

Using GIS to identify landscapes for ecosystem restoration

Authors: Jim McCoy-USDA Forest Service and Mike Brod-USDA Forest Service
Contributing Author: John Andre-USDA Forest Service

ABSTRACT: One hundred years of fire suppression has altered the ecological processes of the Ozark Highlands resulting in unsustainable ecosystems. The Ozark-St. Francis National Forest used GIS and an Ecological Classification System (ECS) to identify, characterize, and map suitable landscapes for ecosystem restoration. The primary use of GIS and ECS was to map land type associations and land types, within a landscape, based on geology, hydrology, topography, aspect, and slope. The land types were used to identify ecosystem restoration areas on the Forest. The use of GIS and ECS is applicable to manage ecosystems on a landscape scale.

Keywords: Ozark, National Forest, Bayou Ranger District, Ecological Classification System, Ecosystem Restoration, Prescribed Fire, National Fire Plan, Mean Fire Interval, Desired Future Condition, Woodland Restoration



Figure 1. National vicinity map of the Ozark-St. Francis National Forest.

I. Introduction:

a. Fire from a historical perspective

Fire is the most important ecosystem disturbance process in the Ozark Highlands. Evidence continues to accumulate that the pine and oak-hickory forests of this area owe their existence to disturbance processes such as wildland fire. The composition, structure, diversity, and spatial arrangement of the forest and woodland ecosystems have been largely determined by the historical fire regime.

The exclusion of fire from Ozark Highland ecosystems for the past several decades has changed the structure and species composition of the forest. Fire exclusion has allowed the development of a dense under-story and mid-story of shade-tolerant, fire-intolerant tree species. The oak-hickory and pine forest and woodland/savannah ecosystems of the Ozark-St. National Forests (OSNF) are not sustaining themselves.

Evidence concerning the pre-historic and historic occurrence of fire in this physiographic area has been summarized in the Ozark-Ouachita Highlands Assessment. Numerous fire history studies from the Missouri Ozarks, the Buffalo National River, and Ouachita Mountains have clearly documented the frequent occurrence of fire in these areas in the past (example: *Proceedings: Workshop on Fire, People, and the Central Hardwoods Landscape*; USDA Forest Service, Northeastern Research Station, General Technical Report NE-274, March 2000).

In 2000, a fire history research project was conducted at three sites on the Bayou Ranger District. The principal investigator, Dr. Richard Guyette, determined the fire return interval for these sites. Guyette's research documents fire return intervals for the Bayou Ranger District sites that are very similar to other documented mean fire intervals (MFI) in the Ozark-Ouachita Highlands. Dr. Guyette established a mean fire return interval of approximately 5 years from 1804 to 1954. The MFI for the Native American Period (1680-1820) was 3.4 years (Guyette 2000, Guyette and Spetich 2002).

b. Federal Wildland Fire Policy

The Federal Wildland Fire Management Policy and Program Review (Review) was initiated after the wildfire season of 1994. The Review was chartered to ensure that uniform federal policies and cohesive interagency and intergovernmental fire management programs exist. (See <http://www.fs.fed.us/land/wdfirex.htm>)

Many of the Review's Guiding Principles and Policies are directly concerned with the use of wildland fire and prescribed fire in forest ecosystem management. Principles among these are:

1. The role of wildland fire as an essential ecological process and natural change agent will be incorporated into the planning process.
2. Fire management plans, programs, and activities support land and resource management plans and their implementation.
3. Fire management programs and activities are economically viable, based upon values to be protected, costs, and land and resource management objectives.
4. Fire management plans and activities are based upon the best available science.

The Review also recognizes that wildland fire, which includes prescribed fire, is a critical natural process that will be integrated into land and resource management plans

and activities on a landscape scale. Concerning the use of fire, the Review policy is that wildland fire will be used to protect, maintain, and enhance resources and, as nearly as possible, be allowed to function in its natural ecological role.

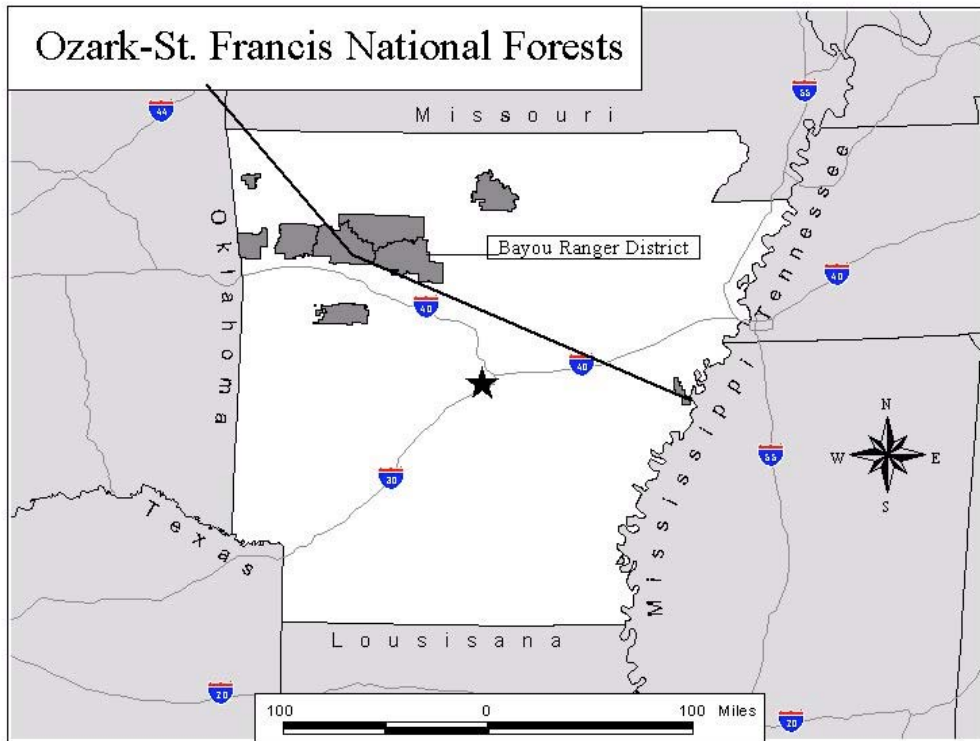


Figure 2. State vicinity map of the Ozark-St. Francis National Forest.

c. Ecosystem Based Land and Resource Management

During the last 80 to 100 years, the historical fire regime has been drastically altered through widespread fire suppression. The goals of an ecosystem-based management approach to forest ecosystems are promoting the health, sustainability, productivity, and diversity of these systems. Ecological disturbance processes from the past to the present have affected all of these ecosystem attributes. The ecosystem restoration initiative currently underway on the OSNF meets many of the goals of both the Review and the National Fire Plan (See: <http://www.fireplan.gov/index.cfm>).

In 1998 the Bayou Ranger District began using landscape scale prescribed fire for hazardous fuel reduction and wildlife and Proposed, Endangered, Threatened, and Sensitive species (PETS) habitat improvement. Forest ecosystem research and years of field observations indicated that initiating the use of prescribed fire at this scale would be a cost-effective first step in reestablishing fire as an ecological disturbance process in our forest ecosystems. Currently, other Ranger Districts on the Forest are also using landscape scale prescribed fire for fuel reduction and wildlife/PETS habitat improvement.

Prescribed fire is the deliberate application of fire to wildlands to achieve specific resource management objectives. Currently, our resource management goals for the use of prescribed fire are for hazardous fuel reduction, wildlife habitat improvement, and seedbed site preparation.

Planning, establishing objectives, and monitoring the results of landscape scale prescribed fire in terms of fuel reduction and habitat improvement goals fails to capture the primary reason for these types of projects. Hazardous fuels loads can be reduced and wildlife/PETS habitat can be improved with prescribed fire, however, the focus should be on restoring the fire-dependent ecosystems of the Ozark National Forest.

With the long-term elimination of wildland fire as an agent of natural change and ecological disturbance, the ecosystems of the National Forest have slowly changed over the years. The consequences of these changes are becoming more apparent each day. The sustainability of the oak-hickory forest ecosystem is in jeopardy due to the lack of advanced oak regeneration. The natural regeneration of the shortleaf pine ecosystem often fails due to hardwood competition. Oak and pine woodlands, once common in the Ozark-Ouachita Highlands, have almost been completely eliminated from the National Forest. Ecological conditions beneficial for PETS species have deteriorated with decades of fire suppression. This is particularly apparent in glade ecosystems that are being degraded by the invasion of fire intolerant woody plant species.

To reverse the ecological effects of decades of fire suppression will require a long term management commitment.

II. Ecosystem Restoration with GIS:

a. Identifying Landscape Burn Blocks

Fire is reintroduced at the landscape scale within defined landscape burning block control lines delineated with GPS/GIS across the District in all Land Types. Landscape burn blocks use both natural fire breaks such as streams and man-made features such as roads. Ecosystem restoration areas were created by combining two or more landscape burning blocks considering a variety of ecological, economic, and social factors. Some of the ecological factors include Land Type Associations, forest types, fire history, and forest health. In addition areas were selected to incorporate silvicultural treatments, wildlife habitat improvements, and prescribed burning treatments already accomplished. Economic and social criteria included municipal water supplies and resources at risk in the wildland/urban interface. These resources include communities and private property with residential and commercial developments, such as poultry and cattle operations.

Six ecosystem restoration areas have been identified. These areas are displayed on the Bayou Ranger District map to show the location of each area and the district-wide distribution of the restoration areas (Figure 3).

The combined acreage of these six areas is 60,000 acres. Each restoration area is made up of 3 to 6 landscape scale prescribed fire units. Figure 3 below details the name and distribution of each area.

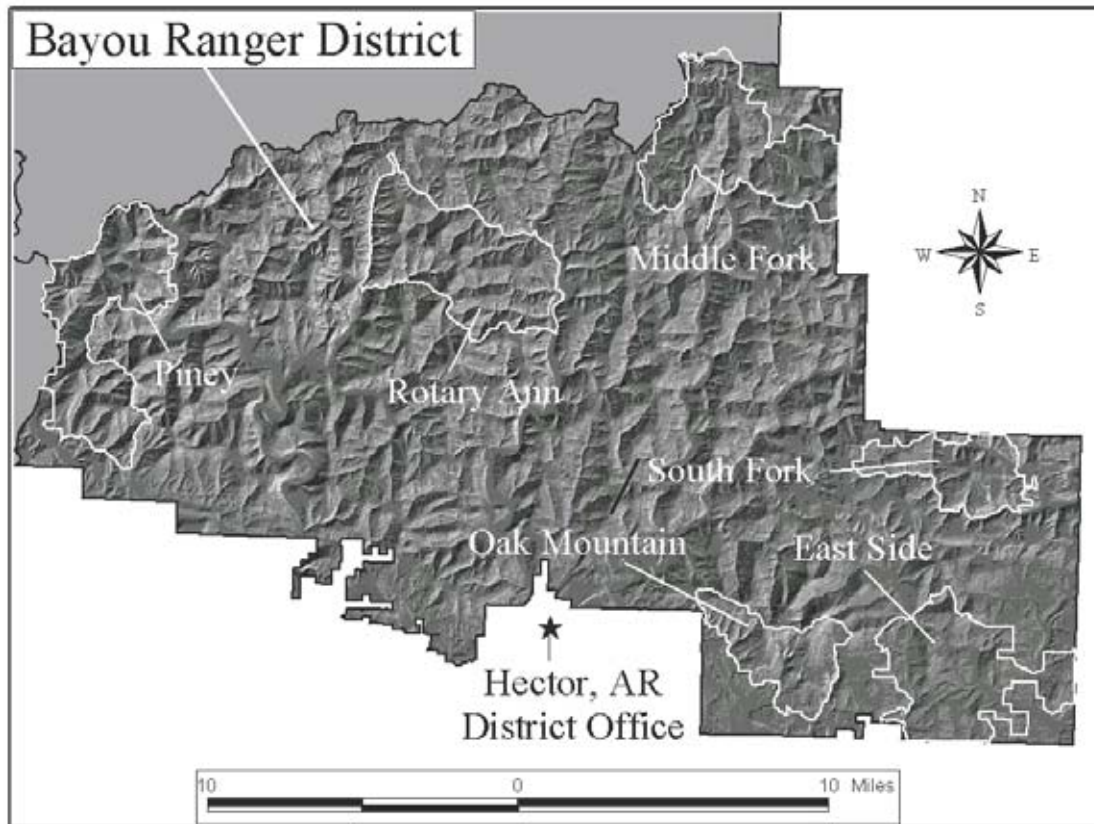


Figure 3. Distribution of Ecosystem Restoration Areas across the Bayou Ranger District.

b. Ecological Classification System (ECS)

ECS is a method used to identify, characterize, and map ecosystems. The system used on the Bayou Ranger District is based on the *National Hierarchy of Ecological Units*, developed by federal and state resource management agencies and universities. This type system has been adopted by many federal, state, county, and non-governmental organizations in the United States.

The aim of an Ecological Classification System (ECS) is to provide a format to convey basic information on the biological and physical characteristics of the landscape in a concise, integrated, standard and thorough manner. By mapping combinations of a landscape’s various characteristics, ECS helps natural resource managers understand the landscape’s capabilities for supporting a forest or wetland, providing wildlife habitat, producing a certain plant species, etc. This understanding can inform land use and resource management decisions. By providing a standard format, ECS allows information to be shared more easily among the various agencies, organizations, and individuals involved in natural resource management (www.iic.state.mn.us/finfo/ecs/what_is.htm).

i. ECS Hierarchy

1. Domain

Domain is the highest level identified in the Ecological Classification System. Domain units are sub-continental units with similar characteristics such as general climate, weather patterns, latitude, and annual precipitation. There are four Domain units globally; the Polar, Humid Temperate, Humid Tropical, and Dry.

2. Division

Divisions are subdivisions of Domains with similar characteristics such as, regional climate, precipitation, winter temperature, and regional vegetation (e.g., forest vs. prairie vs. desert). There are fourteen Divisions within the United States.

3. Province

In general, Provinces are subdivisions of Divisions; these subdivisions are based on climatic sub-zones of moisture and temperature along with broad topographic features such as the Interior Highlands, and the Mississippi Alluvial Plane.

4. Section

Sections are subdivisions of Provinces with similar characteristics such as, bedrock features, land forming processes, types of glacial sediment, and distribution of plant communities.

5. Subsection

Subsections are subdivisions of Sections. The same characteristics are used to differentiate subsections as were used for sections but they are used in more detail.

6. Land Type Association

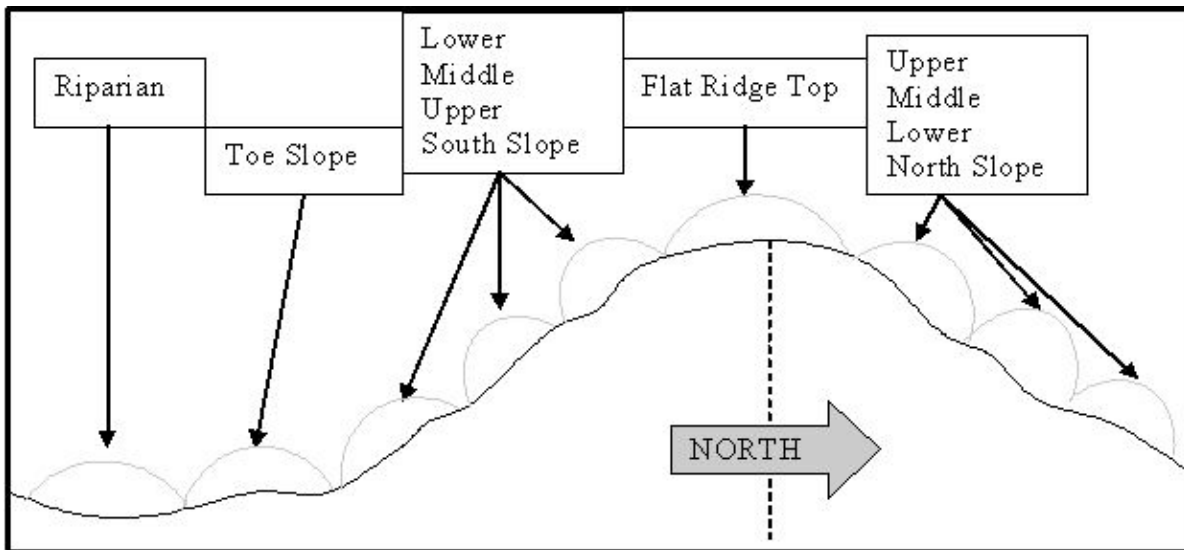
Land Type Associations (LTA's) are subdivisions of Subsections defined by similar patterns of characteristics such as: glacial landforms, depth to bedrock, bedrock type, topographic roughness, soil parent material, regional hydrology, and pre-settlement vegetation. There are four LTA's on the Bayou Ranger District.

7. Land Type

Land Types (LT's) are subdivisions of Land Type Associations. In the Ozark-St. Francis National Forest, land type mapping was based primarily on, slope position. LT's were created with GIS using a Digital Elevation Model (DEM). There are nine LT's on the Ozark-St. Francis NF, including Upper, Middle, and Lower North Slope, Upper, Middle, and Lower South Slope, Riparian, Toe Slope, and Flat Ridge Top as shown in Figure 4 below. Land Type units are the primary unit of delineation for ecosystem restoration projects on the Bayou Ranger District.

8. Land Type Phase

Land Type Phases (LTP) are subdivisions of Land Types and are the smallest level identified by ECS. Currently LTP units have not been identified on the Ozark-St. Francis NF. However, on the Chippewa National Forest, LTP units are defined using



characteristics such as, plant communities, indicator plants, water chemistry, landscape position, soil texture, soil drainage.

Figure 4. Typical Land Type configuration on the Ozark-St. Francis National Forest.

ii. How we use it?

Historical information such as Government Land Office surveys of the 1830's, fire history studies, and vegetation communities indicate that the forest cover of the Ozarks historically varied with slope position or Land Type. We use GIS to identify LT's as treatment areas on the ground (Figure 5). Due to fire exclusion most of the forest currently exists in a closed canopy state with many more trees per acre than were present historically. GIS helps us locate those areas of the Forest which were historically more open. We can then prescribe both mechanical treatments, such as thinning, and prescribed fire treatments to restore those areas to a more ecologically appropriate condition. The desired future condition (DFC) of LT's on the District is summarized in the LT descriptions below.

1. Riparian areas

Riparian areas are mesic with a closed canopy and well developed mid-story and shrub layer. Generally there are two forms of major disturbance in Riparian areas, seasonal flooding and fire. Fire carries through these areas in a highly mosaicked pattern and should have little effect on community structure. The effect of sporadic but frequent fire is that the number of trees per acre expressed in basal area (BA) could be as low as 50ft²/acre, and may be as high as 130ft²/acre. The herbaceous and shrub community will be composed of mesic associates such as witch hazel (*Hamamelis vernalis*), leatherwood (*Dirca palustris*), crested iris (*Iris cristata*), and yellow lady-slipper (*Cypripedium parviflora*).

2. Toe Slope

Very similar to Riparian areas except that fire will burn with a little more intensity having more of an effect on the community structure. Fire will carry through Toe Slope areas but should burn with relatively low intensity. Overall species composition is very similar to Riparian areas but exists in a somewhat more open state.

3. Lower South Slope

Lower South Slope may be dominated by oaks (*Quercus* spp.) or shortleaf pine (*Pinus echinata*) with interspersed hickory (*Carya* spp.) and other canopy species. South slopes in general are xeric in nature, but the lower south slope should have more water available throughout a longer portion of the year than points higher up the slope. Fire will occur frequently, every three to seven years, on all south slopes. The effect of frequent fire is that the number of trees per acre expressed in BA should be from 30 to 50ft²/acre, but should tend to be on the high end of the range. The herbaceous and shrub community will consist of fire dependent native grasses, forbs, legumes and shrubs such as bluestem (*Andropogon* spp.), woodland sunflower (*Helianthus* spp.), blazing star (*Liatris* spp.) rattlesnake master (*Eryngium yuccifolium*), peas (*Chamaecrista*, *Centrosema*, and *Clitoria* spp.), and huckleberry (*Vaccinium* spp.)

4. Middle South Slope

Middle South Slope may be dominated by oaks, primarily white oaks (*Quercus alba*, *Q. stellata*), or shortleaf pine with interspersed hickory and other canopy species. South slopes in general are xeric in nature, but the Middle South Slope should have less water available throughout the year than points lower on the slope. Fire will occur frequently and burn with moderate to high intensity. The effect of frequent fire is that the number of trees per acre expressed in BA should be from 30 to 50ft²/acre, but should be on average in the middle of the range. The herbaceous and shrub community will be similar on all south slope LT's, however the relative abundance of grasses, forbs and legumes should be more than that of the Lower South Slope.

5. Upper South Slope

Upper South Slope may be dominated by oaks, primarily white oaks, or shortleaf pine with interspersed hickory and other canopy species. South slopes in general are xeric in nature, but the Upper South Slope should have less water available throughout the year than points lower on the slope. Fire will occur frequently and burn with moderate to high intensity. The effect of frequent fire is that the number of trees per acre expressed in BA should be from 30 to 50ft²/acre, but should be on average on the lower end of the range. The herbaceous community will be similar on all south slope LT's, however the relative abundance of grasses, forbs and legumes should be more than that of the Lower South Slope or the Middle South Slope, and could best be characterized as mixed hardwood-conifer woodland rather than forest.

6. Flat Ridge Top

Flat Ridge Top may be dominated by oaks, primarily white oaks, or shortleaf pine with interspersed hickory and other canopy species. Flat Ridge Tops are generally xeric

in nature, and cover types here are best characterized as woodland or savannah with canopy trees being widely spaced with an open growth form. Fire will occur frequently, every three to seven years, and burn with moderate to high intensity. The effect of frequent fire is that the number of trees per acre expressed in BA should be from 30 to 50ft²/acre, but should be on average on the lower end of the range. The herbaceous community will consist of fire dependent native grasses, forbs, legumes, and shrubs however the relative abundance of grasses, forbs and legumes should be more than that of any other LT, with many prairie obligate species such as prairie parsley (*Polytaenia nuttallii*), and prairie coreopsis (*Coreopsis palmata*) being present.

7. Upper North Slope

Upper North Slope may be dominated by oaks or shortleaf pine with interspersed hickory and other canopy species. North slopes in general are mesic in nature, but the Upper North Slope should have less water available throughout the year than points lower on the slope. Northern Red Oak (*Quercus rubra*) and Black Oak (*Quercus velutina*) should have a higher relative abundance on north slopes than on south slopes in general. Fire will occur frequently on all north slopes, every three to seven years; however they should generally burn with less intensity than south slopes. The effect of frequent low to moderate intensity fire is that the number of trees per acre expressed in BA should be from 50 to 70ft²/acre, but should be on average on the lower end of the range. The herbaceous community will consist of fire dependent native grasses, forbs, legumes, and shrubs however the relative abundance of grasses, forbs and legumes should be more than that of the Lower North Slope or the Middle North Slope, and could best be characterized as mixed hardwood-conifer woodland rather than forest.

8. Middle North Slope

Middle North Slope may be dominated by oaks or shortleaf pine with interspersed hickory and other canopy species. North slopes in general are mesic in nature, but the Middle North Slope should have more water available throughout the year than points higher on the slope. Northern Red Oak and Black Oak should have a higher relative abundance on north slopes than on south slopes in general. Fire will occur frequently on all north slopes, every three to seven years; however they should generally burn with less intensity than south slopes. The effect of frequent low to moderate intensity fire is that the number of trees per acre expressed in BA should be from 50 to 70ft²/acre, but should be on average in the middle of the range. The herbaceous community will consist of mix of fire dependent and mesic associate native grasses, forbs, legumes, and shrubs however the relative abundance of fire dependent grasses, forbs and legumes should be less than that of the Upper North Slope and species composition will include mesic plants and shrubs such as ginseng (*Panax quinquefolius*), trillium (*Trillium* spp.), spicebush (*Lindera benzoin*), and paw-paw (*Asimina triloba*).

9. Lower North Slope

Lower North Slope may be dominated by oaks or shortleaf pine with interspersed hickory and other canopy species. North slopes in general are mesic in nature, but the Lower North Slope should have more water available throughout the year than points higher on the slope, being generally dominated in the under-story by mesic plants.

Northern Red Oak and Black Oak should have a higher relative abundance on north slopes than on south slopes in general. Fire will occur frequently on all north slopes, every three to seven years; however Lower North Slopes should generally burn with low intensity. The effect of frequent low to moderate intensity fire is that the number of trees per acre expressed in BA should be from 50 to 70ft²/acre, but should be on average on the high end of the range. The herbaceous community will consist of native grasses, forbs, legumes, and shrubs however the relative abundance of fire dependent herbs and forbs should be low due to the relatively closed canopy of this LT. Lower North Slope can best be characterized as closed canopy forest with an under-story composed of mesic plant and shrub associates.

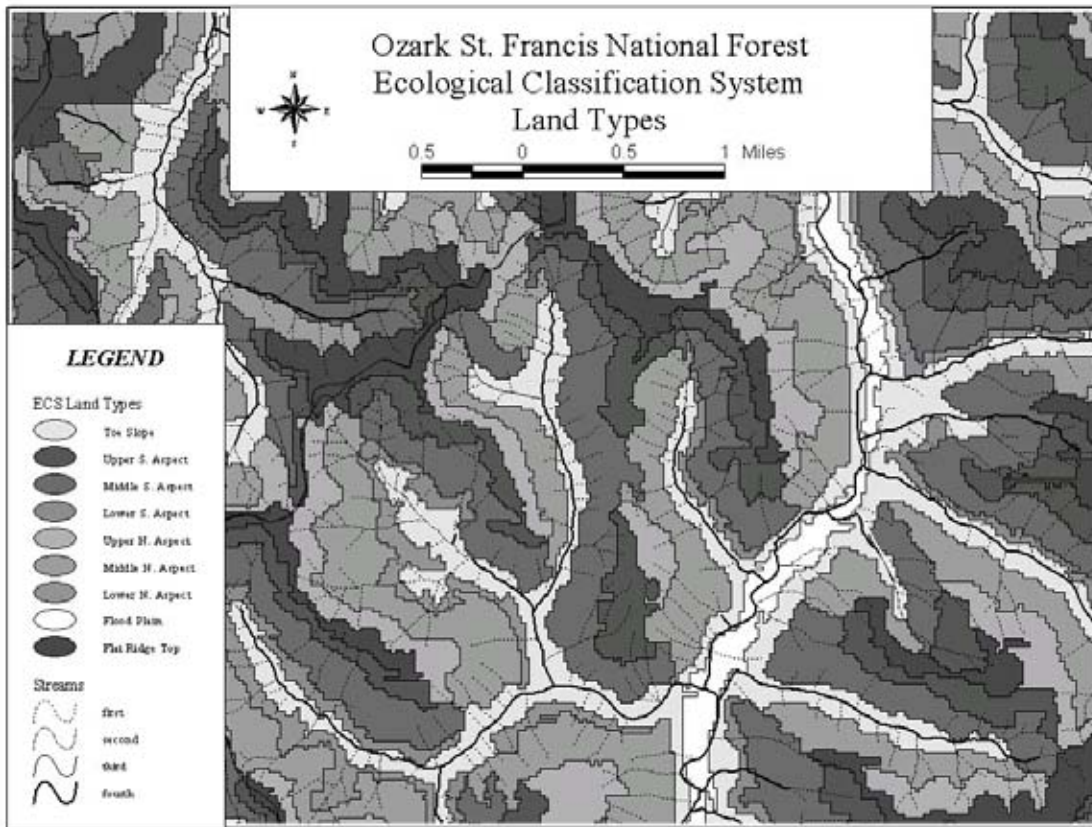


Figure 5. ECS-Land Types on the Bayou Ranger District viewed in ArcView 3.2 GIS.

III. Treatments:

Implementation is the act of applying treatments to the landscape to affect a shift from the current condition to the desired future condition. Treatment areas are delineated with GIS and are based on LT.

a. Landscape scale burning

Prescribed fire is used on all restoration areas before and after thinning. It is understood that some degree of ambiguity in describing the desired future condition is necessary as fire must be allowed to manipulate vegetation to the degree necessary to restore fire dependence and other ecosystem processes. This ambiguity is expressed in the BA ranges for the LT descriptions.

Prescribed fire at the landscape scale requires some means of rapid ignition of the interior of the burning block in conjunction with perimeter ignition by ground crews. We use aerial (“ping-pong ball”) ignition by helicopter to ignite the interior of the burn block, and hand crews using a variety of ignition techniques to hold the fire with the block. We use GPS/GIS onboard the helicopter to aid coordination with ground crews, to control fire intensity, and to direct ignition.

Once ignited, the fire burns with varying degrees of intensity based on available fuels, moisture content of fuels, slope, aspect, and distance between points of ignition, similar to the manner that would be expected in a natural wildland fire.

b. Thinning

All forms of tree removal yield virtually the same product; a thinned stand of timber. The choice of methods is reflective of one or more of the following criteria: commercial viability, commercial accessibility, and vicinity to urban interface. Commercial accessibility and vicinity to urban interface are determined with GIS using existing roads, slope, and property boundaries.

i. Commercial timber sales

Commercial timber sales are used to meet resource management objectives where it is prudent and possible to do so. Stands of timber must, in most cases, be thinned to approach historic densities and to stimulate herbaceous development. The primary carrier of fire in wildlands is leaf litter and small woody debris. These fuels dry rapidly when exposed to sun and wind in open forest stands, and they are consumed rapidly with low to moderate intensity by fire. It is necessary to conduct commercial timber sales to provide for market needs, remove fuel, expose the forest floor to sunlight, provide and restore their pyrogenic nature. A portion of the funds derived from the sale of timber can be returned to the area to conduct non commercial treatments in areas which are not commercially viable for one or more reasons such as inadequate road system (as no new roads are being constructed with this project), slopes are too steep and erosive for logging traffic, or the timber is not commercially appealing.

ii. Noncommercial timber sales

1. Wildlife Stand Improvement (WSI)

Wildlife Stand Improvement is chosen when a site is not commercially viable. It involves the marking of trees to leave or not to be cut. The actual cutting is accomplished by contract. The result is the same as an ecosystem restoration commercial timber sale but is somewhat less desirable because of the large quantity of “slash” or wood left on the site. The amount of wood left on site can be greatly reduced with the letting of personal firewood collection permits. The results of permit firewood cutting are however variable.

2. Wildland Urban Interface (WUI)

Wildland Urban Interface is chosen when a site is not commercially viable and lies within a defined urban interface zone. WUI meets the objectives of the National Fire Plan in reducing the danger of wildfire in urban interface areas with wildland characteristics. Mechanical thinning and prescribed fire are used to reduce the fire danger, but these actions have positive ecosystem restoration effects as well. It involves the marking of trees to leave or not to be cut. The actual cutting is accomplished by

contract. The result is the same as an ecosystem restoration commercial timber sale or WSI treatment and has drawbacks similar to that of WSI. WUI meets the objectives of the National Fire Plan in reducing the danger of wildfire in wildland urban interface.

IV. What we have accomplished to date:

i. Planning (NEPA)

The National Environmental Policy Act requires us to state in clear terms the purpose and need of the proposed action, conduct analysis on the proposed action, analyze alternatives to the proposed action, aggressively collect public comment on the proposed action, and make a published decision on the proposed action. Decisions are subject to appeal unless Categorically excluded from appeal by the CEQ. Further NEPA requires that monitoring will occur to ensure implementation.

We are conducting analysis on around 48,000 acres in Ecosystem Restoration Areas on the District. NEPA analysis will be completed, a decision will be signed and the project will be placed on the Federal Register for the appeal period by October 1st, 2003.

Ongoing analysis includes a detailed inventory of the biodiversity of the project, roads analysis, economic analysis, recreation impact analysis, water quality analysis, and wildfire fuels analysis. Much of the data collection associated with our analysis is aided or conducted with the help of GIS. In addition GIS is used for project tracking purposes.

Many aspects of our analysis are conducted with the help of partners or contractors. Some of the partners are The Nature Conservancy, the US Fish and Wildlife Service, the Southwest Fire Use Training Academy, the Arkansas Game and Fish Commission, the Arkansas Natural Heritage Commission, the Arkansas Archeological Survey, Quail Unlimited, the National Wild Turkey Federation, and the Audubon Society.

Other aspects of our analysis are being conducted with the help of Universities including; the University of Arkansas at Monticello where researchers are investigating the effect of prescribed fire on thinning on oak regeneration, and Arkansas Technological University where researchers are investigating the effect of ecosystem restoration treatments on avian communities.

Still more of the data we need is being collected in the field by qualified contractors in the areas of biodiversity and water quality.

ii. Implementation

One of our ecosystem restoration areas, the Middle Fork Project Area, has undergone the NEPA process and is currently in the implementation phase. Stands of timber are currently being marked for commercial timber sales, WSI, and WUI treatments. At full implementation the Middle Fork Project will be transformed from over 12,000 acres of closed canopy mixed forest to 5,000 acres of mixed oak-hickory-pine woodland and savannah and 7,000 acres of closed canopy mixed forest all of which will benefit from the maintaining effect of repeated prescribed fire on a three to five year rotation. According to all available research this condition will more closely resemble the condition as it existed before the era of European settlement and fire exclusion. Treatments will take from five to ten years.

V. Conclusion:

The era of fire suppression that began in 1905 as one of the missions of the Forest Service has altered the ecological processes of the Ozark Highlands resulting in unsustainable ecosystems. GIS and an Ecological Classification System (ECS) are valuable tools to identify, characterize, and map suitable landscapes for ecosystem restoration. GIS and ECS can be used to maximize agency efforts and financial allocation to affect ecosystem restoration treatments at a meaningful scale. The use of GIS and ECS is applicable to manage ecosystems on a landscape scale.

VI. Acknowledgements

We would like to acknowledge the following governments, agencies, and organizations for their support of this project; USDI-National Park Service, USDI-Fish and Wildlife Service, Caddo Nation of Oklahoma, Southwest Fire Use Training Academy, Arkansas Forestry Commission, Arkansas Natural Heritage Commission, Arkansas Game and Fish Commission, The Nature Conservancy, National Wild Turkey Federation, Audubon Society-Arkansas, Quail Unlimited, Rocky Mountain Foundation.

VII. References

Interagency Information Cooperative: Enhancing the access and use of forest resources data in Minnesota [web application] Available:

<http://www.iic.state.mn.us/index.html>. (Accessed: June 19, 2003)

Guyette, R. P. and M. A. Spetich, in press. Fire history of oak-pine forests in the Lower Boston Mountains, Arkansas, USA. Manuscript submitted to Forest Ecology and Management.

VIII. Author Information

Jim McCoy Wildlife Biologist Trainee, USDA Forest Service Ozark-St. Francis National Forests, Bayou Ranger District, 12000 SR 27 Hector, AR 72843, Phone: 479-284-3150, Fax: 479-284-2015, e-mail: jrmccoy@fs.fed.us.

Mike Brod Ecologist Trainee, USDA Forest Service Ozark-St. Francis National Forests, Bayou Ranger District, 12000 SR 27 Hector, AR 72843, Phone: 479-284-3150, Fax: 479-284-2015, e-mail: mbrod@fs.fed.us.

John Andre Ecologist, USDA Forest Service Ozark-St. Francis National Forests, Bayou Ranger District, 12000 SR 27 Hector, AR 72843, Phone: 479-284-3150, Fax: 479-284-2015, e-mail: jandre@fs.fed.us.



Enhancing the access and use of forest resources data in Minnesota.

A partnership between the: Minnesota Forest Resources Council, MN Association of County Land Commissioners, MN Department of Natural Resources, MN Land Management Information Center, University of MN, and US Forest Service.

<u>Background</u>	<u>Forest Information</u>	<u>Links to Forest Related Internet Sites</u>
<ul style="list-style-type: none"> A Brief Overview Purpose History Sustainable Forest Resources Act Needs Assessment Members Minutes Thanks 	<ul style="list-style-type: none"> Land Cover Rare Plants and Animals General Wildlife and Plants Natural Physical Data Strategic Plans Ecosystem Overview Archaeological and Historic Land Use/Harvest Reports Land Ownership & Political Roads and Trails Forest models Forest Resources Council Landscape Program Common Forest Inventory GIS Data 	<ul style="list-style-type: none"> Biological and Wildlife Urban Forestry Forest Inventory and/or Analysis Biological Diversity Air and Soil Riparian Resources Tourism, Recreational and Aesthetic Historical and Cultural Timber Harvest/Forestry Products Environmental Education General Resources GIS Resources
<p><u>Quick Click to MN GIS Data</u></p> <p><u>View the 1994 Generic Environmental Impact Statement Study on Timber Harvesting and Forest Management in Minnesota</u></p>		<p><u>Email Lists</u></p> <p><i>We really appreciate input/suggestions/comments to help keep this site up-to-date!</i></p>

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