

**National Park Service
Ozark Highlands Fire Ecology Cluster
Fire Ecology Annual Report
Calendar Year 2005**

Introduction

Ozark Highlands Fire Ecology Cluster provides fire effects monitoring support to five different national park units including Ozark National Scenic Riverways in Missouri, Buffalo National River in Arkansas, Pea Ridge National Military Park in Arkansas, Hot Springs National Park in Arkansas, and George Washington Carver National Monument in Missouri. OZAR, BUFF, PERI, and HOSP currently have active monitoring programs with established National Park Service (NPS) Fire Monitoring Handbook (FMH) plots. Please see Tables 1 and 3 for detailed information regarding plots monitored and management objectives. Please see Table 2 for a staffing summary.

Summary

All data for OZAR, BUFF, and PERI was successfully converted from the FMH program to FEAT in early April. During the 2005 burn season in the Ozarks, all of the fires at Ozark National Scenic Riverways were monitored for fuel reduction, fire weather, fire behavior, and smoke production. Fuels plots were established in all nine FY05 burn units prior to the winter/spring burning season with pre and post reads completed since many of these burn's objectives included hazard fuel reduction. Susan Farrington was hired as the assistant lead fire effects monitor in mid May and was tremendously valuable with her Missouri botany skills. This year's crew worked very well together and accomplished everything on schedule. All plots were successfully completed and monitored by mid September. All the seasonals went to fire school in June and everyone was red carded. Adam Luraas went on a severity assignment with a FWS engine from Minnesota to St. George, UT, from late July to early August. They patrolled the Arizona strip district of the BLM and Adam worked as an ICT4 trainee. Shaun Collins, seasonal fire effects monitor, went on an OZAR fire engine to the Wallowa-Whitman NF in Oregon on a severity assignment the end of August for two weeks. Dan Swanson went on a 20 person crew to Louisiana in mid September to help with trailer / mobile home inspection and parking associated with the Hurricane Katrina recovery.

Table 1. Ozark Highlands Fire Effects Plot Workload 2005

Park	Monitoring Unit	Type of Plot (FMH, photo point, other)	Plot Locations	Pre-Burn	Immed. Post	Post-burn (1-20 yrs.)	Total Plots Reads
Ozark National Scenic Riverways	Glade/Transition	Modified FMH forest plot	18	0	1	8	9
	Dry-Mesic Woodland (Oak/Hickory/Pine)	FMH forest plot	12	2	0	2	4
	Dry Woodland (Oak/Hickory/Pine)	FMH forest plot	14	2	1	8	11
	Various	Fuels	61	48	42	0	90
	Total		105	52	44	18	114
Buffalo National River	Glade/Savannah/Woodland	Modified FMH forest plot	10	0	2	10	12
	Mixed Oak Forest/Dry Woodland	FMH forest plot	10	0	3	10	13
	Open Fields/Cane Communities	FMH grass plot	2	0	0	2	2
	Mixed Oak Forest/Dry Woodland	Fuels	4	0	4	0	4
	Mixed Oak Forest/Dry Woodland	CBI	na	na	na	na	na
	Total		26	0	9	22	31
Pea Ridge National Military Park	E. red cedar/Mixed Hardwood/Old Fields/Disturbed Sites	None established to date	0	na	na	na	na
	Oak Hickory Forest/Woodland	FMH forest plot	3	0	0	0	0
	Post oak-blackjack oak savannah/woodland	FMH forest plot	3	0	0	1	1
	Restored Prairies/Fields/Glades	FMH grass plot	2	0	0	2	2
	Total		8	0	0	3	3
Hot Springs National Park	Pine-Oak Dry Woodland	FMH forest plot	2	2	0	0	2
	Wildland-urban interface	Mechanical thinning plot	4	4	0	0	4
	Total		6	8	0	0	6
TOTAL			145*	58	53	43	156

*Total Plot Reads indicate plot visits and TOTAL Plot Locations indicates number of permanent plots

Table 2. Ozark Highlands Fire Ecology Staffing 2005

Personnel	Starting Date	Ending Date	# of Pay Periods	Training and Development	Fire Assignments
Dan Swanson, Fire Ecologist	NA	Permanent, full time	26	S-491, L280, botany, I-200, I-300	Hurricane Katrina relief, Baton Rouge, LA, 18 days
Adam Luraas, Lead Monitor	1/10/05	Permanent, STF 12/9/05	24	S-200, RX-310, L-280, Paraprofessional Archeology, S270, Aircraft Safety, botany	Fire Severity, Utah, BLM-Arizona Strip District, St. George, UT, 18 days
Susan Farrington, Assistant Lead Monitor	5/16/05	9/29/05	10	Basic Fire School, botany	NA
Shaun Collins, Monitor	5/16/05	9/29/05	10	Basic Fire School, botany	Fire Severity, Oregon, Wallowa-Whitman NF, LaGrande, OR, 20 days
Emily Baker, Monitor	5/16/05	8/14/05	7	Basic Fire School, botany	NA

Aaron Stevenson, Monitor	6/27/05	8/14/05	4	Basic Fire School, botany	NA
Michele Disney, Fire Monitor	1/10/05	5/26/05	10	L-280, S-270	NA



Figure 1. 2004 Ozark Highlands Fire Effects Crew



Figure 2. Typical backing fire behavior in Ozarks



Figure 3. OZAR fire personnel igniting field next to Current River



Figure 4. Fire effects monitoring in Ozarks glade

Table 3. Ozark Highlands Management Objectives and Monitoring Results 2005

Park	Monitoring Unit	Management Objective	Monitoring Results	Objective Achieved
Ozark National Scenic Riverways	Glade/Transition	Reduce the density of trees > 1.4 m tall and < than 10 cm dbh by at least 40% ; (80% C.I.)	29% Decrease	No
		increase the average number of species (per quadrat) in the herbaceous layer by at least 40% within two growing seasons after the second burn (90% C.I.)	22% Increase	No
	Dry-Mesic Woodland (Oak/Hickory/Pine)	Reduce the density of trees > 1.4 m tall and < than 10 cm dbh by at least 30% ; (80% C.I.)	48% Decrease	Yes
		increase the average number of species (per quadrat) in the herbaceous layer by at least 20% within two growing seasons after the second burn (90% C.I.)	67% Increase	Yes
	Dry Woodland (Oak/Hickory/Pine)	Reduce the density of trees > 1.4 m tall and < than 10 cm dbh by at least 30%; (80% C.I.)	60% Decrease	Yes
		increase the average number of species (per quadrat) in the herbaceous layer by at least 40% within two growing seasons after the second burn (90% C.I.)	79% Increase	No
Buffalo National River	Glade/Savannah/Woodland	Herbaceous layer – increase cover of native species by 40% after 10 years of burning; (90% C.I.)	5% Increase ¹	NA
		reduce stem density by 60% after 10 years of burning; (80% C.I.)	4% Increase ¹	NA
		reduce new growth eastern red cedar by 95% after three consecutive burns (90% C.I.)	44% Increase ¹	NA
		¹ two seasons after 1 st burn treatment		
	Dry Woodland	Reduce tree density to open vista with a target density of 30-50 trees/acre after 20 years (80% C.I.)	117 tpa	NA
		reduce pole density by 60% after 10 years of burning; (80% C.I.)	46% Decrease ¹	NA
Pea Ridge National Military Park	E. Red Cedar/Mixed Hardwood/Old Fields/Disturbed Sites	reduce live stems/acre by 60 % over 10 years of burning (90% C.I.)	NA	NA
		¹ two seasons after 1 st burn treatment		
	Oak Hickory Forest/Woodland	Open fields - Maintain/restore/introduce native grass species and increase percent cover of native species by 25% after three prescribed burn applications (80% C.I.)	NA	NA
		Cultural/historic - Maintain historical farmstead openings, establish monitoring photopoints, maintain woody species density at 90% of preburn level within open fields over 10 years of burning (80% C.I.)		
		Cane communities - maintain or increase size of cane community after 10 years of burning (90% C.I.)		
Pea Ridge National Military Park	Post oak-blackjack oak savannah/woodland	Reduce mean density of pole-sized trees (2.5-15cm dbh) by 30-40% after four burns; (80% C.I.)	NA	NA
		increase mean density of oak seedlings and/or resprouts by 300-500% after four burns; (80% C.I.)		
		increase mean percent cover of native herbaceous species by 50-70% after four burns. (80% C.I.)		
Pea Ridge National Military Park	Oak Hickory Forest/Woodland	Reduce mean density of pole-sized trees (2.5-15cm dbh) by 50-70% after four burns; (80% C.I.)	NA	NA
		increase mean density of oak seedlings and/or resprouts by 300-500% after four burns. (80% C.I.)		
Pea Ridge National Military Park	Post oak-blackjack oak savannah/woodland	Reduce mean density of pole-sized trees (2.5-15cm dbh) by 50-70% after four burns; (80% C.I.)	NA	NA
		increase mean percent cover of native herbaceous		

		species by 60-100% after four burns (80% C.I.)		
	Restored Prairies/ Fields/Glades	Reduce mean percent cover of live trees, shrubs, and woody vines by 75-85% after four burns; (80% C.I.) reduce the mean percent cover of non-native species by 30-40% after four burns (80% C.I.)	NA	NA

Ozark Highlands Fire Ecologist Accomplishments

During the late winter and early spring of 2005 I successfully converted all the FMH data into the FEAT program for each of the parks that we have fire effects data: Ozark National Scenic Riverways, Buffalo National River, and Pea Ridge National Military Park. After the conversion I worked to more efficiently organize the structure that the data was stored to minimize data entry errors. Recently, I've been involved in testing the summary builder within FEAT to assess the accuracy of its calculations. This year I was able to start analyzing the fire effects data for each of the park units. Many of the objectives at Ozark National Scenic Riverways have been addressed and longer term objectives need to be developed. The objectives at Buffalo National River are long-term (10 to 20 years post initiation of prescribed burn program) and, I need to develop some objectives in the five to seven year frame. Therefore, the current analysis can only be looked at for trends right now.

Table 4. Fire Ecologist Accomplishments/Focus Area

Category	Percent Time	Accomplishments/Focus Areas
General Planning	4%	Reviewed and made comments on Park Vegetation map and fuels map.
Monitoring Plans	0%	
Presentations	4%	Park staff, public meetings and training, etc.
NPS Meetings/ Task Groups	7%	Park, regional or national – FMH to FEAT data conversion working group, testing of summary builder
Interagency Work	4%	FRCC
Fire Assignments and Fuels Projects	11%	FEMO on 5 RX fires (5 operational shifts), FFT2 on 7 RX fires (8 operational shifts), FEMO on 1 WF fire (1 operational shift), FFT2 on 3 WF (4 operational shifts), FFT1(T) on 1 WF (1 operational shift), FFT1(T) on hurricane Katrina recovery (14 operational periods).
Research	5%	Literature review of Ozark Highlands fire ecology research.
Monitoring Field Work	11%	Estimated amount of time spent collecting field data/working in the field.
Data Entry	1%	Estimated amount of time spent entering data from paper to PC
Data Management and Conversion	13%	Estimated amount of time spent converting FMH data to FEAT and to manage monitoring data; includes preparing species lists, error checking, learning conversion program, etc.
Data Analysis	16%	Estimated amount of time spent analyzing monitoring data.
Supervision/Admin	6%	Hiring, supervision, travel, payroll, etc.
Training & Professional Development	12%	Training, scientific meetings attended, etc.
Miscellaneous	6%	Assist with hurricane Katrina recovery.

Table 5. Fire Effects Crew Accomplishments

Category	Percent Time	Notes
FMH plots	40%	Time spent collecting plot data; including preparation time.
Mechanical Treatment plots	0%	
CBI plots	0%	
Other plot work	3%	Live / dead fuel moisture monitoring
Fire Assignments and Fuels Projects	14%	Lead went on a two week fire severity assignment as an engine boss trainee (14 operational periods), crewmember went on a two week

Category	Percent Time	Notes
		assignment as an engine crewmember (14 operational periods), Lead and assistant were on 12-14 RX fires (16 operational periods) and 5 WF (6 operational periods).
Data Entry	14%	Estimated amount of time spent entering data from paper to PC
Data Management and Conversion	13%	Managing monitoring data; includes preparing species lists, error checking, learning conversion program, etc.
Data Analysis	3%	
Supervision/Admin	5%	Travel, payroll, etc.
Training & Professional Development	8%	Training, scientific meetings attended, PT, etc.

Ozark National Scenic Riverways

Glade / Woodland Transition Monitoring Type

First I looked at relative change in density for each of the monitoring types from preburn to second growing season after second prescribed burn. There was an average 29% decrease in pole density in the glade / woodland transition monitoring type but these results were well below the target of a 40% decrease ($p > .20$) (Figure 1). Statistically, there is an 80% certainty that there is at least an 18% decrease in pole trees pre to second season after second prescribed burn. I believe that we need to burn the glade areas later in the year (mid April to May as opposed to February and March) when the trees are coming out of dormancy or actively growing in order to achieve higher pole mortality rates. Eastern red cedar pole-size trees decreased an average of 31% in density but fell short of the objective of a 40% decrease ($p > .20$) (Figure 2). There is an 80% certainty that the eastern red cedar pole trees decreased by at least 18%. Density of overstory trees actually significantly increased 21% ($p < .20$) in the glade / glade transition monitoring type (Figure 3). In addition, overstory eastern red cedar trees also significantly increased by 16% ($p < .20$) (Figure 4). Sometimes the fire spread and intensity are minimal where the cedar is dense due to lack of fuels. We are considering cutting the cedar down in the glade areas prior to the burn, letting them cure out, and then conducting the prescribed burn. The fire would then be able to spread through these areas and consume the down cedars. These glade areas could then be maintained with a prescribed burning program which would replicate the historical fire frequency and intensity for these vegetation communities. I also analyzed the change in herbaceous species richness pre to second growing season after second burn. Figure 5 shows there was an average 22% increase in species richness but this was well below the target of a 40% increase and insignificant ($p > .10$). Percent herbaceous ground cover increased significantly ($p < .10$) from 41% to 45% two growing seasons post second burn (Figure 6). Fuel loading decreased 20% from 9.9 to 7.9 tons / acre from pre to post second prescribed burn treatment.

Dry Mesic Woodland

Pole tree density significantly decreased by an average of 48% ($p < .20$) and was well above the objective of a 30% decline (Figure 7). There is an 80% certainty that the decline is at least 40%. Herbaceous species richness values significantly increased ($p < .10$) by an average of 67% and these results were much higher than the objective of a 20% increase (Figure 8). There is a 90% certainty that the increase in species richness is at least 30%. Fuel loadings decreased 24% from 12.5 to 9.4 tons / acre from preburn to post second prescribed burn. Another monitoring objective I'm considering adding is increase in herbaceous cover. Many historical accounts of Missouri's presettlement woodlands indicated that there was a rich coverage of grasses and forbs in the understory. I'm currently reading scientific literature and will be talking with Missouri Department of Conservation, Department of Natural Resources, U.S. Forest Service, The Nature Conservancy, and National Park Service experts to help come up with herbaceous cover objectives. Percent herbaceous ground cover significantly increased ($p < .10$) from 18% to 39% from preburn to two growing seasons post second burn (Figure 9).

Dry Woodland

Pole tree density significantly decreased by an average of 60% ($p < .20$) from pre burn to two years post second burn and was well above the objective of a 30% decline (Figure 10). There is an 80% certainty that the decrease is at least 52%. Herbaceous species richness increased an average of 79% from pre burn to two years post second burn but was insignificant for meeting the 40% increase objective ($p > .10$) (Figure 11). There is a 90% certainty that the herbaceous species richness increased by at least 30%. Fuel loading declined 38% from 15.3 to 9.5 tons / acre from preburn to post second prescribed

burn. Herbaceous ground cover significantly increased from 6% to 21% ($p < .10$) from pre to two growing seasons post second prescribed burn treatment (Figure 12).

Buffalo National River

Effect of Prescribed Fire on Dry Woodland Overstory and Pole Tree Density

Seven fire effects plots located in the Lower Wilderness were burned in March 2004 during a prescribed fire. Two growing seasons after the fire there was a 46% decrease in pole tree (2.5 to 14.9 cm DBH) density. This is below the 60% target value for this objective, but heading in the right direction. Second and third treatments with fire should decrease pole density to at or above the 60% threshold. Actual pole tree densities decreased from 797 trees per acre (TPA) pre-burn to 439 TPA two seasons post-burn. There was virtually no change in overstory tree (DBH >14.9 cm) density one and two growing seasons following the prescribed burn. One hundred sixteen TPA were observed prior to the burn and two seasons following the prescribed burn 117 TPA was recorded. In order to increase overstory mortality in our burn units we would need to either increase the burn intensity, delay burning to when the trees are breaking dormancy (mid April), or burn during the early fall when the trees may be water stressed due to the typically dry months of September and October. Lack of large canopy openings may also be reducing oak and pine regeneration in this monitoring type. I will be analyzing the seedling data in the near future to see how robust the seedling regeneration is as well as the seedling diversity.

Effect of Prescribed Fire on Dry Woodland Native Plant Cover

The seven fire effects plots within the Lower Wilderness burn unit were used to look at how the native plant ground cover has changed with time. Native plant ground cover significantly increased by 47% ($p < .10$) two growing seasons following the prescribed burn. This is probably attributed to the litter / duff depth reduction and pole mortality allowing more incident light to reach the ground.

Effect of Prescribed Fire on Dry Woodland Fuel loadings

Total fuel loadings decreased from 15.71 to 7.49 tons/acre two growing seasons after the Lower Wilderness prescribed burn (Table 6). The table displays average fuel loadings per time lag fuel moisture as well as litter and duff depths. Fine fuel loading (litter, duff, and 1 hr fuels combined) showed a decrease immediately following the Lower Wilderness burn from 9.19 to 7.25 tons / acre and continued declining into the 2nd growing season. This decline from the immediate postburn to 2nd growing season is probably due to the duff material becoming more compacted following precipitation events between the immediate post read and 2nd growing season. Woody fuels (10 hr and 100 hr fuels combined) decreased slightly immediately following the burn from 0.45 tons / acre to 0.38 tons / acre. The prescribed burn probably caused the initial decrease in the woody fuels immediate postburn, but then the mean rebounded back to preburn conditions due to small branches falling on the ground from the dead or dying pole trees. Heavy fuels (1000 hr fuels) decreased from 6.07 to 2.71 tons / acre immediately following the burn.

Table 6 Average fuel loading within the dry woodland monitoring type per fuel class and burn status following the Lower Wilderness RX on March 2004. Data analyzed from seven fire effects plots located within the burn unit.

Burn Status	Average Fuel Loading									
	Average depth		Average Fuel Loading							
	litter	duff	1 hr	10 hr	100 hr	1000 hr Solid	1000 hr Rotten	Litter	Duff	Total
Install	1.23	0.66	0.04	0.05	0.40	6.03	0.04	2.01	7.15	15.71
Immediate Post	0.33	0.62	0.03	0.03	0.35	2.33	0.38	0.53	6.69	10.35
2 nd Growing Season	0.65	0.28	0.03	0.04	0.41	2.76	0.16	1.06	3.02	7.49

Effect of Prescribed Fire on Glade / Woodland Transition Pole Tree Density

Eight plots from the Lower Wilderness burn unit were used to assess the affects of prescribed fire on glade / woodland transition pole density. Two growing seasons after the prescribed burn there was a 4% increase in pole density. This is probably due to only one prescribed burn treatment in the unit so far. Multiple prescribed burns over ten years will be necessary to achieve the objective of a 60 % decrease in pole density. Burning this monitoring type as the trees are breaking dormancy (early to mid April) would cause an increase in mortality of the deciduous trees. In addition we may want to mechanically thin and pile the eastern red cedar trees within the glade areas to increase fire spread. Many times the fire doesn't spread into eastern red cedar thickets due to the lack of fine dead fuels and higher moisture conditions due to

the intense shading. Also, burning the glade monitoring type during late summer and fall would probably yield higher mortality due to lower live fuel moisture values.

Effect of Prescribed Fire on Glade / Woodland Transition Eastern Red Cedar Regeneration

Out of the eight glade plots within the Lower Wilderness burn unit only one of them had more than three eastern red cedar seedlings within our sampling area prior to the burn. This plot had an approximate 44% increase in seedlings two seasons after the burn. Due to this small sample size conclusions can't be drawn with much confidence. Coupled with the results from the glade pole density data though, it appears that multiple fire entries and thinning of overgrown glade areas may be necessary.

Effect of Prescribed Fire on Glade / Woodland Transition Native Plant Cover

Native plant cover increased 5% two growing seasons after the first prescribed burn in the Lower Wilderness burn unit. This is well short of the objective of a 40% increase but this is only the first entry burn. If we can get subsequent prescribed burns to spread through these glade areas better and decrease the pole / overstory canopy coverage there will be an increase in native plant cover due to higher incident light.

Effect of Prescribed Fire on Glade / Woodland Transition Fuel loadings

Total fuel loading decreased from 10.71 to 4.42 tons / acre two growing seasons following the Lower Wilderness prescribed burn (Table 7). Fine fuel loading (litter, duff, and 1 hr fuels combined) decreased following the burn from 6.26 tons / acre to 4.40 tons / acre and continued declining to the 2nd growing season. This is the same trend that was seen with the fine fuels of the dry woodland monitoring type. Again I believe this is due to the compaction of the duff layer following precipitation events between the immediate post-read and 2nd growing season. Woody fuel loading (10 hr and 100 hour fuels combined) decreased from .17 to .11 tons / acre immediately following the burn. The second season after the burn it rebounded back to .16 tons / acre probably due to small branches falling off of dead or dying pole trees as a result of the burn. Heavy fuels (1000 hr) decreased substantially from 4.28 to .52 tons / acre immediately following the burn.

Table 7 Average fuel loading within the glade / woodland transition monitoring type per fuel class and burn status following the Lower Wilderness RX on March 2004. Data analyzed from seven fire effects plots located within the burn unit.

SCSC Average Fuel Loading										
Burn Status	Average depth		Average Fuel Loading							
	litter	duff	1 hr	10 hr	100 hr	1000 hr S	1000 hr R	Litter	Duff	Total
Install	1	0.43	0.04	0.03	0.13	4.18	0.11	1.63	4.6	10.71
Immediate Post	0.47	0.33	0.04	0.03	0.08	0.17	0.36	0.76	3.6	5.04
2 nd Growing Season	0.45	0.27	0.02	0.08	0.08	0.61	0	0.73	2.96	4.42

Pea Ridge National Military Park

As of yet very little statistical analysis has been done with the data. Currently we have very small sample sizes for each of our monitoring types so there isn't much power in the data analysis. Average total fuel loading increased from 15.2 to 17.1 tons / acre one year postburn for the Oak hickory monitoring type. This can be attributed to the increase in 1000 hr fuels that fell on the ground due to the burn. Within the post oak and blackjack oak monitoring type the average total fuel loading decreased 19% from 10.3 to 8.3 tons / acre.

Hot Springs National Park

Four pre mechanical thinning monitoring plots were established in WUI treatment areas that are proposed for thinning spring of 2006. Attributes that are measured include overstory trees, pole trees, shrubs, exotic species, dead and downed wood, litter, and duff. Appropriate objectives still need to be established for the monitoring plan and this will be done with Buffalo's FMO as well as staff at Hot Springs NP. Two FMH plots were established in an oak-pine woodland within the North Mountain burn unit that is proposed for a spring 2006 prescribed burn. Appropriate monitoring objectives and monitoring type descriptions still need to be developed.

2006 Outlook and Program Challenges/Solutions

I will continue analyzing the fire effects data for each of the park units to help determine if we are on track with desired future ecological conditions. This information will help us determine if we need to alter the seasonality, intensity, frequency, or firing methods when we conduct prescribed burns. This field season we will start collecting some or all of our fire effects data with PDA's. We need to determine how much more efficient this method of data collection is as well as the potential data entry errors that may result from it. New FMH plots will be established within Ozark National Scenic Riverways and Buffalo National River while more mechanical thinning plots put in at Hot Springs National Park.

Fire regime and condition class (FRCC) will be implemented for the 2006 field season at Ozark National Scenic Riverways, Buffalo National River, and Hot Springs National Park into each burn unit so we can compare historic vegetation/structure and fire frequency/severity to current levels and see what our departure is. We will assess these sites after the completion of prescribed burns to see if we indeed are returning vegetation communities back to reference conditions.

Figure 1 Relative change in pole tree density (DBH < 15.0 cm) within the glade / woodland transition monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 80% confidence intervals.

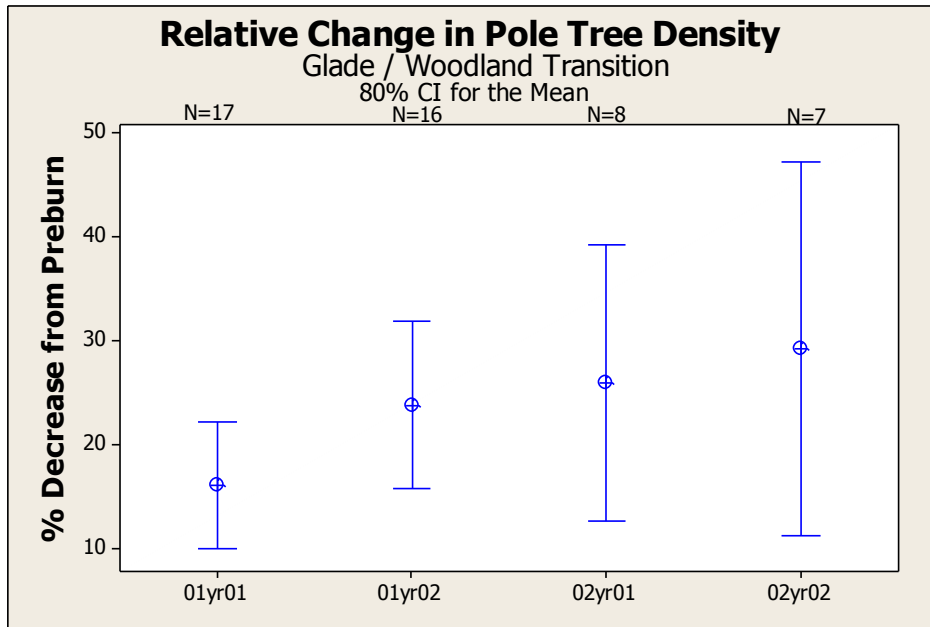


Figure 2 Relative change in cedar pole tree density (DBH < 15.0 cm) within the glade / woodland transition monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 80% confidence intervals.

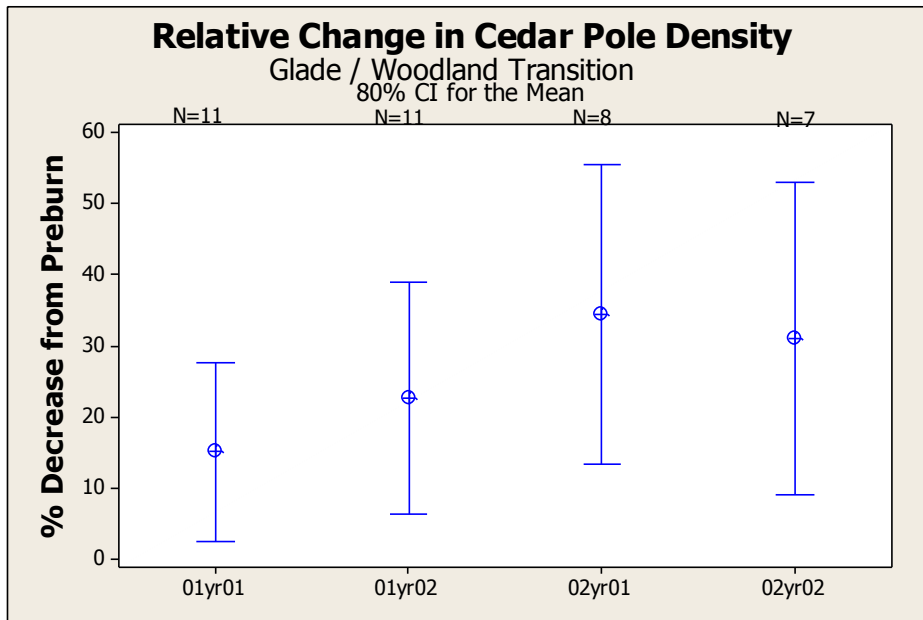


Figure 3 Relative change in overstory tree density (DBH ≥ 15.0 cm) within the glade / woodland transition monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 80% confidence intervals.

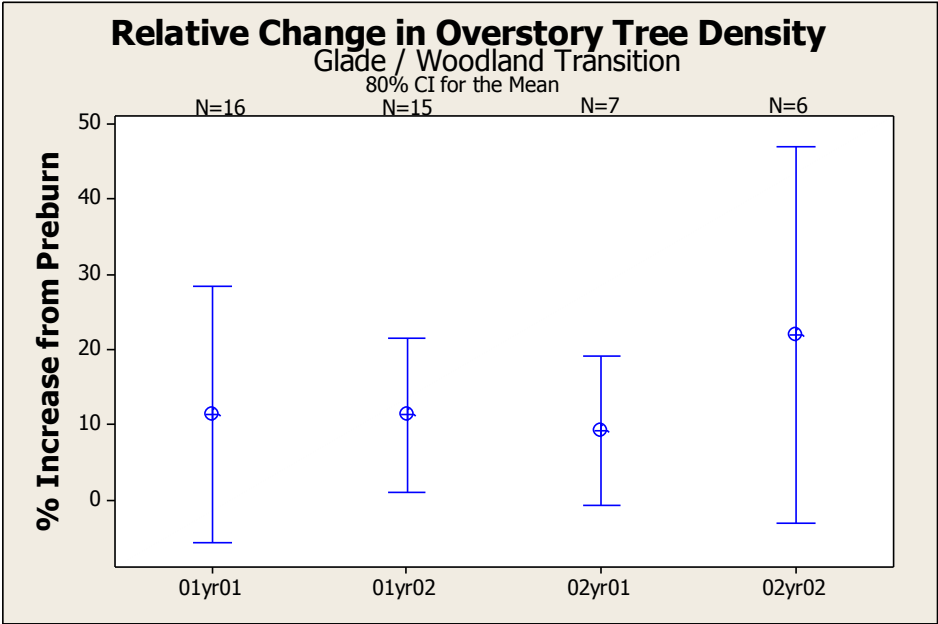


Figure 4 Relative change in overstory cedar tree density (DBH ≥ 15.0 cm) within the glade / woodland transition monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 80% confidence intervals.

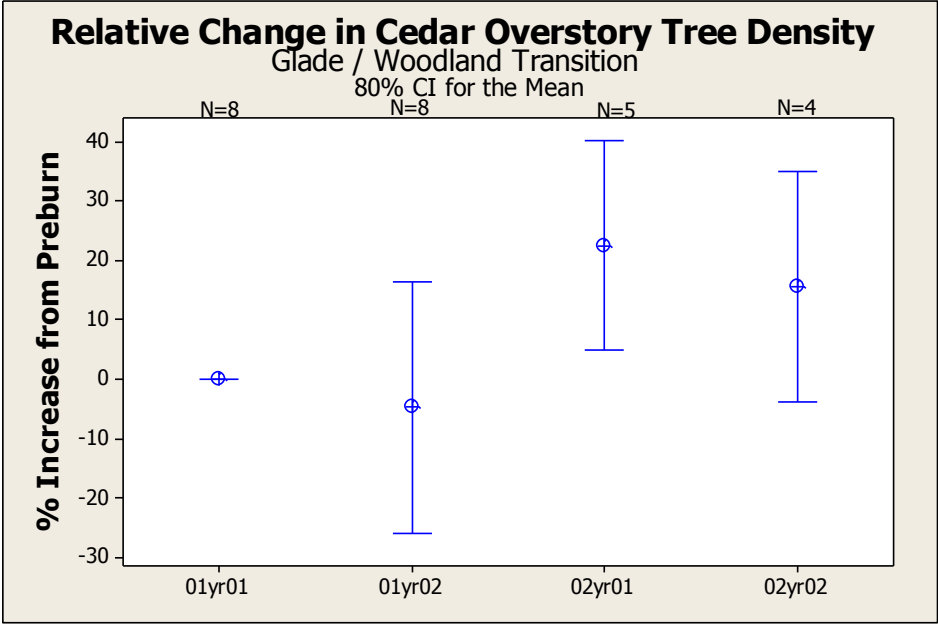


Figure 5 Relative change in herbaceous species richness within the glade / woodland transition monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 90% confidence intervals.

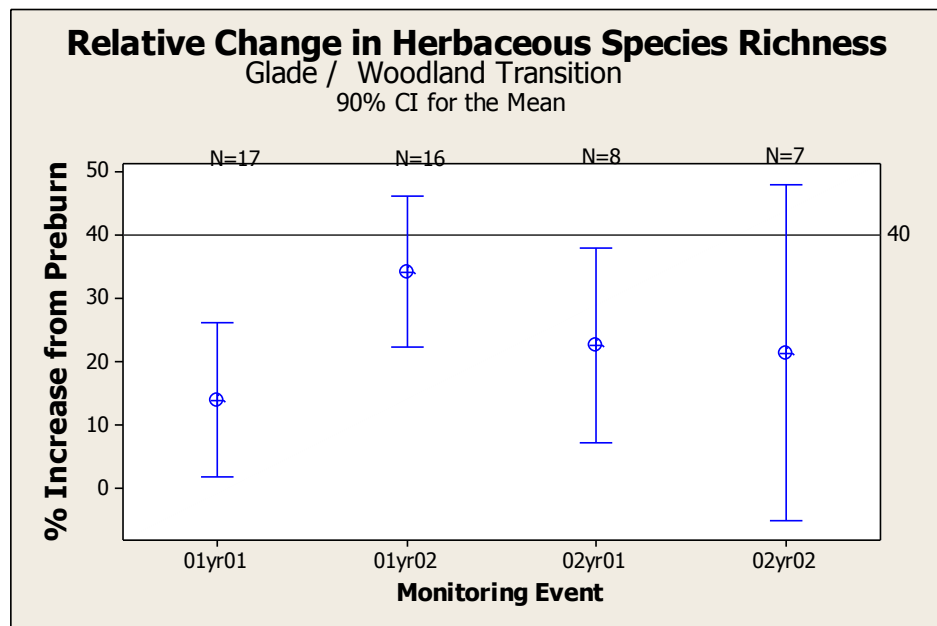


Figure 6 Herbaceous ground cover within the glade / woodland transition monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 90% confidence intervals.

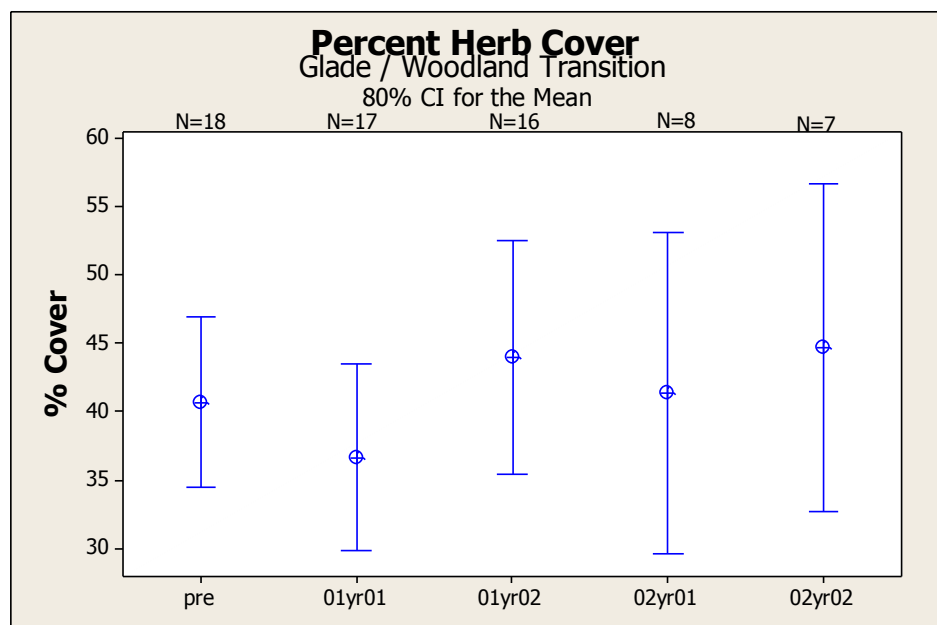


Figure 7 Relative change in pole tree density (DBH < 15.0 cm) within the dry-mesic woodland monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 80% confidence intervals.

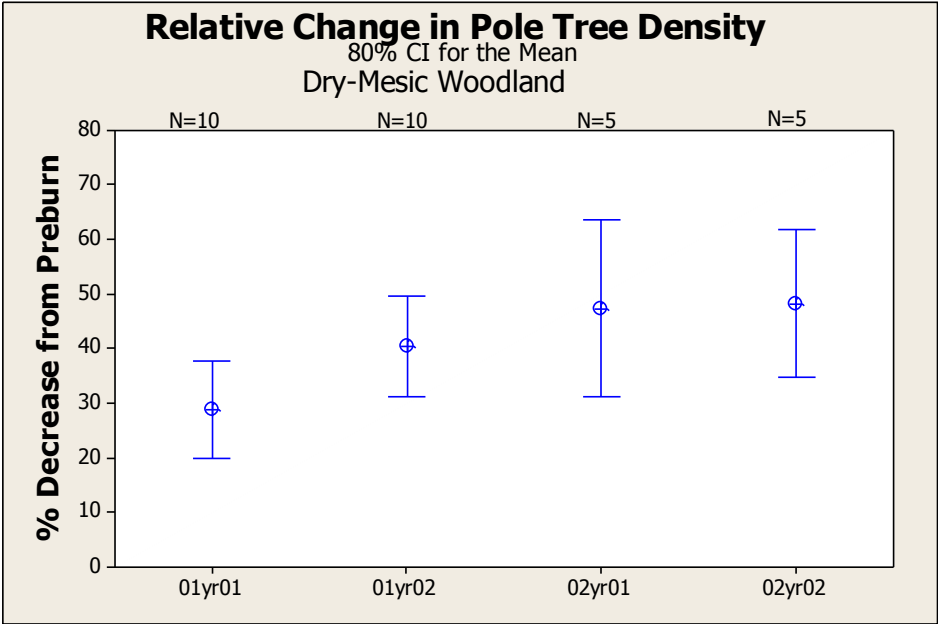


Figure 8 Relative change in herbaceous species richness within the dry-mesic woodland monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 90% confidence intervals.

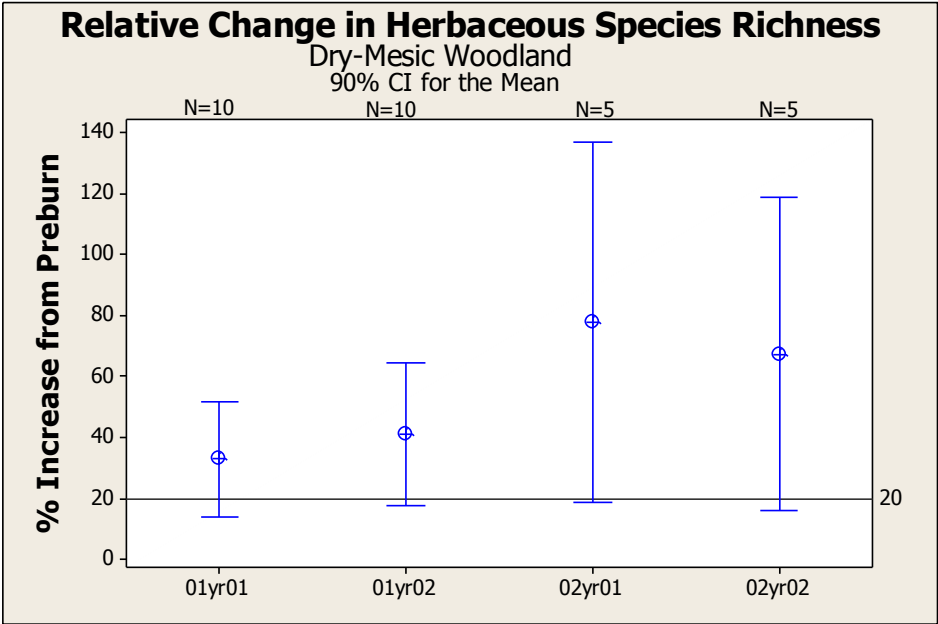


Figure 9 Herbaceous ground cover within the dry-mesic woodland monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 90% confidence intervals.

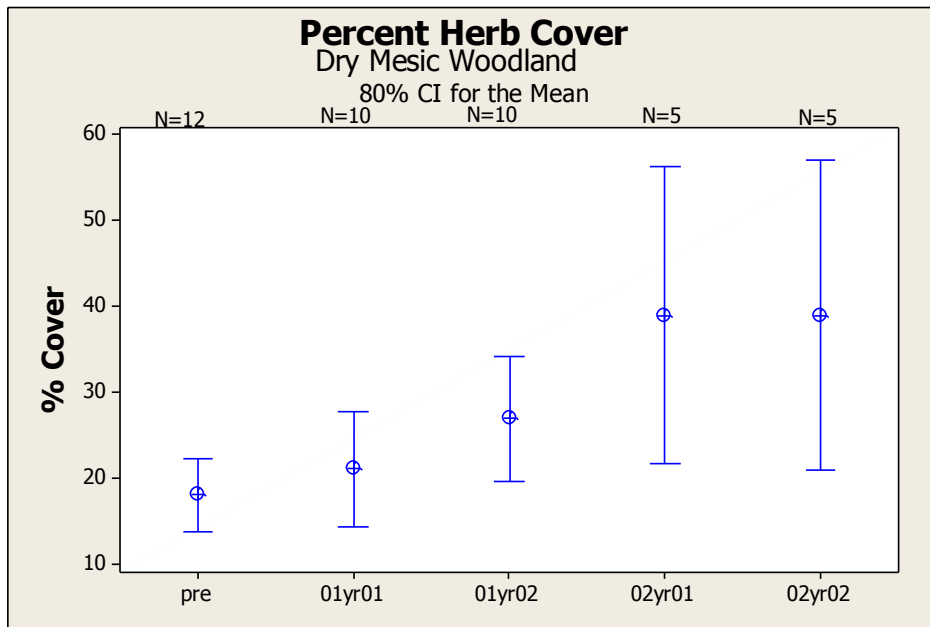


Figure 10 Relative change in pole tree density (DBH < 15.0 cm) within the dry woodland monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 80% confidence intervals.

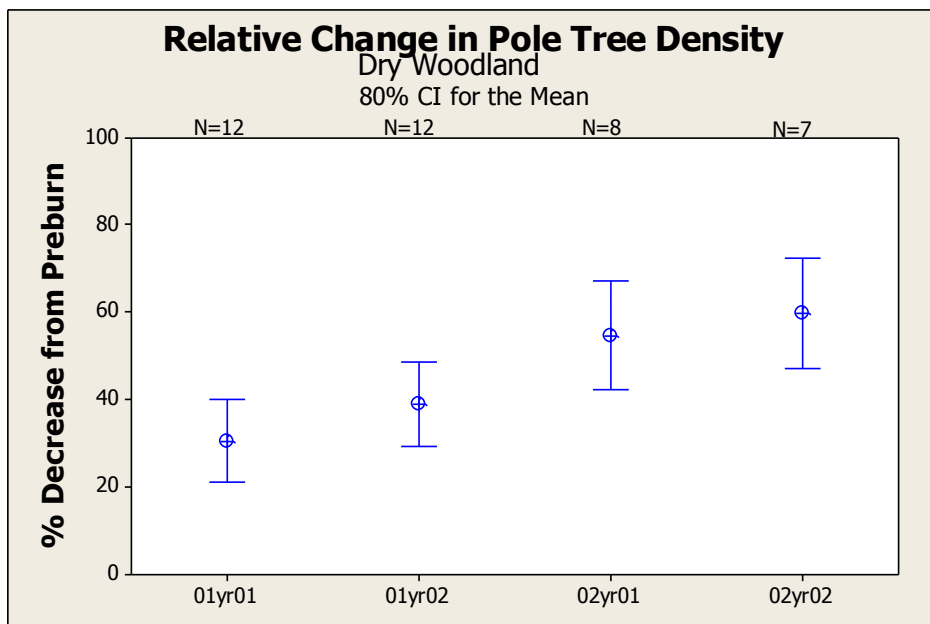


Figure 11 Relative change in herbaceous species richness within the dry woodland monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 90% confidence intervals.

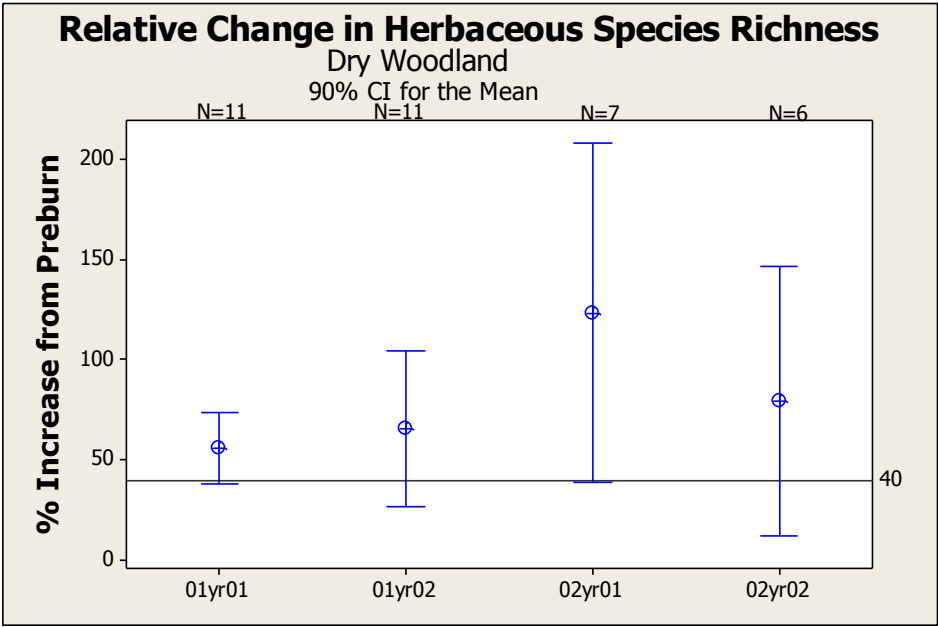


Figure 12 Herbaceous ground cover within the dry woodland monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 90% confidence intervals.

