INTEGRATING FUEL AND FOREST MANAGEMENT: DEVELOPING PRESCRIPTIONS FOR THE CENTRAL HARDWOOD REGION

Edward F. Loewenstein, Keith W. Grabner, George W. Hartman, and Erin R. McMurry[1]

ABSTRACT.—The oak dominated forests in the Ozarks of southern Missouri evolved under the influence of fire for thousands of years. However, fire exclusion and timber harvests have changed historical fuel loads and modified vegetative structure. The resurgent interest in restoration of fire dependent ecosystems in conjunction with the needs of resource managers to control fuel loads and affect the incidence and severity of wildfire suggests that the use of prescribed fire as a silvicultural tool will continue to increase above current levels. In order to develop the predictive models necessary to safely manage this tool, a replicated study was initiated in 2001. The rationale for this research and results from the pretreatment vegetation survey are presented.

General characteristics of pre-settlement Ozark forests were open woodlands with widely scattered trees and a diverse understory composed of grasses and wildflowers. Journal entries from early explorers in the late 1600s and throughout the 1700s describe the lands surrounding the Ozarks as open, thinly scattered with trees, and grassy (Beilmann and Brenner 1951). The character of the Ozarks was seemingly unchanged through the early 1800s when Henry Rowe Schoolcraft traveled through the area and described the uplands he encountered as open with scattered trees and the ground covered with grasses (Schoolcraft 1821). Observations of other travelers and settlers to this region further support these observations, as do surveys contracted by the General Land Office (GLO) from 1815 to the 1850s (Schroeder 1981).

The journals that provide a glimpse of the historic Ozark vegetation also provided an explanation for the cause of their open character. They described the practice of Native American burning, especially in the fall, as the reason for the open character of the forests (Beilmann and Brenner 1951, Ladd 1991, Nigh 1992). A pyrotechnic history for Central Hardwood forests can also be derived from historic forest structure and the ongoing species composition changes that are occurring in this region (Hicks 1998). A final clue to the fire history of the central hardwoods is found in dendrochronological fire histories. Pre-European settlement fire histories for the Ozarks have been developed that indicate fire return intervals from 2.8 to 12.4 years (table 1) with intervals ranging from 1 to 57 years (Guyette and Cutter 1991, 1997; Guyette 1994; Cutter and Guyette 1994). It is important to remember that dendrochronological fire histories tend to underestimate fire frequencies because not all trees are scared by fires, due to variability in fuels and fire intensities (Guyette and Cutter 1997).

The disturbance regimes responsible for creating the early structure and composition of the Missouri Ozarks changed markedly starting with region wide forest clearing during the Ozark timber boom from 1887 to 1920. After the land was cleared of merchantable trees, many unemployed mill workers tried to make a living by crop farming and raising livestock. Annual burning was used to control the vigorous growth of hardwood sprouts on these farms. The grazing and frequent burning in conjunction with the almost complete removal

[1] Assistant Professor of Silviculture (EFL), School of Forestry and Wildlife Sciences, Auburn University, 108 M. White Smith Hall, Auburn, AL 36849-5418 (formerly, Research Forester, USDA Forest Service, North Central Research Station, Columbia, MO 65211-7260; Fire Ecologist (KWG), Northern Prairie Wildlife Research Center, U.S. Geological Survey, 301 Gentry Hall, Columbia, MO 65211; Fire Ecologist (GWH), Missouri Department of Conservation, Conservation Research Center, 1110 S. College Ave., Columbia, MO 65201; and Graduate Research Assistant (ERM), School of Natural Resources, University of Missouri, 203 Natural Resources Building, Columbia, MO 65211. EFL is corresponding author: to contact, call (334) 844-1069 or e-mail at loewenstein@auburn.edu.

Citation for proceedings: Van Sambeek, J.W.; Dawson, J.O.; Ponder, F., Jr.; Loewenstein, E.F.; Fralish, J.S., eds. 2003. Proceedings, 13th Central Hardwood Forest conference; 2002 April 1-3; Urbana, IL. Gen. Tech. Rep. NC-234. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 565 p. [Research note from poster presentation].

Table 1.—*Pre-European settlement fire histories for the Ozarks*

Area	Mean fire return interval & (range) in years		
	1581 – 1700	1701 - 1820	1821 – 1940
Peck Ranch Conservation Area, Shannon and Carter Counties, Missouri		6.3 (2-24)	3.1 (1-10)
Current River Watershed, Missouri	17.7 (1-60)	12.4 (1-57)	3.7 (1-33)
Huckleberry Hollow, Shannon County, Missouri		7.1 (1-24)	2.2 (1-11)
Turkey Mountain, Marion County, Arkansas		5.7 (1-34), 1770 - 1993	
Laclede County, Missouri		2.8 years, 1740 to 1850 24.0 years, 1851 to 1993	
Caney Mountain Conservation Area, Missouri		4.3 years, 1710 to 1810 6.4 years, 1811 to 1990	

of a pine seed source greatly impacted pine reproduction. When many of these farms were abandoned, the forests regenerated primarily from oak sprouts; the pine component was greatly reduced from pre-exploitation levels (Cunningham and Hauser 1989).

About this same time, fire suppression by the USDA Forest Service and Missouri Department of Conservation became quite effective, nearly eliminating widespread wildfire from the area (Guyette and Cutter 1997). Without recurring fire to hold it in check, the density of the newly regenerating forest was much greater than historic levels. As this new forest matured, the deep shade beneath its closed canopy affected the composition and development of the understory vegetation as well. Thus, primarily because of an altered disturbance regime, we now find four major differences between current and historic forest conditions in the Ozarks:

1) tree density has increased since pre-settlement,
2) a midstory and shrub layer has developed,
3) actual and relative density of shortleaf pine (*Pinus echinata* Mill.) has decreased, and
4) the ground cover has changed from predominantly grasses and forbs to leaf litter and some shade tolerant forbs.

In recent years, many federal, state, and non-governmental organizations began using prescribed fire as a tool to restore Missouri Ozark forest stands to historic conditions. In fact, during the spring of 1999, state and federal agencies in Missouri treated 69,000 acres of land with prescribed fire (George Hartman, personal communication). The principal objectives of these treatments were vegetation management, exotic species control, and enhancement of native species; little emphasis was given to fuel loadings or fuel reduction. At the same time, fuel loads are increasing across the Ozarks of southern Missouri, primarily due to fire suppression and the accumulation of slash from timber harvests. Concern is increasing regarding fuel accumulation in many areas. Fuel reduction treatments, including prescribed fire and thinning, can benefit forest management in the Ozarks by modifying stand structure to meet residual density objectives and reducing the chance or intensity of wildfire. Thus, it seems that the same tools, currently employed for very different objectives, may in fact accomplish multiple goals if properly applied across the landscape.

A quantitative evaluation of fuel reduction treatments in the Missouri Ozarks, to include change in forest structure, fuel structure and loading, cost effectiveness of treatments, and the ecological response to treatment, provides an opportunity to develop detailed fuel and fire behavior data for the oak-hickory forest type of the eastern deciduous forest. It also facilitates the evaluation and development of fuel reduction methods for the Missouri Ozarks, allows for parameterization and validation of fire behavior models, and allows for the quantification of fuel loads in a forest type that lacks fuel inventory data. Further, it allows land managers to predict the vegetative response to these treatments based on pre-treatment conditions and, therefore, tailor management to achieve the desired outcome. The treatments being examined are prescribed fire, overstory thinning, and their interaction. Because topographic position affects not only vegetation but also fire behavior, data were collected across three broad topographic classes: protected or north-facing slopes, exposed or south-facing slopes, and ridge tops. In order to keep site- to site-variation to a minimum, the three replicated study blocks were maintained within the same land type association in southern Missouri.

Commonly occurring species in the pretreatment understory are presented in tables 2 and 3. The lack of recent disturbance on these sites is evidenced by the widespread occurrence of shade tolerant, fire intolerant species such as red maple (*Acer rubrum* L.), dogwood (*Cornus florida* L.), and black gum (*Nyssa sylvatica* Marsh.) across most topographic positions and sites. Some species such as bare-stemmed tick trefoil (*Desmodium nudifolia* (L.) DC.) were ubiquitous, occurring in nearly every plot across all sites. Other common species such as white oak (*Quercus alba* L.) and black oak (*Q. velutina* Lam.) were more prevalent on the more drought prone ridges and exposed slopes. Based on the experience of local resource managers, an immediate and marked response is expected from the initial treatments scheduled to be applied during the 2002 growing season.

LITERATURE CITED

Beilmann, A.P.; Brenner, L.G. 1951. The changing forest flora of the Ozarks. Annals of the Missouri Botanical Garden. 38: 283-291.

Cunningham, R.J.; Hauser, C. 1989. The decline of the Missouri Ozark forest between 1880 and 1920. In: Waldrop, T.A., ed. Proceedings, Symposium on the management and ecology of pine-hardwood mixtures. Atlanta, GA: [Publisher unknown]: 36-37.

Cutter, B.E.; Guyette, R.P. 1994. Fire frequency on an oak-hickory ridgetop in the Missouri Ozarks. American Midland Naturalist. 132: 393-398.

Guyette, R. 1994. Fire history of Turkey Mountain, Arkansas. Harrison, AR: Report prepared for the National Park Service, Buffalo National River.

Guyette, R.P.; Cutter, B.E. 1991. Tree-ring analysis of fire history of a post oak savanna in the Missouri Ozarks. Natural Areas Journal. 11: 93-99.

Guyette, R.P.; Cutter, B.E. 1997. Fire history, population, and calcium cycling in the Current River watershed. In: Pallardy, S.G.; Cecich, R.A.; Garrett, H.G.; Johnson, P.S., eds. Proceedings, 11th Central Hardwood Forest conference. Gen. Tech. Rep. NC-188. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 355-373.

Hicks, R.R. 1998. Ecology and management of Central Hardwood forests. New York, NY: John Wiley and Sons, Inc. 412 p.

Ladd, D. 1991. Reexamination of the role of fire in Missouri oak woodlands. In: Burger, G.V.;

Table 2.—*Five most common woody species by topographic position and treatment block*

SITE 1		SITE 2		SITE 3	
Protected		**Protected**		**Protected**	
Acer rubrum	Red maple	*Acer rubrum*	Red maple	*Acer rubrum*	Red maple
Nyssa sylvatica	Black gum	*Cornus florida*	Flowering dogwood	*Nyssa sylvatica*	Black gum
Cornus florida	Flowering dogwood	*Sassafras albidum*	Sassafras	*Carya texana*	Black hickory
Carya tomentosa	Mockernut hickory	*Quercus alba*	White oak	*Sassafras albidum*	Sassafras
Sassafras albidum	Sassafras	*Quercus coccinea*	Scarlet oak	*Corylus americana*	American hazelnut
Ridge top		**Ridge top**		**Ridge top**	
Sassafras albidum	Sassafras	*Quercus alba*	White oak	*Sassafras albidum*	Sassafras
Cornus florida	Flowering dogwood	*Quercus velutina*	Black oak	*Corylus americana*	American hazelnut
Acer rubrum	Red maple	*Carya texana*	Black hickory	*Carya texana*	Black hickory
Diospyros virginiana	Common persimmon	*Nyssa sylvatica*	Black gum	*Quercus alba*	White oak
Quercus alba	White oak	*Sassafras albidum*	Sassafras	*Rhamnus caroliniana*	Carolina buckthorn
Exposed		**Exposed**		**Exposed**	
Sassafras albidum	Sassafras	*Sassafras albidum*	Sassafras	*Cornus florida*	Flowering dogwood
Acer rubrum	Red maple	*Quercus alba*	White oak	*Sassafras albidum*	Sassafras
Nyssa sylvatica	Black gum	*Nyssa sylvatica*	Black gum	*Nyssa sylvatica*	Black gum
Quercus velutina	Black oak	*Acer rubrum*	Red maple	*Quercus velutina*	Black oak
Carya tomentosa	Mockernut hickory	*Quercus velutina*	Black oak	*Quercus alba*	White oak

*Top 5 regenerating woody species (<1.6” dbh) by site and topographic position, based on total percent coverage across plots.

Table 3.—*Five most common ground flora species by topographic position and treatment block.*

SITE 1		SITE 2		SITE 3	
Protected		**Protected**		**Protected**	
Desmodium nudiflorum	Bare-stemmed tick trefoil	*Desmodium nudiflorum*	Bare-stemmed tick trefoil	*Desmodium nudiflorum*	Bare-stemmed tick trefoil
Acer rubrum	Red maple	*Acer rubrum*	Red maple	*Acer rubrum*	Red maple
Parthenocissus quinquefolia	Virginia creeper	*Cornus florida*	Flowering dogwood	*Parthenocissus quinquefolia*	Virginia creeper
Nyssa sylvatica	Black gum	*Sassafras albidum*	Sassafras	*Nyssa sylvatica*	Black gum
Cornus florida	Flowering dogwood	*Quercus alba*	White oak	*Carya texana*	Black hickory
Ridge top		**Ridge top**		**Ridge top**	
Desmodium nudiflorum	Bare-stemmed tick trefoil	*Quercus alba*	White oak	*Parthenocissus quinquefolia*	Virginia creeper
Parthenocissus quinquefolia	Virginia creeper	*Quercus velutina*	Black oak	*Sassafras albidum*	Sassafras
Rhus radicans	Poison ivy	*Carya texana*	Black hickory	*Corylus americana*	American hazelnut
Sassafras albidum	Sassafras	*Nyssa sylvatica*	Black gum	*Carya texana*	Black hickory
Cornus florida	Flowering dogwood	*Desmodium nudiflorum*	Bare-stemmed tick trefoil	*Desmodium nudiflorum*	Bare-stemmed tick trefoil
Exposed		**Exposed**		**Exposed**	
Sassafras albidum	Sassafras	*Vaccinium vacillans*	Lowbush blueberry	*Cornus florida*	Flowering dogwood
Desmodium nudiflorum	Bare-stemmed tick trefoil	*Sassafras albidum*	Sassafras	*Desmodium nudiflorum*	Bare-stemmed tick trefoil
Acer rubrum	Red maple	*Quercus alba*	White oak	*Sassafras albidum*	Sassafras
Parthenocissus quinquefolia	Virginia creeper	*Nyssa sylvatica*	Black gum	*Vaccinium vacillans*	Lowbush blueberry
Nyssa sylvatica	Black gum	*Acer rubrum*	Red maple	*Nyssa sylvatica*	Black gum

*Top 5 ground flora species by site and topographic position, based on total relative cover of each species by plot.

Ebinger, J.E.; Wilhelm, G.S., eds. Proceedings, Oak woods management workshop. Charleston, IL: Eastern Illinois University: 67-80.

Nigh, T. 1992. The forests prior to European settlement. In: Journet, A.R.P.; Spratt, H., eds. Towards a vision for Missouri's public forests. Cape Girardeau, MO: Southeast Missouri State University: 6-13.

Schoolcraft, H.R. 1821. Journal of a tour into the interior of Missouri and Arkansas performed in the years 1818 and 1819. London, UK: Sir Richard Phillips and Co.

Schroeder, W.A. 1981. Presettlement prairie of Missouri. Missouri Nat. Hist. Ser. 2. Jefferson City, MO: Missouri Department of Conservation. 37 p.