



**National Park Service
Northeast Region
Fire Ecology Annual Report
2012**



2012 Neighbor Mountain fire.

2012 Season

The fire effects monitoring crew had an interesting and eventful year. The new crew leader, Steve Paull, joined the team in mid-June, just before the Neighbor Mountain Fire took off and kept the entire fire office busy well into July. The crew was integral in the planning, suppression and rehabilitation efforts of the fire with crew members serving in roles including READ, WFDSS, FEMO, FFT2, FFT1(t), Plans/Logistics and preparing the BAER/BAR report.

Despite the fire and Steve's late arrival, the crew was able to achieve all of its high priority monitoring goals for the season. New forest FMH plots were installed in Shenandoah Pine-Oak and Xeric-Oak monitoring types at Blackrock, Rip Rap, and Jarman Gap burn units. New forest FMH plots were installed at two additional Park units, New River Gorge National Recreation Area and Catoclin Mountain Park in the National Capitol Region. Both of these parks are new additions to the fire effects monitoring program. No grassland FMH plots were read this year as the program focuses efforts on strongly advocating and completing monitoring in forested units.

The crew traveled to Great Smoky Mountains National Park in August for a week of CBI training. It was a great opportunity for new crew leader Steve to learn about CBI methods and protocols, and to share observations and ideas regarding the monitoring programs. The crew returned to Shenandoah and installed CBI plots in the area burned by the Smith Run Fire in early 2011. Additionally, a trip was made to

Rockytop in Shenandoah to observe Table Mountain pine regeneration in CBI plots that experienced a high severity wildfire in 2002.



2002 CBI Rockytop, Initial Assess.

2012 CBI Rockytop, 10yrs post fire.

Other accomplishments include further progress on ArcGIS maps and data management, participation in a summer prescribed burn at Fredericksburg & Spotsylvania National Military Park, participation in a search-and-rescue mission, and aviation safety (B-3) training. Steve traveled to Cape Hatteras National Seashore as part of a small Regional in October to join the Southeast fire ecology team for plot installations on Bodie Island in preparation for planned 2013 prescribed burns.

2013 Direction

We will continue to focus on forest units and only collect grassland data every three to five years. As new projects come on board we will evaluate the level of monitoring required, budget outlook and ability to maintain that monitoring investment. Moreover, we will continue to diversify and broaden our skill sets pursuing operational and prescribed fire qualifications along with leading and participating in planning efforts in areas such as spatial FMPs, project prioritization, WFDSS, burn plans and compliance.



Summer prescribed burn FRSP.

Table 1. Fire Effects Plot Workload (2012) and Total Plots Installed

Park		Monitoring Type	Type of Plot (FMH, photo point, other)	Pre-burn 2012	Imm. Post 2012	Post-burn 2012	Annual Total (2012)	Total Plots
Appomattox Courthouse NBP	Active Plots	Mixed Grassland	FMH Brush Plot	0	0	0	0	8
		White Oak	FMH Forest Plot	0	0	0	0	3
Catoctin Mountain Park		Pine-Oak	FMH Forest Plot	1	0	0	2	2
Delaware Water Gap NRA		Mixed Grassland	FMH Brush Plot	0	0	0	0	10
Fredericksburg and Spotsylvania NMP		Mixed Grassland	FMH Brush Plot	0	0	0	0	14
		Xeric Oak	FMH Forest 2013	--	--	--	--	--
New River Gorge NRA		Xeric Oak	FMH Forest Plot					
		Mesic Oak		4	0	0	4	4
Richmond NBP			photo points	0	0	0	0	4
		Loblolly Pine	FMH Forest Plot	0	0	0	0	2
		Mixed Grassland	FMH Brush Plot	0	0	0	0	13
Saratoga NHP		Mixed Grassland	FMH Brush plots	0	0	0	0	24
Shenandoah NP		Pine-Oak	FMH Forest Plot	3	0	3	6	13
		Xeric Oak	FMH Forest Plot	2	0	0	2	9
		Mesic Oak	FMH Forest Plot	0	0	0	0	3
		Smith Run	CBI	-	-	15	15	15
		Big Meadows	I&M brush transects	-	-	24	24	79
SHEN MTTs Total (without CACO)				10	0	42	53	189

Table 2. Fire Ecology Staffing 2012

	Starting Date	Ending Date	# of Pay Periods	READ Qualified (Yes or No)	Training and Development
Missy Forder Ecologist	12/31/2012	1/1/2012	26	Yes	Progress on CRWB(t) and FIRB(t), WFDSS, S-260 (Incident Business Management) , S-261 (Applied Interagency Incident Business Management) S-491 (Intermediate Fire Danger Rating), First Responder credits, UTV refresher, fire refresher.
Steve Paull Lead Monitor	6/17/2012	12/16/2012	13	No	S-130/190 (Introductory Wildland Firefighter training and Introduction To Wildland Fire Behavior), B3 (Combination helicopter and airplane safety), botany review.
Monica Phillips Crew Member	5/20/2012	9/29/2012	9.5	Yes	Detail Augusta Interagency Hotshot Crew, L-280 (Followship to Leadership), B3 (Combination helicopter and airplane safety), HECM(t) assignment FL, progress on FEMO, Opened FFT1 taskbook, fire refresher, botany review.
Heather Dammayer Crew Member	2/27/2012 came back to assist with lead monitor lapse 5/20/12	5/20/2012 //////////////// 9/29/12	6 9.5	Yes	Completed FEMO taskbook, B3 (Combination helicopter and airplane safety), GPS/GIS Training, botany review, fire refresher.
Lane Gibbons Crew Member	5/20/2012	8/16/2012	6.5	No	L-280 (Followship to Leadership) ,S-131 (Advanced Firefighter Training), B3 Combination helicopter and airplane safety, botany review, defensive driving, Search and Rescue, fire refresher.

Table 3. Management Objectives and Monitoring Results

Park	Monitoring Unit	Management Objective (80% C.I.) α .2	Monitoring Results	Objectives Achieved?	YR Last Analysis?
Richmond National Battlefield Park	Malvern Hill	Maintain percent cover of woody species <25%	Cool Season Grass Fields	Yes	2010 (2005 - 2010)
			Shrub Cover = 4% ($\pm$.2)		
			Tree Cover = 16% ($\pm$ 11)		
		Percent cover of non-natives grasses and forbs < 25%.	Warm Season Grass Fields	Yes	2010 (2005 - 2010)
			Shrub Cover = 0		
			Tree Cover = 2 ($\pm$.1)		
	Cold Harbor	Percent cover of "meadow specialists" native grasses and forbs >75%.	Cool Season Grass Fields	No	2010 (2005 - 2010)
			Non-Native Grass Cover = 47 ($\pm$ 12)		
			Non-Native Forb Cover = 12($\pm$ 5)		
			Warm Season Grass Fields	Yes	2010 (2005 - 2010)
			Non-Native Grass Cover = .3 ($\pm$.3)		
			Non-Native Forb Cover = *10($\pm$ 10) *Plot 10 LESCUN		
	Cold Harbor		Cool Season Grass Fields	Yes	2010 (2005 - 2010)
			Native Grass Cover = 71($\pm$ 12)		
			Native Forb Cover = 43($\pm$ 10)		
			Warm Season Grass Fields	Yes	2010 (2005 - 2010)
			Native Grass Cover = 150($\pm$ 4)		
			Native Forb Cover =13($\pm$ 3)		
	Cold Harbor	>50% Reduction in pole size (2.5-15cm) tree density after four burns.	Pre: 46 pole trees 03YR02: 22 pole trees	Yes	2010 (2003 - 2010)
		Maintain an open forested stand as it appeared at the time of the battle as measured within one year post burn.	Photopoints on going.	Yes	2010 (2003 - 2010)
		Increase native grasses by >75% after four burns.	Pre: 1.2% 03YR02: 7%	Yes	2010 (2003 - 2010)

Appomattox Court House National Historical Park	Ferguson Field Mixed Grassland	Maintain percent cover of woody species <25%	Woody species = 9 (± 3)	Yes	2010 (2008 - 2010)
		Percent cover of non-natives grasses and forbs < 25%.	Non-native grass = 38 (± 7) Non-native forbs = 10(± 4)	Yes	2010 (2008 - 2010)
		Percent cover of native grasses and forbs >75%.	Native grasses = 83 (± 7) Native forbs = 13 (± 4)	Yes	2010 (2008 - 2010)
	NC Woodlot	Short Term: Reduce Fuels: <1/4 inch diameter size class (litter) by 65 - 75%, 1/4 to 1 inch diameter size class by 25% to 50%, 1 in to 3 in diameter size class by 10%-25%	Pre-burn plots only.	N/A	N/A
		Short Term: Reduce Density of pole-sized trees by at least 25% as measured within 1 year post burn.	Pre-burn plots only.	N/A	N/A
		Short Term: Limit overstory mortality to <25% as measured 1 year post burn	Pre-burn plots only.	N/A	N/A
Fredericksburg and Spotsylvania National Historical Park	Spotsylvania Mixed Grassland	Maintain woody species < 25%.	Low Shrub Cover Fields Shrubs=34 (± 3) Trees=27 (± 1) High Shrub Cover Fields Shrubs=50(± 6) Trees=9 (± 1)	No	2011 (2008 - 2011)
		Percent Cover on non-native grasses and forbs <25%.	Low Shrub Cover Fields Non-native grass = .8 (± 2) Non-native forbs = .6(± 2) High Shrub Cover Fields Non-native grass = 25(± 4) Non-native forbs = .8(± 19)	Yes	2011 (2008 - 2011)
		Percent cover of native grasses and forbs >75%.	Low Shrub Cover Fields Native grass = 122 (± 4) Native forbs = 57 (± 4) High Shrub Cover Fields Native grass = 108(± 6) Native grass = 69(± 5)	Yes	2011 (2008 - 2011)

Delaware Water Gap National Recreation Area	Darrones and Silver Spray Units	Percent cover of native grasses and herbs >75%.	PRE Native Grass = 11% (±2)	No	2011 (2009 - 2011)
			01YR01 Native Grass = 15% (±4)		
			01YR02 Native Grass = 22% (±1)		
			PRE Native Herb = 113% (±13)	Yes	
			01YR01 Native Herb = 95% (±12)		
			01YR02 Native Herb = 144% (±3)		
		Percent cover of woody species < 25%.	PRE Native Shrub = 17% (±2)	No	2011 (2009 - 2011)
			01YR01 Native Shrub = 15% (±3)		
			01YR02 Native Shrub= 10% (±1)		
			PRE Non Native Shrub = 0		
			01YR01 Non Native Shrub = 13% (±5)		
			01YR02 Non Native Shrub = 17% (±2)		
		Percent cover of non-natives grasses and forbs < 25%.	PRE Non-native Herbs = 43% (±8)	No	2011 (2009 - 2011)
			01YR01 Non-native Herbs = 42% (±8)		
			01YR02 Non-native Herbs = 25% (±2)		
			PRE Non-native Grass = 127% (±12)		
			01YR01Non-native Grass = 94% (±12)		
			01YR02 Non-native Grass = 101% (±4)		

Cape Cod National Seashore	Fire Cache <i>Corema conradii</i>	Fire Cache <i>Corema conradii</i> transplanting	Measure long term cover and health of 40 <i>Corema</i> plants prior to transplanting	ocular estimate only, 50% mortality	2010
	Lombard Paradise Hollow	Lombard Paradise Hollow	Research, vegetation	in prep year 24 (Patterson et. al.)	2012
	Heathland Monitoring / Marconi Site Heathland restoration	Remove overstory and maintain heath dominated landscape	Research, burning	on-going	2012
	Broom Crowberry burn	Heathland Monitoring / Marconi Site Heathland restoration	Establish pre-treatment baseline data for 35 area heathland restoration in the Marconi area, seed-scarify-burn plots, document results	on-going, Univ FLA (Von Holle, principle invest.)	2012
	Heathland /Hunting summers plots	Broom Crowberry burn	Determine if spring, summer or fall burning favors <i>Corema conradii</i> , three each 03 acres plots were burned (2.7 acres)	in prep year 3 (Patterson et. al.)	2012
	Pilgrim Springs	Reduce fine fuels by 50%	Following treatments will be needed in 3-7 years (Rx fire)	yes	2012

Shenandoah National Park	Big Meadows	Maintain the cultural open landscape.	Analysis in progress. Completed by SHEN Botany.	Yes	NCR 2008 (1998 - 2008)
	Joint monitoring effort with SHEN Botany and Fire Effects.	Examine changes in vegetation over time in response to management.	Analysis in progress. Completed by SHEN Botany.	Yes	NCR 2008 (1998 - 2008)
		Monitor Northern Blue ridge Mafic fen plant community which contains a significant amount of the parks rare plant species.	Analysis in progress. Completed by SHEN Botany.	Yes	NCR 2008 (1998 - 2008)
	Pine-Oak	> 50% reduction in fuel loading.	Pre-burn plots only.	N/A	N/A
		>70% reduction of mesic pole size trees (2.5 - 15 cm dbh) (i.e. red maple (<i>Acer rubrum</i>), blackgum (<i>Nyssa sylvatica</i>), sassafras (<i>Sassafras albidum</i>) and hickory (<i>Carya</i> spp.).	Pre-burn plots only.	N/A	N/A
		25 – 50% reduction in overstory tree density.	Pre-burn plots only.	N/A	N/A
		>200 tall (>60 cm in height) yellow pine seedlings (<i>Pinus pungens</i> , <i>Pinus rigida</i> , <i>Pinus virginiana</i>) per	Pre-burn plots only.	N/A	N/A
		>40% cover of native herbs.	Pre-burn plots only.	N/A	N/A
		No net increase in invasive exotic species cover.	Pre-burn plots only.	N/A	N/A
		> 50% reduction in fuel loading.	Pre-burn plots only.	N/A	N/A
		>70% reduction of mesic pole size trees (2.5 - 15 cm dbh) (i.e. red maple (<i>Acer rubrum</i>), blackgum (<i>Nyssa sylvatica</i>), sassafras (<i>Sassafras albidum</i>) and hickory (<i>Carya</i> spp.).	Pre-burn plots only.	N/A	N/A
	Xeric Oak	15 – 30% reduction in overstory tree density.	Pre-burn plots only.	N/A	N/A
		>200 tall (>60 cm in height) Oak seedlings per acre.	Pre-burn plots only.	N/A	N/A
		>30% cover of native herbs.	Pre-burn plots only.	N/A	N/A
		No net increase in invasive exotic species cover.	Pre-burn plots only.	N/A	N/A
			Pre-burn plots only.		N/A

Saratoga National Historical Park	Mixed Grassland Hillside n=5 (Plots 2,3,15,17,20) Plots burned 3-5 times. The area has been burned ~ 11 times.	Percent cover of native grasses and herbs >75%.	2006 Native Grass = 84% (± 11)		2011 (2006 - 2011)
			2010 Native Grass = 100% (± 11)	YES	
			2011 Native Grass = 110% (± 4)		
			2006 Native Herb = 132% (± 19)		
			2010 Native Herb = 139% (± 15)	YES	
			2011 Native Herb = 169% (± 7)		
		Percent cover of woody species < 35%.	2006 Native Shrub = 31% (± 8)		2011 (2006 - 2011)
			2010 Native Shrub = 28% (± 4)	No	
			2011 Native Shrub = 30% (± 3)		
			2006 Non Native Shrub = 10% (± 5)		
			2010 Non Native Shrub = 7% (± 4)	No	
			2011 Non Native Shrub = 10% (± 4)		
		Percent cover of non-natives grasses and forbs < 50%.	2006 Non-native Herbs = 41% (± 8)	YES	2011 (2006 - 2011)
			2010 Non-native Herbs = 46% (± 15)		
			2011 Non-native Herbs = 40% (± 6)		
			2006 Non-native Grass = .4% ($\pm .2$)		
			2010 Non-native Grass = 9% (± 4)	YES	
			2011 Non-native Grass = 22% (± 3)		
	Grassland Neilson Farm 2008 n=3 (Plots 5,6,7) 2010 / 2011 n=6 (Plots 5,6,7,14,18,24) Plots burned 1 -3 times. The area has been burned 3-7 times.	Percent cover of native grasses and herbs >75%.	2008 Native Grass = 95% (± 16)		2011 (2008 - 2011)
			2010 Native Grass = 117% (± 12)	YES	
			2011 Native Grass = 132% (± 5)		
			2008 Native Herb = 24% (± 14)		
			2010 Native Herb = 23% (± 6)	NO	
			2011 Native Herb = 23% (± 3)		
		Percent cover of woody species < 35%.	2008 Native Shrub = 18% (± 5)		2011 (2008 - 2011)
			2010 Native Shrub = 21% (± 4)	YES	
			2011 Native Shrub = 27% (± 3)		
			2008 Non Native Shrub = 2% ($\pm .3$)		
			2010 Non Native Shrub = .5% ($\pm .2$)	YES	
			2011 Non Native Shrub = .3% ($\pm .08$)		
		Percent cover of non-natives grasses and forbs < 50%.	2008 Non-native Herbs = 150% (± 21)		2011 (2008 - 2011)
			2010 Non-native Herbs = 127% (± 22)	NO	
			2011 Non-native Herbs = 119% (± 10)		
			2008 Non-native Grass = 5% (± 3)		
			2010 Non-native Grass = 16% (± 5)	YES	
			2011 Non-native Grass = 15% (± 2)		

Saratoga National Historical Park	Mixed Grassland Chatfield Farm 2003 n=2 (Plots 11,12)	Percent cover of native grasses and herbs >75%.	2003 Native Grass = 116% (±26)	YES	2011 (2003 - 2011)	
			2010 Native Grass = 101% (±13)			
			2011 Native Grass = 91% (±2)			
			2003 Native Herb = 28% (±2)	NO		
			2010 Native Herb = 19% (±7)			
			2011 Native Herb = 18% (±3)			
	2010 n=3 (Plots 11,12,23) Plots have been burned 1-2 times.	Percent cover of woody species < 35%.	2003 Native Shrub = 42% (±15)	NO	2011 (2003 - 2011)	
			2010 Native Shrub = 33% (±2)			
			2011 Native Shrub = 37% (±3)			
			2003 Non Native Shrub = 2% (±.3)	YES		
		2010 Non Native Shrub = .3% (±.3)				
		2011 Non Native Shrub = 0% (±0)				
		Summer burn 2003 and 2009.	Percent cover of non-natives grasses and forbs < 50%.	2003 Non-native Herbs = 74% (±27)	NO	2011 (2003 - 2011)
				2010 Non-native Herbs = 74% (±13)		
	2011 Non-native Herbs = 92% (±16)					
	2003 Non-native Grass = 7% (±5)			YES		
	2010 Non-native Grass = 2% (±.3)					
	2011 Non-native Grass = 1% (±.1)					

Catoctin Mountain Park	Pine-Oak	> 50% reduction in fuel loading.	Pre-burn plots only.	N/A	N/A
		>70% reduction of mesic pole size trees (2.5 - 15 cm dbh) (i.e. red maple (<i>Acer rubrum</i>), blackgum (<i>Nyssa sylvatica</i>), sassafras (<i>Sassafras albidum</i>) and hickory (<i>Carya</i> spp.).	Pre-burn plots only.	N/A	N/A
		25 – 50% reduction in overstory tree density.	Pre-burn plots only.	N/A	N/A
		>200 tall (>60 cm in height) yellow pine seedlings (<i>Pinus pungens</i> , <i>Pinus rigida</i> , <i>Pinus virginiana</i>) per acre.	Pre-burn plots only.	N/A	N/A
		>40% cover of native herbs.	Pre-burn plots only.	N/A	N/A
		No net increase in invasive exotic species cover.	Pre-burn plots only.	N/A	N/A
		> 50% reduction in fuel loading.	Pre-burn plots only.	N/A	N/A
New River Gorge NRA	Xeric Oak	>70% reduction of mesic pole size trees (2.5 - 15 cm dbh) (i.e. red maple (<i>Acer rubrum</i>), blackgum (<i>Nyssa sylvatica</i>), sassafras (<i>Sassafras albidum</i>) and hickory (<i>Carya</i> spp.).	Pre-burn plots only.	N/A	N/A
		15 – 30% reduction in overstory tree density.	Pre-burn plots only.	N/A	N/A
		>200 tall (>60 cm in height) Oak seedlings per acre.	Pre-burn plots only.	N/A	N/A
		>30% cover of native herbs.	Pre-burn plots only.	N/A	N/A
		No net increase in invasive exotic species cover.	Pre-burn plots only.	N/A	N/A

Table 4. Fire Ecologist Accomplishments and Area of Focus		
Category	Percent Time	Accomplishments and/or areas of activities
Planning	30%	WFDSS
		Spatial FMP development.
		NFPORS
		Compliance (PEPC, Section 7, 106) Assisted with burn plan review of objectives.
Presentations	5%	Presentation at MTTS FMO and Resource Managers meeting.
		Develop a fire podcast about prescribed fire in SHEN.
		Presentations to CATO and NERI managers.
		Annual report.
NPS meetings	3%	Natural Resource Condition Assessment meetings.
		Attend SHEN Natural Resources monthly meetings.
Interagency	1%	Appalachian Fire Learning Network meetings.
Wildfire	12%	CRWB(t)
		FIRB(t)
		READ
		WFDSS
Prescribed Fire	1%	FIRB(t) on two Rx Fires.
Non-fire fuels	1%	READ activities on SHEN Neighbor Mountain Fire.
Research	2%	Literature research for natural resource managers.
Data collection	1%	SHEN data collection.
Data entry	<1%	Assisted with very little data entry.
Data Analysis	2%	Completed data summaries and analysis for supported parks.
Supervision & Administration	10%	Hire seasonal crew.
		Developed performance standards for permanent and seasonal employees.
		Lead, Assistant and seasonal performance evaluations.
Training	5%	S-491 Intermediate Fire Danger Rating.
		S-260 (Incident Business Management) , S-261 (Applied Interagency Incident Business Management)
		Fire Refresher.
Travel out of park for plot or project work	2%	Site visits to develop prescribed fire objectives to GETT, CATO and NERI.
Miscellaneous	25%	SHEN BAER/BAR plan preparation, FMO delegated projects, Leave share.

Table 5. Fire Effects Crew Accomplishments and Areas of Focus

Category	Percent Time	Accomplishments and/or areas of activities
FMH Plots	25%	Forest plots.
WUI Plots	0%	
CBI Plots	25%	CBI plots (Smith Run and GRSM Calderwood).
Other plot work	3%	Cape Hatteras joint monitoring SER.
		Collaborate with I&M to read Big Meadows fire transects.
Wildfire Assignments	20%	Suppression and READ support of SHEN Neighbor Mountain fire.
Prescribed Fire projects	1%	FEMO
Non-fire fuels project	0%	
Data entry	17%	100% of plot data has been entered into FFI and QA/QC for 2012.
Data Analysis	0%	
Supervision & Administration	2%	Lead supervised the crew of three and maintained time, travel and administrative paperwork.
Training	5%	S-130/190 (Introductory Wildland Firefighter training and Introduction To Wildland Fire Behavior), B3 (Combination helicopter and airplane safety), Detail Augusta Interagency Hotshot Crew, L-280 (Followship to Leadership), B3 (Combination helicopter and airplane safety), HECM(t) assignment, S-131 (Advanced Firefighter Training), botany review, defensive driving, Search and Rescue, fire refresher.
Miscellaneous	2%	SAR, 1-3 hours of physical training a week.

Table 6. Planning 2012

Park	Does Park have written DFCs? (yes or no)	Date Park-level Monitoring Plan completed (or revised)	Total # of Project or Community-level Monitoring Plans (not just 2011)	Assisted with how many BAER in 2012?
Cape Cod NS	No	none	5	0
Catoctin National Park	Yes	none	1	0
New River Gorge NRA	Yes	in progress	1	0
Shenandoah NP	Yes	Yes	1	1

Table 7. Monitoring 2012

Park	% 2012 Data Entered	% 2012 Data Quality Checked	# Prescribed Fires Monitored*	# Non-fire Fuels Treatments Monitored*	# Wildfires Monitored*	# BAER Treatments Monitored*
Cape Cod NS (completed by CACO staff)	**100%	**100%	9	60	0	0
New River Gorge NRA	100%	100%	2	0	0	0
Catoctin National Park	100%	100%	0	0	0	0
Shenandoah NP	100%	100%	5	0	1	1

*Number of treatment units with treatment efforts monitoring conducted. Include pre-burn and post-burn monitoring but not burn-day monitoring

**Data entry and quality checking performed by the park and data is maintained by park staff.

Table 8. Communicating Results - 2012.

Park	# of Project Monitoring Reports completed in 2012	# of Annual meeting(s) with Park staff	# of Formal presentations of results	Do you use Minitab?
Cape Cod NS (completed by CACO staff)	1	1	1	no
New River Gorge NRA (preburn data).	0	4	1	no
Catoctin National Park (preburn data).	0	2	1	no
Shenandoah NP	1	15	2	no

Table 9. Research- 2012.

Park	Are research needs identified in FMP or Monitoring Plan? (yes or no)	# of Proposals Submitted in 2012	# of Proposals Funded in 2012	# of Research Projects Supported in 2012*	Additional comments
Cape Cod NS (completed by CACO staff)	yes	0	0	0	Research done in house as possible.
New River Gorge NRA	yes	0	0	0	
Catoctin National Park	yes	0	0	0	
Shenandoah NP	yes	0	0	0	

Shenandoah National Park 2012 Fire Effects Monitoring Annual Report

I. Program Overview

2012 Summary

In the spring of 2012, the Jarman Gap unit was prepped and resources on site however it was not implemented due to unfavorable ventilation. This burn will be completed in spring of 2013. Three pine-oak monitoring type plots were installed in the Jarman Gap, Riprap and Blackrock burn units. Two plots were installed in the xeric-oak monitoring type at Riprap and Blackrock burn units. Three pine-oak plots were re-read in the Blackrock burn unit. The crew also assisted the SHEN botany crew in monitoring the Big Meadows transects. Fifteen CBI plots were installed in the 2011 Smith Run wildfire.

Future Plans

The fire ecology program is trying to complete more projects at Shenandoah National Park. The first step in the process was collaborating with the Natural and Cultural Resources Division and completing a document prioritizing the use of prescribed fire by forest community type and Desired Future Conditions (DFC's). This document serves as the foundation for the parks prescribed fire program. We currently have 25 forest plots installed in three monitoring types in four burn units.

II. Park Overview

Shenandoah National Park (SHEN) is located along the Blue Ridge Mountains in northwestern Virginia and lies closer to more people than does any other national park in the country (Connors 1988). There are 197,438 acres in the park, including 79,579 acres of designated wilderness. The park is divided into three management districts: north, central, and south. Elevations in the park range from 595 ft (181 m) at Front Royal to 4,049 ft (1,234 m) at the top of Hawksbill Summit. One particular aspect of the park is its 105 mile Skyline Drive, which runs the entire length of the park and was one of the first recreational highways of its types in the United States when it was opened to the public in 1934 (Connors 1988). The park also contains 101 miles of the Appalachian Trail, the nation's longest marked footpath (2,175 miles) and first national scenic trail, designated in 1968.

Approximately 93% of SHEN is dominated by second-growth forest, 2 percent is covered by wetland communities, and approximately 3 percent of the area is occupied by other vegetation communities such as barrens. Roughly 2 percent of the park is developed or disturbed by humans and includes drivable roads, parking lots, powerline right-of-ways, and building facilities (Young et al. 2009).

Vegetation of Shenandoah National Park

The composition of the second-growth forest at SHEN has been influenced by the topography, climate, geology, and natural disturbance regimes of the northern Blue Ridge Mountains, as well as by historic land use and other anthropogenic disturbances. Braun (1950) defines the Northern Blue Ridge as a forest section of the Oak-Chestnut Forest region. However, the loss of American chestnut (*Castanea dentata*) in the early 1900s changed the forest composition of the region. SHEN currently resembles the Oak-Hickory Forest region also described by Braun (1950) and 40% of the cover is comprised by oaks with hickories as secondary components. Due to a history of disturbance, SHEN represents one of the nation's most diverse botanical reserves, contains globally rare plant communities, and is an outstanding example of the Northern Blue Ridge Forest (National Park Service 1998). There are 1406 vascular plant species in Shenandoah National Park.

In 2009 the fire effects crew began establishing monitoring types in Shenandoah National Park in an effort to increase projects at the park. Three monitoring types have been established and include; Pine-Oak, Xeric Oak (Chestnut variant), and Mesic Oak. Two additional monitoring types are conceptualized and described to improve future prescribed fire management and monitoring activities including Xeric Oak (White Oak Variant) and Barrens Communities.

- **Pine Oak Monitoring Type**

Central Appalachian Pine - Oak /Heath Woodland & Central Appalachian Xeric Chestnut Oak - Virginia Pine Woodland (Young et al. 2009).

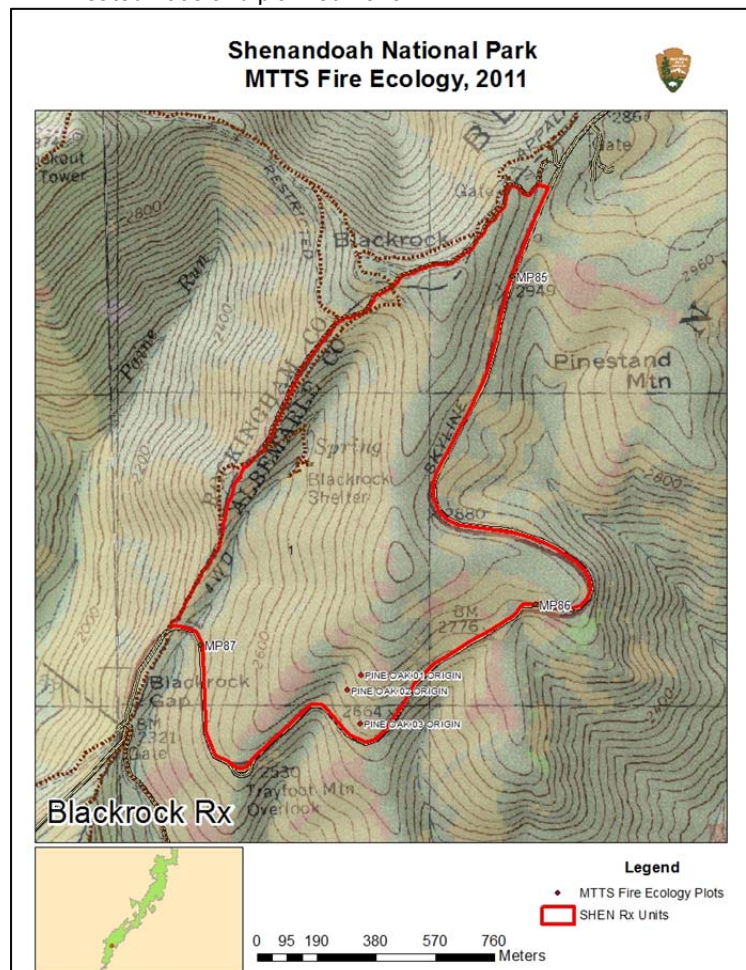
In Shenandoah National Park, Pine-Oak stands typically occupy xeric, upper slopes and ridges on south to northwest aspects and at elevations ranging from 1550-3200 feet. Physiognomy of these stands ranges from closed forest (long-term fire exclusion) to open shrubland (coincident depredation by southern pine beetle and stand-replacing wildfires). Though this community is widely distributed on the Blue Ridge and in the Park, it is most extensive on quartzite ridges in the south district and on the western slopes of the park.

Contemporary Pine-Oak stands vary from closed forest to open woodland that are dominated by *Pinus rigida* or *Pinus pungens*, though most stands observed are dominated by *Pinus rigida*. *Quercus prinus* is consistently a co-dominant in these stands. Most frequent canopy associates include *Quercus coccinea*, *Quercus marilandica*, *Pinus virginiana*, and *Nyssa sylvatica*.

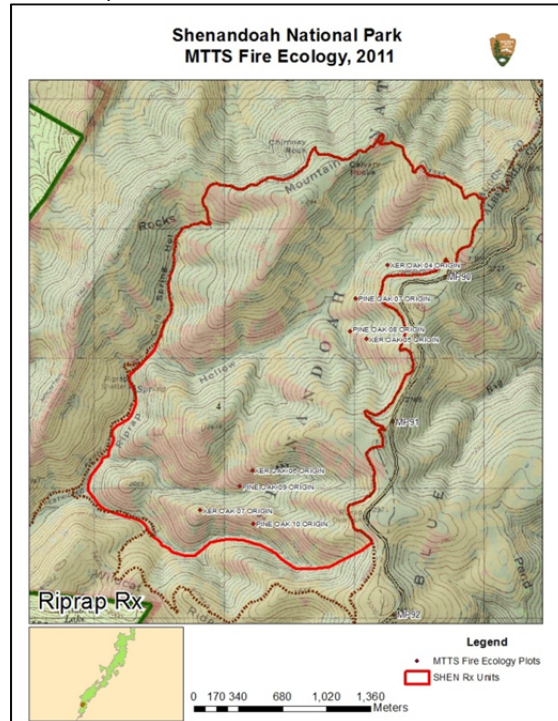
Subcanopy tree strata are frequently dominated by numerous shade-tolerant species including *Nyssa sylvatica*, *Acer rubrum*, and *Sassafras albidum*. Typically, *Quercus ilicifolia* dominates a sporadic to very dense tall-shrub layer, while *Kalmia latifolia*, *Vaccinium pallidum*, *Vaccinium stamineum*, *Gaylussacia baccata*, *Lyonia ligustrina*, *Rhododendron periclymenoides*, and other ericads form a continuous low shrub stratum.

Due to extensive and multi-layered hardwood encroachment, most herb assemblages are very diffuse, while subshrub assemblages occasionally achieve conspicuous abundance. Greatest ground layer abundance is observed in areas characterized by shallow, rocky substrates and/or very open to sparse tree and shrub canopies, as well as along insolated corridors (i.e, trails, roads, gaslines, powerlines, etc.) that maintain favorable growing conditions in the face of extensive shade-displacement.

Blackrock prescribed fire unit. Pine-oak fire effects monitoring plots.
Treated 2008 and planned 2013.



Riprap / Wildcat prescribed fire unit. Pine oak and xeric oak forest plots.



- Xeric Oak Monitoring Type: Chestnut Oak Variant**
 Central Appalachian Dry Chestnut Oak - Northern Red Oak / Heath Forest & Central Appalachian / Northern Piedmont Chestnut Oak Forest
 Xeric oak woodlands exhibit notable structural and compositional variety in the canopy, subcanopy, and herbaceous layers along a north-south gradient. MTTs Fire Ecology recognizes distinct xeric oak communities that are suitable prescribed fire target areas including the following put forth in “Vegetation of Shenandoah National Park in relation to environmental gradients” (Young et al. 2009): Central Appalachian/Northern Piedmont Chestnut Oak Forest, Central Appalachian Dry Chestnut Oak-Northern Red Oak/Heath Forest, Low-Elevation Mixed Oak/Heath Forest, Central Appalachian Acidic Oak-Hickory Forest. For the purposes of MTTs Fire Ecology, two xeric oak monitoring type descriptions are created to improve programmatic sampling design, statistical & analytical groupings, and the placement MTTs Fire Ecology plots within ecological variants that are recognizably distinct within the xeric oak complex. In Shenandoah National Park, Xeric Oak forests and woodlands occupy all geologic substrates, topographic positions and aspects, but is most associated with upper to midslope positions on south to west aspects. It occurs at elevations ranging from the lowest elevations in the park (800 feet) to 3000 feet (occasionally higher) on dry, infertile slopes and ridges, either straight or convex. Contemporary Xeric Oak forests and woodlands range from open to closed stands dominated by *Quercus prinus*. In certain stands, *Quercus alba*, *Quercus coccinea*, *Quercus rubra* and/or *Quercus velutina* achieve co-dominance. Overstory associates may include *Pinus pungens*, *Pinus rigida*, *Pinus virginiana*, *Carya glabra*, and *Fraxinus americana*. Midstory tree strata are frequently dominated by the following shade-tolerant species: *Nyssa sylvatica*, *Acer rubrum*, and *Sassafras albidum*. Typically, *Kalmia latifolia* dominates an abundant tall-shrub layer, while *Vaccinium pallidum*, *Vaccinium stamineum*, *Gaylussacia baccata*, *Lyonia ligustrina*, *Rhododendron catawbiense*, and *Rhododendron periclymenoides* form a continuous low shrub stratum. Ground layer herbaceous and subshrub cover is typically sparse, though rich assemblages are occasionally observed in areas characterized by rocky substrates and/or very open to sparse tree and shrub canopies, as well as along insolated corridors (i.e,

trails, roads, gaslines, powerlines, etc.) that maintain favorable growing conditions in the face of extensive shade-displacement.

III. Goals and Objectives for pine oak and xeric oak monitoring types.

Goal

Reduce fuel loading by > 50% thereby decreasing the threat of a catastrophic wildfire.
Use low to moderate intensity prescribed fire to promote oak and pine recruitment through the reduction of duff depth and elimination of fire intolerant/shade-tolerant tree species.

Burn objectives

- Ensure the public experience no injuries.
- Ensure fire personnel receive no lost time injuries.
- Keep the fire within the defined boundaries of the unit.
- Reduce fuel loading by > 50% thereby decreasing the threat of a catastrophic wildfire.
- Keep ignition out of sensitive riparian areas.
- Use low to moderate intensity prescribed fire to promote oak and pine recruitment through the elimination of fire intolerant tree species.
- Accommodate trainees into the burn organization.
- Contribute to the preparedness of National Park Service and cooperating agency fire personnel.

Monitoring objectives

Pine Oak

1. Greater than 50% reduction in fuel loading.
2. >70% reduction of mesic pole size trees (2.5 - 15 cm dbh) (i.e. red maple, blackgum, sassafras and hickory).
3. 25 – 50% reduction in overstory tree density.
4. 200 tall (>60 cm in height) yellow pine seedlings (*Pinus pungens*, *Pinus rigida*, *Pinus virginiana*) per acre.
5. 40% cover of native herbs.
6. No net increase in invasive exotic species cover.
- 7.

Xeric Oak

1. Greater than 50% reduction in fuel loading.
 2. >70% reduction of mesic pole size trees (2.5 - 15 cm dbh).
 3. 15 – 30% reduction in overstory tree density.
 4. 200 tall (>60 cm in height) Oak seedlings per acre.
 5. 30% cover of native herbs.
- No net increase in invasive exotic species cover.

IV. Discussion

Only preburn data has been collected at the Jarman Gap and Wildcat / Riprap burn units. Jarman Gap is planned for the spring of 2012 and Wildcat /Riprap for spring of 2013. Post burn data has been collected at the Blackrock burn unit, but unfortunately preburn data was not. The Blackrock burn unit is planned to re-treated in the spring of 2013.

Desired conditions for vegetation monitoring types managed with prescribed fire at Shenandoah National Park.

Monitoring Type ^a	Attribute	Indicator	Target Value {Citation} ^b
Pine-Oak CEGL00#-4996	Overstory Trees	Density: Basal Area of Trees (> 15 cm) m ² per ha	11.25-15.5 m ² per ha (all trees overstory and poles) {S BR FLN} Woodland 9-13.5 m ² per ha (all trees overstory and poles) {SW VA FLN}
	Desirable Overstory Species (Yellow Pine / Oak)	Basal Area of Yellow Pine-Oak ($\geq$ 15 cm dbh) / Total Basal Area ($\geq$ 15 cm dbh) * 100	$\geq$ 80% {S BR FLN} > 50% Site Dependent {SW VA FLN}
	Pole-sized Trees	Density: Basal Area of Pole (15 cm $\geq$ Pole > 2.5 cm) m ² per ha	11.25-15.5 m ² per ha (all trees overstory and poles) {S BR FLN} Woodland 9-13.5 m ² per ha (all trees overstory and poles) {SW VA FLN}
	Yellow Pine Seedlings	Percentage of Stems > 14 cm tall	> 50% site dependent {SW VA FLN} 11,000 stems per ha 5 year post burn per NPS FMH Plot {Jenkins et al. 2011}
	Oak Seedlings	Number of Stems per ha	> 400 stems per ha > 1 m tall {S BR FLN}
	Shrub Abundance	Percent Cover	< 30% {S BR FLN} < 10% per stand {Jenkins et al. 2011}
	Herb Abundance	Percent Cover	Woodland > 50% herbs {SW VA FLN}
Xeric Oak CEGL00#-6299, 8521, 8523, 8515 and 6057	Overstory Trees	Density: Basal Area of Trees (> 15 cm) m ² per ha	13.5-20 m ² per ha {S BR FLN} 13.5-18 m ² per ha for Forest & 9-13.5 m ² per ha for Woodland {SW VA FLN}
	Desirable Overstory Species	Basal Area of Yellow Pine-Oak ($\geq$ 15 cm dbh) / Total Basal Area ($\geq$ 15 cm dbh) * 100	$\geq$ 70% {S BR FLN}
	Pole-sized Trees	Density: Basal Area of Pole (15 cm $\geq$ Pole > 2.5 cm) m ² per ha	< 2.25 m ² per ha {S BR FLN}
	Seedlings	Density: number of stems per ha by species	$\geq$ 42 m per FMH seedling sample area. NPS FMH Plot {Steiner et al. 2008} 5, 58-120 and 120-240 stems per NPS FMH Plot {Brose et al. 2008} > 50% of stems that are oak > 14 cm tall {SW VA FLN}
	Shrub Abundance	Percent Cover	< 20 % {S BR FLN}
	Herb Abundance	Percent Cover	Forest > 25% > herbs and Woodland > 75% > herbs {SW VA FLN}

- Mesic Oak Monitoring Type**

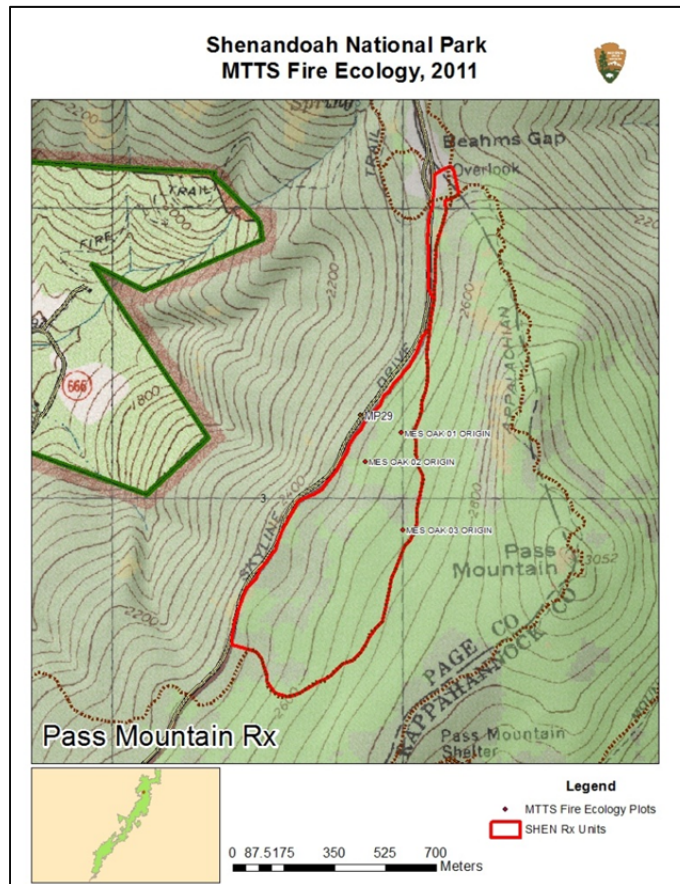
Central Appalachian Montane Oak-Hickory Forest, Basic Type (Young et al. 2009); and, other types to follow.

This monitoring type may be renamed Dry-Mesic Oak or lumped with other oak types in the future.

In Shenandoah National Park, Mesic Oak stands occupy extensive mid- to high elevation areas (2000-3800 feet), on upper slopes and ridgetops of southeast to northwest aspects. Most frequently, this community occurs on sites underlain by metabasalt substrates (Catoctin Formation) on soils that are moderately to strongly acidic. Physiognomy ranges from closed forest (long-term fire exclusion) to open forest.

Contemporary Mesic Oak stands are dominated by *Quercus rubra*. *Quercus alba*, *Fraxinus americana*, *Carya ovalis* are the most frequent canopy associates, though *Carya ovata*, *Carya cordiformis*, and occasionally *Quercus velutina* are conspicuous components of the stratum. In areas characterized by advanced canopy closure, shade-tolerant tree species including *Acer rubrum*, *Betula lenta*, *Liriodendron tulipifera*, *Pinus strobus*, *Prunus serotina* and *Tilia Americana* are compositionally important in over-, mid-, and understory strata. Typically, mid- and understory strata are dominated by advancing mesophytic species including *Acer pensylvanicum*, *Acer rubrum*, *Fraxinus americana*, *Hamamelis virginiana*, *Lindera benzoin*, and *Ostrya virginiana*. In Mesic Oak stands, herbaceous cover is locally rich and continuous, though it is observably sparse in certain dry-mesic settings.

Pass mountain burn unit. Mesic oak plots.



V. Goals and objectives

Objectives are still being defined for the mesic oak monitoring type. This may be close enough to lump with the xeric oak monitoring types.

- **Xeric Oak Monitoring Type: White Oak Variant**

Low-Elevation Mixed Oak / Heath Forest & Central Appalachian Acidic Oak - Hickory Forest (Young et al. 2009)

In Shenandoah National Park, White Oak stands typically occupy low elevation (< 1600 feet), meta-sedimentary substrates on all aspects, though they are most associated with lower to midslope positions on south and west aspects. These stands commonly occur on streamside terraces along the west boundary of the Park and in close proximity to the Shenandoah Valley. Physiognomy of these stands ranges from closed forest (long-term fire exclusion) to very open matrix woodlands with associated barren complexes.

Contemporary White Oak stands are characterized by closed to very open oak woodlands that are consistently co-dominated by *Quercus alba* and *Quercus prinus*. Most frequent canopy associates include *Carya glabra*, *Quercus coccinea*, *Quercus velutina*, *Pinus*

virginiana, and *Pinus rigida*. *Quercus stellata* and *Quercus marilandica* notably increase in importance in open matrix woodland settings and/or in close proximity to barren complexes. Midstory tree strata are frequently dominated by advancing mesophytic species including *Acer rubrum*, *Amelanchier arborea*, *Carya glabra*, *Cercis canadensis*, *Fraxinus americana*, *Juniperus virginiana*, *Ostrya virginiana*, and *Pinus strobus*. Sporadic mid- and low shrub layers are characteristically rich in ericaceous species including *Kalmia latifolia*, *Gaylussacia baccata*, *Vaccinium pallidum*, and *Vaccinium stamineum*. \ In these stands, subcanopy tree and shrub strata are significantly less developed than in the Chestnut Oak variant communities. As a result, herbaceous cover is comparatively rich and more continuously distributed throughout these woodlands. See Table 2 below for commonly encountered woody and herbaceous species in White Oak communities. Please note the list of species is neither complete nor restricted to white oak stands. No plots have been established.

- **Proposed Barrens Monitoring Type**

Central Appalachian Circumneutral Barren and analogs (Young et al. 2009 or ROMP) In Shenandoah National Park, Central Appalachian Circumneutral Barrens (Barrens) typically occupy low elevation exposures (< 1800 feet) on metabasalt substrates on southeast to southwest aspects, though they are most associated with lower to midslope positions on south and southwest aspects. Areas are characterized by moderately fractured, stepwise topography over the Catoctin Formation interspersed with soil beds that have been shown to be rich in calcium and magnesium (VA DCR 2007). Barrens commonly occur in complexes that are surrounded by xeric oak woodlands (Chestnut Oak & White Oak variants). Across barren complexes, physiognomy ranges from open woodlands with sparse, stunted canopies to prairie-like expanses of outcrops, ledges, as well as lichen- and moss-covered bedrock flats. Contemporary Barren Complexes are mixed-grass and forb dominated openings that exhibit mosaic spatial patterns with woodlands of predominantly *Quercus* species including *Quercus alba*, *Quercus coccinea*, *Quercus marilandica*, *Quercus prinus*, *Quercus stellata*, and *Quercus velutina*. *Quercus stellata* and *Quercus marilandica* notably increase in importance in open matrix woodland settings and/or in close proximity to barren complexes. Transition areas (edges) are frequently overgrown by overstory and midstory mixes of shade-tolerant trees including, but not limited to, *Carya glabra*, *Celtis occidentalis*, *Cercis canadensis*, *Fraxinus americanus*, *Juniperus virginiana*, and *Ostrya virginiana*. Discontinuous patches of *Rhus aromatica*, *Rosa carolina*, and *Symphoricarpos orbiculatus* dominate transition areas and, in some cases, open barren terraces. In open Barrens, typical herb assemblages are compositionally unique for the Park in that they support conspicuous swaths of C₄ grasses including *Bouteloua curtipendula*, *Schizachyrium scoparium*, *Sorghastrum nutans*, *Sporobolus clandestinus*, and *Sporobolus vaginiflorus*. *Danthonia spicata* and *Carex pensylvanica* are the dominant C₃ graminoids of open Barrens. Due to open growing conditions, herbaceous cover is comparatively rich and more continuously distributed throughout open barrens and matrix woodlands. Please note the list is typical of north district Central Appalachian Circumneutral Barrens, as originally described by VA DCR. No plots have been established.

- **Big Meadows Monitoring Type** – excerpted from a report by Wendy Cass, Botanist, Shenandoah National Park, 2/2/2011.

Big Meadows is a 130 acre meadow dominated by grasses, sedges and short ericaceous shrubs (Figure1). Vegetation monitoring began in 1998 and is being used to describe the success of mowing and burning to maintain the Meadow as an open landscape.

Vegetation monitoring takes place at 79 permanent 50 meter transects. Transect locations (Figure 2, Appendix A) and direction were randomly located using a stratified random design in 1998 / 1999 that was based on four meadow zones (east, central, north, and south) (Figure 2). However, the Meadow is currently managed in three zones (east, central, west) and sampling transects are currently sampled on a three year rotation that corresponds to the three management zones.

Since this monitoring program was established in 1998 it predates the fire ecology program. The fire effects crew and the SHEN botany crew work together to complete the monitoring each year.



Figure 1. Big Meadows, 2008.

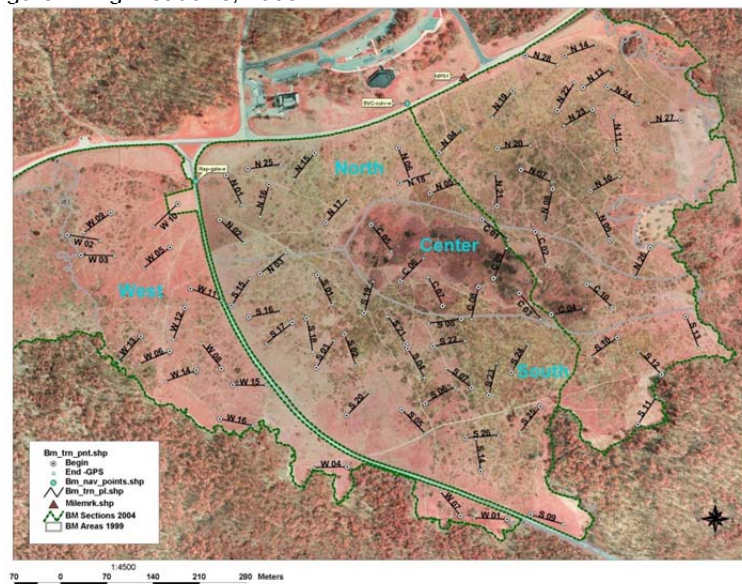
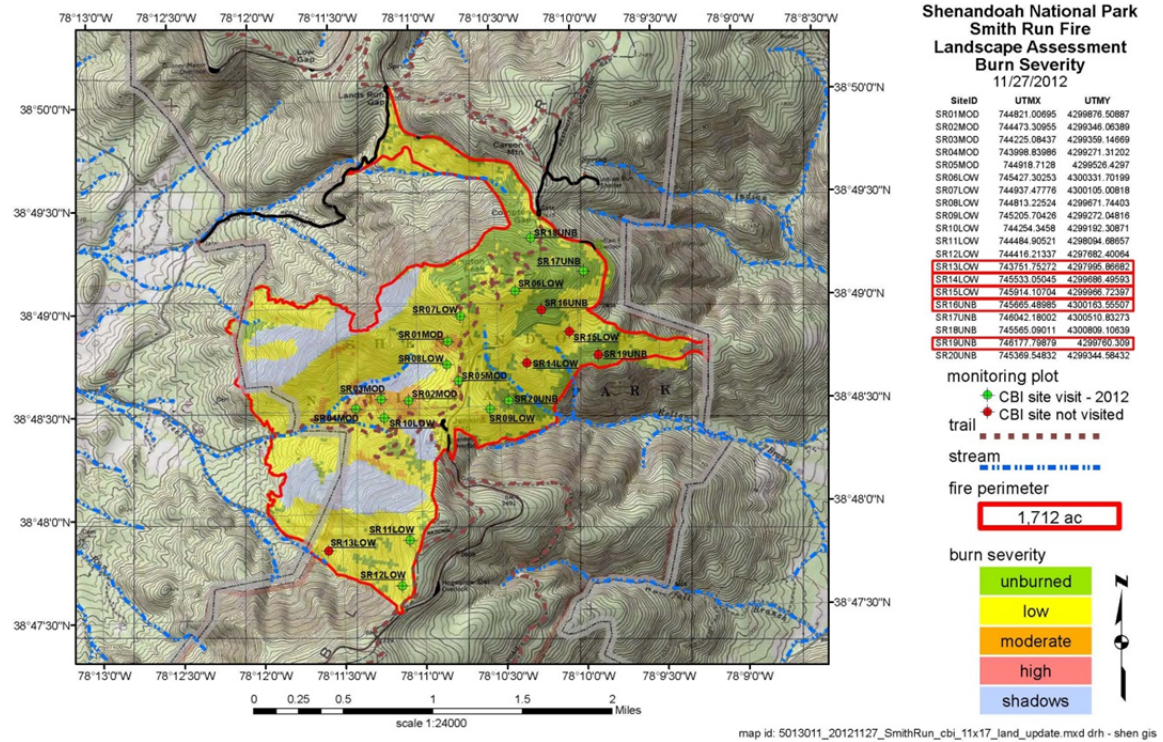


Figure 2. Image showing the location of the 79 Big Meadows sampling transects. Each transect measures 50 meters. The north, center, south, and west labels refer to the original zones used to stratify transects within the meadow. Current sampling and management actions use different zones (see Figure 4).

Smith Run CBI Plots



Fifteen CBI plots were visited in 2012 following the February 2011 Smith Run fire. The fire was a highly wind driven event with mainly low to moderate effects. The 2012 June Neighbor Mountain fire will be monitored in 2013. This fire was driven by low live fuel moistures, high KBDI, high temperatures and low RH and should provide and interesting comparison.



Smith Run fire, February 2011.

Fredericksburg and Spotsylvania National Military Park (FRSP) 2012 Fire Effects Monitoring Annual Report

I. Program Overview

2012 Summary

Three fields were burned this summer in the Spotsylvania Courthouse prescribed burn unit. Monitoring staff served in roles including FEMO, FRIB(t) and FFT2. These three fields will be treated again in late summer 2013 and plots will be re-read in 2014. No data analysis was conducted in 2012.

Future Plans

Two forested units are slated for prescribed fire in the fall of 2013 or spring of 2014. Three forest FMH plots will be installed during the summer of 2013.

The grassland units have moved from the restoration phase to the maintenance stage. With the onset of smaller budgets and increasing workloads the monitoring level and interval will be modified to every *three to five* years. This will continue to provide the necessary data to evaluate whether management goals and objectives are being met and whether undesired effects are occurring. 2008 – 2011 data analysis indicated that dormant season burning was ineffective at reducing cover of woody species. Prescribed fire timing was altered to include summer growing season burns when woody plants are actively growing and peak plant carbohydrate levels are above ground making them more susceptible to stress.

II. Park Overview

Fredericksburg and Spotsylvania National Military Park is located approximately 50 miles south of Washington, D.C. The park is spread out over a 145-square mile area in the city of Fredericksburg, Virginia, at the junction of Interstate 95 and State Route 3, and in Caroline, Orange, Spotsylvania, and Stafford Counties. It is comprised of four separate Civil War battlefields: Fredericksburg, Spotsylvania Court House, Chancellorsville, and Wilderness, and four related sites: Salem Church, Chatham Manor, Jackson Shrine, and the Fredericksburg National Cemetery.

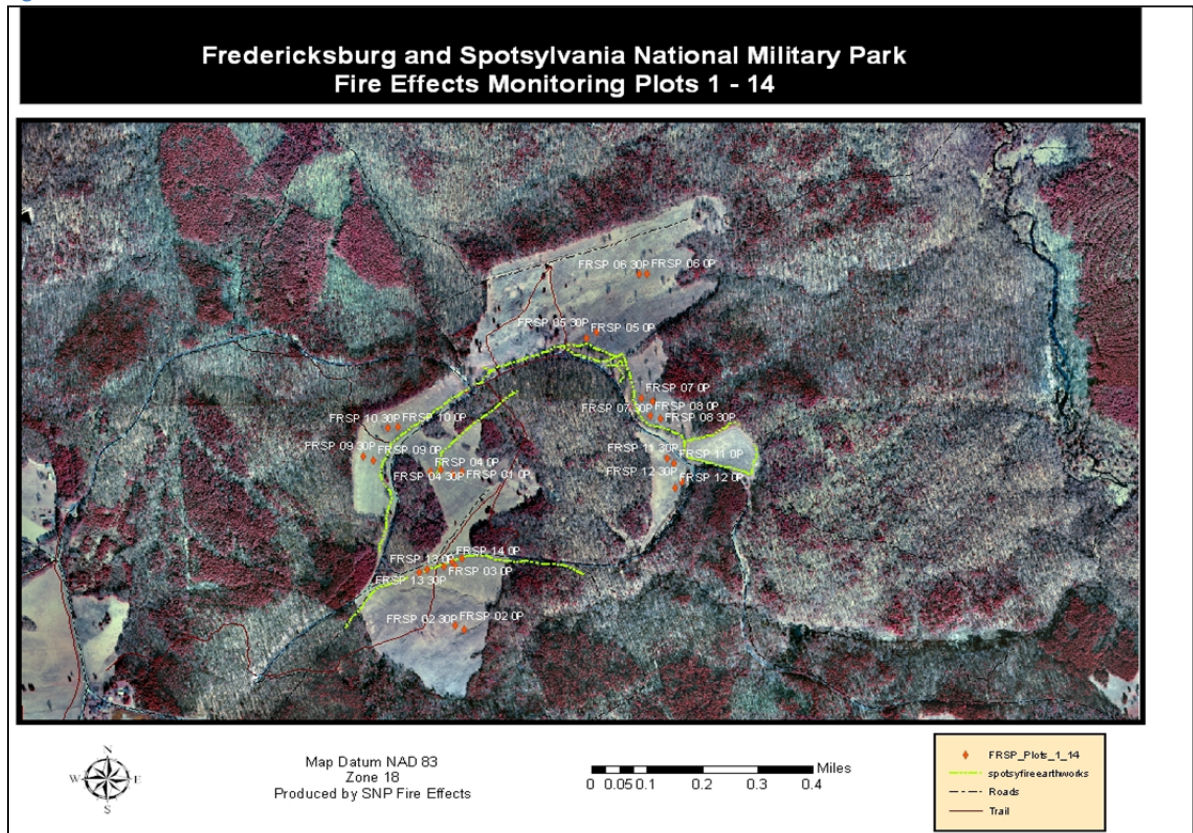
On four separate occasions, the main eastern armies of the United States and the Confederate States fought major battles in and around Fredericksburg, Virginia. The woods and fields of the battles are the primary resources of the park: federal lands encompass 1,200 ac of open fields, 6,000 ac of forest, 540 ac of wetlands, and 102 mi of boundary. In addition, the park has significant terrain features, historic roads and traces, structures, house sites, ruins, cemeteries, monuments, markers, and historic objects. A number of historic structures dating from the mid-19th century add to the park's significance, including more than 43 mi of earthworks built by the soldiers, Salem Church, the house where Stonewall Jackson died, Ellwood, Chatham Manor, and several other structures that were landmarks on the historic fields.

The Spotsy Fields Monitoring unit consists of open fields and earthworks. Open fields in Spotsylvania Court House Battlefield are considered cultural meadows. Cultural Meadow includes all mowed or maintained fields in the park, and are managed to maintain the open fields characteristic of Civil War battlefields. These meadows have a mix of native and exotic grasses and forbs with scattered shrubs. Dense stands of cool season grasses such as meadow fescue (*Schedonorus pratensis*) and orchard grass (*Dactylis glomerata*) typically occur.

Common vegetation encountered in fire monitoring plots include; native grasses and sedges such as, beaked panic grass (*Panicum anceps*), poverty oatgrass (*Danthonia spicata*), rosette grass (*Dichanthelium dichotomum*), broomsedge (*Andropogon virginicus*), little bluestem (*Schizachyrium scoparium*), Indian grass (*Sorghastrum nutans*) and sedges (*Carex spp.*). Shrubs include blackberry (*Rubus spp.*) and winged sumac (*Rhus copallinum*) and herbaceous plants include trailing bush clover (*Lespedeza procumbens*) yarrow (*Achillea millefolium*) and cinquefolia (*Potentilla spp.*) Tree seedlings include blackjack oak (*Quercus marilandica*), sweet-gum (*Liquidambar styraciflua*) and locust (*Robinia pseudoacacia*). Additionally, there are a few exotic species of concern found in the fields. Some of which include, but are not limited to, Japanese Honeysuckle (*Lonicera japonica*), colonial bent grass (*Agrostis capillaris*), sweet vernal grass (*Anthoxanthum odoratum*), cat's ear (*Hypochaeris radicata*) and red sorrel (*Rumex acetosella*).

The Northeast Region Fire Effects Monitoring Crew began monitoring fire effects at the park in 2004. Currently there are 14 FMH brush transect monitoring plots in a complex of seven fields for a total of 125 acres in size. Upton Field 11.8 ac, McCoull House Field 19.3 ac, Harrison House Field 29.7 ac, Crescent Field 5.3 ac, Native Grass Field 4.8 ac, Middle Field 7.2 ac, Landram House Field 46.4 ac.

Figure 1



III. Goals and Objectives

Goal

Open fields would preserve the historic scene as it appeared at the time of the battle while providing critical habitat for birds and small mammals. Native warm season grasses would dominate the vegetation cover while non-native cool season grass cover would be minimal.

Burn Objectives

- Provide for personnel safety.
- 90% - 100% of overall area to be burned as measured immediately post burn
- Limit mineral soil exposure to no more than 5% until greenup as measured immediately post burn.

Monitoring Objectives

- Maintain woody species < 25% as measured after four treatments.
- Percent cover on non-native grasses and forbs <25% as measured after four treatments.
- Percent cover of native grasses <75% as measured after four treatments.

Figure 2

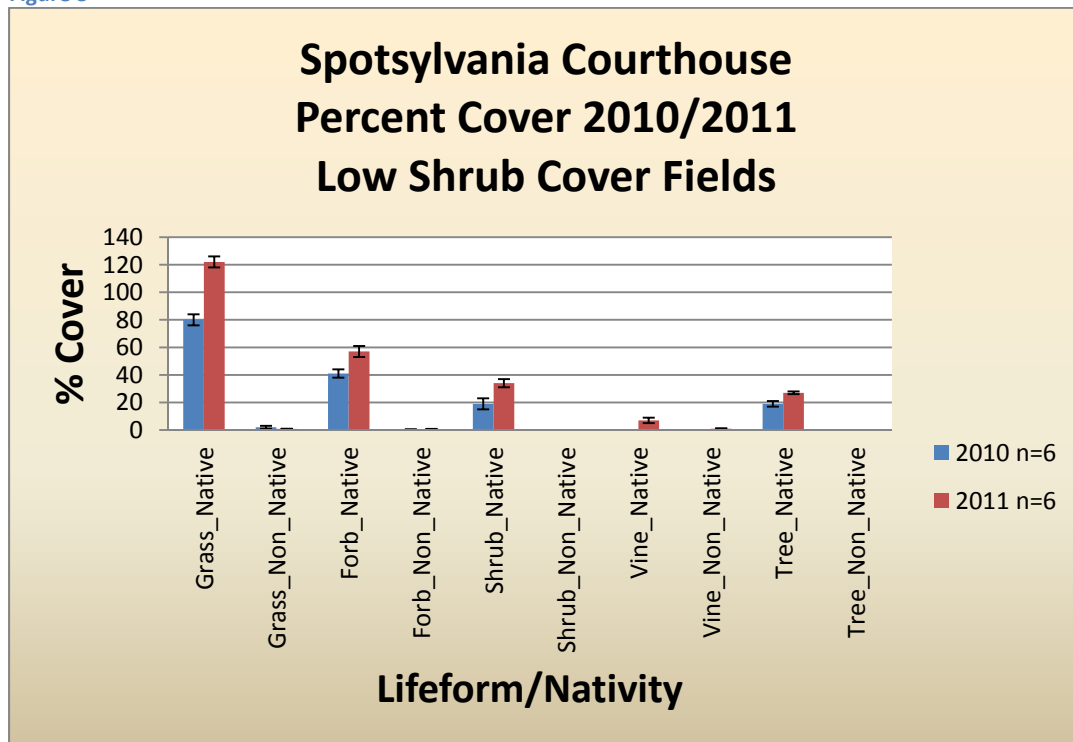
Spotsylvania Courthouse Burn History							11/29/11
Field	Upton Field	McCull House	Harrison House	Crescent Field	Native Grass Field	Middle Field	Landrum House Field
Spring 2004	X		X	X	X	X	X
Summer 2004		X					
Spring 2005	X	X	X	X	X	X	X
Spring 2006	X	X			X		
Spring 2007			X		X	X	X
Spring 2008	X	X	X			X	X
Spring 2009	X	X	X	X	X	X	X
Spring 2010	X	X	X	X		X	X
Spring 2011	X		X				

Table of objectives, Spotsylvania Courthouse Unit.

Fredericksburg and Spotsylvania National Historical Park	Spotsylvania Mixed Grassland	Maintain woody species < 25%.	Low Shrub Cover Fields Shrubs=34 (±3) Trees=27 (±1) High Shrub Cover Fields Shrubs=50(±6) Trees=9 (±1)	No	2011
		Percent Cover on non-native grasses and forbs <25%.	Low Shrub Cover Fields Non-native grass = .8 (±.2) Non-native forbs = .6(±.2) High Shrub Cover Fields Non-native grass = 25(±4) Non-native forbs = .8(±.19)	Yes	2011
		Percent cover of native grasses and forbs >75%.	Low Shrub Cover Fields Native grass =122 (±4) Native forbs = 57 (±4) High Shrub Cover Fields Native grass = 108(±6) Native grass = 69(±5)	Yes	2011

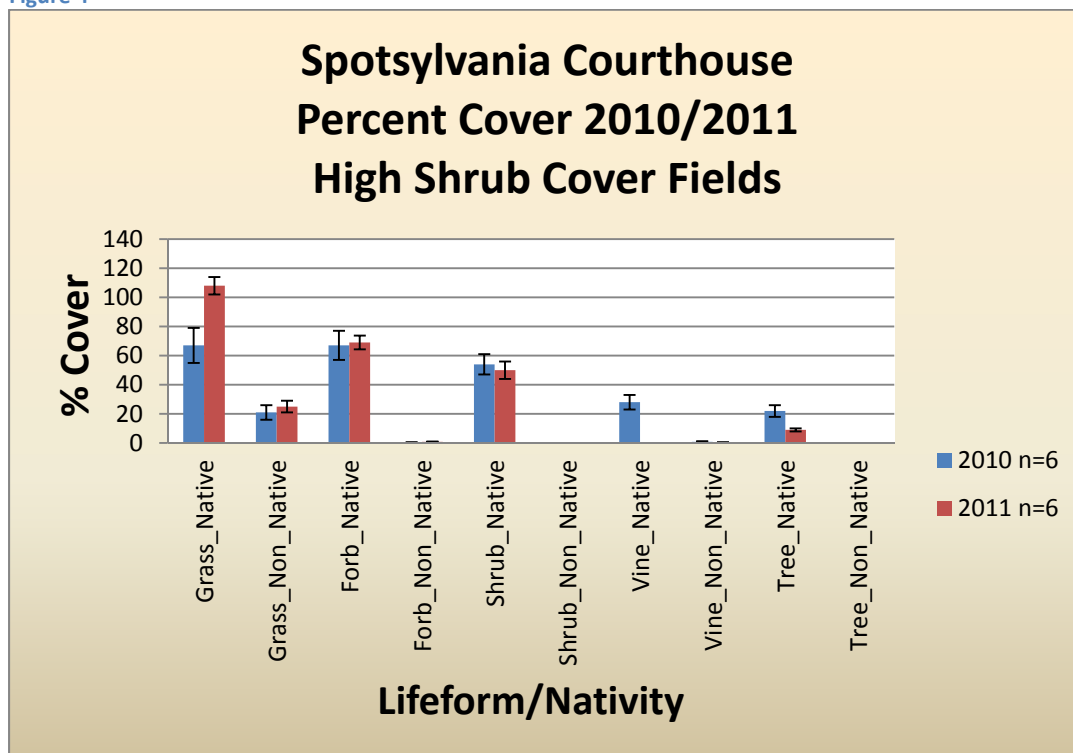
Upton, Harrison and Crescent fields (fields burned 4-7 times).

Figure 3



Landram, McCoull and Middle fields. (fields burned 4 -7 times).

Figure 4



IV. Results and Discussion

To meet the set objective of maintaining woody species <25% it is imperative that growing season burns be implemented. An analysis of our data shows an increase in the desired native warm season grasses and herbs, however no detectable decrease in woody vegetation. 2011 data results indicate the percent cover of trees and shrubs 50% (± 6) and 9% (± 1) respectively in the high shrub cover fields (Figure 4) and 34% (± 3), 27% (± 1) for the low shrub cover fields (Figure 3).

Growing season burning for the mid-Atlantic region would be August to early October when leaves and twigs are consumed and the temperature exceeds 145 degrees Fahrenheit and top kill is imminent. In late summer trees and shrubs prepare for fall senescence and transport carbohydrates, amino acids and other compounds down from the leaves and twigs to the roots. By burning at this critical time period, the plant does not have the nutrients to pass back down to the roots and its ability to start growing the following spring is greatly diminished (Harper *et al.* 2007). Carbohydrate reserves provide an energy source to support growth and respiration when plants are leafless (Loescher *et al.* 1990, Kozlowski 1992). The more reserves, the better an individual will be able to survive stress, whereas depleted reserves can lead to plant death (Kozlowski 1992, Johansson 1993). Late season defoliation causes a decrease in carbohydrate reserves and will impact the vigor of the plant the next growing season (Gregory *et al.* 1986, Loescher *et al.* 1990).

A meeting was held in November of 2010 with the Parks Superintendent, Chief of maintenance and staff, Chief of natural resources and park FMO, cultural resources specialist, MTTs area FMO and Fire Ecologist, to discuss concerns of the visual appearance of the fields. The park had received a few complaints regarding overgrown vegetation impacting the historic vista. In past years, the park bush hogged all of the fields in this unit annually. However, when prescribed burning began in 2004 the amount of bush hogging was significantly scaled back. Small diameter shrubs and tree species appear to be top killed, however vigorously resprout. The reduction in bush hogging has also resulted in taller vegetation with the stems rarely consumed by the fire. As a result of this meeting, it was decided to re-implement bush hogging on a biennial (every other year) basis rotating throughout the fields. The fields were divided into two groups. The low shrub cover fields include; McCoull, Landram and Middle fields. The high shrub cover fields include; Harrison, Upton and Crescent fields. The fields with the highest percent of woody vegetation (high shrub cover fields) were scheduled to be treated with prescribed fire in summer of 2011, however this never occurred (Figure 4).

Mowing alone is an inadequate method to reduce woody encroachment because mowing woody saplings encourages multiple resprouting. A plant's survival response after being cut is to resprout. The plant takes what energy it has remaining in the roots and pushes it above ground resprouts, grows leaves and begins to photosynthesize again. Timing of cutting can have a significant effect on sprout growth during the first 1-2 years following cutting (Kays 1991, Richburg *et al.* 2004). To have the greatest success reducing woody stems a treatment should be conducted during periods of low carbohydrate storage. This can be immediately after spring flush and followed up by another treatment before carbohydrate levels are replenished (Richburg 2003). Multiple treatments within a growing season can be effective so long as the time between treatments is long enough to allow sprouts to regrow and further depletes reserves (Richburg *et al.* 2004). An effective treatment to reduce woody species is a mechanical treatment following spring flush followed by a late growing season burn (Richburg 2004). This effectively depletes carbohydrate reserves and removes slash which inhibits wildlife mobility. Current literature supports multiple growing season treatments over multiple years.

Percent cover of non-native grasses and forbs still remain below the 25% threshold for both the low shrub cover fields (Figure 3) and the high shrub cover fields (Figure 4). Non native herbs are barely detectable at less than 1% (Figure 3 and 4) in both groups of fields. In contrast, the high shrub cover fields have a much larger proportion of non native grasses 25% (± 4) (Figure 4) than the low shrub cover fields .8% ($\pm .2$) (Figure 3). A decrease in woody vegetation in the high shrub cover fields would likely allow for the germination of the desired native warm season grasses and a reduction in some of the more shade tolerant non native grasses. The percent cover of native grasses and forbs is excellent with the low shrub cover field having 122% (± 4) and 57% (± 4) (Figure 3) respectively and 108% (± 6), 69% (± 5) for the high shrub cover fields (Figure 4).

In addition to focusing on growing season burns, it is strongly recommended that the fields be placed on a set rotation allowing for fallow years. Fields have been burned in the spring repetitively

since 2004 (Figure 2) with between 4 – 7 treatments. A change in timing and frequency will allow for the achievement of objectives while maintaining the ecological structure and diversity of the fields.

Spotsylvania Courthouse percent cover by lifeform of 13 plots 2008-2011. (shrubs and trees are all native)

Figure 5

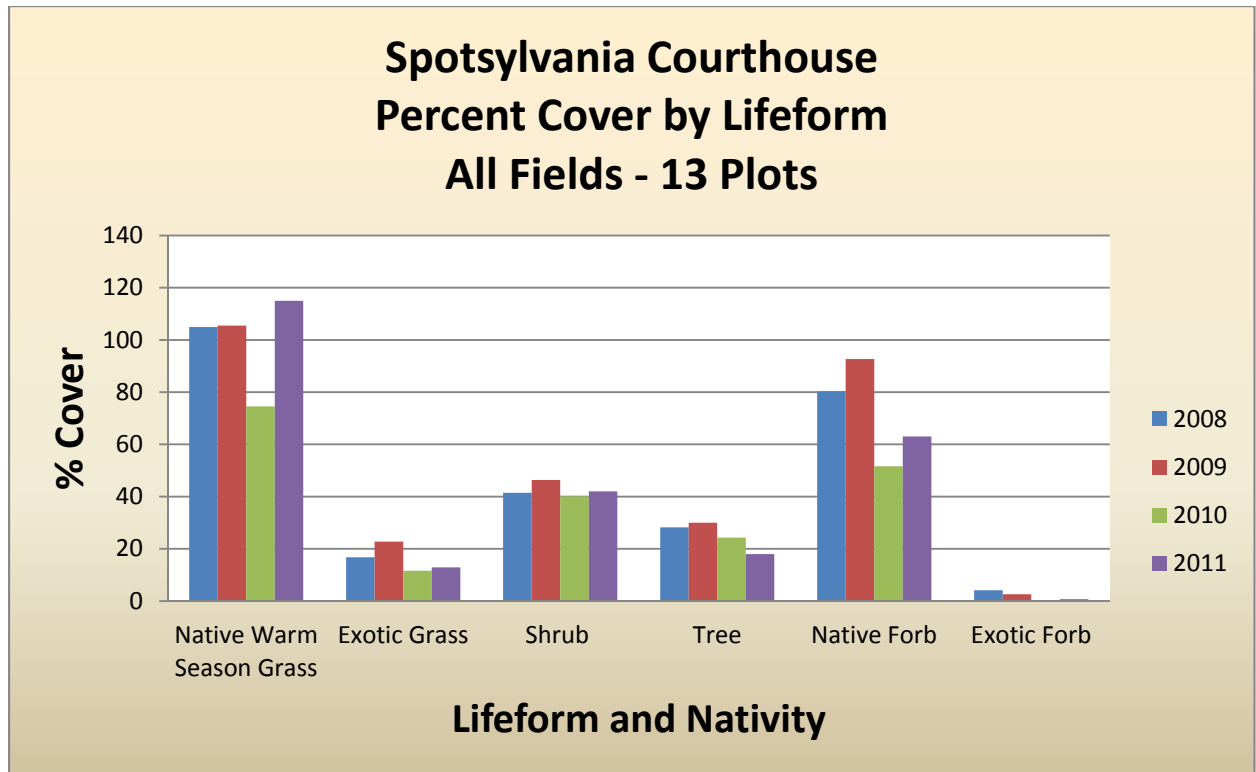


Figure 6

Spotsylvania Courthouse treatment schedule from the November 2010 Spotsylvania field management plan. Summer 2011 prescribed fires were not conducted. Harrison field was burned in spring 2011.

Tentative Cutting / Summer - Spring Prescribed Burning Schedule for 2011 - 2016						
	2011	2012	2013	2014	2015	2016
Upton Field	Summer RX	Bush - hog	Summer RX	Bush - hog	Spring RX	Bush - hog
Landram Field	Spring RX	Spring RX	Bush - hog	Spring RX	Bush - hog	Summer RX
Harrison Field	Summer RX	Bush - hog	Summer RX	Bush - hog	Spring RX	Bush - hog
McCoull Field	Spring RX	Spring RX	Bush - hog	Spring RX	Bush - hog	Summer RX
Middle Field	Spring RX	Spring RX	Bush - hog	Spring RX	Bush - hog	Summer RX
Crescent Field	Summer RX	Bush - hog	Summer RX	Bush - hog	Spring RX	Bush - hog
Native Grass Field	Spring RX	Spring RX	Bush - hog	Spring RX	Bush - hog	Summer RX

Delaware Water Gap National Recreation Area (DEWA)

2012 Effects Monitoring Annual Report

I. Program Overview

2012 Summary

Delaware Water Gap uses prescribed fire to aid in achieving the open space goals and objectives mandated in the park's General Management Plan and Resource Management Plan. The park conducts prescribed fire operations in consultation with resource management staff in select fields each spring. The park is currently in discussion to incorporate summer burning as a method to reduce encroaching woody species. The fire effects crew has plots located in two representative fields. No data analysis was conducted in 2012. Plots may be re-read in 2014 depending on fire frequency/timing and need.

Future Plans

With the onset of smaller travel budgets and increasing workloads, the monitoring interval will be modified to every three to five years. This will continue to provide the necessary data to evaluate if management goals and objectives are being met and whether undesired effects are occurring.

II. Park Overview

Delaware Water Gap National Recreation Area is the largest natural area in the entire National Park System between Virginia and Maine and one of the largest protected natural areas in the metropolitan corridor extending from Washington, D.C., to Boston, Massachusetts. The recreation area encompasses 67,000 acres of mountain ridge, forest, and floodplain on both sides of the Delaware River in the states of New Jersey and Pennsylvania. Forty miles of the Middle Delaware River are within the park unit. The park is the tenth most visited area in the National Park System with almost 5 million recreational visits each year.

The mission of the park is to provide outdoor recreation opportunities while conserving the natural, cultural and scenic resources of the recreation area. The park has a significant number of threatened species including 49 plant, 9 fish, 13 mammals, 7 reptiles and 10 amphibians.

Agriculture, forested areas and suburban development have replaced open fields with Native Warm Season Grasses (NWSGs). Native grasslands with scattered trees and shrub cover, maintained by fire, have also been replaced with non-native grasses such as smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*). Native warm season grass fields provide critical habitat for numerous songbirds and wildlife species.

Resource management staff has identified the use of prescribed fire as a viable management technique to aid in achieving the open space goals and objectives listed in the park's General Management Plan and Resource Management Plan. An open space prescribed fire plan was completed in 2007 which describes many units that can be treated with prescribed fire.

III. Goals and Objective

Goal

The overall objectives of these burns are to perpetuate the native species, perpetuate the open space character of the landscape, maintain wildlife habitat, control invasive exotic species, maintain fire dependent ecosystems, and reduce hazard fuel concentrations by disrupting fuel continuity.

New Objectives – (Revised after initial monitoring. Old objectives in the Open Space Fire Management Plan are below).

- Reduce 1-hour, dead and down fuels by $\geq 75\%$ as determined immediately post burn.
- Percent cover of native grasses and herbs $>75\%$ as measured after four treatments.
- Percent cover of woody species $< 25\%$ as measured after four treatments.
- Percent cover of non-natives grasses and forbs $< 25\%$ as measured after four treatments.

**Objectives stated in the DEWA Open Space Prescribed Fire Plan.
Revised after initial monitoring. See above.**

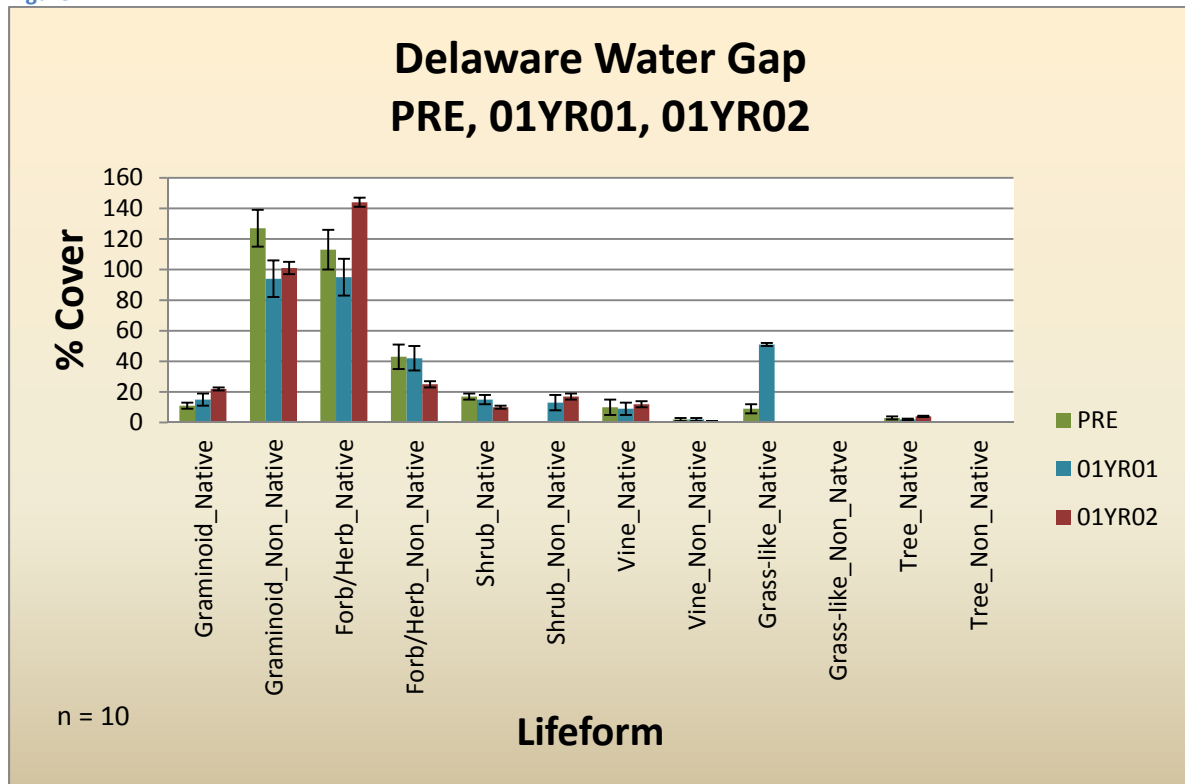
Goal Number 1: Safety. Provide for safety of fire personnel and the public.
• Objective 1: Ensure the public experience no injuries.
• Objective 2: Ensure fire personnel receive no lost time injuries.
Goal Number 2: Perpetuate native plant species
• Objective 3: Maintain native grass cover by $\geq 75\%$ as determined one year post burn.
• Objective 4: Maintain native herbaceous cover by $\geq 75\%$ as determined one year post burn.
Goal Number 3: Perpetuate open space landscape
Goal Number 4: Maintain wildlife habitat
• Objective 4: Reduce available 10-hour fuels $\geq 75\%$ as determined immediately post burn.
• Objective 5: Reduce shrub and brush cover by $\geq 10\%$ as determined one year post burn.
• Objective 5: Minimum overstory mortality (all species) of $\geq 10\%$ as determined one year post burn.
Goal Number 5: Control invasive exotic plant species
• Objective 7: Reduce exotic invasive cover by $\geq 25\%$ as determined one year post burn
Goal Number 6: Hazard Fuels Management - minimize fire risk to park infrastructure, adjacent non federal land and the wildland urban interface/intermix.
• Objective 8: Reduce 1-hour, dead and down fuels by $\geq 75\%$ as determined immediately post burn.
• Objective 9: Minimum overstory mortality (pine/cedar species) of $\geq 25\%$ as determined one year post burn.

Table of Objectives for Delaware Water Gap, Darrones and Silver Spray.

Darrones and Silver Spray Units	Percent cover of native grasses and herbs >75%.	PRE Native Grass = 11% (±2)	No	2011
		01YR01 Native Grass = 15% (±4)		
		01YR02 Native Grass = 22% (±1)		
		PRE Native Herb = 113% (±13)	Yes	
		01YR01 Native Herb = 95% (±12)		
		01YR02 Native Herb = 144% (±3)		
	Percent cover of woody species < 25%.	PRE Native Shrub = 17% (±2)	No	2011
		01YR01 Native Shrub = 15% (±3)		
		01YR02 Native Shrub= 10% (±1)		
		PRE Non Native Shrub = 0		
		01YR01 Non Native Shrub = 13% (±5)		
		01YR02 Non Native Shrub = 17% (±2)		
	Percent cover of non-natives grasses and forbs < 25%.	PRE Non-native Herbs = 43% (±8)	No	2011
		01YR01 Non-native Herbs = 42% (±8)		
		01YR02 Non-native Herbs = 25% (±2)		
		PRE Non-native Grass = 127% (±12)		
		01YR01 Non-native Grass = 94% (±12)		
		01YR02 Non-native Grass = 101% (±4)		

Preburn, postburn year one and two percent cover by lifeform.

Figure 7



IV. Results and Discussion – Darronnes and Silver Spray

Native herbaceous cover is excellent at 144% (± 3) (Figure 7). This exceeds the objective of maintaining percent cover of native herbaceous plants greater than 75%. However, native grass cover is low at 22% (± 1) after one burn. One of the reasons for this lack of native grasses is due to the prevalence of non-native grass cover. Preburn cover for non-native grass was 127% (± 12) and post burn 94% (± 12) and 101% (± 4) (Figure 7). This indicates a small decrease in cover, however, non-native grasses clearly still dominate the fields. Of particular concern is smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*).

These non-native grass species frequently co-occur together. There is a difference in the timing of the most susceptible phenological stages of the two species. However, there is a small window of overlap when both of the species are vulnerable to fire. The optimal time to burn Kentucky Bluegrass is in *early spring* before flower and smooth brome while still in the boot stage (i.e. the flowering head is still enclosed within the sheath) or *late spring*. Prescribed burning may reduce smooth brome if repeated annually in mid to late spring. As noted earlier, this is later than would be recommended for control of Kentucky bluegrass. Smooth brome is a good target for selective control by timed close mowing or use of herbicides. One close mowing when the plants are 18-24 inches tall, or treatment with glyphosate at 0.5 to 1.1 kg/ha before flowering, may improve chances of selectively controlling this species. The literature supports, prescribed burns need to be repeated for several consecutive years because a single burn would allow smooth brome to recover the following year. A multifaceted approach will be needed to control these two species. There are pockets of native warm season grasses such as little blue stem (*Schizachyrium scoparium*) which responds positively to fire and should continue to increase as non-native grasses are controlled. Non-native herbaceous cover level decreased in the second year from preburn to postburn levels 43% (± 8) and 25% (± 2) respectively. However, as noted earlier, the fields still remain surprisingly diverse with native herbaceous cover at 144% (± 3). Goldenrods are particularly diverse in the Silver Spray field. Shrub cover has remained the same with 10% (± 1) native shrubs and 17% (± 2) non-native shrubs after one treatment. These fields would benefit by repeated spring burns to encourage native warm season grasses, selectively applying herbicides and planting native warm season grasses if possible.

Saratoga National Historical Park

2012 Fire Effects Monitoring Annual Report

I. Program Overview

2012 Summary

The park has an extremely complex history of mowing, burning and chemically treating vegetation over the last 20 years. The prescribed fire program dates back to the early 1990's. No data was collected in 2012. Future data collection will depend upon the needs of park managers.

Future Plans

With the onset of smaller travel budgets and increasing workloads the monitoring interval will be modified to every three to five years. This will continue to provide the necessary data to evaluate if management goals and objectives are being met and whether undesired effects are occurring.

II. Park Overview

Saratoga National Historical Park is located in the towns of Stillwater and Saratoga, in Saratoga County in upstate New York, about 30 north of the state capital at Albany. Although a neighbor to the highly urbanized "Capital District," the park is rural in character and farming is the major use of adjacent lands. The park comprises 2,912 acres preserving the sites associated with a significant American military victory during the Revolution. In 1777 American forces met, defeated, and forced a major British army to surrender, an event which led France to recognize the independence of the United States and enter the war as a decisive military ally of the struggling Americans. The Battlefield Unit, 2,843 acres, was made part of the national park system in 1938 when Saratoga National Historical Park was authorized by the United States Congress.

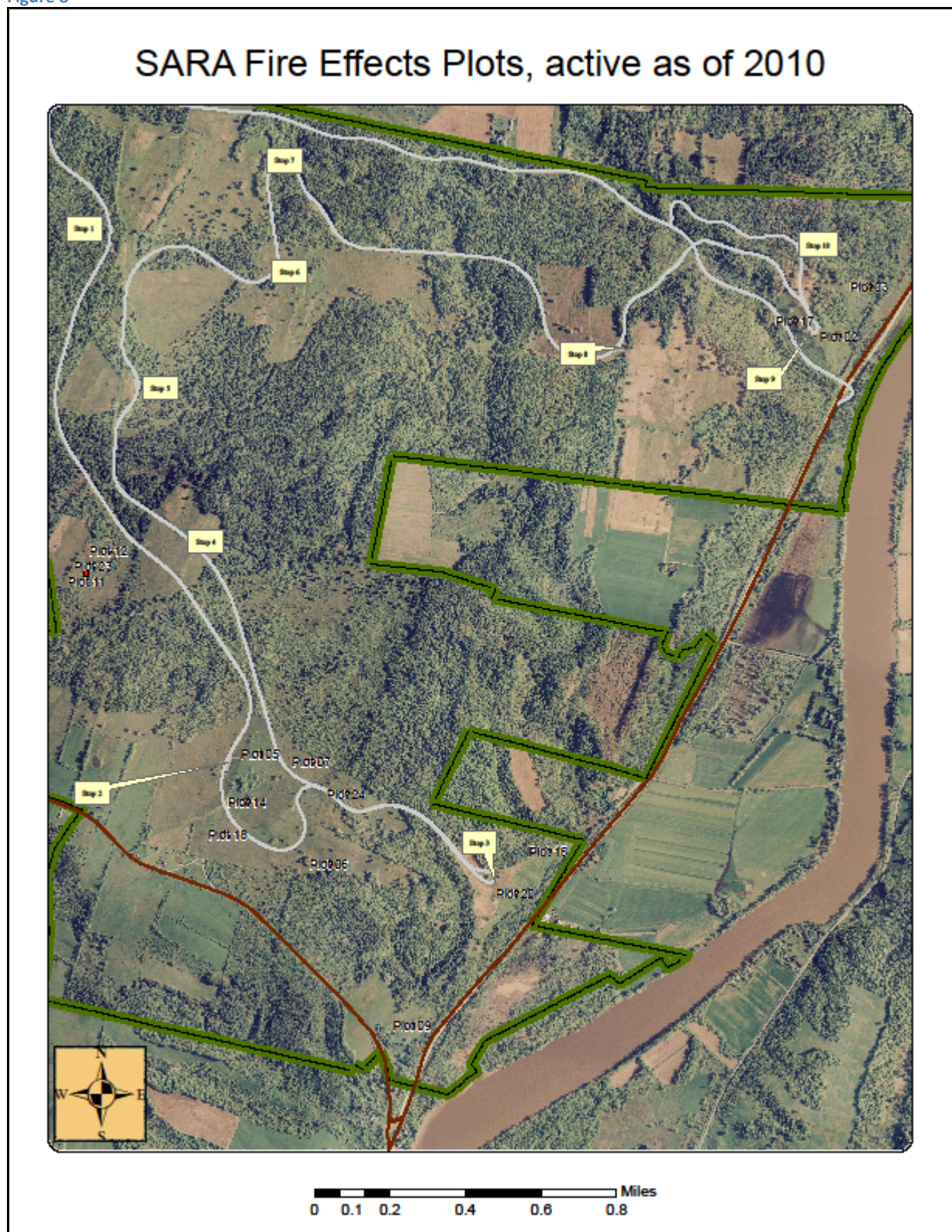
Prior to 1760's the predominant vegetative cover was forest with perhaps some meadow/field areas along the river floodplain. Settlement and agriculture brought about great change. By the mid 1800's the forests had been cut leaving only small wood lots, orchards, and forested ravines. Many of the cultivated fields have persisted to present day. There were really no native grasslands comprising the battlefield. Continued agriculture (mostly for forage with agriculture leases), deer browsing, mowing by park staff, and using prescribed fire have helped to maintain these fields. Over the years a few native warm season grasses (predominantly Little Bluestem-*Schizachyrium scoparium*) have been populating these clearings, particularly in the sandy soil areas. Recently Big Bluestem-*Andropogon gerardi*, has appeared, most likely attributed to one of the farmers with the agricultural lease. While native warm season grasses do provide habitat for a suite of grassland birds, the majority of these species are in the fields dominated by non-native grasses and forbs which comprise The Important Bird Area.

Grasslands are comprised of vegetation dominated by bluestem (*Schizachyrium scoparium*), sedge (*Carex* spp.), panic-grass (*Dichanthelium* spp.), fescue (*Festuca* spp., *Schedonorus pratensis*) and Reed Canary Grass - *Phalaris arundinacea*, an invasive exotic. Common forbs include yarrow (*Achillea millefolium*), knapweed (*Centaurea jacea* and *biebersteinii* - an invasive exotic), bedstraw (*Galium* spp.), cinquefoil (*Potentilla* spp.), goldenrod (*Solidago* spp.), and thyme (*Thymus* spp.). Woody species including dogwood (*Cornus racemosa*), black cherry (*Prunus serotina*), buckthorn (*Rhamnus cathartica* - an invasive exotic.), sumac (*Rhus* spp.), brambles (*Rubus* spp.), poison ivy (*Toxicodendron radicans*), viburnum (*Viburnum* spp.), and grape (*Vitis* spp.). Ferns are common to dominant in one field (Field 37, called The Fern Field) and include lady-fern (*Athyrium filix-femina*), sensitive fern (*Onoclea sensibilis*), and royal fern (*Osmunda regalis*).

The Northeast Region Fire Effects Monitoring Crew began monitoring fire effects at the park in 2001. There are 24 plots installed throughout the park, all in fields. In 2010, it was decided to retire 9 of the plots that were primarily located in mown areas. Fifteen plots still remain active as of 2011. Due to varying location, topography and treatments, plots were broken up into three analysis groups. The first group, the *hillside plots*, are located on steep slopes and are maintained with fire to reduce woody vegetation. Steep slopes are a safety issue and pose a safety hazard when mowing. The second group, *Neilson Farm plots*, are maintained with fire to reduce woody vegetation and also reduce invasive exotic knapweeds. The third group, *Chatfield Farm*, are maintained with fire to reduce woody vegetation and control knapweed. The Chatfield Farm fields have been experimentally burned in the summer of 2003 and 2009 to eliminate woody vegetation.

Map of active Saratoga fire effects plots in 2011.

Figure 8



III. Goals and Objective

The Saratoga NHP Fire Management Plan states the objective to, "Maintain and rehabilitate park fields, meadows, and historic landscapes through the application of prescribed fire and other techniques.

Old Monitoring Objectives (2001 – 2010)

- Reduce the density of woody stems by 70% to 90%.
- Reduce the cover of nonnative herbaceous species, expressed as a percent of the total cover of herbaceous species, by 20% to 40%.
- Increase the cover of native herbaceous species, expressed as a percent of the total cover of herbaceous species, by 20% to 40%.

New Proposed Monitoring Objectives 2011(*with input from Linda White on 10/31/2011*)

- Reduce 1 and 10 hour, dead and down fuels by $\geq 75\%$ as determined immediately post burn.
- Percent cover of woody species $< 35\%$ as measured following two growing season burns.
- Percent cover of non-natives grasses and forbs $< 50\%$ as measured after 5-7 burns.
- Percent cover of native grasses and forbs $> 75\%$ as measured after 5-7 burns.
- Maintain Knapweed species at ?? % cover as measured after 5-7 burns.

IV. Hillside Plots

Discussion – Hillside Plots

Native grass and herb cover is excellent with Native Herb 169% (± 7) and Native Grass 110% (± 4) (Figure 9) respectively. Percent cover of shrubs has remained the consistently the same throughout the data set. The current percent cover is near the new desired threshold of $< 35\%$. This threshold was raised after re-evaluating the objectives in 2010. Recent literature supports burning during the late summer-early fall to achieve a higher mortality of woody species. An analysis of our data shows an increase in the desired native warm season grasses and herbs, however no detectable decrease in woody vegetation. If a further reduction of woody species is desired by park managers, multiple growing season burns are recommended to achieve this objective.

Growing season burning would be August to early October when leaves and twigs are consumed and the temperature exceeds 145 degrees Fahrenheit and top kill is imminent. In late summer trees and shrubs prepare for fall senescence and transport carbohydrates, amino acids and other compounds down from the leaves and twigs to the roots. By burning at this critical time period, the plant does not have the nutrients to pass back down to the roots and its ability to start growing the following spring is greatly diminished (Harper *et al.* 2007). Carbohydrate reserves provide an energy source to support growth and respiration when plants are leafless (Loescher *et al.* 1990, Kozlowski 1992). The more reserves, the better an individual will be able to survive stress, whereas depleted reserves can lead to plant death (Kozlowski 1992, Johansson 1993). Late season defoliation causes a decrease in carbohydrate reserves and will impact the vigor of the plant the next growing season (Gregory *et al.* 1986, Loescher *et al.* 1990).

Mowing alone is an inadequate method to reduce woody encroachment because mowing woody saplings encourages multiple resprouting. A plants survival response after being cut is to resprout. The plant takes what energy it has remaining in the roots and pushes it above ground resprouts, grows leaves and begins to photosynthesize again. Timing of cutting can have a significant effect on sprout growth during the first 1-2 years following cutting (Kays 1991, Richburg *et al.* 2004). To have the greatest success reducing woody stems a treatment should be conducted during periods of low carbohydrate storage. This can be immediately after spring flush and followed up by another treatment before carbohydrate levels are replenished (Richburg 2003). Multiple treatments within a growing season can be effective so long as the time between treatments is long enough to allow sprouts to regrow and further depletes reserves (Richburg *et al.* 2004). An effective treatment to reduce woody species is a mechanical treatment following spring flush followed by a late growing season burn (Richburg 2004). This effectively depletes carbohydrate reserves and removes slash which inhibits wildlife mobility. Current literature supports multiple growing season treatments over multiple years.

Cover of non-native grass is still low at 22% (± 3) (Figure 9) in 2011, it did however increase from 9% measured in 2010. However, non-native herbs are below the desired threshold of $< 50\%$ with 41% (± 8)

(Figure 9) in 2011. Plots 2 and 3 at Stop 10 have high concentrations of knapweeds which influence the high amounts of cover. This condition objective threshold was raised in 2010 from <25% to <50%. The hillside area has been burned approximately 11 times since the start of the prescribed fire program in the early 1990's. Plots have been burned 3-5 times after installation.

Figure 9

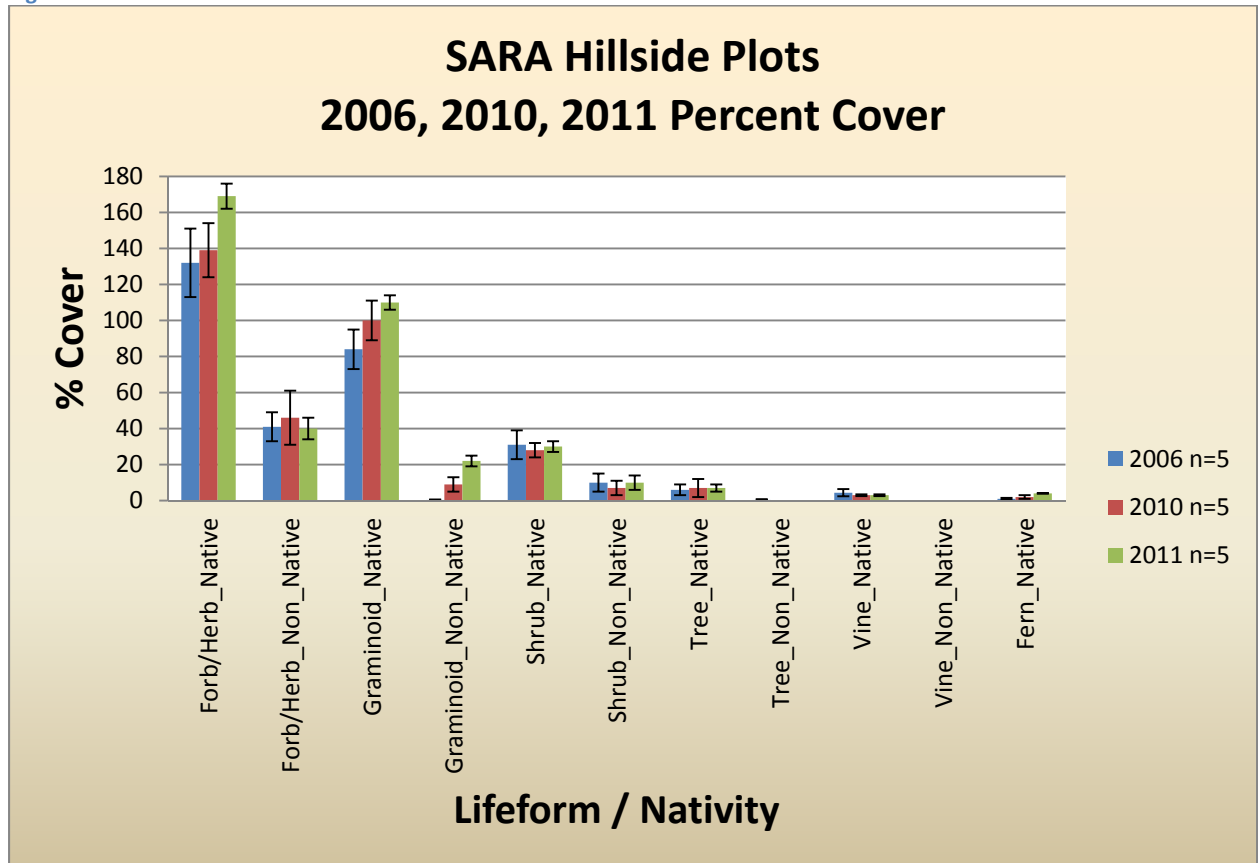


Table of objectives for Saratoga - Hillside Plots.

Mixed Grassland Hillside Plots n=5 (Plots 2,3,15,17,20) Plots burned 3-5 times. The area has been burned ~ 11 times.	Percent cover of native grasses and herbs >75%.	2006 Native Grass = 84% (±11)	YES	2011
		2010 Native Grass = 100% (±11)		
		2011 Native Grass = 110% (±4)		
		2006 Native Herb = 132% (±19)	YES	
		2010 Native Herb = 139% (±15)		
		2011 Native Herb = 169% (±7)		
	Percent cover of woody species < 35%.	2006 Native Shrub = 31% (±8)	No	2011
		2010 Native Shrub = 28% (±4)		
		2011 Native Shrub = 30% (±3)		
		2006 Non Native Shrub = 10% (±5)	No	
		2010 Non Native Shrub = 7% (±4)		
		2011 Non Native Shrub = 10% (±4)		
	Percent cover of non-natives grasses and forbs < 50%.	2006 Non-native Herbs = 41% (±8)	YES	2011
		2010 Non-native Herbs = 46% (±15)		
		2011 Non-native Herbs = 40% (±6)		
		2006 Non-native Grass = .4% (±.2)	YES	
		2010 Non-native Grass = 9% (±4)		
		2011 Non-native Grass = 22% (±3)		

V. Neilson Farm

Discussion – Neilson Farm

Native grass cover is excellent with Native Grass at 132% (± 5) (Figure 10). In contrast, native herbaceous cover is very low with 23% (± 3) (Figure 10) in 2011. This low native herb cover is likely the result of an extremely high percentage of non native herbs 119% (± 10) (Figure 10), mostly the invasive exotic herb spotted knapweed. Non native grass cover still remains below the <50% threshold at 15% (± 2) (Figure 10). Native and Non-native shrub cover were below the <25% threshold with 27% (± 3) and .3% ($\pm .08$) (Figure 10) respectively. Stinger herbicide has been experimentally introduced into some of the areas infested by brown and spotted knapweed.

Neilson farm percent cover by lifeform and nativity. Three plots in 2008 and six plots in 2010 and 2011.

Figure 10

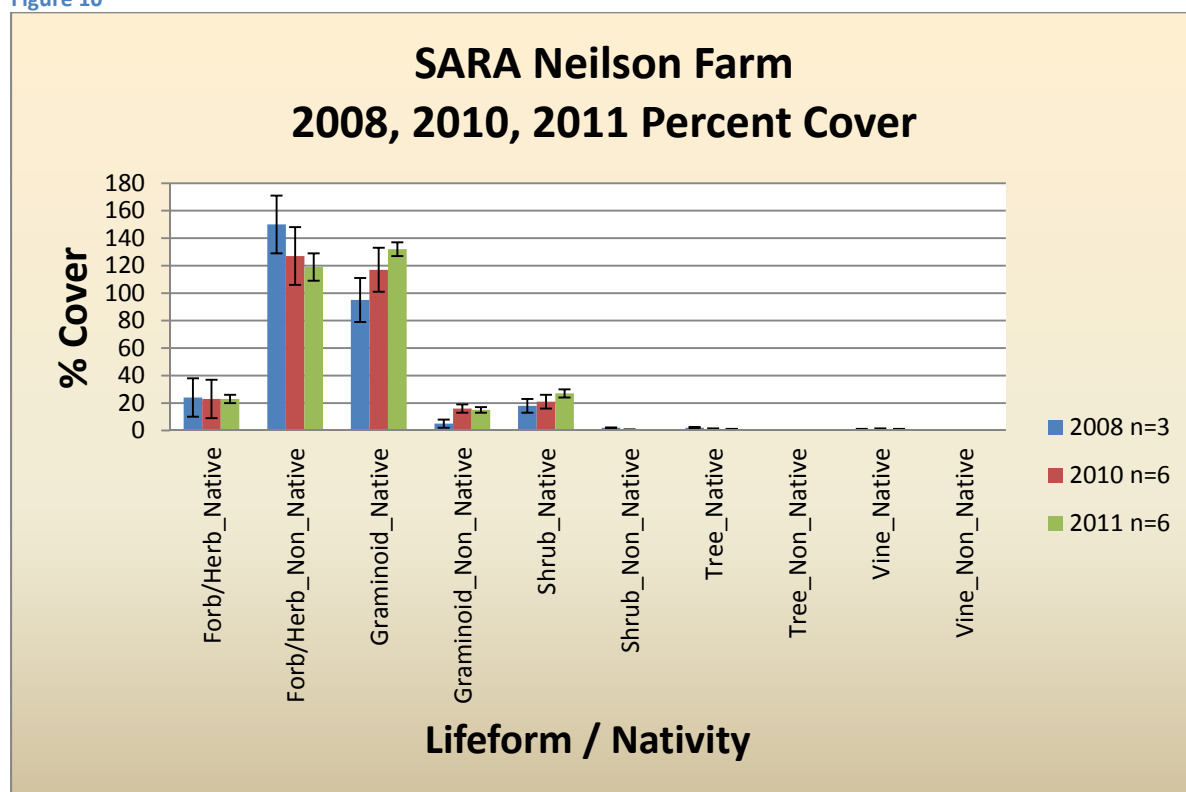


Table of objectives for Saratoga - Neilson Farm.

Mixed Grassland Neilson Farm 2008 n=3 (Plots 5,6,7)	Percent cover of native grasses and herbs >75%.	2008 Native Grass = 95% (±16)	YES	2011
		2010 Native Grass = 117% (±12)		
		2011 Native Grass = 132% (±5)		
		2008 Native Herb = 24% (±14)	NO	
		2010 Native Herb = 23% (±6)		
		2011 Native Herb =23% (±3)		
2010 / 2011 n=6 (Plots 5,6,7,14,18,24)	Percent cover of woody species < 35%.	2008 Native Shrub = 18% (±5)	YES	2011
		2010 Native Shrub = 21% (±4)		
		2011 Native Shrub = 27% (±3)		
		2008 Non Native Shrub = 2% (±.3)	YES	
		2010 Non Native Shrub = .5% (±.2)		
		2011 Non Native Shrub = .3% (±.08)		
Plots burned 1 - 3 times. The area has been burned 3-7 times.	Percent cover of non-natives grasses and forbs < 50%.	2008 Non-native Herbs =150% (±21)	NO	2011
		2010 Non-native Herbs = 127% (±22)		
		2011 Non-native Herbs = 119% (±10)		
		2008 Non-native Grass = 5% (±3)	YES	
		2010 Non-native Grass = 16% (±5)		
		2011 Non-native Grass = 15% (±2)		

VI. Chatfield Farm

Discussion – Chatfield Farm

Native grass cover remains high with 91% (± 2) and non-native grass is low with 1% (± 1) (Figure 11) in 2011. Similar to the Nielson Farm area, non-native herbaceous plants remain high with 92% (± 16) (Figure 11) measured in 2011. This area appears to have less knapweed than the Nielson Farm, however, native herbs are still outnumbered almost 3:1 by non-native herbs. In 2011, native herbs were measured at 18% (± 3) (Figure 11). Woody vegetation remains above the 35% threshold in 2011 (37% (± 3) (Figure 11). There has been approximately a 10% decrease since the “preburn” measure in 2003 (42% (± 15)). The area was burned experimentally in the summer 2003 and 2009. Additional growing season burns are recommended along with the application of herbicide to control the knapweed species.

Percent cover by lifeform and nativity from Chatfield farm plots. Sample size in 2003 two plots and three plots in 2010 and 2011.

Figure 11

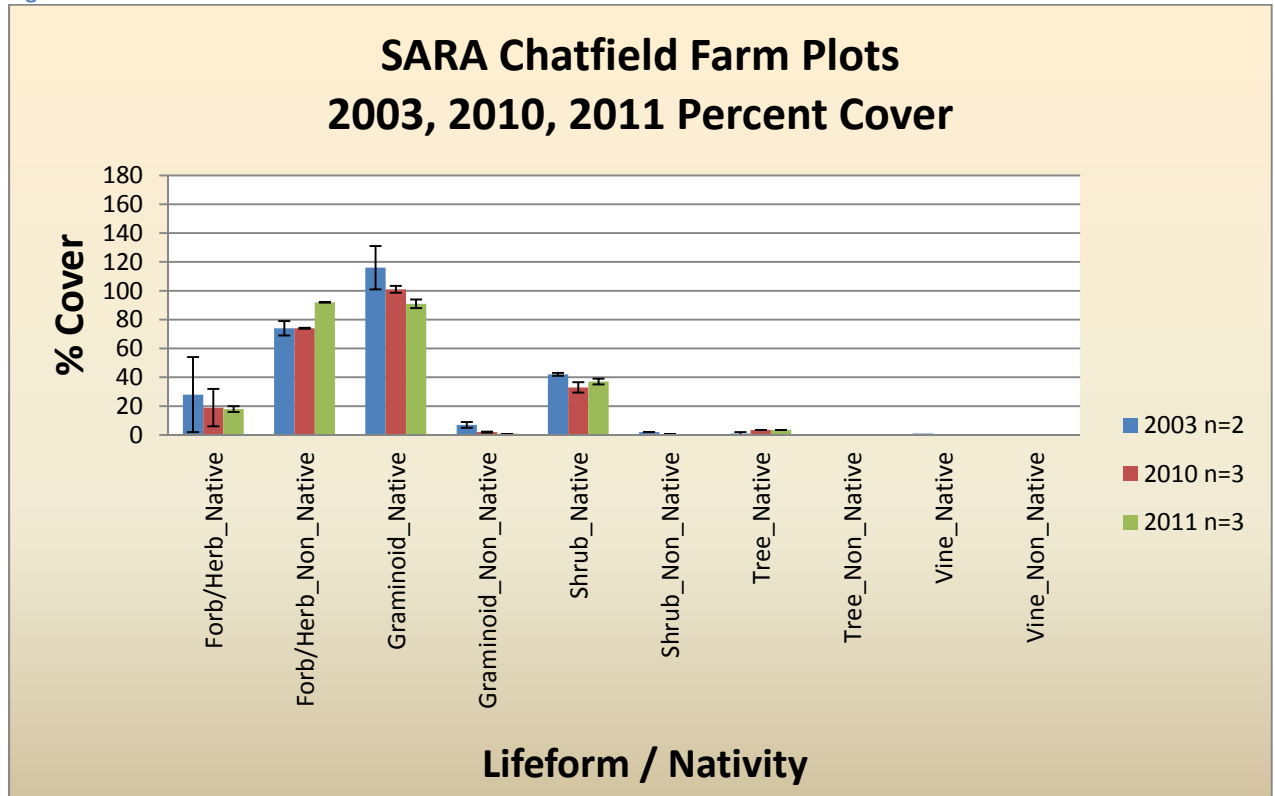


Table of objectives for Saratoga - Chatfield Farm.

Mixed Grassland Chatfield Farm 2003 n=2 (Plots 11,12)	Percent cover of native grasses and herbs >75%.	2003 Native Grass = 116% (±26)	YES	2011	
		2010 Native Grass = 101% (±13)			
		2011 Native Grass = 91% (±2)			
		2003 Native Herb = 28% (±2)	NO		
		2010 Native Herb = 19% (±7)			
2011 Native Herb =18% (±3)					
2010 n=3 (Plots 11,12,23) Plots have been burned 1-2 times. Summer burn 2003 and 2009.	Percent cover of woody species < 35%.	2003 Native Shrub = 42% (±15)	NO	2011	
		2010 Native Shrub = 33% (±2)			
		2011 Native Shrub =37% (±3)			
		2003 Non Native Shrub = 2% (±.3)	YES		
		2010 Non Native Shrub = .3% (±.3)			
	2011 Non Native Shrub = 0% (±0)				
	Percent cover of non-natives grasses and forbs < 50%.	2003 Non-native Herbs = 74% (±27)	NO	2011	
		2010 Non-native Herbs = 74% (±13)			
		2011 Non-native Herbs = 92% (±16)			
2003 Non-native Grass = 7% (±5)		YES			
2010 Non-native Grass = 2% (±.3)					
2011 Non-native Grass = 1% (±.1)					

Cape Cod National Seashore (CACO)

2012 Fire Effects Monitoring Annual Report

(Prepared by David Crary)

I. Program Overview

Fire is a natural and integral part of the ecosystem encompassing Cape Cod National Seashore (CACO). The natural communities and historic cultural landscapes occurring on the Seashore reflect the influence of naturally ignited fires, fires ignited by Native Americans prior to the arrival of European settlers (Dunwiddie and Adams 1995), and fires ignited by European settlers themselves. Fire acts as a significant force of change to the resources of the Seashore and surrounding non-federal lands. The potential for wildland fire to impact life and property is substantial. Under certain weather conditions, the wildland fuels of southeastern Massachusetts are as explosively flammable as the fuels found in California chaparral.

The fire management plan (FMP) is a strategic document that defines the program for fire management in the wildland fuels of Cape Cod National Seashore. The reasons for development of the FMP were:

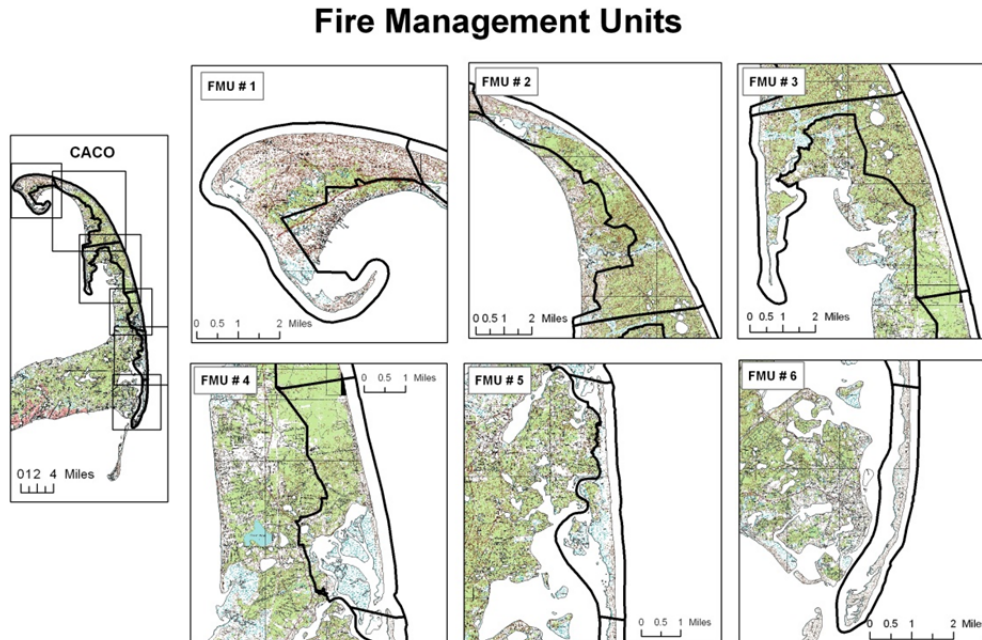
- (1) to protect life, structures, natural resources, and cultural resources from harmful effects of wildland fire;
- (2) to restore fire as an ecological process on the landscape, returning the Seashore to a diverse, mosaic of fire-influenced natural communities through the use of prescribed burning.
- (3) to restore, maintain, or protect rare, threatened, and endangered species and significant natural communities;
- (4) to investigate the effects of fire on natural resources of the Seashore;
- (5) to reduce the accumulation of hazardous wildland fuels using prescribed burning and mechanical treatments; and
- (6) to comply with the National Park Service (NPS) Director's Order #18: Wildland Fire Management that requires all areas of NPS units containing vegetation capable of sustaining fire develop a FMP.

II. Park Overview

Fire Management Units at CACO

A Fire Management Unit (FMU) is any land management area definable by objectives, topographic features, access, values to be protected, political boundaries, fuel types, or major fire regimes that sets it apart from an adjacent unit. Cape Cod National Seashore has six FMU's (Figure 5). For largely administrative purposes, the FMU's are defined by town boundaries. The Seashore often cooperates with town fire departments to suppress wildland fires, and maintains inter-agency agreements with each of the town fire departments for wildland fire suppression. Further, prescribed burns are ignited after concurrence is obtained from the fire department chief of the respective town. Community involvement with wildland fire and prescribed fire issues is often handled at the town government level (e.g., via public town meetings, presentations at schools, fire department membership meetings). Some general fuel type differences exist among the towns on NPS-owned property. For these reasons, the Seashore is divided into fire management units according to the political boundaries of the towns of Provincetown (FMU 1), Truro (FMU 2), Wellfleet (FMU 3), Eastham (FMU 4), Orleans (FMU 5), and Chatham (FMU 6). Each FMU is discussed in some detail below. Note that fire weather cycles are similar for all FMU's and is described in detail in the Seashore Fire Management Plan in the *Wildland Fire Management Situation* section.

Figure 12



Goals and Objectives for Fire Management Units

- (1) Coordinate fire suppression and prescribed burning activities with the Community and Town Fire Department
- (2) Aggressively suppress all wildland fires in the FMU.
- (3) Conduct prescribed burning and mechanical treatments in the FMU to reduce hazardous fuel loadings, restore and maintain heathlands and rare species habitat, and maintain cultural landscapes.

Management Constraints

- (1) Do not violate national ambient air quality standards or cause unacceptable smoke hazards/nuisance with prescribed burning.
- (2) Do not negatively affect cultural resources or rare, threatened, or endangered species with fire management activities except under wildland fire situations where lives or structures are in imminent danger.
- (3) Do not jeopardize positive public relations with the FMU community; keep the affected community adequately informed as to fire management activities planned and in progress.
- (4) Do not allow structures or their occupants to be placed at risk during prescribed fires; make all reasonable efforts to protect structures from wildland fires.

III. 2012 Monitoring Results and Discussion

- Marconi WUI Broom Crowberry monitoring: No formal sampling was completed in 2012, however ocular estimation is that minimal to no recruitment of new *Corema* seedlings have become established. This contradicts findings by Schall (2005) who observed up to 2,000 seedlings in similar burn pile footprints on sites 0.5 miles south of the Marconi WUI.
- Fire Cache *Corema* transplanting. On-going, no formal sampling completed in 2012, however ocular estimation is that mortality of transplants is about 70% four years after transplanting. About half of the transplants (15 of 30) died during the first two years following transplanting.
- Lombard Paradise Hollow (vegetation monitoring and burning): First order fire effects were recorded during and immediately after 2012 plot burns (12 total). The project is ongoing and is expected to continue thru 2022 (year 36 of the experiment). Intensive pre- and post-burn monitoring is expected in years 35 and 36 which will be the fourth time in history (year 0, 12, 24, and 36) when all plots of the 1-4 years intervals will be treated in the same year. A contract employee (Motzkin) is finishing the first draft documenting the first 24 years of the experiment. The

site is expected to be included in the Tall Timbers field tour during its 25th Fire Ecology **Conference** that will be held October 27 – 31, **2013** at the Resort and **Conference** Center in **Hyannis, MA**.

- Heathland Monitoring / Marconi Site Heathland restoration: Update: Heathland Monitoring / Marconi Site Heathland restoration: Dr. Von Holle had a graduate student and an undergraduate technician establish and sample vegetation on 90 plots in two distinct sample areas at Marconi during the summer of 2011. Standing trees were removed from plots and treatment plots were scarified, seeded, and burned (summer treatment 2011). Spring treatment (burning) was conducted in March 2012 (the resources (hose, engines and personnel can be observed on the current Google Earth Image near (southeast 300 yards) of the NPS CACO Headquarters in Wellfleet).
- Broom Crowberry burn: Sampling observations were conducted in the spring of 2012 by Patterson and Henderson. The thousands of seedlings observed in 2011 have reduced to tens or hundreds (Visual estimates and photo documentation in the spring of 2011 show up to a thousand *Corema* seedlings on the spring treatments (after two growing seasons), hundreds of seedlings on the summer treatment plots (after two growing seasons) and only tens on the fall treatment plots (after one growing season)).

Table of Objectives for CACO.

Cape Cod NS (Monitoring conducted by CACO staff)	Lombard Paradise Hollow Research Area	(Collaborative with Crary)	0	0	0	0	12
	Fort Hill	Plant germination	0	35	0	35	35
	Marconi Heathland	Photo Points, Point Intercept, Wx data (day of treatment)	0	0	0	0	0
	Broom Crowberry	Point Intercept, Ocular percent cover estimate, photo	0	0	0	9	9
	Broom Crowberry	Sub-plot	35	35	35	35	35
	Marconi Heathland	Photo Points, Point Intercept, Wx data (day of treatment)	2	2	2	2	2
	Pilgrim Springs	CACO Monitoring Plot (BAF, Releve, Browns transect)	3	0	0	0	3
	2013 Rx Burn Plan	Photo	25	0	0	0	25



Heathland Restoration Burning at Marconi Area, Wellfleet, MA, July 31, 2012.

Richmond National Battlefield Park (RICH) 2012 Fire Effects Monitoring Annual Report

I. Program Overview

2012 Summary

No prescribed burns or monitoring took place at Richmond this year (2012), therefore additional data analysis was not completed. Two prescribed burns are planned for 2013 including a portion of the Malvern Hill grass unit and the Cold Harbor oak-pine unit.

Future Plans

The Cold Harbor oak-pine unit will be monitored in 2013. 2010 data analysis indicate the achievement of all but one objective. Recent data analysis indicates that both of these projects have moved from the restoration phase to the maintenance stage. With the onset of smaller travel budgets and increasing workloads the monitoring interval will be modified to every three to five years. This will continue to provide the necessary data to evaluate whether management goals and objectives are being met and whether undesired effects are occurring.

II. Park Overview

Richmond National Battlefield Park is located 110 miles south of Washington, D.C., in and near the city of Richmond, Virginia. The park manages approximately 1200 acres in 13 individual units spread over a 132-square mile area. Established as part of the National Park System in 1936, the park protects Civil War battle sites where in 1862 and 1864-65 the Union Army attempted to take the city of Richmond, the capital of the Confederacy, and to destroy the Army of Northern Virginia.

III. Malvern Hill Unit Overview

The Malvern Hill consists of approximately 1,040 acres of agricultural crop fields, mixed oak and hardwood-conifer woodlands, hedgerows, mown grass fields, lawn, and an interpretive facility. The field burn unit is partially surrounded by blacktop road and is fuel model 1 and 3. The area consists of warm season native grasses, cool season exotic grasses, and patchy shrub species to a height of 1- 3 meters. Prescribed fire is being used to reduce brushy fuels to open up the historic scene, maintain vistas, reduce invasive non-native species and promote the growth of native warm season grasses, so that park maintenance will no longer need to use time, equipment, and fuel to maintain these open fields, so that park visitors can get a feeling for the battlefield as it was during the Civil War, and to create grassland habitats suitable for a diversity of birds, herps and small mammals.

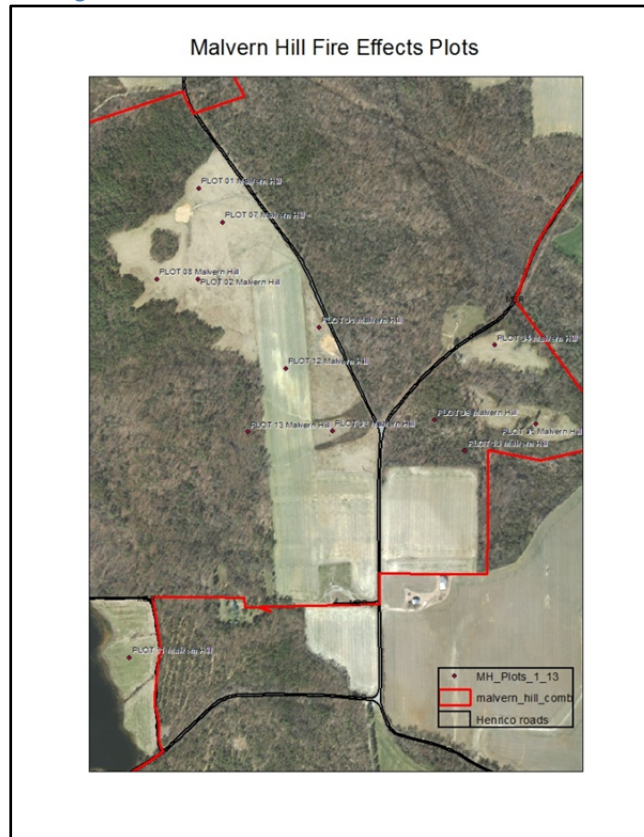
The Mid-South historically contained vast acreages of native grassland and savannas with scattered trees and shrub cover, which was maintained by fire. Through the years, these have been replaced with non-native grasses such as meadow fescue (*Schedonorus pratensis*). Agriculture, trees and suburban development have also replaced open fields with Native Warm Season Grasses (NWSGs). Native warm season grasses provide critical habitat for numerous songbirds and wildlife species. These native grasslands are the most endangered ecosystems in the Mid-South and as a result of their loss numerous wildlife and grassland bird species have experienced steep, long term declines.

The unit contains several invasive species of concern including Johnson grass (*Sorghum halepense*), Chinese bush clover (*Lespedeza cuneata*) and Japanese Honeysuckle (*Lonicera japonica*). These exotics are actively being treated with herbicide. Dense patches of meadow fescue (*Schedonorus pratensis*), an exotic cool season grass, are also being sprayed. This grass forms a dense carpet and prevents the establishment of desired native warm season grasses. Common native grasses include Broomsedge (*Andropogon virginicus*), purpletop (*Tridens flavus*), little bluestem (*Schizachyrium scoparium*) and Indian grass (*Sorghastrum nutans*). The shrub layer is dominated by winged sumac (*Rhus copallinum*) and blackberry (*Rubus* spp.). Common native forbs include ragweed (*Ambrosia artemisiifolia*) and gypsyweed (*Veronica officinalis*).

The crew began monitoring the Malvern Hill grassland unit in 2005. Currently, there are 13 FMH brush monitoring plots located in a complex of seven fields. In 2008 it was decided to analyze the fields in two separate groups relating to their management history. The first group, referred to as the cool season grass fields were planted with meadow fescue (*Schedonorus pratensis*) prior to the establishment of the current natural resource program. An objective for these fields is to remove the carpet of fescue and allow the NWSGs to re-establish. These fields include 29 acre North, Parsonage North and South and the 12 acre South field (not planted with fescue). The warm season grass fields have been planted with NWSGs and include Parsonage West and the Crewes Channel field. The objective for this group of fields is to maintain the planted NWSGs (Figure 1). In the future the 12 acre South field will be lumped with the warm season grass fields or they may be analyzed together.

Map of fire effects plots Malvern Hill.

Figure 13



IV. Goals and Objective – Malvern Hill

Goal

The primary goal is to restore and maintain the historic scene of July 1, 1862 and perpetuate native grassland species. This will be accomplished through mechanically removing trees, herbicide treatment of exotic vegetation, bushhogging, and the use of prescribed fire.

Burn Objectives

- >90% consumption of fine fuels as measured immediately post burn.
- < 5% mineral soil exposure prior to green up as measured immediately post burn.

Monitoring Objectives

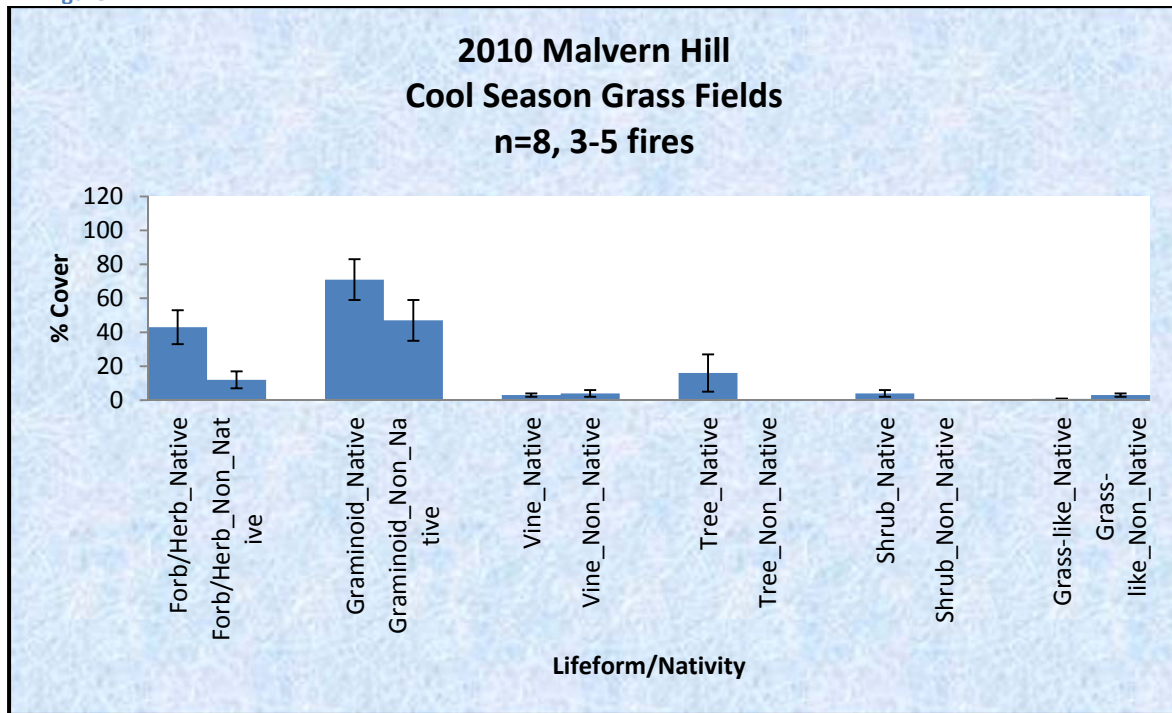
- Percent cover of woody species < 25% as measured after four treatments.
- Percent cover of non-natives grasses and forbs < 25% as measured after four treatments.
 - ◆ Resource Management staff measures from NRCA:
 - proportion of plot cover in "non-natives"
 - number of species per plot of "non-natives"
 - proportion of total species "non-natives"
- Percent cover of "meadow specialists" native grasses and forbs >75% as measured after four treatments.
 - ◆ Resource Management staff measures from NRCA:
 - proportion of plot cover in "meadow specialists"
 - number of species per plot of "meadow specialists"
 - proportion of total species in "meadow specialists"

Table of objectives for the Malvern Hill burn unit.

Malvern Hill	Maintain percent cover of woody species <25%	Cool Season Grass Fields	Yes	2010
		Shrub Cover = 4% ($\pm$.2)		
		Tree Cover = 16% ($\pm$ 11)		
		Warm Season Grass Fields	Yes	
		Shrub Cover = 0		
	Tree Cover = 2 ($\pm$.1)			
	Percent cover of non-natives grasses and forbs < 25%.	Cool Season Grass Fields	No	2010
		Non-Native Grass Cover = 47 ($\pm$ 12)		
		Non-Native Forb Cover = 12($\pm$ 5)		
		Warm Season Grass Fields	Yes	
Non-Native Grass Cover = .3 ($\pm$.3)				
Non-Native Forb Cover = *10($\pm$ 10)				
*Plot 10 LESCUN				
Percent cover of “meadow specialists” native grasses and forbs >75%.	Cool Season Grass Fields	Yes	2010	
	Native Grass Cover = 71($\pm$ 12)			
	Native Forb Cover = 43($\pm$ 10)			
	Warm Season Grass Fields	Yes		
	Native Grass Cover = 150($\pm$ 4)			
Native Forb Cover =13($\pm$ 3)				

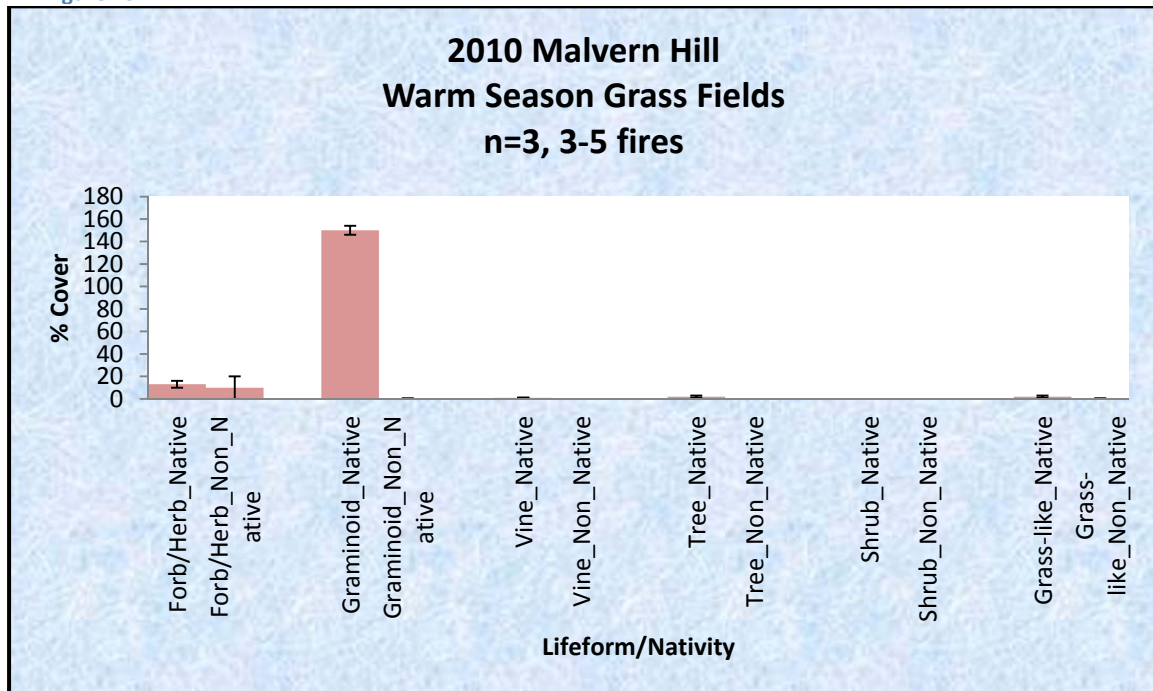
2010 graph of percent cover by lifeform and nativity cool season grass fields.

Figure 14



2010 graph of percent cover by lifeform and nativity in the warm season grass fields.

Figure 15



V. 2010 Results and Discussion – Malvern Hill

All objectives are being met with the exception of maintaining non native grass cover below 25 percent in the cool season grass fields. In the fall of 2010, 18 acres of meadow fescue (*Schedonorus pratensis*) in the largest cool season grass field, along with woody species throughout all of the fields were contracted and sprayed with herbicide. The non native honeysuckle (*Lespedeza cuneata*) will be treated during the summer of 2011. This year's prescribed fire had a very positive impact with a noted reduction of non native grass from 72% (± 16) in 2008 pre- treatment to 47% (± 12) in 2010 after treatment (Figure 14). The burn day weather conditions (low RH, high temp.) allowed the fire to carry continuously through the fields. In the last three years native grass cover in the cool season grass fields has remained approximately the same. Hopefully, the spraying will provide more bare ground and allow native warm season grasses to germinate. The 12 acre south field, which is currently grouped in with the cool season grass fields, continues increase with NWSGs. The two plots in this field had 84% and 116% native grass cover, with only 2% and 0% non native grass cover. This field should be moved in with the warm season grass group and burn rotation.

The Native warm season grass fields continue to have exceptional native grass cover at 150% (± 4) and .3% ($\pm .3$) (Figure 15) non native grass percent cover. Native forbs also continue to increase from 5% (± 3) in 2008 to 13% (± 3) (Figure 15). Current research supports biannual spring burning and should allow for more native forbs to germinate. Plot 10 in the Parsonage West field was noted to have an increase in the non native invasive honeysuckle (*Lespedeza cuneata*). This should be treated as there are not many other native forbs in this field and it will likely quickly spread.

VI. Cold Harbor Overview

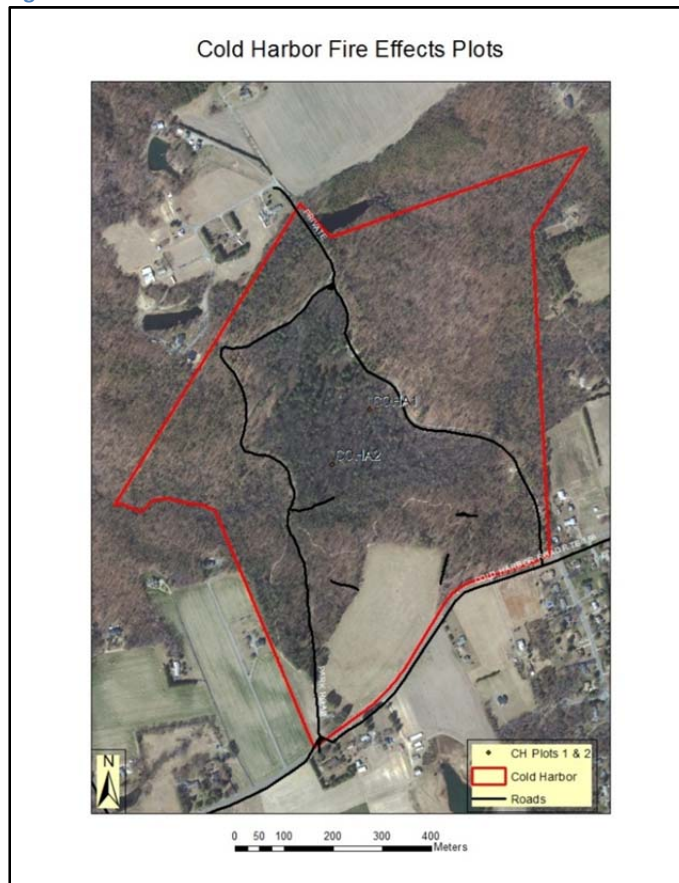
Cold Harbor Unit is predominately composed of a Coastal Plain Oak Heath Forest, with a Coastal Plain Acidic Seepage Swamp community bisecting the unit and running along Bloody Run Creek. Historically, Bloody Run Creek looked much like it does now, with deciduous trees in the overstory and thick underbrush, spreading up the hill and eventually mixing with the pine community on the uplands. The majority of the forest is 70-80 years in age and in fair health. During the Civil War

most of the ridge areas were open farmland, and the slopes and streams were covered by woods; however, many of these fields have since been allowed to become mixed hardwood and coniferous forests. The understory vegetation along the drainage is an acidic seepage swamp community characterized by an extremely dense and brushy shrub layer.

The community that runs along the creek has an overstory dominated by blackgum and American holly, with an understory of sweet pepperbush, wild azalea and blueberry. The oak heath forest community is dominated by loblolly pine and black oak, white oak, northern red oak and American holly. The understory of these communities consists of saplings of tree species that dominate the overstory, with the addition of hickory, sassafras and blueberry. The herbaceous layer is sparse and dominated by muscadine, Virginia creeper and Japanese honeysuckle (*Lonicera japonica*). This burn unit comprises an area of approximately 30 acres, which is in the central portion of the Cold Harbor Unit and is surrounded by a blacktop road Anderson and Wright Drive. The unit was first burned in 1997 before the establishment of monitoring plots. FMH forest plots were installed in 2003, and have been treated in 2004, 2005 and 2009. Plot design is consistent with the specifications for forest plots found in the NPS Fire Monitoring Handbook. Mechanical (logging and chain sawing) and chemical treatments have also taken place in the unit. A tropical storm impacted the area in 2005, falling numerous large trees.

Map of Cold Harbor fire effects plots. Sample size is 2.

Figure 16



VII. Goals and Objectives - Cold Harbor

A. Burn Objectives – as measured during and immediately postburn

- 75%-100% of overall area will be burned as measured immediately post burn.
- Limit flame height to be not more than 6 feet on average as measured during the burn.
- Scorch height to be not more than 50% – 60% of overstory tree height as measured immediately post burn.
- < 10% mineral soil exposure prior to green up as measured immediately post burn.
- Preserve an acceptable duff layer of .5 inch as measured immediately post burn.

B. Long Term Goals and Objectives

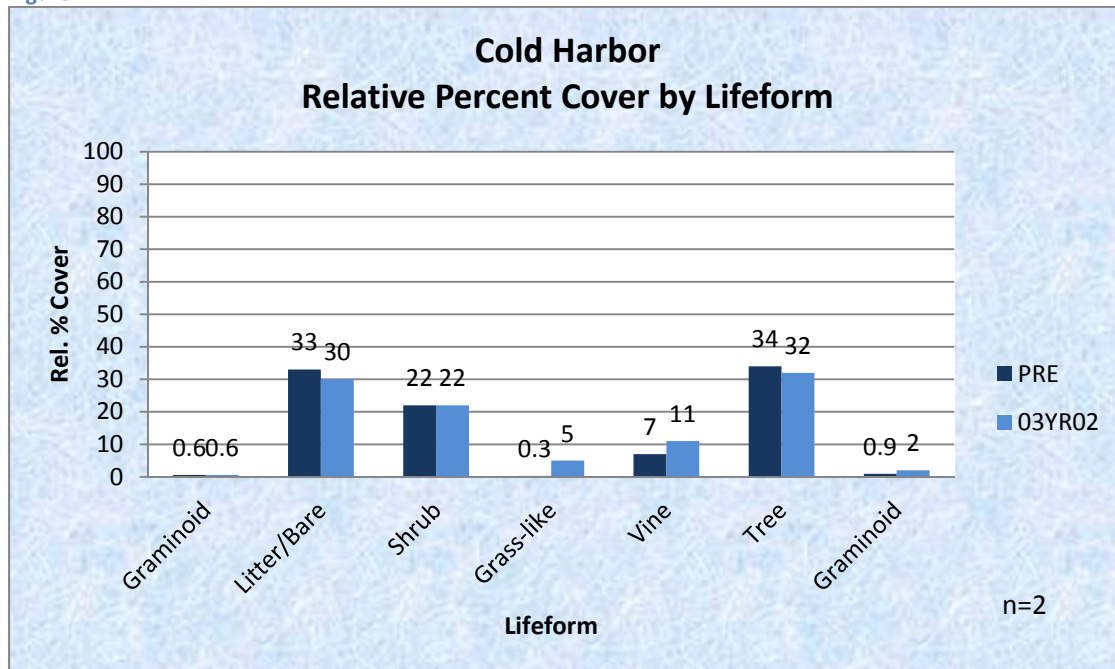
Goal Maintain the historic scene much as it was July 1, 1862.
Objectives >50% Reduction in pole size (2.5-15cm) tree density after four burns. - Increase native grasses by >75% after four burns. - Maintain an open forested stand as it appeared at the time of the battle as measured within one year post burn.
Goal Reduce the potential for a catastrophic wildfire in the wildland urban interface through fuel reduction projects adjacent to park boundaries and structures.
Objective Reduce 1,10 and 100 hour fuels by 50% within one year postburn.

Table of objectives for the Cold Harbor Unit.

Cold Harbor	>50% Reduction in pole size (2.5-15cm) tree density after four burns.	Pre: 46 pole trees 03YR02: 22 pole trees	Yes	2010
	Maintain an open forested stand as it appeared at the time of the battle as measured within one year post burn.	Photopoints on going.	Yes	2010
	Increase native grasses by >75% after four burns.	Pre: 1.2% 03YR02: 7%	Yes	2010

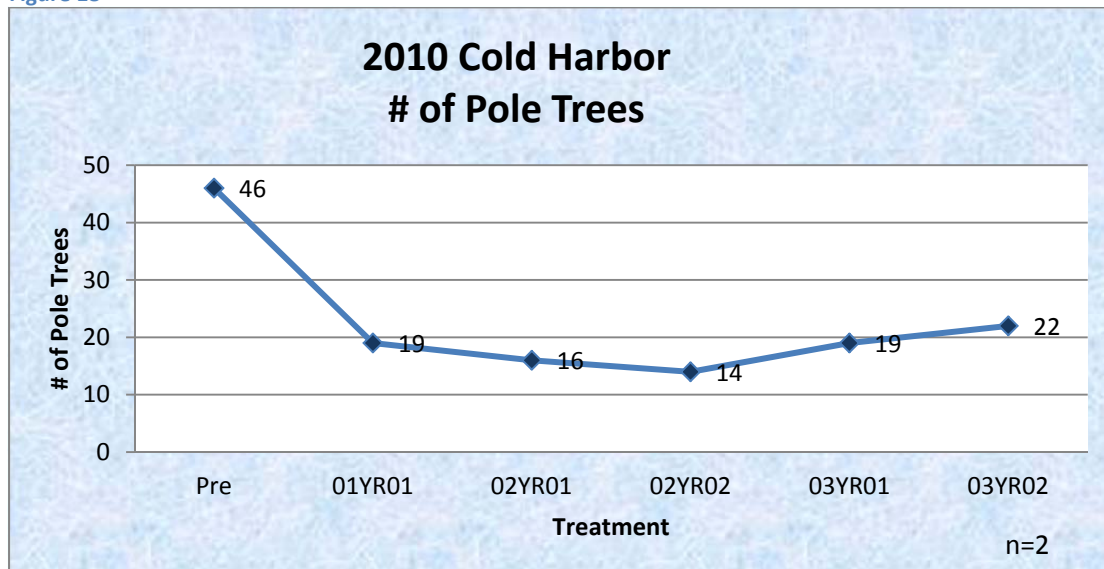
Relative percent cover by lifeform and nativity. No error bars used with two plots.

Figure 17



Number of pole trees in the Cold Harbor unit after three prescribed fires.

Figure 18



VIII. 2010 Results and Discussion – Cold Harbor

After the third burn, objectives are being met for the Cold Harbor unit. The objective to reduce shrub density cover was dropped last year due to the difficulty in accurately tallying *Ericaceous* species. There continues to be an increase in grasses and sedge species which is an excellent sign (Figure 17). This open pine habitat historically had a significant open grass understory. There have been very few non native species noted in the plot areas to date. The density of pole trees has been decreased by 50% (Figure 18) after three burns. A few seedling trees have now moved into the pole size class, however the level still remains below half of pre burn levels. Standard error was not calculated for results due to the unit only having two plots with the entire area only 20 acres in size. This unit is on schedule to be treated again in 2013.

Appomattox Courthouse (APCO)

2012 Fire Effects Monitoring Annual Report

I. Program Overview

2012 Summary

No prescribed burns or monitoring took place at Appomattox Courthouse this year, therefore additional data analysis was not completed. Prescribed burns are planned for 2013 include the Ferguson Field and four additional grass units.

Future Plans

2010 data analysis indicate the achievement of all but one objective in the Ferguson Field. With the onset of smaller travel budgets and increasing workloads the monitoring interval will be modified to every three years. This will continue to provide the necessary data to evaluate whether management goals and objectives are being met and whether undesired effects are occurring. The Ferguson Field and N.C. woodlot unit will be monitored after it is burned. This may occur in spring 2013 at the discretion of park management.

II. Park Overview

APCO is located in Appomattox County, Virginia, and is comprised of 1,743 acres that contain a number of nationally significant cultural resources, the majority of which are historical in nature. Natural resources include woodlands, wetland systems, cultivated fields and grasslands, and various small creeks that, altogether, present a landscape relatively unchanged since 1865. The acreage of the park is comprised of: 45% agricultural fields (approximately 400 acres are leased), pastures, and lawns, 45% forests, 6% streams /wetlands, and 4% developed areas.

On April 9, 1865, after four years of Civil War, approximately 630,000 deaths and over 1 million casualties, General Robert E. Lee surrendered the Confederate Army of Northern Virginia to Lieutenant General Ulysses S. Grant, at the home of Wilmer and Virginia McLean in the rural town of Appomattox Court House, Virginia.

III. Ferguson Field

Most of the grassland areas in the park have been managed in one form or another for years. Currently, approximately 400 acres of grasslands are managed for cool-season grasses (primarily fescues) for hay production (~200 acres) and for pasture for cattle grazing (~ 200 acres) through the Historic Property Leasing Program. Fifty-four acres (Sweeney Prizery Field and Village Back Field) are managed as native, warm-season grasses for hay production through the same program. Forty-two acres (Ferguson Field and Upper Nash Field) are managed as a mature grassland community.

The Mid-South historically contained vast acreages of native grassland and savannas with scattered trees and shrub cover, which was maintained by fire. Through the years, these have been replaced with non-native grasses such as meadow fescue (*Schedonorus pratensis*). Agriculture, trees and suburban development have also replaced open fields with Native Warm Season Grasses (NWSGs). Native warm season grasses provide critical habitat for numerous songbirds and wildlife species. These native grasslands are the most endangered ecosystems in the Mid-South and as a result of their loss numerous wildlife and grassland bird species have experienced steep, long term declines.

The vegetation of the Ferguson Field is characterized by native perennial grasses include *Andropogon virginicus*, *Tridens flavus*, *Sorghastrum nutans*, *Panicum virgatum* and *Andropogon gerardii*. Non-native perennial grass is mostly meadow fescue (*Schedonorus pratensis*). Annual grasses include many *Panicum* species. Native forbs, shrubs and trees include *Solidago* species, *Erechtites hieracifolia*, *Symphoricarpos orbiculatus*, *Rubus* species, *Juniperus virginiana*, and *Pinus virginiana*. Invasive, non-native vegetation includes *Rosa multiflora* and *Centaurea maculosa*. Ferguson field was a pasture utilized for cattle grazing until 2001. The field was treated with a selective herbicide in 2002 to reduce non-native perennial grasses and replanted with a mixture of Native Warm Season Grasses (NWSGs) including *Sorghastrum nutans*, *Panicum virgatum* and *Andropogon gerardii*. The field was first burned in the spring of 2009. A few weeks following the initial prescribed fire, the Mid Atlantic Exotic Plant Management Team re-treated the newly re sprouting cool season meadow fescue (*Schedonorus pratensis*). This combination of burning and follow up spraying was notably successful at reducing the coverage of this non native grass. Map of Ferguson Field grassland plots.

Figure 19



IV. Goals and Objective

Goals

The primary goal is to maintain the historic scene of April 9, 1865 that the park commemorates, while creating a diverse grassland habitat. This is being accomplished by mechanically removing the trees, herbicide treatment of exotic vegetation, bushhogging, and through the use of prescribed fire.

Burn Objectives

- >90% consumption of fine fuels as measured immediately post burn.
- < 5% mineral soil exposure prior to green up as measured immediately post burn.

Monitoring Objectives

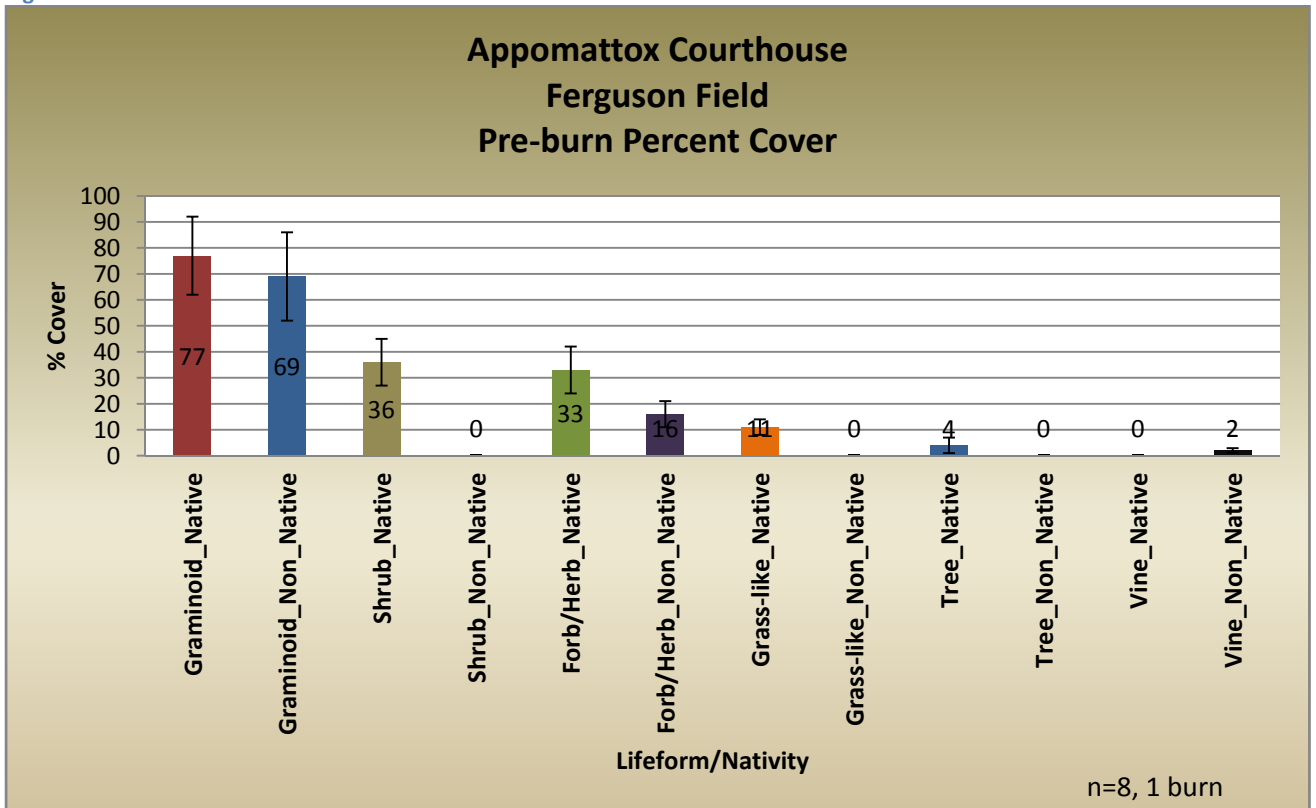
- Percent cover of woody species < 25% as measured after three treatments.
- Percent cover of non-natives grasses and forbs < 25% as measured after three treatments.
- Percent cover of native grasses and forbs >75% as measured after three treatments.

2010 data. Table of objectives for fields at APCO.

Ferguson Field Mixed Grassland	Maintain percent cover of woody species <25%	Woody species = 9 (± 3)	Yes	2010
	Percent cover of non-natives grasses and forbs < 25%.	Non-native grass = 38 (± 7) Non-native forbs = 10 (± 4)	Yes	2010
	Percent cover of native grasses and forbs >75%.	Native grasses = 83 (± 7) Native forbs = 13 (± 4)	Yes	2010

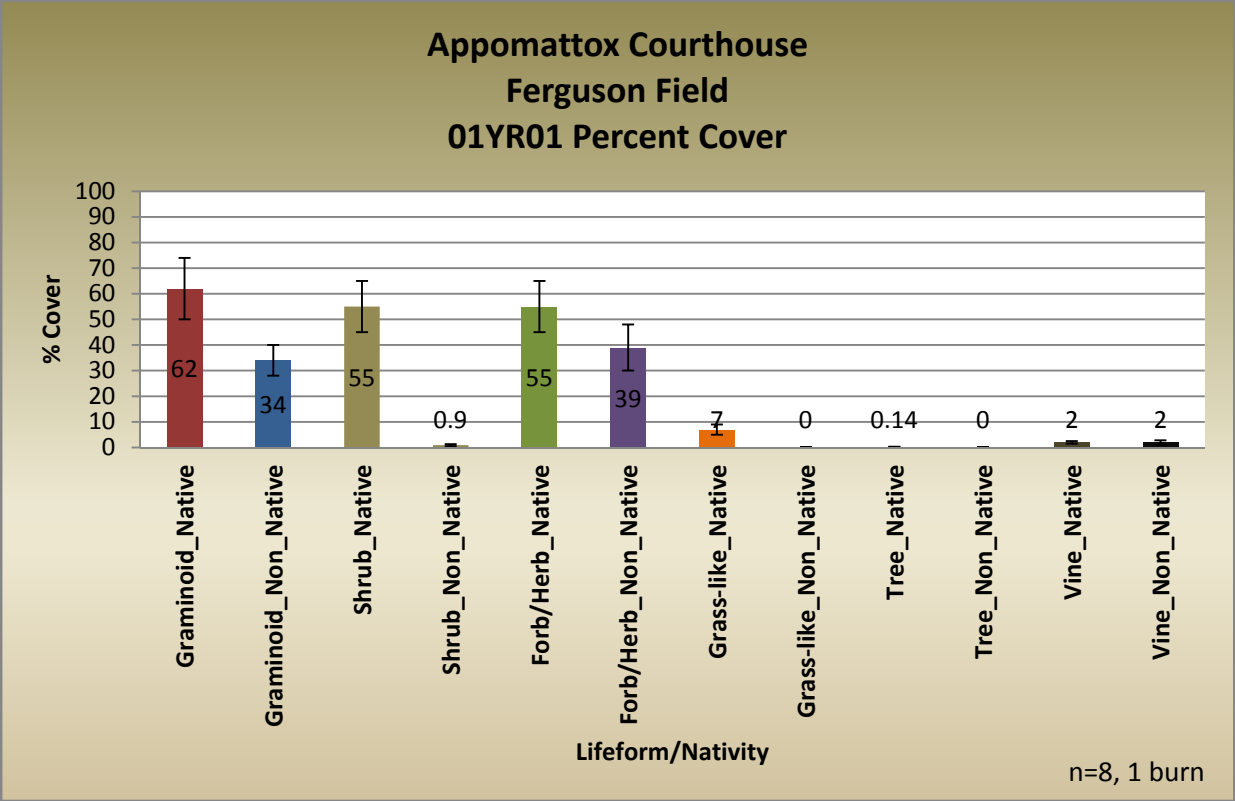
Percent cover by lifeform and nativity for Ferguson Field pre burn.

Figure 20



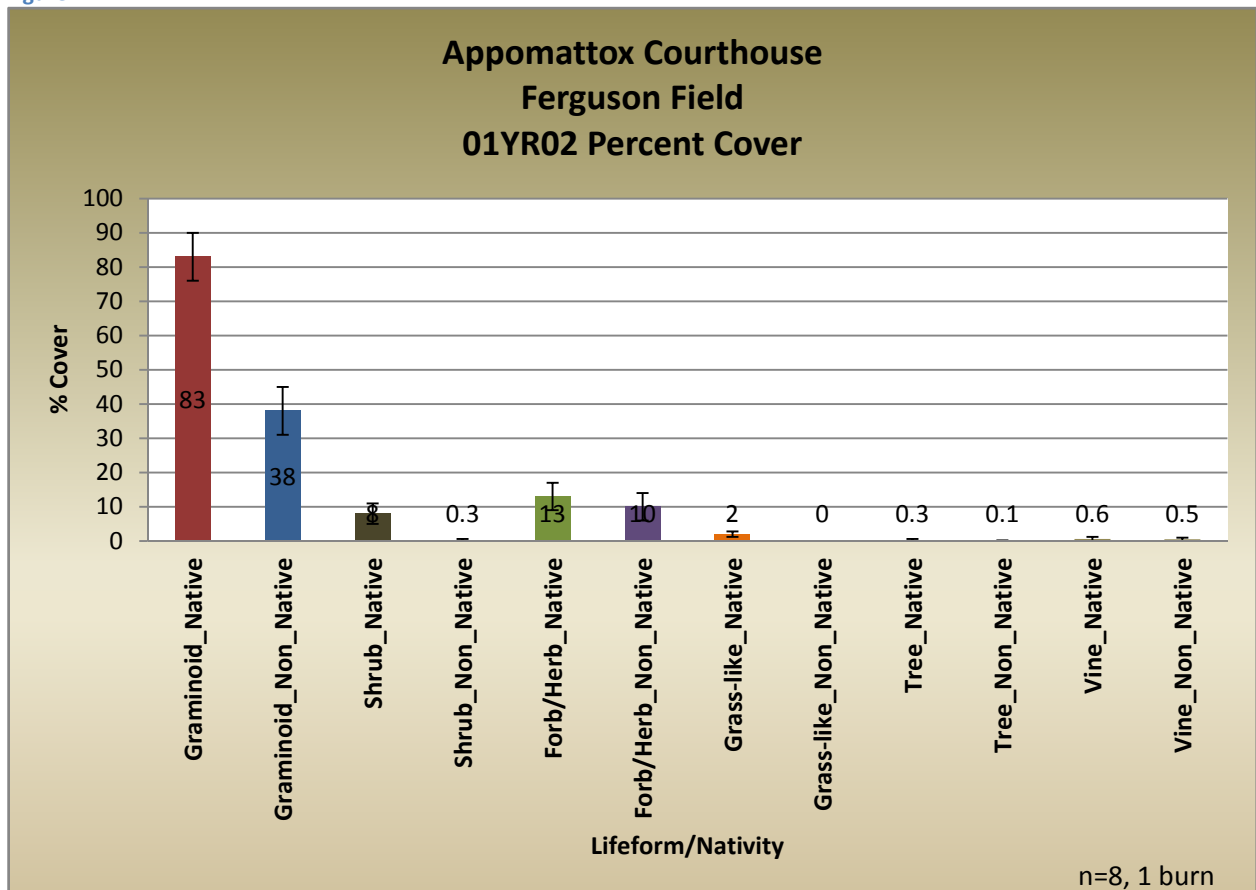
Percent cover by lifeform and nativity for Ferguson Field after one prescribed fire, year one.

Figure 21



Percent cover by lifeform and nativity for Ferguson Field after one prescribed fire, year two.

Figure 22



V. Results and Discussion – Ferguson Field

A combination of prescribed fire and herbicide treatment has been used throughout the field to meet management objectives. Native warm season grasses have continued to show an increase in the second year of monitoring after the initial prescribed fire. Percent cover of native grasses is 83% (± 7) (Figure 22) in 2010 compared to 77 (± 15) (Figure 20) in pre burn monitoring. More remarkably non native grasses have decreased from 69% (± 17) (Figure 20) to 38% (± 7) (Figure 22). In early 2010 the Mid Atlantic Exotic Plant Management Team (EPMT) treated large patches of fescue with the herbicide Glyphosate. While non native grass cover still exceeds the objective to maintain cover < 25%, significant progress has been made after one burn in meeting this objective. Furthermore, shrub levels have decreased from 36% (± 9) (Figure 20) in pre burn monitoring to 8% (± 3) (Figure 22). The Mid Atlantic EPMT also treated much of the field with Garlon 4 in early spring/summer 2010 to control the highly invasive non native herb spotted knapweed. The spotted knapweed rosettes accounted for 55% (± 10) (Figure 21) cover after the initial burn treatment. After the herbicide treatment, percent cover had been reduced to 10% (± 4) (Figure 22). The herbicide application also impacted native herb cover with a decrease from 55% (± 10) (Figure 21) in 2009 to 13% (± 4) (Figure 22) in 2010. Native herbaceous plant cover are expected to rebound in the next few years as the knapweed is kept in check through spot herbicide treatments. This multi -faceted approach of burning and herbicide application appears to be effective in restoring this native warm season grass fields after being managed as pasture lands for many years.

VI.

NC Woodlot

Forested areas in the park include both natural and semi-natural stands of hardwoods and pine. The natural dominant forest type is oak-pine with oak species being dominant. Other tree species of lesser dominance include black walnut, shortleaf pine, Virginia pine, loblolly pine, sweetgum, black gum, black cherry, sycamore, tulip poplar, dogwood, redbud, sweet bay magnolia, red maple, hickory, and eastern redcedar. The understory is dominated by eastern redbud, sassafras, flowering dogwood, red maple, and black gum. Small stands of eastern redcedar also exist throughout much of the park. An abundance of mid-story and understory stems are present in most units. Most of the forest floor is densely shaded.

Map of forest plots at Appomattox Courthouse.

Figure 23



VII. Goals and Objective

Restore the cultural landscape associated with the Civil War Era 1865 that the park commemorates while restoring and promoting oak regeneration.

Burn Objectives

- Reduce >50% of the fine fuels over 75% of the unit as measured immediately post burn.
- Reduce pole sized trees by >30% as measured within one year post burn.
- Maintain >80% overstory oak trees as measured within one year post burn.

Monitoring Objectives

- >50% reduction in total fuel loading as measured after three treatments.
- >70% reduction in pole size tree density as measured after three treatments.
- >200 Oak seedlings per acre >60cm as measured after three treatments.
- >20% cover of native herbs as measured after three treatments.
- <20% cover of non-native species as measured after three treatments.

VIII. Discussion

Three pre burn forest monitoring plots were installed in 2010. The planned prescribed fire for 2011 was cancelled. Burning in this area may not occur until management changes .