Wind Cave National Park
American Elk Prescribed Fire
October 20-22, 2010
Prepared by Dan Swanson

Burn Unit Summary
The American Elk prescribed fire was completed October 20 - 22, 2010. At 3,450 acres, it was the largest prescribed fire in the history of Wind Cave National Park. The unit was located primarily within forested communities of the park but also included mixed-grass prairie, prairie dog towns, and ponderosa pine encroached meadows. The first day of the fire consisted of two ignition teams blacklining approximately 12 miles of unit perimeter. Day two involved blacklining the final half-mile of the unit perimeter and interior helicopter ignition. The primary objective for the fire was to restore fire back into the project area where fire has been excluded since the Park's creation.

Group tree torching during aerial ignition phase on the second day of burning.

Objectives
- Achieve 70% - 95% mortality in ponderosa pine seedlings.
- Achieve 50% - 70% mortality in pole size ponderosa pine (1-6" dbh).
- Achieve 20% - 50% mortality in ponderosa pine greater than 6" dbh.
- Achieve > 40% reduction in 100 & 1000 hr fuel loading.
- Decrease encroachment of ponderosa pine regeneration at the forest-prairie ecotone.

Surface fire moving upslope through seedlings & dead and down fuels

Personnel
Burn Boss: Alan Farnsworth, Jason Devcich (trainee)
Task Force Division Lead #1: Sonya Feaster
Task Force Division Lead #2: B. Daunt, C. Bennett (trainee)
Task Force Division Lead #3: Rod Skalsky, M. Klick (trainee)
Fire Monitors: Dan Swanson, Daniel Beveridge
Safety Officer: T. Rohrer
Information Officer: Tom Farrell

8 Type 6 Engines
2 20-person Type II IA handcrew
3 UTV's
1 Water Tender

Weather conditions

The National Weather Service in Rapid City predicted that high pressure would bring sunny skies and very warm temperatures to the area Thursday (Oct. 20) through Saturday (Oct. 22) with winds out of the northwest on Oct. 20 and west on Oct. 21. The Spot forecast was quite accurate for temperatures all three days. Minimum relative humidity was actually quite a bit higher on Oct. 20 than forecasted but was accurately predicted for the second and third days of the burn. Winds on Oct. 20 were primarily from the ESE and SE which was about 180 degrees off the forecasted direction, which necessitated the ignition teams to move quickly along the eastern and southern fire perimeters to keep ahead of the main fire.

Weather Observations October 20, 2010

Time	Temp.	RH	Wind Speed	Wind Direction	Comments
0600	46	44	4 G7	NW	
1030	61	32	1 G3	variable	
1100	64	35	5 G8	ESE	
1200	64	31	5-8 G10	SE	
1300	67	31	1-3 G5	SSE	Isolated torching
1400	64	35	1-3 G5	NE	Slight wind shift
1500	62	37	5-10 G12	ESE	Exposed site, increased winds
1600	63	34	2-5 G8	SE	Isolated torching
1700	60	39	1 G3	SE	Smoke settling, laying over w/lt wind
1800	56	44	2	NNW	

Wind speed in miles per hour, Temperature in degrees Fahrenheit

Weather Observations October 21, 2010

Time	Temp.	RH	Wind Speed	Wind Direction	Comments
0550	39	63	---	calm	
0900	54	47	---	calm	
1000	59	38	1-3 G4	E	Inv. Layer approx. 1200 ft
1100	62	37	---	calm	
1200	70	30	1-3 G4	SW	Smoke column pushed w/ sw wind
1300	71	28	1-3 G4	SW	Significant increase in column size
1400	72	23	3-5 G6	W	West winds as forecast
1500	73	21	3-5	W	
1600	72	23	3-5 G6	W	
1700	70	24	1-3	W	
1800	65	25	---	calm	

Wind speed in miles per hour, Temperature in degrees Fahrenheit

Fire Behavior

October 20

The test burn and fire ignition teams started from DP 7 due to the forecasted northwest winds. Prior to the test-burn at 1030 winds were light and variable from the east to southwest. The testburn was completed at 1100 and the winds quickly set-up from the east-southeast to southeast

for the next one to two hours. The head fire immediately pushed interior of the burn perimeter in the mixed grass prairie with rates of spread over 70 ch/hr and flame lengths between 3 and 8 feet. Backing rates of spread were observed between 0.5 to 4 ch/hr with flanking spread rates around 2-3 ch/hr. Isolated tree torching could be seen on some trees that were scattered throughout the prairie as well as in the forest-prairie ecotone. Backing and flanking rates of spread in the timber were low with heavy fuels consuming well. Ponderosa pine regeneration was knocked back substantially in most cases as the flame front pushed from the forest-prairie ecotone into the forest communities. Fire activity decreased after 1430 as the large smoke column shaded much of the burn unit.

October 21

An inversion developed overnight and persisted until approximately 1100. During this period fire activity was minimal with low rates of spread and continued consumption of the heavy fuels on the ground. After the inversion lifted around 1100, fire activity increased interior. The helicopter reconnaissance flight began at 1120 to look for interior acreage that hadn't been consumed yet. Following the flight, there was reported an approximate 1000 acres that hadn't been consumed by the fire. Aerial ignition began at 1220 and continued until 1320. Approximately 8000 psd balls were dropped within the interior portion of the unit during this time in a concentric circle pattern. The fire effects monitors, Dan Swanson and Daniel Beveridge, were located on a ridgeline approximately 0.36 miles northwest of the Pigtail bridge and had a great vantage for the aerial ignition operation. Consistent single and group tree torching was witnessed shortly after aerial ignition began through the burning period. A sustained crown fire run was noticed at 1405, 50-75 yards in length lasting approximately one minute along the main ridge east of highway 87 between drop points one and sixteen. Dan Swanson hiked down from the ridgeline northwest of the Pigtail bridge and observed fire behavior from the two ignition teams near the Centennial trailhead on Highway 87 at 1420. A headfire moved through grass fuel and needlecast with a rate of spread at 40 ch/hr and flame lengths between 6 and 12 inches. At 1425 both ignition teams tied in near the Centennial trailhead off of Highway 87.

Fire Behavior Observations October 20, 2010

Time	Location	Fire Type	ROS	FL	Comments
1120	Just N of DP7	H	15-20	5-7'	Grass meadow, var.winds
1131	Just N of DP7	B	1	6" – 2'	Grass meadow, var.winds
1200	DP6	H	72	3–8'	Prairie around dog town
1210	300 yds N of DP6	B	4	6-12"	
1240	N of DP6	H	54	5-8'	Isolated group torching
1335	NW of DP5	B	1	6-12"	Heavy fuels consuming well, thorough burning well behind flame front
1350	0.3 mile south of DP4	F	2-3	6-12"	
1430	300 yds N of DP5	F	0.5-1	6-12"	Mature PIPO w/ very dense regeneration around
1520	300 yds N of DP4	F	2	4-10"	Minimal wind
1530	Midpoint b/w DP3 & DP4	B	0.5	4-6"	
1550	0.4 mile E of				Isolated torching in pole trees,

	DP3				moderate torching of seedlings

B=backing fire; F=flanking fire; H=head fire

ROS = rate of spread measured in chains per hour (1 chain = 66 feet or ≈ 20 meters)

Fire Behavior Observations October 21, 2010

Time	Location	Fire Type	ROS	FL	Comments
0900-1000	DP2/Rankin Ridge L.O.				Smoldering fire interior of perimeter due to inversion
1100					Inversion lifts
1135	Ridgeline 0.36 mi. NW Pigtail bridge	T			Isolated tree torching ENE of lookout within unit. Fire activity increasing over the past 30 min.
1220	Ridgeline 0.36 mi. NW Pigtail bridge				Aerial ignition commences within interior portion of unit.
1230	Ridgeline 0.36 mi. NW Pigtail bridge	T			Consistent single and group tree torching observed shortly after aerial ignition starts through 1430
1405	Ridgeline 0.36 mi. NW Pigtail bridge	T			Sustained crown run 50-75 yds in length lasting 1 min. along main ridge just E of Hwy 87 between DP1 & DP16
1415	Centennial TH - Hwy 87	H	4	6-12”	
1420	Centennial TH - Hwy 87	H	40	6-12”	

B=backing fire; F=flanking fire; H=head fire; T=torching

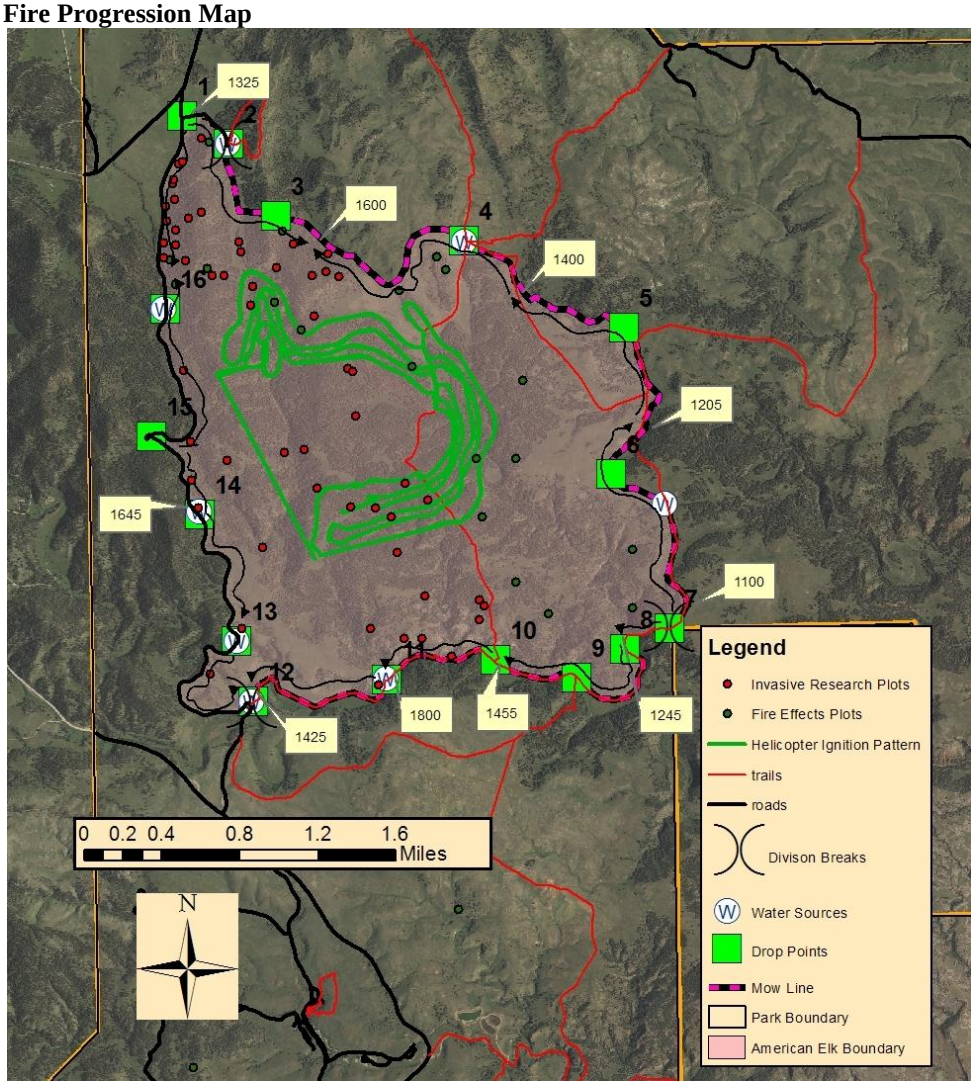
ROS = rate of spread measured in chains per hour (1 chain = 66 feet or ≈ 20 meters)

Fire Progression

With west winds forecasted, the test burn was initiated at DP 7 at 1100 on October 20. Winds were light and variable during the testburn. Shortly after the burn was determined a “go”, ignition team 3 blacklined north along the burn perimeter towards DP 6. Ignition team 2 blacklined along the southern perimeter towards DP 8. Winds were primarily from the ESE and SE most of the late morning and afternoon which required ignition teams 2 & 3 to blackline quickly to stay ahead of the main fire. At 1205 ignition team 3 had progressed just north of DP 6. Ignition team 2 reached DP 8 at 1245. Sonya Feaster and ignitors from team 1 began blacking east from DP 1 towards DP 2 at 1325. Favorable winds allowed ignition team 3 to reach within 0.25 miles southeast of DP 4 by 1400. Ignition team 2 reached DP 10 at 1455. The north fire perimeter was tied in with ignition teams 1 and 3 about 0.1 miles east of DP 3 at 1600. Ignition team 1 blacklined south along Hwy 87 and finished up near DP 13 at the end of the burning period on October 20 while ignition team 2 blacklined to DP 11. The fire continued burning interior from the burn perimeter during the evening hours and overnight. By the morning of October 21, the fire had consumed about 2400 of the 3450 acres. Fire activity was minimal with primarily smoldering fire behavior through late morning. Aerial helicopter ignition targeted this interior 1000 unburned acres and began at 1220 and continued through

1320. Fire activity dramatically increased over this hour with single and group tree torching witnessed throughout this portion of the unit for the remainder of the burning period. Ignition team 1 continued south blacklining from DP 13 along Hwy 87 while ignition team 3 worked their way west from DP 11. The unit was tied in at Hwy 387 near the Centennial trailhead at 1420.

Fire Progression Map



Smoke Monitoring

October 20

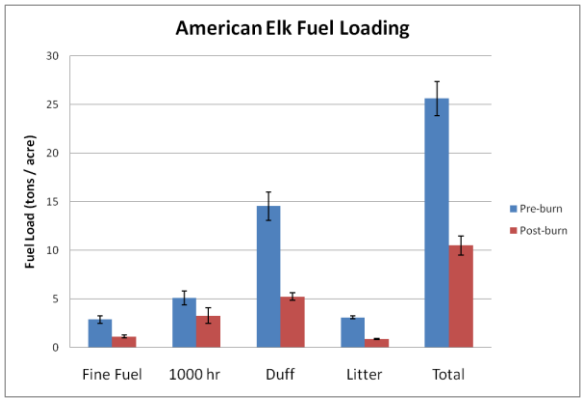
The National Weather Service forecast predicted "good" smoke dispersal during the day, with mixing heights between 4900 and 5900 feet above ground level (AGL). With winds primarily from the ESE and SE during the late morning and afternoon the smoke column was pushed to the northwest and west northwest. Smoke column heights were around 500-600 feet AGL with good vertical development at 1140. By 1250 the smoke column had reach about 2500 feet AGL. Between 1400 and 1435 the smoke column had reached 7000 feet AGL and the column was pushed to the WNW. By late afternoon, 1705, with the sun's energy waning the smoke column had lowered to 3000 feet AGL. The column was pushed to the west although the transport winds pushed the smoke to the ESE. Overnight smoke dispersal fell to "poor" as predicted by the NWS.

October 21

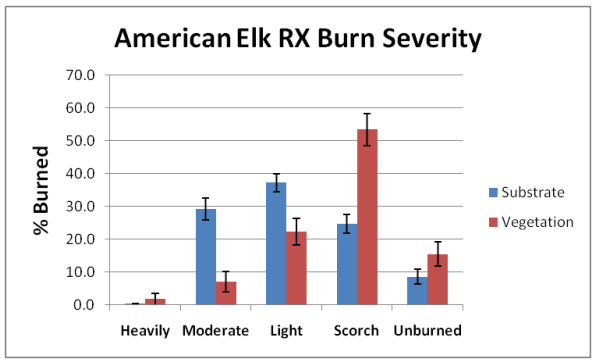
The National Weather Service forecast predicted "fair" smoke dispersal during the day, with mixing heights between 3800 and 4800 feet above ground level (AGL). An inversion enveloped the burn unit until approximately 1100. At 1000 the smoke column was 1200 feet AGL and moving to the east. After the inversion lifted, the smoke column rose to 2000 feet AGL at 1145, with the column moving to the NNE. The smoke column dramatically increased after the helicopter ignition commenced at 1220. The smoke column reached its maximum extent at 12000 feet AGL at 1330. There is a substantial dark component to the column now. By 1505 the smoke column height was between 4000 and 5000 feet, mostly light and white/gray, and was flattening and dispersing to the east. At 1725 the column lowered further to less than 3000 feet, leaning heavily to the east. Smoke in shaded areas was settling to the ground.

Fire Effects Monitoring

In November and early December post-burn data from over seventy five plots was collected. Analyses indicated that 100 hr and 1000 hr fuels were reduced by 61% and 36% respectively. Total fuel load was also reduced by 59%.



Severity measurements on these plots indicated the substrate burn severity was primarily light to moderate indicating that the litter was partially to entirely consumed and duff partially to deeply charred. Vegetation severity was predominantly scorched to light indicating the foliage and smaller twigs were scorched to being partially/completely consumed.



Conclusions

Most of this unit hadn't been burned previously which resulted in dense, closed canopy stands consisting of unusually high numbers of small diameter trees. Therefore, the crown fire potential had dramatically increased and the forest was subject to a high severity stand-replacing fire. The large size of this unit allowed the prescribed fire to burn over multiple burn periods and

weather conditions which replicates natural fire activity. The use of a helicopter allowed us to achieve variable fire severities across the landscape due to varied ignition patterns and provided fire fighter safety by eliminating the need for interior hand ignition. This summer our fire effects monitoring crew and invasive species research crew will be revisiting these same plots to look at mortality rates in the seedling, pole, and overstory size classes to see if our objectives were met. In addition, the invasive species research crew will collect year one data on changes to the frequency and abundance of the target invasive species within the burn unit.

Smoke column about 1 hour after aerial ignition commences.