Warm Wildland Fire Use Fire

Fire Behavior Assessment Report

Video from inside fire on plot 1, slope to south of 89A in ponderosa pine-gambel oak stand
High intensity surface fire with firewhirl

Prepared 6/30/2006
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Executive Summary

Introduction

Wildland fire use fire management and wildfire suppression is dependent upon good fire behavior and resource effects predictions. Existing fire behavior and resource effects prediction models are based upon limited data from fire in the field, especially quantitative data. The Fire Behavior Assessment Team (FBAT) collects data to improve our ability to predict fire behavior and resource effects in the long-term and provides short-term intelligence to the wildland fire use managers and wildfire incident management teams on fire behavior-fuel and effects relationships. The team also collects information on fire fighter safety, such as convective heat in safety zones as opportunities arise.

This report contains the results of the assessment of fire behavior in relation to fuels, weather and topography, and fire effects to resources in relation to fire behavior for the Warm Wildland Fire Use Fire.

Objectives

The team met with the Ranger District to prioritize vegetation and fuel types and resources to focus on. The priorities were:

1. fire behavior and effects in ponderosa pine fuel type
2. fire behavior and effects in mixed conifer vegetation type
3. effects of fire in goshawk habitat
4. fire behavior and effects in paradine plains cactus habitat
5. fire behavior and effects at pre-historic cultural sites

Accomplishments

- *fire behavior and effects in ponderosa pine fuel type*
  - 8 sites completed (video, rate of spread, fuels and vegetation pre and post)
- *fire behavior and effects in mixed conifer vegetation type*
  - 1 site completed (video, rate of spread, fuels and vegetation pre and post)
- *rapid assessment of effects of fire in goshawk habitat*
  - 4 transects complted
- *fire behavior and effects in paradine plains cactus habitat*
  - 1 site completed, with 10 cactus (video, rate of spread, temperature, fuels and vegetation pre and post)
- fire behavior and effects at pre-historic cultural sites
  - 1 site set-up in pinyon-juniper that did not burn, a second site in ponderosa pine with artifacts placed by archeologists (video, temperature, heat flux {total, radiant and convective} but artifacts were removed before the site burned)
- a portable RAWS was set-up
- foliar moisture samples were collected and processed most days and submitted to FBAN.

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The team met with the Ranger District to prioritize vegetation and fuel types and resources to focus on. The priorities were:

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10. fire behavior and effects at pre-historic cultural sites

Approach

Pre- and post-fire fuels and fire behavior measurements were made at sites throughout the fire. Sites were selected to represent a variety of fire behavior and vegetation or fuel conditions. Priority was on sites that would most likely receive fire. A rapid assessment of fire severity and effects was conducted across the portions of the fire that had burned.

Fire Behavior Measurements and Observations

At each site, sensors were set up to gather information on fire behavior including: rate of spread, fire type, flamelength, and flaming duration. In addition, at some sites, temperature and heat flux (total, radiant and convective heat) were also measured.

Flamelength and Flaming Duration

Flamelength was determined from video and sometimes supplemented by tree height or char. If crowning occurred above the view of the camera, then tree height was used to estimate the minimum flamelength. If the video camera failed (due to extreme temperatures or trigger malfunction), then char height on tree boles or direct observation were used to estimate flamelength. Flaming duration was based on direct video observation and when temperature was measured, from those sensors as well.

Fire Type
Fire type was determined from video as well as post-fire effects at each site. Observations from the video were recorded on transitions to crown fire, including the type of fuel that carried the fire from the surface to crown.

Rate of Spread and Temperature
Rate of spread was determined by rate of spread sensors (RASPS) which have a piece of solder attached to a computer chip (buried in the ground) that records the date and time when the solder melts or from thermocouples that measure temperature. The distance and angle between RASPS or thermocouples were measured. In some cases where the RASPS failed, rate of spread was estimated from the video. Thermocouples were placed at two sites were cultural resources were present or placed.

Heat Flux
Heat flux is the heat output per unit area per unit time for a given “view” of the sensor. It is the fire behavior measure that is used to determine injury to humans (in addition to temperature) and structures. Our heat flux sensors measure total and radiant heat and convective heat is calculated by subtracting radiant from the total. A heat flux sensor was set-up where cultural resources were present or placed. In addition, we set up three different heat flux sensors to measure the effectiveness of Pleasant Valley Meadow as a safety zone. The fire never reached Pleasant Valley, but the sensors would have shown how deep into the meadow convective and radiant heat would have traveled.

Vegetation and Fuel Measurements

Vegetation and fuels were inventoried before the fire reached each site and then after. Consumption and fire effects (i.e. scorch) were inventoried after burning. Mortality was not determined for trees, since mortality can be delayed for some time after the fire.

Crown Fuels and Overstory Vegetation Structure
Tree density, basal area, tree diameters, tree heights and canopy base heights were measured by species for each site. A relaskop was used for overstory and pole plots. Heights were measured with an impulse laser. Diameters were measured with a biltmore stick or in some cases a diameter tape. The Forest

Vegetation Simulator (FVS) program was used to calculate canopy bulk density, canopy base height, tree density and basal area.

One plot was in pinyon-juniper woodlands and a different protocol was used there based upon the approach developed by the Dr. Robin Tausch of the Rocky Mountain Research Station. A belt plot was used for trees rather than a relaskop and basal diameters were measured on trees instead of diameters at breast height (dbh).

Surface fuels were inventoried with a Brown's planar intercept. Understory vegetation and live fuels were estimated occularly in a 1 meter wide belt plot along the Brown's transect. The Burgan and Rothermel fuels photo series was used in order to estimate tons per acre of live fuels.

Foliar Moisture and Weather

Live foliage was collected on each plot and oven dried to determine foliar moisture. Weather data was downloaded from the Jacob Lake remote automated weather station (RAWS).

Rapid Assessment of Immediate Fire Effects

Three systematically placed transects were placed across broad sections of the wildland fire use area in addition to the post-fire measurements at each of the sites where pre-fire vegetation, fuels and fire behavior were measured in order to assess immediate post-fire severity and effects. The emphasis on fire severity for this assessment is on the effects to vegetation. Some information was gathered on fire effects to soils, but the overall severity assessment would be different than a typical Burned Area Emergency Rehabilitation (BAER) severity map, which are usually focused on soil severity.

The transects bisected the fire in three locations at the north, center and southern portions of the wildland fire use area. Along each transect, patches of different severities (i.e. unburned, low, moderate or high) were identified. The distance across each patch was estimated by pacing. In each patch a plot was randomly placed off of the transect. The FIREMON (www.fire.org) composite burn index (CBI) plot protocol was used for the plots. This plot protocol is consistent with the national interagency post-fire landscape severity mapping program. This post-fire severity mapping program is in the initial stages and will likely be conducted for this fire at one year post-fire. It is based on changes in Landsat satellite data. Additional CBI plots gathered one-year post-fire can be used to calibrate the satellite data to interpret fire severity.

Findings

Overall

Sites were grouped into dominant vegetation types to summarize the data. Information for each site. Five different vegetation types (Table 1) were sampled, most ponderosa pine dominated since ponderosa pine forests encompassed most of the fire area. Pre-fire data was collected and fire behavior sensors were set up at 15 sites (Figure 1). Eight pre-fire plots were in ponderosa pine types, four in spruce-fir-aspen, one in white-fir mixed conifer, and 1 in pinyon-juniper (table 1). Fire behavior and post-fire data were collected at 10 sites that burned. None of the spruce-fir-aspen plots burned but all of the remaining did, except for the cultural resource site which was in the pinyon-juniper type. Sixteen plots were collected across the four rapid fire fire effects transects.

Table 1. Vegetation types assigned to each site and used to group data.

Vegetation Type	Description	Number of Sites Sampled
Pinyon-Juniper	Pinyon pine and juniper dominate the site. Scattered ponderosa pine may be present.	2
Ponderosa pine/grass	Ponderosa pine dominates the overstory and understory. Understory comprised of grass, but may be patchy and absent under dense thickets of pine saplings or poles.	2
Ponderosa pine-gamble oak	Ponderosa pine dominates the overstory. Gambel oak present in the understory or low sub-canopy. May be present in clumps or across continuous areas.	3
Ponderosa pine-aspen	Ponderosa pine dominates the overstory. Aspen present in varying amounts, may be scattered.	2
White fir – mixed conifer	White fir dominates or co-dominates overstory and mid-story. Ponderosa pine or Douglas-fir may be present in varying amounts. Aspen sometimes present.	2
Spruce-fir-aspen	Spruce dominates the sites. Varying amounts of subalpine or white fir present. Aspen present and often co-dominant in the overstory or regeneration layers.	4

A variety of fire behavior was measured across the sites. It varied from low intensity surface fire, to intense surface fire with torching, to intense crown fire.

Figure 1. Map with locations of detailed and rapid assessment sample locations.

(insert pdf file…for better resolution map)

Vegetation, Fuels, Fire Behavior and Effects for Detailed Plots

Data on pre-fire vegetation structure (tables 2 and 3), pre-fire live fuels (table 4), pre-fire surface fuels (table 5), fire behavior (table 6), post-fire consumption of surface fuels (table 7) and immediate post-fire effects (table 8) were summarized.

Pre-fire Vegetation Structure

Most of the sites were mature forests with variable amounts of pole trees or understory shrubs and herbs (table 3). Gamble oak was the predominant non-conifer live understory plant aside from grass (figure 3). We labeled it as a shrub where it was low growing, since as wildlife habitat or fuel, it acts as a shrub. Most of the grasses were well cured, with 80 to 90% dead component (figure 2).

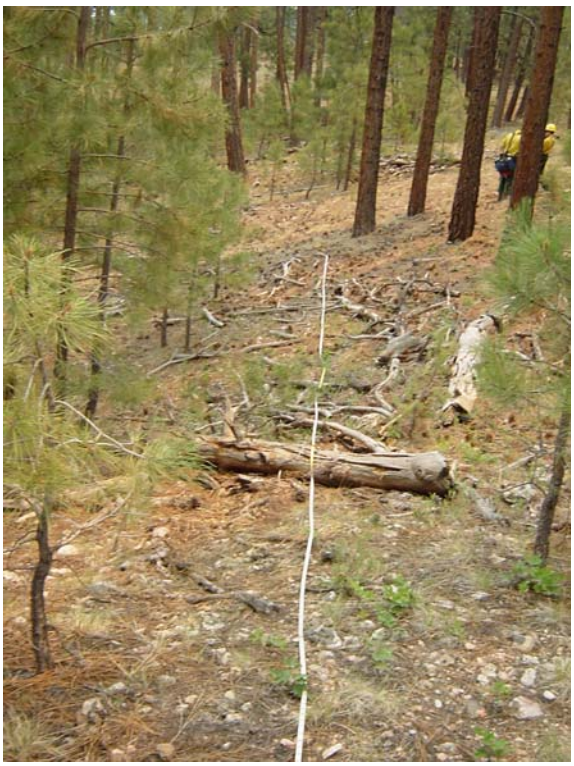

Figure 2. Site 3 pre-burn.


Figure 3. Site 10 pre-burn, with dense gambel oak understory.


Figure 4. Site 8 pre-burn, white fir mixed conifer.

Figure 5. Pinyon- juniper, site 9.

Basal areas ranged from 80 to 277 square feet per acre, exceeding 100 square feet per acre on most sites (table 2). Tree densities were generally high, particularly in the ponderosa pine sites with a high pole component. Stand density indices exceeded 200 on all but two sites.

Canopy cover was variable within sites (table 3), with clumpy spatial patterns resulting in variation from openings with little or not canopy to denser patches with up to 60% cover. Understory cover was comprised primarily of grass. In most cases the grass was well cured.

Table 2. Pre-fire forest structure calculated using Forest Vegetation Simulator, using the southern central rockies variant.

Site	**Basal Area (ft2/acre)**	**Tree Density >1" dbh (trees/acre)**	**Stand Density Index**	**Quadratic Mean Diameter (inches)**
ponderosa pine - grass				
2	215	206	346	13.8
ponderosa pine – oak				
1	101	365	211	7.1
3	121	756	283	5.4
4	80	7484	320	1.4
10	94	106	157	12.8
ponderosa pine – aspen				
5	115	194	207	10.4
6	277	2456	692	4.5
7	201	1591	492	4.8
white fir – mixed conifer				
8	101	110	167	13.0

Table 3. Pre-fire vegetation cover by physiognomic layer, from ocular estimates in plot, vicinity and from photos at site.

Site	Overstory Tree Cover	Pole Tree Cover	Seedling/Sapling Tree Cover	Shrubs	Grass Cover		Herb Cover	
					live	dead	live	dead
ponderosa pine - grass								
2	40-60	0-30[1]	0?	10	1	5	5	2
ponderosa pine - oak								
1	40	10	20[2]	20[3]	10	30	1	0
3	30-40	See photo	5	1-5	1	5	1	1
4	10-30	20-60[4]	0	1	1-10[5]	1-20[5]	0[6]	0
10	30-50	0	0	60[3]	10	50	1	0
ponderosa pine - aspen								
5	20-60[7]	0-10[7]	0-30[7]	5	10	30	0[8]	1
6	30-50[9]	20-60	0-10	1	10	50	1	1
7	10-30	0-50	1	3	1	10	5	1
white fir – mixed conifer								
8	20-60[9]	10	15	5	2	30	25	2
pinyon-juniper								
9	30-60	10-20	0-5	10	10	40	1[10]	0

1 – poles patchy
2 – seedlings and saplings in area, just outside of plot.
3 – shrubs are gambel oak sprouts
4 – patchy in plot
5 – dense doghair thicket in fuels plot, dense patch of gambel oak inbetween camera and fuels plot
6 – Eriogonum outside of plot, low cover
7 – trees are clumpy, site had some selective harvest
8 – Patches of lupine below plot and in greater area above plot upslope
9 – Old growth, with clumps of tree overstory and regeneration patches, some large aspen
10 – Cactus and yucca

Pre-fire Live Fuels

Pre-fire live understory fuels were greatest in the white fir-mixed conifer site (table 4). Canopy fuels were greatest at several of the ponderosa pine sites, particularly where there were dog hair thickets of ponderosa pine poles or clumps of tall gambel oaks.

Pre-fire Surface Fuels

Pre-fire surface fuels varied amongst sites (table 5). The predominant surface fuels were litter, which varied from 1 to 3 inches and 1 hour fuels. We did not include litter in the calculation of 1-hour fuels but they do contribute to that fuel size class in fire spread and intensity. Several of the sites had high 1000 hour fuel loadings, particularly the white fir-mixed conifer site. Several of the ponderosa pine sites also had substantial 1000 hour fuels, ranging from 7 to 26 tons per acre.

Table 4. Live fuels by site. Crown fuels were calculated using the Forest Vegetation Simulator. Understory fuels were calculated using the Burgan and Rothermel (1984) method.

Site	**Trees**		**Understory**		
	Canopy Base Height (ft)[1]	**Canopy Bulk Density (kg/m3)**	**Live Shrub, Herbs, Grass (tons/acre)**	**Live & Dead Grass, Herb (tons/acre)**	**Live & Dead Shrub (tons/acre)**
ponderosa pine – grass					
2	2	0.10	0.024	0.043	0.010
ponderosa pine – oak					
1	8	0.06	0.747	0.061	0.740
3	2	0.10	0.250	0.020	0.198
4	2	0.40	0	0.001	0
10	15	0.06	3.763	0.554	4.101
ponderosa pine – aspen					
5	3	0.08	0.008	0.054	3.857
6	4	0.26	0.053	0.279	0.016
7	4	0.28	0.128	0.055	0.096
White fir – mixed conifer					
8	*	*	2.273	0.184	2.155
pinyon-juniper					
9	*	*	0.100	0.069	0.098

* preliminary results not reliable

1 – canopy base height from FVS may be higher than what is important for fire behavior because the seedling, sapling and shrub layers were not included.

Table 5. Pre-fire surface fuels. Sampled using Brown's planar intercept method.

Site	Small surface fuels (tons/acre)				1000 hour fuels (tons/acre)		Forest floor depths (inches)	
	1 hour	10 hour	100 hour	Total	Rotten	Sound	Litter	Duff
Ponderosa pine – grass								
2	.05	.61	.00	.66	23	3	3	1.4
Ponderosa pine - oak								
1	.11	.61	3.63	4.35	0	0	1.1	.4
3	.05	.3	0	.35	6.8	1.6	1	.6
4	.05	.3	0	.35	0	0	1.8	.8
10	.05	0	1.21	1.26	0	0	1.4	.8
Ponderosa pine - aspen								
5	.03	.91	2.42	3.37	0	7.2	2.6	.8
6	.06	0	1.21	1.27	0	0	2	1.4
7	.11	.61	3.63	4.35	8.5	3.5	2.2	.4
White fir – mixed conifer								
8	.35	2.76	4.88	7.98	3.5	19.5	1.2	.4
Pinyon - juniper								
9	.22	.91	0	1.13	0	0	n/a	n/a

Fire Behavior

A variety of fire behavior was measured but most of it was surface fire (table 6). Surface fire was mostly moderate to high intensity with flamelengths often greater than 4 or 8 feet (Figures 6 and 7). At several sites, torching, transition to torching or crown fire, and on one site active crown fire was measured. On the sites with crown fire, some of the sensors failed or the cameras were frozen or tapes need to be recovered. These will need to be sent to a special facility in Hollywood to retrieve but will likely be retrievable.

Figure 6. High intensity surface fire on site 1.

Figure 7. Low to moderate intensity surface fire on site 2.

Sites where transitions to torching or crown fire occurred or where intense fire occurred, there was often a presence of ladder fuel clumps such as gambel oak or doghair thickets of ponderosa pine poles. The white fir-mixed conifer site that experienced active crown fire had crowns of all size trees that extended to the ground or near the ground and heavy loading of 1000 hour fuels. In addition, this site as near the upper portion of a drainage and it appears that the fire accelerated from the bottom up, according to observations on the fireline and air.

Figure 8. Torching on site 3.

Firewhirls were observed on several sites where high intensity surface fire occurred. At site four, after surface fire transition to crown fire, a firewhirl was observed (figure 9).

Figure 9. Firewhirl on site four after transition to crown fire.

Table 6. Fire behavior measurements and observations by site.

Site	**Slope (%)**	**Fire Type**	**Flamelength (feet)**	**Rate of Spread (chains/hr)**	**Flame Duration across site**	**Temperature**[1] **(^{0} F)**
		ponderosa pine - grass				
2-upslope	29	High intensity surface fire	8’	20	7 min.[2]	
2-drainage	8	*Tape is frozen in camera*				
		ponderosa pine - oak				
1-slope	44	high intense surface, with torching	>12’	80-100	40 min.	
1-flat	2	low intensity surface fire	1’		60 min.	
3	12	high intensity surface, with torching of poles (ladder fuels), fire whirls	3 to 7’ and then to 17’	10 and then 60 to 70	21 min.	
4[3]	34	transition from high intensity surface to active crowning, fire whirls	6” to 20’ to 120’	2-45	6 min.	
10		low intensity surface fire with some torching of tree clumps	2 to 3’	2	Smoke obscured view	687 ^{o}
		ponderosa pine - aspen				
5	8	*Camera did not trigger*, variable intensity evident from surface fuel consumption and crown scorch	9’[4]	½ to 15		
6-downhill	18-25	high intensity surface fire	6 to 10’	2-5	82 minutes	
6-across slope	18	low intensity surface fire (backing)	3’	1/2	83 min.	
7-downill	35	mainly low intensity surface fire, with some high intensity below trees	9’	4	24 min.	
		White fir – mixed conifer				
8	38	*Tape frozen, post-fire conditions and observations during the fire show that active crowning occurred*	>150’			2089^o
		Pinyon-juniper				
9	5	transition from smoldering to high intensity fire with torching	5 to 7’ and then 30 to 50’	½ to 20	56 minutes	

2 – smoke covered view after 7 minutes, may have been longer post-frontal combustion but could not determine
3 – gambel oak inbetween fuel plot and camera
4 – estimated from char height on bark

Post-fire Consumption and Immediate Effects

Consumption of surface fuels was high at most sites (Table 7). Most sites had 100% litter, duff and surface fuel consumption. Soils were covered by ash or charred litter at most sites, although at many sites sampled there were scorched needles that are likely to cover the soil surface in the near future, particularly with wind. Understory vegetation was also at least partly consumed on most sites (Table 8). Tree scorch and torch varied by site. On those with crown fire, there was 100% needle consumption. On those sites with high intensity surface fire, and torching, there was variable amounts of torch and scorch. Many sites had >50% scorch. It is important to note that we did not sample portions of the fire that did not burn and our sample sites are not necessarily representative of the extent of low intensity fire that occurred—we under-sampled low intensity fire.

Figure 10. Post-fire photo at site 6, ponderosa pine forest.

Figure 11. Post-fire photo at site 9, pinyon-juniper.

Figure 12. Post-fire photo at site 8, white fir-mixed conifer

Figure 13. Site 4, post burn, ponderosa pine-gambel oak.

Table 7. Surface and ground fuel consumption by site.

Site	Soil Severity (NPS rating)[1]	Duff Consumption (%)	Litter Consumption (%)	Surface Fuels			
				1- hour	10- hour	100- hour	1,000 hour
ponderosa pine - grass							
2	2	100	100	100	100	100	100[2]
ponderosa pine - oak							
1	2, scattered 3	Mostly 100, some patches of 33%	100	100	100	100	None prior to burn in plot
3	2, 1 where logs were	75-100	mostly 100, some areas of 60	66	Some charred added, pre-fire consumed 100	None pre-fire	100
4	3, 1 where logs were	75	100	100	100	100	None prior to burn in plot
10	3	100 and some 0 prior to burn	90 and unburned	66	None pre-fire in plot	0	None pre-fire in plot
ponderosa pine - aspen							
5	3	75	100	100, but accumulation from charred branch (limited to transect)	66	100	100
6	3-4	0 to 25	50-83	100	None pre-fire in plot	100	None pre-fire in plot
7	2	0 (2 points) to 100 (1 point)	100	100	100	100	100
white fir – mixed conifer							
8	1	100	100	100	100	100	100
pinyon-juniper							
9	2	0 to 67	100	100	100	None pre-fire	None-pre fire, one added

1 – National Park Service, Western US Monitoring Handbook, substrate severity ratings: 1- very high, white ash, some discoloration of soil; 2 – high, gray and black ash; 3 – moderate, ash and some patches of charred litter or duff; 4 – low severity, charred litter and some unburned litter and duff remain; 5 – unburned.
2 – large logs charred and partially consumed outside of Brown's planar intercept line.

Table 8. Summary of immediate post fire effects per site. Mortality is not included, since survival cannot be determined immediately post-fire. Trees that are scorched can survive. Data below shows **torch, where needles are consumed**, and **scorch, where needles are brown** but not consumed. Results below are based upon a rapid analysis of measured crown scorch and torch. Detailed data by individual tree was recorded but not summarized quantitatively.

Site	**Understory consumption (%)**		**Midstory**		**Overstory Severity**		**Bole Char Heights (feet)**
	Grass/herb	**Shrubs /seedlings**	**Scorch (% crown)**	**Torch (% crown)**	**Scorch (% crown)**	**Torch (% crown)**	
ponderosa pine - grass							
2	100	100	100	<10	80-100	<10	3-6’
ponderosa pine - oak							
1	100	100	All torch	100	70-100	<10	15-60’
3	100	100	All torch	100	30-90	<1	10
4	100	None present	All torch	100	30-90	30-50	Not recorded
10	80-100	100	None present		0-40	0-10	6-20’
ponderosa pine - aspen							
5	100[1]	100 scorch seedlings, shrubs consumed	Variable, one totally consumed, 1 100% scorch and another with no effects		0-70	0	9’
6	100[2]	100	90-100	0	0-20, 1 tree 100	0	Not recorded
7	100	100	Large clump totally consumed, next to large tree that burned hot		50-100	0-20	Not recorded
white fir – mixed conifer							
8	100	100	All torched		100 torch, several large trees completely consumed (>40 cm dbh)		Completely up boles
pinyon-juniper							
9	100[3]	100			All torched		Completely up boles

1 – patch of lupine below patch scorched but not consumed.
2 – Grass mostly consumed but some basal litter remains. Some herbs in plot and patch of lupine below patch scorched and not consumed.
3 – stubble left on grass. Cactus outside of plot in gravelly area with limited surface fuels were scorched but not charred or consumed.

Archeological Resources

Fire behavior sensors were set up at one archeological resource site in pinyon-juniper but the site never burned. At a second site, archeological artifacts were placed next to sensors by archeologists but they retrieved them before the site burned.

Cactus

The pinyon-juniper site that burned had cactus that may be the paradine plains cactus but we are confirming this with the district botanist (figure 16). Nine individual or clusters of cactus were censused before and after the fire at this site. After the fire, each cactus was revisited and photographed. They were all scorched but did not appear to have sustained long-duration heat, showing no signs of char or heat dessication. It is too soon to determine survival.

Figure 16. Picture of cactus pre-fire

Figure 17. Picture of cactus post-fire.

Rapid Fire Severity and Effects Assessment

Four transects were sampled for the rapid fire severity and effects assessment across a total distance of 1.6 miles. At this time, only a preliminary assessment of severity and effects can be made because pine mortality will take at least several months to express themselves. According to the Forest Fire Planner and Fuels Specialist, the amount of monsoonal moisture received will greatly affect the level of pine and other tree mortality.

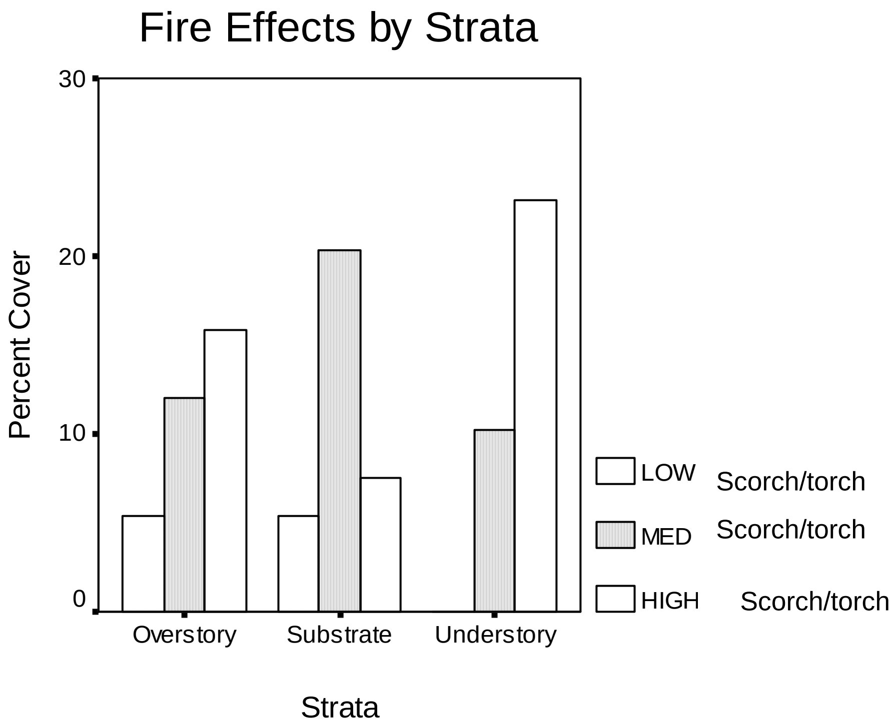

Figure 18. Composite burn data were averaged by substrate (A factor), understory (B and C factors) and overstory (D and E factors). Because data were gathered several days after the burn, % canopy mortality, % living/resprout, colonizers and species composition factors were not included.

Appendix A

About the Fire Behavior Assessment Team

We are a unique module that specializes in measuring fire behavior on active fires of all kinds including wildland fire use fires, prescribed fires or wildfires. We utilize fire behavior sensors and special video camera set-ups to measure direction and variation in rate of spread, fire type (e.g. surface, passive or active crown fire behavior) in relation to fuel loading and configuration, topography, fuel moisture, weather and operations. We measure changes in fuels from the fire and can compare the effectiveness of past fuel treatments or fires on fire behavior and effects. We are prepared to process and report data while on the incident, which makes the information immediately applicable for verifying LTAN or FBAN fire behavior prediction assumptions. In addition, the video and data are useful for conveying specific information to the public, line officers and others. We can also collect and analyze data to meet longer term management needs such as verifying or testing fire behavior modeling assumptions for fire management plans, unit resource management plans or project plans.

We are team of fireline qualified technical specialists and experienced fire overhead. The overhead personnel includes a minimum of crew boss and more often one or more division supervisor qualified persons. The team can vary in size, depending upon availability and needs of order, from 5 to 12 persons. Our lead fire overhead is Mike Campbell, Division Supervisor. We have extensive experience in fire behavior measurements during wildfires, wildland fire use fires and prescribed fires, having worked safely and effectively with over 16 incident management teams.

We can be ordered from ROSS, where we are set up as “TEAM- FIRE BEHAVIOR ASSESSMENT – FITES”. We can be requested by the following steps: 1) Overhead, 2) Group, 3) Squad, and 4) in Special Needs box, “Requesting –Fire Behavior Assessment Team- Fites’ Team out of CA-ONCC 530-226-2800. You can also contact us directly by phone to notify us that you are placing an order, to speed up the process. You can reach Jo Ann at 530-478-6151 or cell (only works while on travel status) at 530-277-1258. Or you can reach Mike Campbell at 530-288-3231 or cell (only works while on travel status) 559-967-7806. Do not assume that we are not available if you call dispatch and we are already on a fire. We have and can work more than one fire simultaneously and may be ready for remobilization.

Appendix B

Fuel Moistures from Warm Fire 6/22-26/06

PLOT ID	COLLECTION DATE_TIME	Sample number	SAMPLE TYPE	Fuel Moisture
Day 1	6/22 1912	1	Ponderosa pine	69.72
Day 1	6/22 1912	2	Ponderosa pine	78.29
Plot 2	6/23 0930	1	Ponderosa pine	90.35
Plot 2	6/23 0930	2	oak	65.77
Plot 2	6/23 0930	3	Ponderosa pine	93.86
Plot 3	6/23 1225	1	juniper	53.13
Plot 3	6/23 1225	5	grass	11.97
Plot 4	6/23 1330	1	Ponderosa pine	77.12
Plot 4	6/23 1330	2	Ponderosa pine	82.57
Plot 6	6/24 0830	1	Ponderosa pine	70.81
Plot 6	6/24 0830	2	Ponderosa pine	76.39
Plot 6	6/24 0830	3	grass	28.87
Plot 6	6/24 0830	4	grass	30.93
PJ site	6/24 1315	1	juniper	56.80
PJ site	6/24 1315	2	pinyon	67.35
PJ site	6/24 1315	3	sagebrush	78.65
Plot 8	6/25 0800	1	white fir	78.54
Plot 8	6/25 0800	2	white fir	78.23
Plot 8	6/25 0800	3	white fir	78.89
Plot 9	6/25 0900	1	juniper	75.96
Plot 10	6/25 1130	1	grass	32.99
Plot 10	6/25 1130	2	oak	56.80
Plot 10	6/25 1130	3	oak	60.98
Plot 11	6/26 1000	1	white fir	82.10
Plot 11	6/26 1000	2	douglas fir	80.42
Plot 12	6/26 1210	1	spruce*	48.06
Plot 12	6/26 1210	2	spruce*	59.24
Plot 12	6/26 1210	3	spruce*	60.48
Plot 13	6/26 1645	1	spruce*	14.93
Plot 13	6/26 1645	2	spruce*	70.47
Plot 14	6/25 1818	1	spruce*	64.03
Plot 14	6/25 1818	2	aspen	124.47
Plot 14	6/25 1818	3	aspen	130.33

* Note that spruce moistures seemed low due to poor health of trees.