National Park Service
Fire Ecology Annual Report
Calendar Year 2012

A. Summary

2012 was a productive year for the Northern Great Plains (NGP) fire ecology program. A total of 204 plots of various types were measured in nine park units, which included 54 installs in five park units. Four prescribed fires occurred in the NGP parks, resulting in 15 plots being burned, 7 of which were measured immediately post-burn. Severe to exceptional drought enveloped all of the Northern Great Plains parks this summer, which led to burn ban restrictions in most of the park units. Therefore, no prescribed burns were conducted through the Fall burning months of September and October.

This was the third year of a three year research project at Wind Cave N.P., Jewel Cave N.M., and Devils Tower N.M. in which Dan Swanson partnered with Amy Symstad of the USGS assessing the relationship between prescribed fire burn severity and target invasive plant species abundance taking into account a variety of pre- and post-fire environmental characteristics at each park. This past season two seasonals collected year two post-burn data on 90 plots at Wind Cave N.P. and Jewel Cave N.M. Data analysis comparing preburn to year one post-burn effects indicate that most invasive plant species did not significantly increase in cover one growing season after the prescribed fire at Wind Cave N.P. and Jewel Cave. N.P.. Bull thistle and common mullein did significantly increase in absolute cover from preburn to year one, however it was less than 0.5% absolute change. More analysis and a final report will be completed this spring on the research.

This year we continued collaboration with the Northern Great Plains Inventory and Monitoring Network (NGPN). The NGP fire effects crew and NGPN installed and read ninety forest, tall shrub, and fuels plots at Wind Cave N.P. this summer which are spatially balanced throughout the park. In addition, we collaborated on reading sixty forest, tall shrub, and fuels plots at Mount Rushmore N.M. to assess the success of the 2010 hazardous fuel reduction project. To reduce the potential for crown fire, nearly all ponderosa pine trees less than 10 inches DBH were cut and chipped or piled in 43% of the Memorial in 2010. Forest structure data collected in sixty plots before and two years after thinning are being used to assess the treatment's effect on forest structure and to model the effectiveness of the thinning in reducing crown fire potential. Since both programs are using the same sampling design and monitoring protocols, we continued to coordinate plot sampling visits this year throughout our park network.

Table 1. Fire Effects Plot Workload (2012) and Total Plots Installed

Park	Monitoring Unit	Type of Plot (FMH, photo point, other)	Pre-burn 2012	Imm. Post 2012	Postburn (1-20 yrs) 2012	Annual Total (2012)	Total Plots
Agate Fossil Beds	Mixed grass prairie	Grassland Fuels Veg. Plot (GFV)			1	1	4
	Mixed grass prairie	I&M Veg Plot	6			6	6
Badlands	Mixed grass prairie	FMH Grass Plot			5	5	5
	Mixed grass prairie	GFV Plot			3	3	3
	Mixed grass prairie	I&M Veg Plot	13	7	19	39	34
	Shrubland	FMH Shrub Plot					
Devils Tower	Ponderosa forest	FMH Forest Plot			3	3	15
	Mixed grass prairie	FMH Grass Plot					
	Ponderosa forest	Forest, Fuels, and Veg. Plot (FFV)			2	2	2
	Ponderosa forest	Forest & Fuels Plot (F&F)					3
	Mixed grass prairie	I&M Veg Plot	6				9
Fort Union	Cottonwood forest	FMH Forest Plot					1
	Mixed grass prairie	FMH Grass Plot					2
Jewel Cave	Ponderosa forest	FFV Plot					3
	Ponderosa forest	F&F Plot					3
	Ponderosa forest	FMH Forest			3	3	3
	Ponderosa forest	I&M Forest & Fuels Plot		2		2	62
Knife River	Mixed grass prairie	GFV Plot			5	5	5
	Mixed grass prairie	FMH Grass Plot					
	Green ash forest	FMH Forest Plot					3
	Mixed grass prairie	I&M Veg Plot			6	6	8
Mount Rushmore	Ponderosa forest	I&M Forest & Fuels Plot			50	50	60
Scotts Bluff	Mixed grass prairie	FMH Grass Plot			3	3	6
	Mixed grass prairie	I&M Veg Plot					14
	Juniper Woodland	FMH Forest Plot			2	2	2
	Shrubland	FMH Shrub Plot					1
Theodore Roosevelt	Mixed grass prairie	FMH Grass Plot			3	3	9
	Mixed grass prairie	GFV Plot			2	2	2
	Mixed grass prairie	I&M Veg Plot	3			3	7
	Juniper Woodland	I&M Veg Plot					5
	Cottonwood Forest	FMH Forest Plot					2
	Shrubland	FMH Brush Plot					5
Wind Cave	Mixed grass prairie	FMH Grass Plot			1	2	14
	Ponderosa forest	FMH Forest Plot			1	1	5
	Ponderosa forest	FFV Plot					3
	Ponderosa forest	F&F Plot			11	11	11
	Ponderosa forest	I&M Forest, Veg, & Fuels					14
	Ponderosa forest	I&M Forest & Fuels Plot	29		8	37	90
	Mixed grass prairie	I&M Veg plot					5
	Ponderosa forest	CBI plot					48
Photo Points, various parks	Mixed grass prairie	Photo point			3	3	15
	Ponderosa forest	Photo point			7	7	6
	Juniper woodland	Photo point					7
Total			**54**	**9**	**141**	**204**	**502**

Table 2. Fire Ecology Staffing 2012

Ecologist and Monitors	Starting Date	Ending Date	# of Pay Periods	READ qualified	Training and Development
Dan Swanson	1/1/2012	12/31/2012	26	No	Black Hills Area Bot/Eco workshop, 3 fire operational periods
Phil Graeve	4/23/12	10/18/2012	13	No	Wilderness First Aid and botany training. Elk Butte, Sheepherder Hill, Dakota, Draw, JECA, and MORU Wildfires. FEMO, HECM, FALB, and ICT5. 33 fire operational periods.
Valena Hofman	5/7/2012	10/18/2012	12	No	Wilderness First Aid, botany training, 28-day assignment with BLHI WFM, worked on FALA, FFT1, 28 fire operational periods
Marcus Lund	5/7/2012	8/05/2012	6.5	No	L380, Wilderness First Aid, botany training
Ellery Watson	5/7/2012	10/18/2012	12	No	Wilderness First Aid, S-130/190, botany training, 14-day assignment with BLHI WFM, 14 fire operational periods
Dan Townsend	8/13/2012	9/20/2012	3	No	

Table 3. 2012 Management Objectives and Monitoring Results

All results shown are 80% confidence intervals of the mean. Fuel reduction objectives/results are mean percent reduction from pre-burn to immediate post-burn. Stand density objectives/results are for five-year post-burn mean stand density. An underlined number of plots indicates that the minimum sample size has been attained for that variable.

Park	Monitoring Unit	Management Objective	Monitoring Results (80% C.I.)	Objective Achieved	Year Last Analysis Completed (Range of data included in analysis)
Wind Cave N.P.	Native Mixed-grass Prairie	Increase the relative cover of native grasses by at least 10% within two growing seasons after the burn	5% Decrease	No; N=7	2008
		Increase the relative cover of native forbs by at least 30% within two growing seasons after the burn	No change	No; N=7	
		Decrease the relative cover of non-native grasses by at least 20% within two growing seasons after the burn.	23% Decrease	Yes; N=6	
	Non-native Grass Prairie	Increase the relative cover of native grasses by at least 20% within two growing seasons after the burn	59% Increase	Yes; N=5	2008
		Increase the relative cover of native forbs by at least 20% within two growing seasons after the burn	No change	No; N=5	
		Decrease the relative cover of non-native grasses by at least 30% within two growing seasons after the burn.	No change	No; N=5	
	Ponderosa Pine Forest	Increase the relative cover of native herbs by at least 25% within two growing seasons after the burn	17% Decrease	No; N=5	2008
		Decrease the relative cover of non-native herbs by at least 25% within two growing seasons after the burn	No change	No; N=5	
		Reduce the density of overstory ponderosa pine (≥ 14.9 cm dbh) by at least 30% two growing seasons after the burn.	6% Decrease	No; N=9	
		Reduce the density of pole-size ponderosa pine (2.5 – 14.8 cm dbh) by at least 50% two growing seasons after the burn.	No change	No; N=9	
		Reduce the density of seedling ponderosa pine by at least 70% one growing season after the burn	78% Decrease	Yes; N=9	
		Reduce total fuel loading by at least 30% following one prescribed burn	21% Decrease	No; N=9	
Devils Tower N.M.	Non-native Grass Prairie	Increase the relative cover of native grasses by at least 10% within two growing seasons after the burn	39% Increase	Yes; N=3	2008
		Increase the relative cover of native forbs by at least 20% within two growing seasons after the burn	74% Increase	Yes; N=3	
		Decrease the relative cover of non-native grasses by at least 20% within two growing seasons after the burn.	49% Decrease	Yes; N=3	
	Ponderosa Pine	Increase the relative cover of native grasses by at least 10% within two growing seasons after the burn	13% Increase	Yes; N=7	2008
		Increase the relative cover of native forbs by at least 10% within two growing seasons after the burn	36% Increase	Yes; N=6	
		Decrease the relative cover of non-native grasses by at least 30% within two growing seasons after the burn.	No change	No; N=7	
		Reduce total fuel loading by at least 30% following one prescribed burn	38% Decrease	Yes; N=7	
Badlands N.P.	Western wheatgrass Mixed-grass Prairie	Increase the relative cover of native grasses by at least 10% within two growing seasons after the burn	6% Decrease	No; N=20	2008
		Increase the relative cover of native forbs by at least 30% within two growing seasons after the burn	4% Increase	No; N=18	
		Decrease the relative cover of non-native grasses by at	No change	No; N=19	

		least 20% within two growing seasons after the burn.			
	Non-native grass Prairie	Increase the relative cover of native grasses by at least 10% within two growing seasons after the burn Increase the relative cover of native forbs by at least 10% within two growing seasons after the burn Decrease the relative cover of non-native grasses by at least 30% within two growing seasons after the burn.	30% Increase 37% Increase No change	Yes; N=4 Yes; N=4 No; N=4	2008
Theodore Roosevelt N.P.	Kentucky Bluegrass Non-native Prairie	Increase the relative cover of native grasses by at least 20% within two growing seasons after the burn Increase the relative cover of native forbs by at least 20% within two growing seasons after the burn Decrease the relative cover of non-native grasses by at least 30% within two growing seasons after the burn.	57% Increase No change 3% Decrease	Yes; N=3 No; N=3 No; N=3	2008
	Crested Wheatgrass Non-native Prairie	Increase the relative cover of native grasses by at least 20% within five growing seasons after the burn Decrease the relative cover of non-native grasses by at least 20% within five growing seasons after the burn.	No change No change	No; N=3 No; N=3	2008
	Native Mixed-grass Prairie	Increase the relative cover of native grasses by at least 20% within five growing seasons after the burn Decrease the relative cover of non-native herbs by at least 20% within two growing seasons after the burn.	8% Increase 8% Increase	No; N=3 No; N=3	2008
Agate Fossil Beds N.M	Native Mixed-grass Prairie	Increase the relative cover of native grasses by at least 20% within two growing seasons after the burn. Decrease the relative cover of non-native herbs by at least 20% within two growing seasons after the burn.	5% Increase (Yr 1) 31% Decrease (Yr1)	TBD TBD	2009

Wind Cave N.P.

The largest prescribed burn in the history of Wind Cave N.P. was completed October 20-21, 2010. The 3,450 acre American Elk 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 primary objective of the burn was to restore fire back into the project area since most of the unit hadn't experienced fire since the Park's creation in 1903. Additional resource objectives included reducing overstory, pole, and seedling densities. We also wanted to decrease the dead and down fuel loading within the forested communities and encroachment of ponderosa pine regeneration at the forest-prairie ecotone.

The first day of the burn consisted of two ignition teams blacklining approximately 12 miles of burn perimeter. Day two involved blacklining the final half-mile of burn perimeter and interior helicopter ignition. Approximately 39% of the unit was unburned to low, 29% low-low moderate, 26% moderate, and 6% high severity (Figure 1) based on the analysis of 48 composite burn index (CBI) plots that were read within the four burn severity classes during the summer of 2011. Plot data was used to validate the association between ground severity (CBI) and the remote sensing index, and then burn severity classes were calibrated to produce burn severity map.

This unit had seventy-five fire effects monitoring plots established in it which was the most for any unit and park within the Northern Great Plains park group. Fifty-seven of these plots were associated with a three-year invasive plant research project which was funded by research reserve funds. Since the research project's sampling design and plot layout were identical to most of the Northern Great Plains fire effects plots, I was able to analyze sixty of the fire effects plots together. All plots were read pre-burn between 2008 and 2010 and year 1 post-burn in 2011. Resource objectives included: 1) Achieve 20-50% mortality in overstory ponderosa pine (>6" dbh), 2.) Achieve 50-70% mortality in pole-size ponderosa pine (1-6" dbh), 3.) Achieve 70-95% mortality in ponderosa pine seedlings, 4.)Achieve > 40% reduction in 100 and 1000 hr fuel loading.

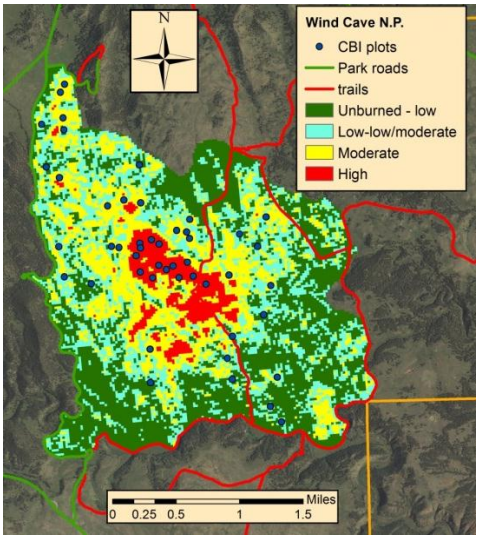

Figure 1. American Elk prescribed fire calibrated burn severity assessment map

Passive tree torching shortly after helicopter ignition commenced on October 21.

The paired fire effects data was analyzed for relative change using ratio of means (RoM) at an 80% confidence level. There was an average 29% mortality of overstory ponderosa pine trees with 80% confidence that it decreased between 23 and 37%. Pole-sized ponderosa pine decreased an average 64% with 80% confidence the mortality was between 55 and 72%. Ponderosa pine seedlings decreased an average 72% with 80% confidence the mortality was between 59 and 81%. 100 hr fuels decreased an average 61% with 80% confidence this fuel loading class decreased between 51 and 70%. 1000 hr fuels decreased by 36% with 80% confidence this fuel loading class decreased between 11 and 50%. Four of the five resource objectives were met and statistically significant with the fifth objective (1000 hr fuels) only slightly below target levels.

The several thousand acre unit allowed the prescribed fire to burn over multiple burn periods and weather conditions which replicates natural fire activity. The use of a helicopter provided for fire fighter safety by eliminating the need for interior hand ignition and enabled us to achieve a mosaic of burn severities across the landscape. Prescribed burns at Wind Cave N.P. are an integral tool for restoring these forests to their naturally diverse structure.

Badlands N.P.

The 1969 acre Interior prescribed burn was completed on September 11, 2010, in a vegetation type consisting of native perennial and non-native annual grasses. This was the first entry of fire into this unit. Seven plots were installed within the unit in June 2010 and post-burn monitoring indicated that the majority of the transect points had a moderate burn severity. Plots were monitored the first and second growing season following the prescribed fire. Primary objectives included increasing native grass and forb cover while decreasing non-native grass cover.

The paired fire effects data was analyzed for relative change from pre-burn to second growing season after prescribed fire using ratio of means (RoM) at an 80% confidence level. Badlands N.P. precipitation was 80% of normal from September 2011 through May 2012 (Table 4). This resulted in reduced vegetative cover values when the plots were read in June 2012. Extreme drought covered the park by late summer, and 2012 ended up with only had 68% of normal precipitation which ranked as the as the eighth driest since records began in 1956. There was an average 91% decrease in non-native forb cover with 80% confidence that it decreased between

83 and 96% (Figure 2). Native forb cover decreased by an average of 72% with 80% confidence level that it decreased between 52 and 82%. Non-native grass cover significantly decreased by an average of 96% and native grass cover was essentially unchanged.

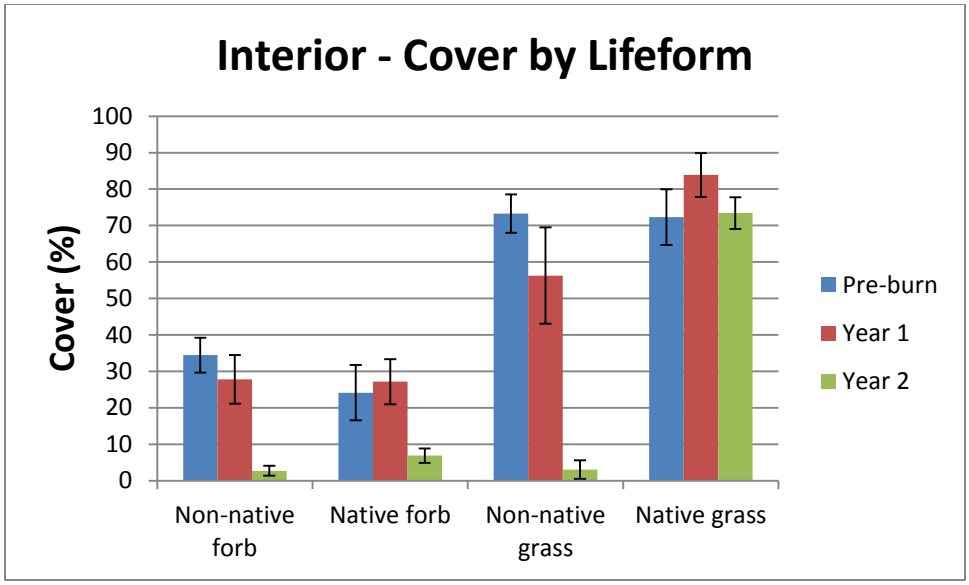

Figure 2 Changes in vegetative cover by lifeform for seven plots within the Interior unit after the first prescribed burn. Values represent means ± standard errors.

Figure 3 shows that the two most abundant non-native plants in the plots, Japanese brome and yellow sweetclover, significantly decreased two growing seasons after the fire. Japanese brome decreased in cover by an average of 97% while yellow sweetclover decreased by an average of 89%. Western wheatgrass also significantly decreased in cover with an 80% confidence that it was between 10 and 26%. Needleleaf sedge cover slightly increased while blue grama, threadleaf sedge, and Needle & Thread did not significantly change.

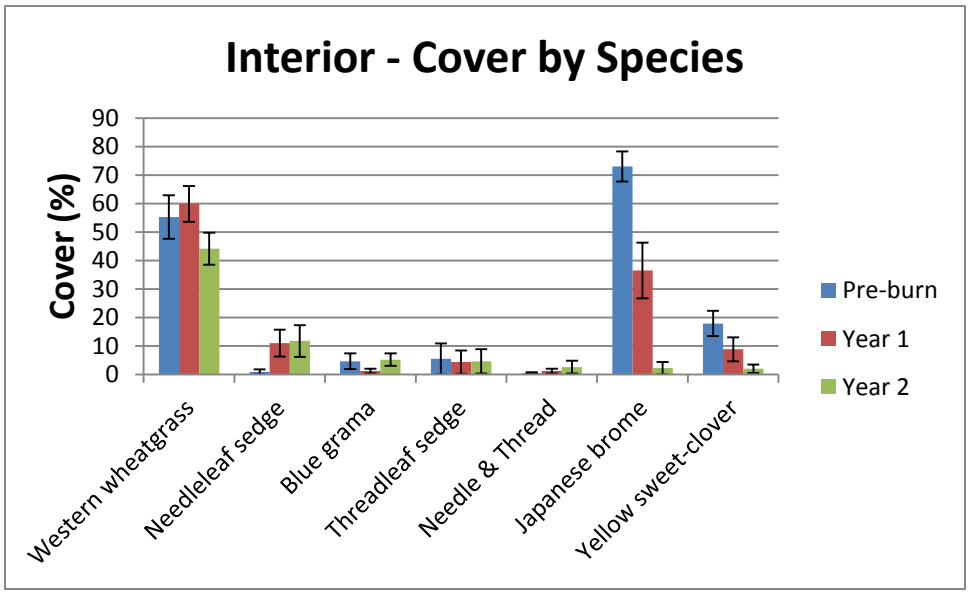

Figure 3 Changes in vegetative cover by species for seven plots within the Interior unit after the first prescribed burn. Values represent means ± standard errors.

Decreases in vegetative cover for native and non-native forbs and non-native grasses is likely partly attributed that the pre-burn plots read in June 2010 were in the midst of a wet cycle (2009-2011) and those read in June 2012 were at the beginning of a drought cycle. It is desirable to see that the most significant declines in cover were from Japanese brome and yellow sweet clover, and that the native grasses showed either only a minor decrease or no change in cover. Steven Whisenant's (1990) research indicates that Japanese brome populations are drastically reduced when prescribed burns are followed by below average precipitation. In the absence of fire, thicker litter accumulations create a more mesic environment for seeds and result in higher establishment rates for plants (Kirsch and Kruse 1973; Whisenant and Bulsiewicz 1986).

Table 4 2012 Precipitation Summary

Park	2012 PPT	30 yr avg (1981-2010)	% Normal	Rank (Driest)	Dataset Began	Sep '11 – May '12 PPT	30 yr avg (1981-2010)	% Normal
AGFO	4.46"	14.33"	31%	1st	1948	5.15"	8.26"	62%
SCBL	6.99"	15.80"	44%	1st	1893	4.59"	9.81"	47%
BADL	12.58"	18.38"	68%	8th	1956	8.93"	11.22"	80%
WICA	14.30"	19.88"	72%	14th	1952	10.31"	12.02"	86%
MORU	14.44"	21.19"	68%	5th	1962	10.16"	12.98"	78%
DETO	10.87"	17.68"	61%	3rd	1959	10.31"	10.86"	95%
THRO^	10.43"	15.75"	66%	3rd	1949	4.95"	8.60"	58%
KNRI*	14.09"	17.40"	81%	12th	1954	8.37"	9.70"	86%

^ Weather observations taken from Dickinson, ND station
* Weather observations taken from Underwood, ND station

The 2237 acre Castle prescribed burn was completed on September 9, 2011, in a vegetation type consisting of native perennial and non-native annual grasses. This was the first entry of fire into this unit. Seven plots were installed within the unit in June 2010 and post-burn monitoring indicated that the majority of the transect points had a light burn severity. Plots were monitored in 2012, the first growing season following the prescribed fire. Primary objectives included increasing native grass and forb cover while decreasing non-native grass cover.

The paired fire effects data was analyzed for relative change from pre-burn to second growing season after prescribed fire using ratio of means (RoM) at an 80% confidence level. There was an average 40% decrease in non-native forb cover with 80% confidence that it decreased between 16 and 56% (Figure 4). Native forb cover decreased by an average of 67% with 80% confidence level that it decreased between 56 and 74%. Non-native grass cover significantly decreased by an average of 98% and native grass cover decreased by an average of 26% with 80% confidence it was between 12 and 33%.

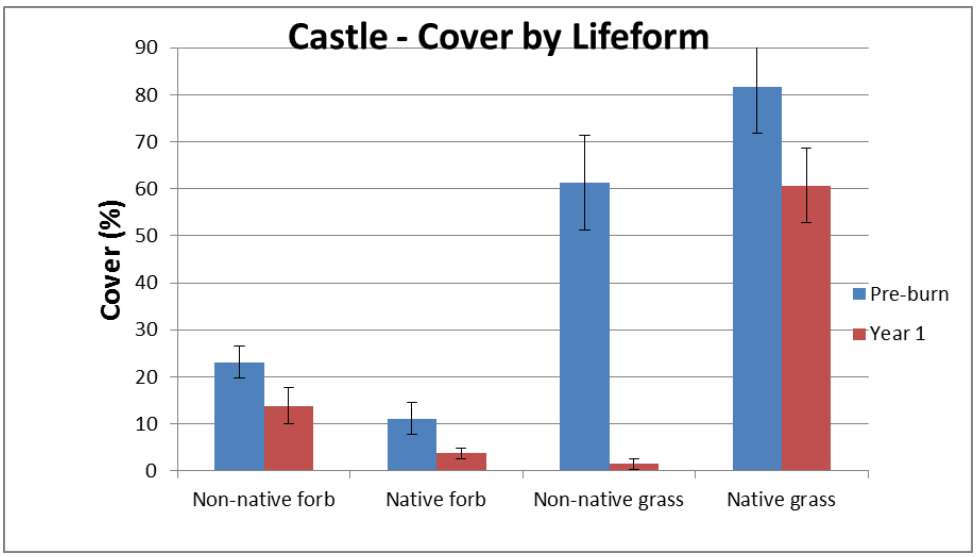

Figure 4 Changes in vegetative cover by lifeform for seven plots within the Castle unit after the first prescribed burn. Values represent means ± standard errors.

Figure 5 shows that western wheatgrass was the only species to significantly change in cover one growing season after the prescribed burn. Western wheatgrass decreased by an average of 32% with an 80% confidence level that the decrease was between 28 and 38%. If the drought continues or intensifies in 2013 it's likely that the vegetative cover values will decrease more this coming summer.

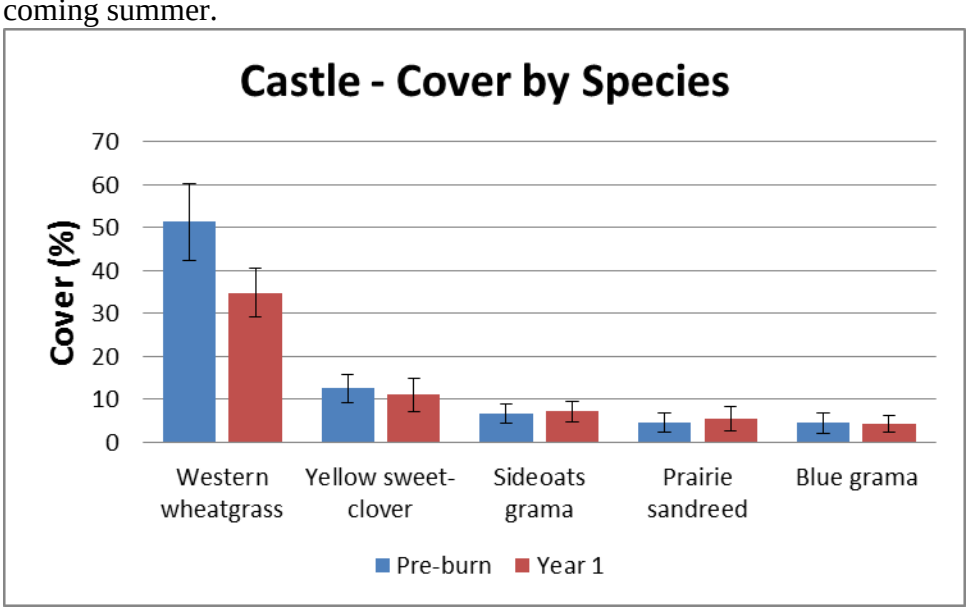

Figure 5 Changes in vegetative cover by species for seven plots within the Castle unit after the first prescribed burn. Values represent means ± standard errors.

The 580 acre Pinnacles prescribed burn was completed on April 24, 2012, in a vegetation type consisting of native and non-native perennial grasses and non-native annual grasses. This was the first entry of fire into this unit. Seven plots were installed within the unit in June 2010 and post-burn monitoring indicated that the majority of the transect points had a light burn severity. Plots were monitored in 2012, the first growing season following the prescribed fire. Primary

objectives included increasing native grass and forb cover while decreasing non-native grass cover.

The paired fire effects data was analyzed for relative change from pre-burn to first growing season after prescribed fire using ratio of means (RoM) at an 80% confidence level. There was only an average 1% non-native forb cover in 2010 (preburn) and there was no significant change in this cover post-burn (Figure 6). Native forb cover decreased by an average of 49% with 80% confidence level that it decreased between 37 and 59%. Non-native grass cover significantly decreased by an average of 62% with 80% confidence it was between 52 and 72%, and native grass cover decreased by an average of 26% with 80% confidence it was between 25 and 29%.

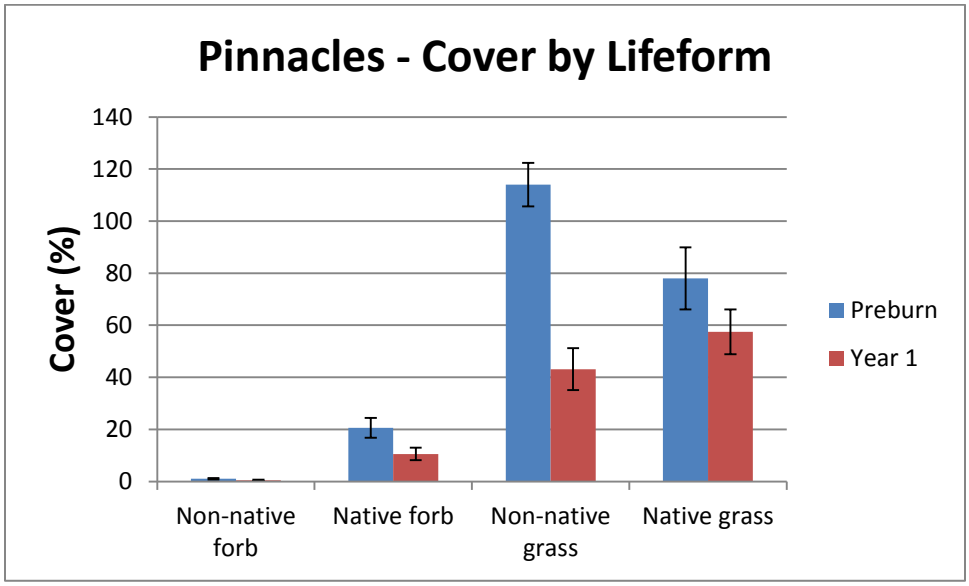

Figure 6 Changes in vegetative cover by lifeform for seven plots within the Pinnacles unit after the first prescribed burn. Values represent means ± standard errors.

Kentucky bluegrass and Japanese brome were the two most dominant grass species in 2010 with average cover values of 59% and 49% respectively. Kentucky bluegrass significantly decreased an average of 46% postburn with an 80% confidence it was between 41 and 52% (Figure 7). Japanese brome significantly decreased 100% after the burn. Western wheatgrass and threadleaf sedge, the most dominant native grass and sedge at preborn, both significantly decreased 27% and 50% respectively. Needleleaf sedge and smooth brome which had preburn cover values just under 5% did not significantly change in cover the first growing season after the burn.

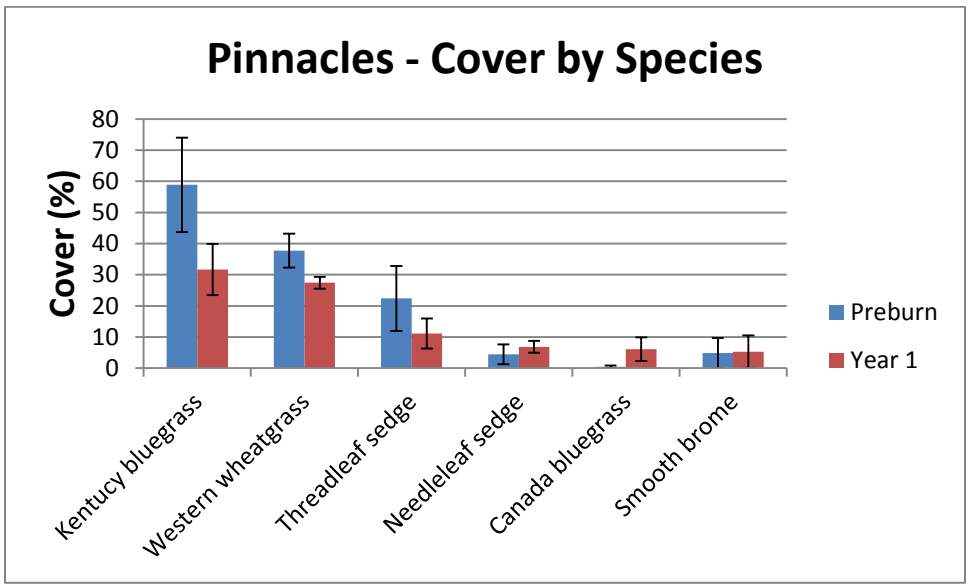

Figure 7 Changes in vegetative cover by species for seven plots within the Pinnacles unit after the first prescribed burn. Values represent means ± standard errors.

The 2000 acre Conata 2 and 1800 acre Conata 1 prescribed burns were completed on October 3 and 11, 2007, in a vegetation type consisting of native and non-native perennial grasses and non-native annual grasses. This was the first entry of fire into this unit. Five plots were installed within the units in June 2006. Plots were monitored immediate post-burn (2007), and 1st (2008), 2nd(2009), and 5th (2012) growing seasons following the prescribed fire. Primary objectives included increasing native grass cover, improving prairie dog habitat, and reducing 1-hr dead and down fuels.

The paired fire effects data was analyzed for relative change from pre-burn to fifth growing season after prescribed fire using ratio of means (RoM) at an 80% confidence level. There was no change in non-native forb cover between pre-burn and 5th growing season post-burn (Figure 8). Native forb cover significantly decreased by an average 55% with 80% confidence it was between 46 and 66%. There was no change in non-native grass and native grass cover between pre-burn and 5th growing season post-burn. However, most lifeforms showed significant declines in cover between the 2nd and 5th growing seasons that can be attributed to the 2012 drought. September 2008 through May 2009 precipitation was 13.04", 16% above the 30-year average (1981-2010) for this time period, while September 2011 through May 2012 precipitation was 8.93", only 80% of the 30-year average.

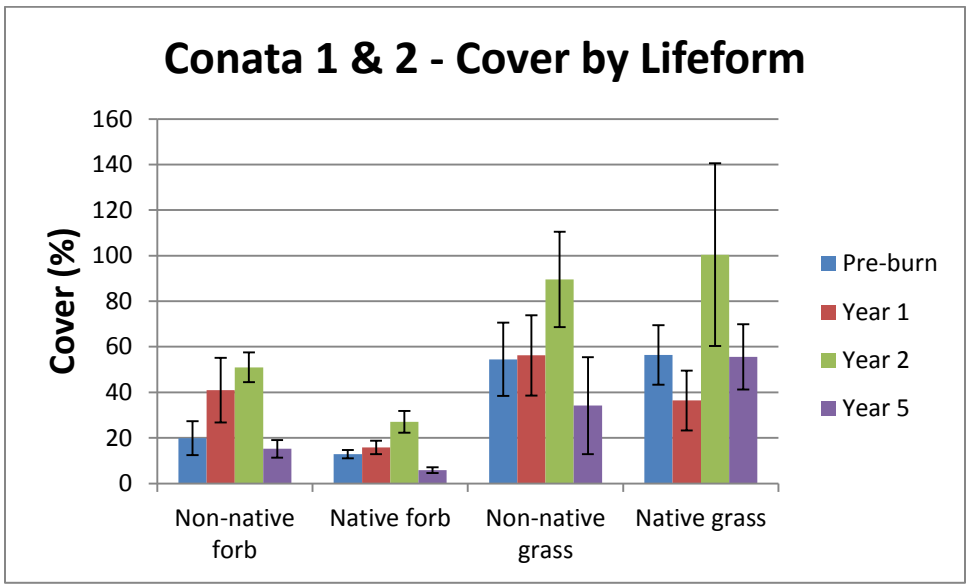

Figure 8 Changes in vegetative cover by lifeform for five plots within the Conata 1&2 units after the first prescribed burn. Values represent means ± standard errors.

Japanese brome and cheatgrass significantly decreased by 99 and 100% respectively from pre-burn to 5th season post-burn. All other species which comprised the largest component of the vegetative cover pre-burn did not significantly change when compared to 5th growing season post-burn (Figure 9).

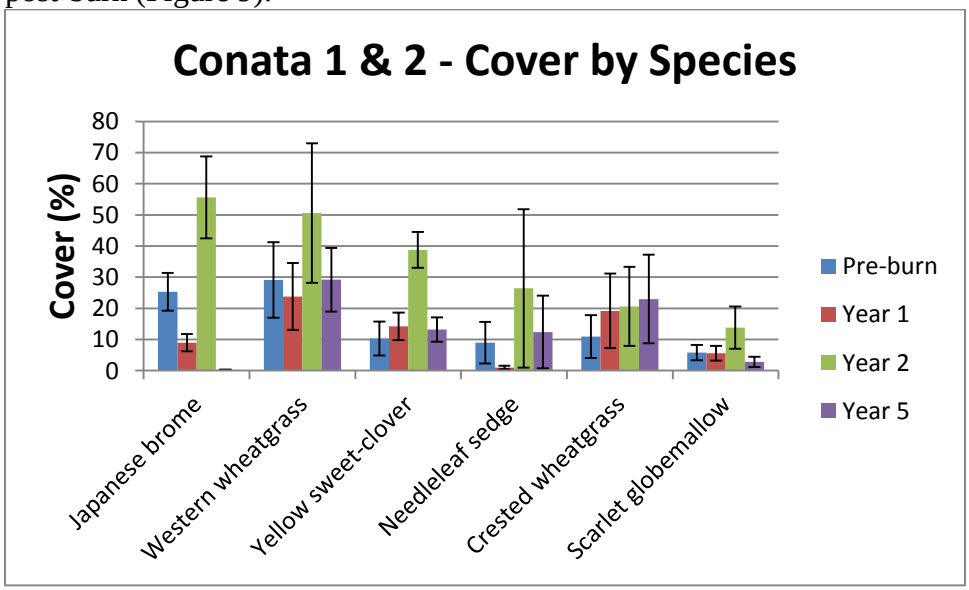

Figure 9 Changes in vegetative cover by species for five plots within the Conata 1&2 units after the first prescribed burn. Values represent means ± standard errors.

Mount Rushmore N.M.

Prompted by an ongoing mountain pine beetle outbreak in the central Black Hills, staff at Mount Rushmore requested assistance from the Midwest Regional Office in February 2010 to help prepare a plan to mitigate the impacts of a potential mountain pine beetle infestation. A plan was completed by a small group of specialists with input from memorial staff, the Black Hills National Forest, and other local stakeholders. 544 acres were either thin and piled or thin

and chipped in late summer and Fall of 2010. Project parameters included cutting trees with 6 inch dbh or less within the thin/pile area and 10 inch dbh or less within the thin/chip area. The NGP fire effects and I&M crews installed and read 60 forest structure and fuels plots within the park in 2010 prior to this project's implementation as well as reread the same plots in the summer of 2012 to assess the success of the project. Ponderosa pine density in the 1 to 4" and 4 to 7" dbh class decreased by an average of 97% and 86% respectively in the thin and pile treatment unit (Figure 10).

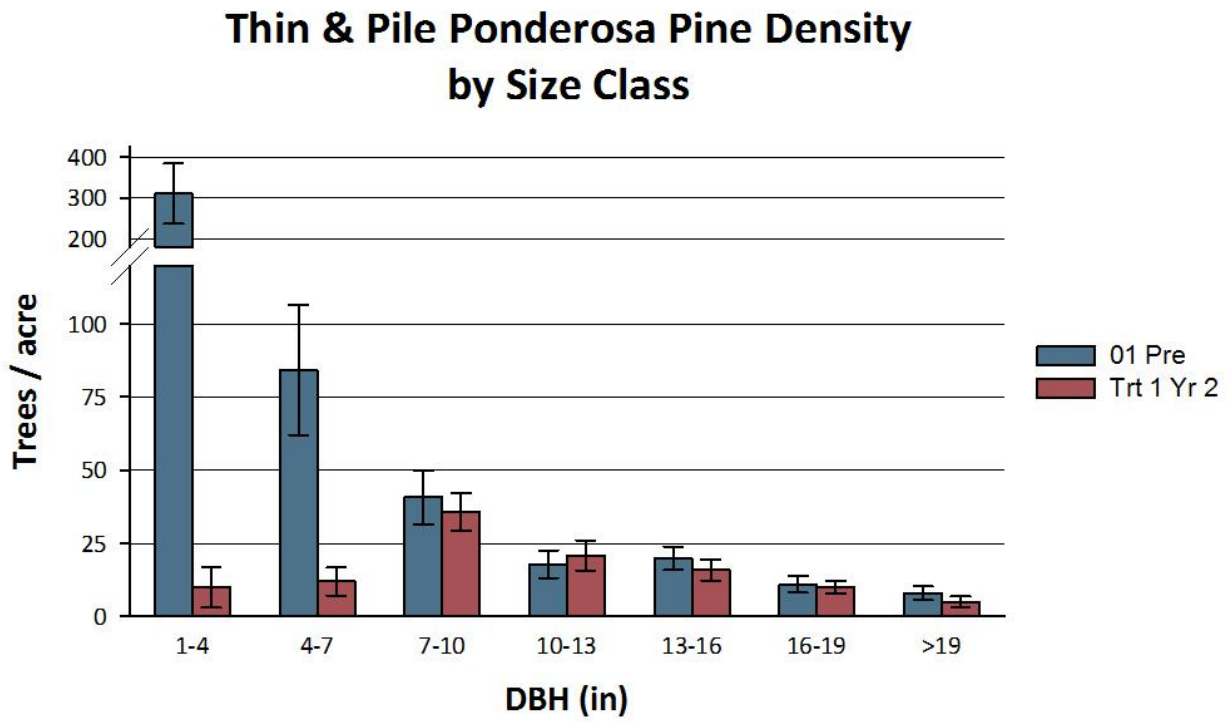

Figure 10 Changes in forest structure by size class in 13 monitoring plots within the thin & pile treatment area at Mount Rushmore N.M. following the hazardous fuel reduction project. Values represent means ± standard errors.

Total fuel loading increased by an average of 18% in the thin and pile treatment area (Figure 11). Only one of the ten monitoring plots had their associated piles burned as of the summer 2012 read. The NGP fire management program continues to burn piles at Mount Rushmore in the winter months as weather conditions allow. Ponderosa pine density in the 1 to 4" and 4 to 7" dbh class decreased by an average of 99% and 96% respectively in the thin and chip treatment unit (Figure 12). There was also a 52% decrease in ponderosa density in the 7 to 10" dbh class as the contract allowed for thinning up to 10" dbh.

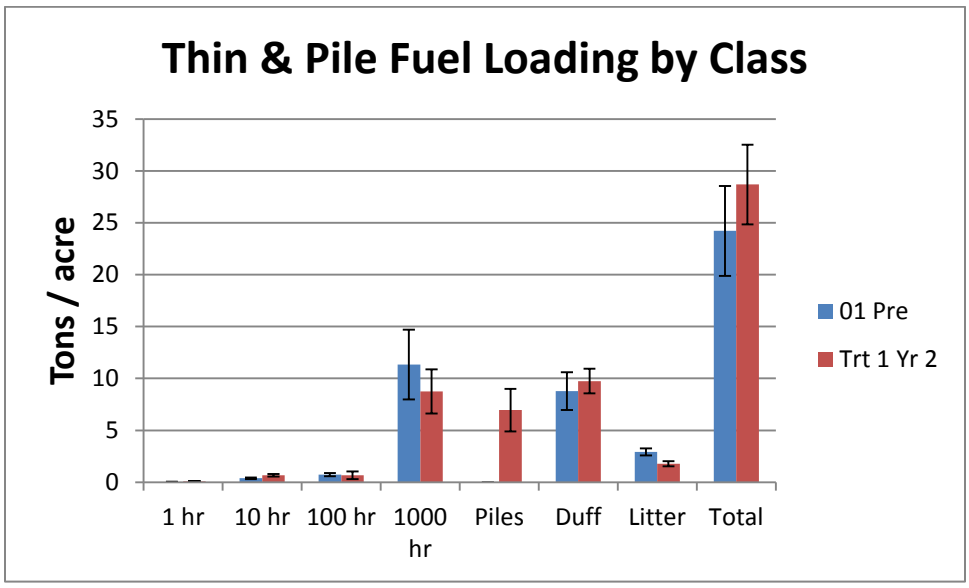

Figure 11 Changes in fuel loading in 10 monitoring plots within the thin & pile treatment area at Mount Rushmore N.M. following the hazardous fuel reduction project. Values represent means ± standard errors.

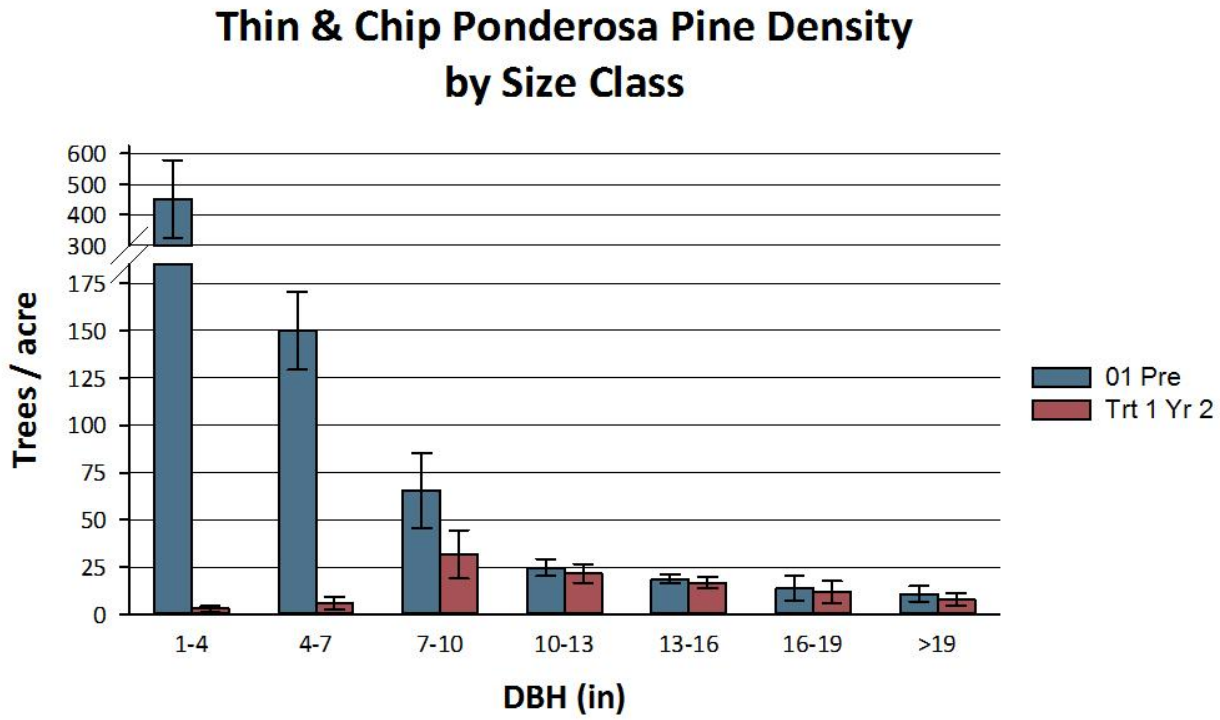

Figure 12 Changes in forest structure by size class in 13 monitoring plots within the thin & chip treatment area at Mount Rushmore N.M. following the hazardous fuel reduction project. Values represent means ± standard errors.

Total fuel loading increased by an average of 29% in the thin and chip treatment area (Figure 13). Most of the fuel loading increased in the 1 hr, 10 hr, and litter fuel classes as these are the primary fuel classes that compose the chips.

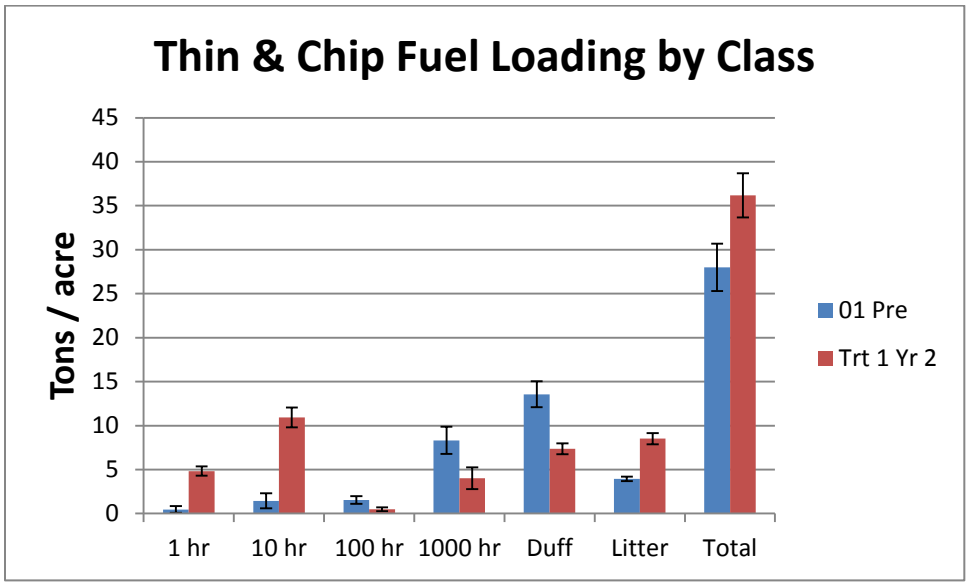

Figure 13 Changes in fuel loading in 12 monitoring plots within the thin & chip treatment area at Mount Rushmore N.M. following the hazardous fuel reduction project. Values represent means ± standard errors.

FlamMap v.5 was used to model crown fire potential pre and post mechanical treatments at the memorial. LANDFIRE National 2001 was used as the base vegetation map for this analysis which has a 30 meter pixel resolution. Modelling inputs include canopy cover, stand height, crown base height, canopy bulk density, fuel model, fuel / foliar moisture, temperature, relative humidity, wind speed, elevation, slope, and aspect. 90% percentile weather conditions for mid to late July were used in the model to capture the typical height of the fire season which included temperatures of 90 degrees F, relative humidity of 10%, and 20-foot winds from the southwest at 20 mph. Crown base heights averaged 3.9 meters in the plots that had no mechanical treatments, 5.7 meters and 6.4 meters respectively in the thin & pile and thin & chip treatment areas following the 2010 hazardous fuel reduction project, and 6.7 meters in plots that were mechanically treated between 2003 and 2009. Figure 14 shows that approximately 29% of the memorial would have had a surface fire in 2001 prior to the Lafferty Gulch (2003), Old Growth (2009), Colorado State University Research (2009), and 2010 hazardous fuel reduction projects. Passive and active crown fire accounted for 44 and 13% of the fire activity classification in the

pretreatment state.

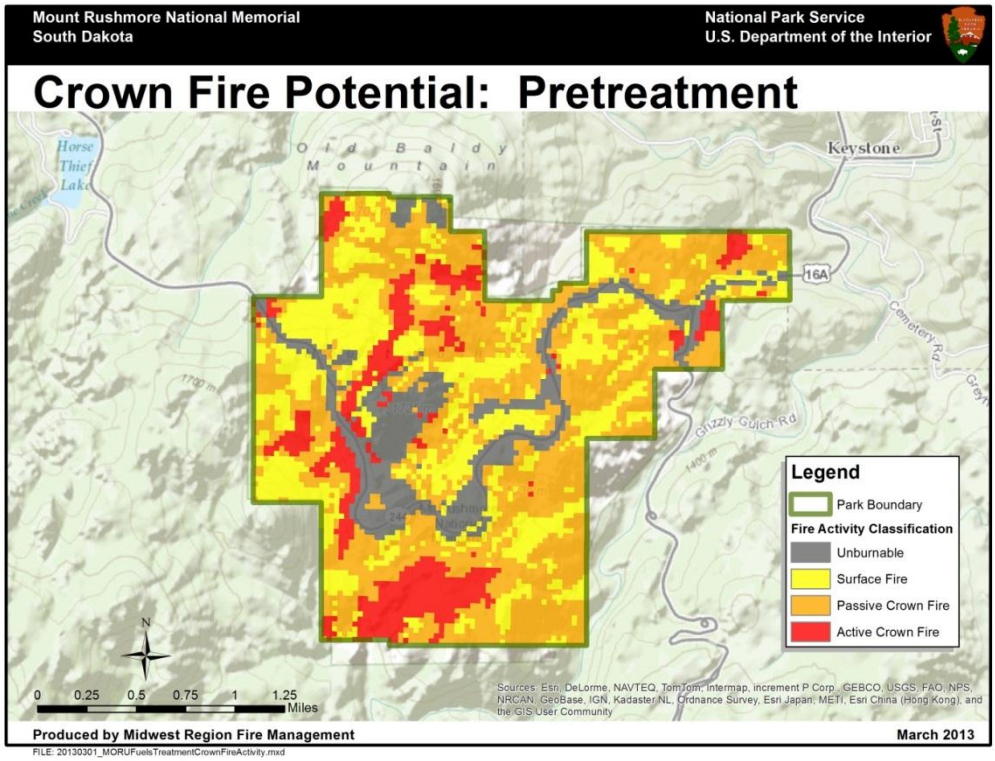

Figure 14 Crown fire potential at Mount Rushmore N.M. in 2001 prior to modern-day mechanical treatment projects. FlamMap v. 5 was used to model fire behavior using LANDFIRE 2001 as a base map with a 30 meter pixel resolution.

Following the four mechanical treatment projects passive and active crown fire potential combined decreased to only 8% of the memorial (Figure 15). Removing most of the smaller trees greatly reduced the potential for a stand-replacing crown fire within the memorial primarily due to the significant increase in crown base heights post-treatment.

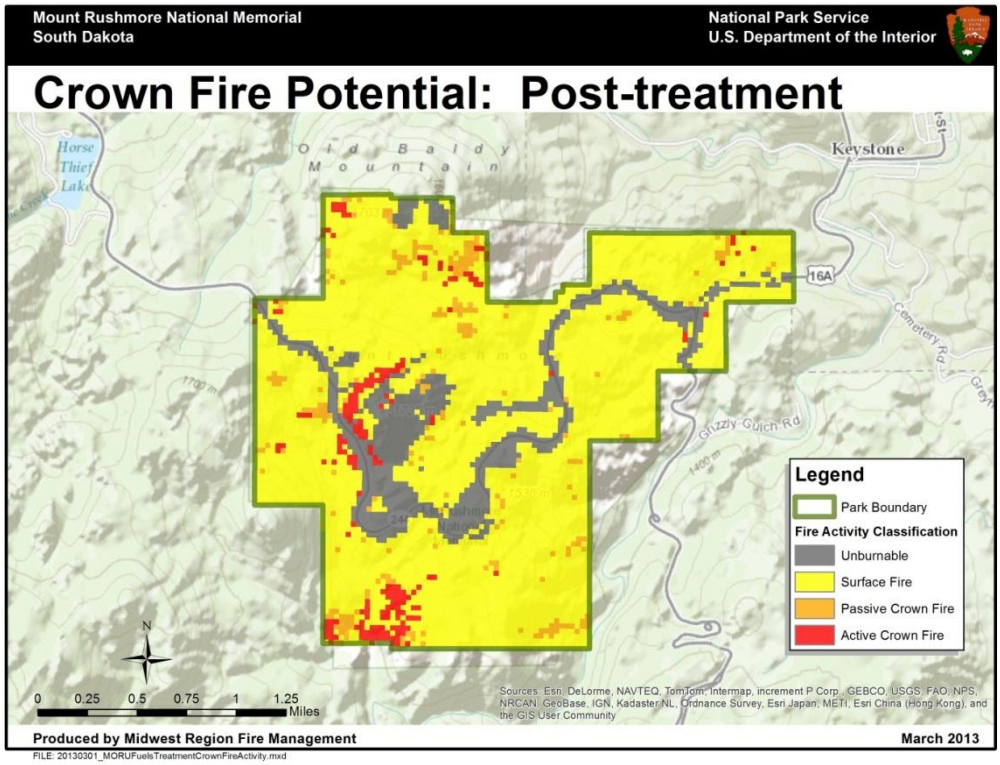

Figure 15 Crown fire potential at Mount Rushmore N.M. in 2012 following modern-day mechanical treatment projects. FlamMap v. 5 was used to model fire behavior using LANDFIRE 2001 as a base map with a 30 meter pixel resolution.

The next step is to continue to burn the piles remaining throughout the memorial. In the past year, the Northern Great Plains Fire Management office has revised the pile burning specifications to allow for greater burning windows. Broadcast pile burns are now conducted based on 1-hr and 10-hr fuel moistures as well as probability of ignition. Ultimately, it is the hope that these treatments will make the forest more resilient and resistant to infestation of mountain pine beetle, as well as allow for prescribed burn treatments to be primarily surface fire which was historically the most dominant fire type at the memorial.

Jewel Cave N.M.

The JECA WF occurred on October 18, 2012, and burned approximately 21 acres of the monument. Sixty I&M forest structure and fuel plots were established and read throughout the monument in 2011and two of these plots were burned in this wildfire. On October 30 and 31, both plots were remeasured to assess changes in fuel loading. Figure 16 shows that there insignificant changes post-burn with regards to fine fuel (1 hr, 10 hr, and 100 hr fuels combined) and litter and duff. There was an average decrease in 1000 hr fuels by 56% with total fuel loading decreasing by an average of 48%.

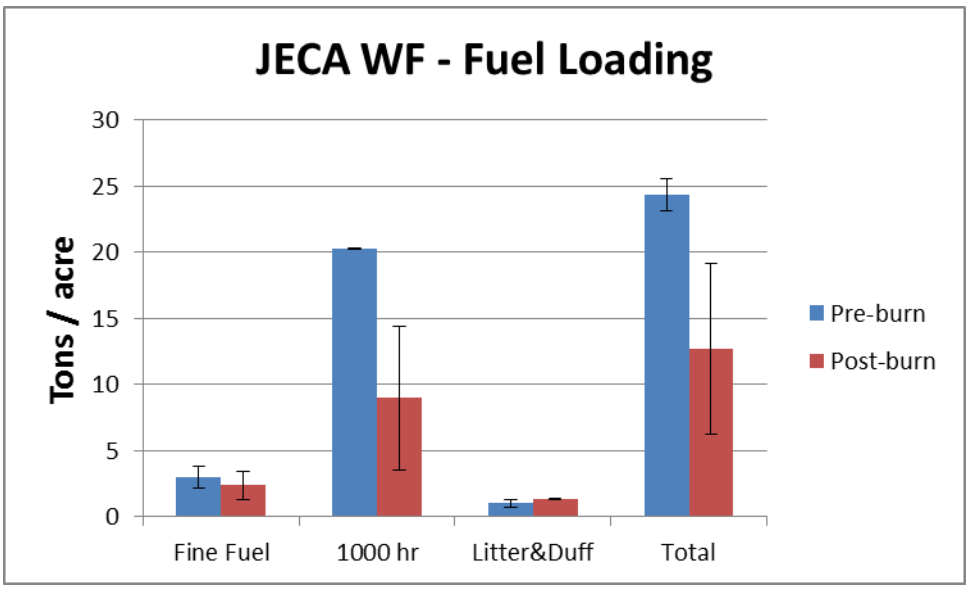

Figure 16 Changes in fuel loading in 2 monitoring plots at Jewel Cave N.M. following the JECA wildfire on October 18, 2012. Values represent means ± standard errors.

Devils Tower N.M.

Three ponderosa pine plots were installed within the 109 acre Red Beds unit in 2007 and 2008. This unit has a fairly open ponderosa pine midstory and overstory but high amounts of ponderosa pine seedling encroachment in the meadows. Objectives included decreasing pine encroachement in the meadows as well as decreasing non-native herbaceous cover. A prescribed burn occurred on October 14, 2010, and the plots were reread in July 2011 and 2012 for year one and two post-burn effects. Figure 17 shows that there was no significant decrease in either overstory or pole density following the burn. Seedling density significantly decreased by an average of 98% (Figure 18).

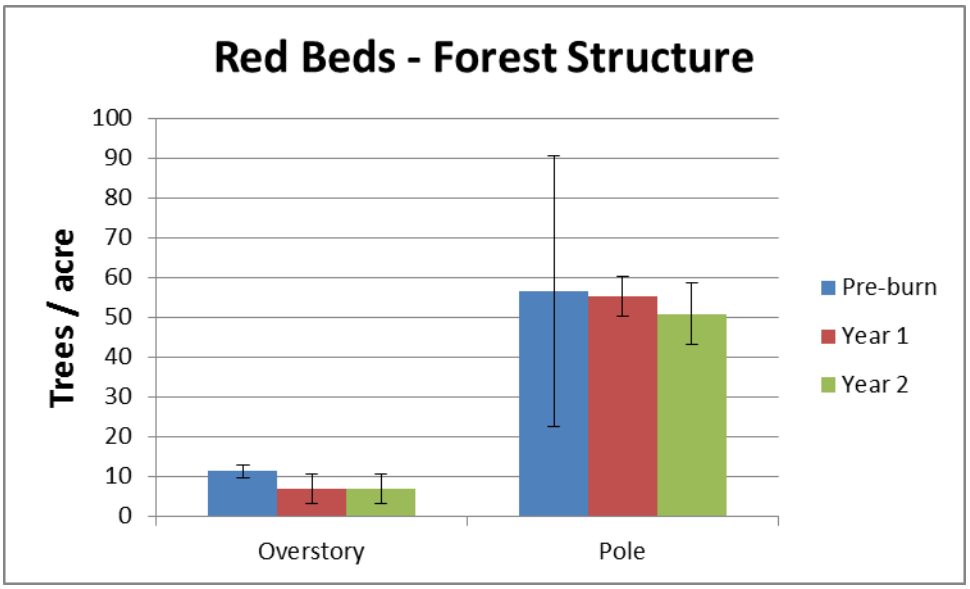

Figure 17 Changes in forest structure in 3 monitoring plots within the Red Beds unit at Devils Tower N.M. following a prescribed burn. Values represent means ± standard errors.

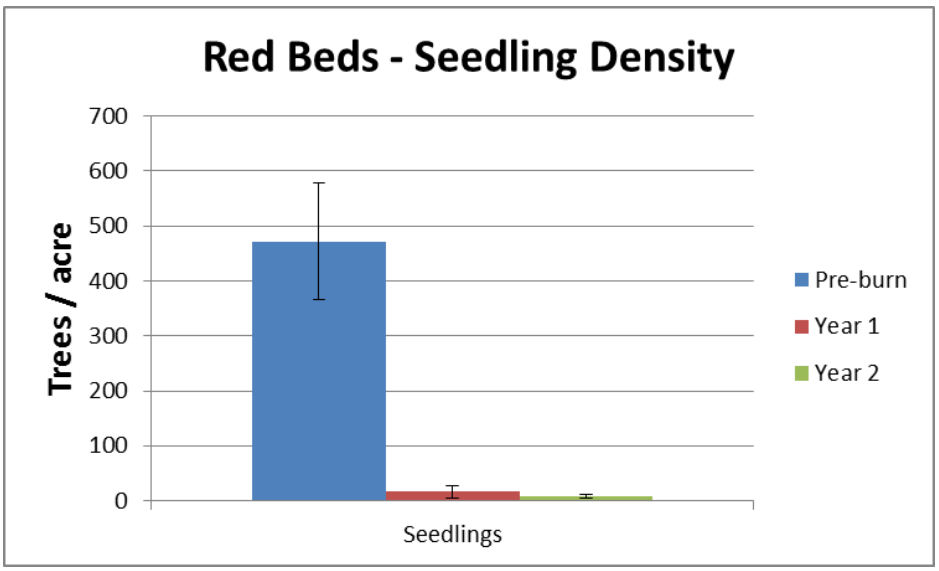

Figure 18 Changes in seedling density in 3 monitoring plots within the Red Beds unit at Devils Tower N.M. following a prescribed burn. Values represent means ± standard errors.

Native grass cover significantly decreased by an average 21% (Figure 19) from pre-burn to year 2 post-burn. Non-native forb, native forb, and non-native grass cover didn't statistically change over this period. Nearly all the individual species trended downward from pre-burn to year 2 post-burn even though these changes weren't significant (Figure 20). However, needleleaf sedge had a significant 8% incremental increase in cover two growing seasons after the burn. This slight downward trend in cover is most likely attributable to very dry conditions in late Spring and early Summer 2012. Even though September 2011 to May 2012 precipitation was approximately average, June and July precipitation was only 33% of normal. Severe drought conditions enveloped the park by late summer, and 2012 ended up with only 61% normal precipitation and ranked as the 3rd driest in the past 54 years (Table 4).

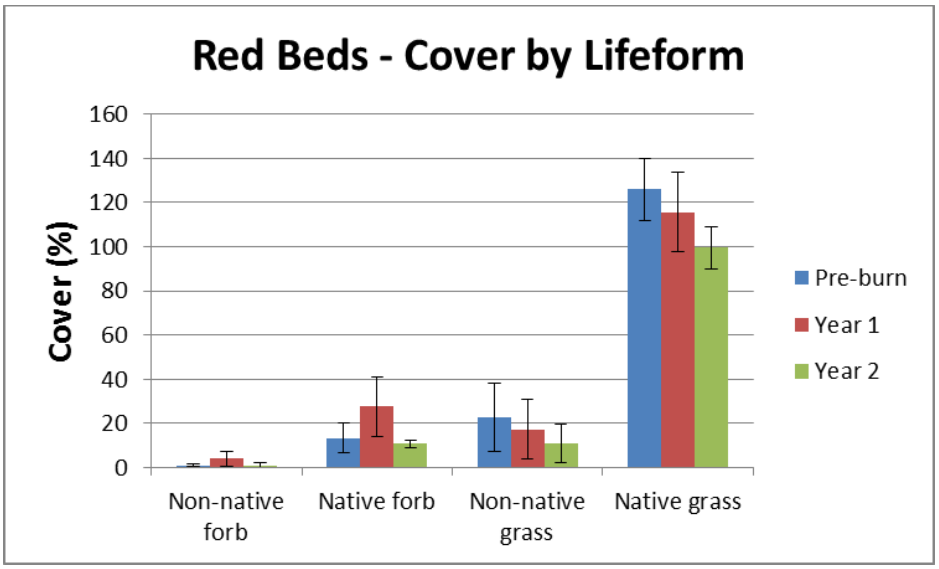

Figure 19 Changes in vegetative cover by lifeform for three plots within the Red Beds unit after the first prescribed burn. Values represent means ± standard errors.

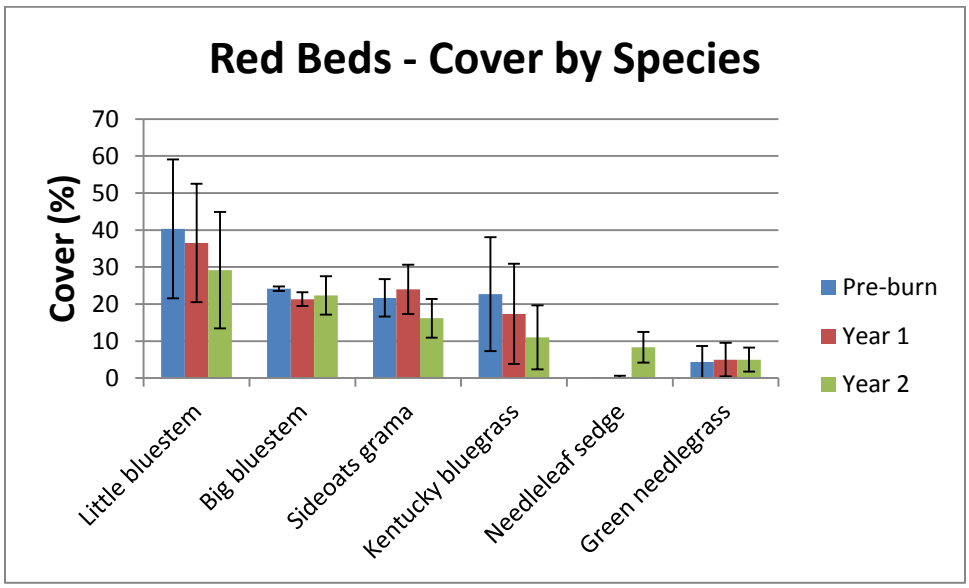

Figure 20 Changes in vegetative cover by species for three plots within the Red Beds unit after the first prescribed burn. Values represent means ± standard errors.

Scotts Bluff N.M.

The 1124 acre Prairie prescribed burn which was the second entry of fire into the unit, was completed on May 5, 2011, in a vegetation type consisting of native and non-native perennial grasses as well as non-native annual grasses. The first entry of fire into this unit occurred on August 25, 1998. Three plots were installed and read within the unit in June 1998, and they were reread one, two, five, and ten years after the first prescribed burn as well as in 2012 which was the first growing season after the second treatment. Primary objectives included reducing thatch in the prairie as well as decreasing non-native grass and forb cover.

The paired fire effects data was analyzed for relative change from pre-burn to first growing season after the second prescribed fire using ratio of means (RoM) at an 80% confidence level. The park only had 47% of normal precipitation from Fall 2011 to Spring 2012 (Table 4) which led to a minimal green-up and reduced vegetative cover values by the time we read our plots in early June 2012. The drought intensified to the exceptional classification by mid-summer, and 2012 ended up being the driest year on record for the monument in the past 120 years. There was an average 100% decrease in non-native and native forb cover (Figure 21). Non-native grass cover increased by an average of 296% with 80% confidence level that it increased by at least 33%. Native grass cover decreased by an average of 53%.

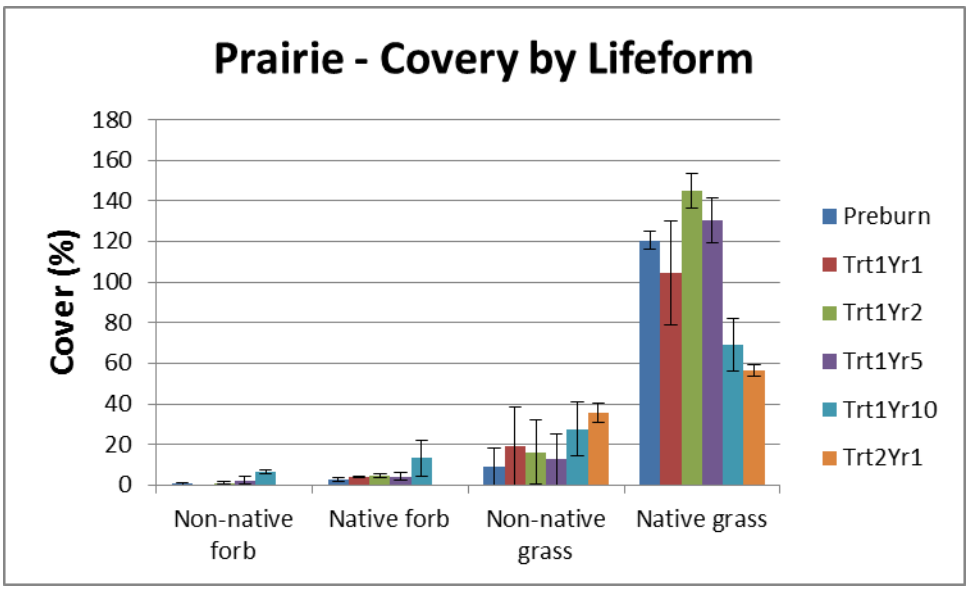

Figure 21 Changes in vegetative cover by lifeform for three plots within the Prairie unit following two prescribed burns. Values represent means ± standard errors.

Cheatgrass and Japanese brome were the only two species which significantly increased in vegetative cover following the second prescribed burn (Figure 22). Cheatgrass and Japanese brome had 22% and 12% incremental increases in cover from pre-burn (1998) to the first growing season after the second treatment (2012). I believe the primary reason for this is that the thatch layer wasn't reduced enough due to the patchiness and low burn intensity. May 5, 2011, was a very unusual spring day in the western Nebraska panhandle, in that there was virtually no wind to carry the fire. Since green-up was in full swing, the fire had difficulties carrying through the grass without any wind or slope. UTV's were deployed to help with ignition, but they were only marginally successful. Most of the native grasses (Threadleaf sedge, Needle & Thread, and Sideoats grama) decreased in cover from pre-burn to year 1 following the second treatment most likely due to the extreme drought conditions that were in the park in late May 2012.

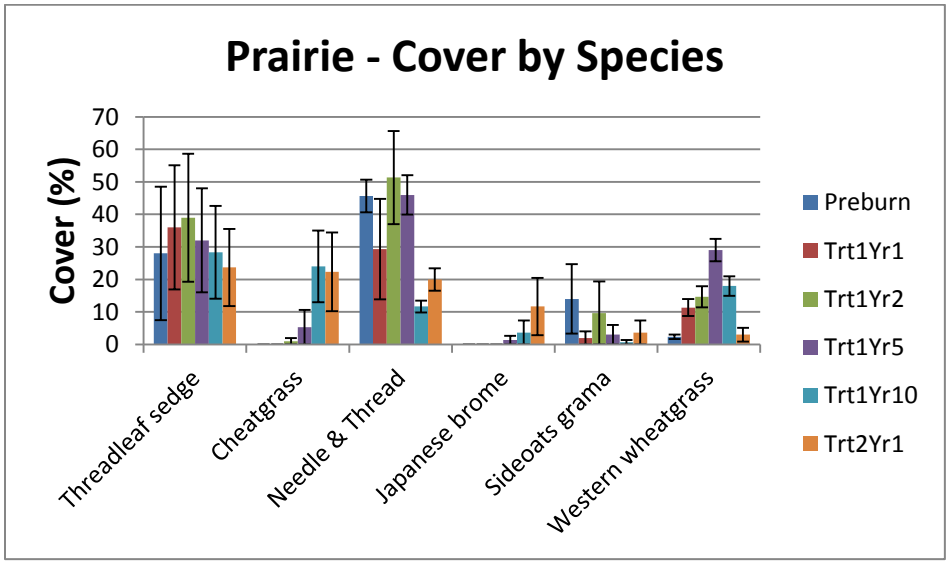

Figure 22 Changes in vegetative cover by species for three plots within the Prairie unit following two prescribed burns. Values represent means ± standard errors.

Theodore Roosevelt N.P.

The 500 acre I-94 unit was completed in two prescribed burns: October 10, 2002, and May 2, 2003. Pre-burn monitoring indicates the most dominant species were crested wheatgrass followed by Kentucky bluegrass. Objectives for the prescribed burn included reducing cover of non-native cool season grasses and increasing cover of native warm-season grasses and forbs. Three plots were installed and read within the unit in July 2000. Plots were monitored the first, second, fifth, and tenth growing season following the prescribed fire.

The paired fire effects data was analyzed for relative change from pre-burn to second growing season after prescribed fire using ratio of means (RoM) at an 80% confidence level. Severe drought conditions enveloped the park by mid to late summer which was observed in reduced vegetative cover values when the monitoring plots were read in July 2012. 2012 had only 66% of normal precipitation and ranked as the third driest since records began in 1949 (Table 4). Nearly all species had lower vegetative cover values in the year 10 read compared to the year 5 read (Figure 23). There was no non-native forb cover at pre-burn or year 10 reads. Average native forb cover was at approximately 8%, and there was no significant change between pre-burn and year 10 conditions. There was an average 45% decrease in non-native grass cover with 80% confidence that it decreased between 37 and 71%. Native grass cover decreased by an average of 50% with 80% confidence level that it decreased between 18 and 93%.

Crested wheatgrass, slender wheatgrass, and little bluestem did not change in cover from pre-burn (2000) to year 10 (2012) (Figure 24). Kentucky bluegrass decreased by an average of 92% with 80% confidence level that it decreased between 85 and 99%. Western wheatgrass trended downward from pre-burn to year 10 reads. This burn was unsuccessful in meeting resource objectives. Research does indicate that prescribed burning is not effective in decreasing crested wheatgrass populations since the coarse stems and sparse leaf components minimize heat transfer down into the culms (Pechanec et al 1954, Ralphs et al 1975, Young 1983).

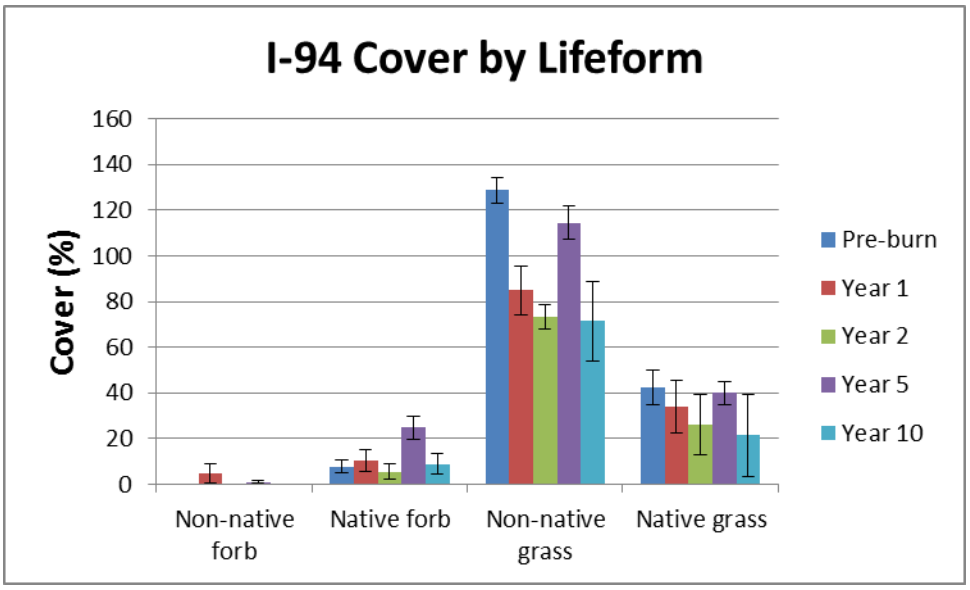

Figure 23 Changes in vegetative cover by lifeform for three plots within the I-94 unit following one prescribed burn. Values represent means ± standard errors.

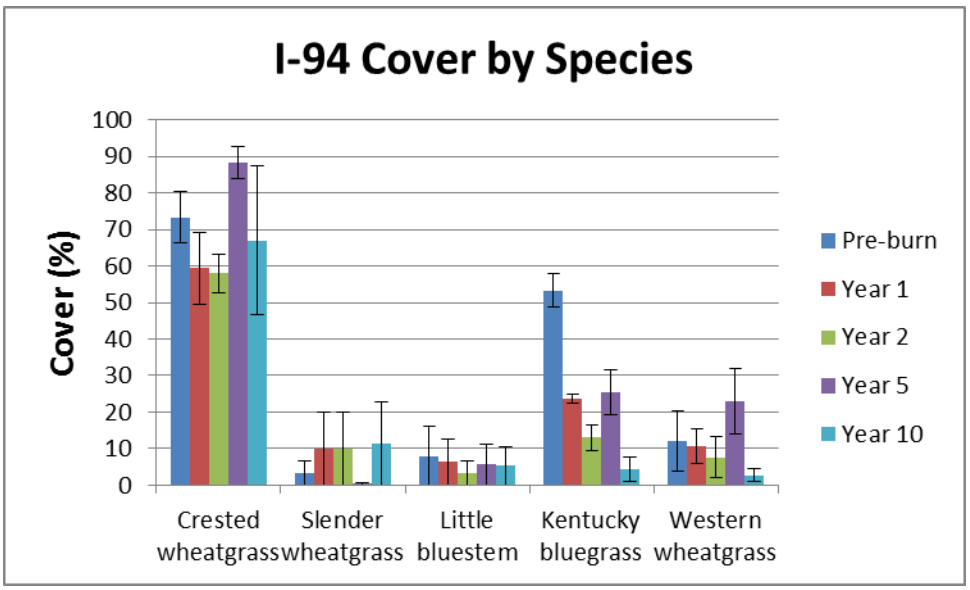

Figure 24 Changes in vegetative cover by species for three plots within the I-94 unit following one prescribed burn. Values represent means ± standard errors.

The 98 acre Radio Tower prescribed burn unit was completed on October 4, 2007, in a vegetation type consisting of native and non-native perennial and annual grasses. The most dominant species prior to the burn were needle & thread, threadleaf sedge, needleleaf sedge, western wheatgrass, and Kentucky bluegrass. Objectives for the prescribed burn included evaluating and documenting fire effects and fire behavior of a fall burn, reducing thatch accumulation, and encouraging nutrient cycling and soil gas exchange. Two plots were installed and read within the unit in July 2007 and represent the pre-burn read. Plots were monitored the first, second, and fifth growing season following the prescribed fire. Many of the grass species declined in cover from the year 2 read (2009) to year 5 read (2012). This can be attributed to 2009 being a wetter than normal year and 2012 being in moderate drought. Non-native forb cover was an extremely small component on the landscape and its cover didn't change significantly throughout our measurement sequence. Typically, native herbaceous cover diminishes the first growing season after the burn and then rebounds to near or above pre-burn levels by the second growing season. Native forb cover decreased significantly by an average 62% from pre-burn (2007) to year 5 (2012) post-burn (Figure 25). Non-native grass cover was predominantly Kentucky bluegrass 16% and Japanese brome 20% at pre-burn conditions in 2007. Kentucky bluegrass and Japanese brome significantly decreased by an average of 88% and 100% respectively from pre-burn to year 5 post-burn. Native grass and sedge cover significantly decreased by an average of 51% from pre-burn to year 5 post-burn.

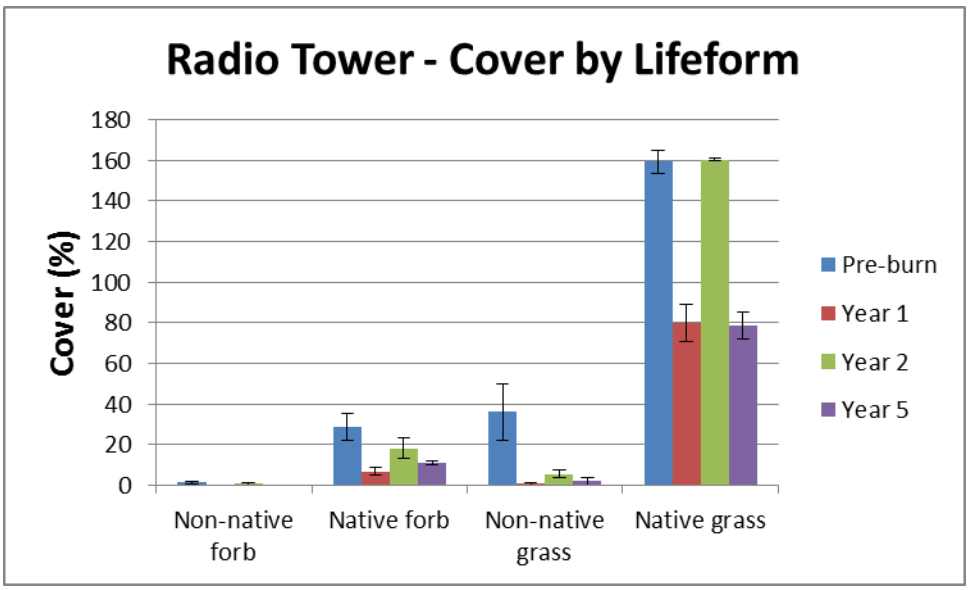

Figure 25 Changes in vegetative cover by lifeform for two plots within the Radio Tower unit following one prescribed burn. Values represent means ± standard errors.

Most of this decrease was attributed to significant decreases in needle & thread, western wheatgrass, and sedge cover (Figure 26). Sideoats grama and purple three-awn significantly increased by an average of 212% and 700% respectively from pre-burn to year 5 post-burn. Both species are warm season grasses and are more drought tolerant than needle & thread and western wheatgrass which are cool season grasses.

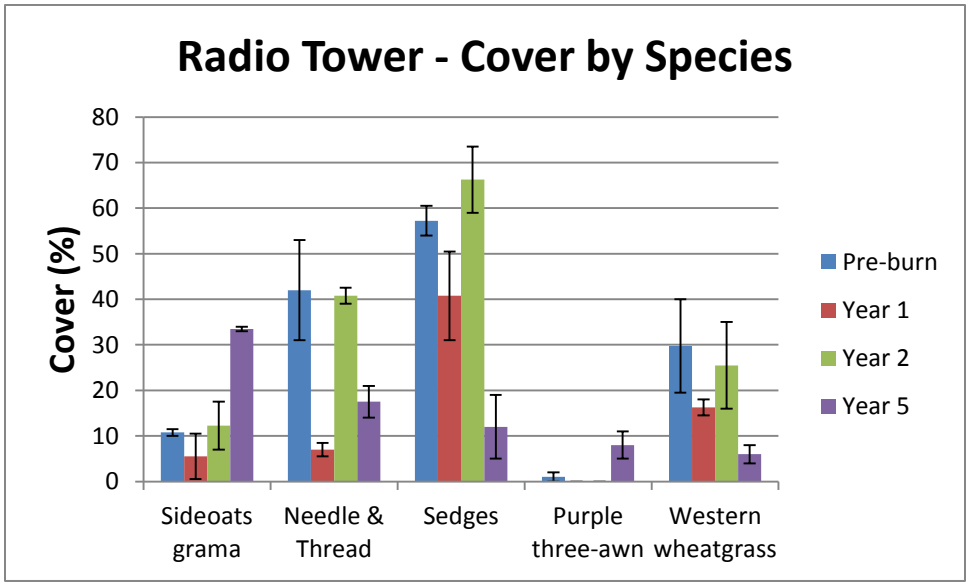

Figure 26 Changes in vegetative cover by species for two plots within the Radio Tower unit following one prescribed burn. Values represent means ± standard errors.

Knife River Indian Villages N.H.S.

The 175 acre North Prairie prescribed burns were completed in May 2009, May 2011, and February 2012 in a vegetation type consisting of native and non-native perennial grasses. The most dominant species prior to the burn were Kentucky bluegrass, western wheatgrass,

threadleaf sedge, needle & thread, and green needlegrass. The primary objective for the prescribed burns included reducing non-native grass cover. Four plots were installed and read within the unit in July 2008 and represent the pre-burn read. Plots were monitored the first (2009) and second (2010) year after the first burn and the first growing season (2011, 2012) after the second and third treatments as well. Moderate drought conditions enveloped the park by mid to late summer which was observed in reduced vegetative cover values when the monitoring plots were read in July 2012. 2012 had only 81% of normal precipitation and ranked as the twelth driest since records began in 1954 (Table 4). Non-native forbs were a small contribution to the vegetative cover in this unit and there were no significant changes in cover in each plot read. Native forb cover significantly increased by an average of 273% from pre-burn to first growing season after the third treatment with an 80% confidence that the increase was between 97 and 362% (Figure 27). There was however a significant decline from the previous read (treatment 2 Year 1) in 2011, and this is attributed to the moderate drought conditions in 2012. Non-native grass cover, almost exclusively Kentucky bluegrass, significantly decreased by an average of 25%, with an 80% confidence that the decrease was between 19 and 37% (Figures 27 and 28). Native grass cover did not change from pre-burn to first growing season after the third prescribed burn.

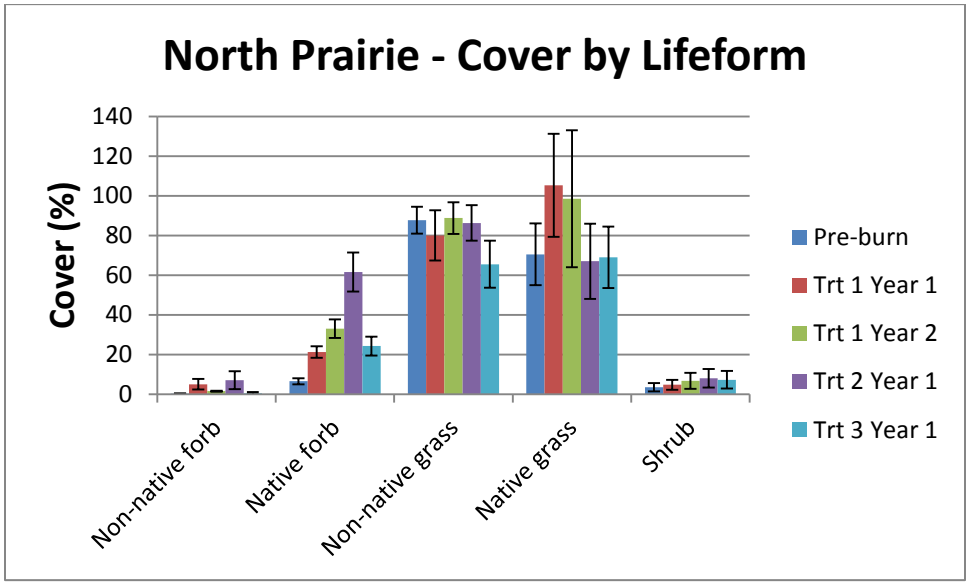

Figure 27 Changes in vegetative cover by lifeform for four plots within the North Prairie unit following three prescribed burns. Values represent means ± standard errors.

Western wheatgrass significantly decreased in cover by an average of 21% with 80% confidence that the decrease was between 10 and 47% (Figure 28). There was no change in cover for threadleaf sedge or western snowberry. Blue lettuce and scarlet beeblossom, both native forbs, significantly increased in absolute cover by 6% from pre-burn to first growing season after the third prescribed burn.

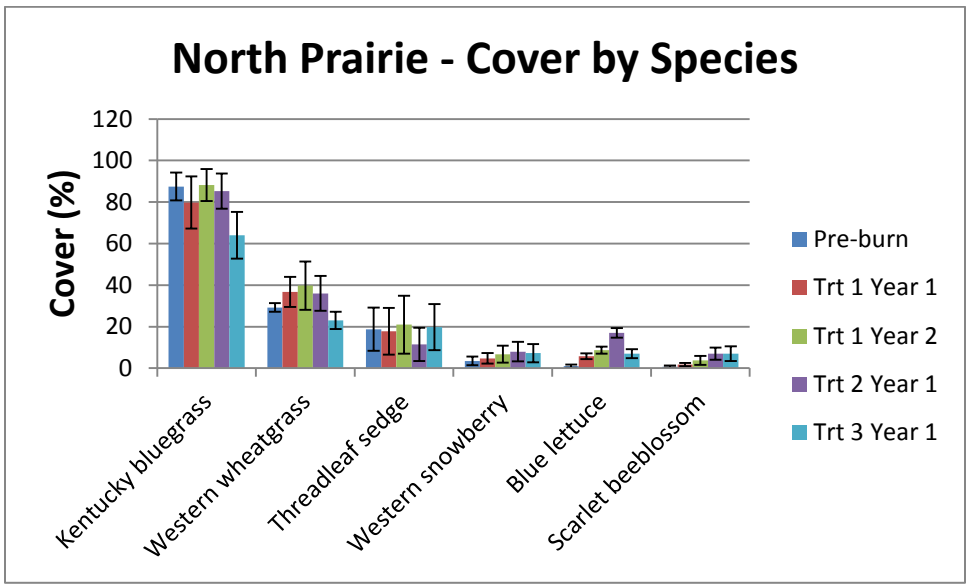

Figure 28 Changes in vegetative cover by species for four plots within the North Prairie unit following three prescribed burns. Values represent means ± standard errors.

The 278 acre V.C. East prescribed burn was completed on May 2, 2012, in a vegetation type consisting primarily of non-native perennial grasses smooth brome and Kentucky bluegrass as well as yellow sweetclover. The primary objective for this prescribed burn was to decrease the non-native grass cover and increase native grass and forb cover. Six plots were installed and read within the unit in July 2011 and represent the pre-burn read. Plots were reread in 2012 the first growing season following the prescribed fire. There is 80% confidence that non-native forb cover decreased between 18 and 75% between pre-burn and year 1 reads (Figure 29). Non-native grass cover significantly decreased between 21 and 51%. Native grass and forb cover did not change following the prescribed burn.

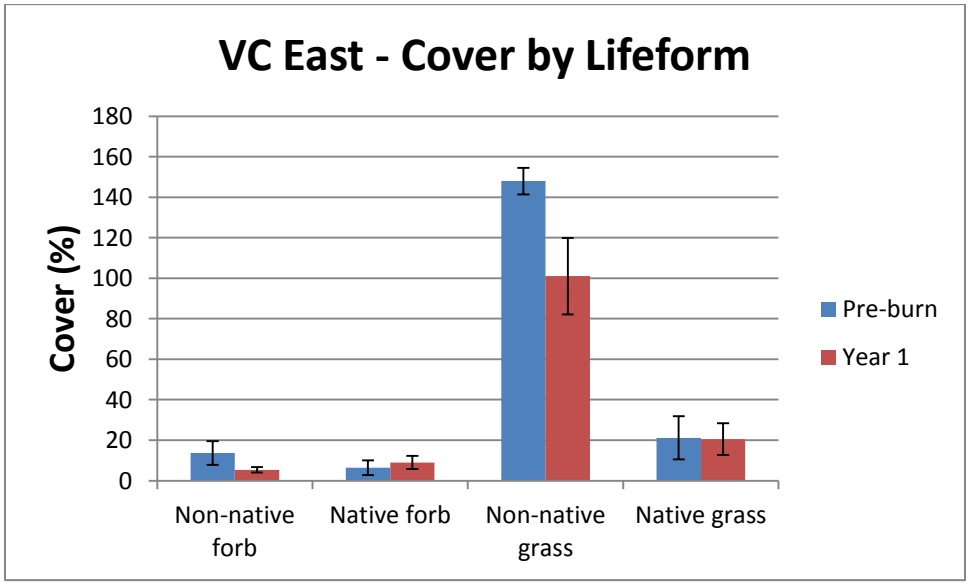

Figure 29 Changes in vegetative cover by lifeform for six plots within the V.C. East unit following one prescribed burn. Values represent means ± standard errors.

Smooth brome significantly decreased between 20 and 62% following the burn with Kentucky blue grass significantly decreasing between 12 and 36% (Figure 30). Hairy wildrye and intermediate wheatgrass didn't change in cover with sideoats grama showing a slight increase in cover following the burn. Yellow sweetclover also is trending downward after the May 2012 burn.

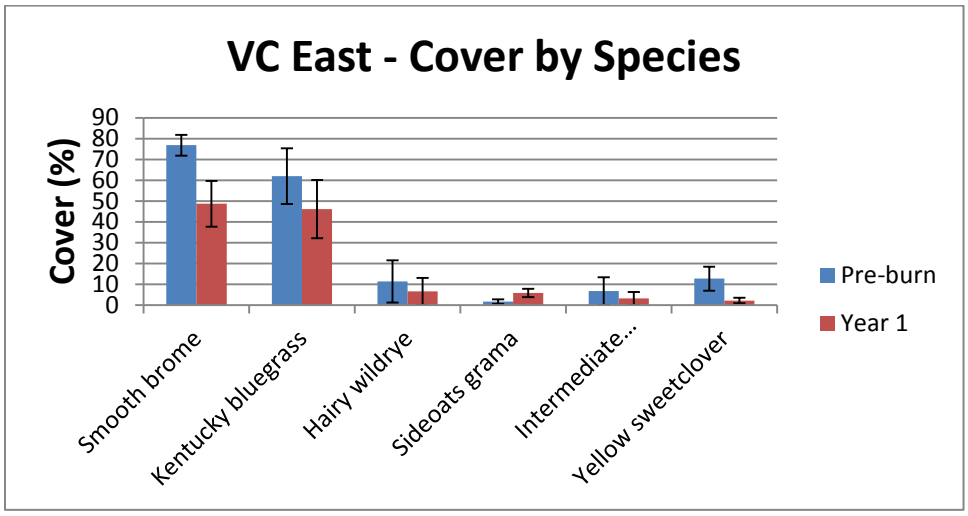

Figure 30 Changes in vegetative cover by species for six plots within the V.C. East unit following one prescribed burn. Values represent means ± standard errors.

B. Fire ecologist accomplishments and areas of focus

Dan edited the following documents: fire regime component for Theodore Roosevelt N.P.'s natural resource condition assessment, Integrative forest stewardship strategy, and Mount Rushmore N.M. flying squirrel study. Dan is also currently involved in a climate change research project at Wind Cave N.P. which will be finalized next year.

In February and March Dan gave presentations at the Black Hills Area botanist & ecologist workshop and the Northern Great Plains Network technical committee meeting on the results from the composite burn index (CBI) data analysis from the 2010 American Elk RX burn at Wind Cave N.P.

In May, we finished integrating our FFI databases between our programs, and we now have one database per park which is housed on the server located in the Northern Great Plains I&M office in Rapid City. The NGP fire ecology program now connects to their server to enter FFI data which streamlines data management and analysis for both programs. This past field season both programs successfully entered their biological data directly into this shared database.

Table 4. Fire Ecologist 2012 Accomplishments/Focus Areas

Category	Percent Time	Accomplishments and/or areas of activities
Planning	6%	Determining fire effects travel costs to area parks, training of field crew in FFI
Presentations	5%	Scientific meetings, park staff, public, etc.
NPS Meetings/ task groups	7%	Park, I&M, & FESC meetings; NGP Technical Committee meeting; Worked on THRO Natural Resource Condition assessment;
Interagency work	1%	Black Hills Area Ecologist & Botanist Workshop; Southern Rockies Fire Science Consortia meeting
Wildfire Assignments	1%	MORU WF
Prescribed fire projects	1%	FEMO on 1 RX fire (1 operational period)
Non-fire fuels projects	0%	
Research	8%	Invasive plant species research project – training field crew
Data Collection	16%	BADL, MORU, WICA, THRO, & KNRI fire effects & I&M plot work; Invasive plant species research project – WICA;
Data entry, check	4%	MORU data entry; MORU & WICA data checking
Data management & analysis	30%	Northern Great Plains area parks fire effects database management and analysis
Supervision/Admin	15%	Hiring, supervision, travel, payroll, etc.
Training	3%	Botany, Supervisory, EEO training
Travel out-of-park for plot or project work	2%	Travel to BADL, KNRI, & THRO for monitoring and RX fires
Miscellaneous	1%	NGP fire management web site, Writing burn reports

C. Fire effects crew accomplishments and areas of focus

Table 5. Fire Effects Crew 2012 Accomplishments/Focus Areas

Category	Percent Time	Notes
FMH plots	7%	Re-reading of FMH plots (Forest, Grass, and Brush)
NGP Plots	8%	Re-reading of burn-unit specific plots (FFV, GFV, photo points)
I&M Plots	36%	Installing & rereading I&M style plots. At WICA these were installed park-wide. All other parks' installs fell inside active burn units.
WUI plots	0%	
Wildfire assignments	9%	Wildfire assignments, including local I.A., details with the Black Hills Wildland Fire Module
Prescribed fire projects	1%	Prescribed fires in the NGP park group, calendar year 2012
Non-fire fuels projects	1%	Estimated amount of time spent assisting with non-fire fuels projects; Wind Cave canyon fuel reduction project
Travel out-of-park for plot or project work	4%	Travel to AGFO, SCBL, DETO, BADL, THRO, & KNRI for monitoring and RX fires
Data entry, check	12%	100% of plot data entered & 100% checked in FFI as of 11/27/12
Data analysis	0%	
Supervision/Admin	11%	Travel, payroll, field season preparation, equipment upkeep and repair,

		end of season closeout
Training	8%	Each crewmember had botany training & Wilderness First Aid training. Additional courses taken by some individuals include S-130/190, L 380.
Miscellaneous	3%	physical training, fuel sampling, herbarium updates.

Table 6. Monitoring – 2012

Park	% 2012 Data Entered	% 2012 Data Quality Checked	# Prescribed Fires Monitored*	# Non-fire Fuels Treatments Monitored*	# Wildfires Monitored*	# BAER Treatments Monitored*
Agate Fossil Beds N.M.	100%	100%	2	0	0	0
Badlands N.P.	100%	100%	8	0	0	0
Devils Tower N.M.	100%	100%	4	0	0	0
Fort Union Trading Post NHS	100%	100%	0	0	0	0
Jewel Cave N.M.	100%	100%	2	0	1	0
Knife River Indian Villages NHS	100%	100%	5	0	0	0
Mount Rushmore N.M.	100%	100%	0	1	0	0
Scotts Bluff N.M.	100%	100%	1	0	0	0
Theodore Roosevelt N.P.	100%	100%	4	0	0	0
Wind Cave N.P.	100%	100%	2	0	0	0

***** Number of treatment units with treatment effects monitoring conducted. Include pre-burn and post-burn monitoring but not burn-day monitoring.

E. 2013 Direction

Budget cuts will hit the Northern Great Plains fire ecology program again in FY13. Our seasonal fire effects staffing will be reduced from 36 to 24 pay periods. As a result we will be hiring two seasonals instead of three for the 2013 field season. In addition, it's likely that fire effects travel funds will not be given to fire ecology programs in the Midwest Region this year and into the future, so we hope that prescribed fire project funds will cover this expense. I understand that we have come to a point where we must prioritize our monitoring efforts within our park group due to fiscal and personnel constraints. It's likely we won't be able to monitor as many prescribed fire projects in the future and may have fewer plots in those projects in which monitoring does take place. I will continue to engage with Park group FMOs and resource managers to determine what their priorities are for monitoring. In 2013 the NGP fire effects monitoring crew, Black Hills Fire Use Module, and Wind Cave N.P. engine crew will work with each other at times throughout their core seasons to ensure that highly prioritized work assignments are done. The Black Hills Fire Use Module and Wind Cave N.P. engine crew are also short on staff, so by working together we will maximize our productivity and maintain our viability.

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