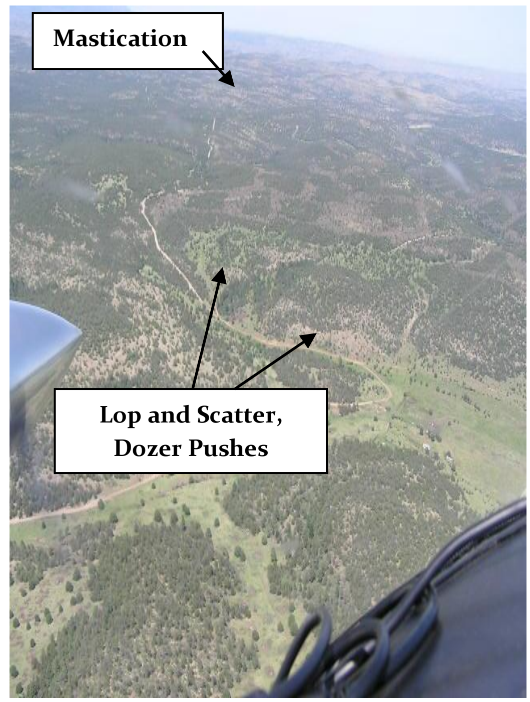


Photo 20

Observed fire behavior in masticated area next to FR 443, during burnout operations, Donaldson fire. Observation occurred midafternoon.

Photo 21

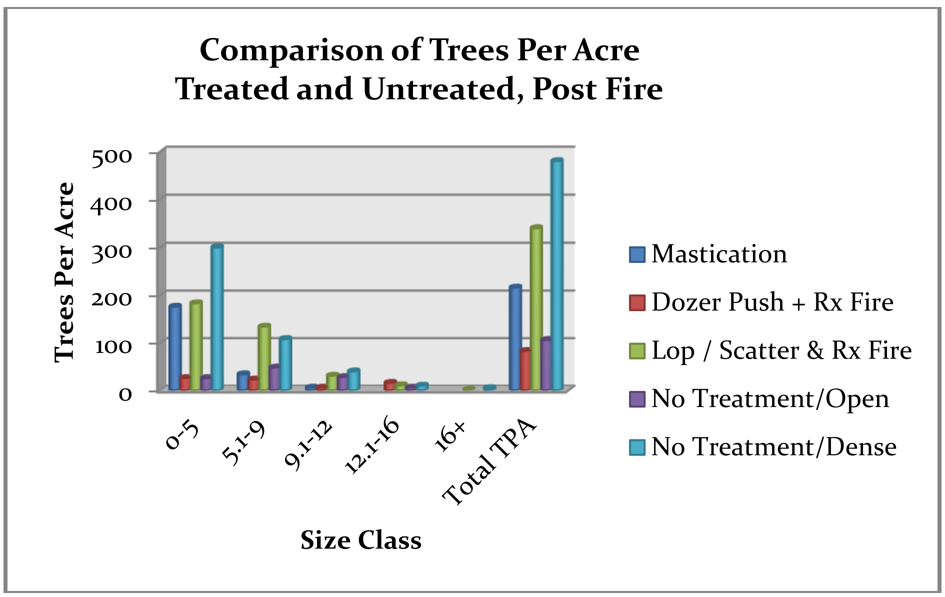
Vegetative structure and composition

Landscapes are a combination of grassland and pinyon-juniper woodland. Small stringers of ponderosa pine are scattered primarily in the southern portion of the wildfire area. Limited data exists pre-treatment concerning tree density. Tree density is estimated at 440 trees per acre, with 38% less than five inch diameter. Photo points in photos 22 and 23 occurred prior to mastication treatment.

Photo 22: Stand conditions prior to treatment within wildfire area.

Photo 23: Stand vary from clumpy to scattered trees.

Data collected post wildfire characterizes tree density post fuels treatment. Graph 2 compares tree density and size class amongst treatments. Regardless of tree density fire effects were variable across the landscape. Surface cover throughout the wildfire averaged 32% vegetative cover and 68% rock, bare ground, and litter.



Graph 2

Photos 24 thru 27 characterize a variety of fire effects. Treatments display multiple vegetative structures and composition. Within open areas, such as lop and scatter units, high intensity fire can be seen in background based on effects to residual tees as seen in photo 26. Other areas, depicted in photo 27, had little evidence of the passage of fire. Photo 27 was taken in a stand adjacent to Photo 26, where residual trees were scorched due to residual lop and scatter and abundant grass from previous years growth.

Photo 24: Mastication (2007) – 216 trees per acre mainly found in clumps as seen in picture to right

Photo 25: Mastication (2006) with leave clumps.

Photo 26: Lop scatter / prescribed fire (1998/2005)

Photo 27: Leave clump in lop and scatter post fire. 340 trees per acre in eave clumps post rx fire and wildfire

In 2010 3 forested permanent plots were installed. Plots were revisited post fire to capture pre and post fire effects. Photo 28 is pre-wildfire, while photo 29 taken at same point post wildfire. Photo 29 displays high intensity fire which removed much of the tree and shrub canopy. The area was not treated, however similar effects can be found in treated units as well. The topography of the landscape lends itself to the funneling of winds, combined with grass production which supported high intensity fire behavior. This landscape is east of the 443 where the fire was contained.

Photo 28: Trees monitored at this plot in 2010 average 440 per acre, with 45% surface vegetative cover.

Photo 29: The same area post fire had 100% mortality and 10% surface vegetative cover.

Photos 30 thru 32 further illustrate the variability of fire effects regardless of vegetation treatment. Photo 30 is along an exposed ridge top where no treatment had occurred, photo 31 is within a narrow creek drainage on a steep slope with little to no evidence of fire. Photo 32 is a lop and scatter unit which experience high intensity fire and removal of residual canopy.

Photo 30: No treatment, 100 % mortality, 130 trees per acre.

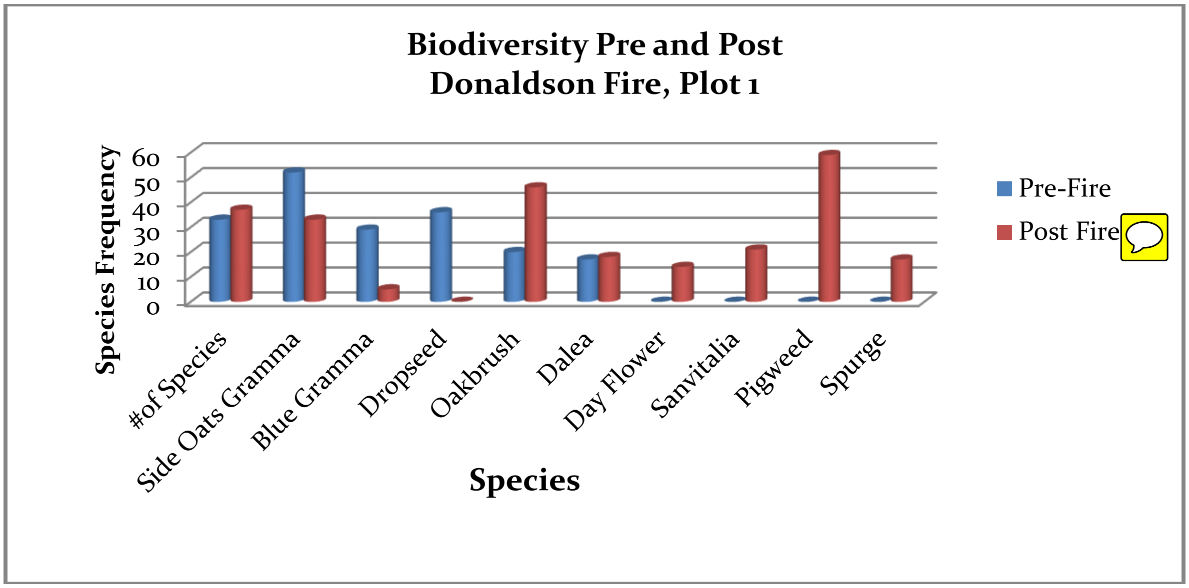
Photo 31: No treatment, average 170 trees per acre with 22% mortality in the stand.

Photo 32: Lop and scatter(2005), 100% mortality, 40 trees per acre.

Based on previous monitoring data lop and scatter is beneficial in creating soil stability, favorable microsites and supporting growth and re-vegetation of an area. Areas monitored in 2010 had higher biodiversity, less soil exposure where lop and scatter had occurred. However during wildfire residual activity fuels from lop and scatter impact both tree canopy and soil through increased fire intensity and residence time of fire. These effects have been consistent in both Donaldson and Mayhill fires and can be seen in photos 26 and 32.

Shifts in Surface Vegetation
Four permanent plots were installed using non-forested monitoring methods in 2010. The area monitored incorporated both treated and untreated plots. Treatment method was mastication. All plots were revisited after the wildfire to compare pre and post fire vegetative regeneration.

Graphs 3 compare pre and post biodiversity within a masticated area. Biodiversity increases post wildfire. Grass species drop in frequency while oak brush and other forbs increase in frequency during the first growing season.



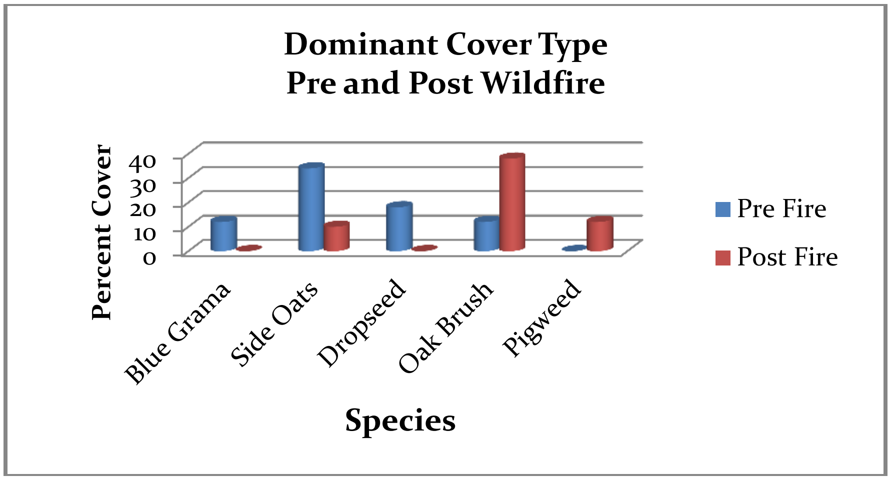
Graph 3

Photos 33 and 34 are in plot 1 characterized by graph 3 above. There is little change in overall vegetative structure. Fire behavior within the masticated area was low to moderate intensity. Area of stand replacement seen in photo 29, was immediately east and less than an eighth of a mile from photo 34.

Photo 33: Mastication (2006) / Pre Wildfire

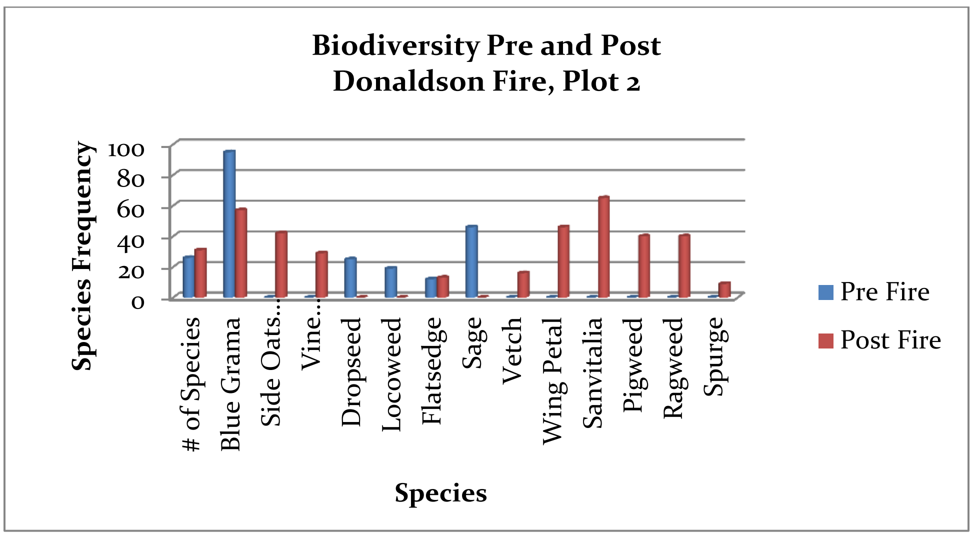
Photo 34: Mastication(2006) / Post Wildfire

Graph 4 compares canopy cover of dominant species pre and post wildfire. Pre-wildfire grass species were the dominant cover while oak brush became the dominant cover post wildfire.



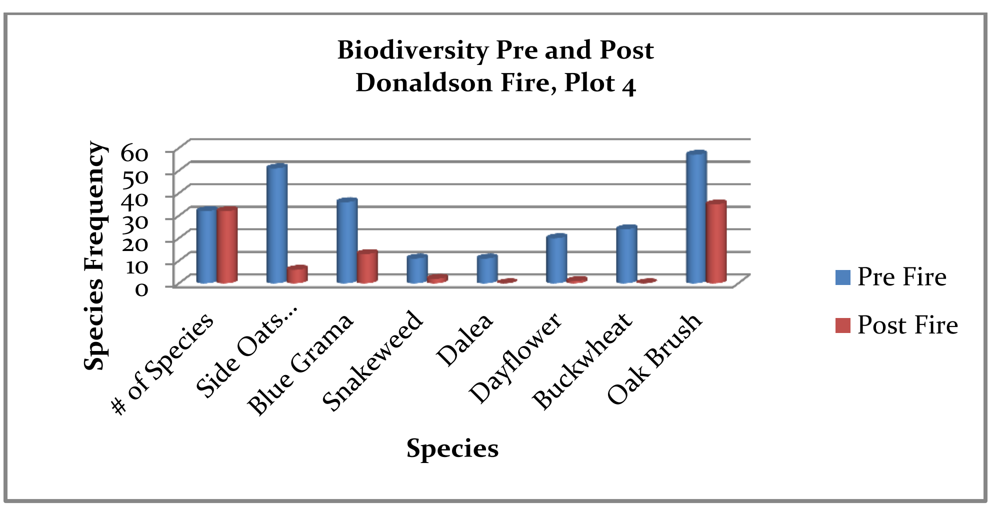
Graph 4

Graph 5 characterizing plot 2 is another masticated area. Both biodiversity and species shift are similar to plot 1. Biodiversity increases while grass species are less frequent or absent post wildfire. Biodiversity and frequency of forbs increase post wildfire. No oak was recorded within the plot pre or post wildfire.



Graph 5

Plot 4, untreated, had no change in number of species though frequency increased in some grass species and oak brush.



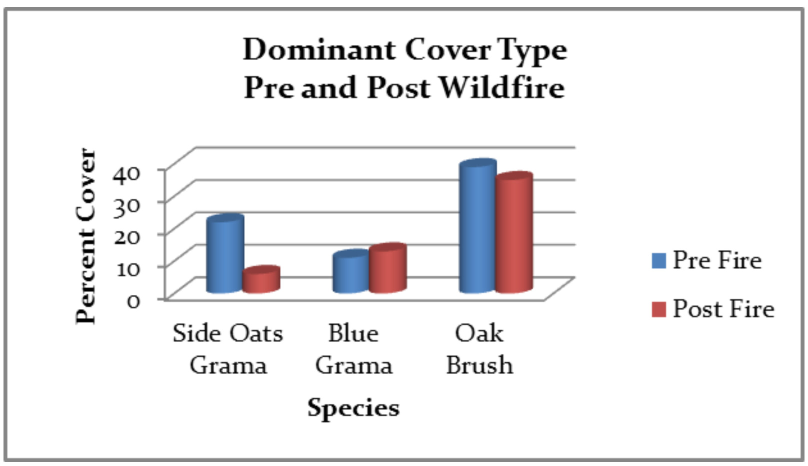
Graph 6

Photos 35 and 36 compare pre and post treatment fire effects. Photo on right is post wildfire, with little evidence of wildfire. Photo 29 of untreated stand where high intensity fire occurred is within same topographical feature, approximately 1/8 mile north.

Photo 35: Pre Wildfire /Untreated


Photo 36: Post Wildfire /Untreated

Graph 7 displays shift in vegetative cover. Little change occurs with the exception of a decrease in cover of side oats grama. Oak brush cover decreases slightly. Compared to treated area, plot 1 where oak brush cover increases.



Graph 7

Conclusions:
Fuels treatments improved suppression capability within the fire. Large treated landscapes, which were linked together both with road systems and adjacent treatments was advantageous in successful containment of the fire. Residual activity fuels did have impacts to tree canopy and soil through scorching of canopy and heating of soil horizons.

Fire effects monitored across the area were inconclusive in determining shifts in fire behavior due to vegetation treatment. Effects were often variable regardless of vegetative structure in treated or untreated areas. Initial data in areas with previous monitoring indicate an increase in biodiversity where previous treatment had occurred. Increase in biodiversity occurred in extreme drought and in a monsoon which had ¼ to 1/3 the amount of rainfall compared to previous years.

Mayhill Fire

The human caused Mayhill fire occurred on May 9 during red flag conditions. Major growth days occurred the 11 through the 13th of May with total fire size 31,941 acres. Temperatures were in the 60's with winds averaging 25 mph with gusts over 50 mph. Humidity's ranged from 12-16%. The fire burned through multiple fuel types, shrubland, ponderosa pine, pinyon-juniper woodland, and mixed conifer. The landscape is heavily dissected contributing to high severity fire effects in places through amplification of winds in favorable topographical locations. Photos 37 and 38 show variations in fire behavior at the Mayhill fire.

Photo 37: Mayhill Fire/Torching

Photo 38: Mayhill Fire/Evening

Live fuel moistures at the time of the fire were lower than two years previous, a wetter year for moisture trends. 2009 had 23 inches of precipitation while 2011 received just 7.6 inches of precipitation.

Table 7: Live Fuel Moistures

Species	2011	2009
Alligator Juniper	**87**	**101**
Pinyon Pine	**86**	**79**
Ponderosa Pine	**105**	**90**

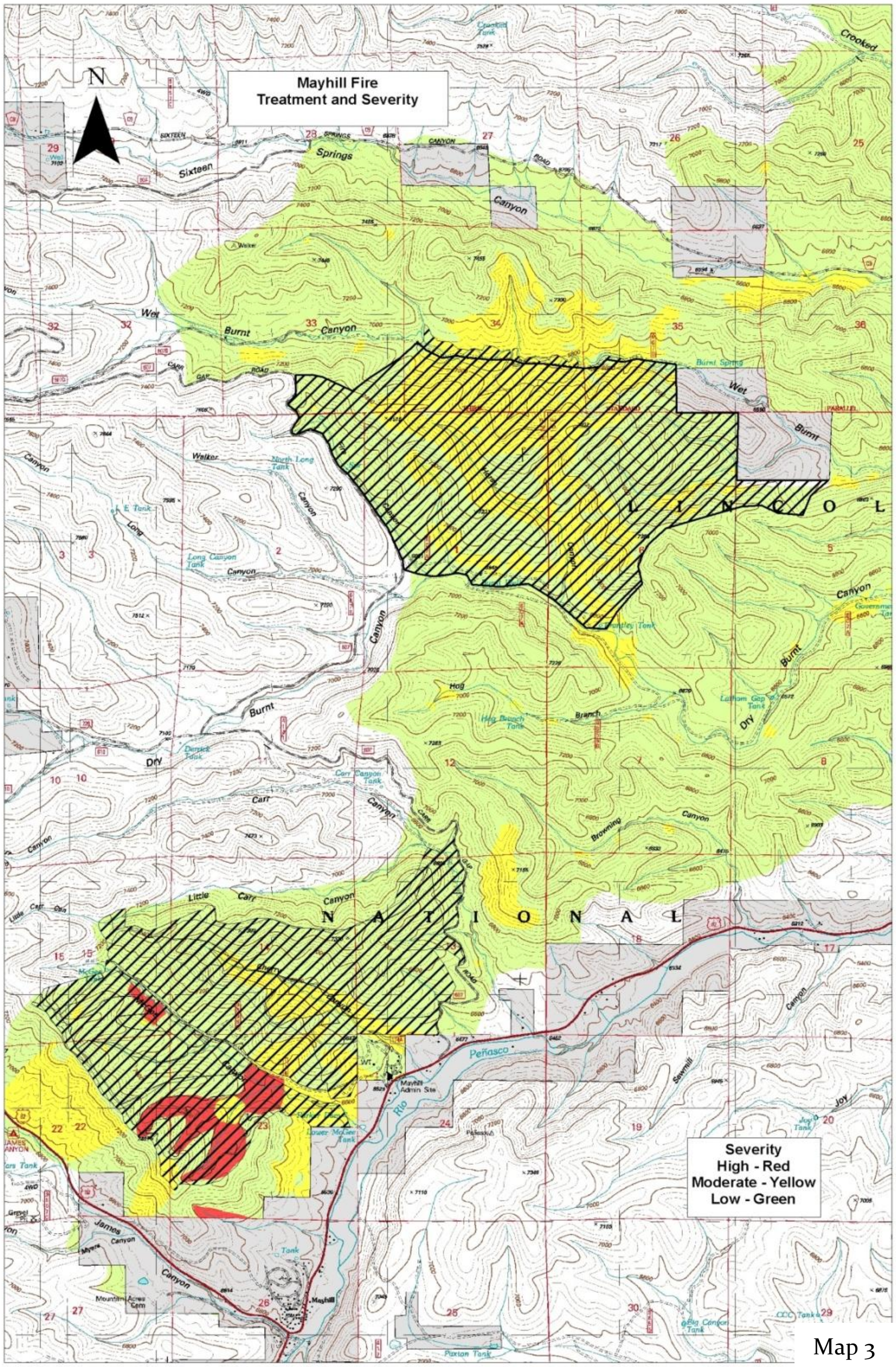
Fire burned with mixed intensity and severity across the landscape, creating a mosaic of effects. Sixty-nine plots were installed throughout the fire. Areas were selected to assess treated, untreated landscapes as well as MSO habitat.

Eight fuels treatments were implemented within the project area, totaling 3,613 acres. Approximately 11% of the landscape was treated. Treatments were primarily lop and scatter followed by prescribed fire. Wet Burnt was a commercial timber sale, with residual slash from trees left as lop and scatter.

Map 3, a portion of the Mayhill fire where treatments occurred, displays locations of treatments within the boundary of the Mayhill fire. Treatments often overlap one another and are hatch marked on the map. Fire severity is also displayed on the map to show combination of treatments and fire effects.

Table 8: Fuels Projects

Project	Treatment	Year	Acres
Wet Burnt / Timber Sale	Cut and Remove Tree Boles	2010	58
Wet Burnt Wildlife	Lop and Scatter	2010	1487
Mayhill	Lop & Scatter	1998	133
Lower McGee	Prescribed Burn	2007	208
Jayhill	Lop & Scatter, Prescribed Fire	2005	689
Jayhill	Lop & Scatter, Prescribed Fire	2009	490
Cherry Sikes	Lop & Scatter, Prescribed Fire	1998-2008 (cut & rx)	490
Cherry	Lop & Scatter	2006	58



Map 3

Fire growth was rapid and variable across the landscape. No data was collected during the passage of fire to develop any correlations between treatment effectiveness and alteration of fire spread or fire behavior. Similar to the Donaldson fire, fire effects were variable regardless of treatment. In some instances fire effects were more severe in treated than untreated areas, especially where activity fuels were generated. Many treatments had lop and scatter within them. Even post prescribed fire, residual lop and scatter was present and created some of the fire effects observed after the passage of the Mayhill fire.

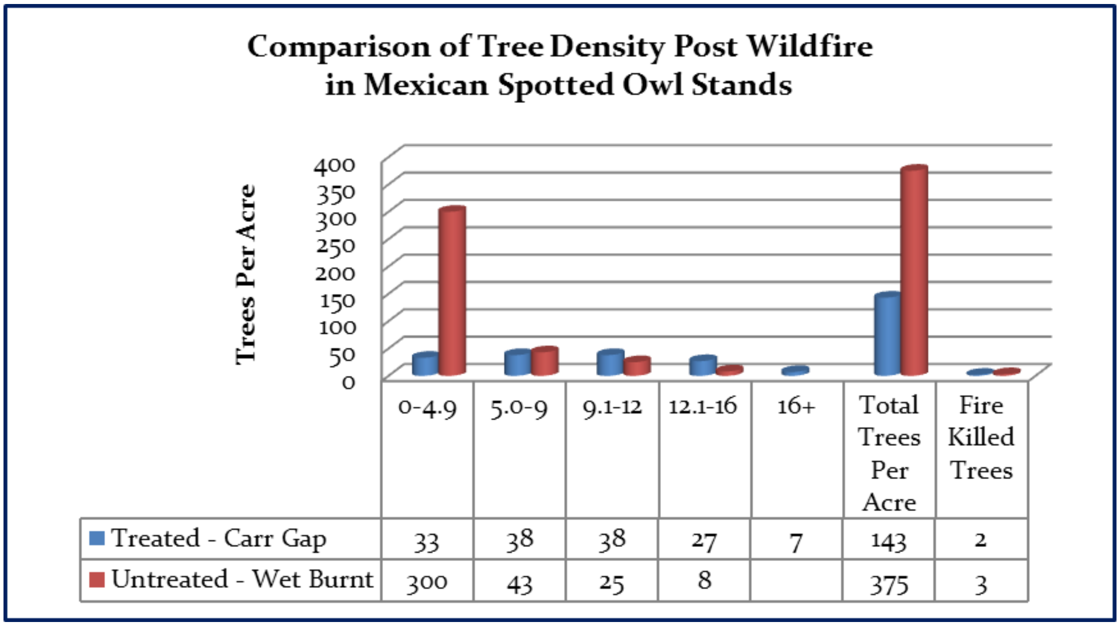
The combination of extreme drought and terrain influenced winds appear to have had the greatest effect on fire behavior and fire severity rather than continuity of fuels.

Comparison of Tree Densities Post Wildfire

MSO

Sixteen Springs, Wet Burnt Canyon, Dry Burnt Canyon and Carr Gap Canyons are either within critical habitat or located within designated MSO PAC areas. Graph 8 compares tree density in Carr Gap Canyon, critical MSO habitat, and Wet Burnt Canyon a designated MSO PAC.

Treated stands within Carr Gap Canyon had fewer trees per acre, while both had similar fire effects, with little stand replacement. The untreated stand had some isolated torching, creating small openings within the canopy. As seen in graph 8 Wet Burnt averaged 375 trees per acre while Carr Gap averaged 143 trees. The untreated had higher numbers of trees, 0-5" diameter, considered contributors to crown fire through ladder fuel development.



	0-4.9	5.0-9	9.1-12	12.1-16	16+	Total Trees Per Acre	Fire Killed Trees
Treated - Carr Gap	33	38	38	27	7	143	2
Untreated - Wet Burnt	300	43	25	8		375	3

Graph 8

Photos 39 thru 41 compare conditions in MSO habitat in Carr Gap and Wet Burnt Canyons. Photo 39 is a stand which was prescribed burned in 2005, while photos 40 and 41 have had no treatment. Photo 41 is a pocket of trees where isolated torching occurred in the untreated stand.

Photo 39: Carr Gap Canyon, Critical Habitat, Prescribed Burn, 143 trees per acre

Photo 40: Wet Burnt Canyon, untreated, MSO PAC, 375 trees per acre

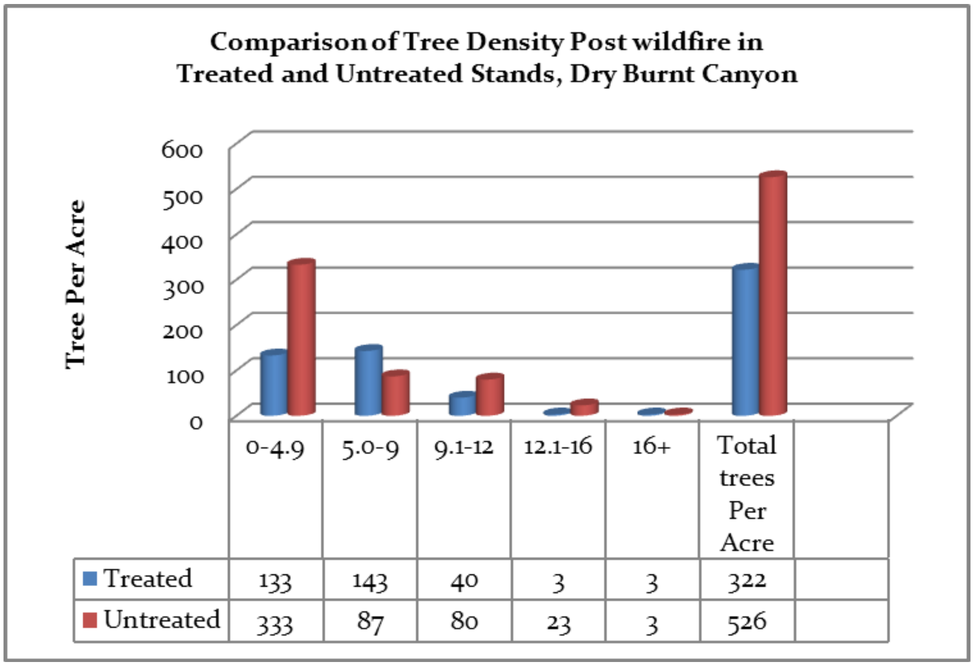
Photo 41: Wet Burnt Canyon, same stand as photo to left, some stand replacement.

Data collected from both stands indicates low to moderate intensity with some isolated torching in the untreated stand. Stand density does not appear to be a factor in the overall fire effects.

Dry Burnt Canyon

Dry Burnt Canyon is a mixture of ponderosa pine, mixed conifer, and pinyon- juniper woodland. Fire burned in varying intensities and severity. Recently completed lop and scatter which opened up tree canopy appeared to reduce crown fire activity. The prescriptions for the treatment designated lop and scatter of all pinion up to 12" diameter, and all juniper up to 14" diameter. Retention of 5 of the larger trees per acre of these species was also a component of the prescription.

Graph 9 compares trees density in treated and untreated ponderosa pine dominated stands. Similar to Wet Burnt Canyon, the untreated stand had higher tree density, predominantly in the less than 5" diameter size class.



Graph 9

Photos 42 thru 42b are a progression of a lop and scatter treatment. Photos capture trees per acre and stand density prior to cut, activity fuels post cut, then post wildfire in photo 42b. The project averaged 322 trees per acre while the untreated area, photo 43 within MSO critical habitat averages 526 trees per acre. Fire intensity and duration impacted both soil and canopy due to residual lop and scatter, seen in photo 42b.

Both stands sustained scorch to canopy as seen by discoloration of tree foliage in both photos. Both stands averaged 1-2 tons per acre of dead and down woody fuels post wildfire; however the treated stand had an estimated 15-20 tons per acre prior to the wildfire, seen in photo 42a.

Photo 42: Pre-lop and scatter, averaged over 500 trees per acre,

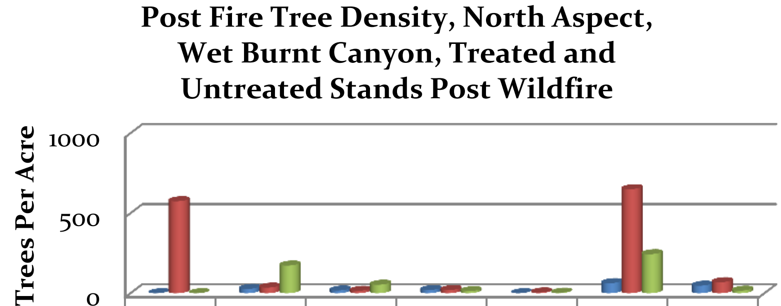
Photo 42a: Lop and scatter, post treatment, 15-20 tons per acres[illegible]dual activity fuel, limb[illegible]oles of trees.

Photo 42b: Treated, lop and scatter. Note scorch, discoloration of canopy, due to slash treatment

Photo 43: Untreated/Within MSO Critical Habitat

Wet Burnt

Treated and untreated stands in Wet Burnt Canyon were compared post fire's to assess stand density and fire effects. Treated areas had far higher expanses of stand replacement than untreated areas. Graph 10 compares trees per acre post wildfire, including mortality due to wildfire. Topographic features amplified the winds as seen in photos 45-48 which display post fire effects and stand mortality.



	0-4.9	5.0-9	9.1-12	12.1-16	16+	Total Trees Per Acre	Fire Killed Trees
Treated	0	27	17	20	0	63	47
Untreated - Stand 1	575	35	15	20	5	650	69
Untreated Stand 2	0	173	53	13	3	244	16

Graph 10

Photo 44: Photo above is an untreated north aspect in Wet Burnt, averaging 650 trees per acre. Stand is within an MSO PAC

Photos 45-48 display vegetation treatment immediately post cut, and then post wildfire. Residual activity fuels in the form of limbs from tree boles combined with favorable topography fostered stand replacement within treated landscapes. Areas treated had less trees per acre compared to untreated landscapes, as seen in graph 10. Comparatively treated landscapes averaged 63 trees per acre while untreated landscape averaged from 244-650 trees per acre. Some isolated torching occurred within untreated areas creating small openings.

Photo 45: Post Treatment, estimated 60-90 trees per acre, 438 trees per acre pre-treatment.

Photo 46: 63 trees per acre. Residual slash post treatment influenced fire behavior.

Photo 47: Same stand post wildfire.

Photo 48: Same stand post wildfire.

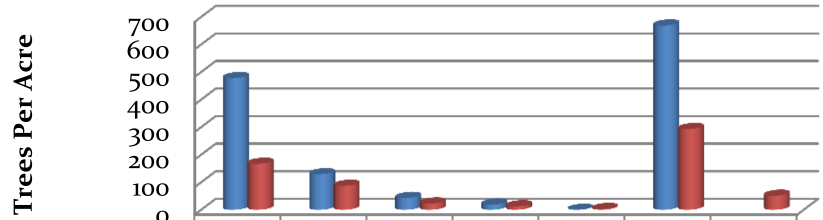
McGee and Cherry Canyons

McGee and Cherry Canyon both had pre-treatment data regarding tree density. Graphs 11 and 12 compare pretreatment and post wildfire tree density. Post wildfire density was also the density of trees post vegetation treatment with exception of mortality due to wildfire. The intent of the graph is to display shifts in tree density through treatment and overall wildfire effects.

Both treatments reduced tree density by half or more. Fire effects were similar in both Canyons. Cherry Canyon, similar to other areas had some lop and scatter prior to the passage of the wildfire. Fuels impacted tree canopy which can be seen in the photo 50.

Both areas had some overstory mortality, with small patches of stand replacement in McGee canyon. The specific area which experienced stand replacement appears to be influenced by amplification of winds. The area of torching occurred at the intersection of a small side drainage and McGee canyon, where winds can eddy and intensify fire behavior.

Comparison of Tree Densities, McGee Canyon

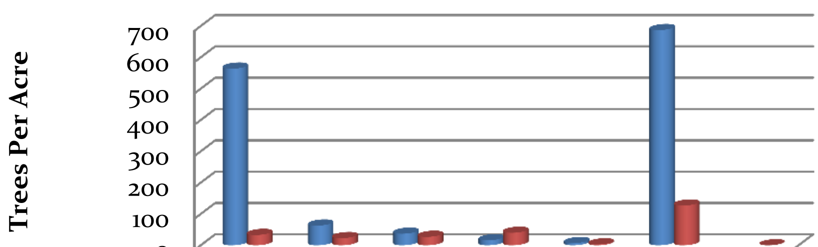


	0-4.9	5.0-9	9.1-12	12.1-16	16+	Total Trees Per Acre	Fire Killed Trees
Pre Treatment	478	129	43	19	0	669	
Post Treatment/Wildfire	167	87	23	13	3	293	51

Graph 11

Photo 49: Tree density post wildfire. Some pockets experienced passive crown fire due to topographical influences.

Comparison of Tree Densities Cherry Canyon



	0-4.9	5.0-9	9.1-12	12.1-16	16+	Total Trees Per Acre	Fire Killed Trees
Pre Treatment	564	63	37	16	7	687	
Post Treatment/Wildfire	33	23	27	40	3	127	0

Graph 12

Photo 50: Cherry Canyon had a combination of lop and scatter and prescribed fire.

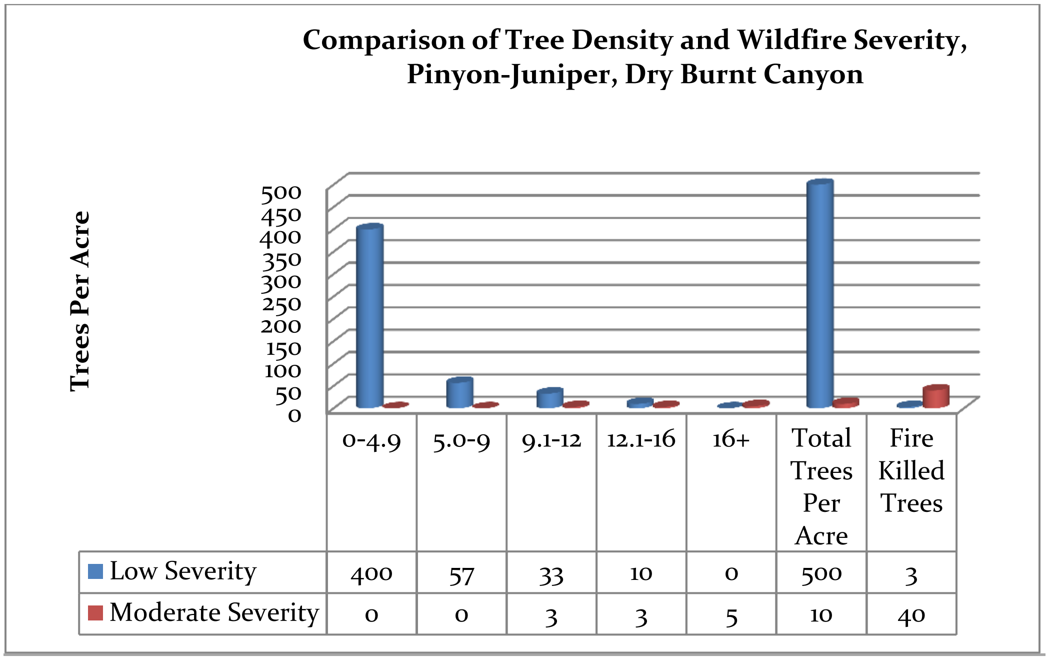
Tree density in both areas did not appear to limit or alter fire behavior. While both treated areas reduced tree density, fire effects are similar with isolated torching, which could be anticipated in prescribed fire activities. Both areas lie within drainages, potentially affected by upslope winds, though perpendicular to prevailing winds. Alignment and aspect may have reduced overall impacts of wildfire.

Burn Severity Pinyon-Juniper Woodlands

Dry Burnt Canyon

Fire burned in varying severities within Pinyon Juniper woodlands within Dry Burnt Canyon. Graph 13 compares tree density in stands which burned at both low and moderate severity. Fire effects were variable regardless of tree density. The stand which experienced low severity had 500 trees per acre, while the stand which experienced moderate severity and nearly 100% mortality had 60 trees per acre. Photos 51 and 52 display conditions post fire in each stand.

Open stands are influenced by wind and solar heating to higher degree than closed stands. These factors are used when calculating winds and making fire behavior estimations.



	0-4.9	5.0-9	9.1-12	12.1-16	16+	Total Trees Per Acre	Fire Killed Trees
Low Severity	400	57	33	10	0	500	3
Moderate Severity	0	0	3	3	5	10	40

Graph 13

Photo 51: Dry Burnt Moderate Severity in pinyon-juniper woodland, 60 tpa.

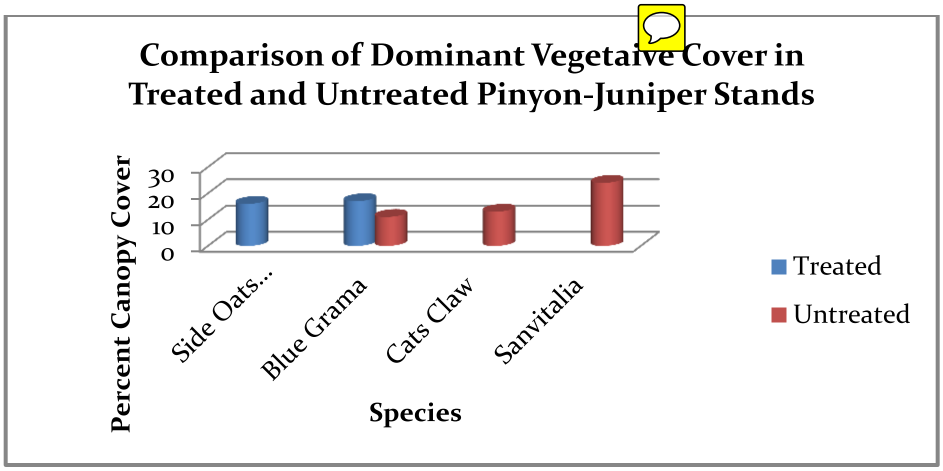
Photo 52: Dry Burnt /Low severity in pinyon-juniper woodland, 500 tpa.

Surface Cover Post Fire

Lop and Scatter Treatments

Pinion- juniper landscapes were compared in treated and untreated areas. Monitoring occurred post wildfire and post monsoon. Vegetation treatment consisted of lop and scatter with some application of prescribed fire.

Thirty-nine species were identified in treated areas and 33 species in the untreated areas post wildfire and after the onset of monsoon. Graph 14 compares species with canopy cover greater than 10% post fire between treated and untreated areas. Grass is the dominant cover within treated area where lop and scatter occurred, while forbs dominate in the untreated site.



Graph 14

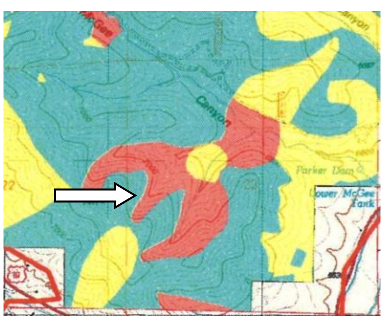
Photo 53 averaged 33 species while photo 54, a lop and scatter unit, also treated with prescribed fire averaged 39 species.

Photo 53: Untreated

Photo 54: Lop/Scatter and Rx fire

Conclusions:

Fire effects throughout the Mayhill fire are variable regardless of treated and untreated landscapes. Climate and topography had a greater role in influencing fire behavior than fuels treatments intended to alter fire behavior. Pictures 55 and 56 combined with maps display both are treated and untreated areas which experienced stand replacement. Note confluence of multiple drainages in each photo. McGee Canyon has deeper drainages. Stand replacement occurred at onset of fire during peak wind conditions. Wet Burnt Canyon burned later.



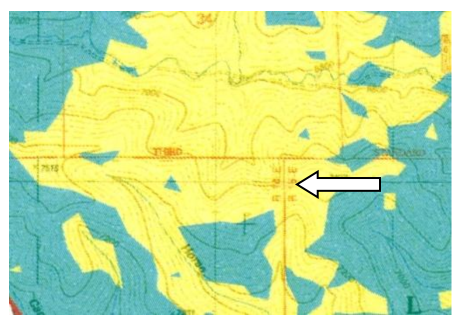


Photo 55: McGee Canyon, stand replacement, no treatment

Photo 56: Wet Burnt Canyon, stand replacement, treated, with removal of tree boles

Improved resistance to crown fire was documented in Dry Burnt Canyon. Timing of fire and terrain which lacked topographical alignment may have played a role as well in reducing crown fire activity. Comparatively stand replacement occurred further down canyon in open pinion-juniper stand. Additionally areas sampled for biodiversity had higher numbers of species within treated areas while untreated had lower numbers of species.

Queen Fire

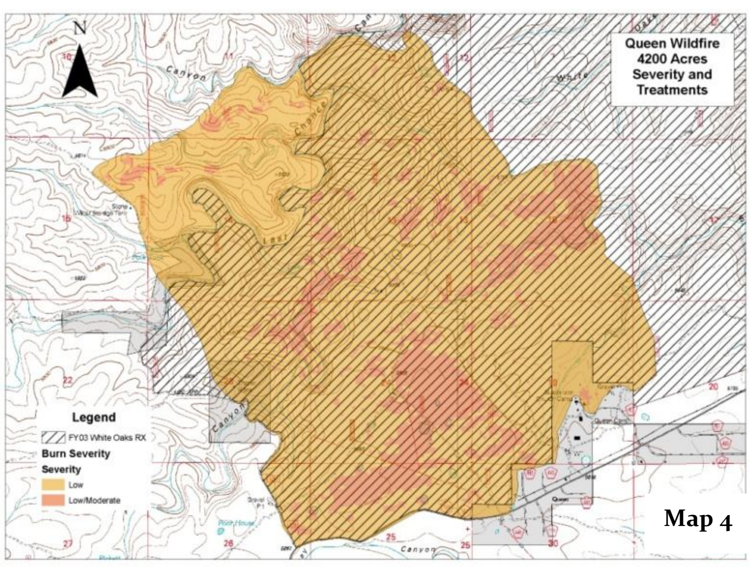
The Queen Fire, human caused, occurred on the evening of May 9th. The fire threatened the Queen subdivision on the north side of the Queen HWY. Weather conditions during the evening had winds at the 20-25 mph, gusting to 35 mph. Temperatures were in the mid 80's with relative humidity 10%. Initial attack occurred during the night, one structure was lost. The fire is an estimated 4200 acres, merging into the April 2011, 50,000 acre Last Chance fire which stopped its spread to the north and east.

Improved suppression capability was evident during the fire with loss of only one structure. Photos 57 and 58 are taken next to private lands with multiple structures on them. Both structures are along the southern flank of the fire, though close to a mile or more apart. General fire effects were low to moderate severity. Photo 58 is a home which was unaffected by the fire, while to the left of the dwelling in photo 58 the only structure on the fire was lost. Fire had burned around the entire subdivision, either due to prevailing winds or ignition operations to burn out and protect the subdivision.

Photo 57: Plot 4, low intensity/severity, day after fire, below residence

Photo 58: Plot 5, day after fire low/moderate severity, single dwelling/trailer burned next door to home, plot is within a small undocumented fuelbreak

Map 4 displays severity with overlay of prescribed burn, 3475 acres within the wildfire area, implemented in 2003. Prescribed fire was applied to over 80% of the project area. Severity of fire indicates that previous treatment limited or reduced extent of severity of the wildfire. Several residences within the Queen subdivision benefited from treatments through improved suppression capability.



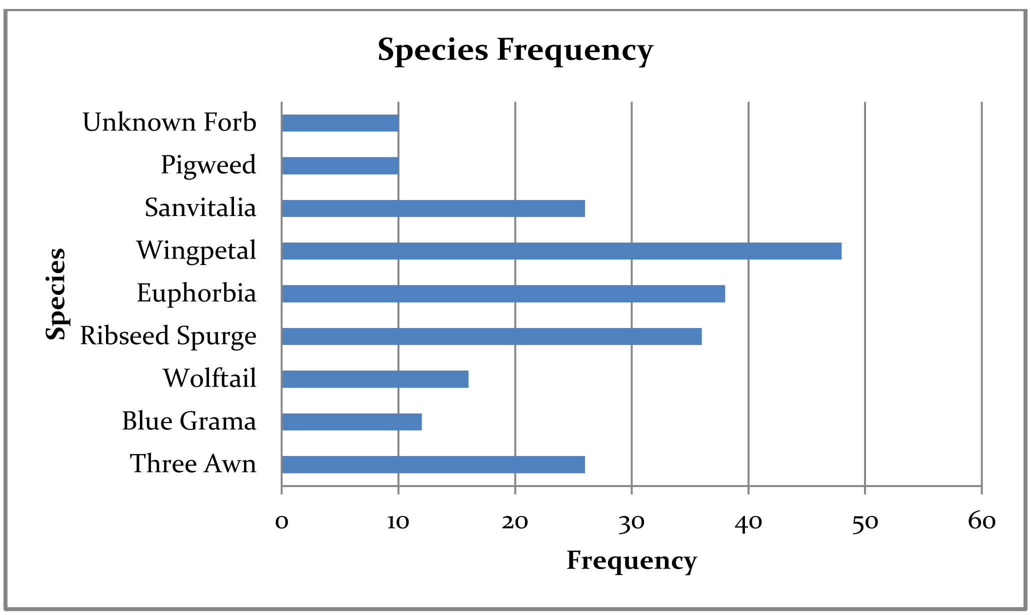
Map 4

Five permanent plots were installed within the wildfire to capture post fire effects and vegetative recovery after monsoon and for long term observation. Fire burned variably with isolated pockets of torching, creating a mosaic of openings across the landscape. Photos 59 and 60 compare changes in landscape from post fire to post monsoon.

Photo 59: Plot 5 Pre and Post Monsoon, Low Severity

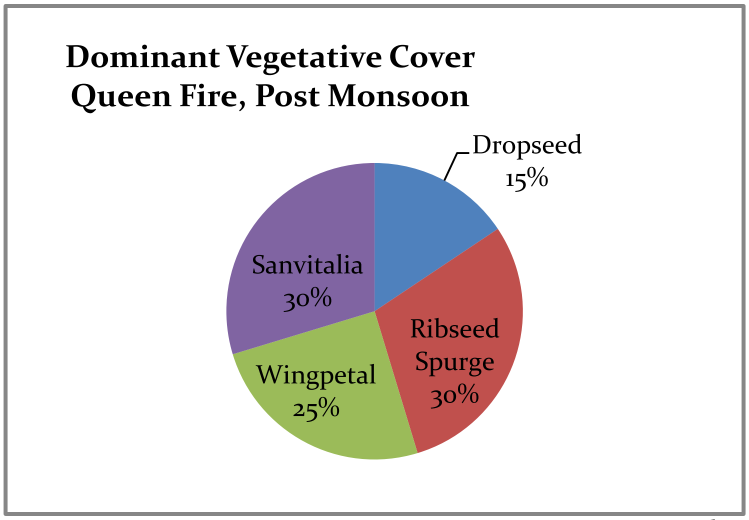
Photo 60: Plot 3 Pre and Post Monsoon, Moderate Severity

CNVSP monitoring methods were used to quantify post monsoon vegetative recovery. 22 species were identified. Graph 14 compares frequency amongst species. Forbs such as wingpetal and euphorbias were quick to establish post monsoon, having the highest frequency of occurrence during sampling. Grass species, such as three awn, wolftail, and blue grama identified. Photo 61 displays characteristics of area post monsoon. Growth is limited, with soil exposure evident.



Graph 14

Photo 61: Monitoring occurred post monsoon to capture peak growth. Wingpetal and Euphorbias have the highest frequency post fire and during limited monsoon precipitation.



Graph 15

Photo 62: Vegetative cover is dominated by four species post monsoon as seen in chart to left. Euphorbia (ribseed spurge) also has a high cover in addition to a high frequency of occurrence.

Graph 15 compares species with dominant canopy cover. Sanvitalia and ribseed spurge (a euphorbia) have the highest canopy cover relative to other species. Photo 62 displays canopy cover of surface vegetation.

Conclusions

The Queen fire occurred in a period of extreme conditions. It actively burned in the evening, when fire behavior in fine fuels would have been expected to be moderated. The fire gained most of its size through the night, with limited growth during the day, mainly due to buffering of recent Last Chance fire.

Both the abilty to successfully protect the Queen subdivision combined with low to moderate severity indicates that the previous prescribed fire treatment had a positive effect on altering fire behavior.

Post fire vegetative recovery was limited in surface cover as seen in photos 61 and 62, during sampling 22 species were identified. Drought conditions influenced vegetative recovery through scant monsoonal weather. Four inches of rain was recorded at the site, when 18” or higher typically fall in the same period.

Non-forested data documenting surface vegetation recovery from 1994 through 2011 occurred on multiple fires. Surface vegetation ranges from 18 years to four months post fire. Photos 63 through 68 display six of the fires. Fires range from 1994, Patos, to 2011 with the Mayhill, Little Lewis, and Queen (pictured in earlier photos).

Photo 63: Patos 1994
18 years post fire

Photo 64: Cree 2000
12 years post fire

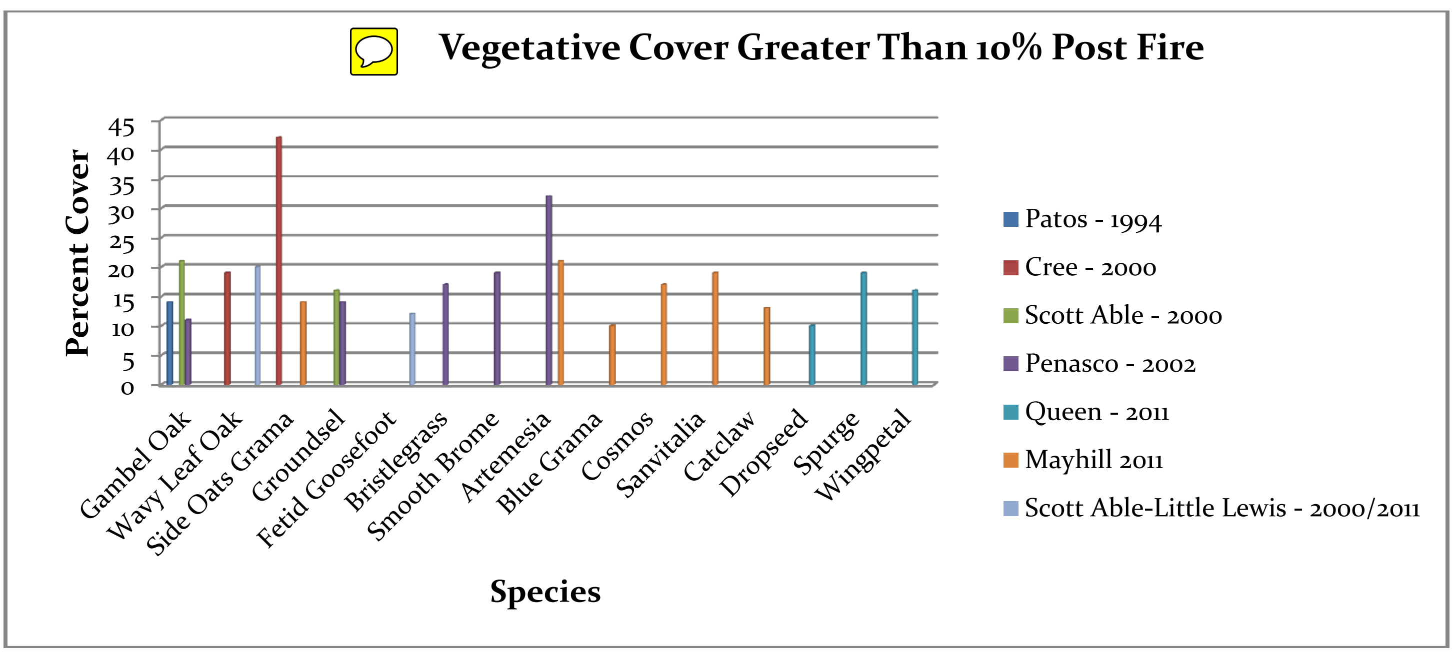
Photo 65: Scott Able 2000
12 years post fire

Photo 66: Penasco 2002
10 years post fire

Photo 67: Mayhill 2011
4 months post fire

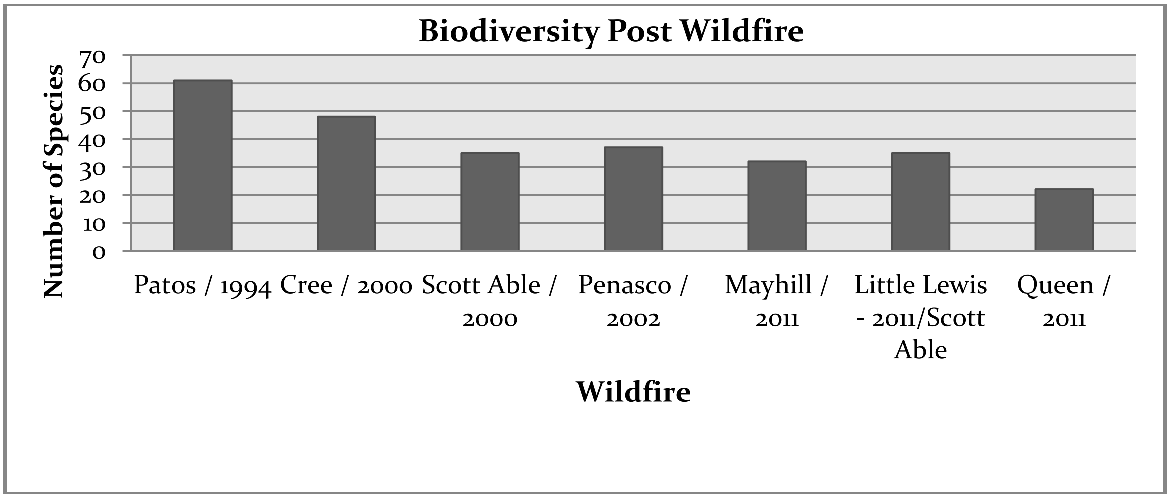
Photo 68: Little Lewis/
Scott Able 2011/2000
3months post fire

Species with canopy cover 10% and higher are displayed in the graph 16 below. Four fires had oak brush dominating vegetative canopy cover. The four fires are older ranging from 12 to 18 years since fire occurred. The newer fires have a wider range of species composition in the canopy cover, as seen in the Mayhill fire which had six species identified.



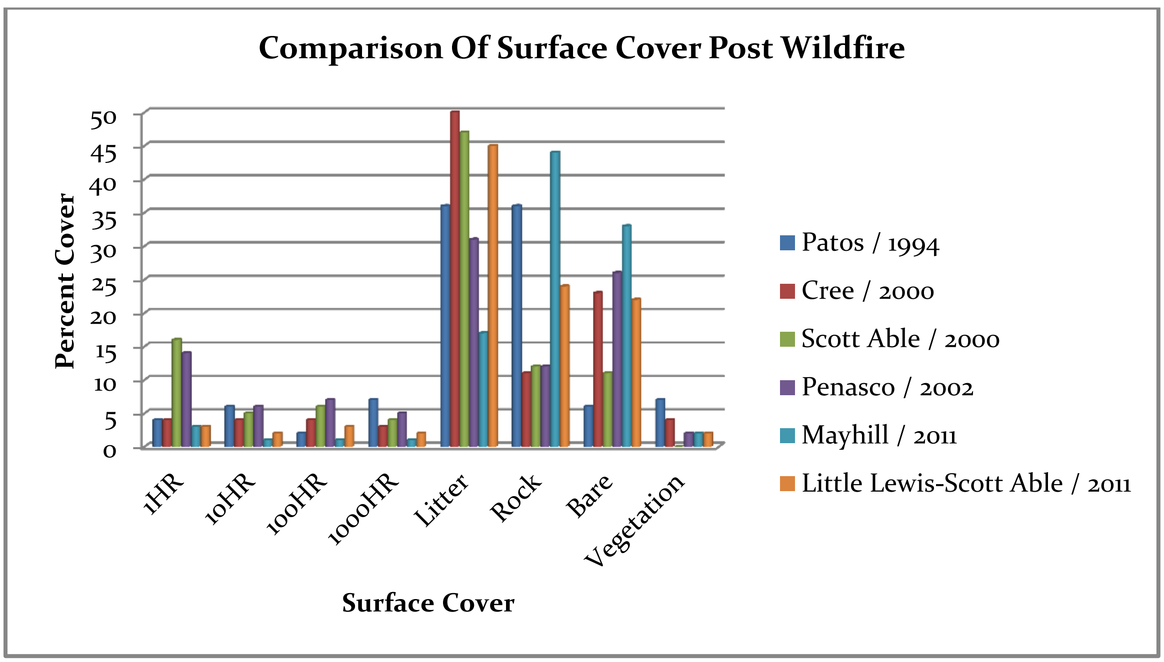
Graph 16

Graph 17 compares biodiversity amongst fires. The oldest fire, Patos, had the highest biodiversity. The Little-Lewis-Scott Able fire is unique in that two fires have affected it within the last 12 years. Little Lewis-Scott Able had comparative numbers of species relative to both older and current fires. Mayhill and Queen wildfires had the lowest biodiversity.



Graph 17

Vegetative surface cover, measured at the ground, rather than canopy cover was variable amongst fires. Patos had the highest vegetative cover and lowest percent bare ground. Other attributes play a role in vegetative cover and bare ground; however Patos also had some of the highest rock as a portion of the surface cover.



Graph 18

Older fires had the highest biodiversity and vegetative cover. Comparatively vegetative cover was variable regardless of age of fire, indicating other factors such as soil type, grazing activity play a role in vegetative recovery.

Post Vegetation Treatment Assessment

Six treatments were assessed forest wide for post treatment effectiveness. Post treatment conditions were compared to goals and objectives of planning and implementation documents to look at shifts in landscape attributes. Where pre-treatment data exists to compare pre a post tree density, information is also used to compare and display change.

Effectiveness post treatment is based on change in ecosystem components such as tree density, basal area, and vegetative cover relative to planning and implementation document direction.

Smokey Bear Ranger District

Three projects were assessed from 2010 to 2011 in the Turkey-Gavilan Planning area. Lucas, Poult-Gobbler, and Old Road.

Goals of Turkey Gavilan Planning Document:

- Shift current conditions to historic conditions:
  - Pinion-Juniper 0-40% canopy cover
  - Ponderosa pine 40-60 BA
  - Mixed Conifer 80-110BA
  - Improve biological biodiversity

Lucas and Poult-Gobbler

Lucas and Poult-Gobbler were combinations of thinning and removal of merchantable timber, piling of residual slash, and prescribed burning within all project units. Project areas are primarily ponderosa pine with some Douglas fir in moist areas and pinyon-juniper encroachment in drier sites. Activities occurred from 2005 through fall of 2010.

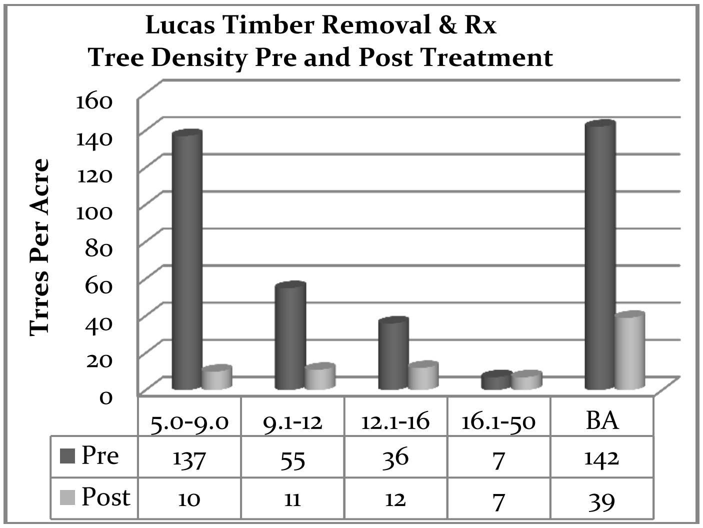
Objectives of prescribed fire:

- Limit individual pinyon-juniper mortality to less than 75% of residual overstory trees.
- Limit ponderosa pine mortality to less than 15% across the project area.
- Reduce activity generated slash by 75% or greater in ten and one hundred hour fuels
- Reduce activity generated thousand hour fuels by 50% or greater

All units are within the same geographical area. Lucas is three miles east of Poult-Gobbler. Poult-Gobbler units are combined due to Gobbler, a small stand, within Poult. Gobbler burned at the same time as portions of Poult. The Poult project was a thin a from below with handpiles, while Gobbler had both thin from below and removal of timber. Residual basal areas meet or exceed desired conditions for ponderosa pine in all units. Primary reductions in density and size class occur in size classes 5"-12" diameter.

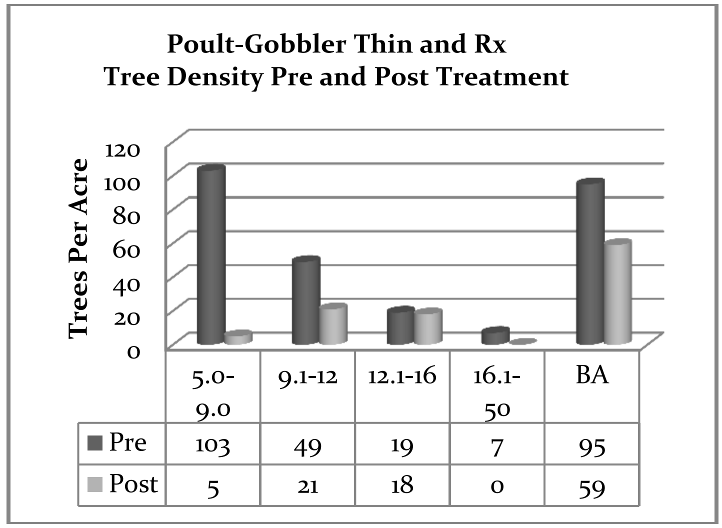
All tree treatments reduce tree density by 50% or greater. Graphs 19 and 20 display shifts in tree density pre and post treatment for all projects in size classes 5" and greater diameter. Basal area had the highest reduction in Lucas, with 72% of the basal area removed in size classes' 5" diameter and greater.

Lucas averaged 1525 trees per acre less than 5" diameter pretreatment and 177 trees per acre less than 5" diameter post treatment. Photos 69 and 70 capture the reduction in understory trees. Poult-Gobbler averaged 936 trees per acre 5" and less diameter pretreatment and 14 trees per acre less than 5" diameter post treatment.



Graph 19

Unit has some Douglas fir, mixed conifer, however primarily ponderosa pine. Basal area was reduced by over 70%.



Graph 20

Area is primary ponderosa pine, with some pinyon-juniper. Basal area was reduced over 30%.

Photos 69and 70 characterize stand conditions pre and post treatment within Lucas, while photos 71 and 72 display stand conditions post treatment in Poult-Gobbler. All units have fuels loadings of 3-5 tons per acre, indicating successful fuels reduction from the application of prescribed fire. Mortality in ponderosa pine greater than 5" diameter averaged 14-15% project wide, meeting prescribed fire objectives for tree mortality.

Photo 69: Lucas – pretreat averaged 235 trees per acre 5" and greater, and 1,525 trees per acre less than 5" diameter size class.

Photo 70: Lucas tpa surface cover. Post treatment Lucas averaged 218 trees per acre 5" and greater and 177 trees per acre less than 5" diameter size class.

Photo 71: Poult burned fall 2010 averaged three tons per acre of dead and down woody fuels. Project was a thin from below, with handpiles.

Photo 72: Poult Gobbler post treatment averaged 77 trees per acre. The Gobbler portion of the project was a removal of large diameter trees; with residual slash left as lop and scatter and some large machine piles.

Conclusions:

All projects meet intent of reduction of tree density and support basal area ranges per planning document direction. Overall fuels reduction of activity slash was successful as was retention of large diameter trees during prescribed fire.

Old Road

Project activities in Old Road consisted of lop and scatter and prescribed burning. Activities occurred from 2008 through fall of 2009 with the application of prescribed fire. The resource objective of the burn is to establish a mosaic which supports structural diversity which provides 60% forage areas and 40 % cover areas across the project landscape.

Objectives of prescribed burn:

- Limit tree mortality to 25-50% within pinyon-juniper.
- Reduce activity generated slash 50-80%

Post prescribed fire mortality averaged 15% in trees greater than 5" diameter for all species. Tree mortality averaged 15 per acre. Tree density was reduced through both lop and scatter and prescribed fire by 50% or greater. Pretreatment trees average 104 per acre as seen in photo 73, and 48 trees per acre as seen in photos 74-76.

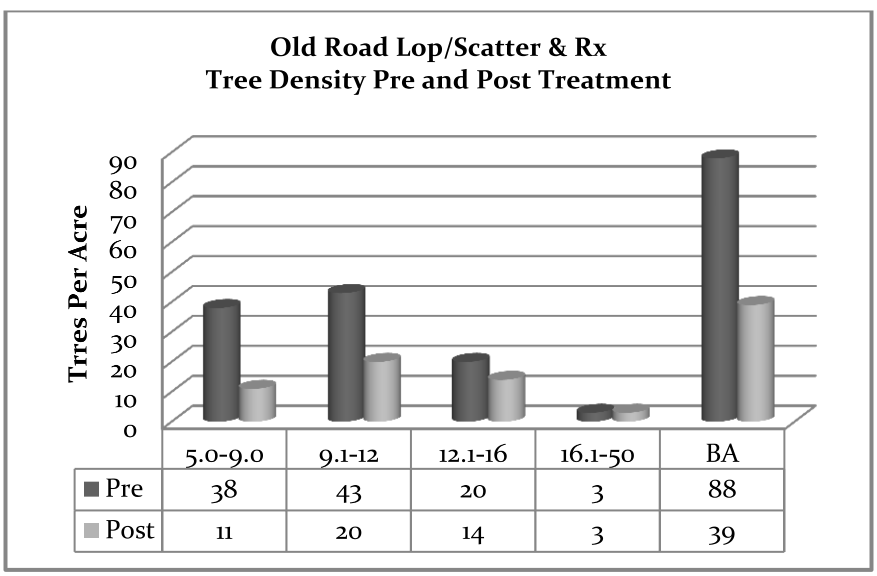
Photo 73: Pretreatment trees averaged 104 trees per acre in size classes 5" and greater diameter.

Photo 74: Post cut and prescribed fire trees average 48 trees per acre in size classes 5" and greater

Photo 75: 15% tree mortality in trees 5" diameter and greater

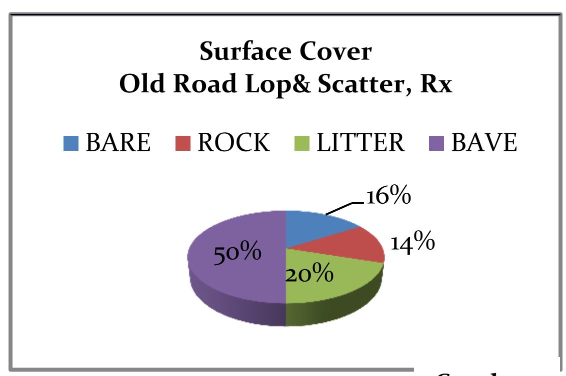
Photo 76: Surface vegetation cover averaged 50%

Residual basal area within the Old Road Project falls within desired conditions for both ponderosa pine and mixed conifer. Canopy cover is the attribute to described change in woodland structure. 40% or less canopy cover is recommended for pinyon-juniper woodland. Reduction of canopy can be seen in photos 74-76.



Graph 21

Basal area vegetation as seen in photos 74-76 and is displayed in graph 22 below averaged 50% cover.



Graph 22

Conditions post treatment within Old Road are similar to Lucas, and Poult-Gobbler, with stand attributes meeting or exceeding planning and implementation document guidance.

Sacramento Ranger District

Two projects, Benson Ridge and Pumphouse, within the Rio Penasco Watershed Restoration Project area were assessed in 2011. Both units lie within or adjacent to multiple Mexican Spotted Owl Protected Activity Centers (MSO PACs). All PACS are occupied, with no reproduction documented in 2011. Landscapes are generally mixed conifer.

Desired conditions within the project area are:

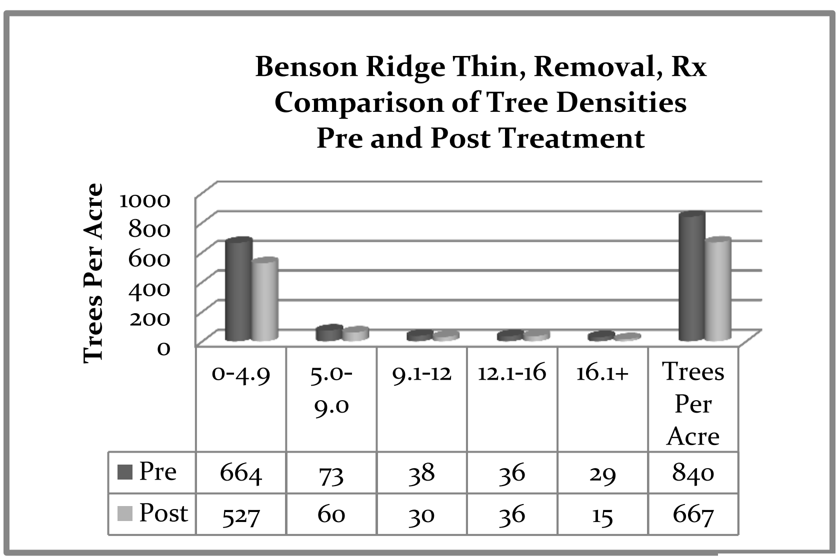
- Reduce the risk of catastrophic wildfire.
- Restore ecological integrity and biological diversity of the forest by restoring a sustainable and resilient forest structure and species distribution the more reflects historic and ecological processes.
- Remove biomass in excess of ecological needs.

Specific treatment objectives within mixed conifer:
Mixed conifer may be reduced to 150 to 250 square feet of basal area per acre.

Treatments were a combination of some commercial harvest and removal and piling of residual activity fuels outside MSO PACS. Thin from below up 9" diameter with hand piling occurred within MSO PACs. In fall of 2010 a wind event significantly impacted the Pumphouse project area increasing dead and down fuels.

Benson Ridge
Benson Ridge project area encompassed 642 acres. Basal area was reduced by 35% in the project area. Basal area pretreatment averaged 215 BA, was reduced to 138 BA post treatment. The highest reduction of basal area occurs within trees 16" diameter and greater. Change in density and subsequent reduction in basal area are greatest in trees 5"-9" and 16" and greater diameter size class. Graph 23 displays shifts in tree density. Trees 16" and greater are favorable for MSO habitat.

Dead and down fuels ranging from 5-46 tons per acre, averaged 23 tons per acre project wide. Photo 77 characterizes tree density post treatment while photo 78 captures litter and large diameter dead and down fuel distribution.



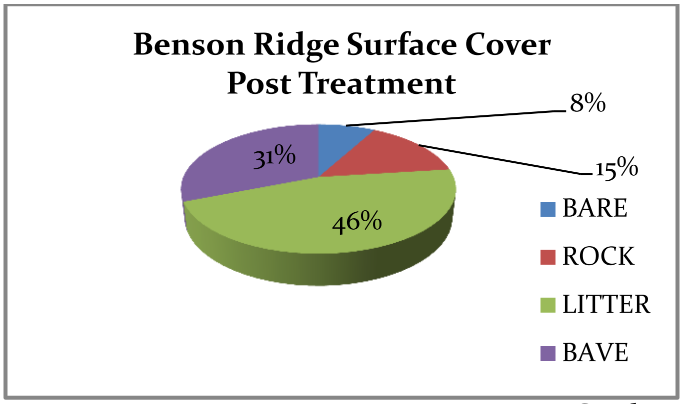
	0-4.9	5.0-9.0	9.1-12	12.1-16	16.1+	Trees Per Acre
Pre	664	73	38	36	29	840
Post	527	60	30	36	15	667

Graph 23

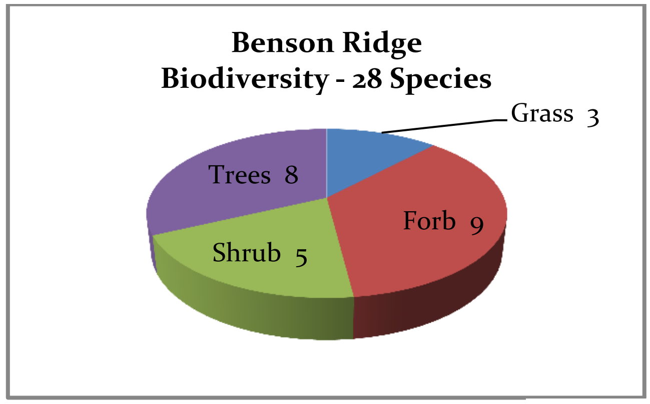
Photo 77: Post treatment trees averaged over 600 trees per acre with 80% less than in the 5" diameter size class.

Photo 78: Dead and down fuel Averaged 23 tons per acre.

Post treatment litter is the predominant surface cover with 46% cover project wide. Photos 78 and 79 characterize litter distribution within the project. 28 plant species were identified within the project area. Graph 25 compares life form and number of species identified. Forbs and trees had the highest biodiversity.



Graph 24

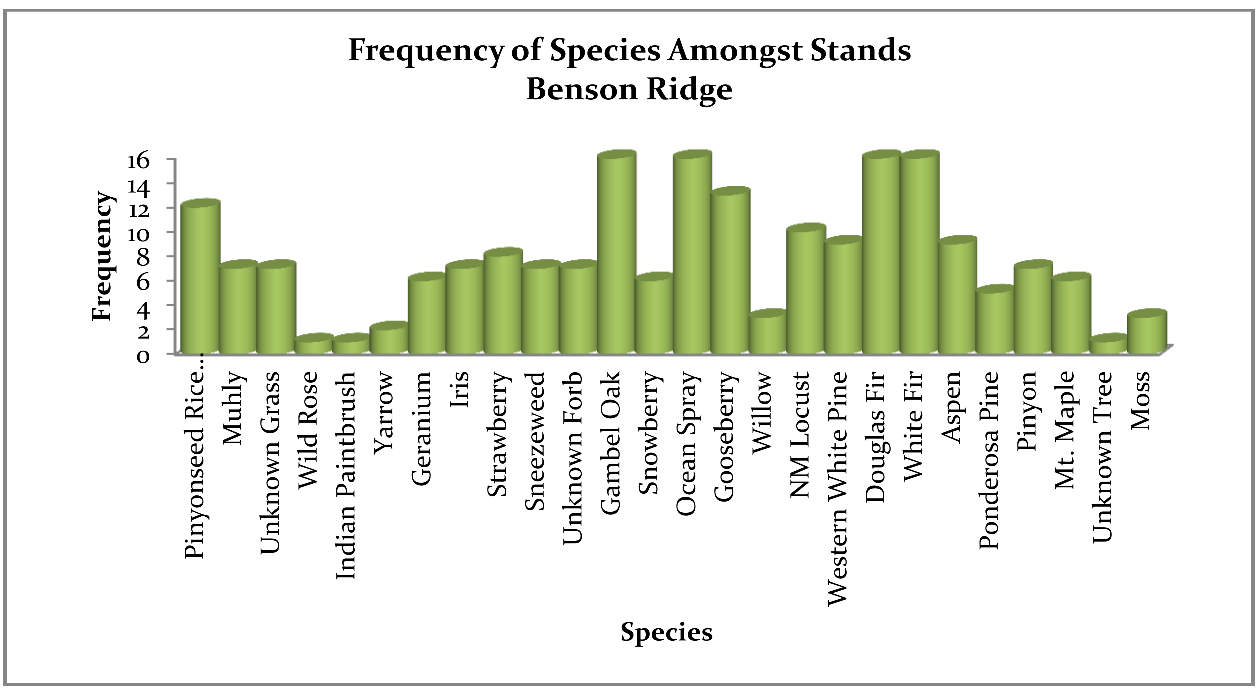


Graph 25

Photo 79

Photo 79 captures both surface cover, displayed in graph 24 at upper left and vegetative cover. Both litter and vegetation comprise the highest surface cover.

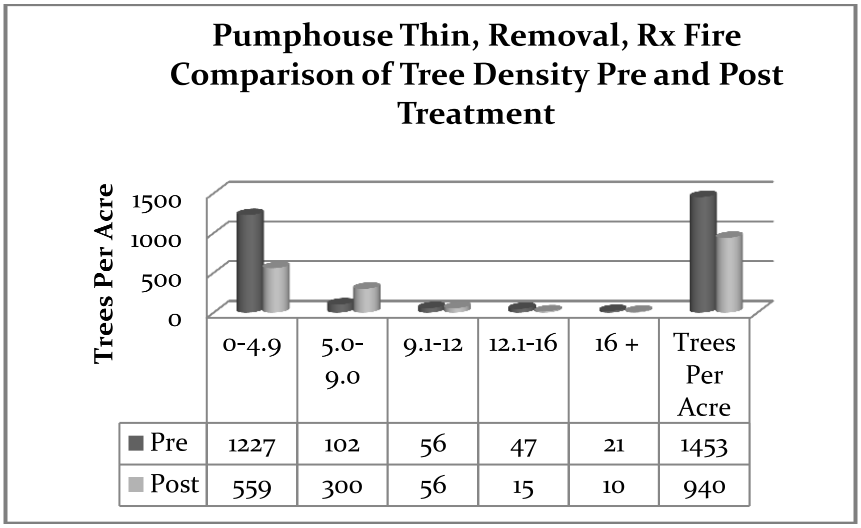
Comparison of species frequency within stands is exhibited in graph 26. Seasonal variations influence species identified at time of observation. The project area was monitored late June into July, capturing some monsoonal moisture. Shrub and tree species had the highest frequency amongst stands.



Graph 26

Pumphouse

Pumphouse project area encompasses 834 acres of timber removal and thin from below. Some inconsistencies occur in tree density post treatment. This is due to vegetation sampling method, pretreatment a variable plot was used, while a fixed plot was used post treatment. A variable plot favors large diameter trees, often excluding small diameter trees. This is evident in the 5”-9” diameter size class where tree density tripled post treatment. Trees averaged 102 per acre prior to treatment and 300 per acre post treatment.



Graph 27

Photo 80: Trees averaged 940 per acre post treatment. The majority of tree density falls within the 0-5” and 5-9” diameter size class.

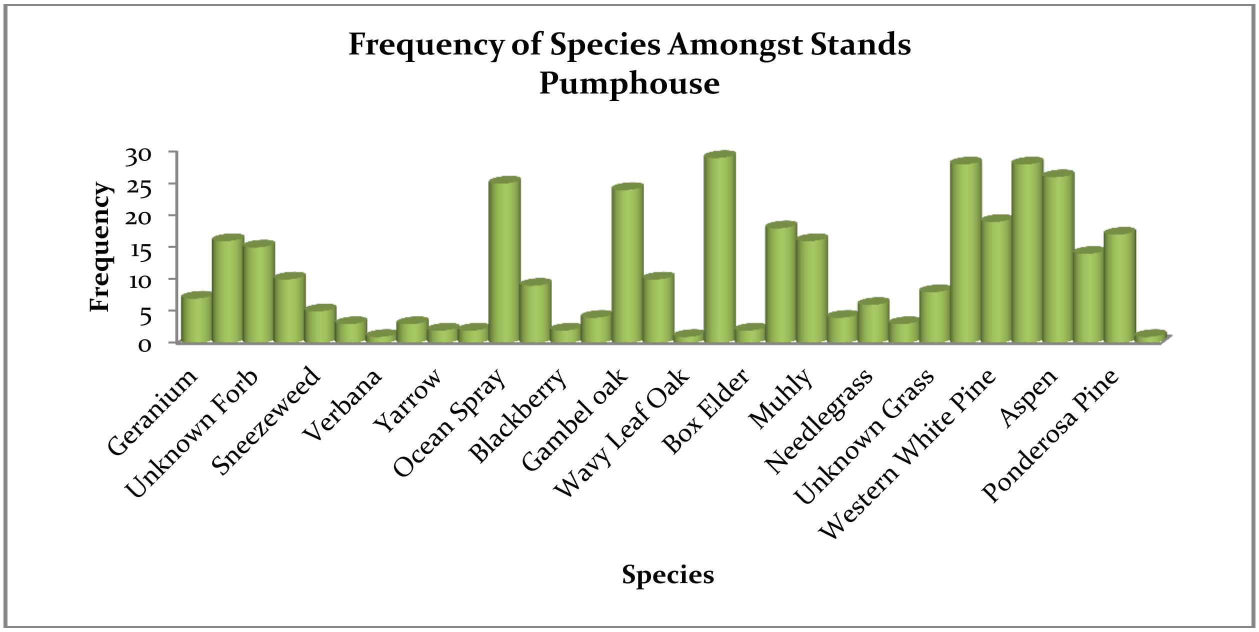
Graph 27 displays shifts in tree density in diameters less than 5”and 12” and greater size classes. Similar to Benson Ridge tree density was reduced by 35%. Photos 80 and 82 exhibit stand density post treatment.

Fuel loadings ranged from 13-109 tons per acre with an average of 32 tons per acre. Areas of higher fuel loadings are due to blow down occurring post treatment. Photo 82 characterizes higher fuel loadings found throughout the project area.

Photo 81: 33 species were identified within the project area.

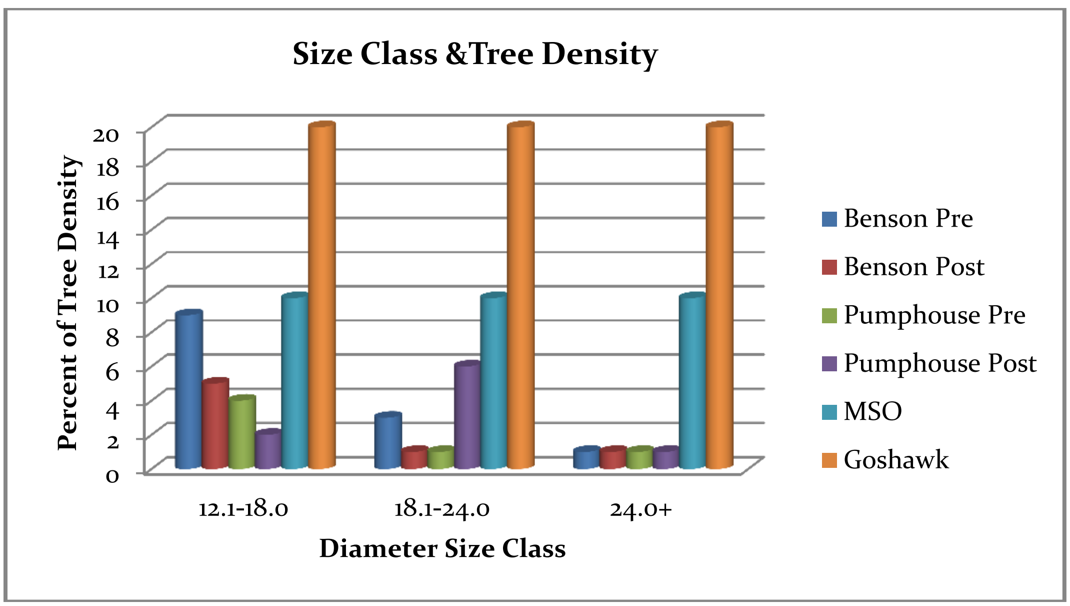
Photo 82: Fuel Loadimgs averaged 32 tons per acre.

Similar to Benson ridge, surface cover was primarily litter, averaging 44% of surface cover, seen in photo 82 above. Photo 81 above shows vegetative cover. 33 species were identified within the project area. Graph x below compares frequency of species identified. Grass, trees, and shrubs had the highest biodiversity and frequency within stands in the project area.



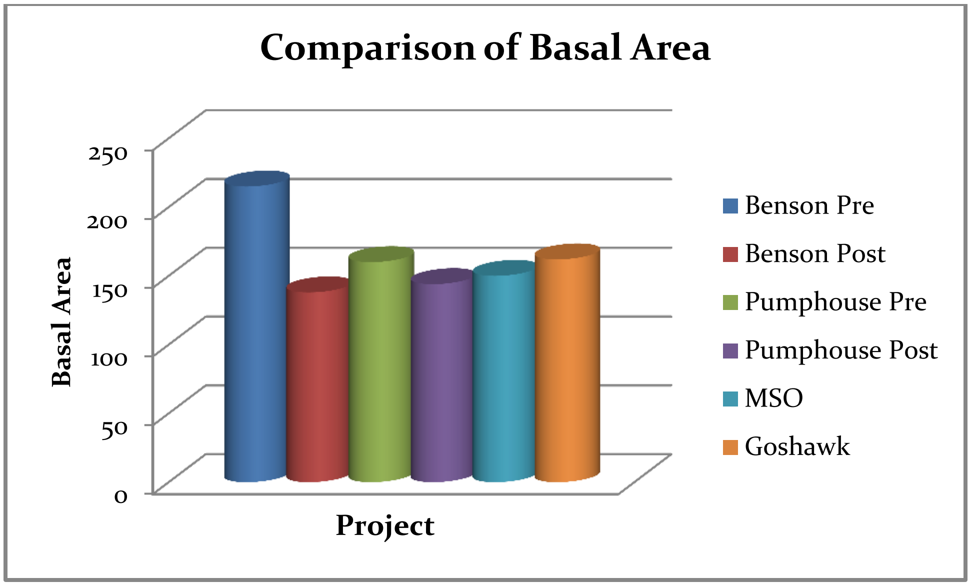
Graph 28

Comparison of Size Classes and Recovery Plan Recommendations
Orange and light blue cylinders in graph 29 are recommended tree densities for Northern Goshawk and Mexican Spotted Owl. Tree densities are expressed as a percent of the total density per size class. Both projects are below recommended densities for size classes, with the lowest percent of tree densities in the 24" and greater diameter size class. Regardless of density Mexican Spotted Owls can still be found adjacent to treated areas. Additionally a new Northern Goshawk PFA was identified within the project area.



Graph 29

Both projects exceeded recovery plan guidelines pretreatment. However similar to tree density, basal area post treatment drops below recovery plan guidelines. Graph 31 displays basal areas amongst recovery plan guidelines and treatment areas.



Graph 30

Conclusions:
Tree density and basal area was reduced through-out both projects. Small diameter trees, less than 5" diameter comprise the majority of the tree density. Reduction was highest in less than 5" and 16" and greater tree diameters. Both projects exceeded reduction of basal area for both the planning document and recovery plan guidelines. All PACs within adjacent to the project area, or within the project area have occupancy, with a new pair of Northern Goshawks identified.

Fuel loadings would be considered high in both projects areas, with litter having the highest surface cover amongst projects.

Guadalupe Ranger District

One project, Bullis Rx, 2500 acres, was monitored within the Guadalupe Pinion-Juniper Woodlands Prescribed Burns and Treatment Project.

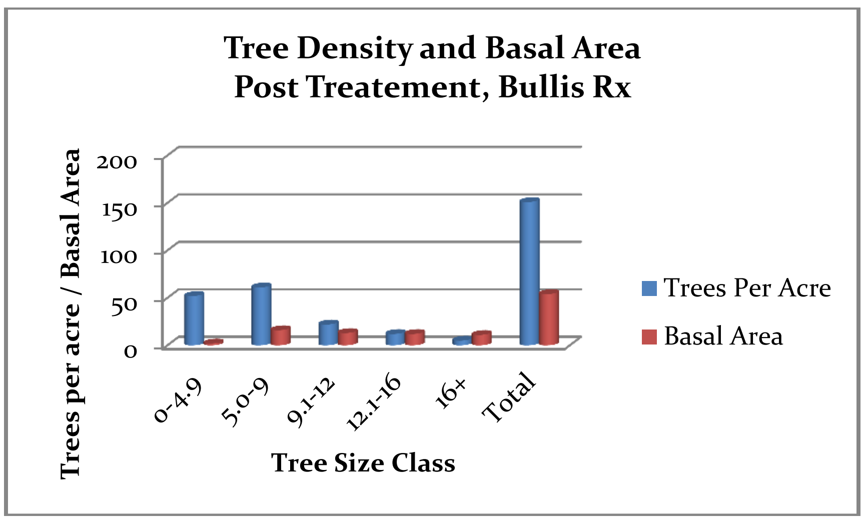
The primary goal of the Planning Area is reduction of fuels
Other planning attributes:

- Reduce fuel loadings
- Reduce risk of wildfire to life, property, and resources
- Improve habitat biodiversity
- Reduce juniper densities by 15-40%
- Rejuvenate 20-40% of mountain mahogany and similar species
- Restore natural ecological systems
- Maintain less than 10% mortality in ponderosa pine

Prescribed fire objectives:

- Reduce the existing wildland fire hazard through removal of dead and down, reducing decadent grass loading and the removal of ladder fuels.
- Retain 15-40% Pinyon/Juniper canopy cover measured immediately post burn.
- Reduce decadent grass cover by 60-90% measured immediately post.

Photo 83



Graph 31

Tree densities averaged 151 trees per acre with over 70% ranging from 0-9" diameter size class, as seen in graph 31. Basal area averaged 54 per acre with the highest basal area in the 5-9" diameter size class range. Trees mortality averaged 11 per acre 5" and greater diameter. Fuel loadings were less than one ton per acre; photos 84 and 85 characterize both fuel loading and tree density found within the project.

Photo 84: Trees density is 151 per acre, mortality is estimated at 11 trees per acre.

Photo 85: Fuel loadings average less than one ton per acre.

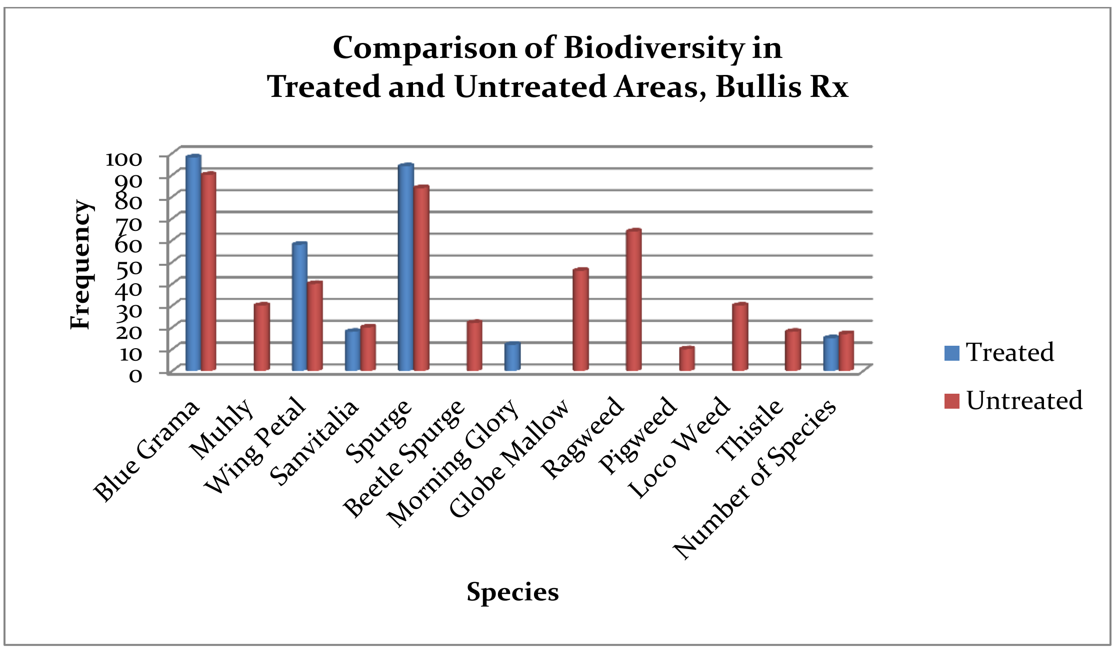
Decadent grass cover was reduced by 60-90% as seen in photos 87 and 88 which compare treated and treated areas adjacent to one another. Photo 86 shows a fence line along boundary of area burned and unburned. Note green-up to left along fence line within the burn unit. Biodiversity also decreased post treatment.

Photo 86: Boundary of Rx left treated/right untreated

Photo 87: 15 plant species were identified post prescribed burn.

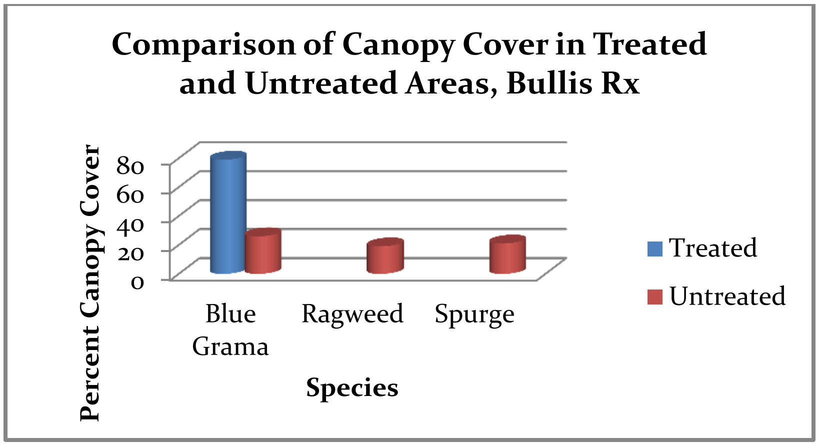
Photo 88: 17 species were identified in adjacent untreated areas. Little green-up is evident within untreated areas compared to where prescribed fire was applied.

Graph 32 compare's species frequency and biodiversity in treated and untreated areas. Plots were installed adjacent to each other to capture similar environmental conditions. Grama grass and spurge have the highest frequency with lower number of species where prescribed fire occurred. The untreated areas have slightly higher biodiversity, and more grass species.



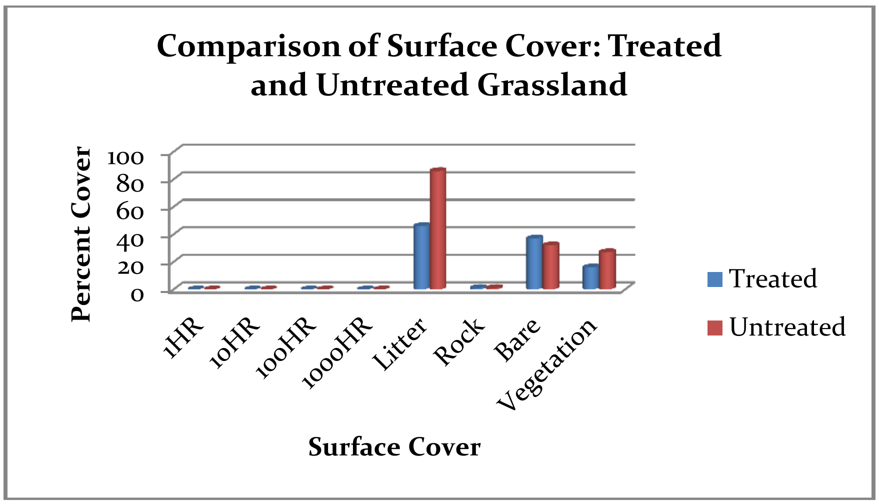
Graph 32

While more grass species were identified within the untreated plot, grama grass had the highest canopy cover where prescribed fire had occurred. Three species had similar canopy cover within he untreated area. Graph 33 below compare's cover and species amongst plots.



Graph 33

Graph 34 compares surface cover in both plots. Surface cover is a combination of bare and some vegetative cover where prescribed fire was applied, while the untreated plot had higher litter, vegetative cover, and less bare ground. Blue grana is the dominant canopy cover in the plot prescribed burned, while the untreated plot has higher overall vegetative cover post treatment, indicating a reduction in decadent grass cover.



Graph 34

Prescribed was successful in reducing tree canopy, decadent grass cover, and dead and down fuels. Biodiversity declined slightly however significant green-up occurred in the treated area, while little to no new growth occurred in the untreated area.

Conclusions/Recommendations

Wildfire

2011 was an historical season in terms of extreme drought, record dry conditions, reflected in ERC's and number of large fires on the Lincoln National Forest. Fuels treatment effectiveness varied amongst fires. In some cases such as the Donaldson and Mayhill fires, overall effects relative to landscape level change in fire behavior were inconclusive due to variability of fire effects and lack of reliable information during the passage of wildfire.

Extreme drought, combined with wind events and topography influenced fire spread often dominating fuel treatments. Evidence of high intensity stand replacing fire can be seen in both the White and Mayhill Fires where fuels treatments had occurred. Topographical influences often amplified winds increasing intensity and extent of stand replacement within the topographical feature, regardless of vegetative structure and condition.

Some treated areas demonstrated change in fire behavior by reducing fireline intensity as seen in the Queen and White Fires where fire effects indicated alteration in fire behavior.

Strategic placement of treatments both in the Donaldson on and White fire increased success in control of wildfire improving suppression capability and firefighter safety. Suppression capability and point protection may be the sound approach to express change in vegetation relative to protecting values at risk.

Hazardous fuels treatments are best described and validated where of protection of values at risk are the priority rather than objectives which focus on landscape level changes in fire behavior. Current climactic trends are extreme and historical in scope. However fuels reduction projects which aggressively reduce tree density and remove activity fuels are successful in protecting values at risk and supporting suppression operations.

In all fires monitored some treatments were successful in altering fire behavior. Treatments which thinned from below, and utilized type conversion were successful in altering fire behavior. The addition of grazing, alignment with favorable topographical features improved effectiveness of the treatment. As stated effects within treated areas was variable.

Lop and scatter varied even within one fire. For example within the Mayhill fire lop and scatter in Cherry and Dry Burnt Canyons limited initiation of crown fire activity, while lop and scatter in Wet Burnt Canyon supported stand replacing fire. In the Donaldson fire lop and scatter killed residual overstory trees on open stands with no canopy closure.

Fuel continuity in general did not contribute to extreme fire behavior as much as weather and topography. Many areas of densely forested landscape had limited canopy replacement, while areas with open canopy such as the White fire experienced high intensity high severity fire.

Continued calibration of fire modeling will improve predictions. Consideration of extreme conditions, 97th and beyond percentile weather should be modeled to gain understanding of potential impacts of fire as well as perspective on treatment capability.

As discussed previously, in 2011 the length of time within extreme conditions had nearly tripled since 2000. These conditions are when the larger fires which are resistant to control tend to occur. Additionally on a temporal scale ERC's have changed dramatically over the last 40 years. What is now moderate would have been considered extreme percentile conditions 40 years ago. Further refining and development of fire models may improve predicting effectiveness and success of fuels treatments.

Regardless of fire intensity areas monitored which had been treated had higher biodiversity than untreated areas. This indicates a positive ecological benefit supporting restoration or other similar land management goals.

Recommendations:

- Develop planning strategies which support:
  - Protecting values at risk through creation of defensible space.
  - Improved suppression capability.
  - Improved Fire fighter safety.
- Develop strategies to place hazardous fuels treatment as point protection relative to values at risk or linked into natural barriers such as roads systems.
- Consider fuel beaks around urban interface, linked into major road systems, and recreational facilities, and other infrastructure considered a value at risk.
- Consider topographical alignment when determining treatment placement. If feasible type conversions may be the most effective in areas where amplification of winds can be anticipated.
  - Recognize potential impacts of lop and scatter which are topographically aligned with winds.

Vegetation Treatments

Treatments continue to shift landscapes to conditions which support a variety of habitat types. Projects are best supported when land management goals and objectives are well defined and flexible. Guiding documents should provide direction on desired future conditions which are measurable. Parameters which are measurable and fit within parameters of planning documents support both the implementation of a treatment and future vegetation planning.

Landscapes are dynamic and variable, with multitudes of microclimates and vegetative states inherent within them. Recognizing key habitat and or ecological components which support and enhance ecological processes will improve abilty to validate changes within project areas. Planning documents should provide guidance on ecological components such as:

- Forest structure based on tree density, size class, and/or basal area
- Biodiversity
- Desirable browse and forage
- Desirable retention of coarse woody debris
  - Often treatments focus on reduction of coarse woody debris without a clear understanding of fuels loading or desired condition post treatment

Components can be measured for change, resilience, abilty to shift landscapes to a desirable condition. Treatment objectives can centered on restoration, habitat improvement, or other objectives which intend to improve ecological health.

Continued monitoring of treatments, for wildlife occupancy and reproduction, livestock use, watershed improvement and vegetative changes are essential in supporting both effectiveness of treatments, development of guidelines and parameters, and adaptive management. The linking of various monitoring attributes such as vegetative condition and wildlife further supports overall effects of a treatments and understanding of ecological processes within an area.

An example of shift in landscape structure is Pumphouse and Benson Ridge projects which occurred within or adjacent to multiple MSO PACs. Both projects reduced basal area to lower than both NEPA and Recovery plan guidelines and still continue to support occupancy within all PACs.

Additionally vegetation treatments do improve ecological resilience. For example areas sampled within wildfires in 2011, which had previous vegetation treatment, had higher levels of biodiversity post wildfire. It is important to recognize this occurred against the back drop of extreme drought which included a limited summer monsoon.

All areas sampled showed change in various landscape components. Often planning guidelines were vague or nonexistent, limiting abilty to demonstrate effectiveness. Both monitoring and adaptive management provide avenues to assess changes on the landscape and continue to develop strategies to effectively manage landscapes and improve ecological heath.

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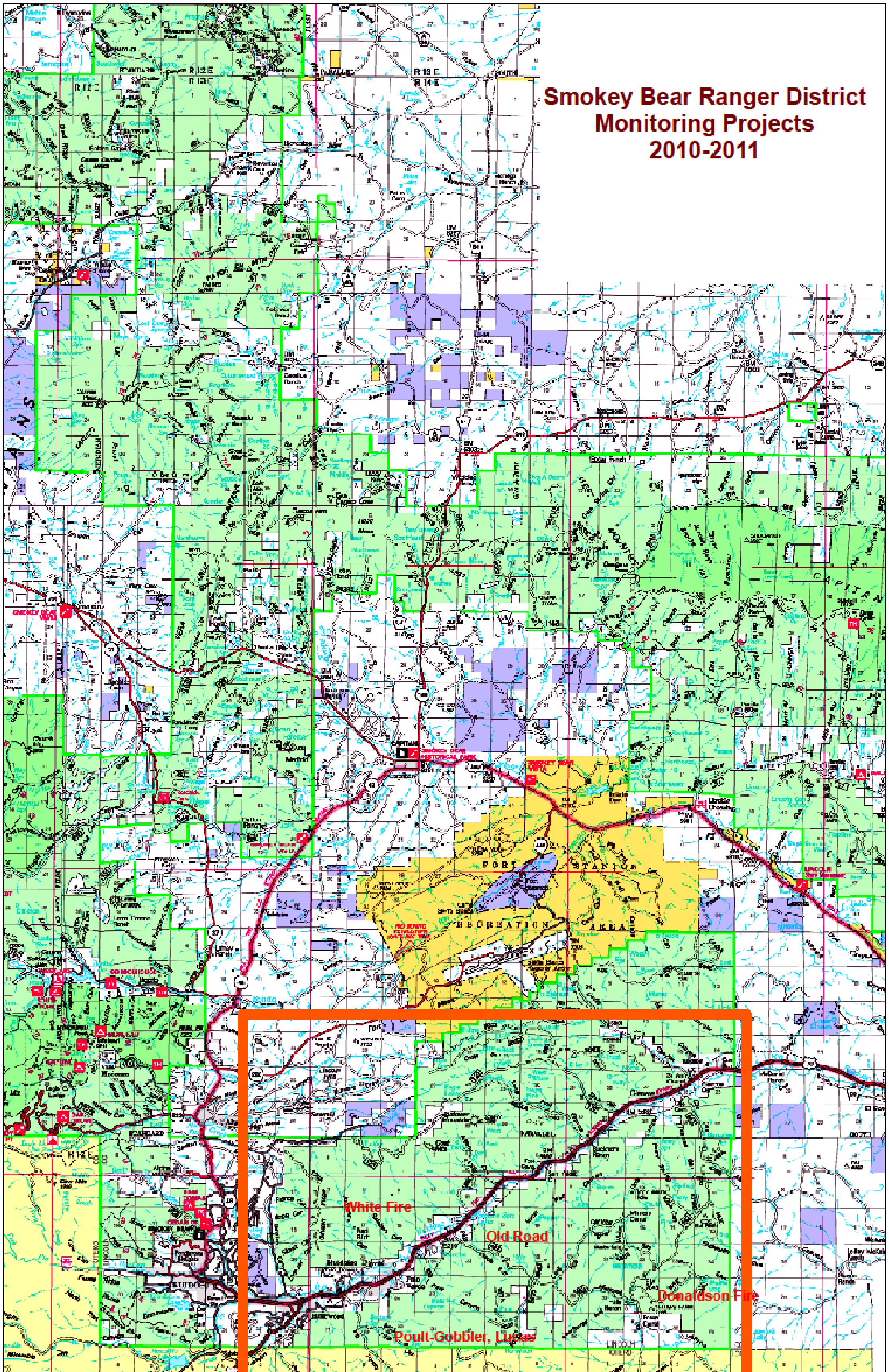
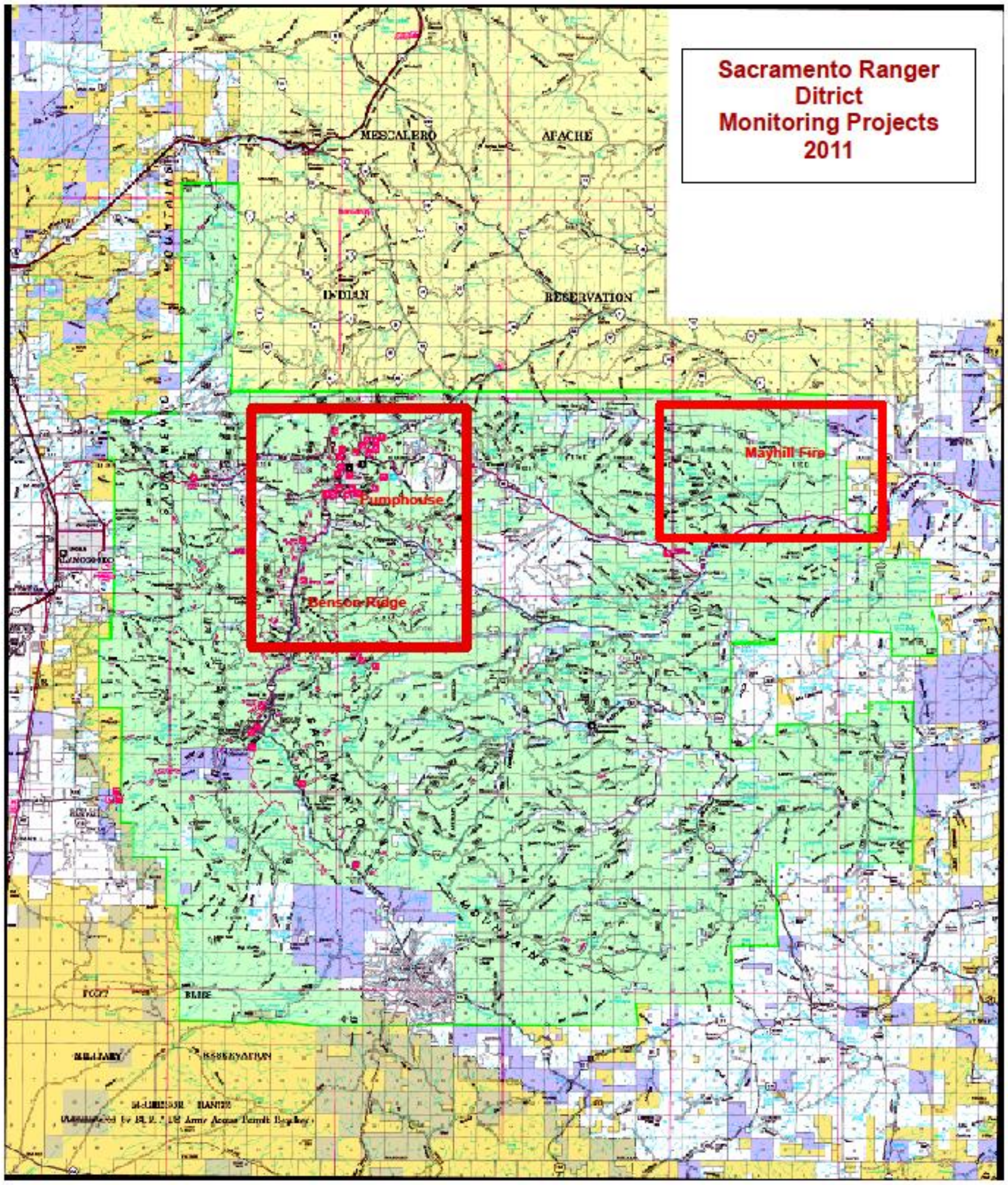
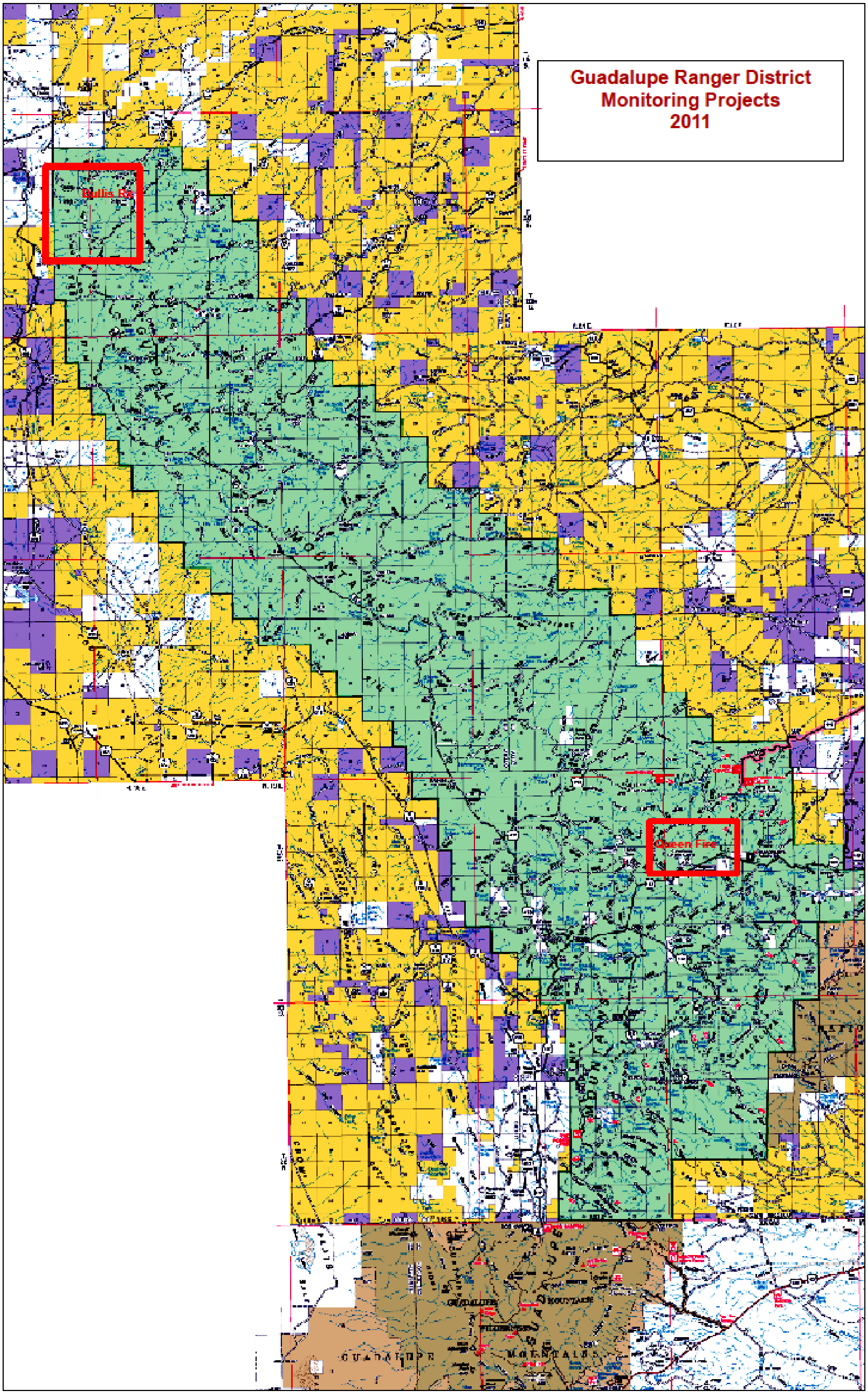
Appendices
Project Vicinity Maps


Smokey Bear Ranger District
Monitoring Projects
2010-2011
White Fire
Old Road
Donaldson Fire
Poult-Gobbler, Lucas


Sacramento Ranger
District
Monitoring Projects
2011
MESCALERO
APACHE
INDIAN
RESERVATION
Pumphouse
Benson Ridge
Mayhill Fire


Guadalupe Ranger District
Monitoring Projects
2011
Queen Fire