



**National Park Service
Ozark Highlands Cluster
Fire Ecology Annual Report
Calendar Year 2006**

Summary

2006 was a very successful year for the Ozark Highlands fire effects cluster. All fire effects plot installations and rereads were completed by the end of the field season even with the crew pared down mid to late summer due to the busy fire season. FRCC was implemented at Ozark NSR, Buffalo NR, and Pea Ridge NMP while CBI plots were conducted at two burn units at Ozark NSR and an adjacent Mark Twain NF unit. The first prescribed burn at Hot Springs NP was conducted in over twenty years and our crew was able to document the positive fire effects from it. In addition six more plots were established within the oak-hickory forest and post oak-blackjack oak woodland monitoring types at Pea Ridge NMP which will allow a greater depth to analysis. A poster was produced documenting the fire effects of the first prescribed burn within the Lower Wilderness at Buffalo NR and displayed at the Midwest fire management meeting.

Table 1. Fire Effects Plot Workload 2006

Park	Monitoring Unit	Type of Plot (FMH, photo point, other)	Pre-burn	Immed. Post	Postburn (1-20 yrs)	Total Plots
Ozark NSR	Glade/Woodland Transition	Modified FMH forest plot	0	5	7	18
Ozark NSR	Dry Mesic Woodland Oak/Hickory	FMH forest plot	2	6	7	14
Ozark NSR	Dry Woodland Oak/Hickory/Pine	FMH forest plot	2	5	6	16
Ozark NSR	Various	Fuels	0	0	0	61
Ozark NSR	Various	CBI	0	0	34	34
Buffalo NR	Glade/Woodland Transition	FMH Forest plot	0	0	2	10
Buffalo	Dry Woodland	FMH Forest plot	7	0	3	17

NR	Oak/Hickory/Pine					
Pea Ridge NMP	Oak Hickory forest/Woodland	FMH Forest plot	3	0	0	6
Pea Ridge NMP	Post Oak – Black Jack Oak Woodland	FMH Forest plot	3	0	0	6
Pea Ridge NMP	Restored Prairie/Fields/Glades	FMH Grass plot	0	0	0	2
Hot Springs NP	Dry Woodland Pine-oak	FMH Forest plot	2	2	2	4
Hot Springs NP	Wildland-urban interface	Mechanical thinning plot	0	0	0	4
Total			19	18	61	192

Table 2. Fire Ecology Staffing 2006

Monitor	Starting Date	Ending Date	# of Pay Periods	Training and Development	Fire Assignments
Dan Swanson Fire Ecologist	NA	Permanent, full time	26	Vegetation monitoring in a mgmt context, RX 410, botany, supervisory, Fire in eastern oak forests conference	South Water Hollow Fire Use, UT, 18 days
Adam Luraas, Lead Monitor	1/8/06	10/14/06	20	Two online Masters Fire Ecology courses	NA
Erin Yeoman, Assistant Lead	5/14/06	9/30/06	10	botany	Cavity Lake WF, MN, 17 days
Emily Baker, monitor	5/14/06	9/30/06	10	botany	Cavity Lake WF, MN, 17 days
Tray Hall, monitor	5/14/06	9/30/06	10	botany	Rattlesnake Complex, ID, 17 days
Raven Lawson, monitor	5/14/06	8/19/06	7	botany	
Heather McCarthy, monitor	1/8/06	4/15/06	7		

Table 3. Management Objectives and Monitoring Results 2006

Park	Monitoring Unit	Management Objective	Monitoring Results	Objective Achieved
Ozark National Scenic Riverways	Glade/Transition	Reduce the density of pole trees (2.5-15 cm dbh) by at least 40% within two growing seasons after 2 nd burn ; (80% C.I.) 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.)	27% Decrease 110% Increase	No n=8, 2 fires No n=8, 2 fires

	Dry-Mesic Woodland (Oak/Hickory/Pine)	Reduce the density of pole trees (2.5-15 cm dbh) by at least 30% within two growing seasons after 2 nd burn; (80% C.I.) 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.)	51% Decrease 52% Increase	Yes n=5, 2 fires No n=5, 2 fires
	Dry Woodland (Oak/Hickory/Pine)	Reduce the density of pole trees (2.5-15 cm dbh) by at least 30% within two growing seasons after 2 nd burn; (80% C.I.) 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.)	60% Decrease 67% Increase	Yes n=8, 2 fires No n=8, 2 fires
Buffalo National River	Glade/Savannah/Woodland	Herbaceous layer – increase cover of native species by 40% after 10 years of burning; (90% C.I.) Reduce pole density (2.5 – 15 cm dbh) by 60% after 10 years of burning; (80% C.I.) Reduce new growth eastern red cedar by 95% after three consecutive burns (90% C.I.) ¹ two seasons after 1 st burn treatment	7% Increase ¹ 5% Decrease ¹ 39% Decrease ¹	NA n=10, 1 fire NA n=10, 1 fire NA n=10, 1 fire
	Dry Woodland	Reduce tree density to open vista with a target density of 74 trees/hectare after 20 years (80% C.I.) Reduce pole density (2.5-15 cm dbh) by 60% after 10 years of burning; (80% C.I.) Reduce live stems/acre by 60 % over 10 years of burning (90% C.I.) ¹ two seasons after 1 st burn treatment	321 tph 33% Decrease ¹ 29% Decrease	NA n=10, 1 fire NA n=10, 1 fire NA n=10, 1 fire
	Open Fields/Cane Communities	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.) 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.)	NA	NA
Pea Ridge National Military Park	E. Red Cedar/Mixed Hardwood/Old Fields/Disturbed Sites	Reduce mean density of pole-sized trees (2.5-15cm dbh) by 30-40% after four burns; (80% C.I.) 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.)	NA	NA
	Oak Hickory Forest/Woodland	Reduce mean density of pole-sized trees (2.5-15cm dbh) by 50-70% after four burns; (80% C.I.) Increase mean density of oak seedlings and/or resprouts by 300-500% after four burns. (80% C.I.)	11% Decrease 24% Increase	NA n=3, 1 fire NA n=3, 1 fire
	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.) Increase mean percent cover of native herbaceous species by 60-100% after four burns (80% C.I.)	12% Decrease 4% Decrease	NA n=3, 1 fire NA n=3, 1 fire
	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

I was involved in the testing of the summary builder in FEAT during the winter by performing data summaries of OZAR, BUFF, and PERI fire effects data. I also edited and provided recommendations on the OZAR fire fuels map that was produced in conjunction with the vegetation map. In March I met with Buffalo NR park staff as well as Nature Serve to review the Buffalo River vegetation classification and mapping project. A fuels map will also be produced in order to look at fuels loading in the various community classes. I helped work with Nature Serve and Buffalo NR park staff in developing protocols and with the training of the field crew. In May I analyzed fire effects data from the Lower Wilderness burn to produce a poster for the Midwest Regional fire management meeting which was held in early June. Fire effects data showed that one dormant season prescribed burn reduced pole density and fuel loading and also increased herbaceous vegetative cover and species diversity. This summer I helped train our fire effects crew in the protocols of FRCC and CBI. Thirty four CBI plots were conducted in two prescribed burns at Ozark NSR and on the Mark Twain NF in which fire intensity varied due to hand and aerial ignition techniques.

Table 4 Fire Ecologist Accomplishments/Focus Areas

Category	Percent Time	Accomplishments and/or areas of activities
Planning	13%	Reviewed and made comments on OZAR vegetation and fuels map Involved with the planning, protocol development, and training of the BUFF vegetation and fuels map Determining fire effects plot location and establishment in monitoring types at OZAR, BUFF, PERI, and HOSP. Training of field crew in FRCC and CBI protocols
Presentations	5%	Park staff, public meetings, and training
NPS Meetings/ task groups	4%	FEAT summary builder testing, OZAR safety committee meetings
Interagency work	7%	FRCC, CBI
Fire Assignments	13%	FEMO on 7 RX fires (7 operational periods), FFT2 on 3 RX fires, FFT2 on 3 WF(3 operational periods), FEMO on 1 WF(14 operational periods)
Research	1%	Literature review of Ozark Highlands fire ecology research
Data entry	1%	Estimated amount of time spent entering data from paper to PC
Data Mgmt	8%	Error checking and species list management
Data analysis	16%	This is expected to be very low number or zero for fire effect crew/lead monitor
Supervision/Admin	8%	Hiring, supervision, travel, payroll, etc
Training	10%	Botany training, Veg Monitoring in a mgmt context, Smoke mgmt, supervisory training, fire refresher
Monitoring Field work	11%	Led crew on trips to BUFF, PERI, HOSP for data collection due to lead femo spouse's pregnancy
Miscellaneous	3%	Writing burn reports

Table 5 Fire effects crew accomplishments and area of focus.

Category	Percent Time	Notes
FMH plots	50%	Time spent collecting plot data; including preparation time.
WUI plots	0%	WUI plots at HOSP not read this year due to project not completed
CBI plots	5%	Plots conducted on two prescribed burn units within OZAR and one on the Mark Twain NF
Other plot work	2%	FRCC, live/dead fuel moisture monitoring
Fire Assignments	12%	Lead and winter femo were on 10 RX fires and 3-6 WF. Assistant lead, and two crewmembers were on 5 WF(58 operational periods)
Fuels Project work	0%	Fuels project work
Data entry	12%	90-95% of 2006 fire effects data entered by Oct. 1
Data Mgmt conversion	5%	Preparing species lists and error checking
Data analysis	2%	Summarized fuel loading data for each park unit
Supervision/Admin	4%	Travel, payroll, etc
Training	8%	Botany, CBI, and FRCC

Ozark National Scenic Riverways

Glade / Woodland Transition Monitoring Type

I looked at relative change in density and species richness as well as absolute change in percent herbaceous cover and floristic quality index (FQI) after two prescribed burns. There was an average 27% 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. This year we are going to implement a growing season burn in a glade / woodland monitoring type to see if we can achieve higher pole and overstory mortality. Overstory tree density has significantly increased by 24% ($p < .20$) throughout this period indicating that dormant season prescribed burns don't have high enough intensity to decrease density within this monitoring type (Figure 2). In addition Eastern red cedar pole-size trees decreased an average of 37% in density but fell short of the objective of a 40% decrease ($p > .20$) (Figure 3). There is an 80% certainty that the eastern red cedar pole trees decreased by at least 23%. In addition, overstory eastern red cedar trees also significantly increased by 23% ($p < .20$). If the eastern red cedar trees become too dense they may need to be cut prior to the burn so that fire will carry through the area. I also analyzed the change in herbaceous species richness pre to second growing season after second burn. Figure 4 shows there was an average 110% increase in species richness but this was insignificant ($p > .10$) and fell short of the 40% target. There was a 90% certainty that species richness increased by at least 27%. Percent herbaceous ground cover increased from 40 to 43% but was insignificant ($p > .10$) two growing seasons post second burn (Figure 5). The Floristic Quality Index (FQI) assesses plant community integrity by combining a site's species diversity and its "species conservatism". Each species is assigned a "coefficient of conservatism" value that reflects its tolerance to disturbance and fidelity to intact community types. I used these "coefficient of conservatism" values for Missouri to assess how FQI changes through time with prescribed fire in each of Ozark NSR monitoring types. FQI significantly increased from 14.0 to 16.9 ($p < .10$) from preburn to two growing seasons after the second burn (Figure 6). Total fuel loading decreased 38% from 11.0 to 6.8 tons / acre, pre to second growing season after second burn treatment.

Dry Mesic Woodland

Pole tree density significantly decreased by an average of 51% ($p < .20$) and was well above the objective of a 30% decline (Figure 7). There is an 80% certainty that the decline is at least 41%. Overstory tree density also showed a significant decrease of 2% ($p < .20$). Herbaceous species richness values increased by an average of 52% but was insignificant ($p > .10$), below the target of 20% (Figure 8). There is a 90% certainty that a 14% increase in species richness occurred. Total fuel loading decreased 28% from 13.5 to 9.7 tons / acre from preburn to post second prescribed burn. Percent herbaceous ground cover significantly increased ($p < .10$) from 19% to 39% from preburn to two growing seasons post second burn (Figure 9). FQI significantly increased from 8.5 to 9.9 ($p < .10$) two growing seasons after the second prescribed burn treatment (Figure 10).

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 11). There is an 80% certainty that the decrease is at least 54%. Herbaceous species richness increased an average of 67% from pre burn to two years post second burn but was insignificant for meeting the 40% increase objective ($p > .10$) (Figure 12). There is a 90% certainty that the herbaceous species richness increased by at least 22 %. Total fuel loading declined 58% from 20.0 to 8.5 tons / acre from preburn to post second prescribed burn. Herbaceous ground cover significantly increased from 5% to 19% ($p < .10$) from pre to two growing seasons post second prescribed burn treatment (Figure 13). The FQI value significantly increased from 7.6 to 10.0 ($p < .10$) two growing seasons after the second burn (Figure 14).

Buffalo National River

Dry Woodland

Ten fire effects monitoring plots were used in this monitoring type to assess overstory and pole tree density, herbaceous plant cover and diversity, as well as fuel loading with response to one prescribed fire.

Effect of Prescribed Fire on Overstory and Pole Tree Density

Two growing seasons after the first prescribed burn there was a 33% 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 1824 trees per hectare (TPH) pre-burn to 1192 TPH two seasons post-burn. There was no change in overstory tree (DBH >14.9 cm) density one and two growing seasons following the prescribed burn. Three hundred twenty one TPH were observed prior to and after the burn. In order to increase overstory mortality in our burn units we would need to either increase the burn intensity through aerial ignition, 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.

Effect of Prescribed Fire on Native Herbaceous Plant Cover

Herbaceous ground cover significantly increased from 35 to 40% ($p < .10$) 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 Herbaceous Species Richness

Herbaceous species richness increased by an average of 52% with a 90% certainty of at least a 28% increase. This value should continue to increase with time as more prescribed burns are instituted and the mid story and overstory layers are opened up.

Effect of Prescribed Fire on Fuel loadings

Ten fire effects plots from three burn units were used to assess fuel reduction following one prescribed burn. The table displays average fuel loadings per time lag fuel moisture as well as litter and duff depths (Table 6). Total fuel loading decreased 30% from 14.83 to 10.45 tons/acre after one prescribed burn. Fine fuel loading (litter, duff, and 1 hr fuels combined) decreased 23% from 8.47 to 6.52 tons / acre. The duff continued to decline from the immediate postburn to 2nd growing season probably because it became compacted following precipitation events. Woody fuels (10 hr and 100 hr fuels combined) decreased 19% following the burn from 1.88 tons / acre to 1.53 tons / acre. Heavy fuels (1000 hr fuels) decreased 46% from 4.48 to 2.42 tons / acre.

Table 6 Average fuel loading within the dry woodland monitoring type per fuel class and burn status following one prescribed burn. Data analyzed from ten fire effects plots located within three burn units.

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	1.10	0.59	0.30	0.38	1.50	4.38	0.10	1.80	6.37	14.83
Immediate Post	0.33	0.53	0.28	0.27	1.26	2.08	0.32	0.54	5.70	10.45
2 nd Growing Season	0.62	0.29	0.30	0.36	1.43	2.54	0.19	1.01	3.11	8.94

Glade / Woodland Transition

Ten plots from the two burn units were used to assess the affect of one prescribed fire on glade / woodland transition pole density, eastern red cedar regeneration, herbaceous plant cover and diversity, and fuel loading.

Effect of Prescribed Fire on Pole Tree Density

Two growing seasons after the prescribed burn there was a 5% decrease 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) or a growing season burn would cause an increase in mortality of the deciduous trees and eastern red cedar. 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.

Effect of Prescribed Fire on Eastern Red Cedar Regeneration

There was an insignificant 39% decrease in seedling density due to the one prescribed burn. There were few eastern red cedar seedlings present on several of the plots prior to the burn and 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 Herbaceous Plant Cover

Herbaceous plant cover increased 7% two growing seasons after the first prescribed burn. This is well short of the objective of a 40% increase but this is only the first entry burn. If we can get higher intensity fires to spread through these glade areas to 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 Fuel loadings

Seven fire effects plots from two burn units were used to assess the effect of one prescribed burn on fuel loadings. Total fuel loading decreased 51% from 11.62 to 5.64 tons / acre following one prescribed burn (Table 7). Fine fuel loading (litter, duff, and 1 hr fuels combined) decreased 29% from 6.68 tons / acre to 4.71 tons / acre. Woody fuel loading (10 hr and 100 hour fuels combined) decreased 37% from .65 to .41 tons / acre. Heavy fuels (1000 hr) decreased 88% from 4.29 to .53 tons / acre.

Table 7 Average fuel loading within the glade / woodland transition monitoring type per fuel class and burn status following one prescribed burn. Data analyzed from seven fire effects plots located within the two burn units.

Burn Status	Average Fuel Loading									
	Average depth		Average Fuel Loading							
	litter	duff	1 hr	10 hr	100 hr	1000 hr S	1000 hr R	Litter	Duff	Total
Install	.98	0.44	0.30	0.20	0.45	4.18	0.11	1.59	4.79	11.62
Immediate Post	0.42	0.34	0.35	0.19	0.22	0.17	0.36	0.68	3.68	5.64
2 nd Growing season	0.42	0.33	0.23	0.21	0.33	0.61	.23	0.69	3.59	5.89

Pea Ridge National Military Park

Oak Hickory Forest/Woodland

Three plots from one burn unit were used to assess the affect of one prescribed fire on pole density, oak seedling regeneration, herbaceous plant cover, and fuel loading.

Effect of Prescribed Fire on Pole Tree Density

After one prescribed burn there was an overall 11% decrease in pole density. This decrease in pole density was observed in only the smaller pole class (2.5 - 8.5 cm dbh) though where a 19% decrease was seen. Large poles (8.5 -15.0 cm dbh) actually increased in density by 22%. Multiple prescribed dormant and growing season burns will be necessary to achieve the 50-70% target for pole reduction.

Effect of Prescribed Fire on Oak Seedling Regeneration

Oak seedlings (< 1.0 cm dbh) increased by 24% following one prescribed burn treatment. Oak seedling regeneration will not increase dramatically until overstory and midstory canopy is reduced. Overstory density wasn't changed following one burn and large pole trees actually increased in density. Therefore, higher incident of light is not reaching the ground which is necessary for successful oak regeneration. Higher intensity burns again are necessary in order for this monitoring objective to be met.

Effect of Prescribed Fire on Herbaceous Plant Cover

Herbaceous plant cover increased 37% following one prescribed burn. Litter and duff consumption were most likely the cause for this increase. In the future as more burns are conducted, herbaceous plant cover should continue to increase as more light reaches the forest floor.

Effect of Prescribed Fire on Fuel loadings

Three fire effects plots from one burn unit were used to assess the effects of one prescribed burn on fuel loading. Total fuel loading increased 17% from 16.90 to 19.74 tons / acre after one prescribed burn (Table 8). Fine fuel loading (litter, duff, and 1 hr fuels combined) increased 7% from 6.92 tons / acre to 7.39 tons / acre. The increase in duff fuel loading following the burn is odd and may be a measurement error as there is no reason why this value would increase following a burn. Woody fuel loading (10 hr and 100 hour fuels combined) increased 24% from 1.97 to 2.44 tons / acre. This increase is probably due to small branches falling off of dead or dying pole trees as a result of the burn. Heavy fuels (1000 hr) increased 23% from 8.07 to 9.91 tons / acre two growing seasons following the burn. This is probably due to some rotten snags falling onto the fuel lines. The sample size is so small that this increase in fuel loading for each of class is probably not significant.

Table 8 Average fuel loading within the oak hickory forest/woodland monitoring type per fuel class and burn status following one prescribed burn. Data analyzed from three fire effects plots located within one burn unit

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	1.02	0.46	0.28	0.32	1.58	7.32	0.75	1.67	4.97	16.90
	Immediate Post	0.25	0.57	0.74	0.47	1.97	6.34	3.57	0.40	6.25	19.74
	2 nd Growing Season	0.41	0.29	0.21	0.32	1.97	5.26	1.83	0.67	3.13	13.38

Post Oak - Blackjack Oak Woodland

Three plots from two burn units were used to assess the affect of one prescribed fire on pole density, herbaceous plant cover, and fuel loading.

Effect of Prescribed Fire on Pole Tree Density

Following one prescribed burn there was an overall 12% decrease in pole density. However, this decrease was found only in the small pole class (2.5 – 8.5 cm dbh) where a 30% decrease was observed. The large pole class (8.5 – 15.0 cm dbh) had a 27% increase in density. Basal area increased 5% within the pole class following the burn. Multiple higher intensity dormant season burns or periodic growing season burns are needed to open up the overstory and midstory trees.

Effect of Prescribed Fire on Herbaceous Plant Cover

Herbaceous plant cover actually decreased slightly by 4% following the burn. Higher incident light due to overstory and midstory mortality is needed for the monitoring objective of a 60% increase.

Effect of Prescribed Fire on Fuel loadings

Three fire effects plots from two burn units were used to assess the effect of one prescribed burn on fuel loadings. Total fuel loading decreased 18% from 12.77 to 10.42 tons / acre following one prescribed burn (Table 9). Fine fuel loading (litter, duff, and 1 hr fuels combined) decreased 39% from 8.65 tons / acre to 5.31 tons / acre. Woody fuel loading (10 hr and 100 hour fuels combined) increased 15% from 2.03 to 2.33 tons / acre probably due to dead branches falling onto the fuel lines after the burn. Heavy fuels (1000 hr) increased 33% from 2.09 to 2.78 tons / acre. As seen with the oak hickory forest monitoring type this is probably from rotten snags falling on the fuel lines after the burn.

Table 9 Average fuel loading within the oak hickory forest/woodland monitoring type per fuel class and burn status following one prescribed burn. Data analyzed from three fire effects plots located within two burn units

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	.97	0.58	0.84	0.48	1.55	1.70	0.39	1.57	6.24	12.77
	Immediate Post	0.47	0.39	0.30	0.39	1.94	2.39	0.39	0.77	4.24	10.42
2 nd Growing Season	0.71	0.31	0.21	0.35	1.67	1.01	0.35	1.16	3.33	8.09	

Hot Springs National Park

Two fire effects plots from the North Mountain burn unit were used to assess the effect of one prescribed burn on overstory and pole density, herbaceous plant cover and diversity, as well as fuel loading.

Effect of Prescribed Fire on Overstory Tree Density

There was a 30% decrease in overstory density (> 15.0 cm dbh) following one prescribed burn with overstory trees declining from 300 to 210 trees per hectare (TPH). Only one of the ten overstory shortleaf pine trees died from the burn and it was within the smallest dbh class (15.0 to 25.0 cm). Black hickory had a 30% (8 out of 27 trees) mortality rate decreasing their density from 135 to 95 TPH. There was a 40% mortality rate among the oak trees with the density decreasing from 100 to 60 TPH. The associated decrease in overstory tree density and canopy cover is beneficial for shortleaf pine regeneration and will increase herbaceous cover and species diversity.

Effect of Prescribed Fire on Pole Tree Density

There was an 80% decrease in pole density (2.5 to 15.0 cm dbh) from 680 to 120 TPH. There were no shortleaf pine pole trees present in either plot prior to the burn. The opening of this midstory will be crucial for the successful establishment of shortleaf pine in the future. In addition the prescribed burn will provide an appropriate seed bed by exposing bare mineral soil for shortleaf pine to regenerate.

Effect of Prescribed Fire on Herbaceous Plant Cover

Percent herbaceous ground cover increased from 3 to 6% following the burn. This value should increase the next year as more seed becomes established in the area and higher incident light levels reach the ground. In the future as these units are burned again significantly higher herbaceous cover should be expected.

Effect of Prescribed Fire on Herbaceous Species

Herbaceous species richness increased by 70% following the burn. This was due to the fire consuming some of the litter/duff layer as well as higher incident light through the midstory and overstory.

Effect of Prescribed Fire on Fuel loadings

Two fire effects plots from the North Mountain burn unit were used to assess the effect of one prescribed burn on fuel loadings. Total fuel loading decreased 35% from 17.59 to 11.49 tons / acre following one prescribed burn (Table 10). Fine fuel loading (litter, duff, and 1 hr fuels combined) decreased 49% from 10.79 tons / acre to 5.55 tons / acre. Woody fuel loading (10 hr and 100 hour fuels combined) decreased 80% from 3.97 to 0.80 tons / acre. Heavy fuels (1000 hr) increased 101% from 2.83 to 5.69 tons / acre. This is probably from snags and large branches falling on the fuel lines after the burn.

Table 10 Average fuel loading within the North Mountain burn unit following one prescribed burn. Data analyzed from two fire effects plots

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	0.72	0.87	0.20	0.66	3.31	1.48	1.35	1.16	9.43	17.59
Immediate Post	0.06	0.45	0.60	0.21	0.59	5.10	0.59	0.10	4.85	11.49
2 nd Growing Season	0.20	0.22	0.11	0.34	2.74	4.26	0	0.33	2.33	10.11

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.

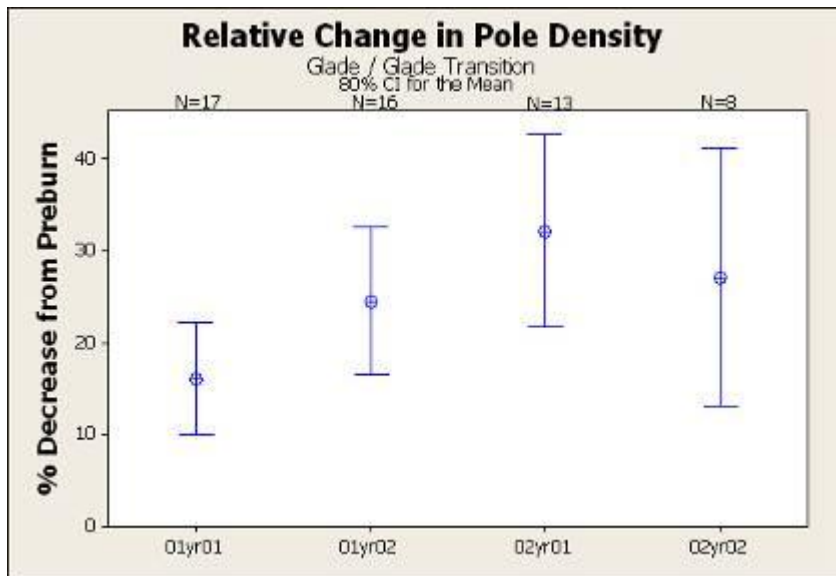


Figure 2 Relative change in overstory tree density (DBH ≥ 15.0 cm) within the glade / woodland transition monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 80% confidence intervals.

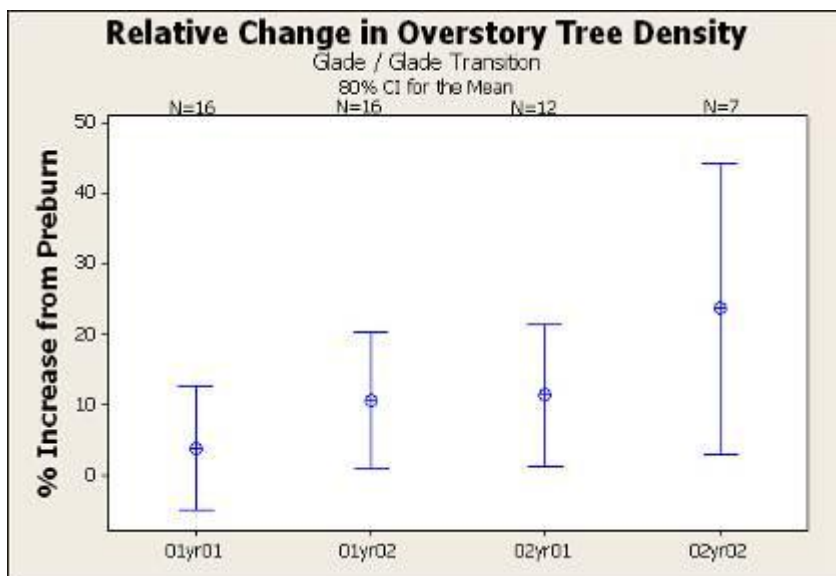


Figure 3 Relative change in cedar pole tree density (DBH < 15.0 cm) within the glade / woodland transition monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 80% confidence intervals.

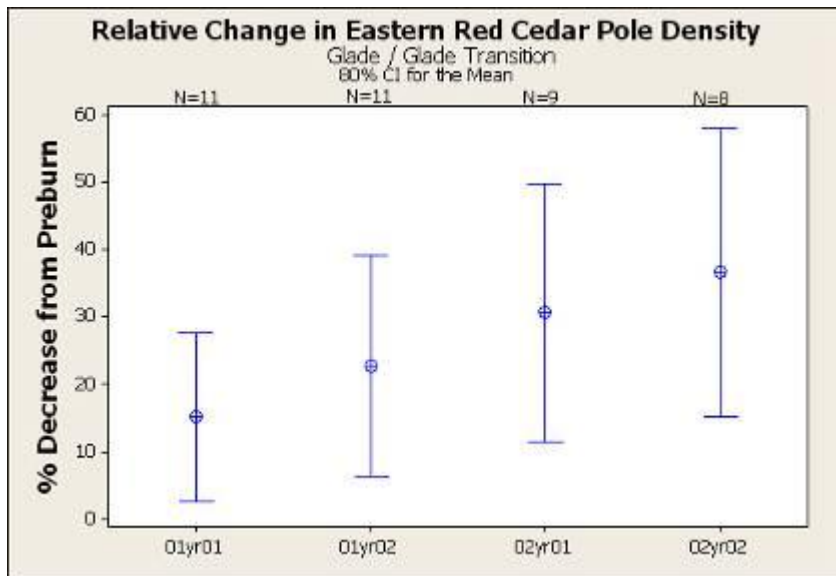


Figure 4 Relative change in herbaceous species richness within the glade / woodland transition monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 90% confidence intervals.

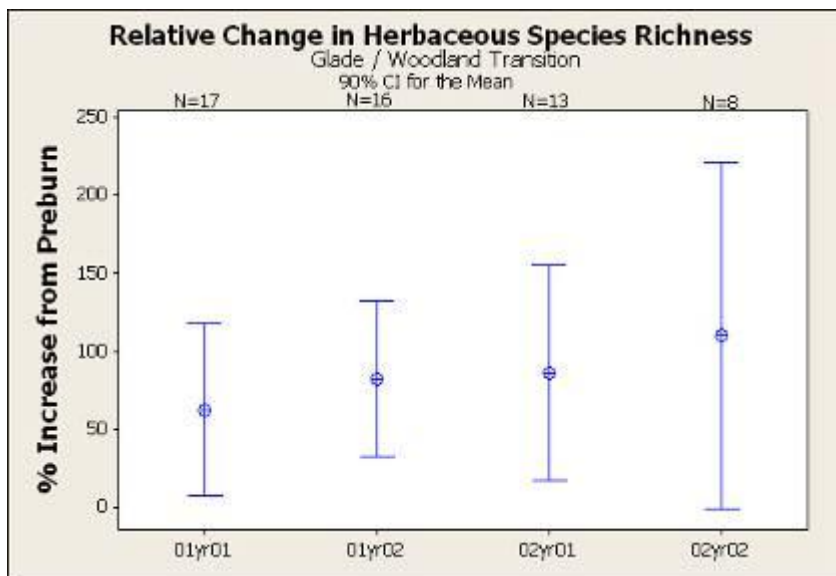


Figure 5 Herbaceous ground cover within the glade / woodland transition monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 90% confidence intervals.

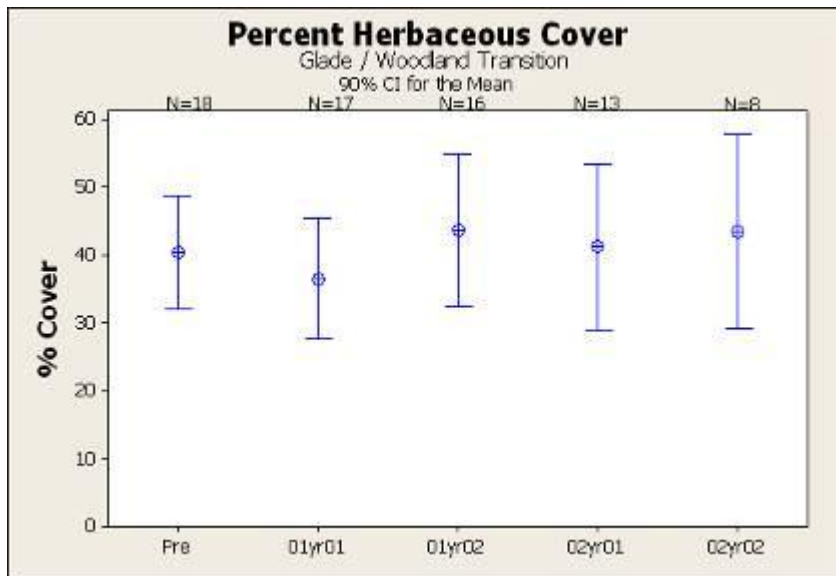


Figure 6 Floristic Quality Index within the glade / woodland transition monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 90% confidence intervals.

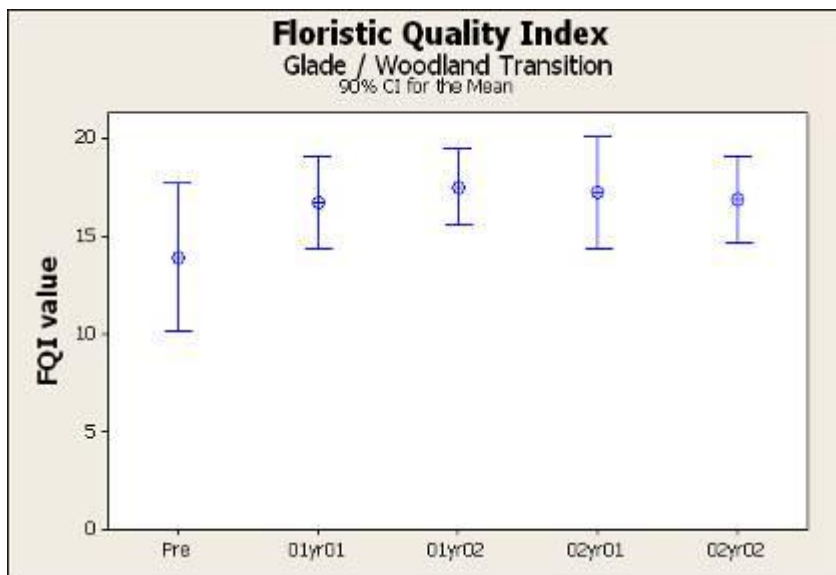


Figure 7 Relative change in pole tree density (DBH < 15.0 cm) within the dry-mesic woodland monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 80% confidence intervals.

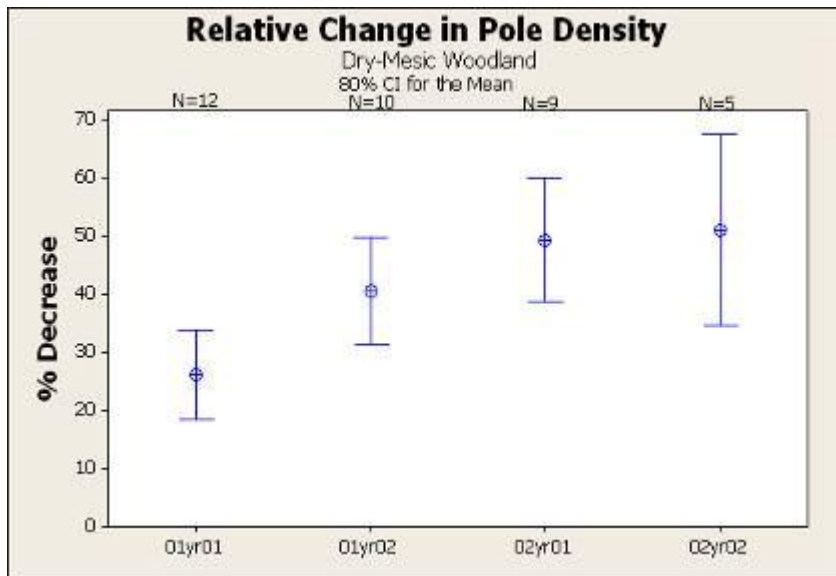


Figure 8 Relative change in herbaceous species richness within the dry-mesic woodland monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 90% confidence intervals.

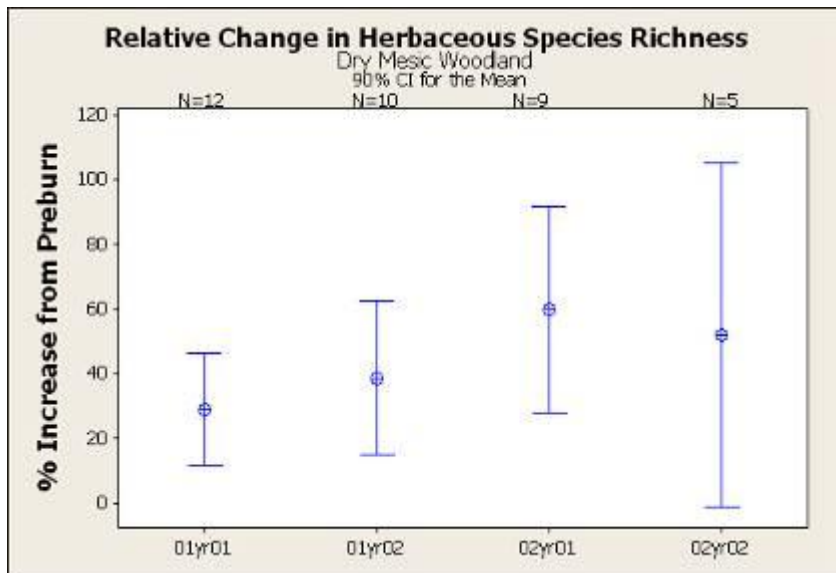


Figure 9 Herbaceous ground cover within the dry-mesic woodland monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 90% confidence intervals.

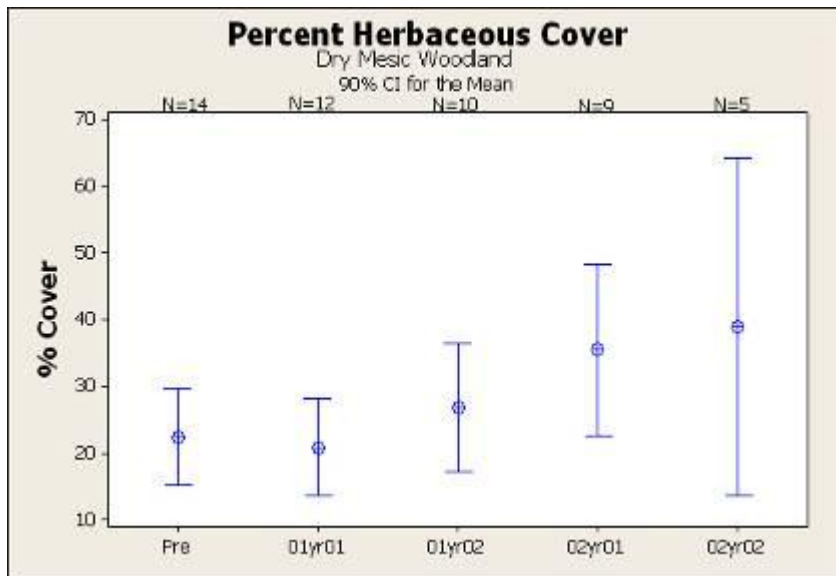


Figure 10 Floristic Quality Index within the dry-mesic woodland monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 90% confidence intervals.

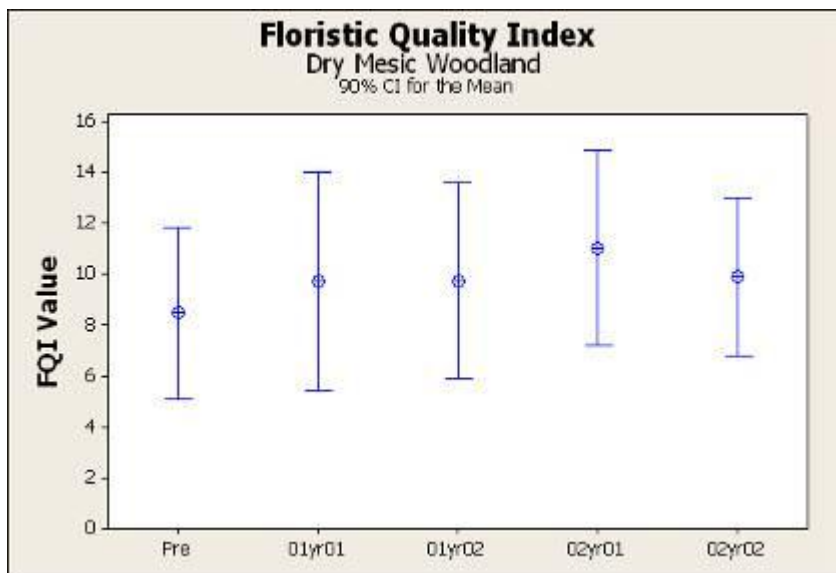


Figure 11 Relative change in pole tree density (DBH < 15.0 cm) within the dry woodland monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 80% confidence intervals.

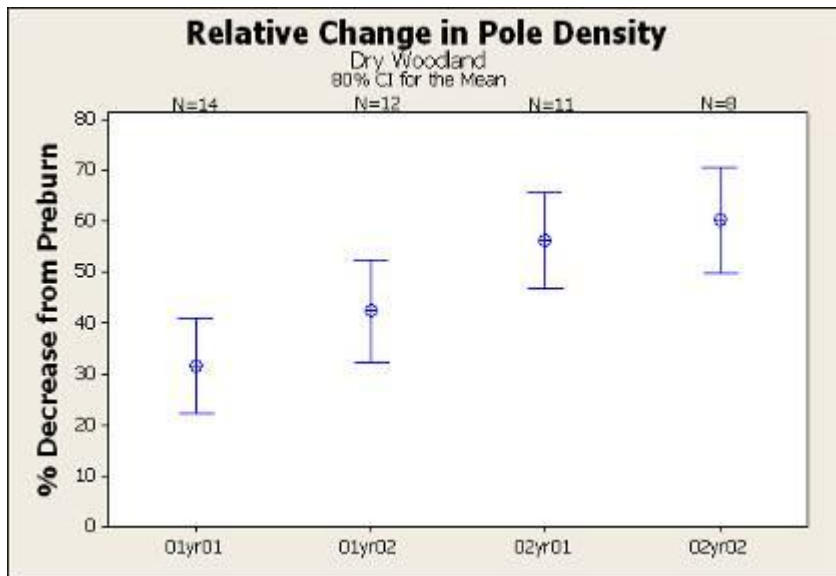


Figure 12 Relative change in herbaceous species richness within the dry woodland monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 90% confidence intervals.

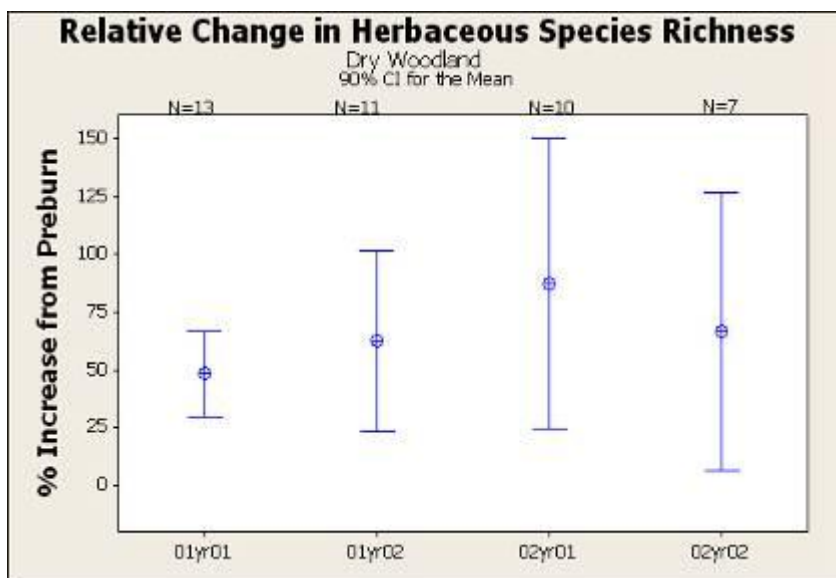


Figure 13 Herbaceous ground cover within the dry woodland monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 90% confidence intervals.

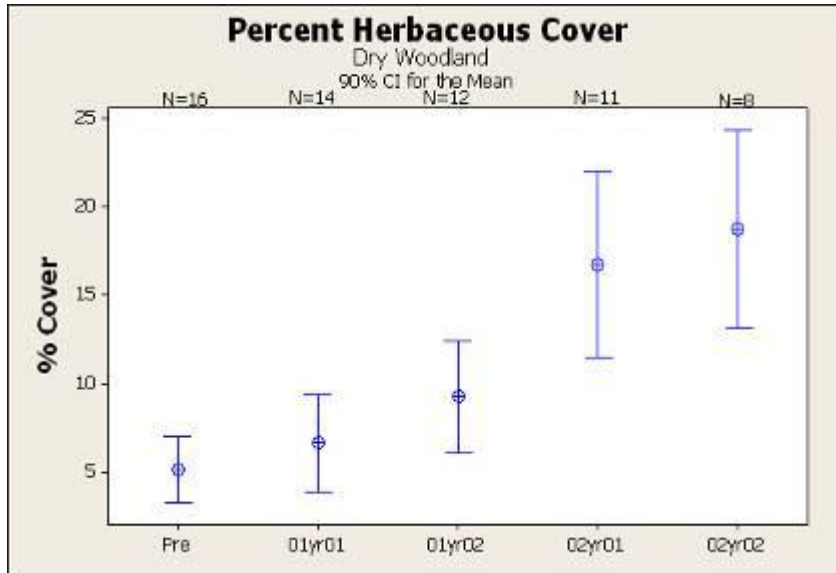


Figure 14 Floristic Quality Index within the dry woodland monitoring type after two prescribed burns at Ozark National Scenic Riverways. X axis represents (# of prescribed burns and the # of growing seasons after burn) Bars represent 90% confidence intervals.

