



SUMMARY

In 2012, full staffing with virtually no turnover from the previous season allowed the Grand Canyon National Park (GRCA) Fire Ecology Program to complete all scheduled work while crewmembers also participated in a wide variety of opportunities supporting incidents nationally and locally. With monitoring of 43 Fire Monitoring Handbook (FMH) plots, 60 Rapid Assessment Protocol (RAP) pilot sampling plots, 97 Composite Burn Index (CBI) burn severity plots, and 16 Inventory & Monitoring (I&M) plots, it was a successful year. Additionally, the tradition of assisting other Fire Ecology programs was renewed, with the Assistant and two crewmembers helping the Saguaro Fire Ecology staff accomplish plot work and data entry in southern Arizona. Returning 6 of the 8 individuals within the Fire Ecology Program from 2011 produced an efficient work environment and freed the crew to concentrate on more advanced skills and allowed the Fire Ecologist to focus on analysis, outreach, and larger-scale tasks.

For the third year, a student position on the crew was filled through Grand Canyon's diversity program, again from Northern Arizona University (NAU). Having two crewmembers and an intern hailing from NAU further strengthened the bond between the school and the GRCA Fire Ecology Program. With a full, well-trained crew, data were gathered, entered, and checked for all of the 2012 season before the seasonal staff departed.

The greatest challenge came from four back-to-back late season prescribed fires on the North Zone (North Rim & North Kaibab Ranger District). Fire Ecology staff were asked to support operations during the burns, but also had to visit 50 plots afterward which were potentially impacted. Due to all of this activity occurring in late October and November, little time existed to complete work before

season-ending snowfall. Outside assistance was cobbled together from visiting operational burn personnel, GRCA Fire Effects crewmembers brought back on intermittent status, and staff from the Zion and Lake Meredith Fire Ecology programs. An imminent storm required haste, subsequent snowfall and frozen ground required patience along with creative data gathering techniques, and a new record was set on December 3 for latest date of a plot read at Grand Canyon, but all data were ultimately collected before winter's permanent mantle of white descended.

Along with the accomplishment of plot-related work, the program supported a busy national fire season, and crewmembers continued to expand both their skill sets plus their variety of contributions to fire operations. This balance would not have been possible without sufficient staffing, as well as the experience of three returning crewmembers and the established permanent fire ecology staff. In some capacity, the crew worked on a total of 21 different incidents. These opportunities led to the completion of three taskbooks (2 FFT1s, FIRB) and work on many others (FEMO, HECM, ENGB) to further increase the crew's ability to fulfill a diverse variety of roles within fire. Highlights of this experience included assignments as engine crewmembers to Nevada, Idaho, California, and Washington; Helicopter Crewmembers (HECM) on the Whitewater-Baldy Fire; a one-month detail with the Saguaro Wildland Fire Module; Geographic Information Systems Specialist (GISS) support on local incidents, and Firing Boss (FIRB) for three local Type 1 prescribed burns. The crew also continued its role as the primary FEMOs within Grand Canyon National Park and continued to provide support for the neighboring Kaibab National Forest on both prescribed and wildfire events, amounting to a total of 79 operational periods of local fire assistance.

Cross-training Fire Ecology crewmembers with other field disciplines in our fire management program continues to allow the crew to build myriad skills and increase overall staffing flexibility. Personal interest by the crew greatly facilitated this multi-disciplinary learning. To spread the wealth of knowledge further, three other GRCA fire personnel, two visiting Fire Ecology staff from Lake Meredith, and several from the invasive plant management crew were cross-trained in fire effects plot protocols.

In addition to the typical data analysis, data management, and budget tasks, the Ecologist continued with a wide variety of support activities this year. Communication continued to be a high priority as the Ecologist prepared extensive materials for two program-wide field trips, presented data at two scientific conferences, and continued outreach activities with the Interpretation & Education and Science & Resource Management Divisions. The Ecologist continued to participate in the larger Southwest and national fire ecology communities by serving on the program committee for the SW Fire Ecology Conference and on a proposal review panel for the Joint Fire Science Program. The Ecologist also continued efforts to expand the use and usability of the park's datasets for in-park fire planning and for planning on the North Kaibab District of the Kaibab NF. The third year of the Fire Ecology and Fuel Management Intern program brought continued success with the intern contributing to fuel planning by assisting with a burn plan and working on an updated fuel map for the park. The intern also contributed extensively to operational fire activity by working 25 shifts on 14 fires in the park and neighboring Kaibab NF.

STAFF ACCOMPLISHMENTS & AREAS OF FOCUS

TABLE 1. Fire Ecology Staff for 2012 calendar year.

Employee	Starting Date	Ending Date	# Pay Periods	Training	NWGG Taskbooks
Windy Bunn, GS-11	1/01/12	12/31/12	26	S-133 S-390 L-280	
Li Brannfors, GS-7	1/15/12 4/22/12 9/9/12	2/25/12 7/28/12 12/15/12	18.5	IS-700 CPR/First Aid	FIRB RXB3-t
Jasper Peach, GS-6	4/30/12 12/10/12	10/20/12 12/14/12	13	L-280 S-490 WFR refresher READ	FALB-t FIRB-t ENGB-t READ-t
Kate Milich, GS-5 ¹	4/30/12	12/01/12	15.5	Helicopter Training Academy (HTA)	FFT1 FALA-t HECM-t ABRO-t
Alexander Spannuth, GS-5	4/30/12 10/29/12 11/26/12	10/06/12 11/19/12 11/29/12	13.5	L-280 CPR/First Aid	FFT1 ABRO-t FALA-t
Jerolyn Byrne, GS-5	4/30/12 11/10/12	10/06/12 11/21/12	12.5	L-280 B3 CPR/First Aid	FEMO-t FALA-t HECM-t
Katelynn Jenkins, GS-5 ²	5/28/12 11/02/12	8/25/12 11/04/12	7	L-280	FEMO-t
Katie Sauerbrey, GS-5 ³	3/25/12 5/06/12 8/26/12	5/05/12 8/25/12 11/29/12	9	S-290 IS-700 HTA	FFT1, ICT5, HECM, FALB, FEMO-t

¹Time for Kate Milich in Nov NOT funded out of hazard fuels base accounts due to funding provided by GRCA Rx burn projects.

²Time for Katelynn Jenkins NOT funded out of hazard fuels base accounts due to funding provided by GRCA diversity student program.

³ Katie Sauerbrey was the intern for this year and her time includes full summer payperiods and part-time project work during spring and fall semesters. Katie's time was funded through the NPS Fire Ecology Internship project and NOT from the fire effects base account.

TABLE 2. Base-hour Fire Effects Crew activities by percent and category. Highlighted areas are where crewmembers spent the majority of base-hour time.

Employee	FMH Plots	RAP Plots	CBI Plots	I&M Plots	Plot Office	Data Entry/Mgmt	Other Office	Monitoring (Rx or Wildfire)	Rx Fire Ops	Wildfire/ Incident Ops	Training Courses	Other
Li Brannfors, GS-7	9	8	1	3	13	3	30	3	8	2	2	18
Jasper Peach, GS-6	13	5	3	1	7	4	23	0	4	5	10	25
Kate Milich, GS-5	12	7	1	3	9	4	10	3	8	27	3	13
Alexander Spannuth, GS-5	18	9	4	1	11	2	6	5	1	29	3	11
Jerolyn Byrne, GS-5	20	5	5	1	8	8	13	1	0	22	2	15
Katelynn Jenkins, GS-5	17	5	0	1	12	5	13	6	1	26	3	11

"Plot Office" includes miscellaneous plot data preparation and management time, plant ID, photo filing, etc.

"Rx Fire Ops" includes time spent on non-fire fuels projects.

"Other" includes PT, leave taken, meetings, paid holidays off, air quality, non-fire duties, etc.

TABLE 3. Base-hour Fire Effects Crew Focus Areas/Accomplishments in 2012.

Focus Area	Percent Time	Accomplishments and Activities
FMH Plots	14%	39 remeasurements, 2 pre-burn reads, 2 immediate post-burn reads - Assistant + 2 crewmembers assisted 2 weeks at Saguaro NP & Chiricahua NM
RAP Plots	7%	20 pre-burn re-reads, 40 immediate post-burn reads across 2 Rx burn units
CBI Plots	2%	97 plots across 5 fires
I&M Plots	2%	9 pre-burn, 7 immediate post-burn reads of fuel and tree data
Plot Office	10%	Includes FMH, RAP, CBI, & I&M plot preparation, plant ID, and data filing/organization
Data Entry	4%	- Entered all scheduled 2012 FMH & RAP plot data by Oct 5 - Checked all scheduled 2012 FMH & RAP plot data by Oct 12 - Entered and checked all fall prescribed fire data by Dec 7
Data Analysis	1%	Annual Report analysis on all major variables in program
General Office/ Supervision/ Admin	17%	- Includes paperwork for travel, credit cards, non-plot related projects - Hiring, evaluations, and supervision by Lead & Assistant - Lead & Ecologist hired 1 new seasonal crewmember - Lead supervised 1 permanent Assistant Lead & 4 seasonals
Fire Monitoring (Rx or Wildfire)	3%*	- Lead FEMO & FEMO-trainees on 2 Rx fires at GRCA & 1 Rx fire on Kaibab NF - Lead FEMO & FEMO-trainees on 3 wildfires at GRCA & 2 wildfires on Kaibab NF
Fire Operations/ Assignments (Rx, Wildfire, Engine, Helitack, Non-fire Fuels Projects)	21%*	2 crewmembers detailed for a total of 4 weeks with Grand Canyon Helitack to New Mexico 1 crewmember detailed for 4 weeks with Saguaro Wildland Fire Module to Yellowstone NP 4 crewmembers detailed for a total of 6 weeks with Grand Canyon and North Zone engine crews to fires in Idaho, Nevada, California, and Washington - FIRB-t assignments by Lead and Assistant on multiple local prescribed burns - ICT5, FFT1, and FFT2 support on multiple North Zone fires - GISS support on multiple North Zone fires - Cross-trained crewmembers with GRCA engines, mechanical fuel reduction projects, fuel sampling
Training	4%	- All attended annual fire refresher 3 completed L280 1 completed S490 1 completed B3 aviation safety 1 attended Helicopter Training Academy (HTA) 1 completed Resource Advisor (READ) training 3 completed First Aid+CPR 1 completed Wilderness First Responder (WFR) refresher
Travel Away from Duty Station	—	Total of ~2 months spent on South Rim, camped out on Walla Valley unit away from duty station, or assisting Saguaro Fire Ecology
Other	16%	4% of crew time spent on PT 5% of crew time spent on leave

*Approximately 1800 hours of overtime spent on fire activities, equaling 22% of total crew work time (base + OT), are not reflected.

TABLE 4. Fire Ecologist Focus Areas/Accomplishments in 2012.

Focus Area	Percent Time	Accomplishments and Activities
Planning	15%	- GRCA Fire IDT – reviewed 3 burn plans and 1 thinning plan, planning meetings and briefings for prescribed fires and wildfires - Worked on compliance tasks (Section 7, wilderness MRA) - Managed activities in NFPORS and participated in out-year planning - Prepared briefing materials for two program-wide field trips
Presentations/ Education	4%	- Presented at the SW Association for Fire Ecology and the Ecological Society of America conferences - Assisted Interpretation & Environmental Education Division with fire field trips, staff orientation, and presentations to students - Guest Lecturer for NAU Fire Ecology class - Worked with NAU journalism students on fire ecology video - Prepared fire data for Resource Management presentation to tribes
NPS Meetings/ Task Groups	4%	- Fire and park staff meetings - Fire, Compliance, & Resource Management collaboration meetings - Greater Grand Canyon Landscape Assessment review and meeting
Interagency Work	5%	- Southwest AFE Conference program committee co-chair - Joint Fire Science proposal review panel - Forest Service: data review for 4FRI, Kaibab NF monitoring plan panel, North Kaibab projects data compilation and MSO meeting
Fire Assignments and Project Work	5%	- FEMO on 2 in-park prescribed fires - FFT2 on 1 in-park and 1 Kaibab NF wildfire
Research	4%	- Meetings and CESU agreement for Reserve Fund research project - Field trip with potential University of Montana research partners - GRCA research permit reviews - Provided data, research ideas, and reviews for 5 other fire-related projects
Data Collection	5%	- FMH, RAP, I&M, and CBI plot data collection - Field recon of prescribed fire and thinning units
Data Entry & Management	5%	- Created quality checking query procedures for FFI database - Identified and remedied FFI database errors
Data Analysis	9%	- Analyzed FMH and RAP plot data, severity data, and weather and fuel data for burn plans, wildfires, field trips, and annual report - Compiled FMH and RAP data for use in new MSO habitat map
Supervision/ Admin	11%	- Supervised Lead Monitor - Hired and supervised Fire Ecology & Fuel Management intern - Worked with Lead Monitor to hire seasonal crewmembers - Managed fire monitoring activities budgets - Travel, time, and purchasing
Training & Conferences	19%	- S-390, L-280, and S-133 fire courses; fire, CPR, and B-3 refreshers - NPS Supervisory Course - Computer Modeling for Fuel Specialists course; FRCC workshop - SW AFE and Ecological Society of America Conferences - NPS Operational Leadership and required annual training - PT (5%)
Other	14%	- Travel between South and North Rims - Paid leave and holidays

FIRE EFFECTS PLOT WORKLOAD

The 2012 season produced a moderate FMH plot load for most of the year at Grand Canyon, followed by an intense 49 immediate post-burn reads due to late-season prescribed fire activity. In addition, 9 I&M plots were added to the program to increase plot representation in North Rim mixed conifer.

TABLE 5. Fire Effects Plot Workload for 2012.

Rim	Monitoring Unit	Plot Type	Install/ Pre-burn	Immed. Post-burn	Year 1	Year 2	Year 5	Year 10/ 20	Annual Total	Total Plots¹
South	Ponderosa Pine PIPO	FMH			5	2	5	1	13	41
South	Pinyon-Juniper Woodland—PIED²	FMH							0	17
South	Lower	CBI			14				14	-
South	New Water	CBI			15				15	-
South	Watson 2/3/4	CBI			10				10	-
South	Moqui Rx	RAP ³							0	5
South	Picnic Rx	RAP ³							0	10
South	Quarry Rx	RAP ³							0	10
North	Ponderosa Pine PIPN	FMH			11		8		19	30
North	Ponderosa Pine with White Fir Encroachment PIAB	FMH	1	1			7		9	27
North	Rocky Mountain Subalpine Conifer PIEN	FMH	1	1					2	17
North	Grassland Interior GRIN	FMH							0	10
North	Grassland Edge GRED	FMH							0	6
North	Point	CBI			45				45	-
North	Woolsey	CBI			13				13	-
North	Fawn Spring Rx	RAP ³							0	20
North	Range Rx	RAP ³	20	20					40	20
North	Spring Canyon Rx	RAP ³							0	20
North	Thompson Rx	RAP ³		20					20	20
North	Walla Valley Rx	RAP ³							0	6
North	Mixed Conifer	I&M ⁴	9	7					16	30
Total			31	49	113	2	20	1	216	289

¹Total Plots includes all permanent plots (FMH , RAP, or I&M) installed to date within a monitoring unit/type

²PIED monitoring type reads were discontinued in 2000

³Pilot sampling

⁴Fuel and tree data collected to add to data collected by I&M crews

MONITORING OBJECTIVES & RESULTS

Fuel Loading & Tree Density – FMH plots

Grand Canyon National Park's Fire Ecology Program has installed 148 permanent FMH-style plots to date and has burned 116 of these same plots. This large body of data allows us the luxury of being able to report results to our desired level of statistical accuracy for many of our major management objectives. The management objectives for each monitoring type were revised in 2010 to establish separate restoration and maintenance objectives. The following tables reflect this revision and, therefore, may differ from results reported in previous years. The PIEN and PIED monitoring types are no longer included in these tables because (1) these areas are thought to be within the natural fire regime and do not need restoration objectives and (2) maintenance objectives were not established because prescribed fires are not the management focus in these areas. Of the 9 restoration objectives listed in Table 6, we can say with statistical confidence we are achieving 5 of them after first entry fire and 3 of them after second entry fire.

Targeted mean fuel loading values were achieved during first entry fires in the PIPO and PIPN monitoring types. In the PIAB monitoring type, mean fuel loading fell within the targeted range, but the confidence limits extend above the targeted range (too much fuel remaining). After second entry fires, mean fuel loading values in all monitoring types were within the targeted range, but the confidence limits extend above the targeted range (too much fuel remaining) in the PIPO and PIAB monitoring types.

In the PIPO and PIPN monitoring types we cannot install the number of plots needed to overcome the variability in pole-sized tree density. In the PIPO monitoring type, mean pole-sized tree density was higher than the targeted value after first and second entry fire. In the PIPN monitoring type, mean pole-sized tree density fell within the targeted range after both first and second entry fire. However, the confidence limits extend above the targeted range (too many pole-sized trees) after the first entry fires and below the targeted range (too few pole-sized trees) after the second entry fires. The PIAB monitoring type has the minimum number of plots required to overcome variability in pole-sized tree density. After first entry fires in the PIAB type, mean pole-sized tree density was within the targeted range; however, the confidence limits extend above the targeted range (too many pole-sized trees). After second entry fires in the PIAB type, mean pole-sized tree density was well below the targeted range.

For large tree density, minimum plot numbers have been reached for all monitoring types except second entry fires for the PIAB monitoring type. Mean large tree density remained within the targeted range (and showed little change from pre-fire values) for first and second entry fires in the PIPO monitoring type. Mean large tree density decreased from pre-fire values in the PIPN monitoring type in both first and second entry fires, but mean values remained within the targeted range. In the PIAB monitoring type, mean large tree density decreased from pre-fire values, but remained within target values after first entry fire. Only four plots have reached the year 5 measurement for second entry fires in the PIAB monitoring type, so values for this type are unreliable.

Table 6. Restoration Management Objectives and Monitoring Results for FMH plots in 2012. 1st entry and 2nd entry refer, respectively, to the first and second times an area has burned in any fire type (prescribed fire or wildfire).

Monitoring Unit	Restoration Management Objectives	Monitoring Results (n = # of plots)		Objectives Achieved?		Minimum Plot #s Achieved?
		1 st Entry	2 nd Entry	1 st Entry	2 nd Entry	
Ponderosa Pine (PIPO) South Rim	Reduce total fuel load to 0.2-9.3 tons/acre immediate post-burn	7.1 ± 0.8 tons/acre (-48%) (n=35)	7.9 ± 1.7 tons/acre (-48% due to fire 1 & 2) (-2% due to fire 2 only) (n=20)	YES	YES*	YES n=10
	Reduce poles (PIPO) with DBH of 1-6" to 16-81 trees/acre 2 years post-burn	82.7 ± 31.9 trees/acre (-26%) (n=36)	112.9 ± 44 trees/acre (-32% due to fire 1 & 2) (-5% due to fire 2 only) (n=19)	NO	NO	NO n=64
	Maintain overstory (PIPO) density with DBH ≥16" of >14 trees/acre 5 years post-burn	19.6 ± 2.5 trees/acre (+0%) (n=34)	18.7 ± 3.7 trees/acre (-3% due to fire 1 & 2) (-0% due to fire 2 only) (n=18)	YES	YES	YES n=16
Ponderosa Pine (PIPN) North Rim	Reduce total fuel load to 0.2-15.7 tons/acre immediate post-burn	12.1 ± 1.6 tons/acre (-56%) (n=30)	10.3 ± 2.6 tons/acre (-60% due to fire 1 & 2) (-42% due to fire 2 only) (n=20)	YES	YES	YES n=10
	Reduce conifer poles with DBH of 1-6" to 16-81 trees/acre 2 years post-burn	70.5 ± 34.6 trees/acre (-60%) (n=29)	16.2 ± 10.2 trees/acre (-78% due to fire 1 & 2) (-44% due to fire 2 only) (n=10)	YES*	YES*	NO n=48
	Maintain overstory conifer density with DBH ≥16" of >17 trees/acre 5 years post-burn	41.0 ± 4.0 trees/acre (-10%) (n=29)	42.8 ± 11.1 trees/acre (-11% due to fire 1 & 2) (-14% due to fire 2 only) (n=7)	YES	YES	YES n=4
Ponderosa Pine w/ White Fir Encroachment (PIAB) North Rim	Reduce total fuel load to 1.7-19.0 tons/acre immediate post-burn	17.5 ± 3.3 tons/acre (-49%) (n=20)	17.6 ± 7.7 tons/acre (-59% due to fire 1 & 2) (-35% due to fire 2 only) (n=11)	YES*	YES*	YES n=6
	Reduce conifer poles with DBH of 1-6" to 16-100 trees/acre 2 years post-burn	86.6 ± 24.8 trees/acre (-65%) (n=20)	1.6 ± 1.5 trees/acre (-98% due to fire 1 & 2) (-63% due to fire 2 only) (n=10)	YES*	NO	YES n=10
	Maintain overstory conifer density with DBH ≥16" of >20 trees/acre 5 years post-burn	28.3 ± 2.6 trees/acre (-22%) (n=19)	27.3 ± 9.5 trees/acre (+9% due to fire 1 & 2) (+11% due to fire 2 only) (n=4)	YES	YES*	YES, 1 st entry NO, 2 nd entry n=7

NOTE: Assessment of objective success and fulfillment of minimum plot requirements are based on 80% confidence intervals, with R-value of 20 for overstory tree and fuel assessment and R-value of 25 for pole-sized tree assessment. Minimum plot calculations are based on pre-fire values; variable fire conditions increase the minimum number of recommended plots for post-fire analysis.

YES* indicates that the mean value meets stated objectives but the confidence interval is outside the range of objective values.

Maintenance objectives were established in 2010 to help refine desired states for each monitoring type. On the South Rim, maintenance burning will likely continue in the form of prescribed fires, while on the North Rim, the expectation is that wildfires will be managed to achieve maintenance objectives. These objectives are for the general state of the landscape and will help define return intervals for prescribed fires on the South Rim and initiate planning for prescribed fires on the North Rim if wildfires are regularly suppressed. Measurement periods currently correspond to those for restoration targets but can be adjusted based on management need.

Maintenance burning in the PIPO type has resulted in achievement of both plot-based objectives. In the PIPN type, two plots have burned in third entry fire, but they both burned 2 years after the second entry fire. The small plot number and anomalous burn interval in the PIPN type make these results unreliable.

Table 7. Maintenance Management Objectives and Monitoring Results for FMH plots in 2012. 3rd entry refers to the third time an area has burned in any fire type (prescribed fire or wildfire).

Monitoring Unit	Maintenance Management Objectives	Monitoring Results 3 rd Entry (n = # of plots)	Objectives Achieved?	Minimum Plot #s Achieved?
Ponderosa Pine (PIPO) South Rim	Maintain total fuel load of 0.2-9.3 tons/acre immediate post-burn	6.4 ± 1.9 tons/acre (-59% due to fire 1, 2, & 3) (-25% due to fire 3 only) (n=16)	YES	YES n=10
	Maintain tree (PIPO) density with DBH ≥1" of 43-135 trees/acre 5 years post-burn	76.2 ± 22.0 trees/acre (-0.5% due to fire 1, 2, & 3) (+0.8% due to fire 3 only) (n=6)	YES	NO n=24
Ponderosa Pine (PIP) North Rim	Maintain total fuel load of 0.2-15.7 tons/acre immediate post-burn	5.3 ± 8.8 tons/acre (-53% due to fire 1, 2, & 3) (-18% due to fire 3 only) (n=2)	YES*	NO n=10
	Maintain conifer pole density with DBH of 1-6" of <81 trees/acre 2 years post-burn	16.2 ± 24.9 trees/acre (-81% due to fire 1, 2, & 3) (-25% due to fire 3 only) (n=2)	YES	NO n=48
Ponderosa Pine w/ White Fir Encroachment (PIAB) North Rim	Maintain total fuel load of 1.7-19.0 tons/acre	Not analyzed (n=0)	N/A	NO n=6
	Maintain conifer pole density with DBH of 1-6" of <100 trees/acre	Not analyzed (n=0)	N/A	NO n=10

NOTE: Assessment of objective success and fulfillment of minimum plot requirements are based on 80% confidence intervals, with R-value of 20 for overstory tree and fuel assessment and R-value of 25 for pole-sized tree assessment. Minimum plot calculations are based on pre-fire values; variable fire conditions increase the minimum number of recommended plots for post-fire analysis.

YES* indicates that the mean value meets stated objectives but the confidence interval is outside the range of objective values.

Range Prescribed Fire– RAP plots

The 2,278 acre Range Prescribed Fire was ignited October 27-31, 2012. The ignition pattern on the Range project was designed to create primarily backing and flanking fire spread along the ridge tops and upper slopes within the unit. The project was the first attempt by the park to conduct prescribed fire in the mixed conifer forest type and represented the first phase in the projected multi-phase project implementation. Objectives for the project focused on reduction of large woody debris (1000-hr TLFM fuel loading) with additional objectives of remaining within the 30% threshold of high severity fire for mixed conifer forests across the landscape and reducing the number of small trees within the unit.

Twenty RAP plots were randomly located in the unit in 2008. These plots were remeasured in 2012 prior to project implementation to ensure that project results were as accurate as possible. Post-fire attributes were measured in the 20 RAP plots in November 2012. Due to the intentionally heterogeneous burn pattern generated during this prescribed fire, 8 of the 20 RAP plots remained unburned after the completion of this project (Figure 1).

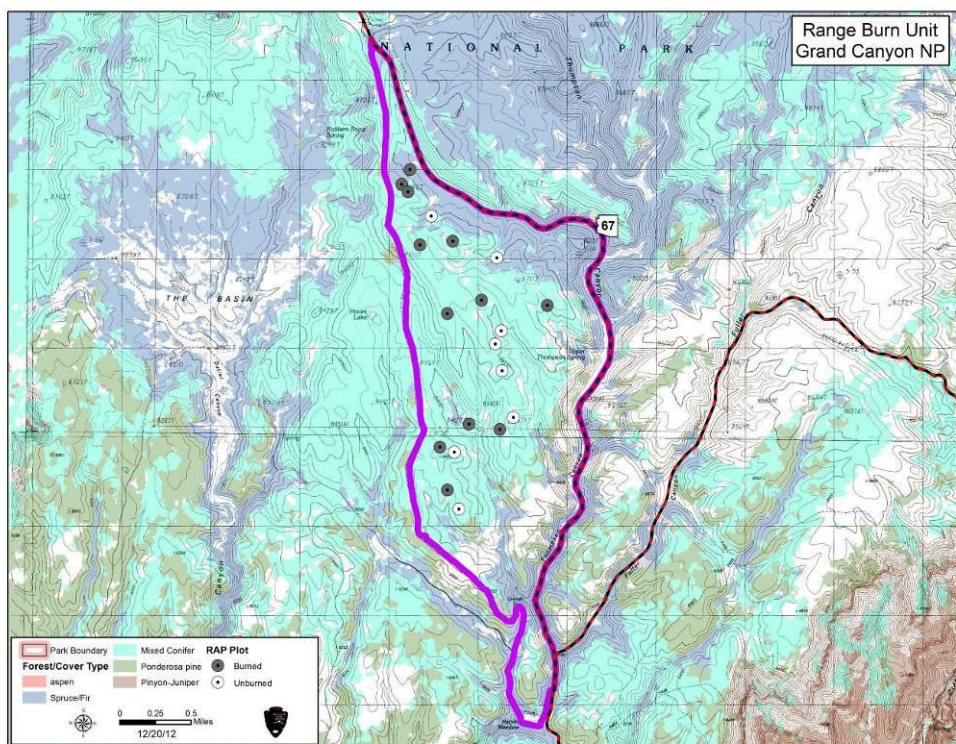


Figure 1. Range Prescribed Fire with burned (gray) and unburned (white) RAP plots.

Objective 1: Reduce % of dead and downed woody fuels by weight in 1000-hour fuel size classes immediately post-burn [Acceptable: 30-60% reduction; Optimal: 40-50% reduction]

Average total reduction in the 1000-hr fuel class across the entire burn unit (all 20 plots) was 18% one month after the fire (Figure 2). The 12 plots that burned met the minimum acceptable 1000-hr fuel reduction of 30%, on average, but due to the number of unburned plots, 1000-hr fuel reduction in the unit as a whole was below the acceptable range. Unburned plots showed no change in 1000-hr fuel loading because the pre-burn measurements were conducted one month prior to the burn. Rotten 1000-hr fuel was reduced by an average of 62% in the burned plots (average of 37% overall) and was the major contributor to total 1000-hr fuel reduction. Sound 1000-hr fuel increased by an average of

120% in the burned plots (average of 72% overall) one month after the fire due to standing dead trees burning and falling down.

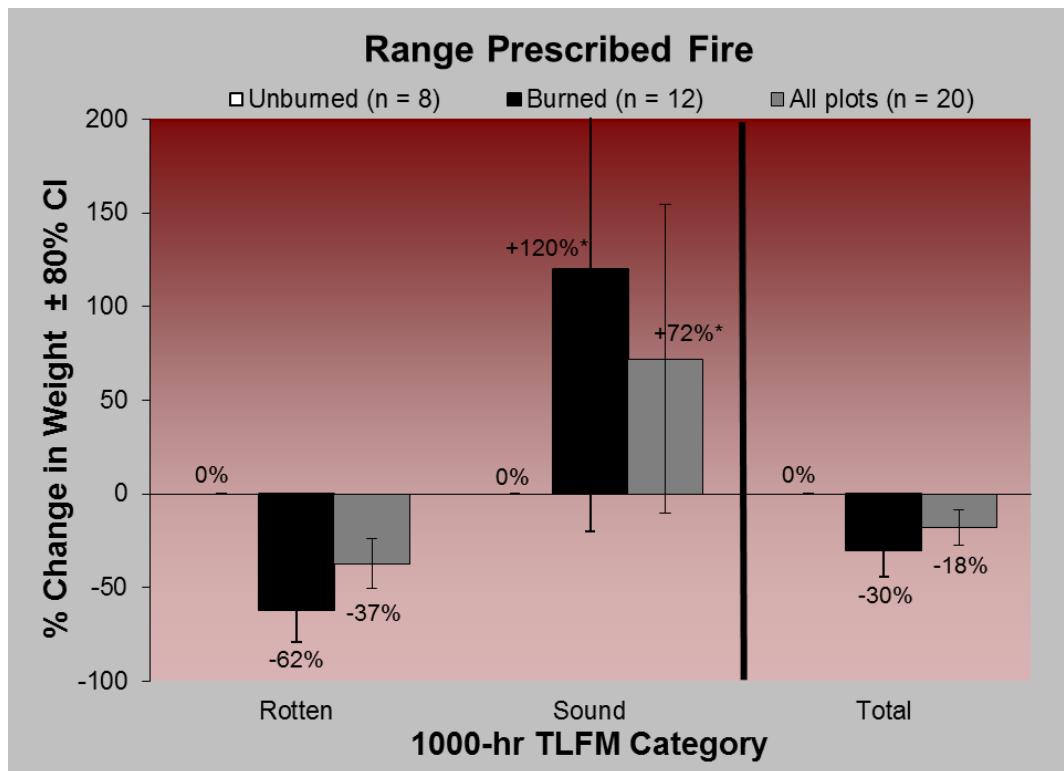


Figure 2. 1000-hour fuel reduction results for the Range Prescribed Fire.

*Objective 2: Reduce % of live seedlings and saplings less than 6" DBH within 2 years post-burn
[Acceptable: 20-50% reduction; Optimal: 40-50% reduction]*

Live conifer seedlings (<1" DBH) and saplings (1 – 6" DBH) were measured during the one-month post read to give an initial assessment of mortality. One month after the fire, conifer seedling density was reduced by an average of 29% and conifer sapling density was reduced by an average of 16% across the entire burn unit (all 20 plots; Figure 3). Unburned plots showed no change in seedling or sapling density because the pre-burn measurements were conducted one month prior to the burn. In burned plots, conifer seedling density was reduced by an average of 48% and conifer sapling density was reduced by an average of 27% one month after the burn. Seedlings and saplings will be measured again two years post-burn to fully assess the achievement of Objective 2.

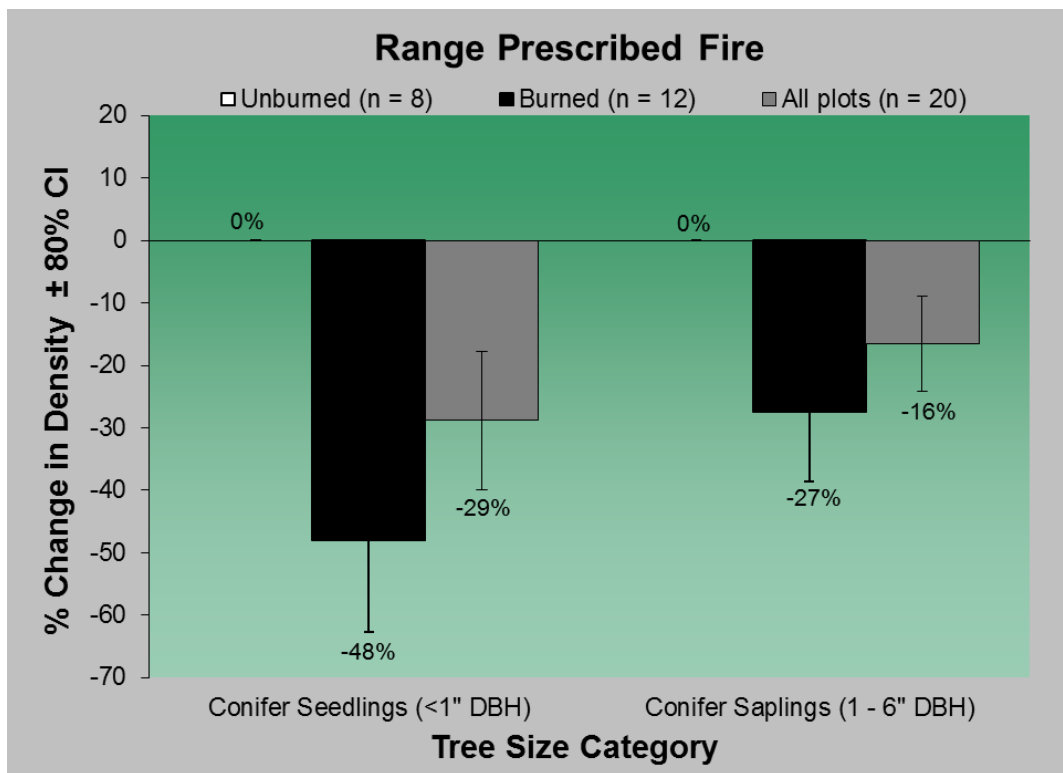


Figure 3. Live seedling and sapling reduction results for the Range Prescribed Fire.

Objective 3: Ensure that no more than 30% of the mixed-conifer vegetation type and MSO mixed-conifer restricted habitat burns with moderate-high and high severity

Objective 3 will be quantitatively assessed in the fall of 2013 when the MTBS burn severity data is available and CBI plots have been visited. Initial assessments show 0% change in intermediate or large conifer trees in the 20 RAP plots one month after fire (see below). Based on the plot visits and post-burn unit reconnaissance, the amount of moderate-high and high severity fire in MSO mixed conifer restricted habitat is expected to be minimal.

Additional analysis: Overstory tree density

Density of intermediate (6 – 16" DBH) and large (>16" DBH) conifer trees changed by an average of 0% one month after fire across the entire burn unit (all 20 plots). In fact, no intermediate or large conifer tree mortality was recorded in any of the 20 plots. Intermediate and large tree density will be measured again two years after the fire to track potential delayed mortality in these tree size classes.

Additional analysis: Small fuel loading

Small fuel loading (litter, duff, and fine woody debris) was also assessed one month after the fire. Across the entire burn unit (all 20 plots), litter and duff loading was reduced by an average of 25% and fine woody debris (1-, 10-, and 100-hr TLFM) was reduced by an average of 14% one month after the fire (Figure 4). Unburned plots showed no change in small fuel loading because the pre-burn measurements were conducted one month prior to the burn. In burned plots, litter and duff loading was reduced by an average of 42% and fine woody debris was reduced by an average of 23% one month after the fire.

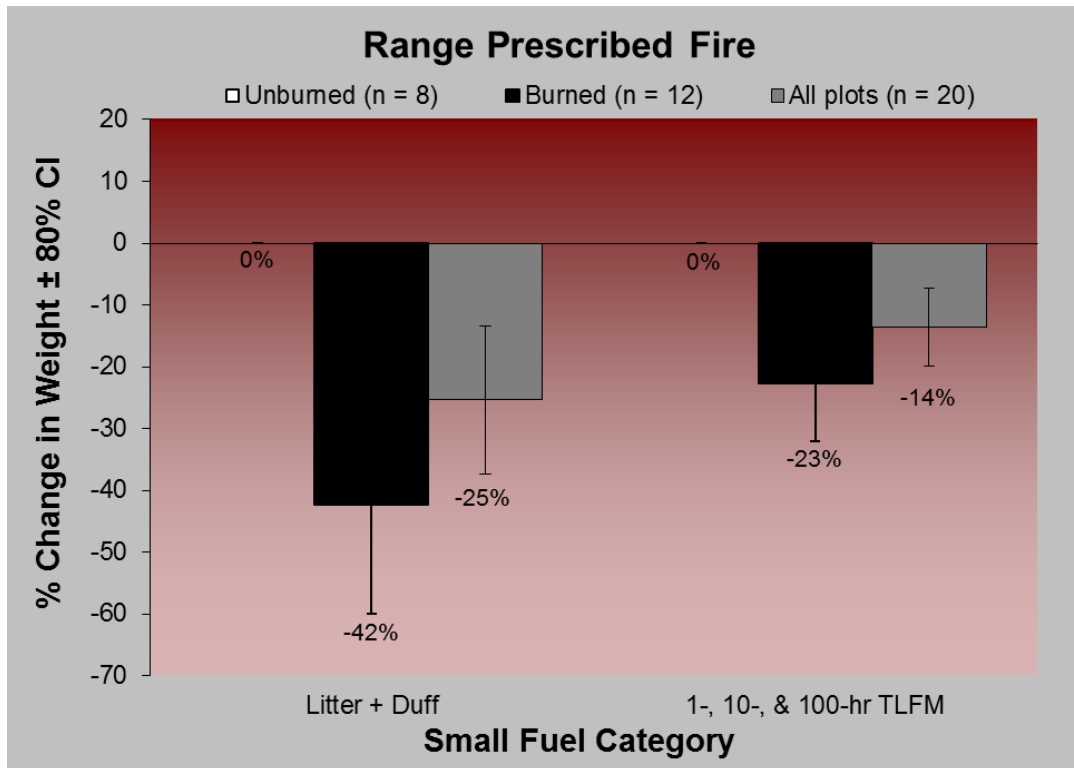


Figure 4. Small fuel reduction results for the Range Prescribed Fire.

Thompson Prescribed Fire– RAP plots

The 2,349 acre Thompson Prescribed Fire was ignited November 2-5, 2012. The primary goal of the Thompson project was to create a buffer between the spruce-fir forests in the park and sensitive resources on the Kaibab National Forest. The project was designed to allow the park flexibility in managing lightning fires in the spruce-fir forest under a more natural fire regime. The ignition pattern on the Thompson project focused on areas with large logs where fire could potentially spread log-to-log. Objectives for the project focused on reduction of large woody debris (1000-hr TLFM fuel loading) within the unit.

Twenty RAP plots were randomly located in the unit in 2009. Post-fire attributes were measured in the 20 RAP plots in November 2012. Due to the heterogeneous burn pattern generated during this prescribed fire, 9 of the 20 RAP plots remained unburned after the completion of this project (Figure 5).

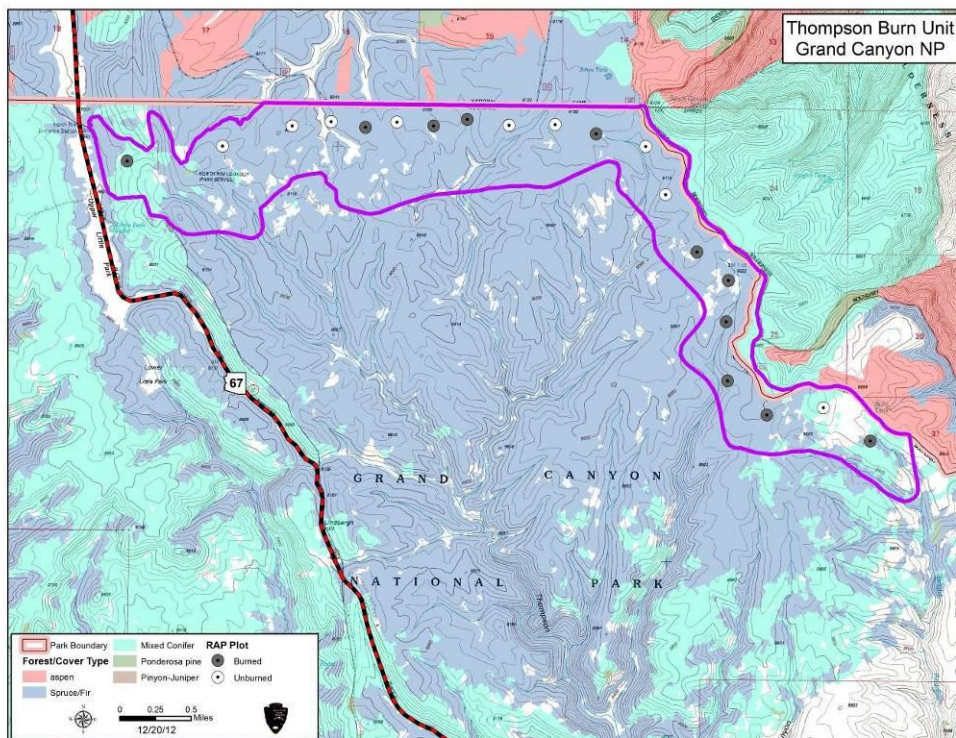


Figure 5. Thompson Prescribed Fire with burned (gray) and unburned (white) RAP plots.

Objective: Reduce % of dead and downed woody fuels by weight in 1000-hour and larger fuel size classes immediately post-burn [Acceptable: 40-70% reduction; Optimal: 40-60% reduction]

Average total change in the 1000-hr fuel class across the entire burn unit (all 20 plots) was an increase of 1% one month after the fire (Figure 6). The 11 plots that burned had a 1000-hr fuel reduction of 29%, on average, from pre-fire measurements. Pre-fire measurements were conducted three years before the fire, and as indicated by the values in the unburned plots, 1000-hr fuel loading likely increased between the pre-fire measurements and the prescribed fire. Unburned plots showed an average 37% increase in total 1000-hr fuel loading with an average 67% increase in sound logs and an average 21% increase in rotten logs. In the burned plots, rotten logs were reduced by an average of 37% and sound logs were reduced by an average of 9% one month after the fire.

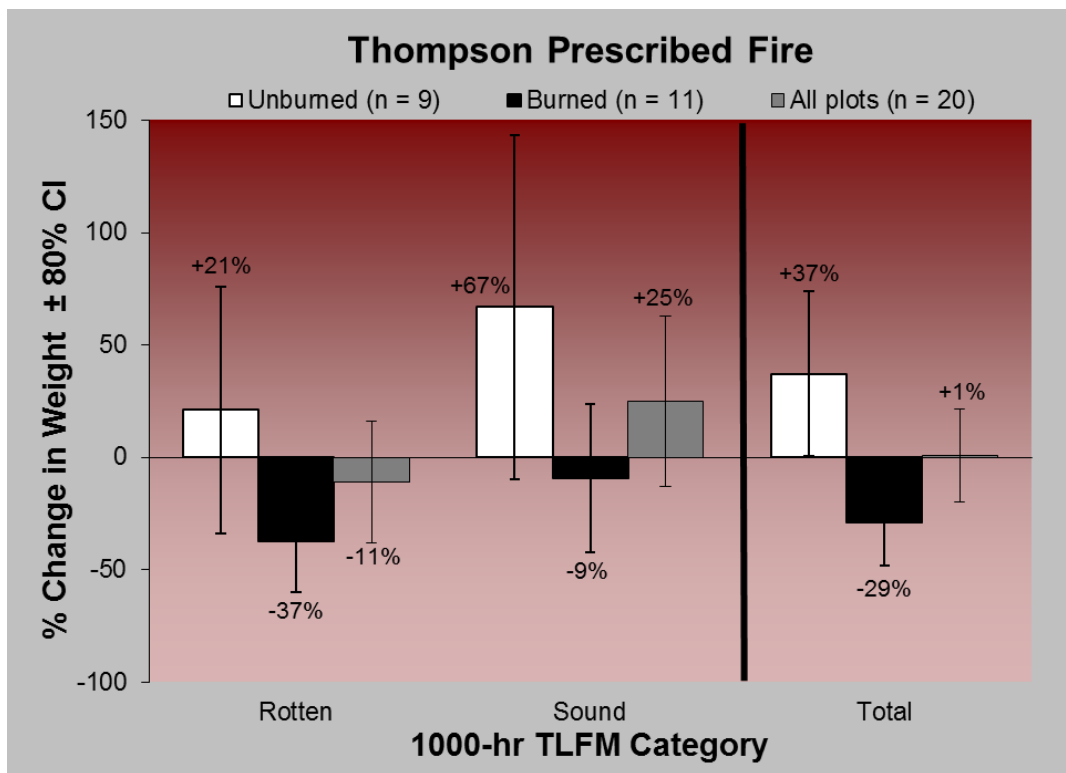


Figure 6. 1000-hour fuel reduction results for the Thompson Prescribed Fire.

Additional analysis: Small fuel loading

Small fuel loading (litter, duff, and fine woody debris) was also assessed one month after the fire. Across the entire burn unit (all 20 plots), litter and duff loading was reduced by an average of 35% and fine woody debris (1-, 10-, and 100-hr TLFM) was reduced by an average of 1% one month after the fire (Figure 7). In burned plots, litter and duff loading was reduced by an average of 62% and fine woody debris was reduced by an average of 25% one month after the fire. Pre-fire measurements were conducted three years before the fire, and as indicated by the values in the unburned plots, fine woody debris loading likely increased (average of 30%) between the pre-fire measurements and the prescribed fire while litter and duff loading may have decreased slightly (average of 2%) between the pre-fire measurements and the prescribed fire.

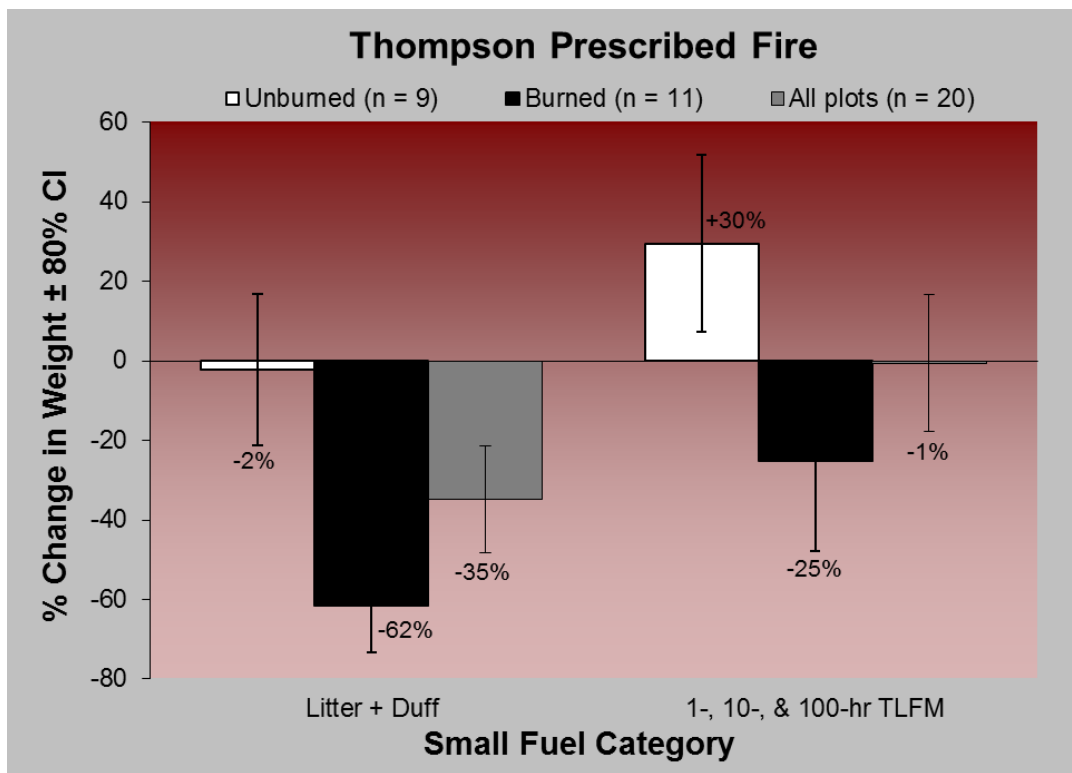


Figure 7. Small fuel reduction results for the Thompson Prescribed Fire.

Additional analysis: Tree density

Live conifer trees were measured during the one-month post read to give an initial assessment of mortality. One month after the fire, conifer seedling density was reduced by an average of 9%, conifer sapling density increased by an average of 19%, and intermediate conifer tree density decreased by an average of 7% across the entire burn unit (all 20 plots; Figure 8). Density of large conifer trees changed by an average of 0% one month after fire and no large conifer tree mortality was recorded in any of the 20 plots. Trends in burned plots followed the overall trends with conifer seedling density reduced by an average of 19%, conifer sapling density increased by an average of 4%, and intermediate conifer tree density reduced by 7%. For intermediate trees, an average density reduction of 8% in the unburned plots in the three years between pre- and post-fire measurements suggests that mortality in this size class is related to factors other than the prescribed fire. In the seedling and sapling size classes, the fire seems to have counteracted background increases in tree density. Unburned plots showed an increase in conifer seedling density by an average of 4% and an increase in conifer sapling density by an average of 38% one month after the burn. Tree density will be measured again two years after the fire to track potential delayed mortality in all tree size classes.

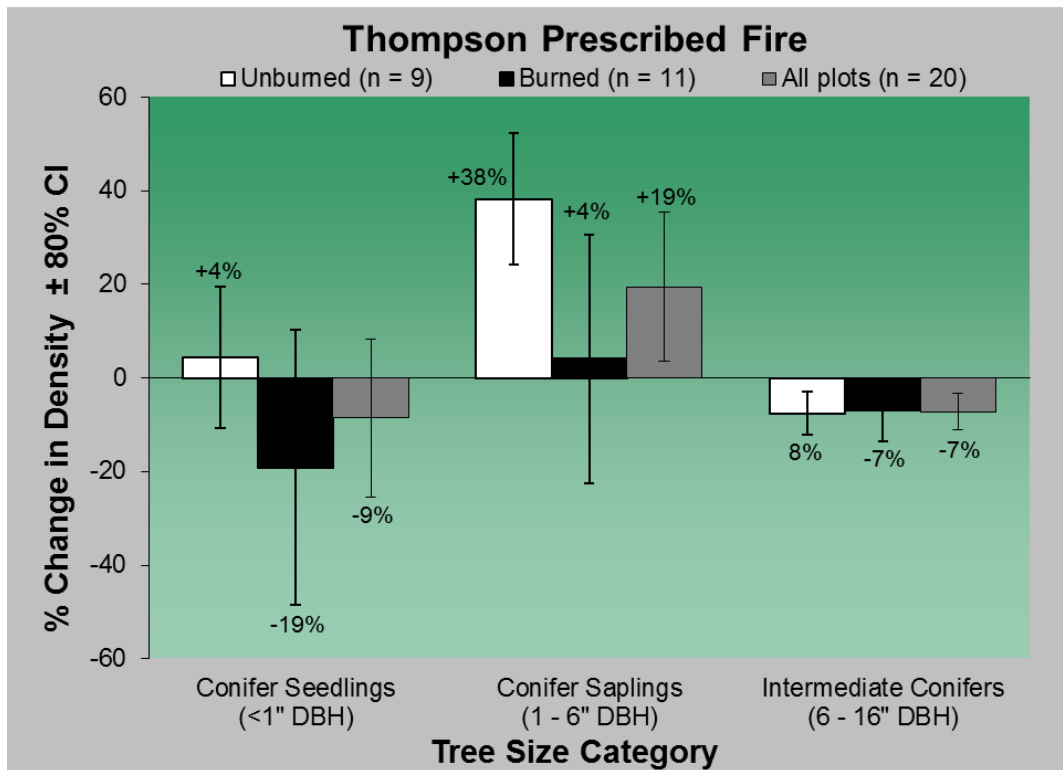


Figure 8. Seedling, sapling, and intermediate tree density change in the Thompson Prescribed Fire.

Burn Severity – MTBS data and CBI plots

As part of the Monitoring Trends in Burn Severity (MTBS) program, Composite Burn Index (CBI) burn severity assessments have been occurring annually at Grand Canyon since 2001. Between 2001 and 2012, 1,190 post-fire year 1 CBI-style plots have been measured in the park, providing Normalized Burn Ratio (NBR) satellite-correlated severity data on 51 fires over 124,000 total acres. This process is designed for field data and satellite imagery gathered one year following a fire; hence, 2012 work was performed on fires which burned in 2011. A total of 97 CBI plots were installed in 2012 across 18,823 acres in the New Water, Lower, Point, and Woolsey Wildfires and the Watson 2/3/4 Prescribed Fire.

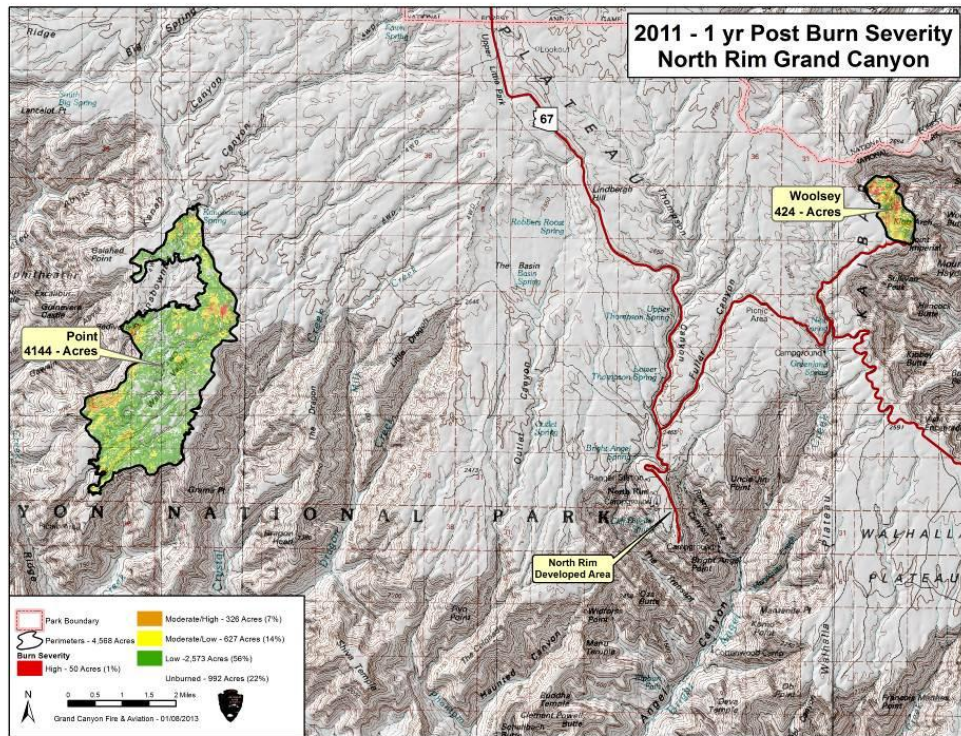


Figure 9. Burn severity data collected one year post-fire on the North Rim.

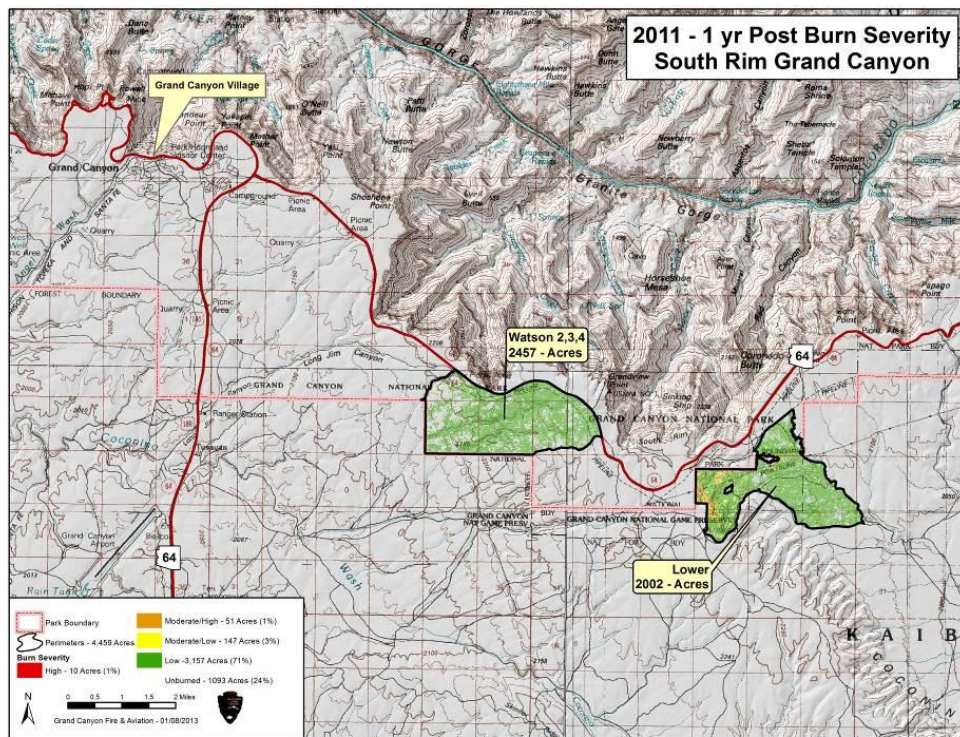


Figure 10. Burn severity data collected one year post-fire on the South Rim.

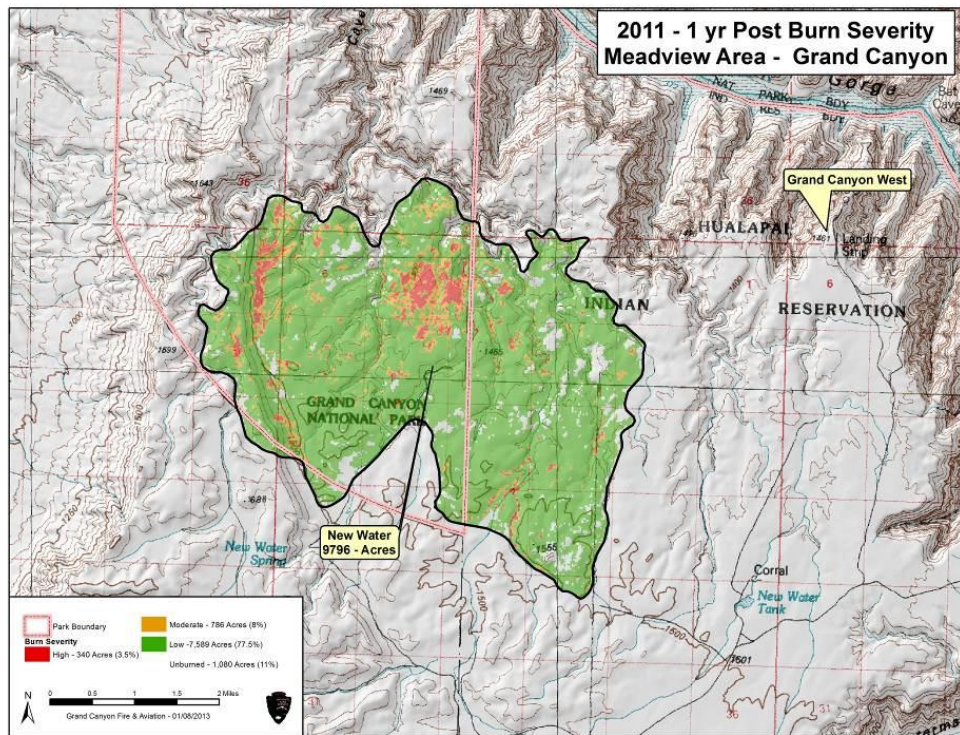


Figure 11. Burn severity data collected one year post-fire in the Meadview Area.

As part of the 2010 monitoring plan revision, landscape-scale severity objectives were established for the three monitoring types in which high severity fire was historically infrequent (PIPO, PIPN, and PIAB). In addition, severity objectives were established for mixed conifer forest in the 2009 Final Fire Management Plan EIS and 2009 Fire Management Plan Biological Assessment for the mixed conifer forest type (currently not an FMH monitoring type), and these objectives were included in the 2010 monitoring plan revision. The following table provides information on the extent of moderate-high and high severity fire in each monitoring type.

In all monitoring types, the percentage of moderate-high and high severity fire on the landscape falls within the objective ranges. Some patches of moderate-high and high severity fire exceed the objective size in all monitoring types.

Table 8. Management Objectives and Monitoring Results for fires from 2002-2011.

Monitoring Unit	Management Objectives	Monitoring Results (all patches >0.1 acres)	Objectives Achieved?
Ponderosa Pine (PIPO) South Rim	Limit high severity fire to patches <5 acres across ≤5 % of monitoring type 10 year period fires from 2002 to 2011	2% moderate-high/high severity 11 patches >5 acres largest patch: 32 acres	YES - percent NO - size
Ponderosa Pine (PIP) North Rim	Limit high severity fire to patches <5 acres across ≤5 % of monitoring type 10 year period fires from 2002 to 2011	3% moderate-high/high severity 18 patches >5 acres largest patch: 52 acres	YES - percent NO - size
Ponderosa Pine w/ White Fir Encroachment (PIAB) North Rim	Limit high severity fire to patches <10 acres across ≤15 % of monitoring type 10 year period fires from 2002 to 2011	12% moderate-high/high severity 48 patches >10 acres largest patch: 288 acres	YES - percent NO - size
Rocky Mountain Montane Conifer (Mixed Conifer) North Rim	Limit high severity fire to ≤30 % of monitoring type fires from 2000 to Present	18% moderate-high/high severity	YES

ADDITIONAL PROGRAM INFORMATION

TABLE 9. Additional Program Information for 2012.

Program Category	Measurement	Park: Grand Canyon
Planning	Does park have written Desired Future Conditions (DFCs)?	Yes
Planning	Date park-level monitoring plan completed (or revised)	2010
Planning	Total # project- or community-level monitoring plans	0
Planning	Assisted with how many Burned Area Emergency Rehabilitation (BAER) plans in 2011?	0
Monitoring	% 2012 data entered	100
Monitoring	% 2012 data quality checked	100
Monitoring	# prescribed fires monitored ¹	2
Monitoring	# non-fire fuels treatments monitored ¹	0
Monitoring	# wildfires monitored ¹	0
Monitoring	# BAER treatments monitored ¹	0
Communication	# project monitoring reports completed in 2012 ²	4
Communication	# annual meeting(s) with park staff	2
Communication	# formal presentations of results	4
Communication	Do you use Minitab?	Yes
Research	Are research needs identified in Fire Management Plan (FMP) or monitoring plan?	Yes
Research	# proposals submitted in 2012	0
Research	# proposals funded in 2012	1
Research	# research projects supported in 2012 ³	7
Research	Additional Comments	

¹Number of fires/treatments completed in 2012 with fire/treatment effects monitoring conducted. Includes pre- and post-fire/treatment monitoring, but not on-site fire behavior monitoring. Does not include post-fire/treatment monitoring of fires/treatments that occurred prior to 2012.

²Project monitoring results for two projects included as part of this annual report. Existing GRCA protocol burn-day monitoring reports are not included in this number.

³Number of funded research projects supported including logistical info or support, staffing, data sharing, product reviews, etc.

RESERVE FUND RESEARCH UPDATE

Comparing modern and historical high-elevation fire regimes at Grand Canyon (Peter Z. Fulé and Larissa L. Yocom, Northern Arizona University)

This research project was funded by the Reserve Fund and NPS Intermountain Region in January 2012 and a cooperative agreement through the Colorado Plateau CESU was in place by February. NAU researchers received a research permit from the park in April and conducted field work from June to August. Tree cores were collected from 911 trees in 72 plots, stratified by dominant tree species. The tree cores are currently being processed in the NAU School of Forestry and data entry has begun. An abstract has been submitted to present initial results at a dendrochronology conference in May 2013.

In addition, NAU researchers obtained funding in September from the NAU Technology and Research Initiative Fund (TRIF) Support for Post-Doctoral Associates (SPA) Program to expand the Reserve Fund research to include modeling forest conditions and thresholds for high-severity fire in the future under changing climatic conditions. The post-doctoral associate job announcement closed in December and NAU hopes to hire the position and begin this phase of the research project in early 2013.

The Reserve Fund project is expected to be completed by February 28, 2014. Project deliverables include:

- Electronic copies of datasets/databases with Federal Geographic Data Committee (FGDC) compliant metadata
- Map of high-severity, stand-initiating fire events with FGDC compliant metadata
- Presentation to Grand Canyon fire managers
- Presentation at a national scientific conference
- Article comparing modern and historical fire regimes submitted to peer-reviewed publication

FUTURE PROGRAM DIRECTION

One of the top priorities for 2013 is to continue our collaboration with the I&M program by adding fire-related measurements to their existing plots and working with them to devise a data management protocol that will work for both groups. The late-season 2012 prescribed burning did very little to increase the FMH or RAP plot workload for 2013, and no more FMH installations are planned since the I&M plots will fill this need. The CBI plot workload will remain at typical levels but the continued struggle with multiple entry fire will persist into next season. Pilot data from the RAP plots will be analyzed to continue providing managers more incident-specific data, and RAP plots will continue to be installed in imminently pending burn units to provide data for burn plans. At present, 2013 work will be mostly on the North Rim (64%).

We would like to also continue to provide insight into the development of a mobile device-based application for FFI. Moving from paper datasheets to a mobile application has long been a goal of our program, and we hope to be heavily involved in the development of future products. The program will also continue our commitment to working with researchers to develop solid scientific datasets for management decision-making and with outreach staff to educate internal and external audiences about fire in GRCA and the NPS.



Figure 12. Reading plots on the North Rim in November takes moxie (and warm gloves).

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