13640

Ozark-Ouachita Dry Oak Woodland

BpS Model/Description Version: Aug. 2020

**Reviewer:** Douglas Zollner

Vegetation Type

Forest and Woodland

Map Zones

32, 44, 49

Model Splits or Lumps

This Biophysical Setting (BpS) is lumped with: 1363, 1312.

Geographic Range

Interior Highlands, including portions of southern Illinois, southern Missouri, northern and west-central Arkansas, and eastern Oklahoma. This vegetation type is represented in map zone (MZ) 44 ECOMAP sections of Arkansas in 223A, M223A, 231G, and M231A. It is limited in MZ49 to just 223A along the Mississippi River. Important ecoregions in Missouri include the White River Hills, Osage River Hills, Gasconade River Hills, Meramec River Hills, and Current River Hills subsections, especially where these subsections transected the Central Plateau Subsection.

Biophysical Site Description

Soils are well- to somewhat excessively drained, shallow to moderately deep with an extremely acid to moderately acid soil reaction in areas underlain by chert, sandstone, and igneous rock while neutral to basic in areas underlain by dolomite or limestone. These occupy moderately dissected to deeply dissected borders of undulating plains, especially those regions bordering the Central Plateau Subsection of the Ozark Highlands in Missouri. This vegetation type occupies ridgetops and south-to-west-facing slope aspects throughout the Arkansas and Missouri Ozarks and the Arkansas and Oklahoma Ouachita Mountains in the absence of shortleaf pine (*Pinus echinata*). They are usually too droughty to sustain shortleaf pine. Elevation ranges between 600-2,500ft throughout its range in Arkansas. The moisture regime is adequate to allow tree and shrub seedling establishment in the absence of fire. Elevations range from 1,000-1,700ft in the St. Francois Mountains Subsection and between 1,500ft to as low as 400ft along the southeastern portion of the Ozarks Plateau. Precipitation ranges from 40-45in fairly evenly distributed over the growing season. Descriptions include all dry woodland types, dolomite glades, sandstone glades, and igneous glades described in Nelson (2005); CES202.692, CES202.691, CES202.707 in the Terrestrial Ecological Systems of the Great Lakes Region. In Arkansas, this vegetation type occupies sandstone, shale, chert, and novaculite glade systems. In Missouri, this type is typically on exposed upper slopes and summits overlaying Roubidoux sandstone or Upper Gasconade dolomite. Soils are rapidly draining with frequent occurrence of chert gravel or boulders at or near the surface.

Vegetation Description

Historic range of variability: Mixed oak, and hickory without pine in Arkansas, and to a lesser extent some shortleaf pine locally within its narrower range, formed a dominant open canopy ranging from as low as 30% (<10% in expansive, open glades of southwest Missouri) to as high as 80%. The ground layer has a sparse to abundant density of perennial grasses, forbs, and low ericaceous half-shrubs. The shrub layer consisted of variable-age oak regeneration and some scattered shrubs. Densities vary widely depending on the random nature of historical ignition sources (30-60% for open canopy and 61-90% for closed canopy). Highly diverse groundcover vegetation consisting of many flammable forbs interspersed in warm season grasses left this fuel type susceptible to rapid drying, moderate fire spread rates, and area coverage. Post oak (*Quercus stellata*) and black oak (*Q. velutina*) co-dominate with incursions of blackjack oak (*Q. marilandica*) and shortleaf pine in acidic soils formed by chert, sandstone, and igneous substrates. In Arkansas, post oak co-dominates with blackjack oak and black hickory (*Carya texana*) with incursions of black oak. Dominant shrub species include farkleberry (*Vaccinium arboreum*) and winged elm (*Ulmus alata*) along with oak and hickory regeneration. Understory vegetation includes braken fern (*Pteridium* spp.), beggarticks (*Desmodium* spp.), poverty oatgrass (*Danthonia spicata*), and bush clover. Chinkapin oak (*Q. muehlenbergii*) and post oak co-dominate on soils underlain by dolomite/limestone -- especially in association with dolomite glades.

BpS Dominant and Indicator Species

Species names are from the NRCS PLANTS database. Check species codes at http://plants.usda.gov.

Disturbance Description

Frequent surface fires promoted an open understory dominated by a groundcover of grasses and forbs. Drought-prone glade and other shallow or bedrock natural communities remained open for longer periods following fire or severe drought disturbance, especially glades. Stand-replacement fires likely occurred during drought. Frequent fire dominated this vegetation group through surface fires associated with productive grass fuels and cycles of moisture and drought. 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. Ice storms or seasonal ice at high elevations often prune and destroy the canopy across tens of thousands of acres. Wind and tornados affected stands less frequently, ranging in size from 10ac to 1,000s of acres. Historically, variable fire and native herbivore grazing patterns maintained a wide diversity of variably aged layers of oaks and shrubs among a uniform grass/forb groundcover.

Dry oak/bluestem woodland occurred over much of the Ozark Highlands section (Cleland et al. 2007) which a large portion of southern Missouri, northern Arkansas, northeastern Oklahoma and southeastern Illinois.   Analysis of historic vegetation shows that this vegetation type ranges from small patches (<10ac) across more deeply dissected, topographically complex subsections to matrix-sized patches (>1000ac) within the remaining geographic range where landforms were more gently dissected. In the aggregate, this vegetation type likely exceeded 5 million acres across the Ozarks landscape.

Fire Frequency

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Percent of all fires is the percent of all fires modeled in that severity class. Minimum and Maximum FIs show the relative range of fire intervals as estimated by model contributors, if known.

Scale Description

Dry oak/bluestem woodland occurred over much of the Ozark Highlands section (Cleland et al. 2007) which a large portion of southern Missouri, northern Arkansas, northeastern Oklahoma and southeastern Illinois). Analysis of historic vegetation shows that this vegetation type ranges from small patches (<10ac) across more deeply dissected, topographically complex subsections to matrix-sized patches (>1000ac) within the remaining geographic range where landforms were more gently dissected. In the aggregate, this vegetation type likely exceeded 5 million acres across the Ozarks landscape.

Adjacency or Identification Concerns

This vegetation group can be modeled and mapped as distinct from the dry to dry-mesic oak-hickory woodlands or forests primarily based on the topographic roughness of the landscape and proximity to surrounding oak savanna, prairie, and White River glades and other glade types. Another distinct breaking point between this and dry-mesic oak/pine woodlands is the dominance or strong presence of warm season grasses, generally south- and west-facing aspects and only moderate dissection of the landscape (ranging from gently dissected plains to moderately steep hills). This vegetation type feathers out in portions of the most deeply dissected Ozarks section, especially around and east of the Current River in Missouri. Uncharacteristic current conditions: much reduced groundcover diversity due to overgrazing, scattered remnant herbs and grasses suppressed beneath dense second growth stands of increased black oak, eastern red cedar (*Juniperus virginiana*), hickory, red oak, lowbush blueberry (*V. angustifolium, pallidum*), and aromatic sumac (*Rhus aromatica*). These conditions are pervasive throughout all classes. Also, observations of native grazing bison and elk in certain enclosed refuges suggests that they played an important role in shaping and modifying the character of woodlands, in conjunction with fire effects. Uncharacteristic red oak, scarlet oak (*Q. coccinea*), white oak, and red cedar along with shrubs such as aromatic sumac, lowbush blueberry, and buckbrush (*Symphoricarpos occidentalis*) dominate in 5-9in or larger mid-story canopy. Canopy is near 100% closed. Fuel model 9.

Issues or Problems

The Historical Vegetation Project of the Missouri Geographic Resources Center at University of Missouri-Columbia mapped this as open woodland across the Ozarks with as much as 35-50% covering the Ozark Highlands. For the most part, dominant grasses and forbs were the primary available fuel that dictated fire behavior. This former fuel type is mostly converted to deciduous artifact leaf litter today under an essentially closed canopy cover. Modeling attributes to map the spatial extent of this vegetation group should focus on southwest aspects, dry rocky soils, glade occurrences, and association with coarse-scale historic vegetation models from University of Missouri-Columbia for shrublands, barrens, and open woodlands. Larger patches of this group (>1000ac) are strongly associated with gentle to moderate undulations associated with dissected landscapes <150ft in elevation change. These decrease in cover as landscapes become more deeply dissected with greater elevation changes. With respect to the coarser-scale grouping of alliances, the descriptions for all dry woodland natural communities published in Nelson 2005 are more accurate, descriptive, and functional.

Native Uncharacteristic Conditions

Increased stem density due to fire suppression. Invasion of eastern red cedar.

Comments

Much of this vegetation group is masked by 150yrs of intense overgrazing and fire suppression, resulting in a much-changed composition and structure more indicative of ecosystem degradation -- especially from overgrazing. This degradation leaves impressions that current vegetation conditions are part of the expected "natural succession" from a former woodland/savanna-dominated landscape to one of natural "forest." Reviewers recognize that the five classes represent vegetation variation (expressed in patch size, variable effects of fire intensity and mortality) as dictated by topographic variations, soils, differences in ignition sources, and characteristic variations of ecological subsections in Ozark Highlands.

Succession Classes

**Mapping Rules**

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

**Description**

Class A 9 Early Development 1 - All Structures

Indicator Species

Description

This class is an early-seral stage, after replacement fire, which occurs in this stage approximately every 5yrs. Patchy grass and oak shrub regrowth; perennial grass seedlings and forbs. Little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), asters (*Aster* spp.), and goldenrods (*Solidago* spp.). Some of this landscape will remain permanently in an open condition due to edaphic conditions. May include scattered relict old growth trees up to 30in DBH and >200yrs old. Grasses and forbs make up the dominant lifeform.

Grasses and forbs still likely comprise most of the available fuel affecting fire behavior. Herbs may maintain dominant canopy of 30-75% with a height of 0.1-1.1m. Oak sprouts may quickly become co-dominant.

*Maximum Tree Size Class*  
None

Class B 17 Mid Development 1 - Closed

Indicator Species

Description

This class is a mid-seral closed system of mixed grass and oak shrub regeneration. Dominant lifeform is oak shrub, particularly on more productive sites associated with open drainages, headwater draws, north- and east-facing backshoulders, and narrow ridges. Glade regions retain openness with few shrubs. Without fire, eastern red cedar will encroach the glade habitats.

*Maximum Tree Size Class*  
Medium 9-21" DBH

Class C 27 Mid Development 1 - Open

Upper-Layer Lifeform: Tree

Indicator Species

Description

This class is a mid-seral open system of mixed grass and scattered groupings or individual oaks; glade openings maintained. Trees age slowly on generally dry soils and/or in competition with dense, highly diverse grass/forb structure. Tree structure is highly variable depending on topographic position. Many characteristic forbs could be included equally in the class dominant species.

Upper-layer lifeform is not the dominant lifeform. A nearly 100% cover of warm season grasses and forbs with a few scattered shrubs, in areas with soil, make up the primary fuel type despite the presence of trees in varying canopy closures.

Class D 45 Late Development 1 - Open

Indicator Species

Description

This class is a late-seral open oak woodland with continued maintained grass/forb groundcover. Some scattered oak shrubs. Glades and openings on southwest-facing slopes maintained. Some mixed, widely distributed oak trees and oak resprouts may be prevalent. Larger trees demonstrate occasional scars and are subject to wind disturbance. Dominance of old-growth oak individuals may decrease over several hundred years due to wind disturbance, burning out of scarred hollow trees, lightning strikes, and competition with grass/forb matrix, thereby reducing total canopy cover.

Upper-layer lifeform is not the dominant lifeform. A nearly 100% cover of warm season grasses and forbs with a few scattered shrubs make up the primary fuel type despite the presence of trees in varying canopy closures.

*Maximum Tree Size Class*  
Large 21-33" DBH

Class E 2 Late Development 2 - Closed

Indicator Species

Description

This class is a late-seral closed canopy patch within a woodland complex. Productive areas missed by fire with thick patches of oak shrubs, sometimes interspersed with variable age and/or mature oak groves; grasses and forbs suppressed beneath dense leaf litter. These occur on sites missed by fire due to randomness, highly dissected topography, and/or locally moist soil environment.

*Maximum Tree Size Class*  
Very Large >33" DBH

Model Parameters

Deterministic Transitions

Probabilistic Transitions

References

Adler, P.B., D.A Raff and W.K. Lauenroth. 2001. The effect of grazing on the spatial heterogeneity of vegetation. Oecologia 128: 465-479.

Anderson, R.C. 1990. The historic role of fire in North American grasslands. Pp. 8-18 in S.L. Collins and L.L. Wallace (eds.). Fire in North American tallgrass prairies. University of Oklahoma Press, Norman, OK.

Batek, M.J., A.J. Rebertus, 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. Journal of Biogeography 26: 397-412.

Burger, J.E. Ebinger and G.S. Wilhelm (eds.). Proceedings of the oak woods management workshop. Eastern Illinois University, Charleston, IL.

Cleland, D.T.; Freeouf, J.A.; Keys, J.E., Jr.; Nowacki, G.J.; Carpenter, C; McNab, W.H. 2007. Ecological Subregions: Sections and Subsections of the Conterminous United States [1:3,500,000] [CD-ROM]. Sloan, A.M., cartog. Gen. Tech. Report WO-76. Washington, DC: U.S. Department of Agriculture, Forest Service.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological systems of the United States: a working classification of U.S. terrestrial systems. NatureServe, Arlington, VA.

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, AR.

Frost, C. Presettlement Fire Frequency Regimes of the United States: A First Approximation. Pages 70-81, May 1996., Proceedings of the 20nd Tall Timbers Fire Ecology Conference: Fire in Ecosystem Management: Shifting the Paradigm from Suppression to Prescription. Tall Timbers Research Station, Tallahassee, FL.

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, AR.

Fuhlendorf, S.D. and D.M. Engle 2001. Restoring heterogeneity on rangelands; ecosystem management based on evolutionary grazing patterns. BioScience 51(8).

Grazulis, T.P. 2001. Tornado: nature’s ultimate windstorm. The University of Oklahoma Press, Norman, OK.

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: 93-99.

Guyette, R.P. and D.C. Dey. 2000. Humans, topography, and wildland fire: the ingredients for long-term patterns in ecosystems. Pp. 28-35 in D.A. Yaussy (ed.). Proceedings of the workshop on fire, people, and the central hardwoods landscape. General Technical Report NE-274. USDA Forest Service, Northeastern Forest Experiment Station. Radnor, PA.

Guyette, R.P. and E.A. McGinnes, Jr. 1982. Fire history of an Ozark glade in Missouri. Transactions of the Missouri Academy of Science 16: 85-93.

Harlan, J.D., T.A. Nigh and W.A. Schroeder. 2001. The Missouri orginial General Land Office survey notes project. University of Missouri, Columbia. In progress.

Kimmel, V.L. and G.E. Probasco. 1980. Change in woody cover on limestone glades between 1938 and 1975. Transactions of the Missouri Academy of Science 14: 69-74.

Kline, V. 1997. Orchards of oak and a sea of grass. Pages 3-22 in: S. Packard and C.F. Mutel (eds.). 1997. The tallgrass restoration handbook for prairies, savannas, and woodlands. Society for Ecological Restoration. Island Press, Washington, D.C.

Kuchler, A. W. 1964. Manual to accompany the map of potential natural vegetation of the conterminous United States. American Geographical Society. Spec. Publ. No. 36. Lib. Congress Cat. Card Num. 64-15417. 156 pp.

Ladd, D. 1991. Reexamination of the role of fire in Missouri oak woodlands. Pages 67-80 in: Brown, James K. and Smith, Jane-Kapler, eds. 2000. Wildland fire in ecosystems: effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station. 257 pp.

Jurney, D., R. Evans, J. Ippolito and John, V. Bergstrom, 2004. The role of wildland fire in portions of southeastern Mareica. Pages 95-116 in: R.T. Engstrom, K.E.M. Galley, and W.J. de Groot (eds.). Proceedings of the 22nd Tall Timbers Fire Ecology Conference: Fire in Montane, Boreal, and Temperate Ecosystems, Tall Timbers Research Station, Tallahassee, FL.

Ladd, D. and B. Heumann. 1994. Baseline ecological assessment of selected oak woodlands on the Houston-Rolla District, Mark Twain National Forest. USDA Forest Service challenge cost share agreement.

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 Forest Service Gen. Tech. Rep. SE-69. Southeast For. Exp. Sta., Asheville, NC.

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 pine grassland restoration for red-cockaded woodpeckers on white-tailed deer forage production. Wildlife Society Bulletin 24: 77-84.

McCarty, K. 1998. Landscape-scale restoration in Missouri savannas and woodlands. Restoration and Management Notes 16: 22-32.

McCarty, K. and F. Hassien. 1984. Distribution patterns of prairie plant species in a closed-canopy forest situation. Pp. 127-130 in G. Clambey and R. Pemble (eds.). Proceedings of the ninth North American Prairie Conference. The prairie: past, present and future. Tri-college University Center for Environmental Studies, North Dakota State University, Fargo, ND.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. Data current as of 10 February 2007.

NatureServe. 2005. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA U.S. A. Data current as of January 13, 2005.

Nelson, Paul W. 2005 The Terrestrial Natural Communities of Missouri. Missouri Natural Areas Committee (in press).

Nelson, P.W. and D. Ladd 1983. Preliminary report on the identification, distribution, and classification of Missouri glades. Pp. 59-76 in C.L. Kucera (ed.). Proceedings of the seventh North American Prairie Conference. Southwest Missouri State University, Springfield, MO.

Nigh, T.A. 1992. The forests prior to European settlement. Pp. 6-13 in A.R.P. Journet and H.G. Spratt, Jr. (eds.). Towards a vision for Missouri public forests: proceedings of a conference at Southeast Missouri State University, Cape Girardeau, MO.

Ozarks Ecoregional Assessment Team. 2003. Ozarks Ecoregional Conservation Assessment. The Nature Conservancy, Midwestern Resource Office. Minneapolis, MN.

Packard, S. and C.F. Mutel (eds.). 1997. The tallgrass restoration handbook for prairies, savannas, and woodlands. Society for Ecological Restoration. Island Press, Washington, D.C.

Rebertus, A.J., S.R. Shifley, R.H. Richards and L.M. Roovers. 1997. Ice storm damage to an old-growth oak-hickory forest in Missouri. American Midland Naturalist 137: 48-61.

Rebertus, A.J. and A.J. Meier. 2001. Blowdown dynamics in oak-hickory forests of the Missouri Ozarks. Journal of the Torrey Botanical Society 128(4): 362-369.

Runkle, J.R. 1985. Disturbance regimes in temperate forests. Pp. 17-33 in S.T.A. Pickett and P.S. White (eds.). The ecology of natural disturbance and patch dynamics. Academic Press, New York.

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. Tech. Rep. RMRS-GTR-87. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 41 pp. + CD.

Schoolcraft, H.R. 1821. Journal of a tour into the interior of Missouri and Arkansas from Potosi, or Mine a Burton, in Missouri territory, in a southwest direction, toward the Rocky Mountains: performed in the years 1818 and 1819. Richard Phillips and Company, London.

Spetich, Martin A., ed. 2004. Upland oak ecology symposium: history, current conditions, and sustainability. Gen. Tech. Rep. SRS–73. Asheville, NC: USDA Forest Service, Southern Research Station. 311 pp.

Taft, J. 1997. Savanna and open woodland communities. Pages 24-54 in: M. Schwartz (ed.). Conservation in highly fragmented landscapes. Chapman and Hall, New York.

USDA Forest Service. 1999. Ozark-Ouachita highlands assessment: terrestrial vegetation and wildlife. Report 5 of 5. General Technical Report SRS-35. USDA Forest Service, Southern Research Station. Asheville, NC.

USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2002, December). Fire Effects Information System, [Online]. Available: http://www.fs.fed.us/database/feis/.

USDA Forest Service, Southern Forest Research Station, Southern Forest Resource Assessment, [Online]. Available: http://www.srs.fs.fed.us/sustain

USDA Forest Service, Southern Region, June 1997, Guidance for Conserving and Restoring Old-Growth Forest Communities on National Forests in the Southern Region – Report of the Region 8 Old-Growth Team, Forestry Report R8-FR 62.