Collaborative Partnerships and Landscape-Scale Fire Restoration on the Bayou Ranger District in the Interior Highlands of Arkansas, USA

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Abstract

The Ozark-St. Francis National Forest, The Nature Conservancy, the Arkansas Natural Heritage Commission, Southwestern Fire Use Training Academy, Quail Unlimited, private landowners and others are currently engaged in a collaborative project to restore the oak-hickory and pine-oak ecosystems of the Interior Highlands. Due to past land management activities, there is substantially more closed canopy forests (oak-hickory, oak-pine and shortleaf pine), and less woodlands/savannas (oak-hickory-pine woodland/savanna, oak-hickory woodland, and shortleaf pine woodland/savanna) than occurred historically under a more frequent fire regime. Historic records indicate that pre-settlement Ozark woodlands averaged around 38-76 trees per acre. Current densities in much of the region average 300-1000 stems per acre. Currently, the native red oak borer is impacting the 1.5 million acres of the Interior Highlands. Red oak decline has impacted at least 300,000 acres of the Ozark National Forest, including the Bayou Ranger District, and intermixed private property. Oak mortality is contributing significantly to increased hazardous fuels in the wildland urban interface, threatening municipal water supplies as well as unwanted impacts to biodiversity. The Bayou Ranger District is implementing a long term, landscape scale ecosystem restoration project in a Nature Conservancy "conservation priority" area. Specific project activities include the application of periodic prescribed fire and forest thinning by commercial and non-commercial methods. The goals of these activities are to increase forest health, restore fire dependent woodland ecosystems, provide for safety in the wildland/urban interface and protect municipal water sources.

1. Introduction

Forest health issues in the Ozark and Ouachita Mountains (collectively referred to as the Interior Highlands) mirror changes occurring in other forests throughout the country. Altered fire regimes and past land management activities have led to a significant increase in fuel loads, tree densities, a shift in species composition, and a decrease in forest health. Currently, there is substantially more closed canopy forest (oak-hickory, oak-pine, and shortleaf pine), and less woodland (oak-pine woodland, oak-hickory woodland, and shortleaf pine woodland) than occurred historically under a more frequent fire regime. The frequent, low intensity fire regime under which the ecosystem evolved has been disrupted. Approximately 80 to100 years ago, the woodlands of the Ozark and Ouachita Mountains were heavily logged and the fire return interval was drastically reduced. Historic records indicate that pre-settlement tree density in the Interior Highlands oak ecosystem ranged from 38 to 76 trees per acre. Current densities in much of the region range from 300 to 1000 stems per acre. Increased stand density leads to increased competition for available nutrients, sunlight, and moisture. Now, during periods of drought, trees already stressed by resource competition become extremely vulnerable to disease and insect attack. The Forest Service estimates that over 1.5 million acres of red oak trees are dead or dying, currently impacting over 60% of National Forest lands in the Interior Highlands. The loss of overstory red oaks has seriously impacted 300,000 acres on the Ozark National Forest and intermixed private property to the west of the Bayou Ranger District. Broad areas with 100% mortality of oaks are common. Given the scale and severity of the problem, a change in the entire composition and structure of the ecosystem is occurring. Oak and pine woodlands, once common in the Interior Highlands, have been greatly reduced on National Forest lands and the integrity of the oak woodland ecosystem is at risk.

These changes have also resulted in dramatically increased hazardous fuel loads within the wildland/urban interface, increased wildfire severity, a risk to public and private water supplies,

a reduction in ecological conditions beneficial for PETS species, and a decline in biodiverity of concern to conservationists. Economically, there are impacts to communities that depend on quality wood products and the associated tourism and economic benefits that flow from a healthy forest.

The Interior Highlands are very important biologically due to the diversity provided by a system of oak woodlands, forests, and savannas, which is the largest contiguous remnant in the United States. More than 150 species of animals and plants are endemic solely to the Interior Highlands. All of these species rely in some way upon healthy oak and pine ecosystems. Many high profile species are reliant upon these ecosystems, as well as a host of neotropical migratory birds, deer, black bear, turkey, and quail. The Interior Highlands contain the headwaters of several rivers considered globally significant resources due to their aquatic diversity.

2. Collaborative Partnerships

A collaborative partnership has formed to address the current state of declining forest health throughout the Interior Highlands. The ecosystem restoration project outlined in this paper receives support from a team of organizations and state and federal agencies that has formed to address the issue in Arkansas. The Oak Ecosystem Team includes representatives from the Arkansas Wildlife Federation, Arkansas Game and Fish Commission, Arkansas Forestry Commission, Arkansas Natural Heritage Commission, US Fish and Wildlife Service, University of Arkansas Cooperative Extension Service, The Nature Conservancy, US Forest Service, and USDA Forest Service Southern Experiment Station. The team's vision is: *"To enhance the understanding of restoration and management needed in the upland oak ecosystem to maintain its health, sustainability, and diversity through public awareness, research, demonstration, and education."*

In the fall of 2002, the team hosted a conference in Fayetteville, Arkansas, entitled "Upland Oak Ecology: History, Current Conditions, and Sustainability." The goal of the conference was to examine the scientific understanding of the causes of oak mortality and discuss the need for ecosystem restoration. Over 350 professionals and researchers attended. The proceedings are being published by the USDA Forest Service Southern Experiment Station. From the conference presentations and discussion, there was a clear need and desire for collaborative ecosystem restoration.

From the information presented at the conference and later meetings, the Oak Ecosystem Team developed five core strategies to restore the ecosystem: (1) develop a suite of large, landscape-scale, multi-ownership demonstration projects across the region, (2) develop a multi-level information and media campaign utilizing the demonstration sites to solidify broad-based public support for ecological restoration (hazardous fuel reduction, forest health enhancement), (3) identify and address state and federal policy barriers to extensive ecological restoration, (4) develop an ecological monitoring program that measures progress in abating the threat of altered fire regimes to the conservation of biodiversity, and (5) secure adequate funding for oak ecosystem restoration on public and private lands throughout the region. Participation on this team is a priority for each of the participating agencies and organizations.
The Oak Ecosystem Team has selected the Bayou Ranger District Ecosystem Restoration Project as a demonstration site in the Interior Highlands. This site will be used to host public, private,

and legislative tours focusing on providing information on current and desired ecological conditions and strategies for achieving ecosystem restoration objectives.

In addition to this regional synergy, the ecosystem restoration project outlined in this paper is participating in the Fire Learning Network (FLN), a collaborative project between the US Forest Service, Department of the Interior, and The Nature Conservancy. The FLN promotes the development and testing of creative, adaptive, multi-ownership fire management strategies that are compatible with the National Fire Plan goals and the conservation goals of The Nature Conservancy. The network strives to achieve tangible, lasting results at landscape and ecoregional scales. Projects within the network have completed ecological models for the landscape, spatially explicit maps of current and desired future conditions, alternative management scenarios for ecological restoration, and monitoring programs to track progress toward desired future conditions. This paper will detail this project.

The Bayou Ranger District has been developing a partner base for many years. As a result of some long-term partnerships and the many diverse issues addressed in the ecosystem restoration project, the district has been successful at creating broad-based partner support. The partner list for this project is a litany of state and federal agencies, private organizations, and community groups who can actively participating in the project and bring tangible, on-the-ground expertise to the success of the ecosystem restoration project. Partners include the following:

Table 1

Collaborative Partnership List
The Arkansas Chapter of The Nature Conservancy
Arkansas Game and Fish Commission
Arkansas Natural Heritage Commission
Arkansas Audubon Society
Arkansas Forestry Commission
National Wild Turkey Federation
Quail Unlimited
Southwest Fire Use Training Academy
Caddo Nation of Oklahoma
National Park Service, Buffalo National River
Rocky Mountain Elk Foundation
US Fish and Wildlife Service, Arkansas Field Office
Watershed Restoration and Enhancement Agreements (Wyden Authority)

3. Ecosystem Restoration Project

Current Landscape Assessment

Past disruptions of natural fire cycles, as well as other management practices, have resulted in unwanted impacts to the ecosystem including wildfires of increasing intensity and severity. Altered fire regimes are contributing to a significant and rapid change to the composition and structure of the oak ecosystem in the Ozark National Forest. Oak and pine woodlands, once common on the Bayou District, covering over 80% of the land area, have been reduced to less than 6% of the land cover.

This project will restore ecosystem structure and function to oak and shortleaf pine ecosystems within the Ozark–St. Francis National Forest. The ecosystem restoration project responds to the

need to implement landscape-scale treatments on woodland ecosystems administered by the USDA Forest Service, which are representative of the vast acreage in the Interior Highlands that is currently in degraded and/or unsustainable condition.

The ultimate benefit is the restoration of forest ecosystem health and sustainability. Long-term goals of this project area are protecting communities in the wildland/urban interface through hazardous fuels reduction, and water supply protection. This project will provide lasting, broad-based results on the ground at a scale significant to address the problem. It will also allow for technology transfer through the national Fire Learning Network.

The ecosystem restoration project is focused on the Bayou Ranger District located in the Ozark–St. Francis National Forest in Arkansas. A portion of the district has experienced a severe, unprecedented eruption of the native red oak borer that is currently impacting the Ozark and Ouachita national forests. Restoration sites were selected to capture the range of ecosystem types on the district, variation in red borer impact (severe, mild, not impacted), restoration potential, and ease of implementation.

As a result of the above-stated issues, the Bayou Ranger District has identified 59,700 acres in six areas (Middlefork–11,200 acres, Rotary Ann–12,550 acres, Piney–12,200 acres, Oak Mt. – 6,000 acres, Eastside–11,400 acres, Southfork–5,770 acres) for a long-term (minimum 10 years) ecosystem restoration project in the wildland/urban interface. Within the project area, the quality of several municipal water supplies is directly affected by resource. The water supplies of Hector, Dover, Russellville, and Clarksville originate in the watersheds of the Illinois Bayou and Big Piney and Little Piney creeks. Municipal water supply quality is at risk from catastrophic wildland fires and is magnified as fuel loads increase due to widespread tree mortality through much of the project area. A small portion of the treatment area also includes private inholdings within the Forest Service boundary.

General resource management treatments across this landscape and within the restoration area include landscape-scale prescribed fire and mechanical thinning from commercial timber sales, wildlife stand improvements and public firewood cutting areas.

4. Methods: Collaborative Planning

This ecosystem restoration project defines resource management activities based on the Forest Service's ecological classification system on 59,700 acres of intermixed public and private lands on the Bayou Ranger District. The project team participated in a planning process through the Fire Learning Network, developed by The Nature Conservancy. This process assists projects with developing the planning tools needed for successful project planning and implementation. Products derived from this include collaborative goals, ecological models, spatially explicit maps of current and desired future conditions, strategies and alternative management scenarios for oak and pine woodland restoration, barriers to implementation, identified non-spatial strategies, assessment of current and future conservation target viability, and the development of a monitoring program to track progress toward a desired future condition. (FLN-Workshop #1 planning paper. 2002)

Collaborative Goals and Ecological Models

Defining broad-based project goals through a collaborative partnership approach ensures that everyone understands the direction and long-term outcomes of the project. Long-term goals of this project area are protecting communities in the wildland/urban interface through hazardous fuels reduction, water supply protection, and restoration of healthy, sustainable ecosystems. To develop an understanding of how the ecosystem within the project area functions, the project team and partners collaboratively developed ecological models for the landscape. This process developed the foundation of the partners' ecological understanding and aligns the ecological understanding, alternative treatment options, and the desired future condition vision for the landscape.

Current Condition

In defining a current and desired future condition for the project area, three tools—land type associations, cover types and land types—were used in this process. Land Type Associations (LTAs) were used to determine the general plant communities that occur within the project area. Approximately four LTAs occur within the project area: the Mesic Morrow Mountain Uplands, Bloyd Mountain Valleys, Lower Atoka Hills and Mountains, and the Arkansas Valley Hills. These were mapped throughout the project area and overlaid with the current cover types (pine vs. hardwood) in the project area. A land type is an area within a suite of ecological characteristics (soil type, aspect, slope, and climate conditions) that distinguish it from other land types. Land types were grouped into riparian, toe slopes, south slopes (lower, middle, and upper), flat ridge tops and north slopes (lower, middle, and upper). Next, this information was projected across the project area. Current cover types have been assessed throughout the project area and a desired future condition quantified. Current cover types include:

- **Oak-Hickory Closed Canopy Forest** (75% of restoration area). Canopy species in this cover type include white oak, red oak, and hickory. The Basal Area (BA) in this cover type ranges from 80 to 120 square feet per acre. There is a well developed midstory with little sunlight penetrating the forest floor. This cover type contains little or no herbaceous understory or oak-hickory regeneration, with those species present being shade tolerant/fire intolerant.

- **Oak-Hickory Woodland** (1% of restoration area). Canopy species in this cover type include white oak, red oak, and hickory. The BA in this cover type ranges from 20 to 60 square feet per acre. The midstory is sparse with an increased amount of sunlight reaching the forest floor. This cover type consists of a well developed herbaceous understory of shade intolerant/fire tolerant species and some oak-hickory advanced regeneration. Characteristic herbaceous understory species include big bluestem, little bluestem, Indian grass, and goldenrods.

- **Oak-Pine Closed Canopy Forest** (8% of restoration area). Canopy species in this cover type include white oak, red oak, shortleaf pine, and hickory. The BA in this cover type ranges from 80 to 120 square feet per acre. There is a well developed midstory with little sunlight penetrating the forest floor. This cover type contains little or no herbaceous understory or oak-hickory regeneration, with those species present being shade tolerant/fire intolerant.

- **Oak-Pine Woodland/Savannah** (4% of restoration area). Canopy species in this cover type include white oak, red oak, shortleaf pine, and hickory. The BA in this cover type ranges from 20 to 60 square feet per acre. The midstory is sparse, consisting mostly of re-sprouting oak and with an increased amount of sunlight reaching the forest floor. This cover type consists of a well developed herbaceous understory of shade intolerant/fire tolerant species and some oak-hickory and pine advanced regeneration. Characteristic herbaceous understory species include big bluestem, little bluestem, Indian grass, and goldenrods.

- **Shortleaf Pine Closed Canopy Forest** (10% of restoration area). The dominant canopy species in this cover type is shortleaf pine. The BA in this cover type ranges from 80 to 120 square feet per acre. There is a well developed midstory of shade tolerant/fire intolerant woody species and with little sunlight penetrating the forest floor. This cover type consists of little to no herbaceous understory or oak-hickory regeneration, with those species present being shade tolerant/fire intolerant. Most of this cover type is uncharacteristic, comprising shortleaf pine in an historic oak woodland (or perhaps oak-pine) land type. The pine succeeded into, or was planted into, old agricultural fields abandoned in the 1930s.

- **Shortleaf Pine Woodland/Savannah** (1% of restoration area). The dominant canopy species in this cover type is shortleaf pine. The BA in this cover type ranges from 20 to 60 square feet per acre. The midstory is sparse with an increased amount of sunlight reaching the forest floor. This cover type consists of a well developed herbaceous understory of shade intolerant/fire tolerant species and some oak-hickory and pine advanced regeneration. Characteristic herbaceous understory species include big bluestem, little bluestem, Indian grass, and goldenrods.

- **Prairie/glade** (1% of restoration area). The prairie cover type consists of a well developed herbaceous/grassland understory comprised of big bluestem, little bluestem, Indian grass, plume grass, and a variety of composites and legumes. This cover type has few to no trees.

Desired future condition

Cover types in the restoration area have been identified and their respective current condition delineated throughout the landscape. Next the desired future condition of each cover type was quantified and delineated using a collaborative approach. Several meeting and field trips were held with partners so everyone involved understood the future ecological condition. The desired future conditions reflect cover types across the project area in ten years. In addition, The Nature Conservancy has identified embedded conservation targets for each desired future condition cover type. These conservation targets will be tracked and monitored during the restoration phase of the project and are discussed in the monitoring section. Quantification of the current and desired future conditions and the embedded conservation targets for each cover type are listed below in Table 2.

Quantification of current and desired future conditions (example Middle Fork Restoration Area):

Table 2

Cover Type	Current Condition (%)	Desired Future Condition (%)	Embedded targets (example)
Oak-Hickory Closed Canopy Forest	75	16	Cerulean Warbler, Bats, Ozark Chinquapin
Oak-Hickory Woodland	1	35	Bachman's Sparrow, Bats, Glades, Diana Fritillary, Elk
Oak-Pine Closed Canopy Forest	8	0	
Oak-Pine Woodland/Savannah	4	38	Bachman's Sparrow, Bats, Glades, Ozark Chinquapin, Diana Fritillary, Elk
Shortleaf Pine Closed Canopy Forest	10	0	
Shortleaf Pine Woodland/Savannah	1	10	Bachman's Sparrow, Bats, Glades
Glade/Prairie	1	1	Diana Fritillary, Elk

Information used to develop the scientific justification for the future desired ecological condition includes historical accounts, dendrochronological studies, Government Land Office records and current scientific literature. Government land office records provide information that can guide

the projects toward a desired future condition. Surveyors recorded direction and distance to each bearing tree, and bearing tree species and size. With this information the density, species composition, and basal area can be calculated at the time of the surveys.

The desired future condition will reduce the risk of catastrophic wildfire by fuel reduction prescribed burns and thinning in dense cover types to reduce basal area. The reduced risk of catastrophic wildfire will protect adjacent landowners and municipal water supplies. Traditional uses of the restoration area include many types of recreation, logging, and woodland grazing. The desired future condition will provide the local economy with a small amount revenue from timber sales. Recreational use, hunting in particular, will increase as game populations respond to the improved habitat conditions.

Assumptions and Barriers

Defining assumptions underlying the desired future condition, difficulties in determining landscape condition, data gaps and barriers to collaboration is crucial for project success. Through the FLN process, the project team had a planning assignment to do just this (FLN-Workshop #1 planning paper. 2002). An outcome from this process is the identified assumptions and barriers for the project, which are listed in Table 3.

Table 3.

Assumptions underlying desired future conditions	Difficulties in determining landscape conditions or strategies, or data gaps	Barriers to collaboration
Funding and workforce requirements are adequate	Past forest management has altered/masked historical landscape conditions	Current Forest Land Management Plan inadequacies
Revision of the Forest Land Management Plan will include ecosystem restoration	Medium and long-term response to restoration in oak woodlands	Land Management Plan in revision
Viable commercial market for low quality hardwood products exists		Lack of understanding by the public of historical forest conditions

Collaborative Development of Alternative Management Scenarios

To determine the best course of action in achieving the desired future ecological condition, the project team assessed three alternatives—No Action, Prescribed Fire Only, and Prescribed Fire and Thinning—and the outcomes of each for the project. This process was done using ecological models developed earlier and spatial data developed during the current condition analysis.

Alternative 1**:** No Action. No management actions will be implemented. Current conditions will continue to decline as ecosystem stress mounts. Red oak borer is causing increased canopy mortality in adjacent areas. The potential for catastrophic wildfires will increase. Forest type conversion from oak-pine dominated to maple-gum dominated systems becomes assured although the timeline is unknown. These figures do not represent what would happen if the red borer outbreak sustains itself into the future. The oak-hickory closed canopy forest would go through a transformation resulting in a closed canopy forest dominated by fire intolerant red maple, sugar maple, black gum, and white oaks.

Alternative 2: Prescribed Fire Only. Implement prescribed fire in all restoration areas. The role of fire will create a mosaic of cover types in the restoration areas. The chance of catastrophic wildfire is decreased. Desired future conditions will not be achieved as quickly as with Alternative 3; consequently, the system has the potential to lose some elements of biodiversity.

Alternative 3. Prescribed Fire and Thinning. Implement prescribed fire and commercial/non-commercial thinnings in the restoration areas. Prescribed fire combined with thinnings will achieve the desired future condition in a reasonable amount of time.

Table 4.

Current Cover Type	Alternative 1		Alternative 2		Alternative 3	
	strategy	area (%)	strategy	area (%)	strategy	area (%)
Oak-Hickory Closed Canopy Forest	No Action	75	Prescribed-Fire Only	50	Prescribed-Fire and Thinnings	16
Oak-Hickory-Pine Woodland/Savannah	No Action	1	Prescribed-Fire Only	20	Prescribed-Fire and Thinnings	38
Oak-Pine Mixed Closed Canopy Forest	No Action	11	Prescribed-Fire Only	3	Prescribed-Fire and Thinnings	0
Oak-Hickory Woodland	No Action	1	Prescribed-Fire Only	15	Prescribed-Fire and Thinnings	35
Shortleaf Pine Closed Canopy Forest	No Action	10	Prescribed-Fire Only	10	Prescribed-Fire and Thinnings	0
Shortleaf Pine Woodland/Savannah	No Action	1	Prescribed-Fire Only	1	Prescribed-Fire and Thinnings	10
Prairie	No Action	1	Prescribed-Fire Only	1	Prescribed-Fire and Thinnings	1

After assessing all the alternatives and correlating them with the projects goals, it was determined that Alternative 3 would enable the team to achieve its desired future ecological condition over a 20-year period.

Non-Spatial Strategies

Non-spatial strategies were also developed through the planning process (FLN-Workshop #1 planning paper. 2002). Defining non-spatial strategies broadens planning thinking and is focused to encompass a variety of issues that are generally not captured under traditional planning efforts. Non-spatial strategies identified the need for the ability of the team to develop public support for the use of prescribed fire for the ecosystem restoration project. Also, the team identified the need to enhance safety in the wildland/urban interface by conducting legislative and public tours; to enhance collaborative relationships with partners; and to develop an outreach process to include new partners.

5. Methods: Implementation

Alternatives

Reviewing the alternatives set forth in the planning process, the project team identified assessment criteria based upon the goals of the project. In Table 5, assessment criteria for the implementation methods determined that Alternative 2 (fire only) and Alternative 3 (fire and thinning) would move the project landscape toward the desired future condition.

Table 5

Assessment criteria	Alternative 1 No Action	Alternative 2 Fire Only	Alternative 3 Fire/Thinning
Feasibility	Not feasible; would not meet Forest Land Management Plan objectives	Very feasible with funding	Very feasible with funding and revised Forest Land Management Plan

In addition to selecting the appropriate alternative(s), the project team assessed the viability ranking for the conservation targets identified in the project area with the preferred alternative. In Table 6, the current viability of the conservation targets was matched with each alternative and compared to the desired future condition of each. Once again, Alternative 3 (fire and thinning) presented the best option for the viability of each conservation target, based on the desired future condition for each target.

Table 6

Conservation Target	Current Viability Rank	DFC	Viability Rank for Alternative 1	Viability Rank for Alternative 2	Viability Rank for Alternative 3
Oak Woodland/ Savannah	Fair	Very Good	Poor	Fair	Good
Pine Woodland/ Savannah	Fair	Very Good	Poor	Fair	Very Good
Glade/Prairie	Poor	Very Good	Poor	Very Good	Very Good
Bachman's Sparrow	Poor	Very Good	Poor	Fair	Very Good
Elk	Poor	Very Good	Poor	Fair	Very Good

Current Status

Landscape-scale fuels reduction and ecosystem restoration activities are currently being implemented in Phase I of this project. This year's restoration activities are in planning, implementation, and monitoring. An Environmental Assessment (EA) for the Middle Fork area for 12,200 acres for growing and dormant season prescribed fire use and mechanical treatments for woodland restoration on 5,000 acres of this landscape is completed. Prescribed fire (8,300 acres burned this year in the Middle Fork area) and commercial sales, wildland/urban interface (WUI) fuels treatments, and wildlife stand improvement (WSI) treatments have been initiated. A second EA, with a project-specific Forest Plan amendment, for ecosystem restoration projects on the remaining 47,500 acres is currently in a 45-day appeal process.

By 2004, all planning and National Environmental Policy Act requirements will be completed for the 59,700 acres composing the Bayou Ranger District ecosystem restoration project,

allowing the project team to concentrate on continuing implementation, monitoring, and education. Mechanical fuel reduction treatments via commercial timber sales will be ongoing in the Middle Fork area from Fiscal Year 2003. Mechanical fuel reduction treatments via commercial timber sales, WUI treatments, and WSI treatments will commence in the South Fork restoration area (5,770 acres) in FY 2004. Approximately 2,300 acres of the South Fork area will be mechanically treated to restore woodland ecosystems. Each year the district will enter a new restoration area to begin mechanical fuel reduction treatments. Fuel reduction prescribed fire will be used on about 18,000 acres in the South Fork and Rotary Ann restoration areas in FY 2004. These will include growing season and dormant season period fires. The ecosystem restoration monitoring program, initiated in FY 2003, will continue in FY 2004 and beyond. To obtain the desired future condition, the project team identified proposed management actions of prescribed burning and mechanical thinning in the following six areas:

Table 7

Project Area	Rx Fire	Thinning
Middle Fork	12,200 acres	4,300 acres
Piney	12,159 acres	6,705 acres
Rotary Ann	12,550 acres	4,478 acres
South Fork	5,773 acres	2,830 acres
Oak Mountain	6,089 acres	4,122 acres
East Side	11,403 acres	5,816 acres

Prescribed Burning

Prescribed burning at this scale is accomplished using aerial ignition via helicopter. Prescribed burning will be used during the dormant season (fall/winter) and growing season (spring/summer). Dormant season fire would be used in parts of the project area that have not been burned recently to begin the process of fuel load reduction. A combination of dormant and growing season fire would be used in various parts of the project area for wildlife/PETS habitat improvement, forest health, and continued fuel reduction. The fire return interval in the project area will generally range from two to four years with the entire area being burned two to four times during the duration of the project (10 years). Restoring the historic fire regime will increase ecosystem health and improve biodiversity at the landscape scale.

Mechanical Treatments

Mechanical treatment operations are being conducted on both public and private land. For the public lands, treatments will be conducted using commercial timber sales, wildlife stand improvements and public firewood cuts. For private lands the Forest Land Enhancement Program, Stewardship Incentive Program, and the Forest Incentive Program will be used. Thinning will reduce competition between trees and promote crown development. Thinning will also allow more sunlight to reach the forest floor, promote the recruitment of oak and hickory advanced regeneration and promotes a diverse herbaceous ground cover response. Basal area (BA) is a measure of the sum of the cross-sectional areas at 4.5 feet above ground level of all trees tallied at the sample point. Basal area is reported in square feet per acre. To accomplish a reduction in BA, pine stands in the project area are being thinned to a BA of 60 and hardwood stands are being reduced to a BA of 40 to 60.

Non-Treatment Strategies Implemented
Correlated with the non-spatial strategies, several non-treatment strategies have been implemented. These include publishing an educational ecosystem restoration brochure that highlights the project need, implementation techniques and the expected desired future condition. Also, the construction of a roadside scenic overlook with interpretive signage to explain ecosystem restoration to the public has been developed, with two more planned in the project area.

This project demonstrates the on-the-ground results of a restoration strategy using prescribed fire and mechanical thinning for restoring forest health to the Interior Highlands. The Ozark–St. Francis National Forest is currently going through a Forest Plan revision process that will be completed in 2004-2005. Alternatives are currently being drafted that include restoration in the next Forest Plan. This project will serve as a demonstration site for the restoration alternative. By developing a collaborative partnership base, a sound planning framework, and a quantifiable desired future ecological condition, the ecosystem restoration project was able to garner $360,000 in National Fire Plan funding for the first year.

6. Collaborative Monitoring and Adaptive Program Development

Collaborative landscape-scale monitoring and adaptive management protocols have been developed for the project. Monitoring components include fire effects, water quality monitoring, fuels loading, bird point counts, and plant communities. The ecological monitoring program was developed by the Bayou Ranger District, The Nature Conservancy, and the Arkansas Natural Heritage Commission and reviewed by the Oak Ecosystem Team. The broad goal of the monitoring program is to document and quantify fuels reduction and forest health enhancement actions in achieving the desired future condition. Specifically, the program includes monitoring goals, project success criteria, macro-plots sampling methodology and nine individual monitoring protocols to determine if the project is meeting success criteria defined by all partners. (Ecological Monitoring Protocol 2003).

Monitoring goals, project success criteria, eight individual monitoring protocols to determine if the project is meeting success criteria, and a description of compiling much of the monitoring into macro-plots for efficiency have been developed for the plant community monitoring. Because a component of the project goals includes forest health enhancement, it is defined to help frame ecosystem attributes to monitor. A healthy forest in the Ozark Mountains is defined as a suite of Ozark plant communities where:

- The density and diversity of overstory and understory woody species is within (and representative of) the historic range of variation.
- The existing set of plant communities (or forest types) is maintaining itself within the site and the regeneration of overstory tree species appropriate to the site and temporal variation is ongoing.
- Understory native herbaceous level community diversity and coverage is within (and representative of) the historic range of variation.
- Selected area-dependent bird species (and other animal species as appropriate) are maintaining viable breeding populations.
- Key ecological processes (like fire and forest pest insects) are maintained within their historic range of variation.

- Selected site-specific native rare plant and animal species populations are maintained or increased.
- Non-native species are not a dominant part of any native plant communities (or forest types) and are not pushing ecosystem process parameters outside the historic range of variation.

The numeric components of the above forest characteristics are used to quantify the desired future condition for any plant community or forest type. Specific project activities for these areas may include prescribed fire and commercial, non-commercial, and pre-commercial silvicultural treatments. To determine attainment of these success criteria and project goals, eight monitoring protocols are listed below:

- *USFS fuels assessment* to document fuel loading.
- *Cover type assessments* through aerial photo interpretation and ground-truthing to quantify the size and distribution of the desired plant communities (forest types).
- *Plant community monitoring* to quantify the structure, diversity, regeneration of plant communities (forest type groups), and ratio of native/non-native species.
- *Avian monitoring* to quantify populations of selected area-dependent birds.
- *Fire regime condition class (FRCC) monitoring* to track attainment of the historic fire regime.
- *Post-burn assessments* to determine individual unit coverage and post burn severity.
- *Photo-monitoring* to qualitatively document and communicate restoration progress.
- *Program accomplishments*. Acres burned, thinned, harvested, and project costs.

Table 8

Plant Community (Conservation Targets)	Desired Future Condition (Acres)
Closed canopy oak hickory forest	6,313
Oak pine mixed closed canopy forest	650
Shortleaf pine closed canopy forest	2002
Oak hickory woodland	28,869
Oak pine mix woodland	2,444
Shortleaf pine woodland	17,925
Prairie/glade	800

7. Conclusion

The Bayou Ranger District has identified 59,700 acres in six areas (Middlefork–11,200 acres, Rotary Ann–12,550 acres, Piney–12,200 acres, Oak Mountain–6,000 acres, Eastside–11,400 acres, Southfork–5,770 acres) for a long-term (minimum 10 years) hazardous fuels reduction project in the wildland/urban interface. Collaborative landscape-scale fire restoration in the Interior Highlands of Arkansas depends on a multi-partner approach, a defined project vision, quantification of current and desired future ecological condition, identified assumptions and barriers to the project and a monitoring protocol to track progress toward achieving the desired future condition. Partners bringing expertise from a variety of backgrounds and having a variety of skill sets, resources and expertise are key to the success of these landscape-scale projects. This project has brought together many partners from different backgrounds and put them through an organized process that included:

Collaborative Landscape-scale Planning Process

- Collaborative goals
- Collaborative ecological models
- Analysis of current ecological and socio-political conditions and challenges
- Collaborative development of desired future conditions
- Collaborative development of strategies and alternative scenarios to reach them
- Identification of barriers
- Development of non-treatment strategies
- Collaborative development of monitoring and adaptive management procedure
- Implementation

A defined, measurable project plan and vision outlining the steps needed to achieve the desired ecological outcome is crucial for successful partners to understand the goals of the project, and for long-term involvement and participation. This project has integrated the ecological justification of a long-term, landscape-scale fire restoration project with the education of a diverse partner base. It has coalesced successful partnerships, a common vision for a sustainable restored ecosystem of oak and pine woodlands, restored fire regime, private property protection, and reduced hazardous fuels in a 59,700-acre project area.

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