



SUMMARY

In 2013, full staffing with 100% returning employees 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 29 Fire Monitoring Handbook (FMH) plots, 42 Rapid Assessment Protocol (RAP) pilot sampling plots, 81 Composite Burn Index (CBI) burn severity plots, and 14 Inventory & Monitoring (I&M) plots, it was a successful year while battling one of the wettest monsoon thunderstorm seasons on record in northern Arizona.

The tradition of assisting other Fire Ecology programs was continued, with the Lead, Assistant, and two crewmembers helping the Saguaro Fire Effects staff accomplish plot work at Chiricahua National Monument in southern Arizona. Additionally, an official interagency agreement was reached with the Kaibab National Forest to install RAP plots within the Tipover Timber Stand Improvement Unit on the North Kaibab Ranger District to assess baseline conditions and measure the effects of burning and other treatments within the project. This agreement provided funding to extend the crew into the fall and offer monitoring and other operational support on multiple prescribed burns along with gathering data from over 40 plots within the Tipover Unit.

Due to budget cuts wrought by government-wide sequestration early in 2013, for the first time in four years no student positions or internships were filled within GRCA's Fire Ecology Program. Although it was a loss to not be able to introduce new, eager individuals to this line of work, with extended seasonal availability among a previously-trained crew, data were efficiently gathered, entered, and checked as the year progressed. This setup allowed the crew to concentrate on more advanced skills, personal development, and performing beta-testing of new software and hardware for the national office, while also allowing the Fire Ecologist to focus on analysis, outreach, and larger-scale tasks.

If sequestration eliminating funding and delaying the ability to hire seasonal crewmembers were not enough, a partial government shutdown from Oct. 1 – Oct. 16 presented an even greater challenge to accomplishing work goals. In the midst of installing 40 plots in the Tipover unit, all Fire Ecology staff were furloughed. Not only was prime field time lost during the narrow fall weather window on the North Rim, but temporary employees were given no motivation to stay without any possibility of back-pay and without any timeline for being able to resume work. Despite the poor situation and no incentive to remain present or available to start work on a moment's notice, Katelynn Jenkins and Jerolyn Byrne must be singled out by name for enduring the massive uncertainty of the shutdown and returning to help us finish the Tipover project. Simply put, without the dedication of employees like them, we would not have been able to accomplish our work and deliver a completed project report.

Despite the trials and tribulations of sequestration, shutdown, and funding, the GRCA Fire Ecology Program was approached by the national, interagency leadership of the FFI (FEAT-FIREMON Integrated) software to assist beta-testing of a mobile device-based, structurally simplified version called FFI Lite. Utilizing the knowledge gained from testing the third-party CartoPac software two years ago, and acquiring several field-rugged, full-Windows OS tablet computers through a variety of local and national means, the crew was able to perform several months of intensive testing in both the field and office on multiple types of plots using a wide range of protocols. The partnership established with the national FFI developers was invaluable in providing feedback and making dynamic improvements in the software on almost a same-day basis. Our work with FFI Lite produced enough confidence in the refined beta-version that we collected data for our final 4 FMH plots of the year and virtually all of the 40 Tipover RAP plots solely on tablets with the new software, and we anticipate being able to convert to 100% electronic data collection for the 2014 field season. 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 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 24 different incidents over 137 operational periods and attended 7 different NWCG training classes. These opportunities led to the completion of five qualifications (FEMO, FIRB, FFT1, HECM, FALA) and work on many others (FEMO, FIRB, ENGB, ICT5, FFT1, HECM, ABRO) to further increase the crew's ability to fulfill a diverse variety of roles within fire. Highlights of this experience included assignments as initial Type 5 Incident Commander (ICT5) on 6 local fires; Firing Boss (FIRB) or Engine Boss (ENGB) for four local fires; Helicopter Crewmembers (HECM) over 11 weeks on 7 different fires in California and Idaho; a 6-week detail on the South Rim backfilling with GRCA Helitack; Geographic Information Systems Specialist (GISS) support on local incidents; and initiating training toward Long Term Fire Analyst (LTAN). 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 69 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, five other GRCA fire personnel (including the FMO) and almost 30 individuals from the vegetation management crews were cross-trained in fire effects plot protocols.

Even though maternity leave and the government shutdown led to the Ecologist being absent for a portion of the year, many standard tasks and support activities were still completed. In addition to the typical planning, data analysis, and budget tasks, the Ecologist worked on a wide variety of outreach, research, and data management activities this year. Communication continued to be a high priority as the Ecologist submitted an article to Rx Effects, co-authored presentations at two scientific

conferences, provided a guest lecture at Northern Arizona University (NAU), and continued outreach activities with the Interpretation & Education and Concessions Divisions. The Ecologist continued important research collaborations with NAU and the University of Montana and was a co-Principal Investigator on one new Joint Fire Science Proposal with the University of Montana. The Ecologist also continued work to make the park's fire effects data more accessible and usable by adding metadata to the FFI database, uploading all annual reports and monitoring plans to the Integrated Resource Management Applications (IRMA) portal, and converting plot photos to modern formats.

STAFF ACCOMPLISHMENTS & AREAS OF FOCUS

TABLE 1. Fire Ecology Staff for 2013 calendar year.

Employee	Starting Date	Ending Date	# Pay Periods	Training	NWGG Taskbooks
Windy Bunn, GS-11	1/01/13	12/31/13	26	RX410 S490	
Li Brannfors, GS-7 ²	1/01/13 4/07/13 10/15/13	1/26/13 10/01/13 12/31/13	21.5 ¹	S230 S234 S495	FIRB RXB3-t
Jasper Peach, GS-6 ²	4/21/13	11/30/13	16	S211 S230 S234	FALB-t FIRB-t ENGB-t READ-t
Jerolyn Byrne, GS-5 ³	4/21/13 10/17/13	10/01/13 11/16/13	14	S211 S212 S234 S271 Search & Rescue	FALA FEMO-t FFT1-t HECM-t ABRO-t
Katelynn Jenkins, GS-5 ³	6/16/13 10/17/13	10/01/13 11/16/13	10	S211 B3 & A110	FEMO HECM-t
Kate Milich, GS-5 ⁴	4/24/13	08/30/13	9.5	S131 S230 S234 S271 IS200 WFR Refresher	FFT1 HECM FALA ICT5-t ABRO-t

¹Time for Li Brannfors reflects periodic work while in non-pay status from 1/27/13 – 4/06/13.

²After Oct. 1, time for Li Brannfors & Jasper Peach partially funded by USFS Tipover Project.

³After Oct. 1, time for Jerolyn Byrne & Katelynn Jenkins funded by USFS Tipover Project. In intermittent status during shutdown.

⁴ Kate Milich finished the season on a detail with GRCA Helitack.

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	13	6	2	3	15	5	21	4	1	2	9	19
Jasper Peach, GS-6	16	5	1	3	11	4	19	5	6	7	5	18
Jerolyn Byrne, GS-5	17	9	2	2	12	5	10	3	2	19	7	12
Katelynn Jenkins, GS-5	15	5	0	3	6	7	16	10	2	20	4	12
Kate Milich, GS-5	21	2	0	1	14	2	8	0	1	36	7	8

"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 Government Shutdown back-pay, PT, leave taken, meetings, paid holidays off, air quality, non-fire duties, etc.

TABLE 3. Base-hour Fire Effects Crew Focus Areas/Accomplishments in 2013.

Focus Area	Percent Time	Accomplishments and Activities
FMH Plots	16%	• 25 remeasurements, 3 immediate post-burn reads, 1 install at GRCA • Lead, Assistant, & 2 crewmembers assisted Saguaro Fire Effects with 37 plots over 1 payperiod at Chiricahua NM
RAP Plots	6%	• 42 installs in Kaibab NF Tipover treatment unit • Majority of RAP data collected electronically with tablet computers while performing national FFI Lite beta-testing
CBI Plots	1%	• 81 plots across 4 fires
I&M Plots	3%	• 14 pre-burn reads of fuel and tree data
Plot Office	12%	• Includes FMH, RAP, CBI, & I&M plot preparation, plant ID, data filing/organization, and FFI Lite beta-testing data management
Data Entry	4%	• Entered and checked all scheduled 2013 FMH plot data by Oct 1 • Entered and checked all 2013 RAP plot data by Nov 14
Data Analysis	1%	• Annual Report analysis on all major variables in program
General Office/ Supervision/ Admin	16%	• 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 & 3 seasonals
Fire Monitoring (Rx or Wildfire)	4%*	• Lead FEMO & FEMO-trainees on 1 Rx fire at GRCA & 1 Rx fire on Kaibab NF • Lead FEMO & FEMO-trainees on 2 wildfires at GRCA & 2 wildfires on Kaibab NF
Fire Operations/ Assignments (Rx, Wildfire, Engine, Helitack, Non-fire Fuels Projects)	16%*	• Qualified personnel as FIRB, FFT1, HECM, FALA, and FEMO • Assistant and 3 crewmembers detailed for a total of 11 weeks on 7 fires with Grand Canyon Helitack to California & Idaho • 1 crewmember detailed for 6 weeks with GRCA Helitack on S Rim • FIRB-t assignments by 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	6%	• All attended annual fire refresher • 1 completed S131 • 3 completed S211 • 1 completed S212 • 2 completed S230 • 4 completed S234 • 2 completed S271 • 1 completed S495 • 1 completed B3 & A110 aviation safety • 1 completed Wilderness First Responder (WFR) refresher • 1 completed Basic Search & Rescue 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 Effects
Other	15%	• 3% of crew time spent on PT • 7% of crew time spent on leave • 2.5 weeks of work productivity lost to government shutdown

*Approximately 1150 hours of overtime spent on fire activities, equaling 17% of total crew work time (base + OT), are not reflected.

TABLE 4. Fire Ecologist Focus Areas/Accomplishments in 2013.

Focus Area	Percent Time	Accomplishments and Activities
Planning	11%	- GRCA Fire IDT – reviewed 3 burn plans and 2 thinning plans; planning meetings & briefings for Rx fires and thinning projects - 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%	- Submitted Rx Effects newsletter article - Co-authored 4 presentations at two conferences - Assisted Interpretation & Environmental Education Division with staff orientation, high school career day, and Ranger Careers video - Assisted Concessions Division with bus driver orientation - Guest Lecturer for NAU Fire Ecology class - Led fire ecology field trip for a CO middle school group
NPS Meetings/ Task Groups	7%	- Fire and park staff 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	5%	- USFS Tipover monitoring plan, budget, and deliverables - Coordination with NAU on USFS Oquer project monitoring - Kaibab NF & Grand Canyon NP annual fire meeting
Fire Assignments and Project Work	<1%	1 in-park prescribed fire
Research	4%	- Meetings for Reserve Fund research project - JFSP proposal with University of Montana partners - GRCA research permit reviews - Provided data, support, research ideas, and/or manuscript & proposal reviews for 8 other fire-related projects
Data Collection	<1%	FMH plot and burn severity data collection
Data Entry & Management	6%	- Completed FFI metadata for all monitoring units - Uploaded current FFI database, all fire monitoring plans, and fire ecology annual reports (1993-2012) to IRMA - Created RAP datasheet printing database for electronic data - Converted plot photos from outdated media to usable formats - Identified and remedied FFI database errors
Data Analysis	3%	- Analyzed FMH and RAP plot data, severity data, and weather and fuel data for burn plans, field trips, and annual report - Analyzed data from USFS Tipover project RAP plots
Supervision/ Admin	10%	- Supervised Lead Monitor - Worked with Lead Monitor to hire seasonal crewmembers - Managed fire monitoring activities budgets - Travel, time, and purchasing
Training & Conferences	10%	- RX-410 and S-490 fire courses; fire refresher - Biennial Conference of Science & Management on the CO Plateau - NPS required annual training - PT (3%)
Other	39%	Maternity leave, other leave, government shutdown, and holidays

FIRE EFFECTS PLOT WORKLOAD

The 2013 season produced a light FMH and CBI plot load for most of the year at Grand Canyon. As in 2012, workload picked up late with 42 RAP plot installations on the Kaibab National Forest, delayed for 3 weeks mid-project by the government shutdown. In addition, 14 I&M plots were added to the program to increase plot representation in North Rim mixed conifer.

TABLE 5. Fire Effects Plot Workload for 2013.

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	2	3		5			10	41 ²
South	Pinyon-Juniper Woodland—PIED³	FMH							0	17
South	Grand Fire	CBI			24				24	-
South	Moqui Rx	RAP ⁴							0	5
South	Picnic Rx	RAP ⁴							0	10
South	Quarry Rx	RAP ⁴							0	10
North	Ponderosa Pine PIPN	FMH				11			11	30
North	Ponderosa Pine with White Fir Encroachment PIAB	FMH	1		1				2	27
North	Rocky Mountain Subalpine Conifer PIEN	FMH	3		1			2	6	17
North	Grassland Interior GRIN	FMH							0	10
North	Grassland Edge GRED	FMH							0	6
North	N Rim Piles	CBI			10				10	-
North	Range Rx	CBI			20				20	-
North	Thompson Rx	CBI			27				27	
North	Fawn Spring Rx	RAP ⁴							0	20
North	Range Rx	RAP ⁴							0	20
North	Spring Canyon Rx	RAP ⁴							0	20
North	Thompson Rx	RAP ⁴							0	20
North	Tipover Rx-USFS	RAP ⁴	42						42	40 ⁵
North	Walla Valley Rx	RAP ⁴							0	6
North	Mixed Conifer	I&M ⁶	14						14	44
Total			62	3	83	16	0	2	166	343

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

²One PIPO FMH plot was rejected and re-installed in a different burn unit in 2013

³PIED monitoring type reads were discontinued in 2000

⁴Pilot sampling

⁵Two Tipover RAP plots were rejected and re-installed in different locations in 2013

⁶Fuel 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 119 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 2013. 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	19.6 ± 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=14
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=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)	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=5
	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=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)	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. 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.

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 2013. 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=43
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=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	Not analyzed (n=0)	N/A	NO n=5
	Maintain conifer pole density with DBH of 1-6" of <100 trees/acre	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.

USFS Tipover Timber Stand Improvement Project – RAP plots

The USFS Tipover Timber Stand Improvement (TSI) project includes 9,123 acres within the Kaibab National Forest, North Kaibab Ranger District. In order to assess the current forest conditions within the project and provide an opportunity for quantitative post-treatment analysis, the Kaibab National Forest entered into an Interagency Agreement with Grand Canyon National Park to install 40 pre-treatment RAP monitoring plots within the Tipover TSI project.

The eastern subunit of the Tipover project is directly adjacent to the GRCA Roost – Fawn Spring and Boundary – Spring Canyon project units. Twenty pre-treatment RAP plots were installed in each of the GRCA project units in 2010. Despite differences in land use history and plot stratification methodology, there were many similarities in the pre-treatment condition of the Tipover and GRCA project plots. Fuel loading; living seedling (< 1" DBH), intermediate (6 – 16" DBH), and large (> 16" DBH) tree density; seedling and sapling (1 – 6" DBH) tree composition; and understory cover measurements were all similar between the project units. The Tipover project had higher living sapling tree density, lower dead intermediate and large tree density, and higher non-native species occurrence compared to the GRCA projects. In addition, intermediate and large trees in the Tipover project were shorter and had lower crown base heights than trees in the GRCA projects.

Surface Fuel Loading

Pre-treatment fuel loading values were similar between the Tipover project and the GRCA projects (Figure 1). Even though average fuel loading values in all surface fuel categories were slightly lower in the Tipover project than in the GRCA projects, these differences were not statistically significant (all $p > 0.05$). In addition to slight differences in average fuel loading, the range of total fuel loading values differed between the Tipover and GRCA projects. Individual plot total fuel loading ranged from 11 to 82 tons/acre in the Tipover project and from 17 to 106 tons/acre in the GRCA projects.

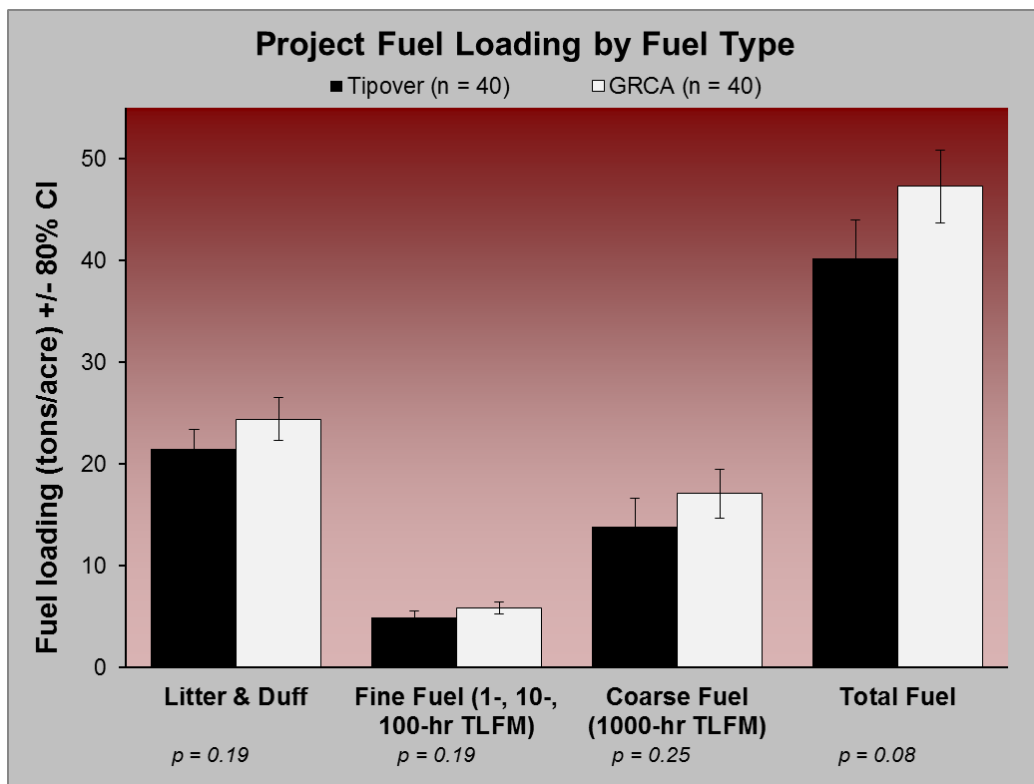


Figure 1. Comparison of mean pre-treatment fuel loading ($\pm$ 80% CI) in the Tipover and GRCA projects.

Understory Cover

There was no difference in understory herbaceous ($p = 0.65$) or shrub ($p = 0.72$) cover between the Tipover project and the GRCA projects. Herbaceous cover averaged 13% and shrub cover averaged 10% across all plots in the Tipover project. In the GRCA projects, herbaceous cover averaged 15% and shrub cover averaged 12% across all plots. The GRCA project plots had no observations of non-native species while six non-native species were observed (in seven of the monitoring plots) in the Tipover project.

Tree Height

On average, intermediate and large trees in the Tipover project were shorter and had lower crown base heights than trees in the GRCA projects (Figure 2). Average intermediate tree height was 4 feet lower ($p = 0.02$) and average intermediate tree crown base height was 7 feet lower ($p < 0.0001$) in the Tipover project than in the GRCA projects. Similarly, average large tree height was 7 feet lower ($p = 0.06$) and average large tree crown base height was 8 feet lower ($p = 0.02$) in the Tipover project than in the GRCA projects.

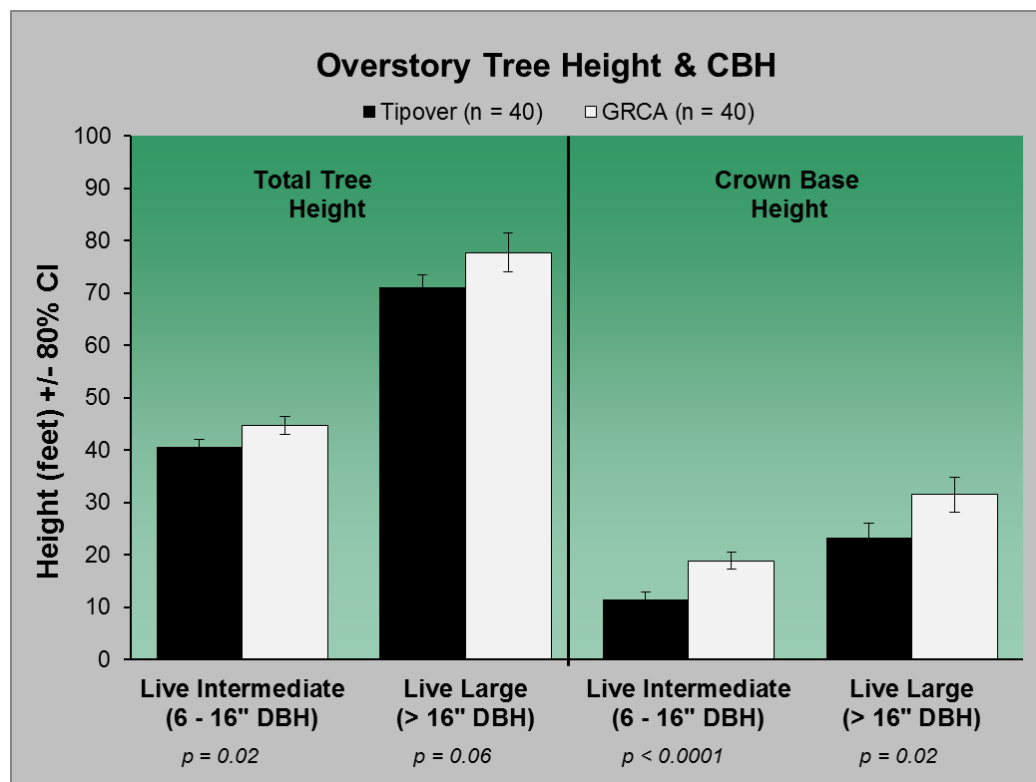


Figure 2. Comparison of mean tree height and crown base height ($\pm 80\%$ CI) in the Tipover and GRCA projects.

Tree Density

Average density of living seedling ($p = 0.29$), intermediate ($p = 0.85$), and large ($p = 0.26$) trees was similar between the Tipover and GRCA projects (Figures 3 and 4). Living sapling tree density was 176 trees/acre higher ($p = 0.007$), on average, in the Tipover project than in the GRCA projects. Intermediate snag density was 31 trees/acre lower ($p = 0.0002$) and large snag density was 5 trees/acre lower ($p = 0.04$) in the Tipover project than in the GRCA projects.

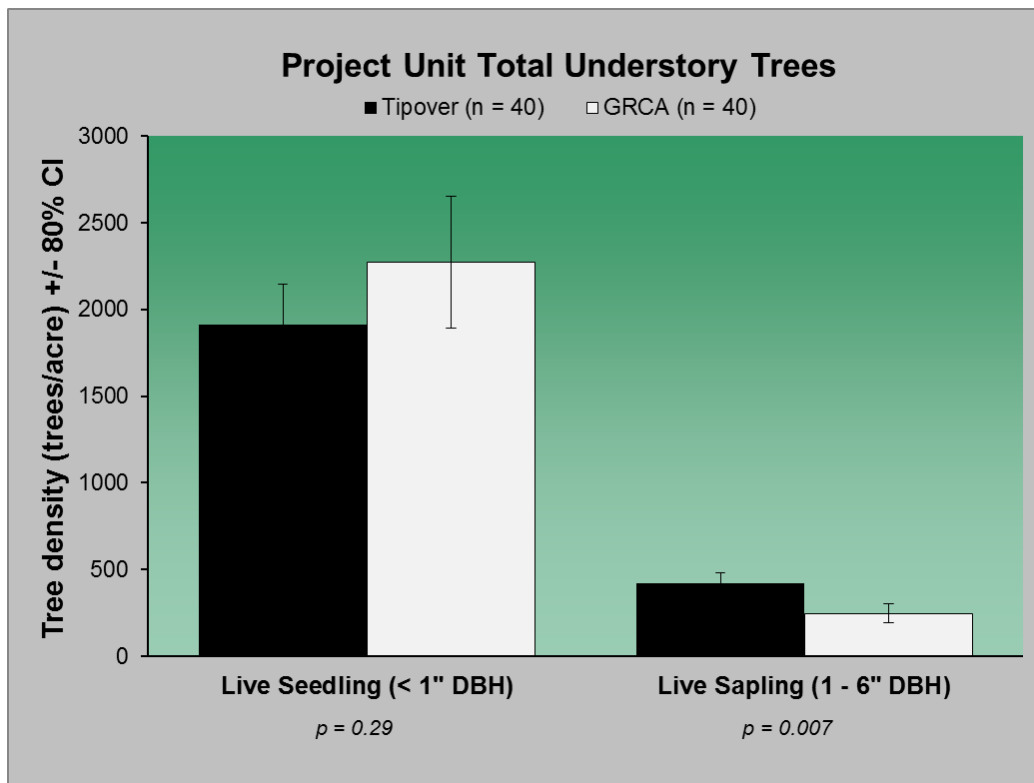


Figure 3. Comparison of mean pre-treatment seedling and sapling tree density ($\pm$ 80% CI) in the Tipover and GRCA projects.

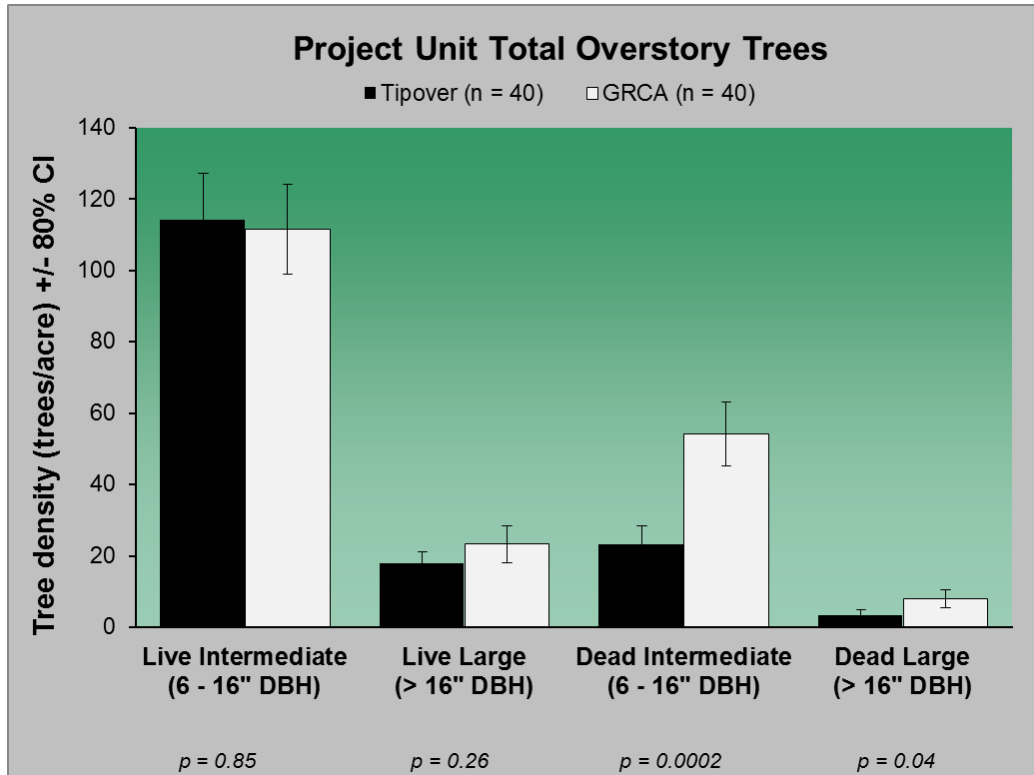


Figure 4. Comparison of mean pre-treatment intermediate and large tree density ($\pm$ 80% CI) in the Tipover and GRCA projects.

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 2013, 1,271 post-fire year 1 CBI-style plots have been measured in the park, providing Normalized Burn Ratio (NBR) satellite derived severity data on 55 fires for 130,332 total acres. This process is designed for field data and satellite imagery gathered one year following a fire; hence, 2013 work was performed on fires which burned in 2012. A total of 81 CBI plots were installed in 2013 across 5,401 acres in the Thompson, Range, and North Rim Piles prescribed fires, as well as the Grand wildfire.

The majority (2,148 acres; 44% of the fire area) of the acres burned in the three 2012 North Rim prescribed fires had low severity effects (Figure 5). The 2012 prescribed fires had a combined total of 2,205 unburned acres (22% of the fire area), 524 acres burned with moderate/low severity effects (11% of the fire area), and 45 acres burned with moderate/high to high severity effects (1% of the fire area).

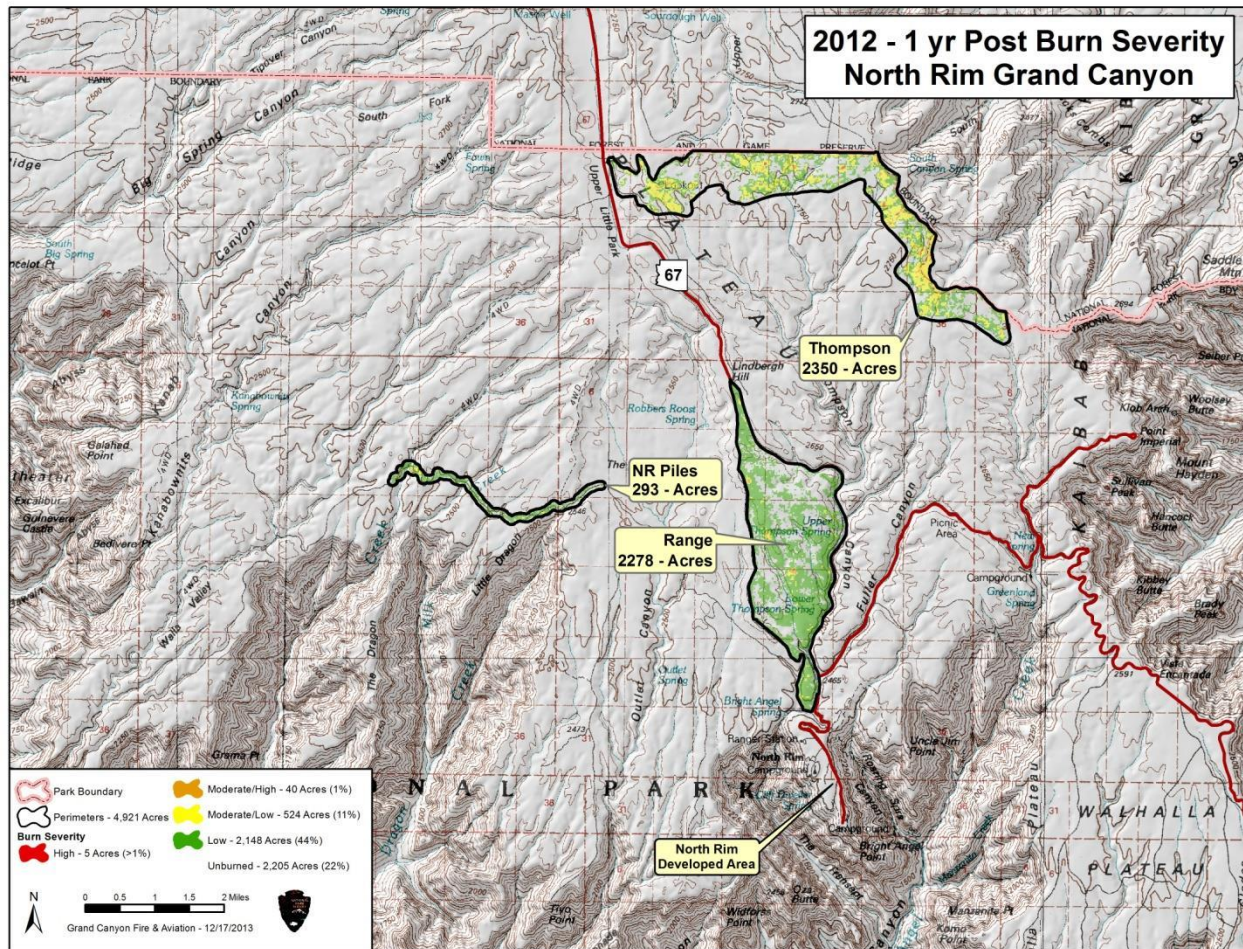


Figure 5. Burn severity data collected one year post-fire on the North Rim.

The Grand wildfire burned 466 acres on the Kaibab National Forest and 14 acres in GRCA. Overall, the fire burned with a fairly even distribution of effects with 7% of the total fire unburned, 26% burned with low severity effects, 27% burned with moderate/low severity effects, 24% burned with moderate/high severity effects, and 16% burned with high severity effects. In the park, 2 acres were unburned, 9 acres burned with low or moderate/low severity effects, and 3 acres burned with moderate/high or high severity effects.

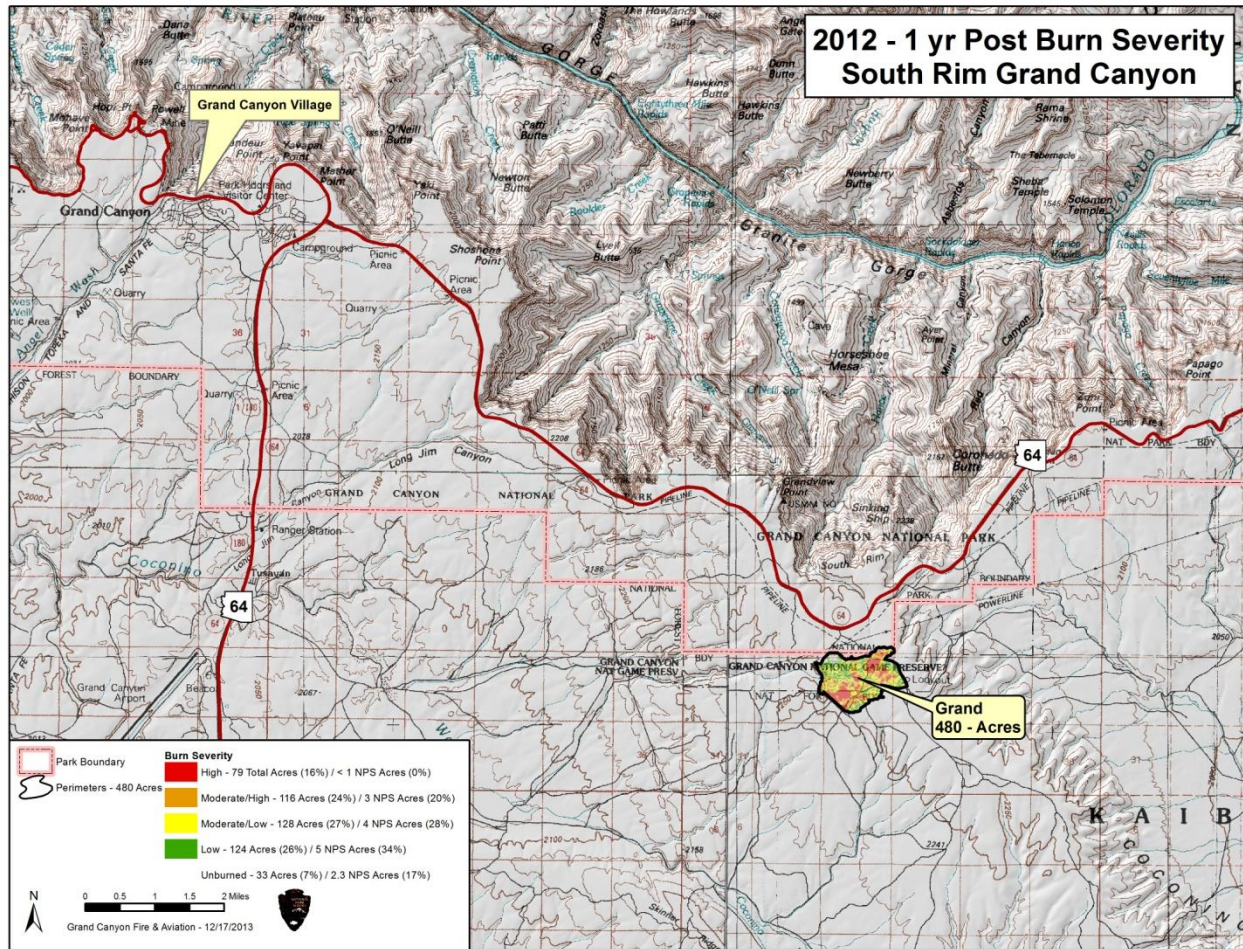


Figure 6. Burn severity data collected one year post-fire on the South Rim.

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 2003-2012.

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 2003 to 2012	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 2003 to 2012	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 2003 to 2012	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	16% moderate-high/high severity ¹	YES

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

ADDITIONAL PROGRAM INFORMATION

TABLE 9. Additional Program Information for 2013.

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 2013?	0
Monitoring	% 2013 data entered	100
Monitoring	% 2013 data quality checked	100
Monitoring	# 2013 prescribed fires monitored (# total prescribed fires monitored) ¹	1 (4)
Monitoring	# non-fire fuels treatments monitored	0
Monitoring	# 2013 wildfires monitored (# total wildfires monitored) ¹	0 (3)
Monitoring	# BAER treatments monitored	0
Communication	# project monitoring reports completed in 2013 ²	1
Communication	# annual meeting(s) with park staff	3
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 2013	1
Research	# proposals funded in 2013	0
Research	# research projects supported in 2013 ³	15
Research	Additional Comments	

¹Number of fires/treatments completed in 2013 with fire/treatment effects monitoring conducted. Includes pre- and post-fire/treatment monitoring, but not on-site fire behavior monitoring. Number in parentheses represents 2013 post-fire/treatment monitoring of fires/treatments that occurred prior to 2013.

²Existing 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. 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 data analysis is underway. Initial results were presented at the AmeriDendro conference in May 2013 and at the Colorado Plateau Conference in September 2013.

In addition, NAU researchers obtained funding in September 2012 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. A post-doctoral associate was hired and began work on this phase of the research in March 2013.

The Reserve Fund project is expected to be completed by May 31, 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 (completed in 2013)
- Article comparing modern and historical fire regimes submitted to peer-reviewed publication

FUTURE PROGRAM DIRECTION

One of the top priorities for the future is to secure stable funding to hire a field crew and maintain the integrity of our long-term datasets. With budget outlooks painting a picture of less hazard fuel project dollars available to fund fire effects crewmembers, and no current allocation of base funding for said personnel, the continuation of the GRCA Fire Effects Crew and its ability to provide current, accurate data to assist with informed adaptive management decisions could be in serious jeopardy in the future.

After completing a 3-year push to add fire-related measurements to all unburned mixed conifer plots in the I&M program, collaboration efforts will shift to devising a data management protocol that will work for both groups and entering the additional data into a unified, master database. The CBI plot workload will be minimal due to only one fire of size at Grand Canyon in 2013, but the continued struggle with multiple entry fire will persist into the future. Year 2 post-burn FMH and RAP plot reads from the 2012 prescribed burning will dominate workload in 2014. Our first large multi-year post-burn dataset in mixed conifer will be analyzed from RAP plot pilot data to continue providing managers more incident-specific data, and RAP plots will, personnel allowing, be installed in imminently pending burn units to provide data for burn plans. As usual, the North Rim will presently be the site of most 2014 field work, hosting 58% of FMH plot and 100% of RAP plot reads.

Building on our recent beta-testing efforts of CartoPac software, FFI Lite software, and tablet hardware platforms, we would like to continue providing insight into the refinement of applications and protocols for mobile device-based data collection in FFI. Moving from paper datasheets to mobile applications has long been a goal of 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 7. Keep your head up--maybe 2014 will hold pleasant surprises.

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