Meadow Prescribed Fire
Devil's Tower National Monument
Fire Monitoring Report

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Introduction

The Meadow Prescribed Fire is located in the northwest corner of Devil's Tower National Monument in eastern Wyoming. Ignition of the approximately 70 acre burn unit of mixed grass prairie and ponderosa woodland occurred between the hours of 1030 and 1630 hours on 7 May 1999.

The goals of the Meadow prescribed fire are to increase native grass and forb cover, to reduce non-native perennial grasses, reduce of fuels beneath the coniferous overstory, reduce pine encroachment in meadow areas, and to restore the natural role of fire in the ecosystem. Specific objectives were to:

- Reduce herbaceous fuel loading in the native prairie by at least 30% immediate postburn
- Reduce dead and down (1, 10, 100-hr.) fuels under coniferous canopy 30-50% immediate postburn
- Decrease non-native herbaceous density and relative cover by at least 25% 1 year postburn
- Limit overstory tree (> 6" dbh) mortality to less than 20% 2 year postburn

Staff for the Meadow burn included Burn Boss Mike Beasley, Ignition Specialist Shaun Larson, Holding Boss Brad Reed, Prescribed Fire Monitor Kara Paintner and Prescribed Fire Monitor - Trainee Todd Suess. Fire Personnel in the ignition and holding assignments were National Park Service staff from Badlands, Devil's Tower, Wind Cave and the Black Hills Fire Use Module and Forest Service staff from the Custer and Newcastle districts of the Black Hills NF.

Summary of Events

Preparations for the burn included mowing areas of the perimeter, removal of heavy fuels near the line, and a hoselay on the northwest and east sides. Roads and trails also served as control line.

The Burn Boss conducted a briefing for personnel on the morning 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 by NPS personnel on the Meadow Fire began the day before ignition and every hour until ignition ceased after 1730 hours. Observations were communicated to all burn personnel. Maximum temperatures occurred about 1300 hours with the minimum relative humidity at 1500 hours.

Winds started the day from the northwest, trending southwest toward midday and becoming variable in mid afternoon. The strongest winds were recorded about 1230 hours at 5-8 mph with gusts of 10 mph. Weather conditions are summarized in Table 1. A graph of the relative humidities and dry bulb temperatures throughout the day is found in Figure 1.

Table 1 Weather Conditions

Condition	Prescription	Predicted	Observed
Temperature (F)	35-90	35-65	47-63
Relative Humidity	20-60%	21	22-43%
Wind Speed (mph)	2-12	5-10	1-10
Wind Direction	any	W	W, NW
1-hr Fuel Moisture	4-11%	NA	4-10%

Ignition Pattern

The burn was divided into five units; A, B, C, D and E (Figure 2). Ignition began on Units A and B at approximately 1030 hours in the center of the east line. The area was strip fired, see Figure 2 for the ignition patterns for the day. A/B ignition was completed around 1300 hours. Unit C ignition started at 1330 and was ring fired starting in the east corner. Ignition was completed at 1350 hours. Unit D ignition started at 1435 and was completed at 1630. Ignition started in the in the center of the west line and used strip firing.

Fire Behavior Observations

During the Meadow burn, fire activity was monitored in different fuel and vegetation types, on all aspects, and on varying slopes. Fire direction, rate of spread, flame zone depth and flame length were measured as the fire moved through the burn units. Monitoring took place throughout the day in order to assess changes in fire behavior.

The first fire behavior observations were taken in on the east line on the test burn. The ignition pattern utilized mostly backing and flanking fire, so there are very few head fire observations. Observations, locations, and fuel types are detailed in Table 2. They are within the fire behavior predictions made by Behave for the unit (See attached Fire Behavior Forecast).

Fuel Loading, Fuel and Soil Moisture Measurements

Fuel loading, fuel moisture and soil moisture samples were taken at the long term monitoring plots on 2 May 1999. Three samples of a known area were clipped to determine biomass or fine fuel loading at all plots. All samples taken were weighed and then dried at 60 degrees Celsius for 24 hours. The average fuel loading for grass plots was 1.09 tons/acre and varied from 0.12-2.35 tons/ acre. The average fine fuel load in ponderosa pine was 1.73 tons/acre and varied from 1.05-2.32 tons/acre. The one live fuel measured was ponderosa pine needles. Dead fuels included ponderosa pine litter, duff, and grass. Grass and litter fuel moistures were higher than the table calculated values. Grass samples included some live component. Three samples of each fuel type were taken weighed and then dried at 60 degrees Celsius for 24 hours. Three size classes of woody fuels were sampled. Hundred and thousand -hour time lag fuels were sampled from pine logs (at least 2 m in length) from these two paired samples were taken. All numbers found in Chart 3 are averages. Three soil moisture samples from the top 5 cm at each plot and dried with fuel and biomass samples.

Table 2 Fire Behavior Observations

FIRE TYPE	FUEL MODEL	LOCATION/ TIME	RATE OF SPREAD (CH/HR)	FLAME LENGTH	FLAME ZONE DEPTH	COMMENTS
Head	1	Unit AB / 1200	60	2-4’		Pine Regeneration
	1	Plot in A / 1300	9	1-1.5’	6’	GPOPR1D01-01
	2	Unit D / 1435	12	3-9”	3”	
	2	Unit D / 1445	7.5	4-12”	3-9”	
	2	Unit D / 1600	20	1-2’	3’	
Flanking	2	Unit AB / 1045	2	1-2’	2’	
	1	Plot in A / 1305	1.2	2-6”	4-6”	GPOPR1D01-01
	1	Plot in B / 1310	1.2	3-12”	3-6”	GPOPR1D01-02
	1	Plot in B / 1312	0.8	2-6”	1-3”	GPOPR1D01-02
	1	Plot in B / 1315	4	3-6”	1-3”	GPOPR1D01-02
	2	Plot in D / 1550	2.2	3-12”	3-9”	FPIPO1D01-05
	2	Plot in D / 1550	1.2	6-18”	3’	FPIPO1D02-05
Backing	2	Unit AB / 1030	4	8-12”	6”	Test burn
	2	Unit AB / 1100	0.25	2-6”	2”	
	1	Unit AB / 1130	1	6-18”	3-12”	
	1	Unit AB / 1200	1	3-6”	2”	
	1	Unit AB / 1230	2	2-6”	2-3”	
	1	Plot in B / 1315	2	3-6”	2-4”	GPOPR1D01-02
	2	Plot in D / 1450	2.2	3-6”	1-3”	FPIPO1D02-05
	2	Plot in D / 1455	6	3-9”	2’	FPIPO1D02-05
	2	Plot in D / 1510	1.2	2-6”	2-8”	FPIPO1D02-05
	1	Unit D / 1630	0.5	1-6”	1-3”	

Table 3 Fuel moistures

Sample Type	Fuel Moisture (%)
Live Ponderosa pine needles	86.8
Ponderosa pine litter	17.0
Ponderosa pine duff	81.3
Grass	43.1
Thatch	7.9
10 hour fuels	13.2
100 hour fuels	92.3
1000 hour fuels	55.9
Soil – grass plots	34.3
Soil – forest plot	26.3

Smoke Monitoring

Winds started the day from the north and switched to the west and back to north throughout the day. Low wind speeds made visibility on the line poor at times. The smoke column after reaching the transport winds did rise due to unstable atmospheric conditions and fair transport winds. No residual smoke was reported in Hulett or Sundance overnight.

Fire Effects Observation

Four long-term fire monitoring plots are located within the Meadow unit. Two Kentucky bluegrass plots were burned during the ignition of Units A and B. One ponderosa pine plot was burned in Unit D. These plots were read immediately postburn to determine burn severity and will be read 1, 2, 5, 10, 15 and 20 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 to determine severity. In the grass plots, the average severity for substrate was scorched. This indicates that surface fuels were partially blackened but not consumed. The wet soils and live component in the fine fuels did not lend to consumption of much litter. The vegetation severity was lightly burned. . This level indicates that the fire consumed most of the grass but that the basal growing stems were unburned. The forest plot had scorched substrate and lightly burned vegetation.

Fuel loading was measured on 4 different transects on the forest plot and re-read in the same place post-burn. The pre-burn value was approximately 24.5 tons per acre while the immediate post-burn showed 13.7 tons per acre remained, indicating a decrease of 44% of available dead fuel. Dead and down woody fuels were measured a 1.9 tons per acres pre-burn and 1.9 tons per acre immediate post burn, showing no change. Litter and duff measured 22.7 tons per acre pre burn and 11.8 tons per acre post burn, showing a 48% reduction.

Conclusions

Since it is the long term health of the ecosystem that is the focus of the prescribed burning program, many criteria need to be assessed. Some objectives are immediately measurable while others need to be viewed over the course of several years before results can be determined. The burn plan objective to reduce herbaceous fuel loading in the native prairie by at least 30% immediate postburn was not met. It was unrealistic to expect much litter consumption with the high fuel and soil moistures found in the grassy areas of the burn unit. The objective to reduce dead and down (1, 10, 100-hr.) fuels under coniferous canopy 30-50% immediate postburn is harder to assess. Total dead fuel load and litter and duff were reduced. Woody fuels (1,10,100 and 1000 hour) were not reduced, the downed woody fuel load was unchanged from preburn values. With a long-term fire monitoring program in place, quantifiable assessment of prescribed fire goals can be made

Attachments

Figure 1 – Temperature, and Relative humidity
Figure 2 – Meadow RX Ignition map
Fire Behavior Forecast