

Rapid Assessment Reference Condition Model

The Rapid Assessment is a component of the LANDFIRE project. Reference condition models for the Rapid Assessment were created through a series of expert workshops and a peer-review process in 2004 and 2005. For more information, please visit www.landfire.gov. Please direct questions to helpdesk@landfire.gov.

Potential Natural Vegetation Group (PNVG)

R50AHldy Interior Highlands Oak-Hickory (Pine)

General Information

Contributors (additional contributors may be listed under "Model Evolution and Comments")

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Vegetation Type

Woodland

General Model Sources

- Literature
 Local Data
 Expert Estimate

Rapid Assessment Model Zones

- California Pacific Northwest
 Great Basin South Central
 Great Lakes Southeast
 Northeast S. Appalachians
 Northern Plains Southwest
 N-Cent.Rockies

Dominant Species*

QUAL QUMA
QUST PIEC2
QURU
QUVE

LANDFIRE Mapping Zones

44

Geographic Range

This potential natural vegetation group (PNVG) is common in the Interior Highlands. More specifically, it is located in Arkansas, Oklahoma and Missouri, within the Ouachita and Boston Mountains, Arkansas River Valley, and the Salem and Springfield Plateaus. It typically occupies dry to xeric sites at elevations between 500 and 2500 feet.

Biophysical Site Description

This PNVG is found exclusively on drier sites primarily on south and west aspects or ridgetops. It is dominated by oaks and hickories, approximately 75% with a lesser component of shortleaf pine. Open conditions describe a single canopy structure with no developed midstory. Closed conditions are multiple canopy usually late-seral forests.

Vegetation Description

Upland woodlands dominated by white oak (*Quercus alba*), post oak (*Quercus stellata*), red oaks, and shortleaf pine (*Pinus echinata*). Dogwood, small oaks, grasses, blueberries dominate the understory. Small, stand replacement fires, oak decline, and wind throw are the major, large-scale, stand replacement agents. Shortleaf pine is restricted to sites within its natural range on more acidic soils within the oak-hickory-pine forests. Historically, forest types with a shortleaf pine component within this region included more than about 50 percent of the landscape, about 20 percent scrub forests, and 30 percent in open condition (Batek et al. 1999). Wind and mortality maintain gaps over about 0.7 percent of the landscape. Shortleaf pine however, is only able to capture about half of these gaps (Stambaugh et al. 2002). Shortleaf pine is drought and low temperature sensitive (Stambaugh and Guyette 2004). On a pre-European landscape basis shortleaf pine was positively associated with fire frequency (Batek et al. 1999) and negatively associated with topographic roughness (Guyette and Kabrick 2003, Guyette and Stambaugh, in press).

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit <http://plants.usda.gov>.

Disturbance Description

Fire is the primary disturbance process in this type. The fire regime is group 1, with high frequency, low intensity surface fires. Replacement fires are infrequent, every 100 to 150 years. Mixed fire is very infrequent in open canopy conditions, but occurs more frequently in closed canopy (every 80 years in closed states). Seasonality helps define surface, mixed fire and stand replacement fire types. Mixed fires are slightly more frequent in closed late-seral stages. Stand replacement fires occurred mostly under drought conditions during the growing season. Late growing season fires under normal moisture conditions were for the most part surface fires. Anthropogenic fire contributes significantly to all fire occurrence. Additional disturbance factors include wind/weather/stress, within stand competition and maintenance, and insect/disease outbreaks. The absence of disturbance, is also significant in movement to classes with closed canopy conditions. Within stand competition and maintenance is most common in closed condition classes, although this disturbance does not significantly alter model results, it was included for consistency with two of the previous FRCC models. Native ungulate grazing may have played a small role in replacement where buffalo and elk concentrated, but fire generally maintained systems. Drought and moist cycles play a strong role interacting with both fire and native grazing.

Adjacency or Identification Concerns

The PNVG was defined using NatureServe - Central Interior and Appalachian (202), CES202.306 Ouachita Montane Oak Forest, CES202.708 Ozark-Ouachita Dry-Mesic Oak Forest, CES202.043 Ozark-Ouachita Mesic Hardwood Forest, CES202.692 Central Interior Dry Acidic Glade and Barrens, Ozark-Ouachita Shortleaf Pine-oak Forest and Woodland, CES202.312 Arkansas Valley Prairie and Woodland. Also identified as Ouachita Mixed Forest and Eastern Broadleaf Forest (R8 Old Growth Guidance).

Scale Description

Sources of Scale Data Literature Local Data Expert Estimate

Landscape is adequate in size to contain natural variation in vegetation and disturbance regime. Topographically complex areas can be relatively small (< 1000 acres). Larger landscapes can be up to several thousand acres in size.

Issues/Problems

Type includes glades and barrens as inclusions within the oak-hickory/pine matrix. It is believed by experts that the fire regime is similar enough between these three types that they can be modeled together. The historic range of pine defines where it occurs within the type.

Model Evolution and Comments

This type is a result of combining three FRCC PNVG (OKHK2 ,OKPN2, SEOK4) and excludes areas shown in these models within the West Gulf Coast Plain. Coverage is limited within the Arkansas River Valley. Review should include authors of the above listed FRCC models along with collaboration and suggested edits from Doug Zollner, Paul Nelson, Tom Foti, Susan Hooks, Bruce Davenport, John Andre and others. The disturbance description and frequency of mixed fire in closed states was altered upon review.

Succession Classes**

Succession classes are the equivalent of "Vegetation Fuel Classes" as defined in the Interagency FRCC Guidebook (www.frcc.gov).

Class A 14 %

Early1 All Struct

Description

Pine and oak reproduction to 15' tall. Community of forbs and perennial grasses. More persistent on dry sites. Openings tend to be small and have scattered live trees. < 25% tree canopy cover (Missouri is in the northern extent of the range of shortleaf pine, in the northern areas of this pnvg there will not be a pine component of this group)

Dominant Species* and Canopy Position

QUERC Upper
CARYA Upper
PIEC2 Upper
ANDR Lower

Upper Layer Lifeform

- Herbaceous
- Shrub
- Tree

Fuel Model 2

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Herb Short <0.5m	Tree Regen <5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

- Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class B 4 %

Mid1 Closed

Description

Mid-seral with closed canopy oak and shortleaf pole-sized trees with little or no herbaceous understory. Some woody understory development. > 50% canopy cover (crown closure estimate). (Missouri is in the northern extent of the range of shortleaf pine, in the northern areas of this pnvg there will not be a pine component of this group)

Dominant Species* and Canopy Position

QUERC Upper
CARYA Upper
PIEC2 Upper

Upper Layer Lifeform

- Herbaceous
- Shrub
- Tree

Fuel Model 9

Structure Data (for upper layer lifeform)

	Min	Max
Cover	61 %	100 %
Height	Tree Short 5-9m	Tree Medium 10-24m
Tree Size Class	Medium 9-21"DBH	

- Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class C 30 %

Mid1 Open

Description

Mid-development, open canopy. Woodland/savanna with herbaceous understory. Oak-pine predominate overstory < 50% canopy cover (Missouri is in the northern extent of the range of shortleaf pine, in the northern areas of this pnvg there will not be a pine component of this group)

Dominant Species* and Canopy Position

QUERC
CARYA
PIEC2
ANDR

Upper Layer Lifeform

- Herbaceous
- Shrub
- Tree

Fuel Model 9

Structure Data (for upper layer lifeform)

	Min	Max
Cover	26 %	60 %
Height	Tree Medium 10-24m	Tree Tall 25-49m
Tree Size Class	Medium 9-21"DBH	

- Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit <http://plants.usda.gov>.

Class D 49%

Late I Open

Description

Late-development, open canopy oak-pine to pine-oak in composition. Late-seral woodland/savanna pine and oak overstory with perennial grasses and limited shrub community. < 50% canopy cover (Missouri is in the northern extent of the range of shortleaf pine, in the northern areas of this pnvgr there will not be a pine component of this group)

Dominant Species* and Canopy Position

QUERC
CARYA
PIEC2
ANDR

Upper Layer Lifeform

- Herbaceous
- Shrub
- Tree

Fuel Model 2

Structure Data (for upper layer lifeform)

	Min	Max
Cover	26 %	60 %
Height	Tree Medium 10-24m	Tree Tall 25-49m
Tree Size Class	Large 21-33"DBH	

- Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class E 3%

Late I Closed

Description

Late-seral, closed canopy, oak dominated overstory community. Some herbaceous cover and "rank" woody shrub understory layer. Canopy gaps with non-oak regeneration. > 50% canopy cover (crown closure estimate) (Missouri is in the northern extent of the range of shortleaf pine, in the northern areas of this pnvgr there will not be a pine component of this group)

Dominant Species* and Canopy Position

QUERC Upper
CARYA Upper
PIEC2 Upper
ANDR

Upper Layer Lifeform

- Herbaceous
- Shrub
- Tree

Fuel Model 9

Structure Data (for upper layer lifeform)

	Min	Max
Cover	61 %	100 %
Height	Tree Medium 10-24m	Tree Tall 25-49m
Tree Size Class	Large 21-33"DBH	

- Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Disturbances

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit <http://plants.usda.gov>.

Disturbances Modeled

- Fire
- Insects/Disease
- Wind/Weather/Stress
- Native Grazing
- Competition
- Other:
- Other

Historical Fire Size (acres)

Avg: 500
 Min: 50
 Max: 2000

Sources of Fire Regime Data

- Literature
- Local Data
- Expert Estimate

Fire Regime Group: 1

- I: 0-35 year frequency, low and mixed severity
- II: 0-35 year frequency, replacement severity
- III: 35-200 year frequency, low and mixed severity
- IV: 35-200 year frequency, replacement severity
- V: 200+ year frequency, replacement severity

Fire Intervals (FI)

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class. All values are estimates and not precise.

	<i>Avg FI</i>	<i>Min FI</i>	<i>Max FI</i>	<i>Probability</i>	<i>Percent of All Fires</i>
<i>Replacement</i>	150	100	300	0.00667	3
<i>Mixed</i>	1000	50	2000	0.001	0
<i>Surface</i>	4	2	10	0.25	97
<i>All Fires</i>	4			0.25767	

References

Albert, Lois E. 1981. Five Thousand Years of Environmental Change in Southeastern Oklahoma. Okla. Arch. Survey, No. 7,;

Batek, M.J., A.J. Rebutus, W.A. Schroeder, T.L. Haithcoat, E. Compas, and R.P Guyette. 1999. Reconstruction of early nineteenth century vegetation and fire regimes in the Missouri Ozarks. J. of Biogeography. 26:397-412.

Bragg, D. C. 2002. Reference conditions for old-growth pine forests in the Upper West Gulf Coastal Plain. Journal of the Torrey Botanical Society 129(4):261-288.

Brissette, J. C. and J. P. Barnett (eds). 1992. Proceedings: Shortleaf Pine Regeneration Workshop. So. For. Exp. Sta., GTR-SO-90.

Burger, George V., et al. (eds). Proceedings of the Oak Woods Management Workshop. E. III. Univ.; 1991.

Brown, J. K. and J. K. Smith editors. Wildland Fire in Ecosystems: effects of fire on flora. Gen, Tech. Rep. RMRS-GTR-42-vol. 1-2. USDA, Forest Service, Rocky Mountain Research Station. 2000.

Cain, M. D. and M. G. Shelton. 2003. Effects of Alternative Thinning Regimes and Prescribed Burning in Natural, Even-aged Loblolly-Shortleaf Pine Stands: 25 year results. Southern Journal of Applied Forestry 27(1):

Cain, M. D. and M. G. Shelton. 2000. Survival and growth of Pinus and Quercus seedlings in response to simulated summer and winter prescribed burns. Canadian Journal of Forest Resources 30:.

Campbell, J.J.N., et al. 1991. Floristic and Historical Evidence of Fire Maintained, Grassy Pineoak Barrens before Settlement in Southeastern Kentucky. In Proc: Fire and the Environment: Ecological and Cultural Perspectives. SE For. Exp. Sta.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit <http://plants.usda.gov>.

Cram, D. S., R. E. Masters, F. S. Guthery, D. M. Engle, and W. G. Montague. 2002. Northern Bobwhite Population and Habitat Response to Pine-grassland Restoration. *Journal of Wildlife Management* 66:1031-1039.

Delcourt, H. R. and P. A. Delcourt. 1991. Late Quaternary Vegetation History of the Interior Highlands of Missouri, Arkansas, and Oklahoma. In D. Henderson and L. D. Hedrick, editors. *Proc: Restoration of Old Growth Forests of the Interior Highlands of Arkansas and Oklahoma*. Winrock International. Morrilton, Ark.

Dey, C.D., and R.P. Guyette. 2000. Anthropogenic fire history and red oak forests in south-central Ontario. *Forestry Chronicle* 76(2):339-347.

Foti, T. and S. Glenn. 1991. The Ouachita Mountains Landscape at the Time of Settlement. In D. Henderson and L. D. Hedrick, editors. *Proc.: Conference on Restoring Old Growth Forest in the Interior Highlands of Arkansas and Oklahoma*. Winrock International, Morrilton, Ark.

Fryar, Roger D. 1991. Old Growth Stands of the Ouachita National Forest. In D. Henderson and L. D. Hedrick, editors. *Proc: Restoration of Old Growth Forest in the Interior Highlands of Arkansas and Oklahoma*. Winrock International. Morrilton, Ark.

Glitzenstein, J. S., P. A. Harcomb, and D. R. Streng. 1986. Disturbances, succession, and maintenance of species diversity in an east Texas forest. *Ecological Monographs* 56:243-258.

Guyette, R.P. and B.E. Cutter. 1997. Fire history, population, and calcium cycling in the Current River Watershed. In:(Pallardy et al. eds.) *Proceedings 11th Central Hardwood Forest Conference*. USDA Forest Service GTR NC-188. 401 p.

Guyette, R. P and B. E. Cutter. 1991. Tree-ring analysis of fire history of a post-oak savanna in the Missouri Ozarks. *Natural Areas Journal* 11(2): 93-99.
Highlands of Arkansas and Oklahoma. *Conf. Proc.*, Winrock International. Morrilton, Ark.

Guyette, R.P. and D.C. Dey. 1997. Historic shortleaf pine (*Pinus echinata*) abundance and fire frequency in a mixed oak - pine forest (MOFEP site 8). In:(B. Brookshire and S. Shifley,eds.) *The Proceeding of the Missouri Ozark Forest Ecosystem Project Symposium: An experimental approach to landscape research*. USDA Forest Service GTR NC-193. 378 p.

Guyette , R.P. Dey, D.C, and M.C. Stambaugh. 2003. Fire history of an Indiana oak barren. *American Midlands Naturalist*. 149:21-34.

Guyette, R.P. and J. Kabrick. 2003. The legacy of forest disturbance, succession, and species at the MOFEP sites. In:(S. Shifley, eds.) *The Proceeding of the Second Missouri Ozark Forest Ecosystem Project Symposium*. USDA Forest Service GTR NC-227.

Guyette, R. P. and E. A. McGinnes, Jr. 1982. Fire History of an Ozark Glade in Missouri. *Trans. Mo. Acad. Sci.*16:85-93.

Guyette, R.P. R.M. Muzika, C.D. Dey. 2002. Dynamics of an anthropogenic fire regime. *Ecosystems*. 5(5): 472-486.

Guyette, R. P. and M. A. Spetich 2003. Fire history in oak-pine forests in the Lower Boston Mountains, Arkansas, USA. *Forest and Ecology Management* 180:463-474.

- Henderson, D. and L. D. Hedricks (eds). 1991. Restoration of Old Growth Forests in the Interior
- Hessl, A. and S. Spackman. 1995. Effects of Fire on Threatened and Endangered Plants: An annotated Bibliography. USDOJ, National biological Service.
- Honess, C. W. 1923. Geology of the southern Ouachita Mountains of Oklahoma. Bulletin 32, Parts I and II. Oklahoma Geological Survey. Norman Okla. 354 pp. Jansma, J. and H. H. Jansma. George Engelmann in Arkansas Territory. Ark. Hist. Quart., pp. 225-248.
- Jenkins, S.E., R.P. Guyette, and A.J. Rebutus. 1997. Vegetation diversity and fire history on Turkey Mountain. In: (Pallardy et al. eds.) Proceedings 11th Central Hardwood Forest Conference. USDA Forest Service GTR NC-188. 401 p.
- Johnson, F. L. and G. D. Schnell. 1985. Wildland Fire History and the Effects of Fire on Vegetative Communities at Hot Springs National Park, Arkansas. Rep. To NPS, Santa Fe, NM., Okla. Biological Survey., University of Oklahoma, Norman, Okla. 49 pp.
- Jurney, D. R. Evans, J. Ippolito, and V. Bergstrom. 2004. The role of Wildland fire in portions of southeastern North America. Pages IN PRESS in R. T. Engstrom and W. J. de Groot (eds). 22nd Tall Timbers Fire Ecology Conf. Proceedings. Kanaskas, Alberta.
- Kreiter, S. D. 1994. Dynamics and Spatial Patterns of a Virgin Old-growth Hardwood-pine Forest in the Ouachita Mountains, Oklahoma, from 1896-1994. M.S. Thesis. Oklahoma State University, Stillwater.
- Langevede, F. V., C. A. D. M. Vande Vijver, L. Kumar, H. Van De Koppel, N. De Ridder, J. Van Andel, A. K. Skidmore, J. W. Hearne, L. Stroosnijder, W. J. Bond, H. H. T. Prins, and M. Rietkerk. 2003. Effects of Fire and Herbivory on the Stability of Savanna Ecosystems. *Ecology* 84(2):337- 350.
- Lewis, A. 1924. La Harpe's first expedition in Oklahoma, 1718-1719. *Chron. Oklahoma* 2(4):331-349.
- MacCleery, D. 1994. Understanding the Role the Human Dimension Played in Shaping America's Forest and Grassland Landscapes: Is there a landscape archaeologist in the house? *Eco-watch* 2: .
- Masters, R. E. 1991. Effects of fire and timber harvest on vegetation and cervid use on oak -pine sites in Oklahoma Ouachita Mountains. Pages 168-176. In S. C. Nodvin and T. A. Waldrop, (eds.). *Fire and the environment: ecological and cultural perspectives*. Proc. Of an international symposium. USDA For. Serv. Gen. Tech. Rep. SE-69. Southeast For. Exp. Sta., Asheville, N.C.
- Masters, R. E. 1991. Effects of timber harvest and prescribed fire on wildlife habitat and use in the Ouachita Mountains of eastern Oklahoma. Ph.D. Thesis, Oklahoma State Univ. Stillwater. 351 pp.
- Masters, R. E., and D. M. Engle. 1994. BEHAVE-evaluated for prescribed fire planning in mountainous oak-shortleaf pine habitats. *Wildlife Society Bulletin* 22:184-191.
- Masters, R. E., D. M. Engle, and R. Robinson. 1993. Effects of timber harvest and periodic fire on soil chemical properties in the Ouachita Mountains. *Southern Journal of Applied Forestry* 17:139-145.
- Masters, R. E., R. L. Lochmiller, and D. M. Engle. 1993. Effects of timber harvest and periodic

fire on white-tailed deer forage production. *Wildlife Society Bulletin* 21:401-411.

Masters, R. E., R. L. Lochmiller, S. T. McMurry, and G. A. Bukenhofer. 1998. Small mammal response to pine-grassland restoration for red-cockaded woodpeckers. *Wildlife Society Bulletin* 28:148-158.

Masters, R. E., J. E. Skeen, and J. A. Garner. 1989. Red-cockaded woodpecker in Oklahoma; an update of Wood's 1974-77 Study. *Proc. Okla. Acad. Sci.* 69:27-31.

Masters, R. E., J. E. Skeen, and J. Whitehead. 1995. Preliminary fire history of McCurtain County Wilderness Area and implications for red-cockaded woodpecker management. Pages 290-302 in D. L. Kulhavy, R. G. Hooper, and R. Costa. (eds.). *Red-cockaded woodpecker: Species recovery, ecology and management*. Center for Applied Studies, Stephen F. Austin University, Nacogdoches, TX.

Masters, R. E., C. W. Wilson, D. S. Cram, G. A. Bukenhofer, and R. L. Lochmiller. 2002. Influence of ecosystem restoration for red-cockaded woodpeckers on breeding bird and small mammal communities. Pages 73-90 in W. M. Ford, K. R. Russell, and C. E. Moorman, editors. *In The role of fire in non-game wildlife management and community restoration: traditional uses and new directions: proceedings of a special workshop. Annual Meeting of The Wildlife Society, Nashville, Tenn. USDA For. Ser. Northeast Research Station. General Technical Report NE- 288.*

Masters, R. E., C. W. Wilson, G. A. Bukenhofer, and M. E. Payton. 1996. Effects of pinegrassland restoration for red-cockaded woodpeckers on white-tailed deer forage production. *Wildlife Society Bulletin* 24:77-84.

Nelson, J. C. 1997. Presettlement Vegetation Patterns along the 5th Principal Meridian, Missouri Territory, 1815. *Am. Midl. Nat.* 137:70-94.

Palmer, E. J. 1921. *The Forest Flora of the Ozark Region*. J. Arnold Arbor. 2:.

Palmer, E. J. 1924. *The Ligneous Flora of Rich Mountain, Arkansas and Oklahoma*. J. Arnold Arbor. 5:

Panzer, R.. Compatibility of Prescribed Burning with Conservation of Insects in Small, Isolated Prairie Preserves. *Conservation Biology*, Vol. 16, no. 5, 2002, pp1296-1307.

Perttula, T. K. 1993. The Long Term Consequences and Effects of the de Soto Entrada on Aboriginal Caddoan Populations. In *Proc: De Soto Sym, 1988 and 1990*;

Rebertus, A. J. and B. R. Burns. 1997. The Importance of gap processes in the development and maintenance of oak savannas and dry forests. *Journal of Ecology* 85:633-645.

Rudis, Victor A. and Thomas V. Skinner. *Fire's Importance in South Central U.S. Forests: distribution of fire evidence.*

Schmidt, Kirsten M, Menakis, James P., Hardy, Colin C., Hann, Wendel J., Bunnell, David L. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. *□Gen.*

Smith, B. A., R. J. Tyrl, and R. E. Masters. 1997. Floristic inventory of the McCurtain County Wilderness Area (Oklahoma). *Okla. Acad. Sci.* 77:99-102.

Smith, K. L. 1986. *Sawmill: The story of cutting the last great virgin forest east of the Rockies*. Univ. Ark. Press.

Smith, K. G. and J. C. Neal. 1992. Pre-settlement Birds and Mammals of the Interior Highlands. In D. Henderson and L. D. Hedrick, editors. Proc.: Conference on Restoring Old Growth Forest in the Interior Highlands of Arkansas and Oklahoma. Winrock International, Morrilton, Ark.

Sparks, J. C. 1996. Growing-Season and Dormant-Season Fire Behavior and Effects on Vegetation in the Ouachita Mountains, Arkansas. M.S. Thesis. Oklahoma State University, Stillwater. 186 pp.

Sparks, J. C., and R. E. Masters. 1996. Fire seasonality effects on vegetation in mid-, tall-, and southeastern pine-grassland communities: a review. Trans. No. Am. Wildlife and Natur. Res. Conf. 61:230-239.

Sparks, J. C., R. E. Masters, D. M. Engle, and G. A. Bukenhofer. 2002. Season of burn influences fire behavior and fuel consumption in restored shortleaf pine-grassland communities. Restoration Ecology 10:714-722.

Sparks, J. C., R. E. Masters, D. M. Engle, M. Palmer and G. A. Bukenhofer. 1998. Effects of late growing-season and late dormant-season prescribed fire on herbaceous vegetation in restored pine-grassland communities. Journal of Vegetation Science 9: 133-142.

Spetich, Martin A., ed. 2004. Upland oak ecology symposium: history, current conditions, and sustainability. Gen. Tech. Rep. SRS-73. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 311 p.

Stambaugh, M.C., R.M. Muzika, and R.P. Guyette. 2002. Disturbance characteristics and overstory composition of an old-growth shortleaf pine (*Pinus echinata* Mill.) forest in the Ozark Highlands, Missouri, USA. Natural Areas Journal 22:108-119.

Stambaugh, M.C., R.P. Guyette. 2004. The long-term growth and climate response of shortleaf pine at the Missouri Ozark Forest Ecosystem Project. In:(Yaussy et al. eds.) The Proceedings of the 14th descrip_template012004.doc Central Hardwoods Conference, Delaware, Ohio. USDA Forest Service GTR NE-316 . pp 448- 458.

Tech. Rep. RMRS-GTR-87. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 41 p. + CD.

U.S. Department of Agriculture, Forest Service, Southern Forest Research Station, Southern Forest Resource Assessment, [Online]. Available: <http://www.srs.fs.fed.us/sustain>

U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2002, December). Fire Effects Information System, [Online]. Available: <http://www.fs.fed.us/database/feis/>.

Williams, G. W. 2002. Aboriginal Use of Fire: are there any “natural “ plant communities?. Wilderness and Political Ecology: Aboriginal Land Management-Myths and Reality (Charles E. Kay and Randy T. Simmons (eds). Univ. of Utah Press.

Wilson, C. W., R. E. Masters, and G. A. Bukenhofer. 1995. Breeding bird response to pinegrassland community restoration for red-cockaded woodpeckers. Journal of Wildlife Manage. 59:56-67.