JEWEL CAVE NATIONAL MONUMENT
Lithograph Canyon Prescribed Fire
Monitoring Report

September 27, 1999

Prepared by Kelly Mathis and Andy Thorstenson
Northern Great Plains Fire Monitoring Team

Introduction

The Lithograph Canyon burn unit is located in the center of Jewel Cave National Monument. It is bounded by the Lithograph Canyon Rd (FS 278), the main park road, Highway 16, and a service road to the sewage lagoons. The unit consists of approximately 154 acres of ponderosa pine forest with grass and timber litter understory. The unit was ignited on September 22 and 23, 1999. Ignition on the 22nd began at 1000 and was halted at 1300 to evaluate burning conditions and tactics. Ignition recommenced at 1500 and continued until 1930. Ignition on the 23rd began at 1100 and continued until 1900. Note that ignition of 2 acres of this unit occurred in October 1998, but poor weather conditions precluded completion of the entire unit.

The primary goals for the burn were to reduce hazardous fuels around monument structures to protect them from wildland fire, reduce fuel loads to reduce likelihood of catastrophic fire, reintroduce fire into the ecosystem, and preserve multi-class stands of ponderosa pine. The specific objectives contained in the burn plan were to:

1. reduce total fuel loading by 40-80% immediately postburn
2. reduce density of trees with a DBH larger than 6" (15 cm) by 15-30% within 2 years
3. reduce density of trees with a DBH smaller than 1" (2.5 cm) by 40-70% within 2 years

The status of burn objectives can be found in Conclusions table 4.

Staff for the Lithograph Canyon burn included Burn Boss Bill Gabbert, Ignition Specialist Bob Kobza, Division Supervisors Scott Lopez, Kevin Merrill, and Denny Ziemann, and Lead Monitor Kelly Mathis. Fire Personnel in other ignition and holding assignments were from Jewel Cave NM, Badlands NP, Scott's Bluff NM, Agate Fossil Beds NM, Wind Cave NP, Black Hills National Forest, BIA Pine Ridge, Mount Rushmore National Memorial, and the Northern Great Plains Fire Monitoring Team.

Summary of Events

Staff from Jewel Cave and Wind Cave did the on-site preparation for the burn including mow lines, staging portable water tanks, and installing a hose lay on the northern boundary. Test burns were conducted along the west and north boundaries to evaluate fuels conditions and assist with blacklining on September 17.

Burn overhead conducted a briefing for personnel on the mornings of the burn. A National Weather Service spot forecast and on-site weather observations were obtained to assess compliance with prescription parameters. These are detailed in the section that follows.

Weather Observations

Monitoring of weather conditions occurred on every day of ignition on the Lithograph Canyon burn. On September 22 and 23, when the main unit was ignited, most burning occurred with temperatures in the upper 70's with relative humidity in the upper teens. Winds were influenced by topography with upslope and upcanyon winds predominating. See Table 1 for a summary.

Table 1 Weather Conditions

Condition	Prescription	Sept 22	Sept 23
Temperature (F)	35-90	53-81	61-76
Relative Humidity	25-70%	16-37%	18-36%
Wind Speed (mph)	1-6 mph	0-5	0-3
Wind Direction	Any	Variable/upslope	Variable/upslope

Ignition Pattern

On September 22, hand ignition began at 1000 hours in the southeast corner of the unit along the junction of Hell Canyon and Lithograph Canyon roads and proceeding north. Ignition continued to the sewage lagoons and continued along the service road to the NE. As this area became secure, ignition began along Lithograph Canyon road heading north. This ignition pattern continued with hand ignition along the north line and ignition along the Lithograph Canyon road holding until the north line was secure. Due to higher than forecasted temperatures, lower than forecasted RH, and higher than forecasted winds, ignition ceased at 1300. A new control line was installed along the current fire edge on the north side. When the weather had stabilized and new tactics discussed, ignition began again near point K and continued to the east. As the north line became secure, ignition also progressed east along Lithograph Canyon Rd. Ignition was halted at 1930 due to rising humidity and lower temperatures.

On September 23, ignition began in the northeast at Point A and proceeded west and south to secure the corner. Strips were then fired on the east of an old two-track road to secure the east line to Lithograph Canyon Rd. Ignition then began along the main park road at the end of the previous days burning and proceeded along the road to Hwy 16. When this line became secure, lighting began along Lithograph Canyon road and continued to the park boundary. Ignition of the unit was completed at 1900 hrs. Please see attached map.

Fire Behavior Observations

During the Lithograph Canyon burn, observations were taken to determine fire behavior in different fuels throughout the course of ignition. The observations taken were associated primarily with the perimeter and the long term monitoring plots. Head fires were rarely observed due to close spacing of ignition strips near the perimeter and the protection of interior power lines.

Fire behavior varied across the unit based on fuel type and weather conditions. Areas burned early or late in the day burned with less intensity than areas burned in the mid-afternoon due to humidity levels. Also, areas with pine litter as the main carrier burned hotter than more open areas with grass as the carrier due to the high live fuel moisture of the grass. Pre-burn fuel moistures in grass averaged 80% while pine litter averaged 11%. In areas with grass as the main carrier the fire either burned very poorly or died completely.

Table 2 **Sept 22, 1999**

Fire Type	Time	Fuel Type	Location	Rate of Spread	Flame Length	Flame Zone Depth
Head	18:56	Model 2	Plot 2	4 ch/hr	9”	5”
Flanking	12:30	Model 9	N. Line	3 ch/hr	9”	3”
Backing	11:50	Model 9	W. Line	.5 ch/hr	3”	2”
Backing	19:30	Model 2	Plot 2	1 ch/hr	3”	2”
Backing	19:30	Model 2	Plot 2	unknown	5”	2”

Table 3 **Sept 23, 1999**

Fire Type	Time	Fuel Type	Location	Rate of Spread	Flame Length	Flame Zone Depth
Head/ Downslope	13:30	Model 9	Main Park Road	1 ch/hr	8”	7”
Head	13:42	Model 9	Plot 1	unknown	12-24”	15-18”
Flanking	12:00	Model 2	Plot 1	.6 ch/hr	2”	2”
Flanking	13:36	Model 9	Plot 1	3 ch/hr	12”	24”
Backing	14:30	Model 1	Lateral powerline	2 ch/hr	4”	4”
Backing	16:50	Model 9	Lateral powerline	.3 ch/hr	6”	3”

Fuel Loading and Fuel Moisture Measurements

Three long-term fire monitoring plots are located within the Lithograph Canyon burn. Fuel loading at these plots is determined using standard Brown’s fuel transects. The average pre-burn fuel loading was 15.6 tons per acre in fuel model 2 with a post burn fuel loading of 5.3 tons per acre. This translates to a 66% reduction in fuel loading. Note that one model 2 plot burned in October of 1998 as well as burning in this most recent burn.

Preburn inventory of one fuel model 9 plot showed 27.6 tons per acre. Postburn analysis showed fuel loading of 10.6 tons per acre for a reduction of 62%.

Fuel moisture samples were taken adjacent to 2 long term monitoring plots before the burn on varying topographic aspects. All samples taken were weighed in the field, then dried at 60 degrees Celsius for 24 hours, reweighed, and percent fuel moisture calculated. Results showed live ponderosa between 90 and 106%, live grass 75-85%, ponderosa litter at 5-18%, 10 hour fuels 18-25%, and 1000 hour fuels between 21 and 29%.

Smoke Monitoring

Predominantly upslope and upcanyon wind was the primary factor for smoke dispersal during ignition. The most significant concern was visibility along Hwy 16 and the main park road. Park personnel provided traffic control as needed in the event of poor visibility and for the safety of fireline personnel. Smoke did not severely impact the roads and traffic proceeded normally.

Smoke on the fireline was generally light with few instances of visibility below 100 feet. Smoke settled in the canyon at night, but didn’t’ affect safety of personnel. Carbon monoxide detectors were issued to various personnel involved with the fire to monitor long term exposure to smoke. No personnel with detectors showed any significant exposure to carbon monoxide.

Fire Effects Observation

Three long-term fire monitoring plots within the Lithograph Canyon unit burned to some degree. These plots were analyzed the day following ignition to determine burn severity and will be read 1, 2, 5, and 10 years after the fire to determine the vegetative effects of this prescribed burn.

The Fire Monitoring Handbook has levels of fire severity that describe the intensity which material burned. Separate readings are taken for substrate (litter and soil) and vegetation (grass and needles) to determine severity. The average severity for the substrate ranged from scorched to lightly burned on 2 plots while the third plot, which had burned last year, was nearly unburned in this fire. The vegetation burn severity of plots was similar; scorched to lightly burned on 2 plots and nearly unburned on the third.

Overstory tree scorch and char measurement is another manner to assess severity immediately postburn. In the model 2 plot that burned, foliar scorch height averaged 1.5 meters and affected 7% of the tree. Charring of the bole of trees was minimal in model 2. In the model 9 plot, scorch height averaged nearly 9 meters and affected 33% of the foliage. Char height averaged nearly 3 meters.

Conclusions

Many criteria need to be assessed to determine the long-term effects of this burn. Some objectives are immediately measurable while others need to be viewed over the course of several years before results can be determined. The objective to burn 60-75% of the project area was met with fire blackening close to 80% of the unit. The change in tree density and canopy composition with respect to stated objectives will be assessed in upcoming years. With a long-term fire monitoring program in place, quantifiable assessment of specific objectives can be made. A summary of results is shown in table 4.

Table 4	
Objective	**Results**
1. Reduce total fuel loading by 40-80% immediately postburn.	Achieved a 62-66% reduction of fuels in 3 fire monitoring plots.
2. Reduce density of trees with a DBH larger than 6” (15cm) by 15-30% within 2 years.	Will be measured in 1 and 2 year post burn reads of FMH plots.
3. Reduce density of trees with a DBH smaller than 1” (2.5cm) by 40-70% within 2 years.	Will be measured in 1 and 2 year post burn reads of FMH plots.