



Barrens to Bayous
Fire Effects Monitoring Network
2010



Summary

The fire effects team located at the Natchez Trace Parkway became fully staffed this calendar year with the welcome additions of fire effects monitor, Michael Rotter and fire ecologist, Jesse Burton. Michael Rotter, from Presidio Native Plant Nursery in San Francisco, joined the fire effects team in January. Rotter's skills as a trained botanist make him a great asset as an NPS fire effects monitor. Coming from Oklahoma State University's Department of Natural Resource Ecology & Management, Jesse Burton filled the fire ecologist position in April. Burton brings knowledge of fire effects on oak hickory forests and ecological statistics to the crew. The lead fire effects monitor, Carol Fields, joined the crew at the end of the 2009 season, and continued to expand her skills in southeastern botany. Fields' expertise with fire operations and fire effects monitoring in other regions has allowed the fire effects team to develop its monitoring program further this year. Fire effects monitor Jennifer Falkey has been with the crew for over three years now and has been vital in maintaining consistency in the program during the multitude of staffing changes over the last few years. The fire effects team relied heavily on Falkey during 2010 for training new crewmembers and providing expertise in the program's objectives and monitoring history.

Even though the team started the year with half its normal staff, it was successful in providing qualified fire effects monitors and trainees to support the majority of both planned and unplanned ignition operations within the Barrens to Bayous geographical response area. The crew completed 64 annual reads, 45 post-burn reads, and installed four new plots. Additionally, CBI data was collected from several spring prescribed burns. The crew drove over 25,000 miles to support fire effects projects in our region, enough miles to encircle the Earth at the equator. The team contributed personnel for various regional operational needs. Michael Rotter detailed with the Cumberland Gap Wildland Fire Module for 16 days during the height of the prescribed fire season. Members of the Barrens to Bayous fire effects team actively participated in approximately 22 planned and unplanned ignitions this calendar year, a total acreage of over 7,800 acres. All members of the crew also assisted with the Deepwater Horizon Oil Spill response as resource advisors at Gulf Islands National Seashore, one of our cluster parks whose resources were impacted.

A major accomplishment this year was the entering of all backlogged data and scanning slide photographs from previous years, making the database of our parks completely up-to-date as of calendar year 2010. This backlog stretched back to as far as 2006 for datasheets and 2003 for the plot photographs. This achievement will greatly increase the team's ability to maintain current data records and progress into the 2011 field season.

To help create uniformity in report style within the Southeast Region, this year's annual report borrows some formatting from the Southern Appalachian/Piedmont Fire Effects/Fire Ecology Annual Report. We would like to thank the fire effects team at GRSM for their assistance during the 2010 monitoring season.

Table 1 | Fire Effects Plot Workload 2010 and Total Plots Installed

Park	Monitoring Type	Type Code	Plot Type	Pre-burn 2010	Immed. Post 2010	Post-burn 2010	Total Plots
Gulf Islands National Seashore	Sand Pine - Scrub Oak	PICL	FMH Forest Plot	0	3	4	12
	Longleaf - Slash Pine	PIPA	FMH Forest Plot	1	5	3	12
	Pitcher Plant Savannah	SAAL	FMH Forest Plot	0	0	1	1
	Fuels Monitoring	FUELS	Fuel Plot	0	0	1	4
Mammoth Cave National Park	Redcedar – Oak Glade	JUVI	FMH Forest Plot	1	5	0	7
	Indiangrass Grassland	SONU	FMH Grass Plot	1	3	0	8
	Big Bluestem Grassland	ANGE	FMH Grass Plot	0	0	0	5
	Oak – Hickory Woodland	OAHI	FMH Forest Plot	1	0	4	9
	Chestnut Oak Woodland	QUMO	FMH Forest Plot	0	0	2	3
	Fuels Monitoring	FUELS	Fuel Plot	0	0	0	4
Little River National Preserve	Shortleaf Pine Forest	PIEC	FMH Forest plot	0	3	8	12
	Green Pitcherplant Bog	SAOR	FMH Forest plot	0	1	5	6
	Chestnut Oak Forest	QUMO	FMH Forest plot	0	1	4	6
Natchez Trace Parkway	Oak – Hickory Woodland	OAHI	FMH Forest Plot	2	1	2	6
	Redcedar Encroached Prairie	JUVI	FMH Brush Plot	0	4	0	4
	Loblolly Pine Forest	PITA	FMH Forest Plot	0	0	7	14
	Redcedar Encroached Prairie	BLACK BELT	FMH Grass Plot	0	4	0	4
	Japanese Grass Invaded Streamside Forest	MIVI	FMH Grass plot	0	0	10	10
Horseshoe Bend National Military Park	Mixed Montane Longleaf Forest	PIPA	FMH Forest Plot	0	1	3	5
Stones River National Battlefield	Little Bluestem Fields	SCSC	FMH Grass Plot	0	7	2	15
	Central Basin Barrens	ANTE	FMH Grass Plot	0	0	8	9
	Grassland Restoration Areas	ANVI	FMH Grass Plot	0	3	0	10
	Fuels Monitoring	FUELS	Fuel Plot	0	0	0	3
	Redcedar Woodland	JUVI	FMH Forest Plot	0	0	0	1
Russell Cave National Monument	Chestnut Oak Forest	QUMO	FMH Forest Plot	0	0	0	1
Vicksburg National Military Park	Exotics Monitoring		Photo Plot	0	4	0	7
Total				6	45	64	178

Table 2 | Fire Ecology Staffing 2010

Ecologist and Monitors	Starting Date	Ending Date	# of Pay Periods	READ Qualified	Training and Development
Jesse Burton Ecologist	3/29/10	12/31/10	19	Yes	Fire Effects Monitoring (FEM), B3 Helicopter/Airplane Safety, Water Ditching and Survival (A-312), Firefighter refresher, FEMO Taskbook Opened, FFT1 Taskbook Opened, Phase 1 Supervisor Training, EEO & Diversity Training, Natural Areas Association Conference, Fire Interpretation Workshop
Carol Fields Lead Monitor	1/1/10	12/31/10	26	Yes	Water Ditching and Survival (A-312), Composite Burn Index (CBI) Training, NEPA Sec 6 Training, Carolina Vegetation Survey, Vegetation Monitoring in a Management Context Training, Firefighter refresher, Fire Interpretation Workshop
Jennifer Falkey Monitor	1/1/10 9/12/10	5/22/10 12/31/10	11 7 (18 total)	Yes	Faller-A Taskbook Open, Firefighter Refresher, FEMO Taskbook Completed, Medicine/Trauma Conference, Southeast READ, First Aid and CPR instructor training, Fire Interpretation Workshop
Michael Rotter Monitor	1/19/10 7/4/10	6/19/10 12/31/10	11 12 (23 total)	Yes	S-130/190, Firefighter refresher, Fundamentals I, FEMO Taskbook Opened, Composite Burn Index (CBI) Training, NEPA Sec 6 Training



Figure 1 | Fields measures heavy fuel loads still remaining within the Naval Live Oak Prescribed Fire Units after hurricanes Ivan, Dennis, & Katrina.



Figure 2 | Rotter illustrates why the orange vests are not just for the hunting seasons; the grey and green of the NPS uniform are inadequate for keeping together in the SONU plots at MACA.

Management Objectives and Monitoring Results 2010

The monitoring results for this report are broken down by park in the following pages. Due to staff changes in last couple of years, it has been some time since a thorough analysis of collected data has been completed. I have analyzed these data and reported results for this year's annual report. Data entry is current up to the end of calendar year 2010 and all analyses have been conducted with the most recent data entered. Results are reported with 80% confidence intervals of the mean unless otherwise noted. Basic formulas for each analysis are now displayed in the management objectives column. Significant changes in monitoring results are in **bold** font. An underlined number of plots denote that minimum sample sizes have been achieved. Estimations of minimum sample size were completed with the 'SS Two Samples' tool created by Ken Gerow (available online at www.statsalive.com). Sample sizes needed with current variance are given in brackets when minimum size has not been achieved. When brackets are not given, variance and correlation of samples do not yet allow for an estimate of minimum sample size.



Figure 3 | In addition to the endangered green pitcherplant (*Sarracenia oreophila*), a vast diversity of increasingly uncommon herbaceous species are benefiting from the planned ignitions at LIRI. The need for continued treatment is apparent by the re-sprouting sourwood (*Oxydendrum arboreum*) in the background.



Figure 4 | Planned ignitions targeting a sub-xeric forest stand along the Turnhole Bend Trail within the Joppa Church Prescribed Burn Unit. This treatment will help to remove invading species such as redcedar (*Juniperus virginiana*) and beech (*Fagus grandifolia*) from the understory on upland sites at MACA, allowing shade intolerant species like oaks and hickories to flourish and replace overstory oaks and hickories when gaps are created.

Table 3.1 | Summary of Long-term Monitoring Results at Gulf Islands National Seashore

Vegetation Type	Management Objectives (Restoration)	Monitoring Results (80% Confidence Intervals)	Objective Achieved?	Year Last Analysis Completed
Sand Pine – Scrub Oak Forest (FPICL1D07)	20-40% litter and duff reduction immediate post-burn $\frac{\beta_{Post} - \text{before } \beta}{\text{before } \beta}$	Decrease of Duff = 14.9 % (± 26 %) after 1 st fire <i>n</i> =8 [32], 3 burn units 1.1 % (± 58 %) after 2 nd fire <i>n</i> =6 [25], 4 burn units 54.5 % (± N/A) after 3 rd fire <i>n</i> =1, 1 burn units Decrease of Litter = 42.0 % (± 19 %) after 1st fire <i>n</i>=8, 3 burn units +20.0 % (± 98 %) after 2nd fire <i>n</i> =6 [42], 4 burn units 8.7 % (± N/A) after 3 rd fire <i>n</i> =1, 1 burn units	Uncertain Data are highly variable, may be confounded by hurricanes Ivan, Dennis, & Katrina	2010
	40-60% reduction of pole-sized trees by 2 nd year after 3 rd burn $\frac{\beta_{YR02} - 00Pre}{00Pre}$	Pole density reduction= 9.6 % (± 4 %) after 1st fire <i>n</i>=10, 5 burn units 21.8 % (± 8 %) after 2nd fire <i>n</i>=3, 2 burn units	Uncertain Plots have not been burned three times and objective reduction has not been met	2010
	20-40% increase in herbaceous cover by 2 nd year after 3 rd burn $\frac{\beta_{YR02} - 00Pre}{00Pre}$	Increase in relative cover = 96.1 % (± 65 %) after 1st fire <i>n</i>=8 [80], 4 burn units 210.7 % (± 124 %) after 2nd <i>n</i>=3 [230], 2 burn units)	Yes/Uncertain Plots have not burned three times	2010
Longleaf – Slash Pine Forest (FPIPA1D07)	50-90% hardwood pole reduction by one Year after the 3 rd burn. $\frac{\beta_{YR01} - 00Pre}{00Pre}$	Density Reduction = 59.3 % (± 15 %) after 1st fire <i>n</i>=9, 4 burn units 67.6 % (± 15 %) after 2nd fire <i>n</i>=9, 4 burn units 82.6 % (± N/A %) after 3 rd fire <i>n</i> =1, 1 burn units	Yes All plots have not burned three times	2010
	20-40% litter and duff reduction immediate post-burn $\frac{\beta_{Post} - \text{before } \beta}{\text{before } \beta}$	Decrease of Duff = 16.7 % (± 17 %) after 1 st fire <i>n</i> =7 [18], 3 burn units 20.7 % (± 18 %) after 2 nd fire <i>n</i> =8 [18], 4 burn units 46.6 % (± 15 %) after 3rd fire <i>n</i>=5, 3 burn units Decrease of Litter = 59.1 % (± 5 %) after 1st fire <i>n</i>=7, 3 burn units 64.0 % (± 12 %) after 2nd fire <i>n</i>=8 [19], 4 burn units 49.1 % (± 23) after 3rd fire <i>n</i>=5 [68], 3 burn units)	Yes Reductions of litter with initiation of Rx fire and duff reductions occurred in later treatments	2010
	20-40% increase of herbaceous cover by 2 nd year after 3 rd burn. $\frac{\beta_{YR02} - 00Pre}{00Pre}$	Increase in cover = 36.9 % (± 32 %) after 1 st fire <i>n</i> =7 [13], 3 burn units 147.5 % (± 82 %) after 2nd fire (<i>n</i>=6 [191], 3 burn units)	Yes/Uncertain Increase in graminoid and forb cover by second burn; however, plots have not burned three times	2010
	Limit mortality of	Density Reduction = 12.0 % (± 13%) after 1 st fire	Uncertain Data are highly	2010

	longleaf and slash pine to 20%	$n=11$, 4 burn units 20.8 % (± 22 %) after 2 nd fire $n=6$ [22], 3 burn units	variable	
	$\frac{\beta_{YR02} - 00Pre}{00Pre}$			
Pitcherplant Savannah (FSAAL1G010)	Decrease litter and duff loading by 20-40% immediate post-burn	Decrease of Duff = 44.7 % ($\pm$ N/A %) after 1 st fire $n=1$, 1 burn units 12.3 % ($\pm$ N/A %) after 2 nd fire $n=1$, 1 burn units Decrease of Litter = 60.8 % ($\pm$ N/A %) after 1 st fire $n=1$, 1 burn units 80.0 % ($\pm$ N/A %) after 2 nd fire $n=1$, 1 burn units	Yes/Uncertain* Only one plot is installed in this monitoring type	2010
	$\frac{\beta_{Post} - before \beta}{before \beta}$			
	Limit mortality of overstory pine trees to less than 20% measured 2 years post burn	Density Reduction = 4.5 % ($\pm$ N/A %) after 1 st fire $n=1$, 1 burn units 25.0 % ($\pm$ N/A %) after 2 nd fire $n=1$, 1 burn units	Yes/Uncertain* Mortality after 2 nd fire is likely a result of hurricanes Ivan, Dennis, & Katrina	2010
	$\frac{\beta_{YR02} - 00Pre}{00Pre}$			
	Reduce pole tree density by 40-90%	Density Reduction = 0 % ($\pm$ N/A %) after 1 st fire $n=1$, 1 burn units 16.7 % ($\pm$ N/A %) after 2 nd fire $n=1$, 1 burn units	No/Uncertain* Pole densities were very low at pre-burn levels (< 50 per/acre)	2010
	$\frac{\beta_{YR02} - 00Pre}{00Pre}$			
	Reduce shrub density by 40-90%	Density Reduction = +108 % ($\pm$ N/A %) after 1 st fire $n=1$, 1 burn units +92.5 % ($\pm$ N/A %) after 2 nd fire $n=1$, 1 burn units	No/Uncertain*	2010
	$\frac{\beta_{YR02} - 00Pre}{00Pre}$			
	Cause no net decrease in cover of yellow trumpets (<i>Sarracenia alata</i>)	Increase in cover = 100 % ($\pm$ N/A %) after 1 st fire $n=1$, 1 burn units 100 % ($\pm$ N/A %) after 2 nd fire $n=1$, 1 burn units	Yes/Uncertain* Only one plot is installed in this monitoring type	2010
	$\frac{\beta_{YR02} - 00Pre}{00Pre}$			
	Increase herbaceous component of the understory by 20-40% measured 2 years after the 3rd burn	Increase in cover = -1.4 % ($\pm$ N/A %) after 1 st fire $n=1$, 1 burn units -36.6 % ($\pm$ N/A %) after 2 nd fire $n=1$, 1 burn units	No/Uncertain* Only one plot is installed in this monitoring type and plot has not burned three times	2010
	$\frac{\beta_{YR02} - 00Pre}{00Pre}$			

*No statistical analysis was conducted on the FSAAL1G01 plots because of the limited number of plots.

Table 3.2 | Summary of Long-term Monitoring Results at Horseshoe Bend National Military Park

Vegetation Type	Management Objectives (Restoration)	Monitoring Results (80% Confidence Intervals)	Objective Achieved?	Year Last Analysis Completed
Mixed Montane Longleaf Pine Forest (FPIPA1D07)	Decrease density of all pole trees by 20-90% as measured 1 year post burn $\frac{\beta_{YR01} - 00Pre}{00Pre}$	Density Reduction = 16.7 % (± 23 %) after 1 st fire <i>n</i> =5 [19], 4 burn units 59.0 % (± N/A %) after 2 nd fire <i>n</i> =1, 1 burn units	Uncertain	2010
	Decrease litter loading by 40-90% as measured immediately post burn $\frac{\beta_{Post} - before \beta}{before \beta}$	Decrease of Duff = 2.3 % (± 13 %) after 1 st fire <i>n</i> =5, 4 burn units +50.0 % (± 1 %) after 2nd fire <i>n</i> =2, 2 burn units Decrease of Litter = 38.5 % (± 16 %) after 1 st fire <i>n</i> =5 [6], 4 burn units 45.1 % (± 13 %) after 2 nd fire <i>n</i> =2, 2 burn units	Uncertain Reductions of litter do not yet meet objective and no reduction of duff	2010
	Limit mortality of overstory longleaf pine (<i>Pinus palustris</i>) trees to less than 10% as measured 2 years post burn $\frac{\beta_{YR02} - 00Pre}{00Pre}$	Density Reduction = 4.8 % (± 4 %) after 1 st fire <i>n</i> =2 [7], 2 burn units 18.2 % (± N/A %) after 2 nd fire <i>n</i> =1, 1 burn units	Yes/Uncertain Not all plots have been monitored two years post	2010
	Cause no net gain in percent cover of exotic plants as measured one year and five years post burn $\frac{\beta_{YR01} - 00Pre}{00Pre}$	Increase in cover = 0.0 % (± N/A %) after 1 st fire <i>n</i> =5, 4 burn units 0.0 % (± N/A %) after 2 nd fire <i>n</i> =1, 1 burn units	Yes No exotic species have been detected in FPIPA1D07 plots and no plots have been monitored five years post-burn	2010



Figure 5 | PIPA02 (HOBE) prior to planned ignitions.



Figure 6 | PIPA02 two fires and six years later.

Table 3.3 | Summary of Long-term Monitoring Results at Little River National Preserve

Vegetation Type	Management Objectives (Restoration)	Monitoring Results (80% Confidence Intervals)	Objective Achieved?	Year Last Analysis Completed
Shortleaf Pine Forest (FPIEC1DG09)	25-80% reduction in pole-sized trees by 3 rd burn <i>$\beta YR01 - 00Pre$ 00Pre</i>	Density Reduction = 6.2 % (± 4 %) after 1 st fire <i>$n=11$, 4 burn units</i> 36.0 % (± 20 %) after 2 nd fire <i>$n=9$ [27], 4 burn units</i> 69.1 % (± 20 %) after 3 rd fire <i>$n=4$ [14], 2 burn units</i>	Yes	2010
	25-50% increase native grass and forb cover <i>$\beta YR02 - Earliest Read$ Earliest Read</i>	Increase in Cover = 225.2 % (± 103 %) after 1 st fire <i>$n=5$, 2 burn units</i> 194.5 % (± 136 %) after 2 nd <i>$n=6$, 3 burn units</i> 418.2 % (± 129 %) after 3 rd <i>$n=2$, 1 burn units</i>	Yes	2010
	50% reduction in duff, litter, and downed woody fuel by 3 rd burn <i>$\beta Post - 00Pre$ 00Pre</i>	Decrease of Duff = 0.6 % (± 12 %) after 1 st fire <i>$n=12$, 6 burn units</i> 43.6 % (± 8 %) after 2 nd fire <i>$n=6$, 2 burn units</i> 37.4 % (± 23 %) after 3 rd fire <i>$n=5$, 3 burn units</i> Decrease of Litter = 51.3 % (± 6 %) after 1 st fire <i>$n=12$, 6 burn units</i> 56.6 % (± 14 %) after 2 nd fire <i>$n=6$, 2 burn units</i> 78.6 % (± 4 %) after 3 rd fire <i>$n=5$, 3 burn units</i> Decrease in Total Wood = +15.1 % (± 23 %) after 1 st fire <i>$n=12$, 6 burn units</i> +63.5 % (± 54 %) after 2 nd fire <i>$n=6$ [13], 2 burn units</i> +117 % (± 75 %) after 3 rd fire <i>$n=5$ [31], 3 burn units</i>	Uncertain Objective has been achieved for litter fuel loading; however, duff has had limited reductions and total woody debris is increasing during initial treatments	2010
Green Pitcherplant Bog Forest (FSAOR1G10)	30-90% decrease in shrub cover by second year after 3 rd burn <i>$\beta YR02 - Earliest Read$ Earliest Read</i>	Decrease in cover = 29.3 % (± 12 %) after 2 nd fire <i>$n=6$, 3 burn units</i> 32.1 % (± 25 %) after 3 rd fire <i>$n=2$ [3], 1 burn units</i> +61.6 % (± 56 %) after 4 th fire <i>$n=2$ [6], 1 burn units</i>	Uncertain All plots must burn 3 times	2010
	20% increase cover of green pitcherplant (<i>Sarracenia oreophila</i>) by second year after 3 rd burn <i>$\beta YR02 - Earliest Read$ Earliest Read</i>	Increase in cover = 21.4 % (± 26 %) after 2 nd fire <i>$n=6$ [18], 3 burn units</i> 80.1 % (± 26 %) after 3 rd fire <i>$n=2$ [26], 1 burn units</i> 70.1 % (± 90 %) after 4 th fire <i>$n=2$, 1 burn units</i>	Yes/Uncertain Plots have not burned 3 times and high variability due to low numbers of individuals along transects; additional methods have been added to these plots to address this issue	2010
	30-90% decrease in pole-sized trees by second year after 3 rd burn	Pole reduction = 13.2 % (± 21 %) after 1 st fire <i>$n=3$ [5], 1 burn units</i> 57.8 % (± 15 %) after 2 nd fire <i>$n=5$ [10], 3 burn units</i> 68.7 % (± 20 %) after 3 rd fire	Yes Local park staff is also applying mechanical treatment to pole size trees	2010

	<u>$\beta YR02 - 00Pre$</u> <u>00Pre</u>	<i>n=3 [20], 2 burn units</i> 58.3 % (± 34 %) after 4 th fire <i>n=2 [7], 1 burn units</i>		
Chestnut Oak Forest (FQUM01G10)	20-60% reduction in pole-sized trees	Density Reduction = 37.6 % (± 14 %) after 1st fire <i>n=4 [19], 3 burn units</i> 41.0 % (± 0 %) after 2 nd fire <i>n=2 [6], 1 burn units</i> 69.0 % (± 17 %) after 3 rd fire <i>n=2 [7], 1 burn units</i>	Yes/Uncertain All plots must burn and have annual read to reach minimum sample size	2010
	<u>$\beta YR01 - 00Pre$</u> <u>00Pre</u>			
	25-50% increase native grass and forb cover	Increase in Cover = 145.1 % (± 197 %) after 1 st fire <i>n=4 [10], 3 burn units</i> 383.7 % (± 105 %) after 2 nd fire <i>n=2, 1 burn units</i> 0.0 % (± 0.0 %) after 3 rd fire <i>n=2, 1 burn units</i>	Uncertain All plots must burn and have annual read to reach minimum sample size	2010
	<u>$\beta YR01 - 00Pre$</u> <u>00Pre</u>			



Figure 7 | PIEC22 (LIRI) prior to planned ignitions in 1999. Figure 8 | PIEC22 after two fires and eleven years.

Table 3.4 | Summary of Long-term Monitoring Results at Mammoth Cave National Park

Vegetation Type	Management Objectives (Restoration)	Monitoring Results (80% Confidence Intervals)	Objective Achieved?	Year Last Analysis Completed
Oak-Hickory Forest (FOAHI1D09)	Decrease density of shade tolerant pole trees by 30-90% $\frac{\beta_{YR01} - 00Pre}{00Pre}$	Density Reduction = 58.5 % (± 15 %) after 1 st fire <i>n</i> =7 [9], 5 burn units	Yes Density of shade intolerant species significantly reduced by > 30%, All plots must burn and be monitored during annual read to meet min sample size	2010
	Limit mortality of overstory trees to less than 20% $\frac{\beta_{YR01} - 00Pre}{00Pre}$	Density Reduction = 7.4 % (± 5 %) after 1 st fire <i>n</i> =7, 5 burn units	Yes	2010
	Increase native herbaceous cover by 10-25% by 1 year after the 3 rd burn $\frac{\beta_{YR02} - 00Pre}{00Pre}$	Increase in cover = 148.3 % (± 63 %) after 1 st fire <i>n</i> =7, 5 burn units	Yes All plots have experienced increases in herbaceous cover; however, plots have not burned 3 times	2010
	Reduce total fuel load by 25-50% immediately postburn. $\frac{\beta_{Post} - before \beta}{before \beta}$	Decrease in total fuels = 33.3 % (± 10 %) after 1 st fire <i>n</i> =7, 5 burn units	Yes Reduction objective does not fall outside range of confidence	2010
Redcedar Glade Forest (FJUVI1D09)	Reduce litter, duff, and downed woody fuel load by 25-50% $\frac{\beta_{Post} - before \beta}{before \beta}$	Decrease of Duff = +24.1 % (± 32 %) after 1 st fire <i>n</i> =7 [9], 4 burn units 25.7 % (± 32 %) after 2 nd fire <i>n</i> =3 [25], 1 burn units Decrease of Litter = 46.3 % (± 10 %) after 1 st fire <i>n</i> =7 [21], 4 burn units 31.3 % (± 27 %) after 2 nd fire <i>n</i> =3 [27], 1 burn units Decrease in Total Wood = 3.4 % (± 19 %) after 1 st fire <i>n</i> =7 [8], 4 burn units 36.5 % (± 27 %) after 2 nd fire <i>n</i> =3 [4], 1 burn units	No/Uncertain Significant reductions in litter fuel loading; however, duff and downed woody fuels do not yet show responses to treatment	2010
	Reduce pole-sized trees by 40-60% $\frac{\beta_{YR01} - 00Pre}{00Pre}$	Density Reduction = 12.3 % (± 12 %) after 1 st fire <i>n</i> =6, 3 burn units	No This objective is being reevaluated as very low fire intensities are advised for this ecotype	2010
	Limit mortality to overstory species to less than 20% $\frac{\beta_{YR01} - 00Pre}{00Pre}$	Density Reduction = +2.2 % (± 4 %) after 1 st fire <i>n</i> =6, 3 burn units	Yes	2010

Chestnut Oak Woodland (FQUMO1D09)	Decrease density of shade tolerant pole trees by 30-90 % ¹ $\frac{\beta YR01 - 00Pre}{00Pre}$	Density Reduction = 33.3 % (± N/A %) after 1 st fire <i>n</i> =1, 1 burn units	Yes/Uncertain Limited sample size	2010
	Limit mortality of overstory trees to less than 20 % $\frac{\beta YR01 - 00Pre}{00Pre}$	Density Reduction = 4.0 % (± N/A %) after 1 st fire <i>n</i> =1, 1 burn units	Yes/Uncertain Limited sample size	2010
	Reduce total fuel load by 25-50 % after 3 burns $\frac{\beta Post - before \beta}{before \beta}$	Decrease in total fuels = 20.2 % (± 7 %) after 1st fire <i>n</i>=3, 2 burn units +14.4 % (± N/A %) after 2st fire <i>n</i> =1, 1 burn units	Yes/Uncertain Significant reduction in total fuels; however, fuels not reduced by > 25% after first treatment	2010
	Increase native grass and forb cover by 10-25 % after 3 burns $\frac{\beta YR01 - 00Pre}{00Pre}$	Increase in cover = -68.3 % (± 18 %) after 1st fire <i>n</i>=2, 1 burn units 21.7 % (± N/A %) after 2 nd fire <i>n</i> =1, 1 burn units	Uncertain Limited sample size and plots have not burned three times	2010
Indian Grass Grassland (BSONU1T02)	Reduce density of shade tolerant seedlings 30% to 60% one year after second fire ² $\frac{\beta YR01 - 00Pre}{00Pre}$	Density Reduction = 39.1 % (±21 %) after 1 st fire <i>n</i> =3 [20], 1 burn unit 45.8 % (±25 %) after 2nd fire <i>n</i>=2 [4], 1 burn unit	Yes/Uncertain Reductions are occurring; however, >30% is not outside the confidence interval	2010
	Reduce density of shrubs 30% to 60% one year after second fire $\frac{\beta YR01 - 00Pre}{00Pre}$	Density Reduction = 35.3 % (±9 %) after 1st fire <i>n</i>=3, 1 burn unit 23.2 % (±54 %) after 2 nd fire <i>n</i> =2 [43], 1 burn unit	Uncertain Significant reduction occurred after first treatment; however, all plots must burn 2 two times	2010
	Cause no net gain in percent cover of exotic plants after five years of burning ³ $\frac{\beta YR02 - 00Pre}{00Pre}$	Increase in cover = 156.1 % (± 136 %) after 1 st fire <i>n</i> =3, 1 burn units 371.2 % (± 550 %) after 2 nd fire <i>n</i> =2, 1 burn units	Uncertain Plots have not burned 5 times and minimum sample size not met	2010
	Increase relative cover of Indiangrass (<i>Sorghastrum nutans</i>) 15% after five years of burning $\frac{\beta YR02 - 00Pre}{00Pre}$	Increase in cover = 534.6 % (± 319 %) after 1 st fire <i>n</i> =3, 1 burn units 81.9 % (± 142 %) after 2 nd fire <i>n</i> =2, 1 burn units	Uncertain Plots have not burned 5 times and minimum sample size not met	2010

¹ Shade intolerant species include *Carya*, *Pinus*, and *Quercus* genera. Density analyzed for all other species.

² Density analyzed for *Acer*, *Juniperus*, *Sassafras*, and *Ulmus* genera.

³ Exotics in SONU plots include; *Digitaria* spp., *Kummerowia* spp., *Lespedeza cuneata*, *Lonicera japonica*, *Microstegium vimineum*, *Ligustrum* spp., and *Setaria* spp.

Big Bluestem Grassland (BANGE1D02)	Cause no net gain in percent cover of exotic plants as measured one year and five years post burn.	Decrease in cover = 56.4 % (± 12 %) after 1 st fire <i>n</i> =2, 1 burn units 96.3 % (± 1 %) after 2 nd fire <i>n</i> =2, 1 burn units	Yes Limited sample size and all plots must burn	2010
	$\frac{\beta YR01 - 00Pre}{00Pre}$ Decrease invading woody species by 30% as measured 1-year post burn. $\frac{\beta YR01 - 00Pre}{00Pre}$	Density Reduction = +38.5 % (±135 %) after 1 st fire <i>n</i> =4 [13], 1 burn unit 49.7 % (±5 %) after 2 nd fire <i>n</i> =2 [4], 1 burn unit	Yes/Uncertain Limited sample size and all plots must burn	2010



Figure 9 | QUMO31 (MACA) prior to planned ignitions.



Figure 10 | QUMO31 after two fires and ten years.



Figure 11 | Smoke column rises above the Floating Mill planned ignition on April 1st, 2010.



Figure 12 | The 2010 fire effects team hike to Peanut Knob Burn Unit in MACA.

Table 3.5 | Summary of Long-term Monitoring Results at Natchez Trace Parkway

Vegetation Type	Management Objectives (Restoration)	Monitoring Results (80% Confidence Intervals)	Objective Achieved?	Year Last Analysis Completed
Mixed Loblolly Pine Forest (FPITA1D09)	Reduce total fuel load by 20-40% immediately post-burn $\frac{\beta_{Post} - \text{before } \beta}{\text{before } \beta}$	Total fuel reduction = 40.2% ($\pm 5\%$) after 1st fire $n=12$, 7 burn units 2.0 % ($\pm 15\%$) after 2 nd fire $n=6$ [9], 2 burn units 4.6 % ($\pm 17\%$) after 3 rd fire $n=6$ [8], 2 burn units 28.4 % ($\pm 14\%$) after 4th fire $n=4$ [7], 2 burn units	Yes Significant reduction after 1 st and 4 th burns; however, only first treatment exceeds 20 % reduction	2010
	Reduce conifer poles (2.5-15.0 cm dbh) > 25% one year after 3 rd fire $\frac{\beta_{YR01} - 00Pre}{00Pre}$	Density reduction = 8.3 % ($\pm 10\%$) after 1 st fire $n=4$ [10], 3 burn units +12.5 % ($\pm 14\%$) after 2nd fire $n=4$ [11], 2 burn units 41.7 % ($\pm 29\%$) after 3rd fire $n=4$ [34], 2 burn units 33.3 % ($\pm 33\%$) after 4 th fire $n=3$ [15], 2 burn units	Yes/Uncertain Significant reduction after 3 rd treatment and few plots now contain conifer poles	2010
	Cause no net gain in percent cover of exotic plants after 5 burns ⁴ $\frac{\beta_{YR01} - \text{earliest read}}{\text{earliest veg. read}}$	Average reduction = +10.0 % ($\pm 3.1\%$) after 1st fire $n=2$, 2 burn units + 1.5 % ($\pm 1.5\%$) after 2nd fire $n=2$, 1 burn unit 5.8 % ($\pm 3.4\%$) after 3 rd fire $n=4$, 2 burn unit	Uncertain All existing plots must burn to meet sample size and plots containing exotic species have not experienced five treatments	2010
Black Belt Prairie (BJUVI1D06)	25-50% reduction of redcedar (<i>Juniperus virginiana</i>) density after 5 years of burning $\frac{06YR02 - 00Pre}{00Pre}$	Density reduction = 87.3 % ($\pm 9\%$) after 6th fire $n=4$ [18], 1 burn units	Yes Significant reduction after 6 th burn, data not available immediately after 5 th burn	2010
	20-40% reduction in woody exotic species density by 4 th burn $\frac{06YR02 - 00Pre}{00Pre}$	Density reduction = +4,403 % ($\pm N/A\%$) after 6th fire $n=4$, 1 burn units	No Plots are highly variable in exotic species density and plots that did not have exotics now do	2010
Oak-Hickory Woodland (FOAHI1D09)	Reduce litter and duff load by 30-40% after 3 burns $\frac{\beta_{Post} - 00Pre}{00Pre}$	Duff Reduction = 52.1 % ($\pm 8\%$) after 1st fire $n=3$, 2 burn units Litter Reduction = 66.3 % ($\pm 21\%$) after 1st fire $n=3$ [7], 2 burn units	Yes All plots must burn three times to meet minimum sample size requirements	2010
	Reduce mean density of pole-sized trees by 20-30% after 3 burns $\frac{\beta_{YR01} - Pre00}{Pre00}$	Density reduction = 19.8 % ($\pm 7\%$) after 1st fire $n=3$ [5], 2 burn units	Yes/Uncertain Plots have not been burned three times and all plots must burn to meet minimum sample size requirements	2010

⁴ Exotics in PITA plots include; privet (*Ligustrum spp.*), Japanese honeysuckle (*Lonicera japonica*), & and others.

Japanese Grass Invaded Streamside Forest (FMIVID09)	Decrease percent cover of Japanese grass (<i>Microstegium vimenium</i>) by 50% one year post treatment <i>βYR02–Pre00</i> <i>Pre00</i>	Cover reduction = 90.0 % (± 4 %) 1 st treatment <i>n</i> =10, 1 burn units	Uncertain A significant reduction occurred; however, there was no significant difference in the control and the experimental plots	2010
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Figure 13 | PITA12 (NATR) prior to planned ignitions.



Figure 14 | PITA12 after one fire.



Figures 15-17 | Black Belt Prairie restoration site prior to treatment, after thinning, and after thinning & one Rx fire. Data not reported above.

Table 3.6 | Summary of Long-term Monitoring Results at Stones River National Battlefield

Vegetation Type	Management Objectives (Restoration)	Monitoring Results (80% Confidence Intervals)	Objective Achieved?	Year Last Analysis Completed
Little Bluestem Grassland (GSCSC1G02)	Reduce exotic ⁷ species cover by 20-70% after 5 burns $\frac{\beta YR01 - 00Pre}{00Pre}$	Exotic Cover Reduction = 42.5 % (± 17%) after 1 st fire <i>n</i> =11 [27], 3 burn unit	Yes/Uncertain Significant reductions in exotic species after one burn; however, plots have not been burned five times and include additional treatments such as mowing and herbicide	2010
	Increase native grass and forb cover by 20-50% after 3 fires $\frac{\beta YR01 - 00Pre}{00Pre}$	Native Herb Cover = 14.1 % (± 18%) after 1 st fire <i>n</i> =11 [21], 3 burn unit	Uncertain All plots must burn three times	2010
Middle Tennessee Barrens (GANTE1D05)	Reduce exotic ⁵ and eastern redcedar cover by 20% by 5 years post-burn $\frac{\beta YR01 - 00Pre}{00Pre}$	Exotic Cover Reduction = 0.0 % (± 23%) after 1 st fire <i>n</i> =8 [41], 1 burn unit -11.5 % (± 25%) after 2 nd fire <i>n</i> =8 [104], 1 burn unit Redcedar Reduction = 82.4 % (± 11 %) after 1 st fire <i>n</i> =8 [23], 1 burn unit 73.1 % (± 17 %) after 2 st fire <i>n</i> =8 [22], 1 burn unit	Yes/Uncertain Redcedar is being reduced; however, significant reductions in exotic cover have not yet occurred Plots have not been monitored five years post burn	2010
	Increase native herbaceous species cover and diversity ⁶ by 20-75% $\frac{\beta YR01 - 00Pre}{00Pre}$	Native Herb Cover = -16.7 % (± 8%) after 1 st fire <i>n</i> =8, 1 burn unit -26.1 % (± 10%) after 2 nd fire <i>n</i> =8, 1 burn unit Native Herb Richness = -37.4 % (± 4%) after 1 st fire <i>n</i> =8, 1 burn unit -38.2 % (± 8%) after 2 nd fire <i>n</i> =8, 1 burn unit Native Herb Diversity = -15 % (± N/A%) after 1 st fire <i>n</i> =1, 1 burn unit -15.5 % (± N/A%) after 2 nd fire <i>n</i> =1, 1 burn unit	No/Uncertain Native species have not increased in cover; however, this may be a result of changes in the seasonality of monitoring and misidentification of species in the past Native herbaceous cover, richness, and diversity was reassessed during the growing season in 2010 resulting in increases of -14.8%, +5.7%, +12.6% respectively	2010

⁵ Exotics include *Albizia julibrissin*, *Kummerowia* spp., *Leucanthemum vulgare*, *Ligustrum sinense*, *Lonicera japonica*, *Paspalum dilatatum*. *Lespedeza cuneata* is present at the site(s) but is not included in the current analysis as it may have been misidentified in previous reads.

⁶ Calculations conducted on relative changes in plots' herbaceous species richness and then on total change in diversity utilizing Shannon's diversity index.

Fire ecologist accomplishments and areas of focus

Table 4 | Fire Ecologist Accomplishments/Focus Areas

Category	Percent Time	Accomplishments and/or areas of activities
Planning	15%	Consultation & compliance for Rx burns Reviewed 2011-2013 Davis Bayou (GUIS) Omnibus Rx Fire Plan Reviewed 2011-2013 Naval Live Oaks (GUIS) Rx Fire Plan Reviewed 2011-2013 LIRI Omnibus Rx Fire Plan Reviewed 2011 NATR Burn Plan Provided guidance and review of FMP for MACA
Presentations	<5%	Attended scientific conferences concerning regional fire ecology topics Presented at and assisted with SER/MWR Fire Interpretation Workshop Assisted with local high school field trips discussing succession & fire ecology
NPS Meetings/ task groups	5%	Attended park meetings with resource management staff at local and satellite parks Attended regional fire conference calls
Interagency work	<5%	Served on Educational Committee for Mississippi Rx Fire Council
Wildfire assignments	<5%	Served as FFT2
Prescribed fire projects	5%	Served as FFT2 & FEMO (T)
Non-fire projects	0%	
Research	<5%	Reviewed literature for historical and recent ecological studies
Data collection	15%	Assisted with the collection of fire effects data
Data entry	5%	Assisted with entering backlogged data Made corrections to erroneous data in FFI Troubleshooting database issues
Data analysis	20%	Performed statistical tests and analysis of fire effects data Prepared Fire Ecology Annual Report Prepared handouts with summaries of fire effects for field tours & resource management meetings
Supervision/Admin	10%	Supervised fire effects monitors Timesheets, travel, and other administrative paperwork
Training	10%	FFI Workshop/FEM Training Phase I Supervisory Training Detail with NPS fire ecologists EEO & Diversity Training Firefighter Refresher Physical Training
Miscellaneous	13%	READ at MS Canyon 252 Oil Spill Formatted and updated GIS database of FMH plots, burn units, and park resources Collected, identified, and preserved plant specimens for long-term data collection consistency and reference

Fire effects team accomplishments and areas of focus

Table 5 | Fire Effects Team Accomplishments/Focus Areas

Category	Percent Time	Notes
FMH plots	25%	Monitored over one hundred standard FMH plots
WUI plots	< 1%	Monitored WUI fuels at GUIS
CBI plots	<5%	Read CBI plots for three 2010 burn units at MACA
Other plot work	<5%	Read photo and invasive species plots Assisted with NatureServe vegetation mapping survey
Wildfire assignments	<5%	Served in variety of roles including: FFT2 & FEMO
Prescribed fire projects	15%	Served in variety of roles including: FFT2, FFT1, FEMO, ENB(T), EMT(B) Assisted with burn unit prep work Detailed with CUGA Wildland Fire Module
Non-fire fuels projects	<5%	Monitored local live fuel moisture
Data entry	30%	Entered and scanned all backlogged data and slide photos
Data analysis	<1%	Exported fuels data for a university research project
Supervision/Admin	5%	Payroll, travel authorization/voucher, etc.
Training	15%	Fire Refresher Training, S130/190, B3 Aviation Safety, A312 Carolina Vegetation Survey NEPA Section 6 Training EMT Refresher, Medicine/Trauma Conference First Aid/CPR, First Aid/CPR Teacher Training Physical Training
Miscellaneous*	20%	Served as READs at MS Canyon 252 Oil Spill Attended local and Satellite park meetings Instructed segments of READ course Collected, identified, and preserved plant specimens for long-term data collection consistency and reference

*All members of the NATR team received 8-hour time off safety award

Additional Information

Table 6 | Data Entry and Projects Monitored

Park	% 2010 Data Entered	% 2010 Data Quality Checked	# Prescribed Fires Monitored*	# Non-fire Fuels Treatments Monitored*	# Wildfires Monitored*	# BAER Treatments Monitored*
Gulf Islands National Park	100%	100%	1	0	0	0
Horseshoe Bend National Military Park	100%	100%	0	0	0	0
Little River Canyon National Preserve	100%	100%	2	0	0	0
Mammoth Cave National Park	100%	100%	3	0	0	0
Natchez Trace Parkway	100%	100%	2	2	0	0
Stones River National Battlefield	100%	100%	2	0	0	0
Vicksburg National Military Park	100%	100%	4	0	0	0

* Number of treatment units with treatment effects monitoring conducted. Include pre-burn and post-burn monitoring but not burn-day monitoring. (Most fire effects monitoring is conducted on previous year's projects)



Figure 18 | Mammoth Cave National Park resource management specialist Larry Johnson and fire effects monitor Michael Rotter on holding during planned ignition operations at MACA.

Optional Information

FEAT/FIREMON Integrated (FFI)

All summarized data presented in this annual report are entered into, stored in, and maintained by the FEAT/FIREMON Integrated (FFI) software developed by cooperative partners from the National Park Service, U.S. Forest Service, Systems for Environmental Management, and Spatial Dynamics. The primary use of this tool by the fire ecologist at NATR is to query data needed for specific analysis. The reports and analysis tool was rarely used, as Microsoft Excel 2007 and Minitab 14 are the preferred method of analyzing data. Using external software also allows for rough checks of the data and ensures that methods are valid.

Recommended amendments to the FFI software:

- Modify the way FFI exports queried data for cover data to allow species to have “0” values. E.g., when species occur anywhere in the filter/query, they should get a line of data for every plot and sampling event, if the site was visited. Perhaps when FFI exports the surface fuels report, it could use species instead of fuel types. This would create a file with many columns, and I am not sure if excel is still limited, but it could be transposed. This would allow for a much easier analysis of long-term trends in species, richness, and diversity.
- It would save persons entering tree data a lot of time if there were a way to bring all trees not marked “dead/down” from the previous sample event to the current event. This would be simple for those still tracking trees with tags. We can literally have a hundred trees and dozens of species in a single FMH plot in many of our areas.
- Having the ability to select the administrative unit once FFI is already open in another admin unit would make FFI more user friendly. A user having to close down FFI entirely to select another unit is not very efficient when entering data.
- The ability to save query settings would be exceedingly helpful. While setting up a query I often check the data below. When I notice something peculiar, I go back to the data entry area to check the data. I have to start the process all over again each time. This can make a simple analysis very time consuming. Many of my analyses are the same for multiple project units.

2010 MACA Remote Sensed Burn Severity Classification

In 2010, remote sensed satellite data was taken prior to and immediately following the planned ignition activity at Mammoth Cave National Park. Utilizing differences in vegetative cover, a map was generated to show the various fire severities within each prescribed fire unit (figure 18). During the height of the growing season, fire effects monitors from Natchez Trace Parkway and Great Smoky Mountains National Park sampled plots within each of the various burn severity classifications in order to establish a burn index for the classifications shown in the map (CBI). Results from the CBI plots show that the highest classifications on the map resulted in a mean severity index of 1.72, suggesting only a moderate level of severity was achieved on areas represented as 3* (red) on the severity map. This study suggests that highest severities were achieved on the ridge-tops, primarily within Virginia pine dominated old-fields and oak dominated stands within the Floating Mill prescribed fire unit. Areas of moderate severity were less than three percent of Floating Mill Rx Burn Unit and roughly one percent of the Jappa Church Rx Burn Unit (table 7). CBI plots within old fields in this burn severity classification experienced 50-90% mortality of Virginia pine. The CCC planted these stands approximately eighty years ago, and these individuals are reaching the end of their life cycle. This species experienced great damage from ice storms a couple of years ago, creating latter fuels and increasing heavy fuel loading. MACA resource staff has requested that long-term FMH plots be established by our team in this monitoring type/forest condition. I will be analyzing long-term trends to determine if conditions are being created to establish future desired conditions such as oak-hickory forests, woodlands, and/or savannas.

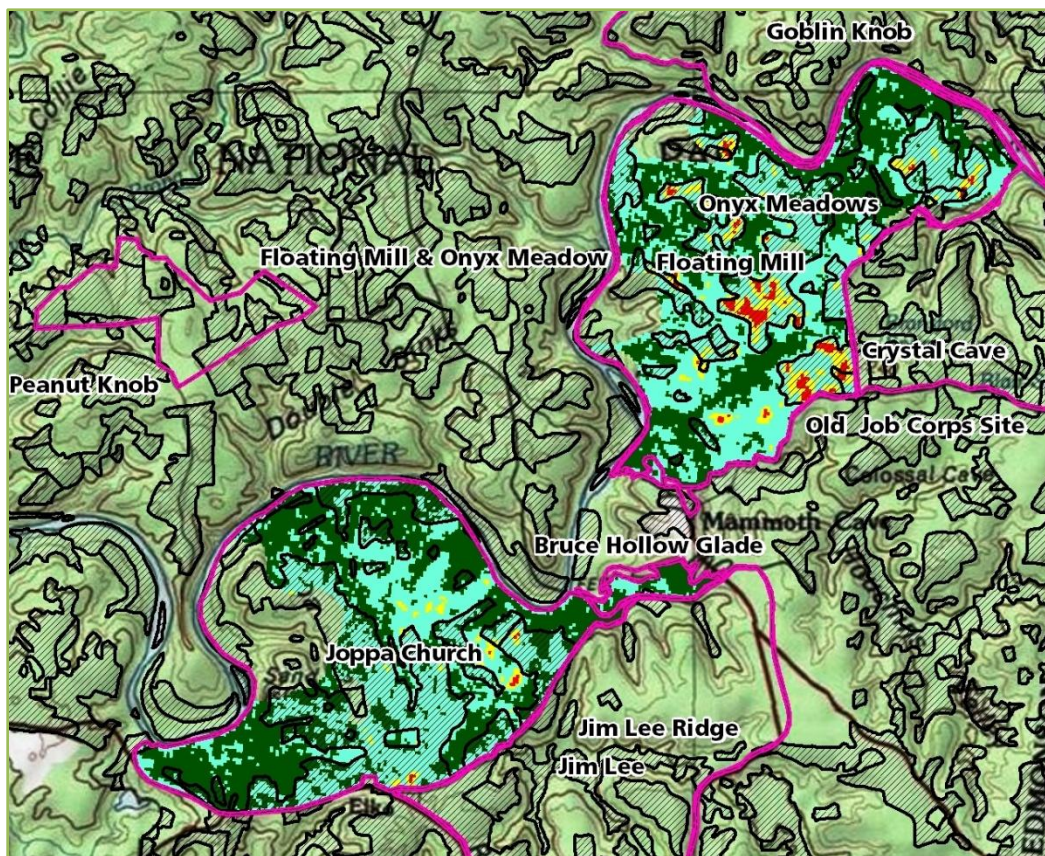


Figure 19 | CBI map of the 2010 planned ignitions at Mammoth Cave National Park.

Table 7 | Percent of burn units in each severity classification

Severity Class	0	1	2	3*
Bruce Hollow	65.24%	34.76%	0.00%	0.00%
Jappa Church	50.97%	46.28%	1.45%	1.29%
Floating Mill	37.32%	54.21%	6.33%	2.15%

Future Goals and Team Projects

In addition to basic assigned duties, our team members have started many new and exciting projects this year, and they will continue to be developed throughout next year. Falkey has expanded her knowledge and expertise in both resource advisement (READ) for interagency incident responses and as an emergency medical technician (EMT). She is also teaching and coordinating Red Cross CPR/first-aid at local NPS parks. Falkey hopes to further develop these important operations with the National Park Service in 2011. Rotter has organized a plant catalog and herbarium for the Barrens to Bayous Fire Effects Parks. This herbarium was started this year, and voucher specimens are now being collected, keyed out, mounted, and preserved in a permanent collection at our office. This collection will be essential in maintaining accurate plant identification and consistency for years to come. Fields is organizing and improving our plot-monitoring schedule to ensure plots are monitored consistently at the same time of year and trips to various sites are made less frequently to reduce travel costs. I will be compiling data collected over the last decade and coordinating with fire and resource management staff to complete a program review of the parks in our network. This research will be used to advance our monitoring protocols, apply the adaptive management process, and better communicate fire ecology with interested parties.

Overall, the various monitoring types at our parks are beginning to meet minimum sample size requirements for the dominant ecosystems being targeted by prescribed fire, especially for woody plant monitoring. Many objectives require multiple burns, and most plots have not yet been burned the required number of times. Once these plots have experienced multiple treatments, objectives will then target components such as herbaceous diversity and species of concern (e.g. exotics, threatened & endangered, and other indicator species). In addition to the scheduled FMH plot work, plot installations in under-monitored eco-types in new burn units, and CBI plot monitoring, our team will likely be installing FMH plots at new parks this summer that have the potential of starting new planned ignition programs in the next couple of years. These parks may include Abraham Lincoln Birthplace National Historical Park, Fort Donelson National Battlefield, Shiloh National Military Park, and Jean Lafitte National Historical Park and Preserve.

The entire fire effects team should be commended for the fantastic work completed in 2010. Even though there will be some budgetary constraints for FY2011, we are looking forward to the 2011 seasons. The fire effects team located at the Natchez Trace Parkway has many forthcoming new and exciting projects, stretching from the Parkway Barrens Burn Unit (MACA) in the Big Barrens Region of Kentucky to the Davis Bayou Burn Unit (GUIS) in the Gulf Coast Flatwoods.

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Figure 20 | 2010 Fire Effects Monitors from left to right; Carol Fields, Jennifer Falkey, & Michael Rotter at Gulf Islands National Seashore.