



SUMMARY

The 2010 season was diversified and productive for Grand Canyon National Park's (GRCA) Fire Ecology Program. In the process of making 44 Fire Monitoring Handbook (FMH) plot visits, all scheduled work was completed while allowing crewmembers wide-ranging training opportunities and contributing to the national fire management effort. Rapid Assessment Protocol (RAP) plots continued their expansion and contribution to the park's monitoring program, with installation of 40 more pilot plots. In addition, 109 Composite Burn Index (CBI) plots were installed within six fires at GRCA to allow assessment of burn severity, resulting in a grand total of 193 plot visits. Full staffing within the Fire Ecology Program for all of 2010 produced an efficient work environment and freed the Fire Ecologist to concentrate on analysis, outreach, and larger-scale tasks.

For the first time in many years, no vacancies occurred in any of the permanent positions, providing much appreciated stability and allowing the opportunity to focus on improving the program rather than merely keeping up with the existing workload. Productivity was further enhanced by the hiring of a student through GRCA's diversity program to augment the standard crew. Data analysis continued to increase with a full-time, dedicated Ecologist on staff for the entire year. In addition to analysis of standard monitoring objectives for the annual report, efforts were expanded to address data needs relating prescribed fire planning and landscape-scale monitoring objective revision. Conversion of the GRCA database to FFI v1.04.01 occurred after the end of the field season, supplying the Ecologist with more robust tools for analysis and easing data entry for the crew.

The Ecologist completed the 2010 monitoring plan revision, continued to work with university cooperators on research projects, worked to expand communication and outreach, served as a member of the steering committee for the SW Interagency Fuel Workshop, and oversaw the first year of the GRCA Fire Ecology and Fuel Management Internship program. The internship program was very successful with the intern gaining experience in monitoring, planning, compliance, analysis, and program management with the Fire Effects Crew, Interagency North Zone staff, South District staff, Wildlife and Archaeology staff, the GIS Specialist, the Ecologist, and the Deputy FMO during the summer. The intern also completed initial GIS analysis to improve the park's fuel layer as part of an independent project in the fall.

The Assistant Lead continued to lead collaborative efforts with the GRCA Environmental Education Branch and the Grand Canyon School to provide fire ecology educational opportunities for local and visiting students. This effort led to a new fire ecology education program for the park that is quickly becoming one of the most requested programs by visiting school groups. In addition, the Ecologist assisted the Division of Interpretation and Environmental Education with fire wayside exhibits and field trips. The Ecologist, Lead, Assistant Lead, and GIS Specialist provided information and field trips about the GRCA fire monitoring program to over 70 burn bosses from The Nature Conservancy, 14 USGS, Forest Service, and NPS remote sensing specialists, a BLM Fire Ecologist, and several Forest Service fuel specialists. The Ecologist also presented fire monitoring data at the NAU School of Forestry weekly seminar series in the spring.

Crewmembers, as usual, took part in a wide array of extracurricular activities. Two new crewmembers were able to provide basic fireline support immediately upon arrival, and subsequently concentrated on building more advanced qualifications. One crewmember stayed on an extra two weeks to gain experience working with the engines. Cross-training Fire Effects crewmembers with other field disciplines in our fire management program allowed the crew to provide 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, two visiting FEMOs from Grand Teton, and much of the invasive plant management crew were cross-trained in fire effects plot protocols.

We continued our role of providing the primary fire behavior and weather monitoring support at Grand Canyon with every staff member from the Ecologist to new crewmembers assisting fire monitoring in-park or on the neighboring Kaibab National Forest on multiple occasions for either prescribed or wildfire events. In-park, the crew gained experience monitoring during the multi-week Saffron Fire and during the Buggeln and Hance/Watson I prescribed fires. Out-of-park, one crewmember detailed with the Saguaro Wildland Fire Module in Colorado and Arizona for two weeks, and another crewmember worked with the Grand Canyon Helitack crew on the Schultz and Saffron Fires in Arizona for two weeks. Everyone served on several incidents as ICT5-trainee, FFT1, FEMO, or simply another hand digging line.

Continuing the tradition of assisting other Fire Effects programs for a tenth consecutive year, two crewmembers helped the Zion Fire Effects Crew accomplish plot work at Zion National Park for two weeks. Additionally, the Lead detailed for five weeks to Grand Teton National Park, followed by the Assistant similarly detailed for three weeks, both as Acting Lead for the Teton Interagency Fire Effects Crew while that position was vacant. During these eight weeks, the GRCA Assistant was temporarily promoted to a GS-7 salary while he fulfilled Lead duties at both locales. We welcome these additional opportunities, as long as we continue to be able to accomplish all of our planned plot work at home. Next season's FMH plot load looks to be a sharp increase over 2010, based on more widespread prescribed burns on both rims. CBI plot workload will remain at typical levels, with the added

challenge of almost all plots falling in areas that were previously burned. Pilot data from the RAP plots will be analyzed, with the intent of refining our protocols and focusing our efforts for plot network expansion through that protocol to give managers more incident-specific data. Expanded use of the FFI database is planned as we hope to delve deeper into the tools for managing all FMH and RAP data in FFI. At present, the 2011 workload will be mostly on the North Rim (62%).

STAFF ACCOMPLISHMENTS & AREAS OF FOCUS

TABLE 1. Fire Ecology Staff for 2010 calendar year.

Employee	Starting Date	Ending Date	# Pay Periods	Training	NWGG Task books
Windy Bunn, GS-11	1/01/10	12/31/10	26	READ NIFTT on-line courses WFDSS	
Li Brannfors, GS-7	1/01/10 5/09/10	2/27/10 12/31/10	21	L280	FIRB-t
Jasper Peach, GS-6/7/6*	3/08/10 6/06/10 8/01/10	6/05/10 7/31/10 11/20/10	18.5*	S341	ICT5-t FALB-t GISS-t
Mary Jo Geldert, GS-5	4/25/10	10/23/10	13		
Alexander Spannuth, GS-5	5/17/10	10/23/10	11.5	S290 S271	FEMO FALA-t HECM-t
Karen Koenig, GS-5	5/17/10	7/31/10	5.5		HECM-t FALA-t
Kate Milich, GS-5**	7/04/10	10/23/10	7**	S130/190	FEMO-t
Matt Flying, GS-5***	5/23/10 8/29/10	8/28/10 12/31/10	7*** 1.5***	B3 CPR/First Aid	FEMO-t

*Time for Jasper Peach includes temporary promotion as Lead Monitor, as well as 2 payperiods NOT funded out of hazard fuels base accounts while working on developing fire ecology curriculum with environmental education staff

**Time for Kate Milich includes 1 payperiod detailed with engine crew, as well as entire season NOT funded out of hazard fuels base accounts due to funding provided by GRCA diversity student program

*** Matt Flying was the intern for this year and his time includes full summer payperiods and independent project work during the fall semester. Matt's time was funded from additional hazard fuels funds and NOT from the fire effects base account

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

Employee	FMH Plots	RAP Plots	CBI Plots	Data Entry/ Mgmt	FX Office	Monitoring (Rx or Wildfire)	Rx Fire Ops	Wildfire and Helibase Ops	Training Courses	Other
Li Brannfors, GS-7	11	10	2	7	44	1	1	0	2	22
Jasper Peach, GS-6/7/6	14	9	1	3	39	3	0	3	5	23
Mary Jo Geldert, GS-5	16	12	1	10	28	7	4	2	2	18
Alexander Spannuth, GS-5	24	16	1	8	23	6	0	9	1	12
Kate Milich, GS-5	17	9	3	3	29	12	13	0	0	14
Karen Koenig, GS-5	30	0	0	3	27	18	0	4	2	16

"FX Office" includes miscellaneous plot data preparation and management time, photo filing, paperwork, supervision, etc.

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

TABLE 3. Fire Effects Crew Focus Areas/Accomplishments in 2010.

Focus Area	Percent Time	Accomplishments and Activities
FMH Plots	16%	41 remeasurements, 2 immediate post-burn reads, 1 install at GRCA 2 crewmembers assisted 2 weeks at Zion NP - Lead & Assistant detailed to Grand Teton NP for a combined 2 months
RAP Plots	10%	40 RAP installs across 2 Rx burn units - Lead & Assistant detailed to Grand Teton NP for a combined 2 months
CBI Plots	1%	109 installs across 6 fires
Data Entry	6%	- Entered all 2010 FMH & RAP plot data by Nov 18 - Checked all 2010 FMH & RAP plot data by Dec 16
Data Conversion & Analysis	1%	- Annual Report analysis on all major variables in program - Additional analysis on newly installed RAP plots
General Office/ Supervision/ Admin	35%	- Assistant Lead temporarily promoted to Lead for 2 months - Includes FMH, RAP, & CBI plot preparation and data filing/organization - Lead & Ecologist hired 3 new seasonal crewmembers - Lead supervised 1 permanent Assistant Lead & 4 seasonals - Paperwork!
Fire Monitoring (Rx or Wildfire)	6%	- Lead FEMO & FEMO-trainees on 3 Rx fires at GRCA & 2 Rx on Kaibab NF - Lead FEMO & FEMO-trainees on 3 wildfires at GRCA
Fire Operations/ Assignments (Rx, Wildfire, or Helitack)	4%	1 crewmember detailed for 2 weeks with Saguaro Wildland Fire Module - Assistant went on multi-day assignment to BLM-AZ Strip - GISS support by Lead and Assistant on multiple fires at GRCA - Cross-trained crewmembers with GRCA engines, helitack, mechanical fuel reduction projects, fuel sampling - Provided IA coverage on N Rim while Engine 831 was out-of-park on assignments
Training	2%	- All attended annual fire refresher 1 seasonal attended S130/190 at Hoopa, CA 1 seasonal attended S271 at GRCA 1 seasonal attended S290 at Sedona, AZ - Assistant Lead attended S341 at Phoenix, AZ & advanced botany course in Ashton, ID - Lead attended L280 at Pinedale, WY
Other	19%	5% of crew time spent on PT 5% of crew time spent on leave 1 month spent developing fire education program

TABLE 4. Fire Ecologist Focus Areas/Accomplishments in 2010.

Focus Area	Percent Time	Accomplishments and Activities
Planning	16%	- Completed GRCA Fire Monitoring Plan - Co-authored draft GRCA Fire Management Plan - Participated in FMP section 7 compliance meetings - Fire ecology literature
Presentations/ Education	4%	- Presented GRCA fire data at NAU School of Forestry seminar series - Co-authored poster at Society of American Foresters Convention - Assisted Interpretation & Environmental Education Division with fire wayside exhibits, field trips, and review of Fire Education curriculum - Field trip for The Nature Conservancy burn boss meeting
NPS Meetings/ Task Groups	8%	- GRCA Fire IDT – reviewed 4 project plans, planning meetings for prescribed fires and wildfires - Review teams for vegetation map and Fire Ecology statistics tools - Fire and park staff meetings - Fire and Science & Resource Management collaboration meetings
Interagency Work	3%	- SW Interagency Fuel Workshop steering committee - Kaibab Forest Plan revision meetings - Monitoring field trip for AZ Strip BLM
Fire Assignments (Rx & Wildfire)	5%	FEMO on 2 in-park Rx fires and 1 in-park wildfire
Research	6%	- Meetings and support for 3 M.S. student projects - Research permit reviews - Provided data and proposal reviews for 5 additional projects - Meetings to define new research needs (SW Consortium, etc)
Data Collection	5%	- FMH, RAP, and CBI plot data collection - Field recon of burn units
Data Entry & Management	7%	- RAP and FMH data checking - Identified and remedied FFI database errors caused by the limitations of historic data entry options
Data Analysis	5%	- Summarized data for inclusion in new monitoring plan - Summarized FMH and RAP data for burn plans and annual report - Provided data analysis support for Fuel Management intern project
Supervision/ Admin	16%	- Supervised Lead Monitor - Hired and supervised Fire Ecology & Fuel Management intern - Worked with Lead Monitor to hire seasonal crew members - Managed H14, project add-on, & fire monitoring activities budgets - Travel, time, and purchasing
Training & Conferences	11%	- Fire training: READ, NIFTT on-line courses (U. Idaho), WFDSS - Webinars & seminars: SW Fire Science Consortium, Climate Change, NAU School of Forestry - NPS required annual training - PT
Other	14%	- Travel between South and North rims - Paid leave and holidays

FIRE EFFECTS PLOT WORKLOAD

The 2010 season produced a moderate FMH plot load at Grand Canyon, with few immediate post-burn reads due to little prescribed fire activity. Although the large-scale Saffron Fire occurred on the North Rim, no existing plots were affected. One new FMH plot was installed on the South Rim in a unit lacking plot representation, but we focused our efforts predominantly on installing pilot RAP plots and thorough CBI plot coverage. In order to supply managers and other stakeholders with more timely and targeted data for upcoming treatments, we installed 40 RAP plots in mixed-conifer forests on the North Rim. On the CBI front, 109 non-permanent severity plots were installed one year following four prescribed fires and two wildfires from 2009.

TABLE 5. Fire Effects Plot Workload for 2010.

Rim	Monitoring Unit	Plot Type	Install/ Pre-burn	Immed. Post-burn	Year 1	Year 2	Year 5	Year 10	Annual Total	Total Plots
South	Ponderosa Pine PIPO	FMH	1	2	7		8		18	41
South	Pinyon-Juniper Woodland PIED¹	FMH							0	17
South	Ruby Complex Fire	CBI	12						12	-
South	Hearst Tank Rx	CBI	14						14	-
South	Picnic Rx	CBI	7						7	-
South	Quarry Rx	CBI	8						8	-
South	Moqui Rx	CBI	15						15	-
South	Picnic Rx	RAP*							0	10
South	Quarry Rx	RAP*							0	10
South	Moqui Rx	RAP*							0	5
North	Ponderosa Pine PIPN	FMH	1		1		4		6	30
North	Ponderosa Pine w/ White Fir Encroachment PIAB	FMH	1		7			5	13	27
North	Rocky Mountain Subalpine Conifer PIEN	FMH						7	7	17
North	Grassland Interior GRIN	FMH							0	10
North	Grassland Edge GRED	FMH							0	6
North	Aspen Fire	CBI	53						53	-

Rim	Monitoring Unit	Plot Type	Install/ Pre-burn	Immed. Post-burn	Year 1	Year 2	Year 5	Year 10	Annual Total	Total Plots
North	Walla Valley Rx	RAP*							0	6
North	Range Rx	RAP*							0	20
North	Thompson Rx	RAP*							0	20
North	Fawn Spring Rx	RAP*	20						20	20
North	Spring Canyon Rx	RAP*	20						20	20
Total			152	2	15	0	12	12	193	259

"Total Plots" includes all permanent plots (FMH & RAP) installed to date within a monitoring unit/type

¹PIED monitoring type reads were discontinued in 2000

*pilot sampling

TABLE 6. Data Entry and Projects Monitored in 2010.

Park	% 2010 Data Entered	% 2010 Data Quality Checked	# Prescribed Fires Monitored*	# Non-Fire Fuel Treatments Monitored*	# Wildfires Monitored*	# BAER Treatments Monitored*
Grand Canyon NP	100	100	2	0	0	0

* Number of fires/treatments completed in 2010 with fire/treatment effects monitoring conducted. Includes pre- and post-fire/treatment monitoring, but not on-site fire behavior monitoring. Does not include post-fire/treatment monitoring of fires/treatments that occurred prior to 2010.

MONITORING OBJECTIVES & RESULTS

FMH

Grand Canyon National Park's Fire Effects monitoring program has installed 148 permanent FMH-style plots to date and has burned 113 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 7, we can confidently say we are achieving 8 of them after first entry fire.

Table 7. Restoration Management Objectives and Monitoring Results for FMH plots in 2010. 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 (-48%) (n=34)	7.6 ± 1.8 tons/acre (-51% due to fire 1 & 2) (+3% due to fire 2 only) (n=19)	YES	YES	YES n=10
	Reduce poles (PIPO) with DBH of 1-6" to 16-81 trees/acre 2 years post-burn	85.9 ± 33.7 trees/acre (-30%) (n=34)	119 ± 46 trees/acre (-36% due to fire 1 & 2) (-7% due to fire 2 only) (n=18)	NO	NO	NO n=64
	Maintain overstory (PIPO) density with DBH ≥16" of >14 trees/acre 5 years post-burn	21.0 ± 3.0 trees/acre (+1%) (n=27)	19.3 ± 3.8 trees/acre (+1% due to fire 1 & 2) (+3% due to fire 2 only) (n=17)	YES	YES	YES n=16
Ponderosa Pine (PIPN) North Rim	Reduce total fuel load to 0.2-15.7 tons/acre immediate post-burn	12.3 ± 1.7 tons/acre (-57%) (n=28)	7.9 ± 2.6 tons/acre (-61% due to fire 1 & 2) (-44% due to fire 2 only) (n=8)	YES	YES	YES, 1 st entry NO, 2 nd entry n=10
	Reduce conifer poles with DBH of 1-6" to 16-81 trees/acre 2 years post-burn	72.6 ± 35.8 trees/acre (-64%) (n=28)	20.3 ± 12.3 trees/acre (-83% due to fire 1 & 2) (-56% due to fire 2 only) (n=8)	YES	YES	NO n=48
	Maintain overstory conifer density with DBH ≥16" of >17 trees/acre 5 years post-burn	43.2 ± 4.0 trees/acre (-8%) (n=25)	51.3 ± 11.1 trees/acre (0% due to fire 1 & 2) (0% due to fire 2 only) (n=3)	YES	YES	YES, 1 st entry NO, 2 nd entry 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	17.1 ± 3.4 tons/acre (-50%) (n=19)	17.6 ± 8.5 tons/acre (-63% due to fire 1 & 2) (-31% due to fire 2 only) (n=10)	YES	YES	YES n=6
	Reduce conifer poles with DBH of 1-6" to 16-100 trees/acre 2 years post-burn	86.6 ± 24.8 trees/acre (-65%) (n=20)	2.7 ± 5.1 trees/acre (-94% due to fire 1 & 2) (-83% due to fire 2 only) (n=3)	YES	NO	YES, 1 st entry NO, 2 nd entry n=10
	Maintain overstory conifer density with DBH ≥16" of >20 trees/acre 5 years post-burn	26.3 ± 3.0 trees/acre (-26%) (n=14)	Not analyzed (n=1)	YES	N/A	YES, 1 st entry NO, 2 nd entry n=7

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

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 has occurred only in the South Rim PIPO type to date and results indicate that maintenance objectives are being achieved in this type.

Table 8. Maintenance Management Objectives and Monitoring Results for FMH plots in 2010. 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	3.7 ± 0.8 tons/acre (-76% due to fire 1, 2, & 3) (-41% due to fire 3 only) (n=12)	YES	YES n=10
	Maintain tree (PIPO) density with DBH ≥1" of 43-135 trees/acre 5 years post-burn	61.7 ± 13.9 trees/acre (-1% due to fire 1, 2, & 3) (-2% due to fire 3 only) (n=4)	YES	NO n=24
Ponderosa Pine (PIPN) North Rim	Maintain total fuel load of 0.2-15.7 tons/acre	Not analyzed (n=0)	N/A	NO n=10
	Maintain conifer pole density with DBH of 1-6" of <81 trees/acre	Not analyzed (n=0)	N/A	NO n=48
Ponderosa Pine w/ White Fir Encroachment (PIAB) North Rim	Maintain total fuel load of 1.7-19.0 tons/acre	Not analyzed (n=0)	N/A	NO n=6
	Maintain conifer pole density with DBH of 1-6" of <100 trees/acre	Not analyzed (n=0)	N/A	NO n=10

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

CBI

Composite Burn Index (CBI) burn severity assessments have been occurring annually at Grand Canyon since 2001. Between 2001 and 2010, 987 post-fire year 1 CBI-style plots have been installed in the park, providing Normalized Burn Ratio (NBR) satellite-correlated severity data on 42 fires over 101,000 total acres. This process is designed for field data and satellite imagery gathered one year following a fire; hence, 2010 work was performed on fires which burned in 2009. A total of 109 CBI plots were installed in 2010 across 10,206 acres in the Aspen and Ruby Complex wildfires and the Picnic, Quarry, Moqui, and Hearst Tank prescribed fires. In addition, the Fire GIS Specialist hosted a four-day Monitoring Trends in Burn Severity (MTBS) annual field trip. This field trip included 14 personnel representing U.S. Geological Survey National Center for Earth Resources Observation and Science (EROS), the USDA Forest Service Remote Sensing Applications Center (RSAC), and the National Park Service and gave scientists and image analysts who produce burn severity products an opportunity to obtain on the ground experience to help improve their mapping techniques.

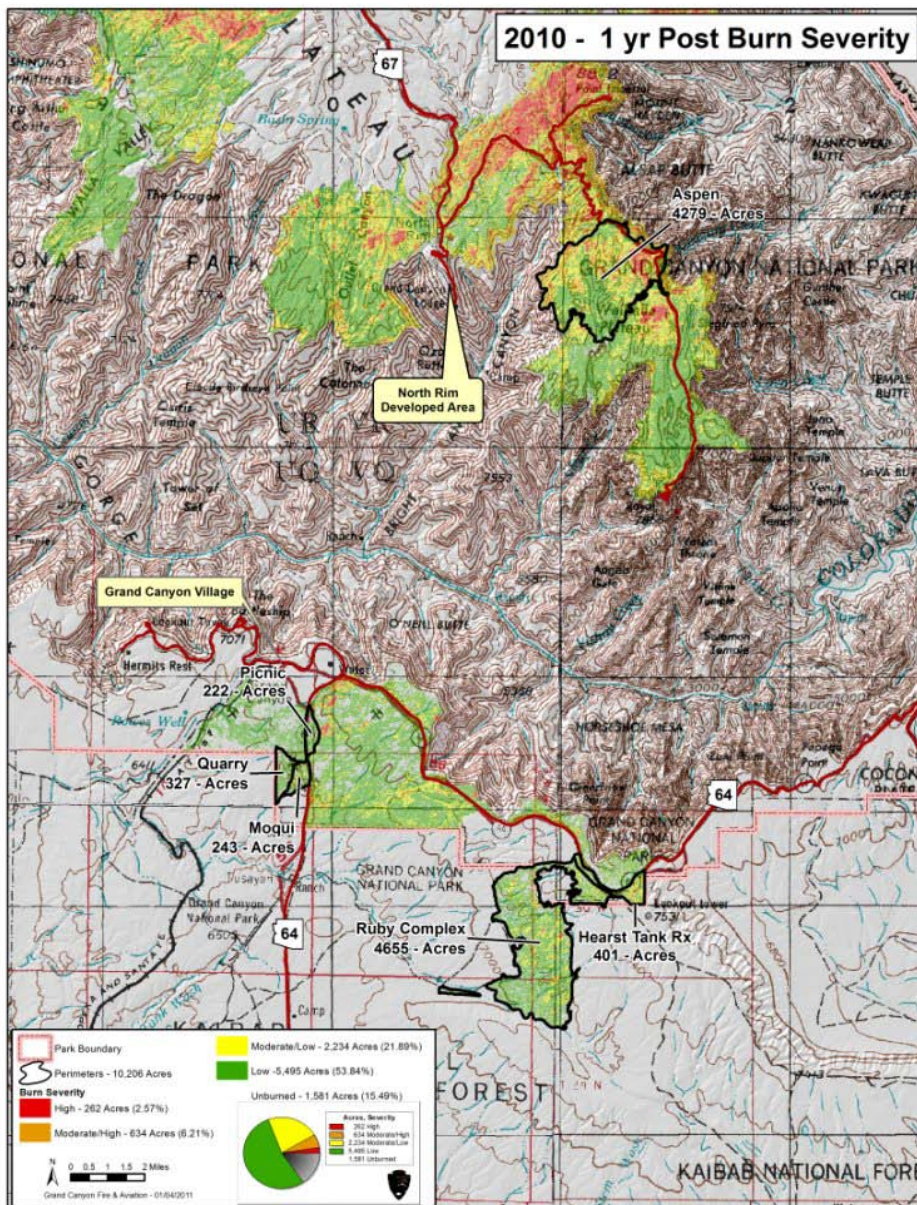


Figure 1. Burn severity data collected one year post fire. Overall severity percentages are represented in the pie chart in the legend.

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 previously limited (South and North Rim Ponderosa Pine and Ponderosa Pine with White Fir Encroachment). 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.

Table 9. Management Objectives and Monitoring Results for CBI plots from 2001-2010.

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 2000 to 2009	2% moderate-high/high severity 9 patches >5 acres largest patch: 33 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 2000 to 2009	3% moderate-high/high severity 27 patches >5 acres largest patch: 63 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 2000 to 2009	12% moderate-high/high severity 51 patches >10 acres largest patch: 325 acres	YES - percent NO - size
Rocky Mountain Montane Conifer (Mixed-Conifer) North Rim	Limit high severity fire to ≤30 % of monitoring type fires from 2000 to Present	18% moderate-high/high severity	YES

ADDITIONAL ANALYSIS

RAPID ASSESSMENT PROTOCOL PLOTS ON THE NORTH RIM

The GRCA Fire Ecology Program began pilot sampling Rapid Assessment Protocol (RAP) plots for project-level monitoring in 2008 and continued this effort in 2010. Project-level monitoring is designed to provide information on whether short-term management objectives have been met for a particular fire. GRCA has recently begun planning for prescribed fire in the higher elevation mixed-conifer and spruce-fir vegetation types on the North Rim. High elevation forests occur in a relatively small area and are of high resource concern, so monitoring and evaluation through the adaptive management process is needed on a unit-by-unit basis. Since project-level monitoring requires a greater number of plots in each unit than landscape-level monitoring, pilot RAP plots were developed to accommodate this need.

The Roost - Fawn Spring prescribed fire unit and Boundary - Spring Canyon prescribed fire units are 2,999 acres and 1,525 acres, respectively. Fawn Spring and Spring Canyon have a series of large ridgelines and valleys throughout the units creating the potential for different vegetation types and fire behavior. To determine whether this potential variation should be considered in the prescribed fire planning process, 10 ridge top plots and 10 slope plots were installed in each of the burn units.

Fawn Spring prescribed fire unit

The Fawn Spring prescribed fire unit is composed primarily of ponderosa pine (*Pinus ponderosa*) and Engelmann spruce (*Picea engelmannii*) in the large-sized tree class ($\geq 16''$ DBH), with ponderosa pine slightly more abundant on the ridges and Engelmann spruce more abundant on the slopes. In the intermediate-sized tree class (6-16'' DBH), quaking aspen (*Populus tremuloides*) is the most abundant species in the ridge plots, while Engelmann spruce is the most abundant on the slopes. On the ridges, white fir (*Abies concolor*), subalpine fir (*Abies lasiocarpa*), quaking aspen, and Douglas-fir (*Pseudotsuga menziesii*) make up the pole-sized trees (1-6'' DBH). Engelmann spruce is the dominant pole-sized tree on the slopes. White fir is the dominant species in the seedling-sized class ($< 1''$ DBH) on the ridges, while quaking aspen is the dominant seedling tree species on the slopes.

All pre-fire tree densities are similar in Fawn Spring ridge top plots and slope plots (Fig. 2). However, the pre-fire intermediate tree density shows a trend toward higher density on the slopes than on the ridges ($p=0.13$). Pre-fire pole tree density on the ridges varies from 52-477 trees/acre (Table 10). Pre-fire pole tree density on the slopes plots varies from 26-464 trees/acre (Table 10). Pre-fire overstory tree density for both ridge top and slopes are 0-54 trees/acre (Table 10).

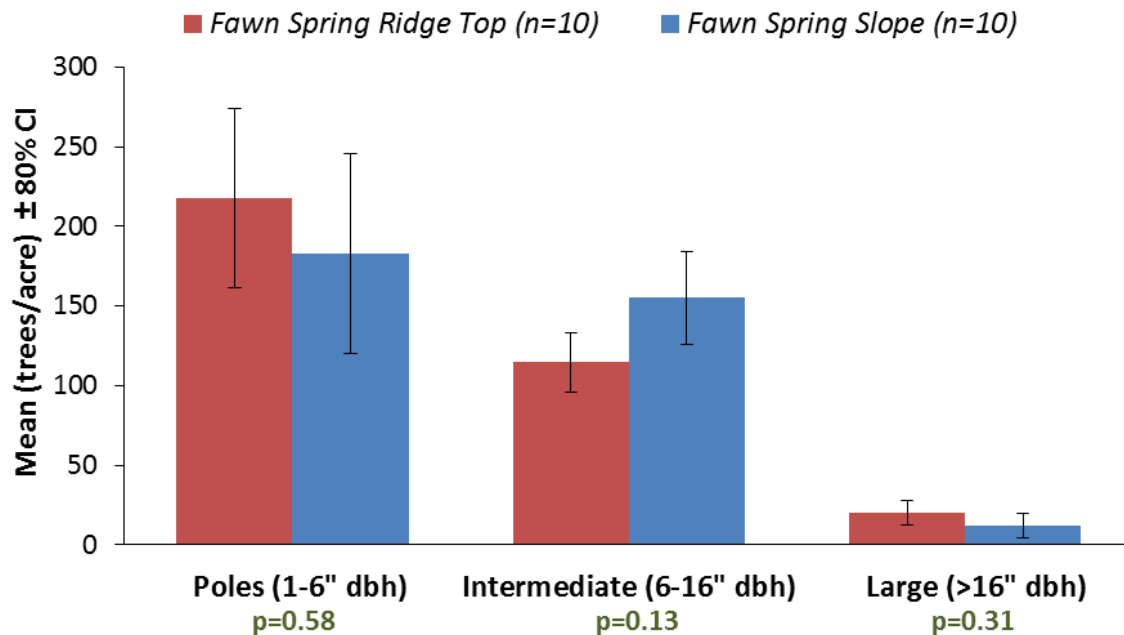


Figure 2. Pre-fire mean tree density by tree size class in Fawn Spring ridge top and slope plots.

Pre-fire fuel loading in all classes is similar between Fawn Spring pre-fire ridge top and slope plots (Fig. 3). Litter and duff loading is the largest component of total fuel load on both the ridges and slopes, with a combined mean litter and duff loading of 22.5 tons/acre in the slope plots and 19.5 tons/acre in the ridge top plots (Table 10). Mean total fuel loads in Fawn Spring ridge top and slope plots are similar at 46.2 and 45.3 tons/acre, respectively (Table 10).

Table 10. Pre-fire tree density and fuel loading for Fawn Spring ridge top and slope plots.

	Fawn Spring All Plots pre-fire (n = 20)		Fawn Spring Ridge Top pre-fire (n = 10)		Fawn Spring Slope pre-fire (n = 10)	
	Mean $\pm$ 80% CI	Min – Max	Mean $\pm$ 80% CI	Min – Max	Mean $\pm$ 80% CI	Min – Max
Tree density (trees/acre):						
Pole-sized trees (1-6")	200 $\pm$ 40	26 – 477	218 $\pm$ 56	52 – 477	183 $\pm$ 63	26 – 464
Intermediate-sized trees (6-16")	135 $\pm$ 17	54 – 270	115 $\pm$ 19	68 – 175	155 $\pm$ 29	54 – 270
Large-sized trees (>16")	16 $\pm$ 5	0 – 54	20 $\pm$ 8	0 – 54	12 $\pm$ 8	0 – 54
Fuel loading (tons/acre):						
Total Loading	45.8 $\pm$ 5.1	16.6 – 77.5	46.2 $\pm$ 7.6	28.6 – 77.5	45.3 $\pm$ 7.7	16.6 – 72.2
1-, 10-, 100-hr TLFM	7.6 $\pm$ 1.1	2.4 – 17.5	7.8 $\pm$ 1.2	2.4 – 12.6	7.3 $\pm$ 2.0	2.8 – 17.5
1000-hr TLFM	17.2 $\pm$ 3.4	3.1 – 41.3	18.9 $\pm$ 5.2	8.7 – 41.3	15.5 $\pm$ 4.9	3.1 – 36.1
Litter + Duff	21.0 $\pm$ 2.4	9.4 – 42.5	19.5 $\pm$ 3.0	9.5 – 30.7	22.5 $\pm$ 4.0	9.4 – 42.5
Litter + Duff Depth (inches)	1.7 $\pm$ 0.2	0.8 – 3.3	1.7 $\pm$ 0.2	0.9 – 2.3	1.8 $\pm$ 0.3	0.8 – 3.3

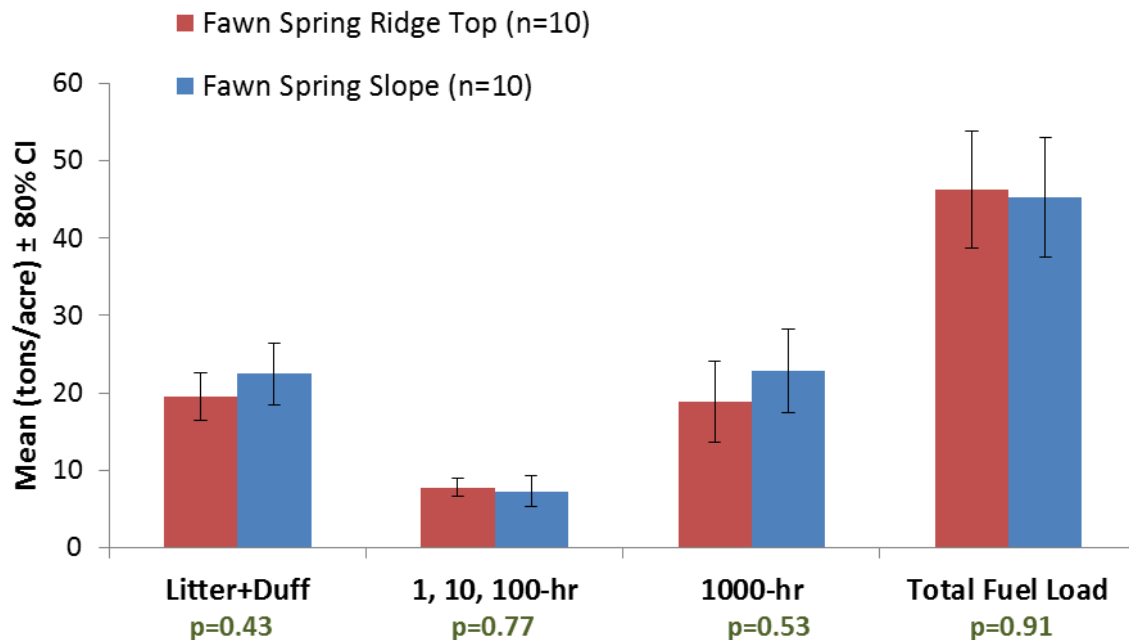


Figure 3. Pre-fire mean fuel loading in Fawn Spring ridge top and slope plots.

Spring Canyon prescribed fire unit

On the Spring Canyon prescribed fire unit ridge tops, large tree composition is a mix of white fir, ponderosa pine and Douglas-fir. On the slopes, Engelmann spruce and ponderosa pine are the dominant large trees. White fir is the dominant component of ridge top intermediate, pole, and seedling trees, with quaking aspen also contributing heavily to seedling tree density. On the slopes, a mix of all species comprises the intermediate tree size class. The pole and seedling size classes on the slopes are dominated by quaking aspen with white fir and subalpine fir also abundant.

Pre-fire pole and large tree mean densities are similar between Spring Canyon ridge top and slope plots (Fig. 4). Mean intermediate tree density for Spring Canyon ridge top plots is 52% less than slope plots (Fig. 4). Mean pole-sized tree density for ridge top plots varies greatly from 13-1482 trees/acre, and pole-sized tree density on the slopes varies from 77-799 trees/acre (Table 11). Mean large tree pre-fire density is 36 ± 15 trees/acre on the ridges and 26 ± 11 trees/acre on the slopes (Table 11).

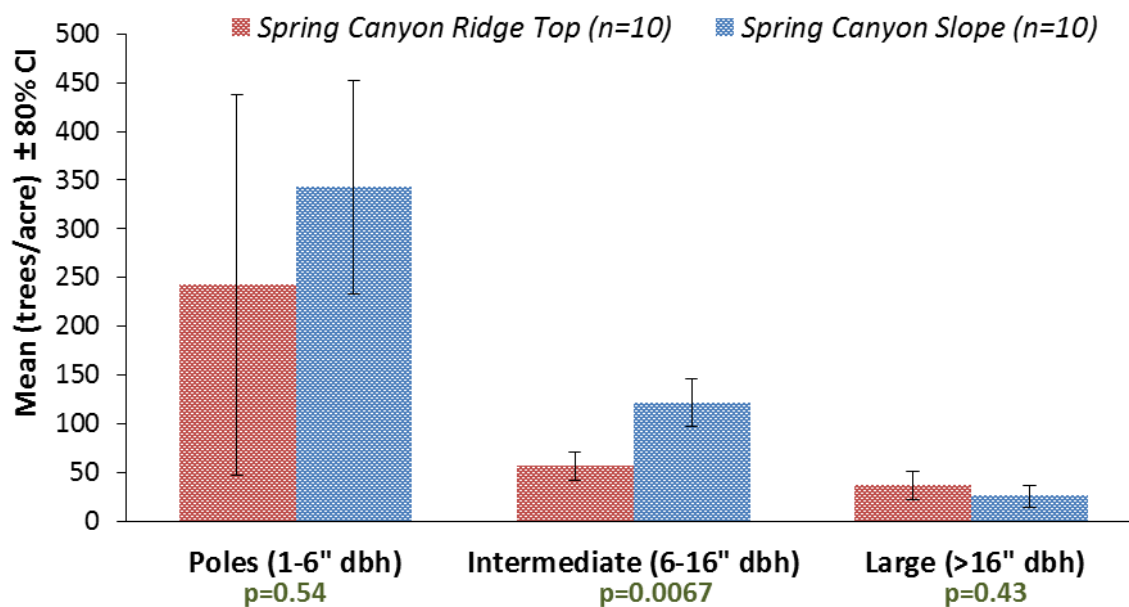


Figure 4. Pre-fire mean tree density by tree size class in Spring Canyon ridge top and slope plots.

Mean total fuel loading is 30% lower in Spring Canyon slope plots than in ridge top plots (Fig. 5). This difference is due primarily to the difference in litter and duff loading between the slopes and the ridges. Mean pre-fire litter and duff loading is 24.0 ± 4.7 tons/acre on the slopes and 35.1 ± 4.6 tons/acre on the ridge tops, while total fuel loading is 61.0 ± 9.1 tons/acre on the slopes and 43.8 ± 5.4 tons/acre on the ridge tops (Table 11).

Table 11. Pre-fire tree density and fuel loading for Spring Canyon ridge top and slope plots.

	Spring Canyon All plots pre-fire (n = 20)		Spring Canyon Ridge Top pre-fire (n = 10)		Spring Canyon Slope pre-fire (n = 10)	
	Mean $\pm$ 80% CI	Min – Max	Mean $\pm$ 80% CI	Min – Max	Mean $\pm$ 80% CI	Min – Max
Tree density (trees/acre):						
Pole-sized trees (1-6")	293 $\pm$ 106	13 – 1482	242 $\pm$ 196	13 – 1482	343 $\pm$ 109	77 – 799
Intermediate-sized trees (6-16")	89 $\pm$ 17	13 – 216	57 $\pm$ 14	13 – 108	121 $\pm$ 25	40 – 216
Large-sized trees (>16")	31 $\pm$ 9	0 – 108	36 $\pm$ 15	0 – 108	26 $\pm$ 11	0 – 67
Fuel loading (tons/acre):						
Total Loading	52.4 $\pm$ 5.6	30.4 – 111.6	61.0 $\pm$ 9.1	31.4 – 111.6	43.8 $\pm$ 5.4	30.4 – 68.3
1-, 10-, 100-hr TLFM	5.4 $\pm$ 0.7	0.7 – 9.8	5.4 $\pm$ 1.0	2.1 – 9.8	5.5 $\pm$ 1.1	0.7 – 8.7
1000-hr TLFM	17.4 $\pm$ 3.8	2.1 – 57.2	20.6 $\pm$ 7.2	2.1 – 57.2	14.3 $\pm$ 3.0	4.2 – 25.5
Litter + Duff	29.5 $\pm$ 3.5	11.6 – 49.4	35.1 $\pm$ 4.6	15.4 – 48.6	24.0 $\pm$ 4.7	11.6 – 49.4
Litter + Duff Depth (inches)	2.4 $\pm$ 0.3	1.2 – 4.5	2.7 $\pm$ 0.4	1.2 – 3.7	2.1 $\pm$ 0.4	1.2 – 4.5

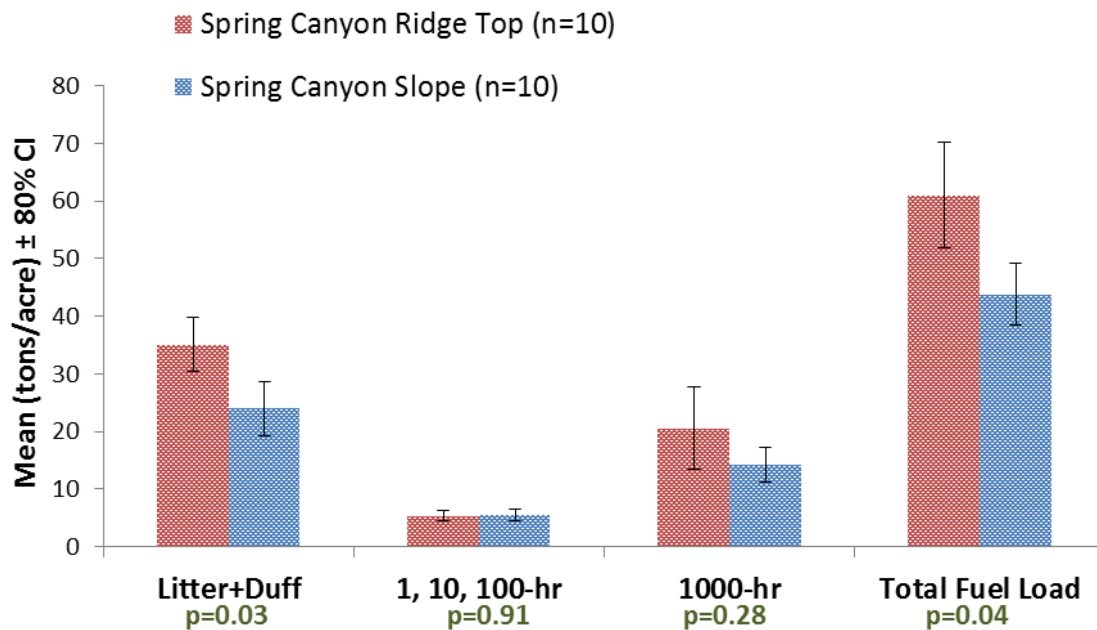


Figure 5. Mean pre-fire fuel loading in Spring Canyon ridge top and slope plots.

2011 is lurking right around the corner...



Figure 6. Fire Effects Crew posers.

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