

# Journal of the Arkansas Academy of Science

---

Volume 35

Article 15

---

1981

## Classification and Protection Status of Remnant Natural Plant Communities in Arkansas

William F. Pell

*Arkansas Natural Heritage Commission*

Follow this and additional works at: <http://scholarworks.uark.edu/jaas>

 Part of the [Botany Commons](#)

---

### Recommended Citation

Pell, William F. (1981) "Classification and Protection Status of Remnant Natural Plant Communities in Arkansas," *Journal of the Arkansas Academy of Science*: Vol. 35 , Article 15.

Available at: <http://scholarworks.uark.edu/jaas/vol35/iss1/15>

This article is available for use under the Creative Commons license: Attribution-NoDerivatives 4.0 International (CC BY-ND 4.0). Users are able to read, download, copy, print, distribute, search, link to the full texts of these articles, or use them for any other lawful purpose, without asking prior permission from the publisher or the author.

This Article is brought to you for free and open access by ScholarWorks@UARK. It has been accepted for inclusion in Journal of the Arkansas Academy of Science by an authorized editor of ScholarWorks@UARK. For more information, please contact [scholar@uark.edu](mailto:scholar@uark.edu), [ccmiddle@uark.edu](mailto:ccmiddle@uark.edu).

# CLASSIFICATION AND PROTECTION STATUS OF REMNANT NATURAL PLANT COMMUNITIES IN ARKANSAS

WILLIAM F. PELL

Arkansas Natural Heritage Commission  
Suite 501, Continental Building  
Main and Markham Streets  
Little Rock, Arkansas 72201

## ABSTRACT

A classification and inventory of Arkansas's remaining tracts of relatively undisturbed vegetation was initiated in 1979. Based on extensive literature surveys and field work, the classification includes five physiognomic classes, 17 cover classes, and 46 cover types, arranged hierarchically. High quality examples of ten of the cover types have been located in designated wilderness or state natural areas, where they are protected by law, while an additional three occur in research natural areas or Forest Service special interest areas. The remaining 33 cover types have no known long-term protection. Lands having wilderness, state natural area, research natural area, or special management area status total nearly 51,000 acres in the state. No more than one-tenth of this area, however, supports vegetation in relatively undisturbed condition.

## INTRODUCTION

Natural, relatively undisturbed plant communities are invaluable for a number of reasons. They serve as control areas or "benchmark" for ascertaining natural rates of nutrient cycling, productivity, and soil erosion; as storehouses of information concerning species interactions; as genetic reservoirs for commercially valuable and presently unutilized plants and animals; as testing grounds for basic ecological laws and principles; and in many other ways not easily duplicated elsewhere (Franklin and Trappe, 1968; Moir, 1972; and Jenkins, 1976).

While preservation of outstanding natural areas has long been a primary goal of many organizations and agencies, it was not until recently that such efforts were directed more towards the entire spectrum of natural diversity than just to those species or communities having obvious appeal (Humke et al., 1975). Within this spectrum of natural diversity, some components—such as immature shortleaf pine and oak-hickory forests—are so well-represented on the landscape that special protection efforts are not warranted, while others—including unplowed prairies and old-growth forests—have been so diminished that complete elimination of some types is a possibility. Setting aside high quality examples of these more threatened types is currently of high priority to The Nature Conservancy, state natural area programs, and others.

Efforts to preserve selected natural plant communities have been underway in Arkansas for more than 20 years, dating to the establishment of Big Lake Research Natural Area in 1959. Only two programs, however, have emphasized community preservation *per se*, the natural area program of the Arkansas Natural Heritage Commission and the research natural area program of the federal government. Nonetheless, portions of Arkansas's statutory wilderness areas, scenic and special interest areas, and certain private lands also provide some protection for high quality natural plant communities.

Heretofore, no comprehensive assessment of the types of natural communities protected on such areas has been available, nor has there been any information regarding types lacking protection. The classification system and analysis of protection status presented here represent an attempt to address these needs.

## METHODS AND MATERIALS

A thorough search of the literature pertaining to the natural vegetation of Arkansas and adjacent states was completed in 1979. An initial working classification was prepared by listing and comparing the vegetations reported or likely to occur in the state. Field surveys

were then undertaken to validate actual occurrence of these types in Arkansas and to collect basic stand data.

One hundred and twenty leads to putatively little-disturbed or otherwise exemplary plant communities were located and surveyed in two field seasons. Communities were surveyed in each of the natural divisions of Arkansas and in two-thirds of the counties. Standardized data collection included estimation of canopy cover by each species (Daubenmire, 1968), determination of degree and types of disturbance, and estimation of the extent of each plant community. Where feasible, canopy cover was estimated within a square, 400 m<sup>2</sup> plot placed within a representative portion of the community, being careful to avoid crossing obvious environmental discontinuities. In many cases, particularly where a tree canopy was monospecific or nearly so, the cover type (defined below) could be determined by simple inspection and the canopy cover estimated over the stand as a whole. In these cases, and where physical conditions were prohibitive, sample plots were not employed.

Stands were considered of high quality and worthy of protection on the basis of several criteria: Forests with no extensive timber removal in the last 60 years, no extensive grazing, no open growth form trees, and predominance of long-lived tree species; and prairies with no plowing, overgrazing, and herbicidal treatment. Other types of vegetation were judged on the basis of relative amounts of various kinds of disturbance. In instances where all known examples of a vegetation type had been fairly recently disturbed, the least disturbed stands were regarded as worthy of preservation.

All stands considered of high quality were classified according to the scheme explained below. Stand data were entered into the files of the Arkansas Natural Heritage Inventory Program.

## RESULTS

### Classification.

Attempts to provide a statewide listing or classification of major vegetations in Arkansas were made previously by Turner (1937) and Foti (1974). A number of other publications, including Putnam and Bull (1932), Society of American Foresters (1954), Clark (1974), Dale and Kuroda (1978), and Bedinger (1979), provide classifications of the vegetation of particular regions or habitats within Arkansas. These studies were drawn upon extensively in developing the current classification system.

This system places emphasis upon vegetation types represented on the landscape by old-growth, little-disturbed, or "virgin" stands, and by certain other rare or previously little-known types; as such, it

focuses attention on the kinds of vegetation most in jeopardy in the state. This bias notwithstanding, the system can probably be used for a variety of purposes.

Vegetal-environmental units of varying degrees of specificity may be recognized on the landscape. The natural vegetation over much of Arkansas, for instance, is "forest." But a particular stand in Newton County might be described as a "beech-umbrella magnolia-yellow mandarin community type." A total of four levels of specificity were identified and incorporated in the classification system. This hierarchical system progresses from physiognomic and cover classes, at the most general levels, to both cover and community types.

Physiognomic classes are defined in terms of predominant life forms and general appearance. Classes found in Arkansas include Forest, Savanna, and Herbaceous Vegetation (Table 1). Cover classes are based on dominant genera in the tallest layer of vegetation and a certain range of site conditions. As shown in Table 1, 17 such units are presently in use. Cover types are generally named according to species which recur under similar environmental conditions and which make up 20% or more of the total canopy of a given stand. This category has proven particularly useful for the Inventory Program and will be discussed in detail.

While dominance is a primary criterion for identifying and naming cover types, overemphasis of this factor easily results in a meaningless proliferation of "types" due more to accidents of dispersal or disturbance than to intrinsic site conditions. Therefore, a certain

amount of variability among stands within a cover type was considered acceptable even if nominate species was rather poorly represented. Emphasis was on species assemblages tending to recur in similar environments, not on species differences considered in isolation from the environment.

In some cases, dominance was abandoned almost entirely as a basis for discriminating cover types from one another; for example, where the physical environment all but overshadowed the biological, as in rock outcrop communities (e.g., the "sandstone outcrop cover type"). This rule also applied when important regional differences in species composition did not necessarily involve dominants, as in the example of "Osage Prairie."

Of the 46 cover types listed in Table 1, at least 15 represent parts of the potential natural vegetation of the Ozark Mountain and Ouachita Mountain Natural Divisions (natural divisions follow Foti, 1974). Five occur, or potentially occur, on Crowley's Ridge; at least 19 are to be expected in the Mississippi Alluvial Plain; and 25-30 belong in the West Gulf Coastal Plain. Each of these cover types is defined in cover type "abstracts" on file in the offices of the Arkansas Natural Heritage Commission.

**Protection Status.**

Published information regarding vegetation of natural area quality

Table 1. Outline of vegetation classification system developed for the Arkansas Natural Heritage Inventory Program.\*

**FOREST VEGETATION**

<b>Quercus Xerophytic Cover Class</b> <i>Q. stellata-Q. marilandica</i>	post oak-blackjack oak
<b>Quercus-Carya Cover Class</b> <i>Q. alba</i> <i>Q. alba-Q. falcata-Carya</i> spp. <i>Q. alba-Q. rubra-Carya</i> spp. <i>Q. rubra-Liquidambar styraciflua-Carya</i> spp. <i>Q. velutina-Carya texana</i> <i>Quercus</i> spp.- <i>Acer saccharum</i> <i>Q. falcata</i> var <i>pagodifolia-Q. michauxii-Carya</i> spp.	white oak white oak-southern red oak-hickory white oak-northern red oak-hickory northern red oak-sweetgum-hickory black oak-black hickory mixed oak-sugar maple cherrybark oak-swamp chestnut oak-hickory
<b>Quercus-Pinus Cover Class</b> <i>Quercus</i> spp.- <i>P. taeda</i> <i>Q. alba-P. echinata</i> <i>Q. stellata-P. echinata</i> <i>P. echinata</i> <i>P. echinata-P. taeda</i>	mixed oak-loblolly pine white oak-shortleaf pine post oak-shortleaf pine shortleaf pine shortleaf pine-loblolly pine
<b>Fagus-Mixed Hardwoods Cover Class</b> <i>F. grandifolia-Liriodendron tulipifera-Quercus</i> spp. <i>F. grandifolia-Quercus</i> spp.- <i>Magnolia tripetala</i> <i>F. grandifolia-Terrace Hardwoods</i>	beech-yellow poplar-oak-hickory beech-mixed oak-umbrella magnolia beech-terrace hardwoods
<b>Nyssa-Taxodium Cover Class</b> <i>T. distichum</i> <i>T. distichum-N. aquatica</i> <i>N. aquatica</i>	haldcypress haldcypress-water tupelo water tupelo
<b>Quercus Hydrophytic Cover Class</b> <i>Q. lyrata-Carya aquatica</i> <i>Q. nuttallii-Q. phellos-Liquidambar styraciflua</i> <i>Q. phellos-Ulmus crassifolia</i> <i>Q. nigra-Liquidambar styraciflua</i> Mixed Hydrophytic Oaks	overcup oak-water hickory Nuttall's oak-willow oak-sweetgum willow oak-cedar elm water oak-sweetgum mixed hydrophytic oaks
<b>Populus-Salis-Betula-Platanus-Acer Cover Class</b> <i>Populus deltoides</i> <i>B. nigra-Platanus occidentalis</i> <i>S. nigra</i> <i>A. saccharinum</i>	cottonwood river birch-sycamore black willow silver maple

**GLADE/OUTCROP VEGETATION**

<b>Xerophytic Hardwood-Juniperus Cover Class</b> <i>Quercus durandii-Juniperus</i> spp. <i>Q. arkansana-Q. incana-Q. stellata</i> var. <i>margareta</i> <i>Juniperus ashei</i> <i>Juniperus virginiana</i> Mixed xerophytic hardwoods	Durand's oak-juniper Arkansas oak-bluejack oak-margareta oak Ashe juniper eastern red cedar —
<b>Rock Outcrop Cover Class</b> Sandstone Outcrop Limestone/Dolomite Outcrop Igneous Rock Outcrop	— — —

**HERBACEOUS VEGETATION**

<b>Andropogon-Sorghastrum-Panicum Cover Class</b> Cherokee Prairie Grand Prairie Osage Prairie	— — —
<b>Schizachyrium-Tripsacum Cover Class</b> Blackland Prairie	—
<b>Arundinaria Cover Class</b> <i>A. gigantea</i>	giant cane
<b>Emergent Wetland Cover Class</b> <i>Typha latifolia</i> Mixed sedge-rush <i>Decodon verticillatus</i>	cat tail — swamp loosestrife
<b>Aquatic Bed Cover Class</b>	—

**SCRUB/SHRUB VEGETATION**

<b>Broad-leaved Scrub/Shrub Wetland Cover Class</b> <i>Acer rubrum</i> -mixed sedge	red maple-mixed sedge
<b>Quercus Cover Class</b>	—

**SAVANNA VEGETATION**

<b>Pinus-Quercus-Graminoid Perennial Cover Class</b> <i>P. echinata-Q. stellata-Graminoid</i>	shortleaf pine-post oak-grass
--	-------------------------------

\*cover types are listed within each cover class; community types have been omitted

found in Arkansas is scanty (Shepard and Boggess, undated; Wagoner, 1975; Federal Committee on Ecological Reserves, 1977; Zachry et al., 1979) and rarely provides sufficient information to permit classification at the cover type level. Agency reports and site surveys completed before 1979 are of similar value. Hence, most of the findings presented here are field surveys by the author.

Of the more than 34 million acres in Arkansas, about 34,000 acres, or 0.1% of the state, have been permanently set aside to preserve natural features and qualities. In some cases, these include little-disturbed plant communities. The latter, however, occupy no more than 10% of the total "protected area." Most of the 34,000 acres fall within three statutory wilderness areas; the remainder, within the state's 23 natural areas.

High quality examples of ten cover types, one of which occurs twice, are represented for these areas (Table 2). Six of the nine areas, which include seven of the ten cover types, are within the Arkansas System of Natural Areas; the other three areas, each with one cover type, are part of the National Wilderness Preservation System. Although most of the vegetation remnants in these areas are quite small (15-200 acres each), those remnants in wilderness areas eventually may develop into very extensive "old-growth" stands.

Somewhat surprisingly, more permanently protected examples of cover types occur in the Mississippi Alluvial Plain than in any other natural division. On Crowley's Ridge and in the West Gulf Coastal Plain, on the other hand, no mature stands of natural vegetation are protected by law. One high quality example of a cover type is protected in the Ouachita Mountains, and five such examples are protected in the Ozark Mountains.

Several other pieces of public land have also been withdrawn from resource extraction and development activities, though not necessarily on a permanent basis. These administrative withdrawals usually are made in recognition of outstanding natural, scenic, or geological features. Included are research natural areas, special interest areas, wilderness study areas, and national natural landmarks. Only the first two, however, will be discussed here.

Arkansas has five research natural areas (RNAs), four of which support outstanding examples of little-disturbed plant communities (Table 3). A candidate research natural area on Crowley's Ridge also contains a high quality forest remnant. Two of the cover types found on RNAs are not represented by high quality stands in either wilderness areas or state natural areas, according to available information, while the remaining types listed in Table 3 are so-represented in these areas. RNAs in the state range from 100 to 973 acres and are managed solely for the purpose of non-destructive research. Three of the five RNAs occur in the Ouachita Mountain Natural Division.

No RNAs have been established in the Ozarks, but the Ozark-St. Francis National Forest has recognized 12 areas, ranging from 220 to 7000 acres—for scenic, botanical, and geological features of special interest. These special management units are administratively excluded from most timber management activities, and certain kinds of recreational activities are discouraged as well. Five of these areas, four of which are in the Ozarks, include remnants of mature forest vegetation in excellent condition (Table 4). All but one of the cover types represented, however, are also found in state natural areas or wilderness areas.

In the Ouachita National Forest, the three "scenic areas" not associated with a research natural area total about 920 acres. No significant remnants of mature vegetation have been located on these lands.

In all, nearly 51,000 acres of public lands in Arkansas have wilderness area, state natural area, research natural area, or special interest area status (Table 5). A total of 13 cover types, several represented at least twice, have been located on these lands. Six cover types are protected on more than one site, but seven are found on only one site each and often occupy only a very small area. No cover types are protected on more than four sites, and those occurring on three or four such sites generally exhibit sufficient intra-type variability to justify some seemingly "redundant" protection. Understories of beech forests in the Ozarks, for instance, differ markedly from the ones in the Ouachitas.

Many other high quality examples of natural vegetation, including ones occurring in certain state parks, state wildlife management areas, Forest Service recreation areas, and roadless and undeveloped area evaluation II (RARE II) areas, currently lack any form of long-term protection. Many of the most significant remnants of natural vegetation in the state also occur on private land, but, to date, very

Table 2. Cover types represented on sites protected by law.

Natural Division	Site	Owner	Cover Type
Ozark Mountains	Upper Buffalo Wilderness	U.S.A.	<i>Fagus grandifolia-Quercus</i> spp.- <i>Magnolia tripetala</i>
	Sweden Creek Falls*	State of Arkansas	<i>Quercus rubra-Liquidambar styraciflua-Carya</i> spp.
	Devil's Knob/ Backbone*	State of Arkansas	<i>Juniperus ashei</i> Sandstone outcrop Hardwood glade
Ouachita Mountains	Cane Creek Wilderness	U.S.A.	<i>Quercus</i> spp.- <i>Pinus echinata</i>
Mississippi Alluvial Plain	Big Lake Wilderness	U.S.A.	<i>Taxodium distichum</i>
	Striplin Woods*	U.S.A.	<i>Quercus lyrata-Carya aquatica</i>
	Smoke Hole*	State of Arkansas	<i>Nyssa aquatica</i>
	Roth Prairie*	State of Arkansas	Grand Prairie
	Konecny Prairie*	Private	Grand Prairie

\*in State System of Natural Areas

Table 3. Cover types represented on research natural areas (RNAs)

Natural Division	Site	Cover type
Ouachita Mountains	Lake Winona RNA	<i>Quercus</i> spp.- <i>Pinus echinata</i>
	Roaring Branch RNA	<i>Quercus</i> spp.- <i>Pinus echinata</i>
Mississippi Alluvial Plain	Big Lake RNA	<i>Taxodium distichum</i>
	White River Sugarberry RNA	<i>Quercus nuttallii-Quercus phellos-Liquidambar styraciflua</i>

Table 4. Cover types represented in Forest Service Special Interest Areas

Natural Division	Site	Cover type
Ozark Mountains	Devil's Canyon	<i>Quercus rubra-Liquidambar styraciflua-Carya</i> spp.
		<i>Quercus alba-Quercus rubra-Carya</i> spp.
	Dismal Hollow	<i>Fagus grandifolia-Mixed Oak-Magnolia tripetala</i>
	Sandstone Hollow	<i>Quercus alba-Quercus rubra-Carya</i> spp.
	Clifty Canyon	<i>Quercus alba-Quercus rubra-Carya</i> spp.
Crowley's Ridge	Turkey Ridge	<i>Fagus grandifolia-Liriodendron tulipifera-Quercus</i> spp.

Table 5. Arkansas public lands on which natural vegetation is legally or administratively protected from commercial use or development.\*

	Units	Acreage	Fraction of State Total
Wilderness Areas	3	27,575	.0008
State Natural Areas	23	4,023	.0001
Research Natural Areas	6	2,143	.0001
Special Interest Areas	14	16,799	.0005
Totals	46	50,540	.0014

\*Sources: Federal Committee on Ecological Reserves (1977), U.S.D.A. Forest Service (1977, 1978a, 1978b), Big Lake National Wildlife Refuge master plan (undated pamphlet), Arkansas Natural Heritage Commission files.

few individuals or corporations have set aside remnant natural vegetation on these lands. One important exception is the old-growth loblolly pine-shortleaf pine stand within Levi-Wilcoxon Demonstration Forest in Ashley County, which has apparently been permanently removed from commercial timber management. Other highly significant natural areas which may be managed to sustain their pristine qualities by the present landowner(s) cannot be regarded as permanently protected.

DISCUSSION

Relatively few of the cover types found in Arkansas are represented by high quality examples in existing wilderness, natural, and special interest areas. In the Ozarks, only mesic oak-hickory and mixed mesophytic types are well-represented, while dry to xeric vegetation has been all but ignored. The Mississippi Alluvial Plain has some fine stands of bald cypress, native prairie, and bottomland hardwood on protected areas, but several bottomland and non-forested wetland types are completely unprotected. The Ouachita Mountains have three protected areas in which high quality communities occur, but the same cover type predominates on each. In the West Gulf Coastal Plain, no mature, little-disturbed plant communities of any kind have been protected and, unfortunately, very few examples of such communities remain. The same could be said for Crowley's Ridge except for the presence there of a single, semi-protected remnant plant community.

Of the 33 unprotected cover types, good examples of all but seven were located during the 1979 and 1980 field seasons. Reflecting the extreme vulnerability of high quality stands, two of the most significant areas—each of which supports two or more cover types—were heavily cut-over during this period. Opportunities to protect outstanding examples of vegetation cover types certainly remain. Accomplishing this goal, however, will require a concerted effort to establish additional research natural areas and wilderness areas, to acquire conservation easements on certain privately-owned lands, and to inform landowners of the irreplaceable nature of the little-disturbed plant communities which remain.

ACKNOWLEDGMENTS

This study was part of a 2-year project undertaken by The Nature Conservancy, under contract with the Department of Arkansas Natural and Cultural Heritage, to identify, locate, and assimilate information on the state's elements of natural diversity. Funding for this project was provided by the Winthrop Rockefeller Foundation, Arkansas Power and Light Company, a consortium of banks in northwest Arkansas, and matching monies from the Land and Water Conservation Fund, administered by the Heritage Conservation

and Recreation Service, U.S. Department of the Interior.

Valuable input regarding the classification system was provided by Steve Buttrick, Bob Irving, and Bill Shepherd. Unpublished site reports, original field data, and leads to high quality areas were graciously offered by Tom Clark, E. E. Dale, Jr., and Jerry Roberts. Bill Shepherd and Ken Smith reviewed the manuscript. Special thanks are due Richard Davis and Gayle Garrison, who accompanied the author in the field on numerous occasions.

LITERATURE CITED

BEDINGER, M. S. 1979. Forests and flooding with special reference to the White River and Ouachita River Basins, Arkansas. Openfile report 79-68. Water Resources Investigations, U.S. Geological Survey.

CLARK, G. T. 1974. A preliminary ecological study of Crowley's Ridge. pp. 213-241 *In* Arkansas natural area plan. Arkansas Dept. of Planning, Little Rock, xvii + 248 pp.

DALE, E. E. and P. M. KURODA. 1978. Vegetation map and natural areas survey. pp. 77-82 *In* (R. E. Babcock, proj. dir.) Final report: Buffalo National River Ecosystems Part IV. Ark. Water Resources Research Center Pub. 58, University of Arkansas, Fayetteville, viii + 112 pp.

DAUBENMIRE, R. 1968. Plant communities. Harper and Row, New York, 300 pp.

FEDERAL COMMITTEE ON ECOLOGICAL RESERVES. 1977. A directory of research natural areas on federal lands of the United States of America. U.S.D.A. Forest Service, v + 280 pp.

FOTT, T. L. 1974. Natural divisions of Arkansas. pp. 11-34 *In* Arkansas natural land plan. Arkansas Dept. of Planning, Little Rock, xvii + 248 pp.

FRANKLIN, J. F. and J. M. TRAPPE. 1968. Natural areas. J. For. 66:456-461.

HUMKE, J. W., B. S. TINDALL, R. E. JENKINS, H. L. WIETING, JR. and M. S. LUKOWSKI (eds.). 1975. The preservation of natural diversity: a survey and recommendations. The Nature Conservancy, Arlington, Virginia, 323 pp.

JENKINS, R. E. 1976. Maintenance of natural diversity: approach and recommendations. pp. 441-451 *In* Trans. 41st North American Wildlife and Natural Resources Conf., Wildlife Management Institute, Washington, D.C.

MOIR, W. H. 1972. Natural areas. U.S.D.A. Forest Service, 5 pp.

PUTNAM, J. A. and H. BULL. 1932. The trees of the bottomlands of the Mississippi River Delta region. So. For. Exper. Sta. Occ. Paper 27.

SHEPARD, R. D. and W. R. BOGGESE. (undated). The oak-hickory forest region of the eastern deciduous forest including an inventory of significant natural areas. U.S. Department of the Interior, National Park Service, Washington, D.C., 197 pp.

SOCIETY OF AMERICAN FORESTERS. 1954. Forest cover types of North America (exclusive of Mexico). Society of American Foresters, Washington, D.C., 67 pp.

- TURNER, L. M. 1937. Some soil characteristics influencing the distribution of forest types and rate of growth of trees in Arkansas. *J. For.* 35:5-11.
- U.S.D.A. FOREST SERVICE. 1977. Final environmental statement and St. Francis Unit Plan. U.S. Forest Service, Ozark-St. Francis National Forests, 131 pp.
- U.S.D.A. FOREST SERVICE. 1978a. Ouachita National Forest timber management plan, final environmental statement. U.S. Forest Service, Ouachita National Forest, 69 pp.
- U.S.D.A. FOREST SERVICE. 1978b. Timber management plan, final environmental statement, Ozark National Forest. U.S. Forest Service, Ozark-St. Francis National Forests, 68 pp.
- WAGGONER, G. S. 1975. Eastern deciduous forest. Vol. 1. Southeastern evergreen and oak-pine region. U.S. Department of the Interior, National Park Service, Washington, D.C., xiv + 206 pp.
- ZACHRY, D. L., E. E. DALE, JR., R. A. BERRY and R. H. DAVIS. 1979. Potential National Natural Landmarks of the Interior Highlands Physiographic Region, Central United States. U.S. Department of the Interior, National Park Service Contract No. 12006B013, 272 pp.