



SUMMARY

The 2008 season was incredibly diverse and productive for Grand Canyon National Park's (GRCA) Fire Ecology Program. In the process of making 33 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. A record 200 Composite Burn Index (CBI) plots were installed within nine fires at GRCA to allow assessment of burn severity. In addition, Rapid Assessment Protocol (RAP) plots were introduced to the park's monitoring program, with installation of 46 pilot plots in advance of four prescribed fire treatments. This total of 279 plot visits at Grand Canyon marks the busiest season in the program's 20-year history by itself, but when combined with the 64 FMH-style plot reads the crew assisted at Bandelier, Saguaro, and Bryce Canyon, 2008 was truly extraordinary.

Vacancies within the Fire Ecology Program once again left key positions unfilled for large blocks of time, but continuity was maintained through existing staff stepping up and filling the voids. The Assistant Lead Monitor continued detailing into the Lead position, and the Lead into the Ecologist position from January 1 – May 18. One crewmember departed in June to become the Lead Monitor at another program. A new Ecologist was hired and began work remotely in mid-July before arriving at the South Rim in early November. After four seasons of dedicated service to the GRCA Fire

Ecology program, the Assistant Lead left for a new job opportunity at the end of September, providing opportunities for increased responsibility for the remaining crewmembers. Amidst the challenge of effectively being understaffed by one to two positions all season, the Grand Canyon crew was able to step into new roles and successfully accomplish all field, office, and operational fire work while expanding the scope of our plot network and assisting three other National Park Service Fire Ecology programs.

Data analysis was increased with the hiring of a full-time, dedicated Ecologist. In addition to analysis of standard monitoring objectives for the annual report, the Lead and Ecologist expanded efforts to address data needs relating to Mexican Spotted Owl critical habitat concerns. Conversion of the GRCA database to FEAT v2.4 and eventually FFI v1.2 occurred before the start of the field season, supplying the new Ecologist with more robust tools for analysis.

Crewmembers as usual took part in a wide array of extracurricular activities. Our return to a crew composed entirely of individuals who had previously been red carded and performed FMH-protocol fire effects monitoring work at NPS units bore huge dividends. Rather than focus on basic training, efforts were concentrated in building more advanced skills and cross-training Fire Effects crewmembers with all other field disciplines in our fire management program. Personal interest by the crew greatly facilitated this multi-disciplinary learning. To spread the wealth of knowledge further, four other Grand Canyon fire personnel 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 crewmember assisting fire monitoring in-park, in nearby Zion National Park, or on the neighboring Kaibab National Forest on multiple occasions for either prescribed or fire use events. Continued progression toward a more mobile, electronic data collection system was made with introduction of ruggedized, GPS- and wireless-enabled PDAs and the refinement of our electronic monitoring forms to auto-calculate relative humidity and dew point based on dry bulb and wet bulb temperature, plus elevation.

Out-of-park, one crewmember detailed with the Zion Fire Use Module to the Grand and Mill Hollow incidents in Colorado and Utah for two weeks. In-park, crewmembers gained experience with the Zion, Bandelier, Saguaro, Yellowstone, and Black Hills Modules during the Walla Valley Fire. Although a slow fire year locally, everyone assisted on several Type 5 incidents as ICT5-trainee, FFT1, FEMO, or simply another hand digging line.

Continuing the tradition of assisting other Fire Effects programs for an eighth consecutive year, three separate trips were made to help accomplish plot work at other parks: 22 immediate post-burn FMH plots at Bandelier National Monument, 20 modified FMH plots at Saguaro National Park, and 12 immediate post-burn FMH plots at Bryce Canyon National Park. 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 may be double that of 2008, assuming more widespread prescribed burns or fire use. However, CBI plot workload will be virtually non-existent due to no large fire activity above the rim in 2008. Pilot data from the new rapid assessment protocol 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. Final conversion and commitment to the FFI database is planned and we hope to manage FMH, CBI, and RAP data in FFI by the end of next year. At present, the 2009 workload will be mostly on the North Rim (68%).

STAFF ACCOMPLISHMENTS & AREAS OF FOCUS

TABLE 1. Fire Ecology Staff for 2008 calendar year.

Employee	Starting Date	Ending Date	# Pay Periods	Training	NWGG Task books
Windy Bunn, GS-9	7/15/08	12/31/08	12.5	IS700 ICS100 ICS200	
Li Brannfors, GS-7/9/7	1/01/08 1/20/08 5/19/08	1/19/08 5/18/08 12/31/08	1.5 8.5 16	S490 FFI	ICT5-t FFT1-t
Melissa Spandl, GS-7/6	1/01/08 5/19/08	5/18/08 9/27/08	18.5	S490 S231 S230 FFI	ICT5 FFT1 ENGB-t
Karen Koenig, GS-5	3/14/08	10/25/08	16	S290 S271 HTA	FEMO HECM-t FALA-t
Jasper Peach, GS-5	5/25/08	11/22/08	13	S271 S212	FEMO FALA HECM-t FALB-t GISS-t
Beth Gastineau, GS-5	4/22/08	6/13/08	4	S271	FEMO-t HECM-t

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

Employee	FMH Plots	CBI Plots	RAP Plots	Data Entry / Mgmt	FX Office	Monitoring (Rx or Fire Use)	Rx Fire Ops	Fire Use Ops	Suppression And Helibase Ops.	Training Courses	Other
Li Brannfors, GS-7/9/7**	16	6	4	3	44	4	1	0	2	5	14
Melissa Spandl, GS-7/6*	17	4	1	2	39	4	3	0	2	10	18
Karen Koenig, GS-5	26	5	5	4	28	5	3	0	9	7	8
Jasper Peach, GS-5	16	4	10	8	24	9	1	8	3	5	12
Beth Gastineau, GS-5	40	0	0	4	25	6	6	0	1	11	8

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

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

**Time for Li Brannfors includes detail into Fire Ecologist position from Jan 1 – May 18, with no furlough in 2008

*Time for Melissa Spandl includes detail into Lead Monitor position from Jan 1 – May 18, with only 2 weeks of furlough in 2008

TABLE 3. Fire Effects Crew Focus Areas/Accomplishments 2008

Focus Area	Percent Time	Accomplishments and Activities
FMH Plots	20%	31 remeasurements, 2 installs at GRCA - Assisted 22 FMH immediate post-burn reads at Bandelier NM - Assisted 20 modified FMH reads at Saguaro NP - Assisted 12 immediate post-burn reads at Bryce Canyon NP
CBI Plots	6%	200 plots installed across 9 fires
RAP Plots	5%	46 pilot rapid assessment plots installed across 4 Rx burn units
Data Entry	3%	Completed all 2008 FMH & CBI plot data entry by Nov 12
Data Conversion & Analysis	1%	- Detailed Lead & Acting Ecologist converted GRCA FMH data to FEAT in preparation for conversion to FFI in Jan 08 2007 Annual Report analysis on all major variables in program - Mexican Spotted Owl critical habitat analysis for fire wildlife biologist
General Office/ Supervision/ Admin	32%	- Lead and Assistant Lead detailed into Ecologist and Lead positions, respectively, from Jan 1 – May 20 - Includes FMH, CBI, & RAP plot preparation and data filing/organization - Detailed Lead & Ecologist hired 3 seasonal crewmembers - Lead supervised 1 permanent Assistant Lead & 3 seasonals 1 hr PT time/day for each crewmember - Paperwork!
Fire Monitoring (Rx or WFU)	6%	- Lead FEMO & FEMO-trainees on 1 Rx/WF at GRCA & 1 Rx on Kaibab NF - Lead FEMO & FEMO-trainees on 3 WFU fires at GRCA & 1 WFU on Kaibab NF - Lead FEMO on 1 Rx at Zion NP
Fire Operations/ Assignments (Suppression, Rx, WFU, or Helitack)	8%	1 crewmember detailed for 2 weeks with Zion Fire Use Module - Lead & Assistant Lead served as ICT5 & ICT5-t on several fires at GRCA - Initial attack support on multiple Type 5 fires at GRCA - GISS support by Lead and crewmember on multiple fires at GRCA - Sent 1 crewmember to 2-week Helicopter Training Academy at GRCA S Rim - 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	6%	- All attended annual fire refresher - Sent 1 seasonal to S-131 in Prescott, AZ - Sent 1 seasonal to S-212 in Jacob Lake, AZ - Sent 3 seasonals to S-271 at GRCA, BAND, & St George, UT - Sent 1 seasonal to S-290 in Prescott, AZ - Sent Assistant Lead to S-230, S-231, S-490, & FFI workshop - Sent Lead to S-490 & FFI workshop
Other	13%	- Set up DataRAM for air quality monitoring on 1 Rx burn 7% of crew time spent on leave

*Table percentages do not include time Lead Monitor spent in Fire Ecologist detail

TABLE 4. Fire Ecologist Focus Areas/Accomplishments 2008

Focus Area	Percent Time	Accomplishments and Activities
Planning	40%	- Draft revision of Fire Monitoring Plan, to be completed in Spring 2009 - Provided comments on the FMP DEIS, Biological Assessment, and Cultural Resources Programmatic Agreement - Reviewed fire ecology literature
Presentations	<5%	Presented M.S. thesis at Ecological Society of America annual meeting
NPS Meetings/ Task Groups	<5%	- GRCA Fire IDT – reviewed 3 project plans - GRCA Biological Assessment working team - Fire staff meetings — as requested
Interagency Work, Fire Assignments, & Research	0%	Arrived at GRCA to begin on-site work late in the season
Data Entry	0%	Fire Effects Crew completed data entry
Data Conversion	<5%	Verified monitoring status and data accuracy in FFI database
Data Analysis	20%	- Analyzed FMH and NAU-ERI mixed-conifer forest plots to determine fire effects on Mexican Spotted Owl habitat components - Summarized FMH data for inclusion in new monitoring plan
Supervision/ Admin	5%	- Supervised Lead Monitor - Worked with Lead Monitor to advertise Assistant Lead and seasonal crewmember positions - Programmed H14 budget - Completed travel and time paperwork
Training	<5%	- On-line training for NIMS compliance (IS-700, ICS-100, ICS-200) - NPS on-line training (IT Security, Privacy, Records, Charge Card, GovTrip, Quicktime) - FFI statistics webinar & self-paced FFI training - PT
Other	25%	- Organized legacy paper and electronic data from previous ecologists - Paid leave and holidays

FIRE EFFECTS PLOT WORKLOAD

The 2008 season produced a light FMH plot load at Grand Canyon, with no immediate post-burn reads due to much lower than expected prescribed and wildland fire activity following the conversion of the Walla Valley Rx Burn in June. Two new FMH plots were installed in units 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 from upcoming treatments, we installed 46 RAP plots between the South and North Rims. On the CBI front, 200 non-permanent severity plots were installed one year following eight prescribed fires and one wildland fire use from 2007.

TABLE 4. Fire Effects Plot Workload 2008

Rim	Monitoring Unit	Plot Type	Install/ Pre-burn	Immed. Post-burn	Year 1	Year 2	Year 5	Year 10	Annual Total	Total FMH Plots
South	Ponderosa Pine PIPO	FMH	1		5	5			11	39
South	Pinyon-Juniper Woodland PIED*	FMH							0	17
South	Entrance Rx	CBI	11						11	-
South	Grandview Rx	CBI	28						28	-
South	Lonetree Rx	CBI	14						14	-
South	Tusayan Rx	CBI	14						14	-
South	Picnic Rx	RAP	10						10	-
South	Quarry Rx	RAP	10						10	-
North	Ponderosa Pine PIPN	FMH			8				8	30
North	Ponderosa Pine w/ White Fir Encroachment PIAB	FMH	1		7			2	10	27
North	Rocky Mountain Subalpine Conifer PIEN	FMH	2				2		4	17
North	Grassland Interior GRIN	FMH							0	10
North	Grassland Edge GRED	FMH							0	6
North	Roosevelt WFU	CBI	43						43	-
North	Walhalla Neck Rx	CBI	23						23	-
North	Uncle Jim Rx	CBI	22						22	-
North	Northwest Rx	CBI	22						22	-
North	SW Roost Rx	CBI	23						23	-
North	Range Rx	RAP	20						20	-
North	Walla Valley Rx	RAP	6						6	-
Total			250	0	20	5	2	2	279	146

*Total FMH Plots" includes all permanent FMH plots installed to date within a monitoring unit/type

*PIED monitoring type reads were discontinued in 2000

MONITORING OBJECTIVES & RESULTS

FMH

Grand Canyon National Park's Fire Effects monitoring program has installed 146 permanent FMH-style plots to date and has burned 111 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 almost all of our major management objectives. Of the 15 objectives listed below, we can confidently say we are achieving 10 of them and the trend is so far very positive on another 5.

Table 5. Management Objectives and Monitoring Results 2008

Monitoring Unit	Management Objectives	Monitoring Results (n = # of plots)	Objectives Achieved?	Minimum Plot #s Achieved?
Ponderosa Pine (PIPO) South Rim	Reduce total fuel load to 0.2-9.3 tons/acre immediate post-burn	7.6 tons/acre (-51.8%) (n=33)	YES	YES n=6
	Limit crown scorch on trees (PIPO) with DBH ≥16" to <30% immediate post-burn	21.6% crown scorch (n=32)	YES – Results are for all trees >6" DBH, so % is likely lower for trees ≥16"	YES n=14
	Reduce poles (PIPO) with DBH of 1-6" to <200 trees/acre 2 years post-burn	95.2 trees/acre (-24.4%) (n=30)	YES	NO n=103
	Achieve overstory (PIPO) density with DBH ≥16" of 19-25 trees/acre 5 years post-burn	19.7 trees/acre (-0%) (n=21)	YES	YES n=14
Pinyon-Juniper Woodland (PIED) South Rim	Reduce total fuel load to <20 tons/acre immediate post-burn	9.0 tons/acre (-24.7%) (n=13)	YES	YES n=5
	Limit overstory tree (all species) mortality to <20% 5 years post-burn	12.4% mortality (n=12)	YES	YES n=4

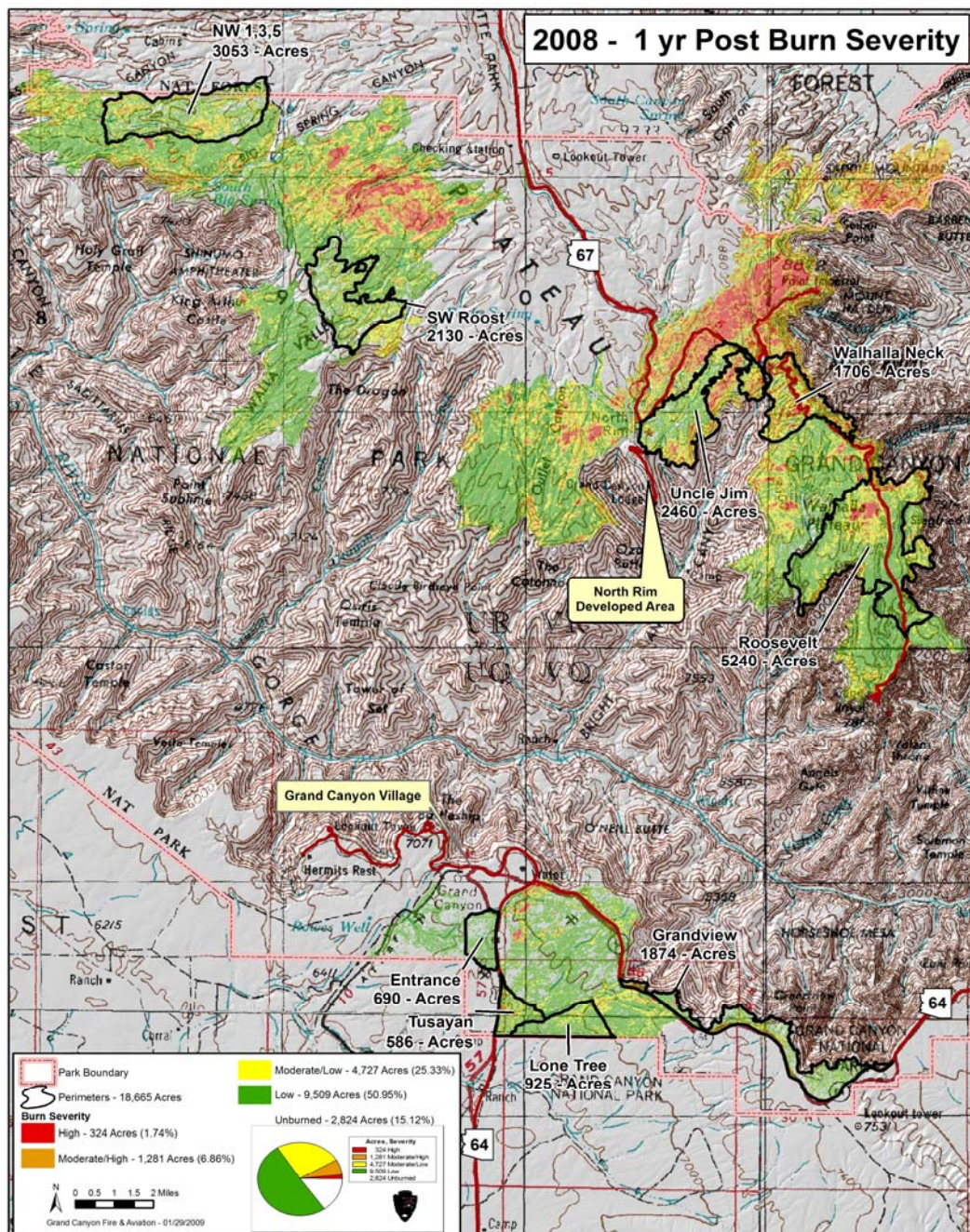
Monitoring Unit	Management Objectives	Monitoring Results (n = # of plots)	Objectives Achieved?	Minimum Plot #s Achieved?
Ponderosa Pine (PIPN) North Rim	Reduce total fuel load to 0.2-9.3 tons/acre immediate post-burn	13.6 tons/acre (-62.6%) (n=29)	NO – Getting close, but second-entry treatment likely needed	YES n=9
	Limit crown scorch on trees (PIPO) with DBH ≥16" to <30% immediate post-burn	18.3% crown scorch (n=29)	YES – Results are for all trees >6" DBH, so % is likely lower for trees ≥16"	YES n=4
	Reduce poles (PIPO) with DBH of 1-6" to <200 trees/acre 2 years post-burn	69.4 trees/acre (-45.6%) (n=26)	YES	NO n=80
	Achieve overstory (PIPO) density with DBH ≥16" of 40-56 trees/acre 5 years post-burn	43.5 trees/acre (-4.9%) (n=20)	YES	YES n=4
Ponderosa Pine w/ White Fir Encroachment (PIAB) North Rim	Reduce total fuel load to 0.2-20 tons/acre immediate post-burn	17.9 tons/acre (-54.7%) (n=19)	YES	YES n=6
	Limit crown scorch on trees (PIPO) with DBH ≥16" to <30% immediate post-burn	11.5% crown scorch (n=19)	YES – Results are for all trees >6" DBH, so % is likely lower for trees ≥16"	YES n=8
	Reduce poles (ABCO) with DBH of 1-6" to <100 trees/acre 2 years post-burn	68.0 trees/acre (-74.0%) (n=15)	YES	YES n=24 (27 plots installed with pre-burn data)
	Achieve overstory (PIPO) density with DBH ≥16" of 19-25 trees/acre 5 years post-burn	20.2 trees/acre (-19.8%) (n=13)	YES	YES n=8
Rocky Mountain Subalpine Conifer (PIEN) North Rim	Reduce total fuel load immediate post-burn	Reduction from 62.8 to 30.2 tons/acre (-51.9%) (n=2)	YES - No quantitative goal has been established, but trend is of solid reduction	YES n=7 (12 plots installed with pre-burn data)

Assessment of objective success and fulfillment of minimum plot requirements are based on 80% confidence intervals, with R-value of 20.

CBI

Composite Burn Index (CBI) burn severity assessments have been occurring annually at Grand Canyon since 2001. Between 2001-2008, 956 CBI-style plots have been installed in the park, providing Normalized Burn Ratio (NBR) satellite-correlated severity data on 34 fires over 90,000 total acres. This process is designed for field data and satellite imagery gathered one year following a fire; hence, 2008 work was performed on fires which burned in 2007. A total of 200 CBI plots were installed in 2008 to help provide these numbers. Below is a map showing cumulative results of burn severity work since 2001, with the 2007 fires outlined in black.

Figure 1. Burn severity by percent and acres for 2007 fires at Grand Canyon



ADDITIONAL ANALYSIS

RX VS. WILDLAND FIRE USE ON THE NORTH RIM

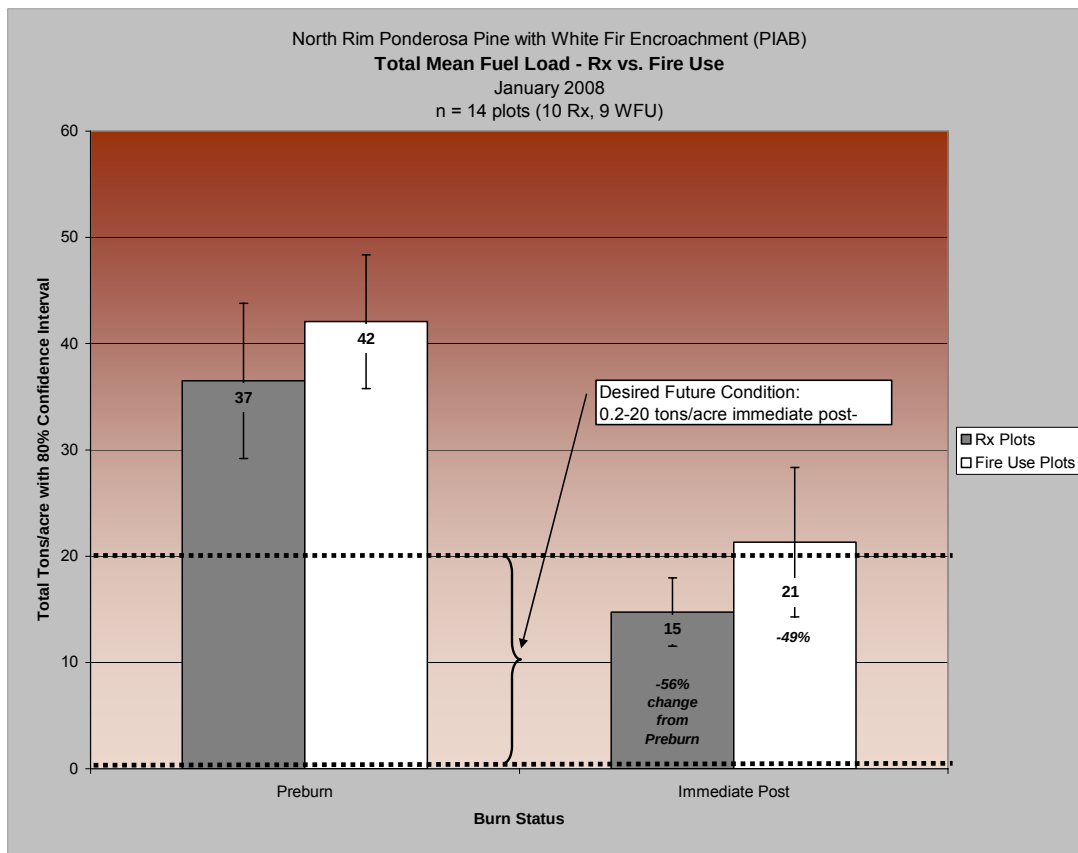
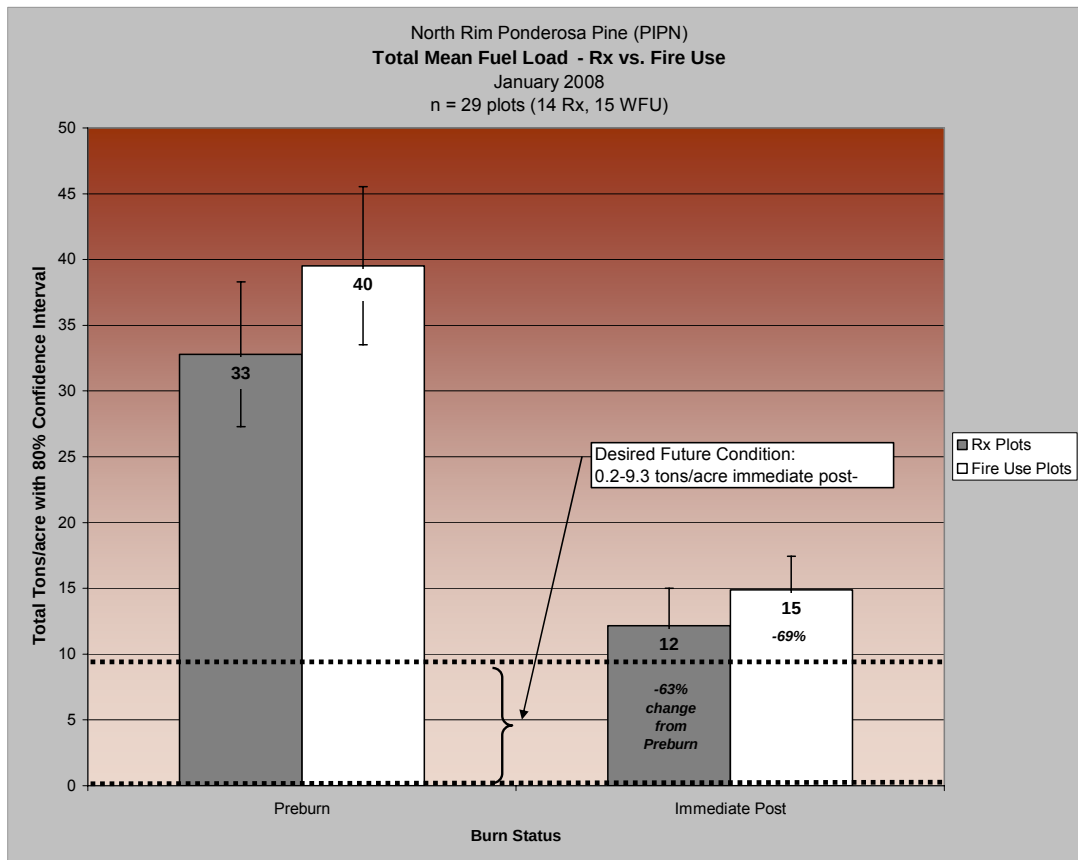
Here at Grand Canyon National Park we are in the incredibly fortunate position of burning equally large acreages with both wildland fire use and prescribed fire treatments. Since 1980, over 60,000 acres have been burned by each treatment type, mostly within designated burn unit boundaries. As permanent FMH plots have been randomized and installed across the landscape of the North Rim, they, too, have burned in both fire use and prescribed events. This combination of management practices and happenstance has produced on the North Rim a perfectly even split of 24 plots burned in first-entry prescribed (Rx) fires and 24 burned in first-entry fire use (WFU) in two of our main monitoring types. We now have five years of post-burn data for many of these 48 plots, and are in a position to present the results comparing prescribed and fire use treatments at Grand Canyon.

Preceding results in Table 5 reflected prescribed and fire use treatments lumped together for the North Rim Ponderosa Pine and Ponderosa Pine with White Fir Encroachment monitoring types. Here we will break out the results by treatment type for three of our management objectives.

Total Fuel Load

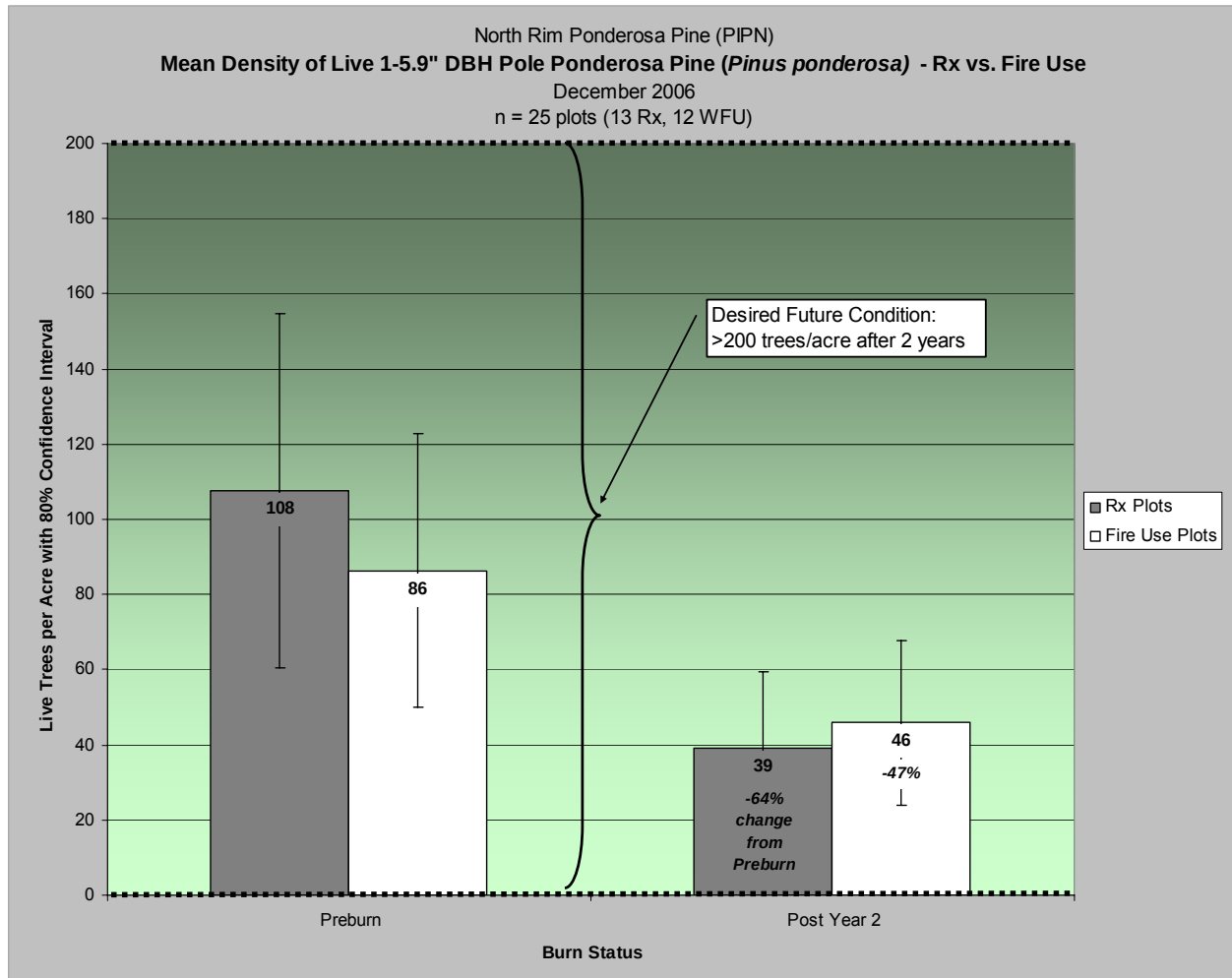
In pure ponderosa, total mean fuel load dropped an average of 63% in 14 Rx plots and 69% in 15 WFU plots immediately post-burn, following a first-entry treatment. While absolute values differ between treatment types, the relative change is nearly identical. Despite the impressive fuel load reduction, we haven't quite reached our desired future condition of less than 9.3 tons/acre. This suggests a second-entry treatment or revisiting our first-entry objectives will be necessary.

The results for the ponderosa zone where white fir has extensively encroached due to fire suppression and more favorable habitat are very similar. Reductions of total fuel load are less than in the pure ponderosa, but almost identical for prescribed and fire use treatments. Here our first-entry objectives are less aggressive and we are right at the upper limit of our desired future condition. Error bars are a bit wider for the pre-burn prescribed values due to a smaller sample size. These numbers reflect a great similarity in fuel reduction effectiveness between prescribed and fire use burns at Grand Canyon.

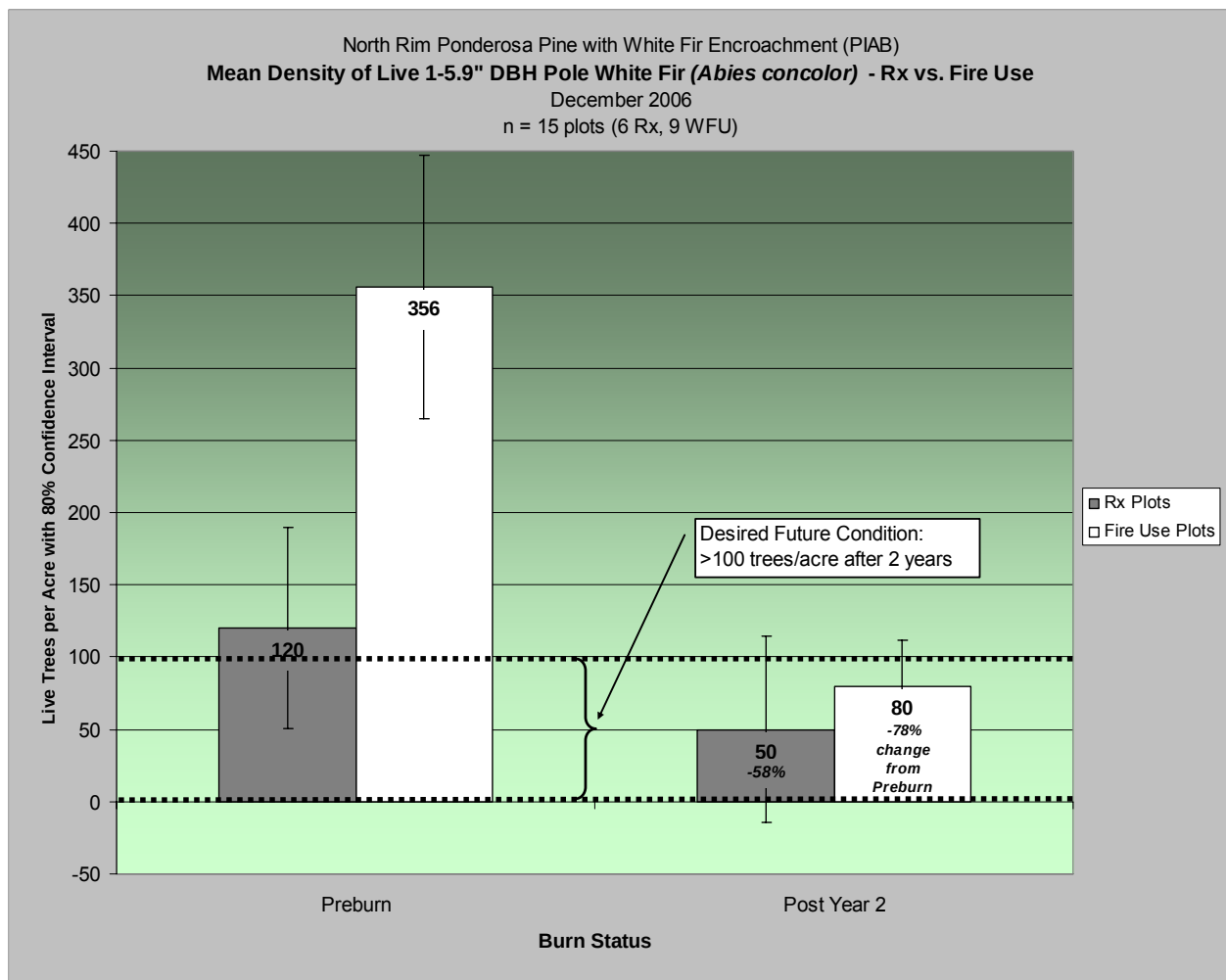


Pole Density

Pole densities are evaluated according to species at Grand Canyon. In pure ponderosa, our goal is to achieve ponderosa pole densities less than 200 trees/acre. A comparable selection of plots demonstrates pole reductions of 47% in fire use and 64% in prescribed fires; however, pre-burn conditions already were well within the desired future condition range. It would seem as though this objective should be refined by further research.



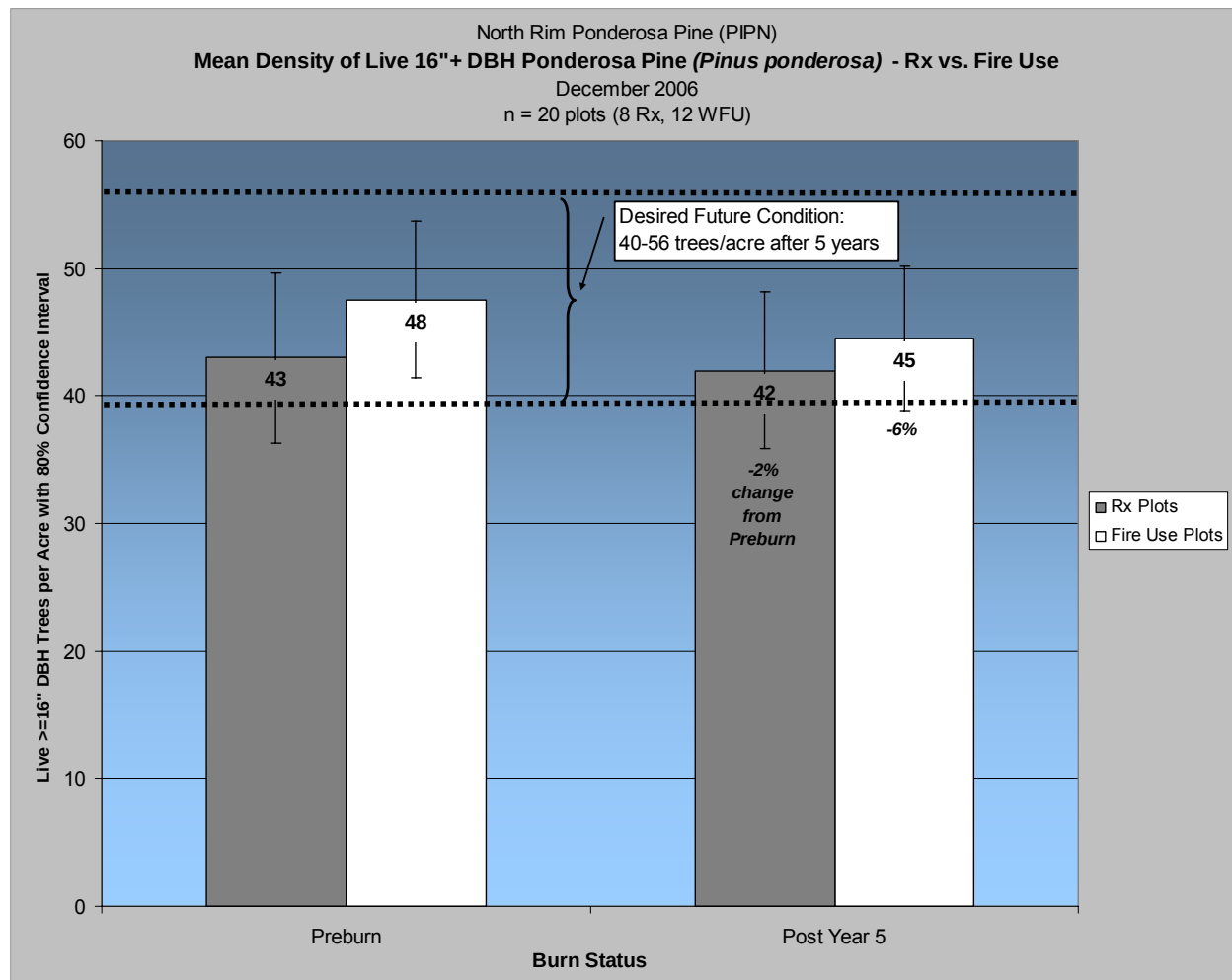
Percent reduction numbers are flip-flopped for ponderosa with white fir encroachment. In this denser monitoring type white fir is the species of concern, and fire use showed 78% reduction while prescribed burning only dropped pole numbers 58%. There is a glaring disparity between pre-burn densities in the two treatment types, with the nine plots burned in fire use demonstrating triple the amount of trees as the six burned in prescribed fires. Nonetheless, numbers two years post-burn show a drop in densities for both types of burns into the desired future condition of less than 100 trees/acre.



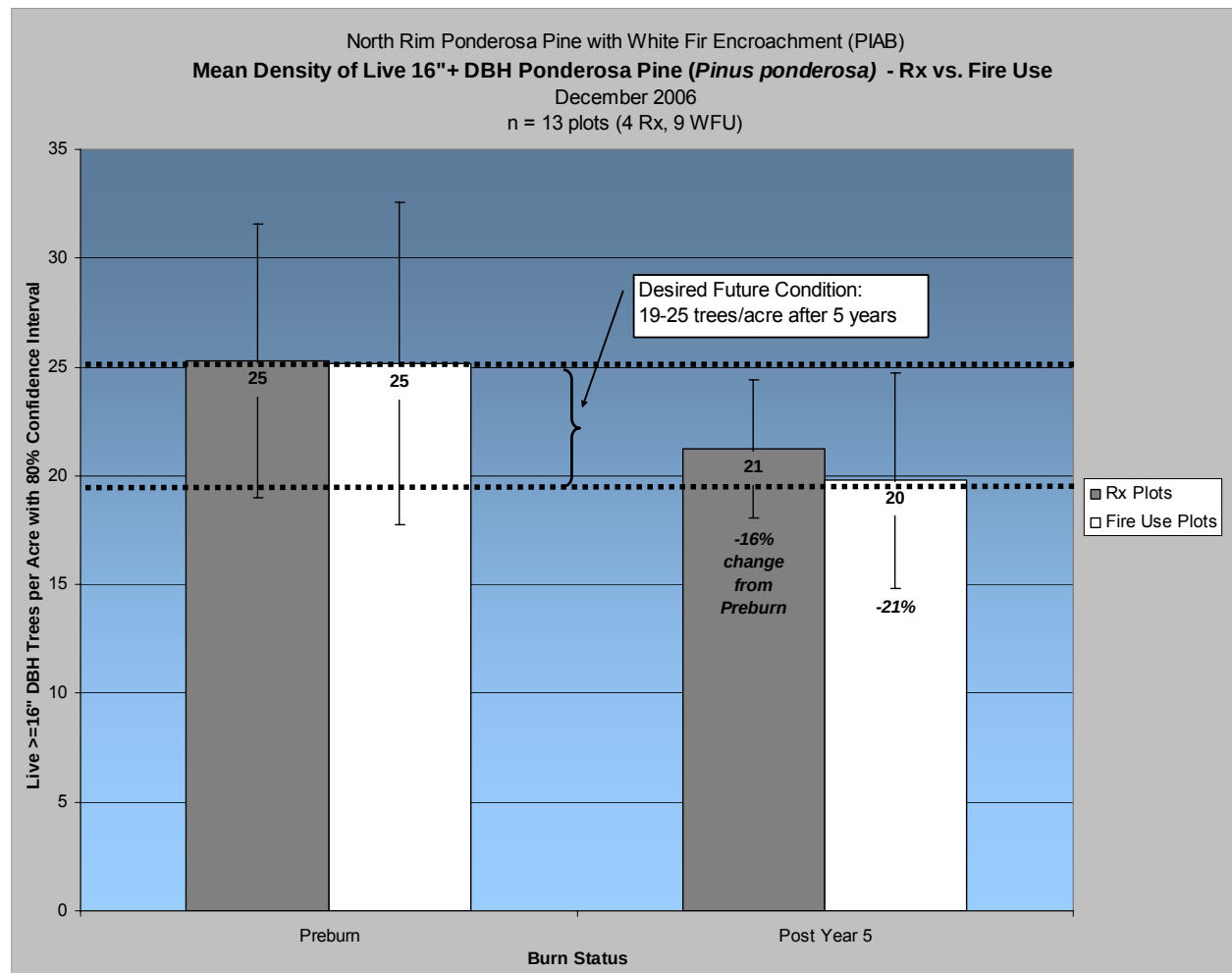
Just as with fuel loading, you'd have to say that prescribed and fire use treatments both seem to be doing the job for reducing poles. Minor variations aside, pole densities on average have dropped by at least half for all treatment types in both pure ponderosa and "mixed conifer" vegetation types.

Overstory Density

Keeping with the trend of comparing results in relation to our standard monitoring objectives, here we look at changes in overstory ponderosa pine with DBH ≥ 16 ". In pure ponderosa pine, we would like to achieve a desired future condition of 40-56 trees/acre in this size class, with the subsidiary goal of limiting mortality to 20%. It appears safe to say we have accomplished the dual objectives with both fire use and prescribed treatments. We were already within the desired range pre-burn, and kept mortality to less than six percent with both types of fire. The data set here is slightly smaller than for other analysis as we do not yet have five year post-burn data for five of the prescribed plots.



Once again, we have apparent success in ponderosa with white fir encroachment. The desired future condition of 19-25 trees/acre in ponderosa pine $\geq 16''$ DBH is half the density of the pure ponderosa monitoring type, owing in part to multiple overstory species competing for the same resources. Pre-burn we were at the upper end of the range and five years post-burn we are at the low end of the desired range. As might be expected, the percent mortality is higher in “mixed conifer” due to factors such as higher understory tree densities and the prevalence of ladder fuels. For fire use treatments, we have slightly exceeded the goal of limiting mortality to 20%, yet we are still within our density range of success for the objective. It appears as though these two objectives could be conflicting under some circumstances, and it begs the question as to which is paramount.



As with our previous two objectives, we again see positive results from both fire use and prescribed burns, with little noticeable difference between the types of treatment.

Taken as a whole, these data seem to demonstrate not only that first-entry prescribed fire and fire use are equally effective tools, but that they are being applied under consistent conditions at Grand Canyon. That there is no great disparity in results between treatment types strongly suggests that both prescribed burning and fire use continue to be employed as management strategies.

FIRE EFFECTS TO MEXICAN SPOTTED OWL CRITICAL HABITAT

The mixed-conifer forest on the North Rim of Grand Canyon is part of the CP-10 critical habitat unit for the federally-listed threatened species Mexican spotted owl (MSO). To better understand the effects of fire on the primary constituent elements of MSO critical habitat, we compiled data from our FMH monitoring network, from our burn severity mapping efforts, and from the Ecological Restoration Institute (ERI) at Northern Arizona University (NAU). Forest plot data from NAU-ERI were collected using the NPS FMH protocols and could, therefore, be combined with our FMH monitoring data for this analysis.

To date, 60 mixed-conifer forest plots have burned and 14 unburned plots have been monitored by NAU as control plots. Overall, 78% of the burned mixed-conifer plots were burned in WFU events, 12% in prescribed fires, and 10% in the Outlet wildland fire. By overlaying the burn severity mapping data with the forest plot locations, we found that 55% of the burned plots were in the low severity class, 17% in the moderate-low severity class, 10% in the moderate-high severity class, and 7% in the high severity class. Seven plots (12%) were burned prior to the initiation of the burn severity mapping program; therefore, these plots were assigned a severity class of “unknown”.

Analysis of fire effects to specific MSO critical habitat primary constituent elements, including tree density by size class, tree canopy cover, snag density, log density, and understory richness and cover, is on-going. Results of this analysis will be presented to park and regional fire management and resource management staff and to Fish and Wildlife Service. These data will also be included in the park's Biological Assessment for the new Fire Management Plan.

Here comes 2009 . . . get out of the way!!



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