



SUMMARY

In 2014, full staffing with multiple returning employees from previous seasons 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. In addition, the GRCA Fire Ecology Program gained responsibility for fire effects monitoring within the three Flagstaff Area National Monuments (Sunset Crater (SUCR), Walnut Canyon (WACA), and Wupatki (WUPA)) and began a collaborative relationship with the Southern Colorado Plateau Inventory and Monitoring Network (I&M) to monitor plots within WACA. With monitoring of 41 Fire Monitoring Handbook (FMH) plots, 45 Rapid Assessment Protocol (RAP) pilot sampling plots, 47 Composite Burn Index (CBI) burn severity plots, and 3 I&M plots at GRCA, it was a successful year while incorporating 19 unplanned plot reads from an early-season wildfire and a late-season prescribed burn.

The tradition of assisting other Fire Ecology programs was continued, with the Lead, Assistant, and two crewmembers helping the Saguaro Fire Ecology staff accomplish plot work in the Rincon Mountains District of Saguaro National Park (SAGU) in southern Arizona. Additionally, further cooperation with the Kaibab National Forest resulted in installation of 25 CBI plots on the North Kaibab Ranger District (NKRd). The interagency North Zone fire management structure provided additional funding to extend the crew into the fall and offer monitoring and other operational support on multiple prescribed burns.

A new challenge and opportunity was presented as the Assistant Lead detailed for 4 months to Yosemite National Park. To maintain productivity and leadership in his absence, 4 different individuals filled the position between June & September in 4-week increments. Through a combination of official training opportunities, details, extended travel, and agreements we were able to bring back past

employees, individuals who had worked extensively in fire at Grand Canyon and in NPS fire effects, as well as extend a leadership opportunity to an existing crewmember. New ideas and skills were brought to the program by the detailers, and fire experience plus knowledge of how our program integrates electronic data collection were given in return. All 4 detailers' previous knowledge of our program and Grand Canyon, as well as their work-ethic and skills, allowed the 2014 field season to stay productive despite changeover in personnel every month.

The GRCA Fire Ecology Program perpetuated its relationship with the national, interagency leadership of the FFI (FEAT/FIREMON Integrated) software to serve as primary testers of the mobile device-based, structurally simplified version called FFI Lite. Utilizing the knowledge gained from beta-testing FFI Lite in the fall of 2013, and acquiring several field-rugged, full-Windows OS tablet computers, the crew was able to perform a full season of electronic field data collection and office data management on multiple types of plots using a wide range of protocols. This conversion to 100% electronic data collection was not without numerous bumps, and required a complete overhaul of our data preparation-collection-management process. Nonetheless, exclusive use of tablets for data collection saved us enough time compared to traditional paper-to-computer data entry that all seasonal crewmembers were able to learn advanced skills by performing standardized data analysis for this annual report. Hopefully our efforts will be to the benefit of all using FFI Lite going forward.

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 and their variety of contributions to fire operations. This balance would not have been possible without sufficient staffing, the experience of existing crewmembers, four Assistant Lead detailers with knowledge of the program, and the established permanent fire ecology staff. In some capacity, the crew worked on a total of 17 different incidents over 136 operational periods and attended 6 different NWCG training classes. Highlights of this experience included assignments as initial Type 5 Incident Commander (ICT5) on 2 local fires; Firing Boss (FIRB) on 1 local fire; 3 details with the Wildland Fire Modules in Arizona, California, and Colorado; Geographic Information Systems Specialist (GISS) support on local incidents; and continued training toward Long Term Fire Analyst (LTAN). The crew also continued its role as the primary Fire Effects Monitors (FEMO) within Grand Canyon National Park and the neighboring North Kaibab Ranger District on both prescribed and wildfire events, amounting to a total of 108 operational periods of local fire assistance. Tablet computer and mobile device use was expanded to FEMO duties, adding a single Google Earth-viewable file of georeferenced incident photos to our monitoring products as well as finally having an all-in-one device portable yet powerful enough to take photos, track perimeters, record weather and fire behavior observations, and write narrative summary reports while out on the fireline. These opportunities led to the completion of three fire qualifications (FEMO, FIRB, FFT1) and work on many others (FEMO, CRWB, ICT5, FFT1, HECM) to further increase the crew's ability to fulfill a diverse variety of roles within fire.

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, four other fire personnel (including the FMO) and 15 individuals from vegetation management and volunteer crews were cross-trained in fire effects plot protocols.

With current and projected budget constraints throughout the NPS Fire Ecology community, the Ecologist took on new roles this year, both permanent and interim. In May, the Ecologist began work with the Saguaro National Park Fire Ecologist to permanently transfer responsibility, databases, and files for the three Flagstaff Area National Monuments to GRCA. The Ecologist collaborated with the I&M program to provide data for their 2014 re-measurements of the fire effects plots at WACA and visited all of the existing ponderosa pine plots in the park. In late April, GRCA entered an annual agreement with the Utah Parks Group for the Ecologist to provide professional level fire ecology support during the transitional period to the future fire management organization. Through this

agreement, the Ecologist served as in the interim Fire Ecologist for the 9 park units in the Utah Parks Group, which includes 3 park units with existing fire monitoring plots. Due to the addition of new park units, the Ecologist spent a large amount of time on planning and data management tasks to gain an understanding of the parks and their fire monitoring programs. Education continued to be a high priority as the Ecologist prepared for and managed 364 hours of volunteer time to conduct a repetition of historic vegetation photos taken previously in 1934 and 1984, conducted field trips for the SW Fire Science Consortium's Fires of Change art exhibit and for the International Forest Research Conference field tour, authored the North Rim Park Guide article on wildland fire, and created posters for the first annual North Rim Wildland Fire Day. The Ecologist continued several research collaborations this year by co-authoring a publication in the journal *Fire Ecology* and serving as a co-Principal Investigator on two new Joint Fire Science Proposals and one new NPS Research Reserve proposal.

STAFF ACCOMPLISHMENTS & AREAS OF FOCUS

TABLE 1. Fire Ecology Staff for 2014 calendar year.

Employee	Starting Date	Ending Date	# Pay Periods	Training	NWGG Taskbooks
Windy Bunn, GS-11	1/01/14	12/31/14	26		
Li Brannfors, GS-7	1/01/14 4/20/14	4/05/14 12/31/14	22.5 ¹	I300 S590	LTAN-t RXB3-t
Jasper Peach, GS-6 ²	4/20/14 9/28/14	5/31/14 11/25/14	7 ³		FIRB FALB CRWB-t ENGB-t READ-t
Jerolyn Byrne, GS-5 ⁵	4/20/14	11/20/14	14 ⁴		FALA FEMO ICT5-t FFT1-t HECM-t ABRO-t
Dominic Ali, GS-5	5/04/14	11/01/14	13	S271 B3 & A110	FFT1 FEMO-t ICT5-t HECM-t
Jessica Moran, GS-5	5/04/14	10/18/14	12	S212 S290	FEMO-t FFT1-t FALA-t
Jessica Page, GS-7 ⁵	6/28/14	7/26/14	2		
Mary Jo Hill, GS-6 ⁵	7/27/14	8/23/14	2		FFT1-t
Sarah Hartsburg, contractor ⁶	8/24/14	9/20/14	2		

¹Time for Li Brannfors reflects part-time work during payperiods 2, 5, & 10.

²After Nov. 2, time for Jasper Peach funded by hazard fuels project accounts.

³Between June 1-September 27, Jasper Peach funded by Yosemite National Park while on a 120-day detail.

⁴After Oct. 18, time for Jerolyn Byrne reflects part-time work in intermittent status.

⁵Jerolyn Byrne, Jessica Page, and Mary Jo Hill each worked in the Asst Lead position for 2 payperiods, funded by GRCA Fire.

⁶Sarah Hartsburg worked in the Asst Lead position for 2 payperiods, funded by the national NPS Fire GIS office.

TABLE 2. Base-hour Fire Effects Crew activities by percent and category.

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	14	7	1	1	13	9	23	7	1	1	7	16
Assistant Lead, GS-6 ¹	20	8	2	2	11	6	23	13	2	1	2	10
Jerolyn Byrne, GS-5	17	12	2	1	12	10	15	11	4	1	2	13
Dominic Ali, GS-5	21	9	2	0	7	5	12	8	2	15	2	17
Jessica Moran, GS-5	18	8	1	0	8	5	11	9	5	16	8	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.

"Wildfire/Incident Ops" includes in-park details with GRCA Helitack, administrative leave associated with fire assignments.

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

¹"Assistant Lead" captures the cumulative time spent by Jasper Peach, Jerolyn Byrne, Jessica Page, Mary Jo Hill, and Sarah Hartsburg while officially serving the role of the GRCA Fire Effects Assistant Lead Monitor.

TABLE 3. Base-hour Fire Effects Crew Focus Areas/Accomplishments in 2014.

Focus Area	Percent Time	Accomplishments and Activities
FMH Plots	18%	30 remeasurements, 11 immediate post-burn reads at GRCA - Lead, Assistant, & 2 crewmembers assisted Saguaro Fire Ecology with 10 plots over 1 payperiod at SAGU
RAP Plots	9%	40 remeasurements, 5 immediate post-burn reads across 3 Rx units
CBI Plots	1%	47 plots across 4 fires
I&M Plots	1%	3 immediate post-burn reads of photo, fuel, and tree data
Plot Office	10%	Includes plot preparation, plant ID, photo filing, hardcopy data filing/organization, and plot-related projects
Data Entry/ Management	7%	<i>ALL 2014 plot data collected and checked electronically with tablet computers in the field; data entry and field checking is included in % time under each plot type</i> - Query-checked all scheduled 2014 plot data by Nov 17 - Includes FFI & FFI Lite electronic data prepping, merging, and checking for FMH, RAP, CBI, & I&M plots
Data Analysis	1%	- Annual Report analysis on all major variables in program - All seasonal Fire Ecology staff analyzed data for annual report
General Office/ Supervision/ Admin	18%	- Includes paperwork for travel, credit cards, non-plot related projects - Hiring, evaluations, and supervision by Lead & Assistant - Lead & Ecologist hired seasonal crew - Lead supervised 1 permanent Assistant (filled by 5 different individuals in 2014) & 3 seasonals
Fire Monitoring (Rx or Wildfire)	9%*	- Lead FEMO & FEMO-trainees on 2 Rx fires at GRCA & 6 Rx fires on Kaibab NF - Lead FEMO & FEMO-trainees on 2 wildfires at GRCA - Trained members of Saguaro and Apache Kid Modules as FEMOs
Fire Operations/ Assignments (Rx, Wildfire, Engine, Helitack, Non-fire Fuels Projects)	8%*	- Qualified personnel as FIRB, FFT1, and FEMO 1 crewmember detailed for 4 weeks with Saguaro Wildland Fire Module on fires and hazard fuels projects in Arizona and Colorado 1 crewmember detailed for 2 weeks with Abajo Wildland Fire Module on fires in California - FIRB, ICT5, FFT1, & 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 1 completed S212 1 completed S271 1 completed S290 1 completed S590 1 completed I300 1 completed B3/A100 aviation safety 2 completed First Aid+CPR 2 completed Emergency Vehicle Operations training
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	14%	4% of crew time spent on PT 6% of crew time spent on leave

*Approximately 920 hours of overtime spent on fire activities, equaling 13% of total crew work time (base + OT), are not reflected.

TABLE 4. Fire Ecologist Focus Areas/Accomplishments in 2014.

Focus Area	Percent Time	Accomplishments and Activities
Planning	16%*	- GRCA Fire IDT – reviewed 3 burn plans and 3 thinning plans; planning meetings for Rx fires, wildfires, and thinning projects - Served as Technical Specialist for Utah Parks FMP EA - Worked on GRCA compliance tasks (Section 7, wilderness MRA) - Managed activities in NFPORS and participated in out-year planning - Gained understanding of Flagstaff Area National Monuments and Utah Parks Group fire monitoring and fire management programs
Presentations/ Education	11%	- Led volunteer project to repeat 30 historic veg. photos in GRCA - Authored North Rim park guide article - Assisted Interpretation & Environmental Education Division with staff orientation, North Rim Wildland Fire day, and wildland fire exhibits - Conducted field trips for the SW Fire Science Consortium and the International Forest Research Conference
NPS Meetings/ Task Groups	7%	- Fire and park staff and strategy meetings - Fire, Compliance, & Resource Management collaboration meetings - MSO habitat, air quality, bison EIS, and GGCLA meetings with SRM - Regional fuel and fire ecology conference calls
Interagency Work	1%	- Tipover East prescribed fire data compilation and plan review - Southwest AFE Conference program committee co-chair
Fire Assignments and Project Work	<1%	In-park pile burning
Research	5%	- Published article in <i>Fire Ecology</i> with Univ. of Montana collaborators - Meetings for Reserve Fund research project - Submitted 2 new JFSP and 1 new Reserve Fund proposals - GRCA research permit reviews - Provided data, support, research ideas, and/or manuscript & proposal reviews for 11 other fire-related projects
Data Collection	3%	- FMH and RAP plot and burn severity data collection - Walnut Canyon PIPO plot recon with I&M staff - Field recon of prescribed fire, wildfire, and thinning projects
Data Entry & Management	16%*	- Converted GRCA I&M data to FFI - Entered fuel and tree data for GRCA I&M plots - Established quality control queries and procedures for GRCA - Identified FFI database errors for ZION and BRCA - Compiled WACA FMH data for I&M collaboration
Data Analysis	5%*	- Analyzed FMH, RAP, and I&M plot data, severity data, and weather and fuel data for burn plans, field trips, and annual report - Analyzed data from BRCA for RAP monitoring protocol development
Supervision/ Admin	12%	- Supervised Lead Monitor - Worked with Lead Monitor to hire seasonal crewmembers - Managed fire monitoring budgets and Asst. Lead detail agreements - Travel, time, and purchasing
Training & Conferences	6%	- Fostering resilience in Southwestern ecosystems workshop - NPS required annual training; fire refresher - PT (3%)
Other	18%	Travel between South and North Rims, leave, holidays

*Approximately 2.5 pay periods (10% of time) spent assisting the Utah Parks Group with planning, data management, and data analysis.

FIRE EFFECTS PLOT WORKLOAD

The 2014 season produced a moderate plot load for most of the year at Grand Canyon. Unplanned workload was created with wildfires and prescribed fires, adding 11 FMH immediate post-burn plot reads in July, and 5 RAP plus 3 I&M reads in mid-November.

TABLE 5. Grand Canyon National Park Fire Effects Plot Workload for 2014.

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 - Forest			3		7	3	13	41
South	Pinyon-Juniper Woodland—PIED²	FMH - Forest							0	17
South	Halfway Fire	CBI			14				14	-
South	Horsethief Rx	CBI			8				8	-
South	Moqui Rx	RAP³							0	5
South	Picnic Rx	RAP³							0	10
South	Quarry Rx	RAP³							0	10
North	Ponderosa Pine PIPN	FMH - Forest		11			1	4	16	30
North	Ponderosa Pine with White Fir Encroachment PIAB	FMH - Forest				1	7	2	10	27
North	Rocky Mountain Subalpine Conifer PIEN	FMH - Forest				1		1	2	17
North	Grassland Interior GRIN	FMH - Brush							0	10
North	Grassland Edge GRED	FMH - Forest							0	6
North	Castle WF-NKRD	CBI			12				12	-
North	Cooper WF-NKRD	CBI			13				13	-
North	Fawn Spring Rx	RAP³		1					1	20
North	Range Rx	RAP³				20			20	20
North	Spring Canyon Rx	RAP³		4					4	20
North	Thompson Rx	RAP³				20			20	20
North	Tipover Rx-NKRD	RAP³							0	40
North	Walla Valley Rx	RAP³							0	6
North	Mixed Conifer	I&M⁴		3					3	44
Total			0	19	50	42	15	10	136	343

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

During 2014, responsibility for fire effects monitoring within the three Flagstaff Area National Monuments was transferred from the SAGU Fire Ecology Program to the GRCA Fire Ecology Program. Long-term plans for prescribed fire and associated monitoring are currently under development for these parks. GRCA worked with the I&M program in 2014 to share data and repeat the pre-burn tree, shrub, and herbaceous measurements in 10 established ponderosa pine (PIPO) plots at Walnut Canyon. The I&M program also established 2 new PIPO plots in Walnut Canyon in 2014.

TABLE 6. Flagstaff Area National Monuments Fire Effects Plot Workload for 2014.

Park	Monitoring Unit	Plot Type	Install/ Pre-burn	Immed. Post-burn	Year 1 - 20	Annual Total	Total Plots¹
Sunset Crater NM	Montane Meadow BOGR	FMH - Grass				0	10
Sunset Crater NM	Pine Encroachment of Montane Meadow PIPO	FMH - Brush				0	5
Walnut Canyon NM	Pinyon-Juniper Woodland PIED	FMH - Forest				0	2
Walnut Canyon NM	Ponderosa Pine Forest PIPO	FMH – Forest / I&M	12 ²			12 ²	13 ²
Wupatki NM	Plains/Great Basin Grassland BOER	FMH - Grass				0	4
Wupatki NM	Plains/Great Basin Grassland HIJA	FMH - Grass				0	12
Total			12²			12²	46

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

²Plot measurements completed by I&M monitoring crew. Fire-specific fuel and tree data were not collected this year.

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 119 of these same plots have burned. 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 PIEN and PIED monitoring types are not included in these tables because (1) these areas are thought to be within the natural fire regime and (2) prescribed fires are not the management focus in these areas. Of the 9 restoration objectives listed in Table 7, 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 realistically install and maintain 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. 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. However, after second entry fires mean large tree density fell below the desired range with confidence limits extending back into the targeted range (i.e. there is some uncertainty about whether tree density is at the low end of the target or below the target).

Table 7. Restoration Management Objectives and Monitoring Results for FMH plots in 2014. 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	7.2 ± 0.8 tons/acre (-47%) (n=38)	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	82.3 ± 31.8 trees/acre (-26%) (n=36)	106.4 ± 42 trees/acre (-33% due to fire 1 & 2) (-8% due to fire 2 only) (n=20)	NO	NO	NO n=61
	Maintain overstory (PIPO) density with DBH ≥16" of >14 trees/acre 5 years post-burn	19.3 ± 2.5 trees/acre (+0%) (n=35)	19.4 ± 3.6 trees/acre (-2% due to fire 1 & 2) (-0% due to fire 2 only) (n=19)	YES	YES	YES n=14
Ponderosa Pine (PIP) 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)	9.8 ± 2.4 tons/acre (-62% due to fire 1 & 2) (-42% due to fire 2 only) (n=22)	YES	YES	YES n=11
	Reduce conifer poles with DBH of 1-6" to 16-81 trees/acre 2 years post-burn	70.1 ± 33.4 trees/acre (-58%) (n=30)	17.0 ± 6.4 trees/acre (-81% due to fire 1 & 2) (-25% due to fire 2 only) (n=20)	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)	37.5 ± 12.1 trees/acre (-22% due to fire 1 & 2) (-12% due to fire 2 only) (n=8)	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=5
	Reduce conifer poles with DBH of 1-6" to 16-100 trees/acre 2 years post-burn	85.9 ± 23.5 trees/acre (-64%) (n=21)	1.6 ± 1.5 trees/acre (-98% due to fire 1 & 2) (-63% due to fire 2 only) (n=10)	YES*	NO	YES n=9
	Maintain overstory conifer density with DBH ≥16" of >20 trees/acre 5 years post-burn	28.3 ± 2.6 trees/acre (-22%) (n=19)	18.0 ± 6.4 trees/acre (-38% due to fire 1 & 2) (-33% due to fire 2 only) (n=11)	YES	NO*	YES n=7

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

NO* indicates that the mean value does not meet stated objectives but the confidence interval is inside the range of objective values.

Maintenance objectives help refine long-term 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 and PIPN monitoring types has resulted in achievement of the fuel loading objectives for each type. However, in the PIPO and PIPN monitoring types we cannot realistically install and maintain the number of plots needed to overcome the variability in tree density. In the PIPO monitoring type, mean tree density fell within the targeted range after maintenance burning, but the confidence limits extend above the targeted range (too many trees remaining). In the PIPN type, only two plots have data two years following third entry fire, and they both burned two years after the second entry fire. The small plot number and anomalous burn interval in the PIPN type make the pole-sized tree results unreliable.

Table 8. Maintenance Management Objectives and Monitoring Results for FMH plots in 2014. 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	128.0 ± 41.5 trees/acre (-11% due to fire 1, 2, & 3) (-3% due to fire 3 only) (n=11)	YES*	NO n=43
Ponderosa Pine (PIP) North Rim	Maintain total fuel load of 0.2-15.7 tons/acre immediate post-burn	10.0 ± 4.6 tons/acre (-62% due to fire 1, 2, & 3) (-16% due to fire 3 only) (n=11)	YES	YES n=11
	Maintain conifer pole density with DBH of 1-6" of <81 trees/acre 2 years post-burn	16.2 ± 24.9 trees/acre (-82% 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 immediate post-burn	Not analyzed (n=0)	N/A	NO n=5
	Maintain conifer pole density with DBH of 1-6" of <100 trees/acre 2 years post-burn	Not analyzed (n=0)	N/A	NO n=9

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

North Rim Slopes Prescribed Fire – RAP and I&M plots

The first aerial ignition operations on the North Rim Slopes Prescribed Fire were conducted on October 18, 23, and 29, 2014. The North Rim Slopes project was designed to reduce fuel loading on south facing slopes of the mixed conifer forest where ponderosa pine dominate the overstory. This project has a multi-year implementation plan and the number of acres treated will vary from year to year. In 2014, 8 burn blocks ranging in size from approximately 170 to 550 acres were ignited for a total estimated burn area of 2,869.

Since the number of acres ignited and the priority areas for burning are determined on a yearly basis, there are no monitoring plots dedicated specifically to measuring the effects of the North Rim Slopes Prescribed Fire. However, 4 RAP plots installed to measure the Spring Canyon Prescribed Fire project, 1 RAP plot installed to measure the Fawn Spring Prescribed Fire project, and 3 I&M plots installed to assess the mixed conifer forest as a whole burned in the North Rim Slopes Prescribed Fire in 2014. Immediate post-fire measurements were taken in November 2014 from the 8 plots that burned.

Objective: Reduce % of dead and downed woody fuels by weight in 1000-hour and larger fuel size classes immediately post-burn in ignition areas. [Acceptable: 25-100% reduction]

The eight plots that burned in the North Rim Slopes project in 2014 were installed for 3 different purposes and employed 2 different sampling protocols, so combining the plots to assess results from the North Rim Slopes project should be done with caution. Pre-fire analysis indicates that there is no difference between the Fawn Spring RAP, Spring Canyon RAP, and I&M 1000-hr fuel fuel loading ($P = 0.49$), which provides some confidence that the post-fire analysis is not biased by plot purpose or sampling protocol. Reduction in 1000-hr fuel loading in the 8 burned plots ranged from 0% to 94% (Figure 1) with 5 of the 8 burned plots falling within the acceptable fuel reduction range. Overall, 1000-hr fuel loading was reduced ($P = 0.04$) by an average of 41% in the 8 burned plots.

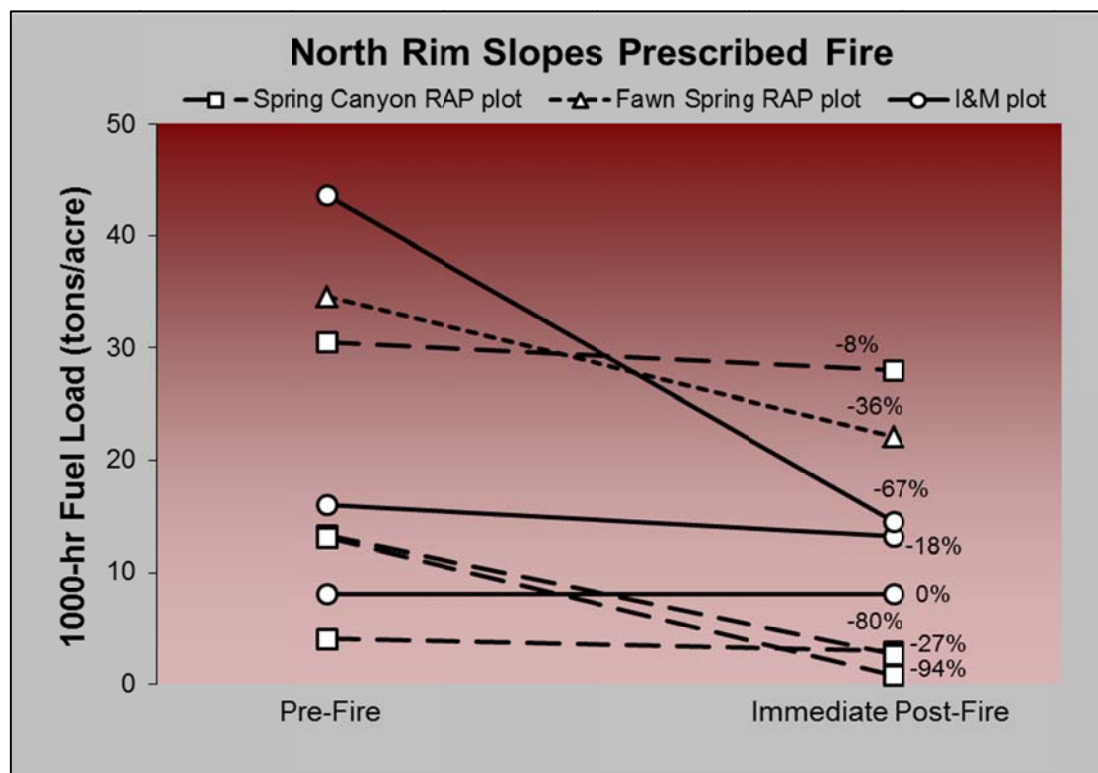


Figure 1. 1000-hour fuel loading and fuel reduction results for individual plots in the North Rim Slopes Prescribed Fire.

Range Prescribed Fire – RAP plots

The 2,278 acre Range Prescribed Fire was ignited in October 2012. The ignition pattern on the Range Prescribed Fire was designed to create primarily backing and flanking fire spread along the ridgetops 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 project unit in 2008. These plots were remeasured or reinstalled in 2012 prior to project implementation to ensure that results were as accurate as possible. Post-fire attributes were measured in the 20 RAP plots in 2012 and 2014. Due to the intentionally heterogeneous burn pattern, 8 of the 20 RAP plots remained unburned after the completion of this prescribed fire.

Prescribed Fire Plan Objectives

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]

As reported in the 2012 Grand Canyon Fire Ecology annual report, average total reduction in the 1000-hr fuel class across the entire burn unit (all 20 plots) was 18% one month after the fire. 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.

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 seedlings (<1" DBH) and saplings (1 – 6" DBH) were measured during the 2014 field season to determine mortality two years post-burn. Changes in seedling tree density were highly variable between plots and depended on seedling type (Figure 2). Conifer seedling density was not significantly changed in either the burned ($P = 0.16$) or unburned ($P = 0.25$) plots two years after the fire. Aspen seedling density also remained unchanged in the unburned plots ($P = 0.73$), but increased by an average of 112% in the burned plots ($P = 0.02$). Objectives for reduction in seedling tree density were not met in either the burned plots or the unit as a whole. Given that aspen will rapidly resprout following fire and that conifer seedling regeneration will likely increase with decreased ground cover, it is unlikely that the seedling reductions specified in this objective will occur two years after fires in this forest type. It is recommended that the seedling portion of this objective be re-evaluated for future prescribed fire plans in this forest type.

Changes in sapling tree density were less variable between plots and sapling type (Figure 3) than changes in seedling tree density. Conifer sapling density remained unchanged in the unburned plots ($P = 0.33$), but decreased by an average of 49% in the burned plots ($P = 0.03$) two years after the fire. Likewise, aspen sapling density remained unchanged in the unburned plots ($P = 0.11$), and decreased by an average of 33% in the burned plots ($P = 0.04$). Total sapling density (conifer and aspen combined) decreased ($P = 0.02$) by an average of 52% ($\pm 15\%$) in burned plots and decreased ($P = 0.02$) by an average of 31% ($\pm 12\%$) across the entire unit (burned and unburned plots combined) two years after the fire. The variability in sapling tree reduction between plots leaves some uncertainty as to whether the percentage reductions specified in the objectives were exactly met. However, sapling tree density

was certainly reduced in the burned plots to a level either within or slightly above the optimal range and was reduced in the unit as whole within the acceptable range.

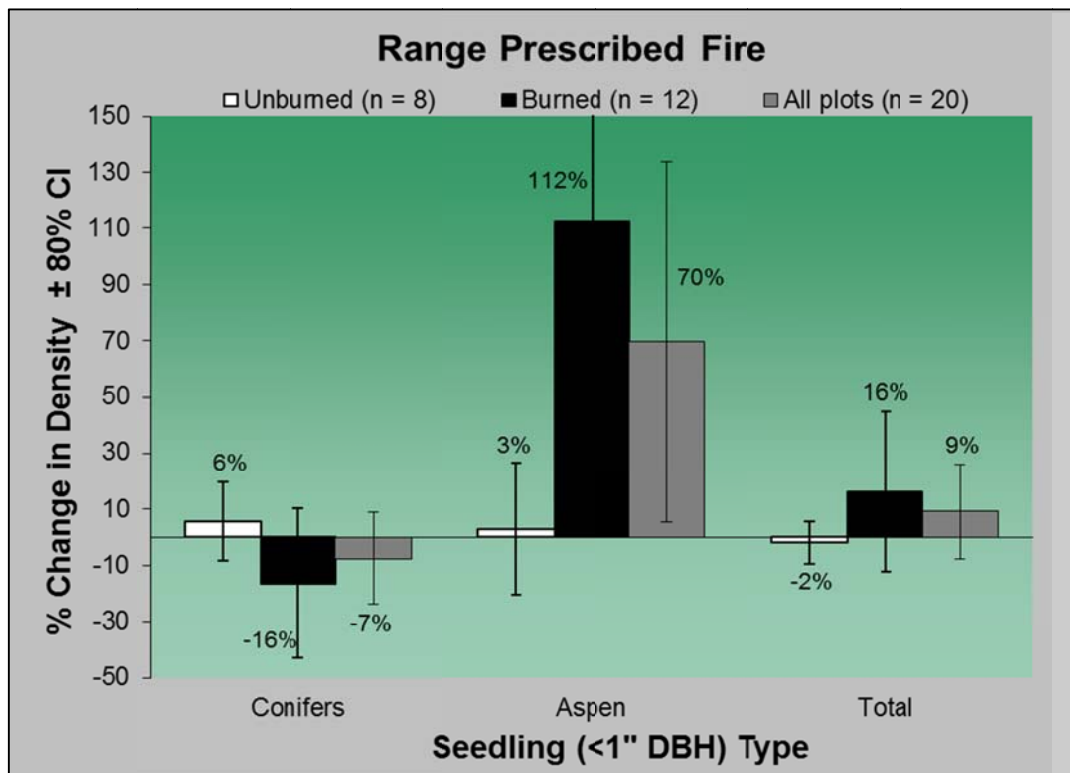


Figure 2. Mean live seedling density ($\pm$ 80% CI) reduction results two years after the Range Prescribed Fire.

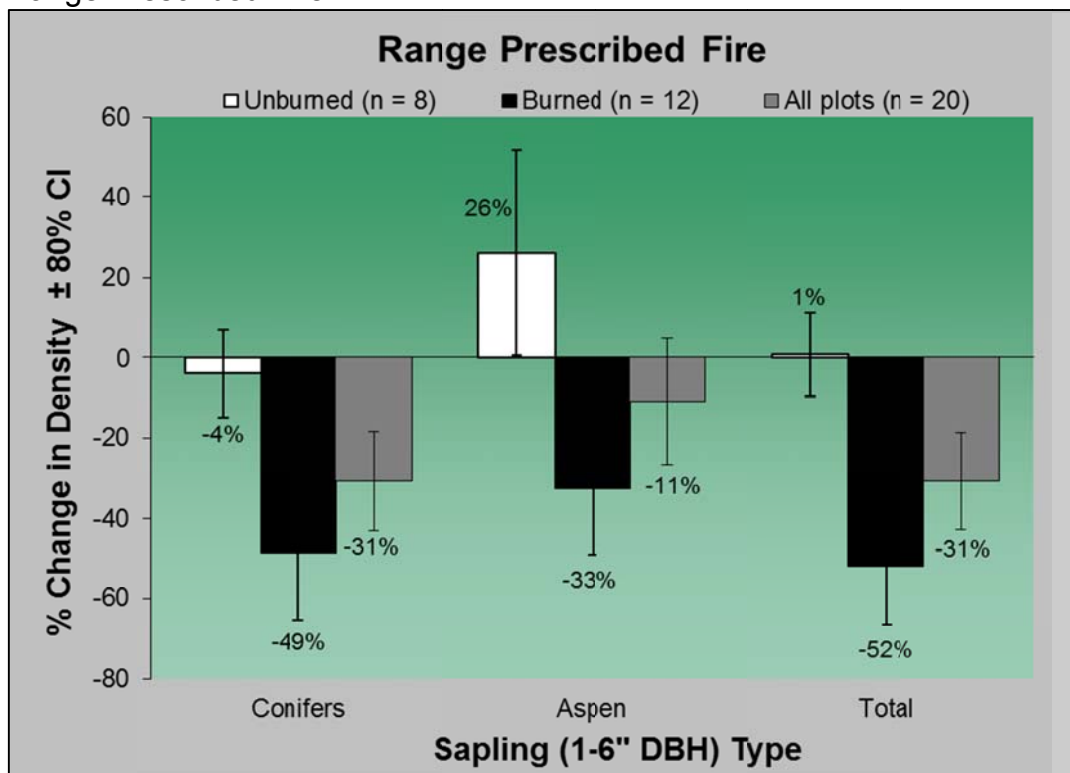


Figure 3. Mean live sapling density ($\pm$ 80% CI) reduction results two years after the Range Prescribed Fire.

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

MTBS burn severity data was compiled for and CBI plots were installed in the Range Prescribed Fire in 2013. Overall, 6.5 acres (or 0.02%) of Mexican spotted owl (MSO) mixed conifer critical habitat burned in moderate/high or high severity within the Range Prescribed Fire. The addition of the Range Prescribed Fire severity brings the total MSO mixed conifer critical habitat burned in moderate/high or high severity to 4,334 acres or 16.1% of the mixed conifer habitat in the park.

Surface Fuel Loading Trends

Pre-treatment fuel loading values in each fuel class (Litter + Duff, 1-, 10-, & 100-hr TLFM, and 1000-hr TLFM) were similar in the plots that burned and plots that did not burn in the Range Prescribed Fire ($P \geq 0.43$ for each fuel class). For plots that did not burn in the fire, fuel loading measurements remained unchanged from pre-fire values for all fuel classes at both the immediate post and two years post-fire measurements ($P \geq 0.49$ for each fuel class). Fuel loading was reduced in all fuel classes immediately after the fire but returned to pre-fire values in the small and large woody fuel classes two years after the fire in plots that burned (Figure 4). Litter + Duff fuel loading decreased ($P < 0.01$) from an average of 24.9 tons/acre before the fire to an average of 11.3 tons/acre two years after the fire. Small woody fuel (1-, 10-, & 100-hr TLFM) loading decreased ($P = 0.03$) from an average of 4.9 tons/acre before the fire to an average of 3.8 tons/acre immediately after the fire but rebounded to an average of 4.3 tons/acre two years after the fire. Large woody fuel (1000-hr TLFM) loading decreased ($P = 0.03$) from an average of 18.5 tons/acre before the fire to an average of 11.2 tons/acre immediately after the fire but returned to an average of 15.3 tons/acre two years after the fire.

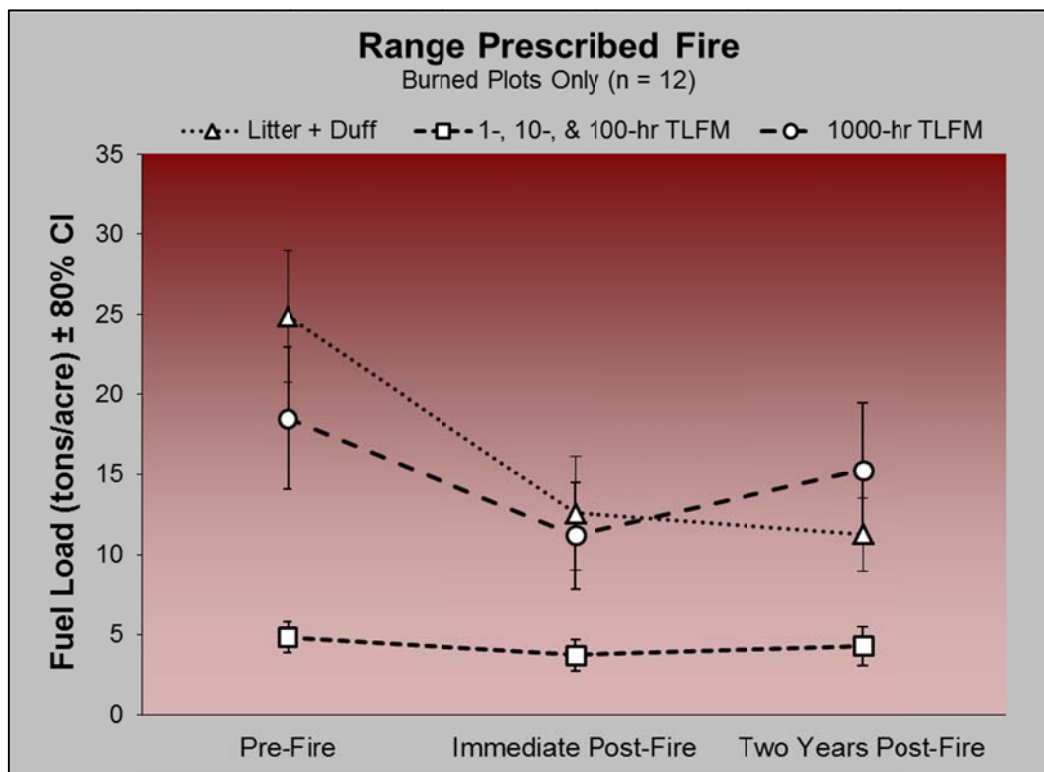


Figure 4. Mean fuel loading ($\pm 80\%$ CI) trends over time for burned plots in the Range Prescribed Fire.

Tree Density Trends

Seedling (<1" DBH) tree density was highly variable between plots (Figure 5) and thus trends in seedling density are difficult to detect. Conifer seedling density was not significantly changed in either the burned ($P = 0.16$) or unburned ($P = 0.25$) plots. The average conifer seedling density changed from 975 trees/acre before the fire to 576 trees/acre two years after the fire, but this trend was not strong enough to overcome the uncertainty introduced by highly variable seedling densities between plots. Aspen seedling density also remained unchanged in the unburned plots ($P = 0.73$), but increased ($P = 0.02$) in the burned plots from an average of 928 trees/acre before the fire to 1448 trees/acre two years after the fire.

Conifer sapling (1 - 6" DBH) density remained unchanged in the unburned plots ($P = 0.33$), but decreased ($P = 0.03$) from an average 248 trees/acre before the fire to an average of 128 trees/acre two years after the fire in the burned plots (Figure 5). Likewise, aspen sapling density remained unchanged in the unburned plots ($P = 0.11$), and decreased ($P = 0.04$) from an average 47 trees/acre before the fire to an average of 16 trees/acre two years after the fire in the burned plots.

Intermediate tree (6 - 16" DBH) density remained unchanged in the unburned plots ($P = 0.35$), but decreased ($P = 0.03$) from an average 89 trees/acre before the fire to an average of 70 trees/acre two years after the fire in the burned plots (Figure 6). Large tree (> 16" DBH) density remained unchanged in both the burned ($P = 0.17$) and unburned plots two years after the fire.

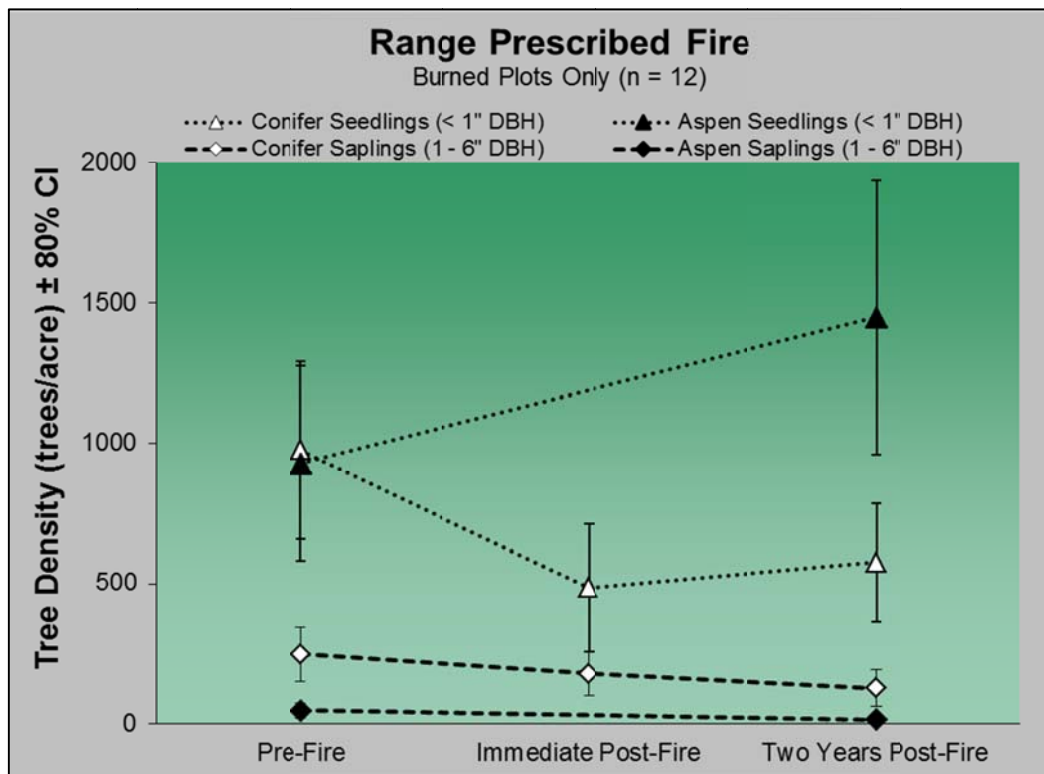


Figure 5. Mean seedling and sapling tree density ($\pm 80\%$ CI) trends over time in the Range Prescribed Fire. Note that aspen seedlings and saplings were not recorded at the immediate post-fire measurement.

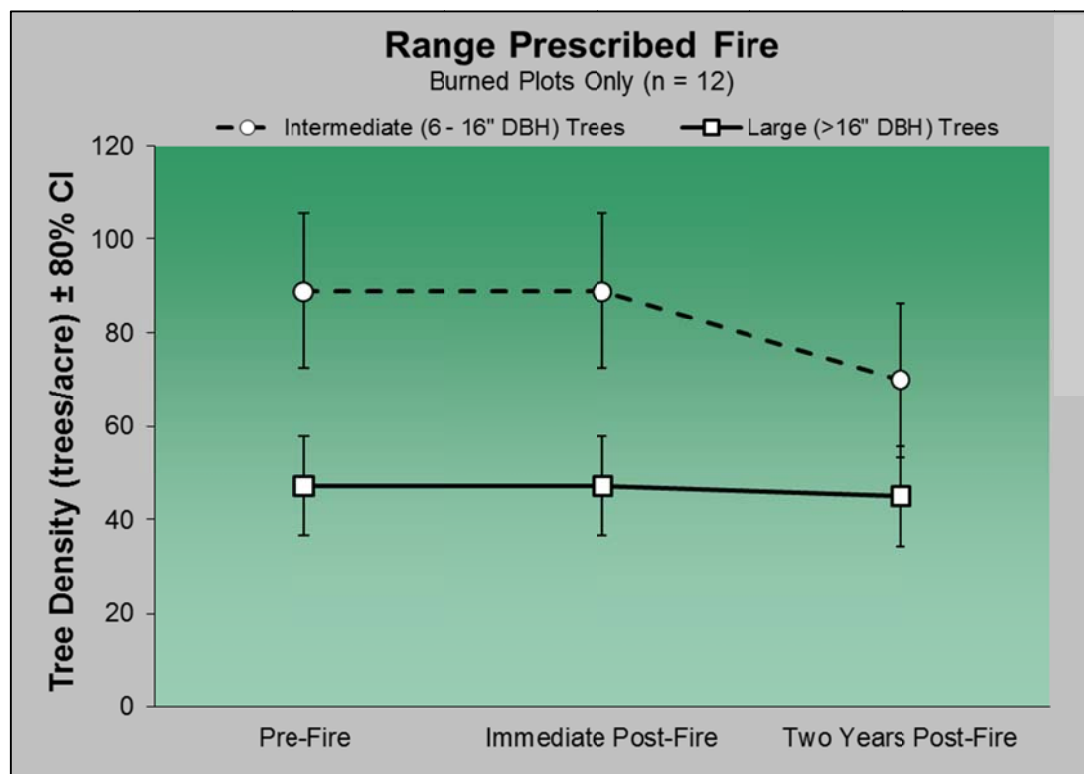


Figure 6. Mean intermediate and large tree density ($\pm 80\%$ CI) trends over time in the Range Prescribed Fire.

Tree Crown Base Height Trends

Overstory ($\geq 6''$ DBH) tree crown base height increased ($P < 0.01$) from an average of 22.4 feet to an average of 29.2 feet in plots that burned in the Range Prescribed Fire. However, overstory tree crown base height also increased ($P = 0.02$) from an average of 27.5 feet to an average of 30.6 feet in plots that did not burn in the fire. The minor differences in average crown base height values between burned and unburned plots were not statistically significant either before the fire ($P = 0.23$) or two years after the fire ($P = 0.76$).

Understory Cover Trends

Understory herbaceous species cover increased ($P = 0.01$) from an average of 10.4% to an average of 19.6% in plots that burned in the Range Prescribed Fire. Understory herbaceous species cover in unburned plots averaged 11.6% before the fire and 7.2% two years after the fire, but this difference was not significant ($P = 0.35$). Shrub species cover in burned plots remained unchanged at an average of 2.5% before and two years after the fire. Shrub species cover increased ($P = 0.08$) in unburned plots from an average of 4.1% before the fire to an average of 8.8% two years after the fire.

Prior to fire, no non-native species were observed in the 20 plots. Two years after the fire, unburned plots still contained no non-native species. However, 4 burned plots contained 1 non-native species each (*Conyza canadensis*) and 1 plot contained two non-native species (*Conyza canadensis* and *Tragopogon dubius*) two years after the fire. On average, non-native species cover in burned plots increased ($P = 0.03$) from 0% before the fire to an average of 1.3% two years after the fire.

Thompson Prescribed Fire– RAP plots

The 2,349 acre Thompson Prescribed Fire was ignited in November 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 ignition pattern on the Thompson Prescribed Fire targeted 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 located in the project unit in 2009. Post-fire attributes were measured in the 20 RAP plots in 2012 and 2014. Due to the heterogeneous burn pattern, 9 of the 20 RAP plots remained unburned after the completion of this prescribed fire.

Prescribed Fire Plan Objectives

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]

As reported in the 2012 Grand Canyon Fire Ecology annual report, 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. The 11 plots that burned had a 1000-hr fuel reduction of 29%, on average, from pre-fire measurements. Unburned plots showed an average 37% increase in total 1000-hr fuel loading from pre-fire measurements.

Surface Fuel Loading Trends

Pre-treatment fuel loading values in each fuel class (Litter + Duff, 1-, 10-, & 100-hr TLFM, and 1000-hr TLFM) were higher in the plots that burned in the Thompson Prescribed Fire than in the plots that did not burn in the fire ($P \leq 0.05$ for each fuel class). For plots that did not burn in the fire, fuel loading measurements remained unchanged from pre-fire values for all fuel classes at both the immediate post- and two years post-fire measurements ($P > 0.1$ for each fuel class). Fuel loading was reduced in all fuel classes immediately after the fire and remained at the reduced levels two years after the fire in plots that burned (Figure 7). Litter + Duff fuel loading decreased ($P < 0.001$) from an average of 26.7 tons/acre before the fire to an average of 10.0 tons/acre two years after the fire. Small woody fuel (1-, 10-, & 100-hr TLFM) loading decreased ($P = 0.04$) from an average of 7.2 tons/acre before the fire to an average of 4.3 tons/acre two years after the fire. Large woody fuel (1000-hr TLFM) loading decreased ($P < 0.001$) from an average of 40.7 tons/acre before the fire to an average of 24.2 tons/acre two years after the fire.

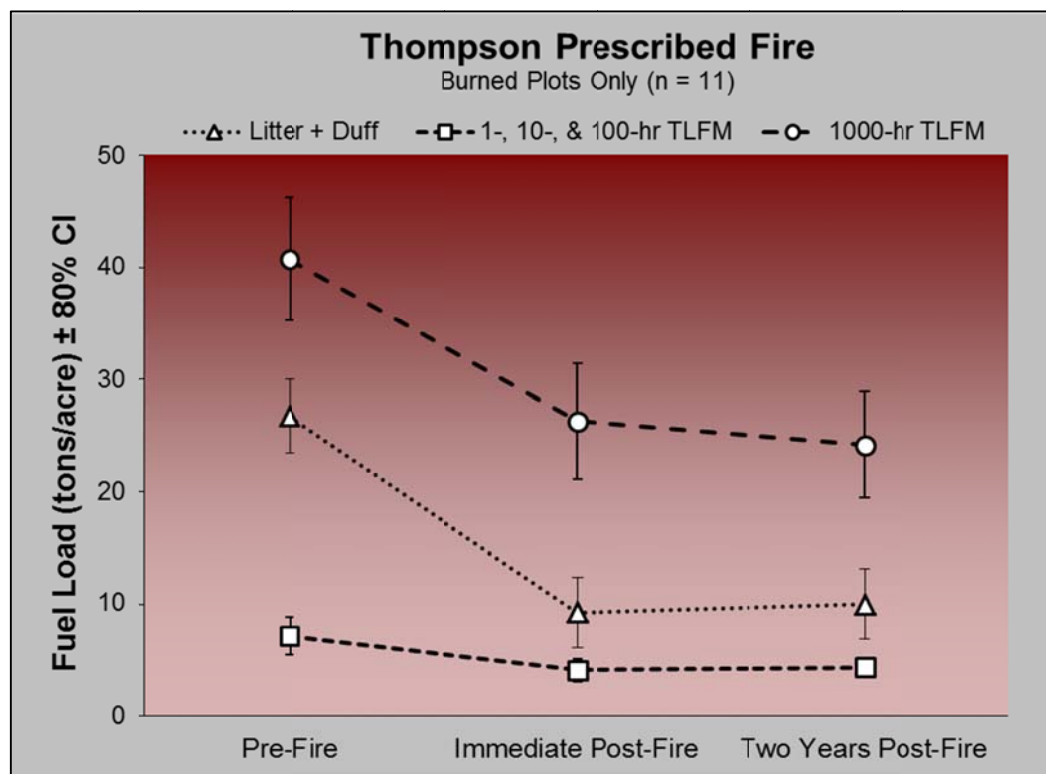


Figure 7. Mean fuel loading ($\pm$ 80% CI) trends over time for burned plots in the Thompson Prescribed Fire.

Tree Density Trends

Conifer seedling (<1" DBH) density decreased ($P = 0.02$) in the burned plots from a pre-fire average of 1584 trees/acre to an average of 919 trees/acre two years after the fire (Figure 8). Conifer seedling density remained unchanged ($P = 0.69$) two years after fire in the unburned plots. Aspen seedlings were not measured before or immediately after the fire. Two years after the fire aspen seedling density was significantly higher ($P = 0.03$) in burned plots (average of 3257 trees/acre) than in unburned plots (average of 1655 trees/acre).

Conifer sapling (1 - 6" DBH) density increased ($P = 0.01$) from an average 325 trees/acre before the fire to an average of 463 trees/acre two years after the fire in the unburned plots, but remained unchanged in the burned plots ($P = 0.44$; Figure 8). Aspen saplings were not measured before or immediately after the fire. Two years after the fire aspen sapling density was not significantly different ($P = 0.14$) between the burned plots (average of 161 trees/acre) and unburned plots (average of 328 trees/acre) largely due to the variability in aspen sapling density between plots.

Intermediate tree (6 - 16" DBH) density decreased ($P = 0.006$) from an average 101 trees/acre before the fire to an average of 63 trees/acre two years after the fire in the burned plots (Figure 9). Intermediate tree density also decreased ($P = 0.02$) from an average 123 trees/acre before the fire to an average of 109 trees/acre two years after the fire in the unburned plots. Large tree (> 16" DBH) density decreased ($P = 0.08$) from an average 14 trees/acre before the fire to an average of 11 trees/acre two years after the fire in the burned plots (Figure 9). Large tree density remained unchanged ($P = 0.20$) in the unburned plots two years after the fire.

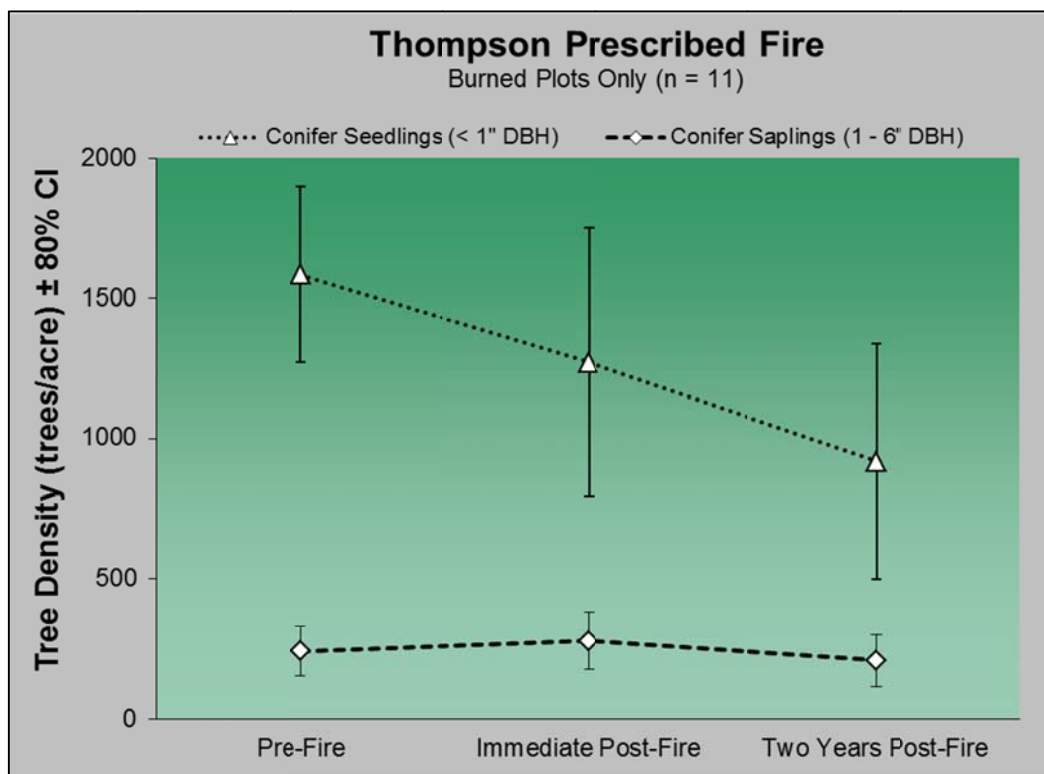


Figure 8. Mean seedling and sapling tree density ($\pm$ 80% CI) trends over time in the Thompson Prescribed Fire.

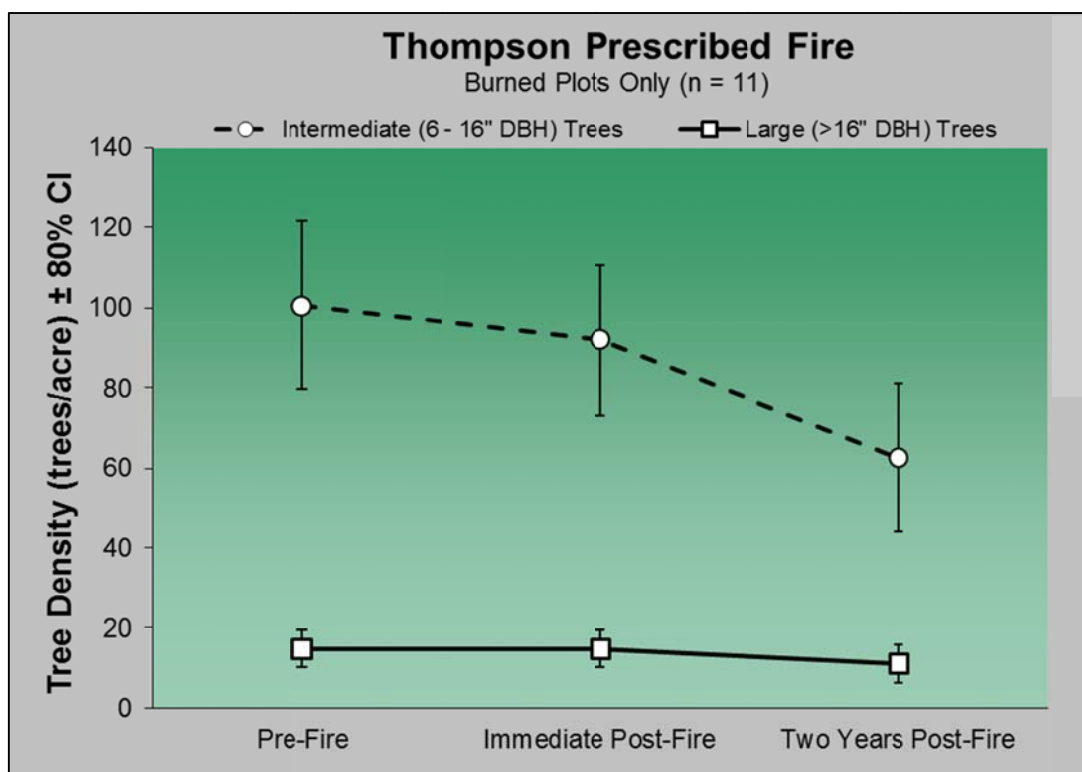


Figure 9. Mean intermediate and large tree density ($\pm$ 80% CI) trends over time in the Thompson Prescribed Fire.

Tree Crown Base Height Trends

Overstory ($\geq 6''$ DBH) tree crown base height was not measured prior to the Thompson Prescribed Fire, so the change in crown base height over time cannot be determined directly. Two years after the fire, crown base height averaged 24.1 feet in burned plots and 22.6 feet in unburned plots. The minor difference in average crown base height values between burned and unburned plots were not statistically significant two years after the fire ($P = 0.77$).

Understory Cover Trends

Understory herbaceous species cover in burned plots averaged 26.4% before the fire and 35.9% two years after the fire ($P = 0.14$). In unburned plots, understory herbaceous species cover averaged 25.3% before the fire and 15.8% two years after the fire ($P = 0.18$). Shrub species cover in burned plots decreased ($P < 0.01$) from an average of 14.8% before the fire to an average of 3.8% two years after the fire. Shrub species cover in unburned plots averaged 15.8% before the fire and averaged 10.6% two years after the fire, but this difference was not significant ($P = 0.39$).

Prior to fire, 2 non-native species (*Bromus inermis* and *Elymus* spp.) were observed in 1 plot each. A total of 9 non-native species were detected two years after fire. *Conyza canadensis* was the most abundant non-native species after fire and was recorded in 6 plots. *Tragopogon dubius* was recorded in 2 plots, and *Bromus inermis*, *Bromus tectorum*, *Elymus* spp., *Lactuca serriola*, *Mentha* spp., *Taraxacum officinale*, and *Verbascum thapsus* were recorded in 1 plot each. *Bromus inermis* was recorded in 1 unburned plot prior to fire and remained in that plot with an unchanged cover estimate two years after the fire. No additional unburned plots had non-native species either before or after the fire. *Elymus* spp. was recorded in 1 burned plot prior to the fire and remained in that plot with an unchanged cover estimate two years after the fire. In addition, 7 burned plots contained at least 1 new non-native species and the most invaded plot contained 4 non-native species two years after the fire. Non-native species cover in burned plots increased ($P = 0.01$) from an average of 1.4% before the fire to an average of 4.3% two years after the fire.

Year 1 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 2014, 1,318 post-fire year 1 CBI-style plots have been measured, providing Normalized Burn Ratio satellite-derived severity data on 59 fires for 133,690 total acres. This process is designed for field data and satellite imagery gathered one year following a fire; hence, 2014 work was performed on fires which burned in 2013. A total of 47 CBI plots were installed in 2014 across 3,358 acres in the Castle (NKRD), Cooper (NKRD), and Halfway wildfires, as well as the Horsethief Prescribed Fire.

The majority (1,654 acres; 66 % of the fire area) of the acres burned in the two 2013 North Kaibab Ranger District wildfires had low severity effects (Figure 10). The two fires had a combined total of 559 unburned acres (22% of the fire area), 200 acres burned with moderate/low severity effects (8% of the fire area), and 68 acres burned with moderate/high to high severity effects (3% of the fire area).

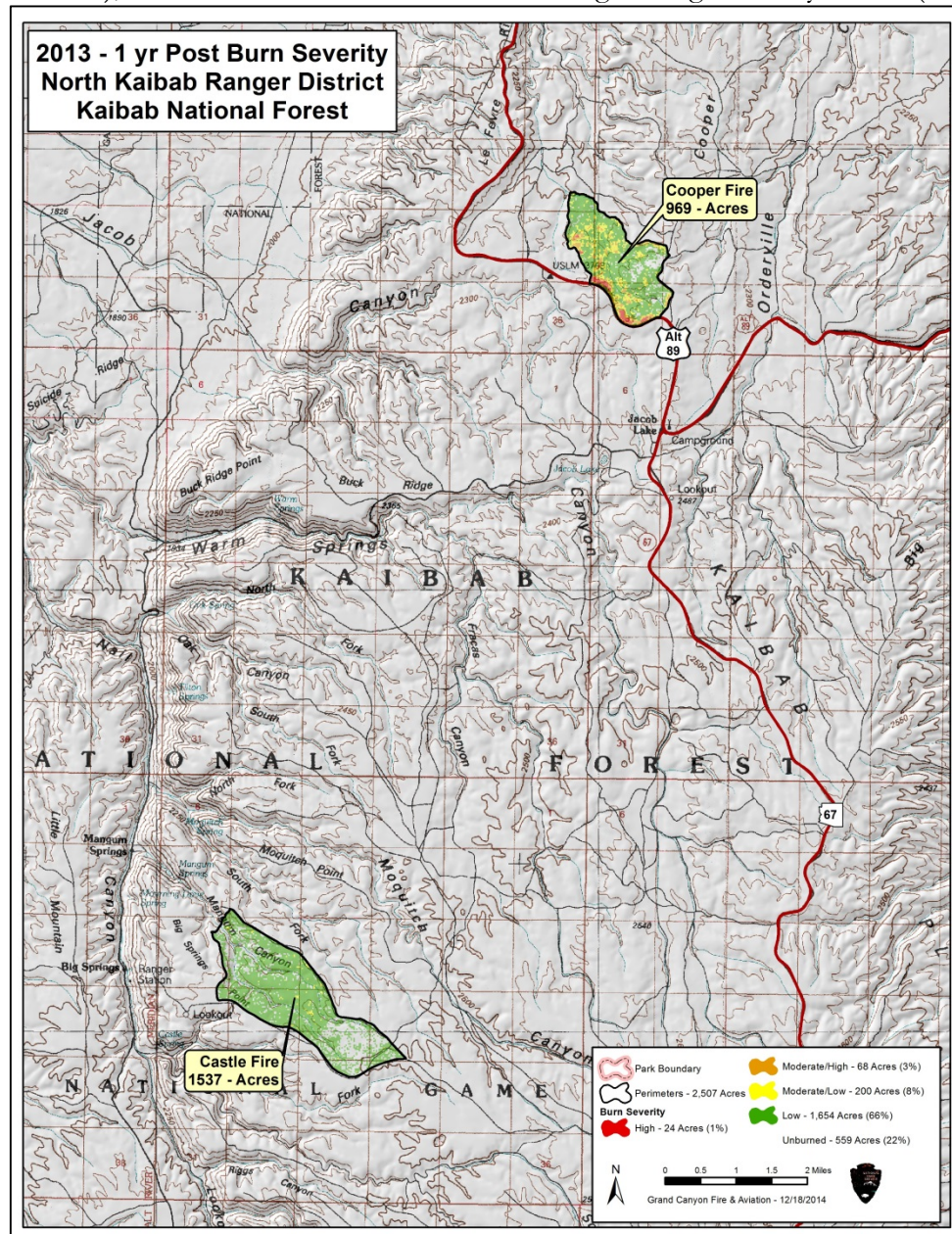


Figure 10. Burn severity data collected one year post-fire on the North Kaibab Ranger District.

The Halfway Wildfire burned 175 acres on the Tusayan Ranger District of the Kaibab National Forest and 75 acres in GRCA. Overall, the fire burned with a very different distribution of effects between the two agencies (Figure 11). On the Tusayan Ranger District, 89 acres (51%) burned with high and moderate/high effects, compared to 3 acres (2%) in the park. With regards to low and moderate/low severity, 92% of the fire within the park (69 acres) burned at these severity levels, contrasted with 48% (85 acres) in low and moderate/low on the Tusayan Ranger District. The difference in these fire effects are most likely tied to the number of recent fuel treatments in the park, compared to those on the forest. The one prescribed fire in the park (Horsethief) was predominately low severity (Figure 11).

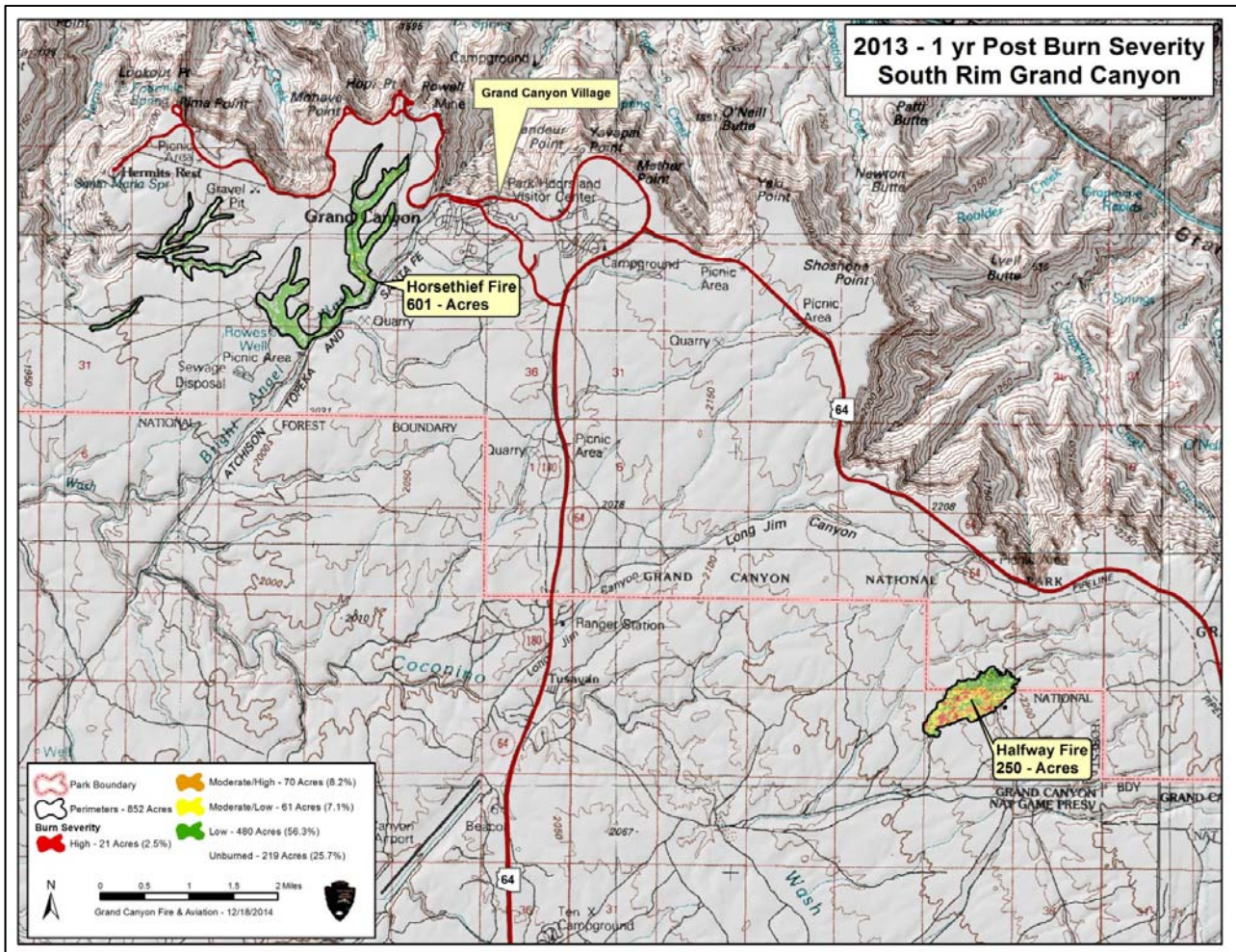


Figure 11. Burn severity data collected one year post-fire on the South Rim and Tusayan Ranger District.

Cumulative Burn Severity –MTBS data and CBI plots

Landscape-scale severity objectives apply to the three monitoring types in which high severity fire was historically infrequent (PIPO, PIPN, and PIAB) and to the mixed conifer forest type (currently not an FMH monitoring type). The following table provides information on the extent of moderate/high and high severity fire in each monitoring type.

In all monitoring/forest types, the percentage of moderate/high and high severity fire on the landscape falls within the objective range. Some patches of moderate/high and high severity fire exceed the objective size in the PIPO, PIPN, and PIAB monitoring types.

Table 9. Management Objectives and Monitoring Results for fire severity.

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 2004 to 2013	2% moderate/high and 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 2004 to 2013	3% moderate/high and 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 2004 to 2013	10% moderate/high and high severity 42 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	16% moderate/high and high severity ¹	YES

¹Updated mapping during 2013 altered the percentage of moderate/high and high severity fire in mixed conifer forests compared with previous years.

ADDITIONAL PROGRAM INFORMATION

TABLE 10. Additional Program Information for 2014.

Program Category	Measurement	Grand Canyon National Park	Flagstaff Area National Monuments
Planning	Does park have written Desired Future Conditions (DFCs)?	Yes	Yes
Planning	Date park-level monitoring plan completed (or revised)	2010	n/a
Planning	Total # project- or community-level monitoring plans	0	0
Planning	Assisted with how many Burned Area Emergency Rehabilitation (BAER) plans in 2014?	0	0
Monitoring	% 2014 data entered	100	n/a
Monitoring	% 2014 data quality checked	100	n/a
Monitoring	# 2014 prescribed fires monitored (# total prescribed fires monitored) ¹	1 (9)	0
Monitoring	# non-fire fuels treatments monitored	0	0
Monitoring	# 2014 wildfires monitored (# total wildfires monitored) ¹	1 (2)	0
Monitoring	# BAER treatments monitored	0	0
Communication	# project monitoring reports completed in 2014 ²	3	0
Communication	# annual meeting(s) with park staff	4	0
Communication	# formal presentations of results	2	0
Communication	Do you use Minitab?	Yes	--
Research	Are research needs identified in Fire Management Plan (FMP) or monitoring plan?	Yes	Yes
Research	# proposals submitted in 2014	4	0
Research	# proposals funded in 2014	0	0
Research	# research projects supported in 2014 ³	13	0
Research	Additional Comments		

¹Number of fires/treatments completed in 2014 with fire/treatment effects monitoring conducted. Includes pre- and post-fire/treatment monitoring, but not on-site fire behavior monitoring. Number in parentheses represents 2014 post-fire/treatment monitoring of fires/treatments that occurred prior to 2014.

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

³Number of 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. In the summer of 2012, tree cores were collected from 911 trees in 72 plots on the North Rim. The tree cores were dated and analyzed at the NAU School of Forestry during the 2012-2013 school year and presentations on initial results were given at the AmeriDendro and Colorado Plateau conferences in 2013.

The research project was completed in May of 2014 with a presentation of results to the park Fire & Aviation and Science & Resource Management staff and copies of all data were provided to the park. A research article detailing the results is in preparation for publication in a peer-reviewed journal. A summary article will be prepared for the next edition of the Rx Effects newsletter.

FUTURE PROGRAM DIRECTION

One of the top priorities for the future is to maintain the integrity of our long-term datasets by continuing to hire a full field crew at GRCA. In addition, a long-term monitoring strategy will need to be developed for the three Flagstaff Area National Monuments in collaboration with staff at the monuments, GRCA fire managers, and the I&M program. The ability of the GRCA Fire Ecology Program to continue to assist in ecology, monitoring, and data management efforts for other parks and the regional and national offices is entirely dependent on maintaining full staffing within the program.

After adding fire-related measurements to all unburned mixed conifer plots installed by the I&M program, and converting the past data into a workable FFI database, collaboration efforts will focus on devising a data management and plot visit protocol that will work for both groups. The CBI plot workload will be moderate due to several fires of size at Grand Canyon in 2014, but the continued struggle with multiple entry fire will persist into the future. RAP plots will, personnel allowing, be re-measured and installed in imminently pending burn units to provide data for burn plans. As usual, the North Rim will presently be the site of most 2015 field work, hosting 50% of FMH plot and 100% of RAP and CBI plot reads.

Building on our recent beta-testing efforts of CartoPac, FFI Lite, and fire monitoring software, as well as tablet hardware platforms, we would like to continue providing insight into the refinement of applications and protocols for mobile device-based data collection on both plots and active fires. Moving from paper datasheets to mobile applications has now been realized within our program, and we hope to stay heavily involved in the development and implementation 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. Eight is enough...

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