# BADLANDS NATIONAL PARK
# Big Buffalo Prescribed Fire
# Monitoring Report

**September 15, 1999**

**Prepared by Andy Thorstenson**
**Northern Great Plains Fire Monitoring Team**

## Introduction

The Big Buffalo burn unit is located in the northeast portion of Badlands National Park bounded by the Badlands Loop Road (Highway 240), the north boundary of the Park, Bigfoot Road, and the Old Northeast Road. The unit consists of approximately 4800 acres of mixed grass prairie and badlands formations. Blackline ignition occurred over the course of five days between August 19 and August 25, 1999. The entire unit was ignited on September 9, 1999 between 1030 and 1630. The primary goals for the burn were to increase the vegetative age class diversity in the park and to increase the vigor of the native species through and infusion of nutrients following the burn. The specific objectives contained in the burn plan were to:

- reduce exotic grass species by 10-30%
- increase the native perennial grass cover by 10-30%
- reduce blackthorn locust and Russian olive trees and shrubs by 20-40%
- burn 60 to 75% of the project area.

The status of burn objectives can be found in the Conclusions section Table 3.

Staff for the Horse Pasture burn included Burn Boss Bill Gabbert, Ignition Specialist Mike Beasley, Ignition trainee Guy 'Gonzo' Keene, Division Supervisors Ron Twiss and Denny Ziemann. Monitors included Andy Thorstenson, Kara Paintner, Kelly Mathis, and Sandee Dingman. The Black Hills helicopter and helitack crew conducted the aerial ignition. Fire Personnel in other ignition and holding assignments were from Badlands, Theodore Roosevelt, and Wind Cave National Parks, Black Hills National Forest, BIA handcrew from Pine Ridge, Mount Rushmore National Memorial, Buffalo Gap National Grasslands, and the Northern Great Plains Fire Monitoring Team.

## Summary of Events

Badlands Maintenance and Resource Management staff did the on-site preparation for the burn that included a mow line along the north boundary of the burn and staging two portable water tanks. Permission was obtained from several neighboring landowners to access the steep, badlands area on the north boundary of the Park. Blackline burning occurred along the east, north, and west perimeters creating a 75 foot wide burned strip to contain the main fire. A total of approximately 9 miles of blackline was constructed in five days.

Burn overhead 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 occurred on every day of ignition on the Big Buffalo burn. During blacklining operations maximum temperatures reached the low 90's in the mid- to late afternoon. Relative humidities were generally in the 30's and 40's during blackline ignition. Wind direction determined the area to be blacklined and the strategy for burning. Generally wind direction remained relatively stable throughout each day, but different wind directions were observed on different days. On September 9 when the main unit was ignited, most burning occurred with temperatures in the upper 60's and low 70's with relative humidity in the 30's and 40's. Winds were generally from the west and northwest throughout the course of helicopter and line ignition. See Table 1 for a summary. For an excellent summary of the weather conditions please see the Rapid City Fire Weather Office webpage for a meteorologist's perspective on the burn at:
**http://www.crh.noaa.gov/unr/firewx/CaseStudies/090999/index.htm**

**Table 1 Weather Conditions**

| Condition | Prescription | Aug 19 | Aug 20 | Aug 23 | Aug 24 | Aug 25 | Sept 9 |
|---|---|---|---|---|---|---|---|
| **Temperature (F)** | 35-90 | 83-94 | 75-88 | 77-85 | 65-93 | 74-92 | 61-73 |
| **Relative Humidity** | 20-60% | 37-46% | 42-56% | 25-32% | 26-45% | 38-59% | 34-56% |
| **Wind Speed (mph)** | 2-10mph | 5-12 G-15 | 0-7 G-11 | 5-10 G-20 | 2-8 G-11 | 3-8 G-9 | 3-10 G-15 |
| **Wind Direction** | Any | SE | Variable | NW | S, SE | SE,SW | W,NW |

## Ignition Pattern

Blackline ignition on August 19 began along the Old Northeast Road at the Park boundary. Due to unfavorable winds ignition moved to the west side in the afternoon and proceeded along Bigfoot Road and the northwest boundary. Ignition on the following four days focused on securing the north perimeter. Three engines supported the blacklining operation. One led the perimeter, another followed in support, and a third engine, 75 feet off the line, secured the interior side of the blackline.

On September 9, hand ignition began at 1030 a.m. in the southeast corner of the unit along the Medicine Root Trail progressing west. Another team of igniters began at the same point working north along the Old Northeast Road. This ignition progressed and secured the east end of the burn. The helicopter then began igniting strip head fire, flying in a north-south line. This ignition pattern continued with hand ignition along the north and south lines with the helicopter igniting the center of the unit.

A map of the blackline and fire progression is found as Attachment 1.

Fire Behavior Observations

During the Big Buffalo burn, observations were taken to determine fire behavior in different fuels throughout the course of ignition. Most behavior observations were associated with the perimeter ignition because safety concerns prohibited the monitoring of interior aerial ignition. As a result some of the head fire observations in the following table may understate the activity in the center of the burn where a larger scale flaming front developed more heat, higher rates of spread, and greater intensity.

Observations showed that residence times were greater for flanking and backing fires than for head fires. Consumption of dead and down materials appeared to be greater in areas of backing and flanking fires as a result of this longer residence time.

Burning conditions varied across the burn unit based on fuel type, litter and thatch density, and elevation. Most of the upland, grassy areas burned well because of vigorous growth based on wetter than usual conditions this year as well as accumulations of decadent material underneath. Low-lying areas burned only marginally because of high live fuel moistures and pockets of standing water, resulting in a mosaic of burned and unburned areas.

**Table 2 Fire Behavior**

| Fire Type | Time | Fuel Type ** | Location | Rate of Spread | Flame Length | Flame Zone Depth |
|---|---|---|---|---|---|---|
| Head | 1104 | agsm | GAGSM-6 2B | 45 ch/hr | 4-5’ | 7-8’ |
| Head | 1242 | stco/brja | mesa top | 40 ch/hr | 3-5’ | 4’ |
| Head | 1515 | agsm/meof /ansc | GAGSM1-5 | 23 ch/hr | 4-6’ | 8-12’ |
| Flanking | 1100 | agsm | GAGSM-6 1A | 15 ch/hr | 3-5’ | 3’ |
| Flanking | 1536 | agsm | GAGSM1-5 | 6 ch/hr | 1.5-2.5’ | 12-15” |
| Flank/Back | 1110 | agsm | GAGSM-6 2A | 2.7 ch/hr | 6-9” | 3-6” |
| Backing | 1200 | ansc/calo | Medicine Root | 2 ch/hr | 2-2.5’ | 12-18” |
| Backing | 1520 | agsm | GAGSM1-5 | 1.5 ch/hr | 6-8” | 3-5” |

** Fuel type abbreviations based on the four letter genus species code

| | | |
|---|---|---|
| agsm | western wheatgrass | Agropyron smithii |
| calo | prairie sandreed | Calomovilfa longifolia |
| stco | needle and thread grass | Stipa comata |
| brja | Japanese brome | Bromus japonicus |
| meof | yellow sweet clover | Melilotus officianalis |
| ansc | little bluestem | Andropogon scoparius |

## Fuel Loading and Fuel Moisture Measurements

Fuel loading samples were taken adjacent to the long term monitoring plots before the burn. Five samples per plot were taken to determine biomass or fuel loading at all plots. All samples taken were weighed and then dried at 60 Celsius for 24 hours. The average pre-burn fuel loading was 4.8 tons/acre and varied from 3.9 to 5.5 tons/acre. Fuel loading was high due to a very wet growing season and a thick thatch layer. Fuel loading post burn showed 0.7 tons/acre or an average reduction in biomass of 85%.

## Smoke Monitoring

During blackline operations, smoke production was minimal due to the quick consumption of fuels under favorable burning conditions. Smoke drifted across the line immediately following ignition then subsided causing few problems for holding forces. Visibility rarely decreased below 100 feet allowing holding forces to stay out of areas impacted by smoke.

Predominantly west and northwest wind was the determining factor for smoke dispersal on the September 9 ignition. The most significant concern was visibility on the Badlands Loop Road which is the main visitor access road through Badlands. A park ranger patrolled the road near the ignition team to act as traffic control in the event of poor visibility. At several points during ignition along the highway, visibility was reduced and slowed vehicle traffic. Visibility below 100 feet stopped traffic on at least two occasions. When winds changed or smoke subsided, traffic resumed moving at reduced rates of speed.

The spot weather forecast for the day of ignition predicted fair smoke dispersal with northwest transport winds. The main smoke column consistently rose above the burn unit and dispersed toward the southeast. At the end of ignition, the smoke column reached a height of 7000 feet and was visible drifting several miles downwind of the fire.

## Fire Effects Observation

Six long-term fire monitoring plots within the Big Buffalo unit burned. 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 to determine severity. The average severity for the substrate showed litter and duff were lightly burned. The residence time of the fire allowed for partial consumption of the thatch layer leaving mostly black ash and charred dead stems. The vegetation burn severity of plots showed the vegetation being moderately consumed. High fuel loading due to a heavy thatch layer caused the fire to burn intensely. The living vegetation was mostly consumed, leaving stems of shrubs and low stubs of grass.

## 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 reduction of exotic grass species and increase in native grasses will not be assessed until new growth occurs next spring and in successive years. The goal to reduce blackthorn honey locust and Russian olive trees and shrubs is not valid, as there are none of these species present in the burn unit. With a long-term fire monitoring program in place, quantifiable assessment of prescribed fire goals can be made. A summary of results is shown in Table 3.

**Table 3 Objectives**

| Objective | Results |
|---|---|
| 1. Reduce exotic grass species by 10-30% | Will be measured in 1,2,5,10 yr post rereads of FMH Plots |
| 2. Increase the native perennial grass cover by 10-30% | Will be measured in 1,2,5,10 yr post rereads of FMH Plots |
| 3. Burn 60 to 75% of the project area. | Achieved |
| 4. Reduce blackthorn honey locust and Russian olive trees and shrubs by 20-40% | Not applicable |

## Attachments

Big Buffalo Ignition and fire growth map
Relative humidity and temperature graph