ANNOTATED BIBLIOGRAPHY OF RESEARCH AND INFORMATION ON PIONEER FOREST

Abstract—A bibliography of research and other scholarly activity undertaken on Pioneer Forest is presented. This bibliography contains the information that managers of Pioneer Forest believe is of greatest importance to them as they refine their management practices to meet the varied objectives that the Drey family and the L-A-D Foundation have had for ownership of Pioneer Forest and natural areas.

INTRODUCTION

Altogether the lands of Pioneer Forest and the L-A-D Foundation total nearly 160,000 acres and are open for research and independent study with permission. Over the years a variety of university and public agency-directed research has been completed. There also has been a significant amount of non-technical information written about individually significant areas. These writings and research include both natural and cultural history and span biological, geological, cultural, and economic aspects of the properties of Pioneer Forest. We have attempted to compile and then annotate these writings and research since our own review and understanding of this information assists in our forest stewardship programs. We also hope that it may help current researchers or those intending to do research on Pioneer Forest to know what kinds of research and information have already been completed here.

This bibliography is periodically updated; copies of most entries are found at the Pioneer Forest office in Salem, MO. There are 170 works listed here.

Aley, T. 1980. Cave management investigations on the Ozark National Scenic Riverways, Missouri. Ozark Underground Laboratory contract report to the National Park Service. 111 p. + appendix. On file with: Pioneer Forest, Highway 19 N., Salem, MO 65560.

The first cave management study of Ozark National Scenic Riverways' caves, reporting on 19 caves including at least one reference to a Pioneer Forest cave, Albert Reinhold Cave (named in this report as Rockclimb Cave).

Aley, T. 1981. Cave management investigations on the Ozark National Scenic Riverways, Missouri; Phase 2. Ozark Underground Laboratory contract report to the National Park Service. 151 p. + appendix.

Follow-up to the 1980 study, here reporting on an additional 60 caves, including Devils Well.

Aley, T.; Aley, C. 1989. Final Report—delineation of recharge areas for four important cave streams, Ozark National Scenic Riverways, Missouri, August 25, 1989. Prepared for the Ozark National Scenic Riverways under Purchase Order PX6640-7- 0556. 28 p.

Two of the four studied caves are on L-A-D property—Flying W Cave and Medlock Cave.

Annand, E.M. 1995. Habitat relationships of migrant songbirds in a managed forest. Columbia, MO: University of Missouri. 73 p. MS Thesis.

Annand studied migrant songbird response to managed forest treatments from 58 sites (12 clearcut, 12 shelterwood, 12 group selection, 10 single-tree selection, and 12 unharvested mature even-aged sites). Using the point count method, relative abundance of all occurring species were measured. Habitat measurements were gathered to assess vegetation characteristics of all sites. Analysis of variance models and multiple regression models were used to analyze habitat relationships. Chapter 2 of the thesis is the manuscript for the paper published in 1997 by Annand and Thompson.

Chapter 3, another manuscript, discusses the relationship of songbirds to vegetation characteristics in regenerating forest stands. Models for six individual bird species (acadian flycatcher, red-eyed vireo, blue-winged warbler, ovenbird, hooded warbler, and the yellow-breasted chat) were established using variables such as basal area, canopy closure, and understory cover. Acadian flycatchers prefer large trees, dense understory, and closed canopy. Red-eyed vireos prefer high basal area and a high percent canopy closure. Ovenbirds preferred high percent canopy closure and short tree regeneration height. Hooded warblers prefer high density of smaller trees, relatively low density of large diameter trees, high shrub stem counts, and high canopy closure (all four of these variables fairly describe single-tree selection treatments).

Annand, E.M.; Thompson, F.R. 1997. Forest bird response to regeneration practices in Central Hardwood Forests. Journal of Wildlife Management. 61(1): 159171.

Study of breeding songbird populations in managed forested landscapes in southern Missouri; includes clearcut, shelterwood, group selection, single-tree forest regeneration methods of harvest, and mature unharvested even-age stands.

Pioneer Forest transects represent the single-tree selection portion of the study. Hooded warblers and northern parulas were more abundant in the selection treatments than other harvest treatments (hooded warblers have been found to nest in gaps in Illinois in another study). Parula warbler numbers were greater in single-tree selection treatments. Species such as the red-eyed vireo, worm-eating warbler, and acadian flycatcher, which are usually associated with mature forests, were abundant in group and single-tree selection treatments. Species usually associated with mature forest were likely abundant in the selection treatments due to the presence of intermediate-and large-diameter trees.

Autry, D.C. 1988. Plant communities on riparian limestone bluffs in Ozark National Scenic Riverways. Carbondale, IL: Southern Illinois University. 139 p. Ph.D. dissertation.

Extensive site sampling from more than 90 bluff transects; includes species lists for each sample and located by latitude, longitude. Includes Pioneer Forest bluff sites in Bay Creek and Leatherwood Creek.

Baigell, M. 1974. Thomas Hart Benton. New York: Harry N. Abrams, Inc. 281 p.

Author describes four periods of Thomas Hart Benton's life. The work, *Cave Spring* is from the 'World War II and Postwar Works' period. Cave Spring is located on the Current River, is owned by the L-A-D Foundation, and was visited by Thomas Hart Benton who depicted the scene in a color painting in 1963. There are 229 plates included in this volume, including numerous color plates. In describing this period of work in general, the author notes "In many ways, though, his more remarkable achievements are the landscapes of this period. In these, it would appear that Benton's overwhelming love for America found its true outlet—in the streams, hills, and mountains of the country, populated by people unsuspectingly living out their time, quietly enjoying themselves, living easily on the land, celebrating nothing more than their existence. Perhaps cumulatively these works glorify "America the Beautiful," a dream America where every prospect pleases. Individually they describe, sometimes with great succulence, a particular segment of that landscape."

"In the scenes painted from landscapes closer to Benton's home the effect is more intimate. The sky appears to be closer, the horizon is nearer at hand, and the vegetation grows more lushly (plate 136, compiler's note: "Cave Spring. 1963. Polymer tempera on canvas mounted on panel, 30 x 40". Field Enterprises Educational Corporation Collection). The streams, gullies, and soft hills of the Middle West - the vacation lands of the artist's mature years - become idyllic haunts of weekend fishermen and Sunday boatmen. The tumult of spirit in earlier paintings has given way to the continuous, easy pulsation of curving water banks, clumps of trees, and those familiar Middle Western clouds. The richness is sometimes overwhelming as one senses that Benton is reaching out to encompass all that he sees in a scene. It is as if he were making love to the trees, bushes, grasses, sandy spots, rocks, and pebbles. Other American artists have celebrated the American landscape, but few with such joy and innocence. Benton painted these works, one imagines, to please himself, and, even if they are stylistically related to earlier paintings, their mood is entirely personal."

"Yet they are personal in a way easily accessible to anybody. Their meanings are still American. Benton is still a painter of the American scene.

Batek, M.J. 1994. Presettlement vegetation of the Current River watershed in the Missouri Ozarks. Columbia, MO: University of Missouri-Columbia. 264 p. + 4 colored maps. M.A. Thesis.

This geography thesis reconstructs early nineteenth-century vegetation from Public Land Survey notes and other sources. The watershed includes a major portion of Pioneer Forest land.

Batek, M.J.; Rebertus, A.; Schroeder, W.A. [and others]. 1999. Reconstruction of early nineteenth-century vegetation and fire regimes in the Missouri Ozarks. journal of Biogeography. 26: 397-412.

Study area is 26 complete and 4 partial townships in the Current River watershed including the Jack's Fork, from about Welch Spring in the Northwest to Van Buren in the Southeast, including three nearly complete townships of the big block on Pioneer Forest and about 9 partial townships. Combines analysis of early nineteenth-century Public Land Survey notes and dencrochronology-based fire histories to reconstruct vegetation and disturbance regimes of pine-oak woodlands. Vegetation patterns are also related to geological parent material, topography, and mean fire intervals. Reveals a distinct fire shadow east of the Current River.

Beckman, H.C.; Hinchey, N.S. 1944. The large springs of Missouri. Rolla, MO: Missouri Geological Survey and Water Resources. 2nd serial, 141 p. Vol. 29.

Summarizes the geology of the big spring country in Missouri, includes a short description of Cave Spring. Reports the only flow measurement made on the spring at that time, a low stage reading and another at high stage, both by the U.S. Geological Survey.

Bedan, D.E.; Goetz, R.E. 1976. Pioneer Forest recreation study. St. Louis, MO: Coalition for the Environment. 54 p. + maps.

Detailed recommendations for lands of Pioneer Forest including trail development, recommended protection for Laxton Spring, Leatherwood Creek, and Rough Hollow as natural areas, and wildlife management recommendations.

Beveridge, T.R. 1966. Grand Gulf ... Missouri Conservationist. 27(10):12-13.

This is an excellent overview of the area written by a geologist with insightful commentary. Beveridge reviews the stream piracy and cave roof collapse. As if this were a long-term geological combat he adds "...the Grand Gulf drainage system represents the greatest booty of any Stygian pirate in the Ozarks, and the battle area records the most extensive, dramatic, and scenic preservation of geological conflict in Missouri."

Beveridge, T.R. 1978. Geologic wonders and curiosities of Missouri. (Vineyard, J.D., revised edition, 1990). Rolla, MO: Missouri Department of Natural Resources, Division of Geology and Land Survey. 400 p.

Includes specific descriptions of the Narrows, Ball Mill Resurgence, Clifty Hollow Natural Bridge, Grand Gulf, and Leatherwood Arch.

Bohm, N.C. 1935. A study of Missouri springs. Rolla, MO: University of Missouri. 77 p. Thesis.

Author tabulated all state and federal records of the time regarding size of Missouri springs and determined relative mean flow. Twenty-seven Ozark springs (Mammoth Spring in Arkansas is the only non-Missouri spring included) are listed with Cave Spring at an estimated 45 cubic feet per second ranking twenty-one. The measurement for Cave Spring is from a single record taken June 22, 1924 and represents 46,600,000 gallons per day. Since it was taken during what would normally be a wet season it probably represents nearly maximum flow. Interestingly the author included black-and-white photographs of the time for some springs (Alley, Bennett, Big, Blue, Greer, Ha Ha Tonka, etc.) though none of Cave Spring.

Bretz, J.H. 1953. Genetic relations of caves to peneplains and big springs in the Ozarks. American Journal of Science. 251: 1-24.

Presents the theory of cave formation in the Ozarks. The origin of most Ozark caves is from circulating water below-ground. When the hydrostatic head disappeared as the uplands continued to age, these water-filled spaces then began to accumulate red clay from the soil above. Uplift caused further dissection on the upland, lowered the water table and drained these spaces. Bretz cites several Ozark caves where streams now flowing on the cave floor are not responsible for the solutional features on the cave walls and ceiling since the present stream is younger than the cave itself. Then Bretz describes four large Ozark springs [Greer, Roaring River, Welch, and Fishing Cave (now more commonly referred to as Cave Spring)] which still function as cave-makers.

Bretz, J.H. 1956. Caves of Missouri. Rolla. MO: Missouri Geological Survey and Water Resources. 490 p. Vol. 39.

Includes a discussion of the nature of Cave Spring, pages 441-444. Bretz considered Cave Spring to be an excellent, functioning example of cave origin in the phreatic (water-filled) zone. Big Creek Cave on the Current River in 536,130 R4W also is noted and briefly described. Medlock Cave, S10 131 R6 is briefly noted. Author includes a brief note regarding Cookstove Cave on page 444 and Grand Gulf on pages 350-355.

Broadhead, G.C. 1873. Maries County. In: Broadhead, G.C.; Meek, F.B.; Shumard, B.F. Reports on the geological survey of the State of Missouri, 1855-1871. Jefferson City, MO: Bureau of Geology and Mines. Regan and Carter Printers and Binders: 7-25.

Mentions Clifty Hollow Natural Bridge from fieldwork of 1857 as "a perfectly clear stream of water courses through this valley. The bottoms near are spread with a dense growth of trees and vines, among which I noticed the Muscadine grape. The valley at this point, being shut in by its perpendicular cliffs, with not a path to guide the traveler through the dense thickets, is wildly picturesque and romantic in its loneliness."

Bruff, G.L. 1977. Preliminary trail study for Ozark National Scenic Riverways. Van Buren, MO: National Park Service, Ozark National Scenic Riverways. 55 p.

Describes the setting for the lands of the national park and the cultural activities in the context of potential trail development. The report emphasizes the discussions which were ongoing at this time regarding Missouri's Ozark Trail under the Ozark Trail Steering Committee. Pioneer Forest is specifically mentioned in the recommendations here, including reference to the Bureau of Outdoor Recreation study (1976). Under a section titled 'Cooperative Efforts' Bluff discusses a meeting with Pioneer Forest staff **in** March of 1977.

Buckman, R.E.; Quintas, R.L. 1972. Natural areas of the Society of American Foresters. Washington, DC: Society of American Foresters. 38 p.

Brief introduction of SAF system with definition, criteria for selection, and procedure for designation. This report then details the name, location, size, owner, and representation of forest type for 281 areas. This is the fourth published list of SAF Natural Areas. As of this listing there are four Missouri areas, the Current River and Pioneer natural areas on Pioneer Forest, and Cupola Gum Pond and Haden Bald on the Mark Twain National Forest. The Pioneer Forest areas are identified here as under indenture and administered by the University of Missouri, School of Forestry.

Burghardt, R. 2003. Missouri's little grand canyon. Missouri Life. 30(2): 20-21.

This is an overview article. This issue of the magazine included a cover photograph of Grand Gulf State Park; other photos published with the article. All of the photos here by Don Kurz.

Chapman, H.H. 1951. Report on examination of forest property in Shannon County, Missouri, for the National Distillers Products Corporation, July 5-15, 1951. Typed manuscript on file with: Pioneer Forest Archives, Salem, MO 65560. 8 p.

This study of National Distillers' lands was to determine a method for securing maximum yields from white oak timber for barrel manufacturing, the practicality of managing these forest lands for continuous yield of forest products, and desirable data for a cruise including estimates of standing timber, rates of growth, and yield. Chapman provides an overview of recommended management practices especially with regard to the continuous production of white oak, appraisal of stocking from earlier work completed in 1949, establishment of sample plots for future inventory, economic return, silvicultural practice including the role of natural pine sites, and a discussion of oak wilt.

Corner, M. 1993. Resources to explore—Dillard Mill State Historic Site. Missouri Resource Review. 10(3): 28-30.

Brief historical sketch plus present day character of mill and surrounding land/buildings.

Curtis, M. 1981. The Ozarks' grandest canyon. The Ozarks Mountaineer. 29(4,5): 44-47.

Descriptive article highlighting geology and natural features of Grand Gulf, also explores management alternatives between state, federal, and private administration.

Davis, M.B. 1993. Old growth in the east, a survey. Richmond, VT: Cenozoic Society. 150 p.

Missouri listings are included in the southern Midwest section. Hickory Canyons Natural Area includes 190 acres of old-growth forest. The Virgin Pine Forest along Highway 19 also is included here. Age notation for the Virgin Pine Forest from this 1993 publication is an estimated 150 to 190 years (Richard Guyette established the canopy here at 200 to 225 years). Interestingly the Current River Natural Area (whose canopy is estimated at 400 years) is not included in this particular study.

Diaz-Granados, C. 1983. Rocky Hollow revisited. Further investigations, update, and recommendations for preserving and maintaining the integrity of a Woodland petroglyph site in Monroe County, Missouri. 76 p. (On file with: The L-A-D Foundation, 705 Olive Street, Room 724, St. Louis, MO 63101.)

Documents petroglyph symbols from Rocky Hollow including thunderbirds, serpents, human figure, turkey tracks, deer, turtle, fish, moon, comet, hunters, elk; they seem to reflect the earlier Woodland period and possibly a transitional period between the Woodland and Mississippian cultures. This report further documents and details features of the site and develops a list of recommendations for preservation including shelter protection, possible chemical treatment of the stone, photogrammetry, permanent castings, and an interpretive center.

Diaz-Granados, C. 1990. Tracking the A.D. 1054 supernova in Missouri's petroglyphs and pictographs. Paper presented at the Annual joint meeting of the Missouri Association of Professional Archaeologists and the Missouri Archaeological Society, May 5, Sedalia. (On file with: The L-A-D Foundation, 705 Olive Street, Room 724, St. Louis, MO 63101.)

The only anthropomorphic figure at Rocky Hollow on the west wall has both arms raised in the "shaman" position. The left hand is open and upright, but the palm is obliterated by a perfect circle. This author has reported that from the earliest work here that circle was believed to be an eclipse being "perpetrated" or a sun "being stopped" by a priest or shaman.

Diaz-Granados, C.; Duncan, J.R. 2000. The petroglyphs and pictographs of Missouri. Tuscaloosa, AL: University of Alabama Press. 333 p.

Presented here are the findings of a survey conducted between 1987 and 1992 to document all known and identifiable petroglyph and pictograh sites and analyzing the variety of ritual activities represented. The result is an inventory of 14 rock art sites. The context along with analysis of two predominant style groupings and ten minor styles are presented. The book's cover illustration is from Rocky Hollow Natural Area, from a photo by Richard C. Smith, the 'hands panel, plate 18 in the book (apparently misidentified as a bird motif from Washington State Park). The antlered animals depicted at Rocky Hollow represent wapiti (elk) rather than deer because of their backward configuration. Nine bird figures are noted. Fish are rare in Missouri and Rocky Hollow is one of only two in the State, and, as noted by this author, carved in considerable detail. Turtles are even less common but also represented. Rocky Hollow portrays the only certain prehistoric fish known from Missouri. Anthropomorphic figures are common at Rocky Hollow with "shaman" figures known because both hands are raised, one obliterated by a circular disk. There are other human figures, most likely hunters who appear to be on their knees and likely shooting with bows.

Diaz-Granados describes the Eichenbarger (1944) investigation among the early projects in Missouri and as a precious record from avocational archaeologists. Thirty-two plates are included as Illustrations, three from Rocky Hollow. The Marion-Rails Archaeological Society work discovered a tool believed to have been used to produce the carvings. In addition the Rocky Hollow site is believed to have been painted (with red or black

pigments). Rocky Hollow was repainted in the 1940's. Rocky Hollow is classified here as the Northeastern style, carvings are more or less sequential on a vertical shelter wall.

Doll, W.L. 1938. Hydrography of the larger springs of the Ozark region of Missouri. Rolla, MO: University of Missouri. 106 p. Thesis.

Presents evidence against stream piracy by springs. A series of discharge measurements were made on the Current River (several miles above a spring and immediately below the spring) and no evidence was found that springs carry an appreciable amount of water from the river. Uses streamflow and rainfall records to outline drainage areas of many Ozark springs. Estimates (see table 5, "Effective Drainage Areas of the Largest Springs in MO", p. 57) the effective drainage area of Cave Spring at 50 square miles. In discussing the Gasconade limestone whose thickness can be as much as 500 feet, author notes it is frequently cavernous and has some of the largest springs in the United States. Includes an estimate that 80 percent of Ozark springs flow from the Gasconade formation. Grand Gulf is specifically mentioned (page 13) as "3j4-mile long and 200 feet deep" and "from the bottom of this chasm a cave leads into a more recent channel exposing the stream, which flows out at Mammoth Spring."

Drees, D.; Flader, S. 2005. Current River Natural Area: Missouri's first designated natural area is bigger and better at 50. Missouri Conservationist. 66(5): *4-7.*

Discusses history and natural history of Missouri's first designated natural area (1955) and a 255-acre expansion (2005), located in the big block on Pioneer Forest.

Drees, D.; Hughes, L.; Flader, S. 2005. Missouri natural area nomination form: Current River Natural Area (expansion). Missouri Natural Areas Committee, Nomination Date March 14, 2005. 14 p. + six appendices.

The natural area, originally established in 1955 at 10 acres, was expanded by 255 acres from adjacent land in Pioneer Forest, The nomination details the history and natural history of the area and includes discussion of principal features and management considerations, a plant list, and maps.

Dwyer, J.P.; Dey, D.C.; Walter, W.D.; Jensen, R.G. 2004. Harvest impacts in uneven-aged and even-aged Missouri Ozark forests. Northern Journal of Applied Forestry. 21(4): 187-193.

While the introduction notes that poorly managed selection harvests may increase damage to residual trees, these authors point out the more than 50 years of management experience on Pioneer Forest and the recent research of Lowenstein and others showing that individual-tree selection harvest can be a sustainable management method for xeric oak-hickory forests. This particular study was conducted entirely on sites, which are part of the Missouri Forest Ecosystem Project and analyzing the effects of clearcut and selection harvests. Few trees suffered bole wounds from either method, 5 percent in the clearcut sites and 8 percent in the selection sites. Crown damage from either method was insignificant. The conclusion is that well-supervised logging operations can minimize damage to the soil as well as leave trees.

Eddleman, W.R.; Clawson, R.L. 1987. Population status and habitat conditions for the red-cockaded woodpecker in Missouri. Transactions, Missouri Academy of Science. 21: 105-117.

Interesting overview, including comment on the historical records of this bird in Missouri. The red-cockaded woodpecker was first recorded in Missouri in 1907 as fairly common in Shannon and Carter counties. Around 1940 all subsequent records were from what was then a virgin pine forest just south of Round Spring (most likely the tract of Pioneer Forest we call the Randolph tract and from the virgin pine forest along Highway 19, now owned by the L-A-D Foundation). Three birds were observed in June of 1940; four in June of 1941; and five in June of 1946. The area was logged in 1946 except for the narrow virgin pine forest. No sightings have been recorded from Missouri since 1946.

Paper also briefly explores management strategies if these birds were to be re-introduced to the State: understory control is essential, rotations of 80 to 100 years would allow continuous production of mature pines needed by the birds, suggested minimum viable population size of 500 birds (250 clans) would be an eventual goal with a minimum area of 80 to 160 ha (200 to 400 acres) needed to support one clan, mature pine along highway right-of-ways could provide links between management areas.

Eichenbarger, J.A. 1944. Investigations of the Marion-Rails Archaeological Society in Northeast Missouri. The Missouri Archaeologist. 10: 1-68.

This paper provides a detailed description of investigations during 1941. Titled Holliday Petroglyph Site MN 1, this article lists petroglyph groupings for four separate features and artifacts from two test trenches. The author provides extensive description of petroglyphs along with illustrations and photographs. Associated artifacts recovered from the site include potsherds, gouge, flake or flake knife, a scraper or graving tool, and chert spalls.

Everson, A.R.; Chilman, K.C. 1987. Final report—Cave recreation at Ozark National Scenic Riverways. Contract No. PX-6640-6-0285. U.S. Department of the Interior, National Park Service.

Includes a review of Medlock Cave.

Fadler, G.; Elder, W.H. 1973. A natural area survey of six eastern Ozark counties—Final report to the L-A-D Foundation. Columbia, MO: University of Missouri Cooperative Wildlife Research Unit. 98 **p.**

Includes natural area descriptions for Carter, Dent, Reynolds, Ripley, Shannon, and Texas counties. This report also includes specific discussion of Lily Pond (p. 68), Bowles Pond (p. 69), Cave Spring (p. 79), Pioneer Natural Area and Current River Natural Areas (p. 82), bluff at Two Rivers where we have a scenic easement (p. 93) and Dripping Spring (p. 94).

Fan, Z.; Shifley, S.R.; Spetich, M.A. 2003. Distribution of cavity trees in Midwestern old-growth and second-growth forests. Canadian Journal of Forest Research. 33: 1,481-1,494.

This paper provides an interesting analysis for predicting cavity trees, using variables such as diameter, species group, and decay class. Although to our knowledge none of the results reported here are from Pioneer Forest there are interesting implications. These authors suggest that thinning and selection harvests repeated over several decades may reduce the cavity tree population but following one harvest may have little net effect. This study points out that for old growth sites there are five times as many cavity trees as there are from mature, second growth sites (generally greater than 110 years old). As a supplement to the information presented here, Thompson's graduate student Elizabeth Annand reported on the similarity of the structural characteristics of Pioneer Forest plots comparing them more closely to mature and old growth forests. Given that the average turnover of the canopy on Pioneer is much greater than 200 years, the management strategy emphasizes leaving trees to fully mature and marking instructions leave wildlife trees may combine to maximize cavity opportunities. This study also points out that greater tree size and greater abundance of cavity-prone species (for Missouri, white oak and red oak have the highest probability) on old growth sites may have the greatest effect on cavity tree presence, characteristics of the forest structure on Pioneer Forest as well.

Fan, Z.; Shifley, S.R.; Spetich, M.A. 2005. Abundance and size distribution of cavity trees in second-growth and old-growth Central Hardwood forests. Northern Journal of Applied Forestry. 22(3): 162-169.

This discussion is more focused on grouping stands into broad size classes, specifically seedling/sapling-pole-sawtimber-old-growth. The authors suggest that the values for old growth forests serve as a reference for comparing conditions in other managed forests for this region. Uneven-aged forests such as those resulting from Pioneer's management, where at least three different age classes are the goal, should be ideal for producing and maintaining cavity trees across the forested landscape.

Faulkner, J.; White, J. 1991. Feasibility study for an Ozark Man and the Biosphere Cooperative. Urbana, IL: Ecological Services. 137 p.

Discusses potential biosphere reserve sites and outlines a specific area of managed use to include Pioneer Forest among other private conservation and preservation lands. See page 39.

Flader, S. 2004. Missouri's pioneer in sustainable forestry. Forest History Today. Spring/Fall 2004: 2-15.

Flader presents a history of Leo Drey's influence in Missouri forestry and conservation efforts. The piece is nicely illustrated with many of the photographs coming from the archived Pioneer Forest collection. Flader traces Leo's first acquisition in 1951 to his largest, nearly 90,000 acres from National Distillers in 1954. The various periods of Pioneer's more than 50-year history are traced beginning with its role in regional development (1955-1976), Pioneer's method of forest management (c. 1970), the silvicultural revolution (1965-1985), Pioneer's role in the controversy over public land management (1985-1990), and vindication (1990-2000). Throughout these five decades Leo's vision and adherence to the goals he and his earliest staff had established in the 1950's have always served as the stabilizing influence with Leo and Kay's gift of nearly all of Pioneer Forest in 2004 to the L-A-D Foundation "perpetuating the Pioneer tradition."

Flader, S., ed. 1992. Exploring Missouri's legacy: state parks and historic sites. Columbia, MO: University of Missouri Press. 352 p.

This extensive review of the Missouri State Park System includes essays and photographs on Dillard Mill State Historic Site and Grand Gulf State Park, both properties of the L-A-D Foundation.

Flader, S.L. 2004. History of Missouri forests and forest conservation. In: Flader, S.L., ed. Toward Sustainability for Missouri Forests. Gen. Tech. Rep. NC-239. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station: 20-59.

This extensive and well-documented paper mentions Leo Drey's leadership organizing the Missouri Forest Resource Conference held in October 1958; his founding of Pioneer Forest in 1951 and his vision "to restore a profitable forest by conservative single-tree selection uneven-aged management that would be productive also of wildlife, recreation, and other social and scientific values."; Pioneer Forest's comprehensive forest inventory and the fact that this ownership proved especially significant in comparison to the more widespread use of even-aged management by clearcutting begun in the 1960's; Leo Drey's position favoring U.S. Forest Service administration of the proposed Ozark National Scenic Riverways, as well as his later support for the Natural Steams Act proposed in 1990; Pioneer Forest's participation in the proposed Ozark Highlands of the Man and the Biosphere project.

Fritz, E.C. 1989. Clearcutting: a crime against nature. Austin, TX: Eakins Press. 124 p.

Examines the practice of clearcutting, reviews alternatives such as individual tree selection. Pioneer Forest cited as "selection forest" and includes photograph from 1987 at unknown location.

Gardner, J.E.; Taft, J.B. 1983. Cave resources of Ozark National Scenic Riverways, an inventory and evaluation. A preliminary copy of a final report submitted to Ozark National Scenic Riverways, National Park Service in compliance with contract CX-6000-2-0075.

Description and management recommendations for several caves on Pioneer Forest and 1-A-D Foundation lands including Flying W Cave, Medlock Cave, Conglomerate Cave, and Wind Cave.

Grant, C. 1967. Rock art of the American Indian. New York: Promontory Press.

Mentions Rocky Hollow and includes an illustration (fish and elk) from the site.

Gremaud, G. 1995. The treasure hunters. Missouri Conservationist. September 1995: 56(9).

Overview article of the Missouri Natural Features Inventory. Running from 1980-1995, the article includes several examples of areas found and mentions the benefits provided from earlier inventories, specifically those counties inventoried by the L-A-D Foundation and graduate students of the University of Missouri. The L-A-D Foundation supported the work of one of the first university students (see Fadler and Elder 1973).

Guyette, R.P.; McGinnes, E.A., Jr.; LeDuc, S. 1982. Climatic history in the Ozark region as reconstructed from the tree-rings of eastern red cedar and white oak. Occasional Paper 7. In: Proceedings of the Cedar Glade Symposium, School of the Ozarks. Point Lookout, MO: Missouri Academy of Science: 80-111.

The period of analysis for this study was 1700-1980. Results show two drought cycles of 2.3 and 6 years. Chronologies for white oak include samples from Current River Natural Area, owned by the L-A-D Foundation.

Guyette, R.P.; Cutter, B.E.; Henderson, G.S. 1991. Long-term correlations between mining activity and levels of lead and cadmium in tree-rings of eastern red cedar. Journal of Environmental Quality. 20(1): 146-150.

Examines lead and cadmium concentrations in growth increments from lead-mining areas compared to control sites. Chronologies from Jerktail Mountain on Pioneer Forest were used as a control.

Guyette, R.P.; Henderson, G.S.; Cutter, B.E. 1992. Reconstructing soil pH from manganese concentrations in tree-rings. Forest Science. 38(4): 727-737.

Uses tree-ring chronologies from jerktail Mountain area including nearby Asher Creek and Thompson Creek, all on Pioneer Forest.

Guyette, R. 1993. Fire history of the Eck Tract on the Big Piney River. 20 p. Unpublished report. Report for the project, ['re-settlement fire history of oak-pine forests in the Ozarks, dated November 22, 1993. On file with: Pioneer Forest, Highway 19 N., Salem, MO 65560.

Tree ring sampling study which compares results on this tract with preliminary sampling of shortleaf pine from the virgin pine tract along Highway 19. Six tree ring samples from the virgin pine tract indicated even-age structure, however, all samples were specifically selected from the largest pine. Twenty-six samples were collected from the Eck Tract and indicated a wider range of ages for dominant canopy trees.

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

The highly dissected nature of this study area has been shown to inhibit the occurrence of fire. Of an average of 108 fires annually in the region, less than 1 percent were from lightning, leaving the majority to be human-caused. The context for this paper then is the apparent relationship here between humans and fire. This study area, especially the northeastern quarter, is largely under the ownership of Pioneer Forest. Especially interesting here is the color map that depicts the forest types, topography, and the average fire or disturbance intervals. Shown on the map are intervals ranging from 10 to 29 years between 1700 to 1850.

Overall, the study area is more than 80 percent forested and located near the western edge of the eastern deciduous forest and dissected by steep ridges and numerous streams. Slopes here average 18 degrees. Considering fire history development, topographic roughness, and human population information these authors have developed a four-stage sequence of the fire regime: ignition-dependent, fuel-limited, fuel-fragmentation, and culture-dependent stages.

Guyette, R.P.; Stambaugh, M.C.; Dey, D.C. 2003. A riparian fire history along the Current River corridor. National Park Service report for the Ozark National Scenic Riverways. Van Buren, MO.

Details the fire history of the Current River corridor from dendrochronology and other records. The L-A-D Foundation (and Pioneer Forest) owns substantial land in the corridor and about 35 miles of L-A-D frontage along the river is under scenic easement to the Ozark National Scenic Riverways.

Haefner, R.A. 1983. A survey of sinkhole pond natural communities in Missouri. Columbia, MO: University of Missouri. 205 p. MS Thesis.

Includes descriptive information and comparative notes for Bowles Pond, pages 138-144, 189 and mentions Vinson Pond, page 189.

Hall, L. 1958. Stars upstream, life along an Ozark river. Chicago, IL: University of Chicago Press. 252 p.

Hall compares the "little rivers of the Ozarks" against any streams in America, his two "favorites by far are the Current and its tributary Jacks Fork". Hall credits Ed Woods (Chief Forester for Pioneer Forest at that time), among others, for teaching him about Ozark timber. In his essay on the Ozark Mountains, Hall cites nine of the large springs, including Cave Spring saying "the location is extremely scenic but difficult to reach except by river, so that it is seldom visited". In his discussion of open range Hall mentions Spencer Jones, who strongly advocated closing the range in the Ozarks, and whose farm is now part of Pioneer Forest. Describing the float from Cedar Grove to Round Spring Hall mentions several of the tributary hollows which include some of the lands of Pioneer Forest, Fishtrap, and Lewis; Hall also writes about entering Cave Spring by canoe.

Hall also recounts the 80,000 acres of cooperage company land, reportedly the largest stand of virgin white oak remaining in America and when they decided to liquidate some of their assets they cut most of the white oak of 14 inches in diameter. Hall's description includes the note that even with this cut, "there were a great many trees left" including "smaller white oak, but there were also extensive stands of pine seedlings, some pine of larger size, and other species of hardwoods such as scarlet oak and black oak, hickory and sour gum". Randolph Hole, a bank along the Current River, is mentioned, where an agreement was made to leave some of the largest white oak uncut, "these will be preserved so that future generations may know what our forests looked like before they were despoiled by the lumberman" Hall mentions the young St. Louis businessman, Leo Drey, who purchased these lands from National Distillers for a long-range forestry project.

Hall, in his description of the Current River from Big Spring to Doniphan floats with canoe enthusiasts, Leo and Kay Drey.

Hawksley, 0. 1976. Missouri Ozark Waterways. Jefferson City, MO: Missouri Conservation Commission. 114 p.

Notable features of interest to floaters along Ozark rivers in Missouri; references along the Current River include the following from Pioneer Forest Medlock Cave and spring (mile 12.6), Cave Spring (mile 21.9), and on the Jacks Fork River Leatherwood Creek (mile 22.2) and Bay Creek (mile 25.2).

Hebrank, A.W. 1989. Geologic natural features classification system for Missouri. Natural Areas Journal. 9(2): 106116.

Geologic natural features are classified according to the physical processes that formed them. They are categorized into fluvial (stream-related), erosional, solution/groundwater, gravity, glacial, eolian (wind-related), oceanic, igneous, tectonic, and 'features of problematic origin'. The classification system published here serves as the standard for the classification of geologic natural features in Missouri. Several of the L-A-D Foundation properties and one area on Pioneer Forest are cited as examples. The Narrows along the Big Piney River in Texas County is cited as one of two examples of a narrows, a fluvial feature. Grand Gulf in Oregon County is cited as one of two examples of a collapse canyon, a solution/groundwater feature. Ball Mill Resurgence in Perry County is the example of an estevella (a reversible swallow hole/spring), a solution/ groundwater feature. Clifty Hollow Natural Bridge is cited as one of two natural tunnels/bridges/arches of lateral piracy origin, a solution/groundwater feature. Grand Gulf's natural bridge is the example of an uncollapsed segment of a cave roof collapse. The Leatherwood Natural Arch is cited as an example of solution enlargement of a joint usually adjacent or parallel to the face of a bluff or cliff. Grand Gulf is one of three karst complex sites.

Hedden, W.J. 1968. The geology of the Thayer area emphasizing the stratigraphy of the Cotter and the Jefferson City formations. Rolla, MO: University of Missouri. MS Thesis.

Discusses geology of Grand Gulf, description of faulting, formation of the gulf, suggests cave entrance resulted from a tornado which uprooted trees upstream during the early 1920's. Author describes isolated karst features of the area of several square miles immediately west of Koshkonong. Pages 112-123.

Hensold, N.C.; Leoschke, M.).; Morgan, S.W. 1986. Rare plants of the Ozark National Scenic Riverways. Jefferson City, MO: Missouri Department of Conservation. 200 p.

Because the Congressional boundary for the Ozark National Scenic Riverways includes a significant amount of privately-owned property, this report includes a number of plant records for Pioneer Forest and L-A-D Foundation properties. Nineteen species are reviewed from their occurrence along both the Jacks Fork and Current rivers. Part II of the report is a descriptive exemplary natural community survey. Among sites detailed in this survey are Jerktail Mountain (high quality dry-mesic igneous forest on the south end of the mountain crest) and an extensive, high quality igneous glade (five distinct large glades occur along all sides of Jerktail Mountain, Cave Spring dolomite glade (the only significant glade on the Lower Current District), Rough Hollow fen (high quality deep muck fen, three rare species known from the site), and Thompson Creek seep fens (a series of four small fens along 3/4-mile of the stream valley). For the specific references here see pages 177, 181, 183, and 190.

Herbeck, L.A. 1998. Ecological interactions of plethodontid salamanders and vegetation in Missouri Ozark forests. Columbia, MO: University of Missouri. 78 p. MS Thesis.

Salamanders alone are the most abundant vertebrate animals, and their annual production of biomass exceeds that of birds or small mammals. This thesis reports research results on plethodontid salamander densities. Relationships between coarse woody debris, canopy cover, ground area cover, herbaceous vegetation, woody vegetation, and plethodontid salamanders occurring among 42 sample plots distributed within three distinct forest structural stages were determined. Second growth and regeneration sites were located on Missouri Department of Conservation lands in Reynolds and Shannon counties, while old-growth sites were located on National Park Service lands in Carter County and on Pioneer Forest land (the uncut Current River Natural Area and the surrounding old-growth forest on that same north-facing hillside) in Shannon County.

During 1995 and 1996 three species and 348 individuals were captured; southern redback salamanders (84 percent) and slimy salamanders (16 percent), and one individual of longtait salamander were captured. Estimated mean densities were 1422.7 salamanders/hectare for old-growth, 287.5 salamanders/hectare for second growth, and 14.87 salamanders/hectare for clearcut. Regeneration cutting reduces microhabitats for salamanders through increased temperatures and decreased moisture availability from the elimination of the forest canopy. This study found 5 times more salamanders in old-growth than in second growth and 20 times more salamanders in second growth than in regeneration cuts.

Forest management focused on rotations of 75 to120 years may truncate succession and prevent development of structural characteristics associated with older, mature forests, including development of larger trees, accumulation of down wood, and development of high density foliage layering.

Herbeck, L.A.; Larsen, D.R. 1999. Plethodontid salamander response to silvicultural practices in Missouri Ozark forests. Conservation Biology. 13(3): 623-632.

Authors present data on salamander densities from regeneration cuts (<5 years old), second•growth cuts (70 to 80 years old), and old growth sites (>120 years old). Among the old growth sites is the Current River Natural Area on Pioneer Forest. Salamander populations were reduced to very low numbers when mature forests had been intensively harvested. Plethodontid salamanders (those species of salamanders which are purely terrestrial and lack an aquatic larval stage; plethodontids lack lungs and exchange gases almost entirely through the skin) appear to be best adapted to conditions characteristic of older, mature forests and management can affect their abundance. During the spring season of 1995 and 1996 the authors found five times more salamanders in second growth forests than in regenerating forests. Increasing the rotation length in managed forests would provide older, mature forests that play a critical role in maintaining relatively high densities of plethodontid salamanders.

Hobbs, N.H., Jr.; Hobbs, H.H., Ill; Daniel, M.A. 1977. A review of the troglobitic decapod crustaceans of the Americas. No. 244. Smithsonian Contributions to zoology. 183 p.

Detailed review of 55 species in 8 families, includes notes on karst regions, adaptations, as well as detailed scientific illustrations and a key. *Cambarus hubrickti,* a white cave crayfish, was collected from Medlock Cave in 1941 (see page 82).

Hoist, S. 1991. Resources to explore—Grand Gulf State Park. Resource Review. 8(1): 28-31.

General write-up on the park, includes description of geology, relationship of surrounding lands, hydrology; specific mention of L-A-D Foundation ownership.

House, S. 1985. Cave maps as management tools. Missouri Speleology. 25(1-4): 68-77.

House discusses various uses for cave maps including land management, inventory, visitor management, interpretation, and scientific; several maps are included as illustrations. Under the discussion of interpretation are comments about Cave Spring and Devil's Well where the author notes that the National Park Service brochure uses the mapped plan and profile views of Devil's Well to help explain the relationship to the Cave Spring supply system. The suggestion is made here that these two features should be connected with a trail as a further aid in explaining these geological relationships. This issue of Missouri Speleology is the Proceedings of the 1984 National Cave Management Symposium.

Iffrig, G.F.; Trammel, C.E.; Cunningham, T. 2004. Pioneer Forest: a case study in sustainable forest management. In: Flader, Susan L, ed. 2004.Toward sustainability for Missouri forests. Gen. Tech. Rep. NC-239. St. Paul, MN: USDA-FS, North Central Forest Experiment Station. 913-204.

Detailed overview of the design and description of single-tree selection forest management as used on Pioneer Forest. Data for the period 1957 to 1997 are presented showing volume measurements for seven major species groups and basal area by diameter class from 6 inches to 24 inches or greater. Economic advantages of this system of forest management are demonstrated by looking at market price increases from Pioneer Forest for the period 1950 to 1999. Using this information an economic model is applied to an average acre of Ozark forest land managed for the most recent 24-year period (1975 to 1999) using clearcutting versus single-tree selection harvest. From the two management scenarios, including management costs for conducting each sale, the authors showed a nearly doubled rate of return by using single-tree selection harvests.

Jackson, O.D. 1988. Every State should have a Leo Drey. Audubon. 90: 78-83.

Interview article discussing background of Leo's acquisition of Pioneer Forest and other lands. Includes management style; relationships with Department of Natural Resources, Missouri Department of Conservation, private conservation groups. Discusses L-A-D Foundation.

Jeffries, J.M. 2004. Community composition, species richness, and abundance of oak herbivore insects in a chronoseries of temperate forests. St. Louis, MO: University of Missouri. 65 p. MS Thesis.

Jeffries' work provides companion research to that reported by Robert Marquis at the University of Missouri-St. Louis (Marquis and Le Conff in 1997 and then Marquis and others 2002) regarding insect herbivore diversity and abundance. Those results indicated increasing rates of diversity and abundance as the age of Missouri Ozark forests increased, however, the range of difference in age from their study was **only** 25 years. Jeffries' interesting addition of Current River Natural Area as a sampling site has provided a much longer chronoseries, extending beyond 300 years. Her results provide strong evidence that increasing structural diversity within forests influences herbivore success. Older forests are not as dense and therefore provide a quite different forest architecture from their canopy layers, multiple diameter classes, shrubs, and forest floor debris. Jeffries discusses the implications for conservation suggesting modifications in forest management which would extend rotation periods for even-aged forests and leaving more, larger diameter trees uncut.

Jenkins, M.A. 1992. A study of oak decline and vegetation dynamics in the forests of the southeastern Missouri Ozark Mountains. Columbia, MO: University of Missouri. 244 p. MS Thesis.

Describes oak decline, traces history and factors involved. Study sites were located on Pioneer Forest, Mark Twain National Forest, and University State Forest. Discussion of once-dominant *Pinus echinata* now found only on the driest sites and replaced by *Quercus coccinea.* This occurred after large scale harvest and subsequent fire suppression, resulting in an apparently even-aged stand of scarlet oak *(Q. coccinea).* Over the decade of the 1980's mortality of *Q. coccinea* in the Ozarks may have resulted from synchronized effects on this particular age class and spread over a vast area of the Ozarks. Also traces changes for *Q. alba* and *Q. velutina;* notes Pioneer Forest showed no major decrease in frequency of *Q. velutina* or *Q. coccinea* and the author suggests that selective cutting and the resulting reduced competition may explain the different vegetational dynamics at play here than in Ozark forests elsewhere.

Jenkins, M.A.; Pallardy, S.G. 1993. A comparison of forest dynamics at two sites in the southeastern Ozark Mountains of Missouri. Gillespie, A.R.; Parker, G.R.; Pope, RE., eds. In: Proceedings of the 9th Central Hardwood Conference. Gen. Tech. Rep. NC-161. St. Paul, MN: U.S. Forest Service, **North** Central Forest Experiment Station: 327-341.

Data from established plots at Pioneer Forest and University State Forest studying mortality and decline of red oak species. Similar mortality rates for *Quercus coccinea;* University Forest exhibited higher mortality rates for *Q. velutina.* Importance value (IV) for *Q. velutina* declined (1962 to 1991) on University forest but remained stable at Pioneer Forest. IV for *Q. coccinea* decreased on both areas 1980 to 1987, increasing after that on Pioneer Forest, while gradually declining at University Forest.

Authors suggest selective cutting at Pioneer Forest may be creating more uneven-aged stands which are less susceptible to synchronous mortality. Results of this study report "oak regeneration on Pioneer Forest is certainly comparable, and perhaps superior, to that of University Forest. Pioneer had significantly greater density of *Q. alba* seedlings; significantly greater *Q. coccinea* and *Q. alba* sapling densities. Again, suggesting "uneven-age management of oak-hickory forests in the Ozarks might provide sufficient regeneration to perpetuate oak species in subsequent stands."

Johnson, C.; DeLano, P. 1990. Missouri: off the beaten path. Chester, CT: Globe Pequot Press. 166 p.

Mentions the town of Dillard and specifically Dillard Mill State Historic Site.

Johnson, P.S. [n.d.]. Uneven-age management of oaks in the Ozark Highlands: is it sustainable? Unpublished report. On file with: Pioneer Forest, 2814 Highway 19 N., Salem, MO 65560.

Uses data exclusively from Pioneer Forest; discusses regeneration dynamics of oaks, the "accumulation" of reproduction over several decades; presents plot data from Pioneer Forest suggesting single tree selection method of harvest can work. Forest-wide size structure conforms to the reverse-J distribution curve; in addition to plot data a limited analysis of the age structure indicates the uneven-aged condition has been created and occurs at a relatively small spatial scale.

Johnson, RS. 1992. Perspectives on the ecology and silviculture of oak-dominated forests in the central and eastern states. Gen. Tech. Rep. NC-153. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 28 p.

Describes the historical and ecological relations between oaks, fire, and humans and reports the consequent silvicultural options and limitations in managing and sustaining oak-dominated forests. Includes a discussion on the history of clearcutting, beginning in the 1960's, noting clearcutting on public lands (especially the national forests) has declined in favor of forest

management less focused on commodity production and more focused on the total of forest values. The overview and history here is interesting. Johnson includes options to clearcutting and discusses the single-tree selection method. Pioneer Forest is mentioned though no specific data is presented. General discussion of the method notes that survival of understory oaks (regeneration) is substantially greater than for trees of the same size in an even-aged forest at the same overall stocking level.

Johnson, P.S. 2004. Thinking about oak forests as responsive ecosystems. In: Spetich, M.A., ed. 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: 13-18.

Important review of forests as continually responsive to forces from within and outside. While presenting a four-stage development process for even-aged forests, Johnson discusses the development of uneven-aged characteristics resulting from stand maturation and gap formation and filling. Johnson also suggests that in the Ozark Highlands oaks are "usually not successionally displaced by other tree species and the relative permanence of oaks is reflected by their relatively high abundance in the smaller diameter classes, even in old-growth stands." Under natural conditions the persistence of diameter distributions often approaches a reverse-J shape, in other words having a greater number of smaller diameters and increasingly fewer numbers of larger diameter trees. In pointing out that specific characteristics of such diameter distributions and their natural occurrence and silvicultural maintenance, depend on species composition and stand density and cites the work of Larsen, Loewenstein, and Johnson in 1999 where the basis for the silvicultural recommendations was the Pioneer Forest dataset, and the work of Loewenstein, Johnson, and Garrett in 2000, which also examined the Pioneer Forest plot data during the thirty-year period 1962 through 1992 declaring the method of management here as strongly positive in maintaining a healthy and sustainable forest.

Johnson, P.S.; Shifley, S.R.; Rogers, R. 2002. The ecology and silviculture of oaks. New York: CABI Publishing. 503 p.

A thorough treatment of the genera, this is primarily a silvicultural approach to managing and sustaining oak forests. The treatment here extends across six regions within the United States where various oak species occur. Included are ecological aspects of oak-dominated ecosystems, regeneration ecology, site productivity, development of natural stands, self-thinning and stand density, even-aged and uneven-aged silvicultural methods, silvicultural methods for multi-resource management, and growth and yield. Of particular interest here is the authors' discussion of uneven-aged silvicultural methods where they credit and reference Pioneer Forest data. Although certainly favoring group selection, and unnecessarily critical, the discussion of the principles and theory of the single-tree selection method are quite important, and notably the most extensive we have seen.

Karel,).A.; Elder, W.H. 1976. A natural area survey of the Southeast Missouri Regional Planning District—Final report to the Missouri Inter-Agency Council **for** Outdoor Recreation. Columbia, MO: University of Missouri, Cooperative Wildlife Research Unit. 151 p.

Includes descriptions for natural areas in Bollinger, Cape Girardeau, Iron, Madison, Perry, St. Francois, and Ste. Genevieve counties. The report describes Ball Mill Resurgence (pages 108109), Hickory Creek Canyon (pages 133-134), and Lower Rock Creek (pages 93-94).

Kirk, C. 1979.1 think on it often. Missouri Conservationist. 40(7): 20-23.

Musings on forest management and the natural world, incorporates observations from several decades of work on Pioneer Forest and Cal Stott's Newsletter on Continuous Forest Inventory. This same article was reprinted in American Forests 85(12): 34-35, 55-57.

Kramer, K.; Thom, R.; Iffrig, G. 1996. Directory of Missouri Natural Areas. Jefferson City, MO: Missouri Natural Areas Committee. 156 p.

This is the updated version of the 1985 publication (see Thom and Ifflig, 1985).

Kurz, D. 1996. Scenic driving in the Ozarks including the Ouachita Mountains. Helena, MT: Falcon Publishing. 274 p.

Details the natural and cultural highlights along some of the most inviting roads in Missouri, Arkansas, and Oklahoma. The "Two Rivers" drive in Missouri, a 64-mile route between Salem and Blue Spring, includes a description of the virgin pine forest and the 2-mile long Pioneer Forest interpretive drive.

Larsen, D.R. 1980. A growth and yield model for managed upland oak-shortleaf pine stands in Missouri. Columbia, MO: University of Missouri. 83 p. MS Thesis.

Study completed entirely on Pioneer Forest; discusses and uses CFI data, establishment plots, develops growth and yield model for oak-pine modified from published work of Sullivan and Clutter in Forest Science, 1972.

Larsen, D.R.; Metzger, M.A.; Johnson, P.S. 1997. Oak regeneration and overstory density in the Missouri Ozarks. Canadian Journal of Forest Research. 27(6): 869-875.

Using data from Pioneer Forest research plots, the authors present models for reducing overstory density to increase the regeneration potential of oak forests. In general, oak reproduction increases as residual stand basal area decreases. Authors note that due to the nature of this relationship, the predictability of individual stands is low, however, these models describe average trends for the highly stochastic regeneration process.

Larsen, D.R.; Johnson, P.S. 1998. Linking the ecology of natural oak regeneration to silviculture. Forest Ecology and Management. 106 (1998): 1-7.

Authors provide a useful interpretation to the regeneration requirements of oaks and point to the need for ecologically sound silvicultural prescriptions. While oaks are often classed as mostly shade intolerant, Larsen and Johnson point **out** that oaks have successfully adapted to and survive during extended periods of shade within the forest. The habit of oaks to grow up from seedlings, survive for a few years, dieback, and then repeat this process for many years is well known. This ability of oak seedlings to persist declines with increasing stem sizes. From unpublished oak root data at the North Central Forest Experiment Station, belowground portions of seedling sprouts can live up to 50 years. This paper notes Lowenstein's work (1996) on Pioneer Forest, identifying the success of selection harvesting of oaks in xeric forests resulting from minimal non-oak competition and the ability of moderately tolerant oak species such as white oak to reproduce and grow in the understory. This paper briefly discusses the shift in silviculture from the traditional expectation to control most ecological processes **to** the role of creation and maintenance of ecologically 'natural' forests. They discuss the move of the Forest Service during the mid-1990's to ecosystem management. Single-tree selection is discussed as one successful cutting method for the drier forests of the Missouri Ozarks but suggest that it may not be successful where it encourages other more shade-tolerant non-oak species.

Larsen, D.R.; Loewenstein, E.F.; Johnson, P.S. 1999. Sustaining recruitment of oak reproduction in uneven-aged stands in the Ozark Highlands. Gen. Tech. Rep. NC-203. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 11 p.

This paper describes the relationship between overstory density and oak reproduction. Criteria are presented for selecting a residual stand structure and density appropriate to the single-tree selection method in the Ozark Highlands and consistent with the regeneration ecology of oaks and thus sustaining a forest dominated by oaks. The basis for the silvicultural recommendations in this paper is the Pioneer Forest dataset.

LaVigne, E.M. 2002. Heterogeneity within and among selectively harvested forest stands in the Missouri mountains. St. Louis, MO: Saint Louis University. 94 p. MS Thesis.

A study of the change in forest structure and composition on Pioneer Forest using a space-for-time substitution. To accomplish this, the author established plots from within the forest representing harvest entries throughout the past twenty-year cutting period. Three stumps were identified at each site. Using stumps as plot centers, data was collected on percent canopy coverage, stem abundance, species abundance, and species diversity. Analysis of the data provided information on heterogeneity among the cuts. Canopy cover was the only significant difference measured across the landscape; ecological heterogeneity occurred at scales smaller than 0.0017 kmi. Heterogeneity produced from single-tree selection harvesting occurs mainly at smaller spatial scales within the forest understory.

A measure of the canopy cover **and** turnover ranged from 189 to 228 years and provides further indication that disturbance within **the** forest is in fact minimized from use of the single-tree selection technique. Yet another indication of this is that the measure of species richness did not significantly change over time, in other words change from sites recently harvested to those measured immediately prior to harvest activity was not significant. LaVigne found there was no consistency as to which species would fill a particular gap that was created; her results indicate this is more a matter of chance events determined largely by the existence of previously established individuals. The interesting analogy established by SanDiego (2000) about opening windows within the forest is further explained here by LaVigne as the canopy gaps created by single-tree selection harvesting act as moving windows that shift in time and space, while varying the concentration of light availability over space and time.

Lewis, 0.1978. The Current River and tributaries (Montauk to Lower Big Creek). Eminence, MO: Ozark Custom Printing Co. 47p.

Author grew up along the Current River and these writings are an effort to preserve some of the area's history and culture. Mentioned are a number of the hollows, springs, **and caves on Pioneer** Forest, often including derivations of particular place names. Included within the text are Razor Hollow, Medlock Cave, Bluff Schoolhouse, description of a float trip in **1908** by Governor Herberet S. Hadley and stop at Cave Spring, Kelley Hollow, Capps Hollow, and Big Creek Cave. Also included is an interesting historical sketch of the settlement of Big Creek Valley and briefly of Brushy Creek.

Lewis, N. 2005. Couple's giving is rooted in their passion for the great outdoors. The Chronicle of Philanthropy. March 3: 7, 22.

Profiles Leo and Kay Drey's conservation and philanthropic interests and activities over the years, with special reference to their gift of 146,000 acres of Pioneer Forest to the L-A-D Foundation, the sixth largest philanthropic gift in the nation in 2004.

Loewenstein, E.F. 1996. An analysis of the size- and age-structure of a managed uneven-aged oak forest. Columbia, MO: University of Missouri. 167 p. Ph.D. Dissertation.

There are two aspects to this study. One is an investigation of age-structure and age/diameter relationships from a random sample of 600 oaks from a one-square mile area of Pioneer **Forest.** Sample data from ten one-acre plots from a one square mile area of the forest showed that seven of the ten plots were uneven-aged, two were two-aged, and one was even-aged.

This research also investigates the long-term trends in species composition, basal area, density, and quadratic mean diameter using data from the 370, 1/5-acre permanent plots. During the period from 1952 through 1992 the average basal area increased by 68 percent and average density by 89 percent. Ingrowth of trees into the 5-inch diameter class was sufficient to maintain or increase density for all principle species, even after accounting for harvested trees. No compositional shift toward shade-tolerant species was noted. In addition a chi-square test showed that the diameters from the plot data conformed to the forest-wide average at a scale of 0.6 acres.

Loewenstein, E.F.; Garrett, H.E.; Johnson, RS. 1995. Changes in a Missouri Ozark oak-hickory forest during 40 years of uneven-aged management. Gottschalk, K.W.; Fosbroke, SIX, eds. In: Proceedings, 10th Central Hardwood Forest Conference. Gen. Tech. Rep. NE-197. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 159-164.

Examines changes in basal area, density, and average diameter from Pioneer Forest plot data from 1962 through 1992. Describes the forest, management strategy, and methods of data collection from the permanent plots. Basal area and density are increasing. Forest composition has not changed measurably during the data collection period; the seven species prominent in the forest 40 years ago still comprise the same relative proportion on the forest today. *Quercus alba* has increased its density three-fold and its basal area has more than doubled. Conclusions are that the management "appears to be maintaining a healthy, sustainable forest...ingrowth into the five-inch diameter class is occurring at a rate sufficient to maintain or increase density for all of the principal forest species even after accounting for harvested stems."

Loewenstein, E.F.; Johnson, P.S.; Garrett, H.E. 2000. Age and diameter structure of a managed uneven-aged oak forest. Canadian Journal of Forest Research. 30(7): 1060-1070.

Discusses age and diameter structure on one section of Pioneer Forest. Authors note advance oak reproduction in the Ozarks and cite the evidence that "this relatively shade-tolerant oak can survive beneath a forest canopy for up to 90 years." Using ten study plots these authors data confirmed a reverse-) shaped diameter distribution, however, diameter measurement alone can be a result of variation in growth rates among similar aged trees or especially among different species expressing varying growth rates. When the data was analyzed by species alone, the study area population of red oak as well as the population of white oak each expressed uneven-aged distribution based on diameter. Analysis of actual age distributions showed the forest conforms to an uneven-aged state at a scale of 0.4-ha on 70 percent of its area. Interestingly, this same analysis of actual age showed a range from 12 to 233 years and the authors suggested that a significant proportion of these trees were already established by 1954. Only 13 percent of the population of trees from this study have been established since 1954.

A fundamental conclusion is that just as a reverse-) shaped diameter distribution does not confirm an uneven-aged state, a bell-shaped age distribution does not preclude its existence. Therefore, when managing forests using uneven-aged silvicultural systems, diameter structure should be the primary factor to consider.

Loewenstein, E.F.; Guldin, J.M. 2004. Conversion of successionally stable even-aged oak stands to an uneven-aged structure. Spetich, M.A., ed. In: 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: 264-268.

Authors present four conversion prescriptions targeting mostly fully-stocked even-aged stands of varying ages into an uneven-aged forest structure. They note the experience of Pioneer Forest in creating well-structured uneven-aged upland oak stands from poorly stocked, cutover stands through judicious tending of residual growing stock. Furthermore, authors note this pattern has also been common for southern pine.

Lootens, J.R.; Larsen, **D.R.; Loewenstein, E.F.** 1999. A matrix transition model for an uneven-aged, oak-hickory forest in the Missouri Ozark Highlands. A paper presented to the 1999 Missouri Natural Resources Conference. Haywood, J.D., ed. In: Proceedings of the Tenth Biennial Southern Silvicultural Research Conference. Asheville, NC: U.S. Forest Service, Southern Research Station: 536-538.

Authors present a matrix growth model for an uneven-aged, oak-hickory forest in the Ozark Highlands of Missouri. The model was developed to predict ingrowth, growth of surviving trees and mortality by diameter class for a 5-year period. Tree removal from management is accounted for. The model is based on Pioneer Forest data from 400 0.2-acre permanent plots, measured over eight, 5-year periods from 1957 to 1992. Variables include basal area, site index, and species group. Models were evaluated using 100 reserved plots and comparing predicted and actual diameter-distributions over 5-, 15-, and 35-year periods.

Love, K. 2003. Building natural wealth. Missouri Conservationist. 64(11): 8-11.

A personal look at Leo's many accomplishments over the years, including recollections about people he acquired land from, his forest managers, particularly about building and managing Pioneer Forest for more than 50 years, acquiring and preserving natural areas, and working on various conservation issues (for example, founding the Open Space Council, Ozark National Scenic Riverways, founding the Coalition for the Environment, and acquiring Greer Spring).

Lynch, D.W. 1964. Report of the Committee on Natural Areas. Journal of Forestry. 1964 (December): 916-918.

Report on Pioneer Natural Area as one of three added during the year. Reference to the establishment in 1955 of the Current River Natural Area. Both "are examples of outstanding contributions by a private timber landowner in which he relinquishes the management of the areas to a board of trustees under the protection of legal indenture." Measurements of eastern red cedar at approximately 30 percent of the basal area in age classes ranging from 20 to 80 years old. Individual red cedar trees were measured at 18 inches d.b.h.

Marling, K.A. 1985. Tom Benton and his drawings—a biographical essay and a collection of his sketches, studies, and mural cartoons. Columbia, MO: University of Missouri Press. 224 p.

See page 8 of this book for the sketch of Lyman Field, friend of Thomas Hart Benton, on a river float on the Buffalo River in Arkansas. This sketch was later incorporated into the painting of Cave Spring that Benton completed in 1963 (see also Baigell 1974).

McKee, J. 1998. Milling around. Missouri Conservationist. (January 1998): 4-9.

This is a story about Russ Noah, retired forester from Pioneer Forest. During the 34-year portion of his career in the Missouri Ozarks Noah acquired an extensive knowledge of old forestry equipment. Russ began working with Pioneer Forest in 1951. Here is an inside look at the collecting and restoring of antique logging equipment. The article mentions the 1800's portable railroad tie mill he restored and pictured is the restored 1906 Case steam engine (see also Santhuff 1998).

McPherson, A. 1997. One hundred nature walks in the Missouri Ozarks. Vienna, IL: Cache River Press. 327 p.

The author includes trails at Dillard Mill State Historic Site and Grand Gulf State Park. Devils Well is written up and includes reference to our planned 2-mile trail to Cave Spring. The Blair Creek Section of the Ozark Trail is also reviewed by McPherson with notes on the mileage, maps, trailheads, and descriptions.

Melick, R.A. 1989. Uneven-aged management opportunities in upland oak-hickory stands in the Missouri Ozarks, with silvicultural prescriptions for three stands near the Mill Creek Recreation Area. Mark Twain National Forest, Rolla Ranger District. A paper presented to the U.S. Forest Service Region 9, to meet one of the requirements for the Program for Advanced Silvicultural Studies and Silvicultural Certification. 103 pages with literature cited and appendices.

This paper presents some of the earliest work in the Mark Twain National Forest' consideration of uneven-aged management. References Pioneer Forest work and specific discussions in June of 1987. Mention of Pioneer Forest, see pages 52, 59, and 66 for general advantages of uneven-age management, see Table 11 on page 68, also page 54.

Meyer, A.B. 1949. Pioneer Forest. Missouri Conservationist. August: 1-3, 16.

Interesting review of "Pioneer Forest of National Distillers Products Corporation." Summarizes early history prior to National Distiller's ownership when Current River Land Company owned part of the property and when ancient white oaks and shortleaf pine were common; discusses both companies conservative management practices. Mentions Ed Woods and Charlie Kirk and their forest inventory and leaving seed trees for shortleaf pine.

Millman, E. [n.d.J. A history of Deloss Lovine Millman and Millman Lumber Company. Unpublished printed manuscript. On file with: Pioneer Forest, Highway 19 N., Salem, MO 95560.

This is an interesting historical overview of a company working on the lands which would become Pioneer Forest during the 10 to 20 year period before Leo's purchase of these lands from National Distillers. This work was compiled by Ellen Millman with contributions by family members and others associated with Millman Lumber Company and Great Western Lumber Company. This work explores the family's long history of operating sawmills in southern Missouri and northern Arkansas.

In 1937 Millman Lumber Company purchased all of the yellow pine timber (from what was then Pioneer Cooperage Company, later purchased by National Distillers and then sold to Leo) estimated at 60,000,000 board feet and requiring 9 separate sawmill locations and 11 years to cut. In 1935 to 1937 they established a sawmill on Blair Creek (perhaps in Spring Hollow near Spout Spring). In 1938 they located a sawmill at Himont and then on Big Creek. The Big Creek mill was probably located near the creek and just north of the current Pioneer Forest property and included a steam-powered sawmill, dry kilns, planing mill, several houses, bunkhouse, and store. In 1939 the author notes "final cut of virgin pine forest in the State of Missouri." Author notes that D. L. Millman sold the 200-foot wide strip of virgin pine to the state, however, our records show Pioneer Cooperage sold the land to the State, Millman may have agreed to sell their rights to the yellow pine timber here at the same time.

Missouri Department of Conservation. 1993. Management plan for the black bear in Missouri. Jefferson City, MO: Missouri Department of Conservation. 50 p.

L-A-D Foundation listed, among others, for forest management for black bears and landscape level conservation needs. See page 11.

Missouri Department of Natural Resources. 1991. Challenge of the 90's—Our threatened state parks; park threat summaries. Jefferson City, MO: Missouri Department of Natural Resources. 155 p.

Park-by-park overview for eight broad threat categories: air pollution, aesthetic degradation, physical removal or loss of resources, exotic encroachment, visitor physical impacts, water quality changes, park operations, and ecosystem degradation. L-A-D Foundation properties, Grand Gulf State Park and Dillard Mill State Historic Site, are reviewed.

Mohlenbrock, R.H. 1983. Botanical inventory of the Ball Mill Resurgence Natural Area. Unpublished manuscript submitted to the L-A-D Foundation, November 1, 1983. 28 p. On file with: Pioneer Forest, Highway 19 N., Salem, MO 65560.

Brief overview of the area with a description of dominant vegetational communities (upland woods, floodplain forest, old field, and disturbed areas). Included is a complete list of taxa observed from the site during the late spring, summer, and autumn of 1983, totaling 339 ferns and flowering plants. No specimens were collected.

Mohlenbrock, R.H. 1984. Biological inventory of the Clifty Creek Natural Bridge Natural Area. Unpublished report submitted to the L-A-D Foundation, June 20, 1984. 43 p. On file with: Pioneer Forest, Highway 19 N., Salem, MO 65560.

Overview of the area including description of the dominant vegetational communities (upland woods, mesic woods, stream and streambank, glade, bluff faces, and disturbed). The study was conducted during late summer and autumn of 1983 and early and late spring of 1984. Included is a listing of 458 taxa of ferns and flowering plants recorded from the site. Collections were made during the 1984 visits.

Mohlenbrock, R.H. 1985. first interim report on botanical inventory of Hickory Canyons Natural Area. Report prepared for L-A-D Foundation by Biotic Consultants, Inc. June 20, 1985. 7 p. On file with: Pioneer Forest, Highway 19 *N.,* Salem, MO 65560.

Details plant communities listing dominant species; estimates as many as 700 species of ferns and flowering plants.

Nelson, P. 1985. The terrestrial natural communities of Missouri. Jefferson City, MO: Missouri Natural Areas Committee. 197 p.

Specific mention of Dripping Springs (Texas County) as a type example of moist limestone/dolomite cliff; Rocky Hollow as type example for dry sandstone cliff; Grand Gulf as type example for influent cave. Each of these areas is owned by the L-A-D Foundation.

Nelson, P.W. 2005. The terrestrial natural communities of Missouri. Jefferson City, MO: Missouri Natural Areas Committee. 550 p.

Nelson's 1985 work was revised in 1987 and this latest revision has been greatly expanded. In a table showing Missouri Natural Areas ownership (table 6, page 71) there are 10 L-A-D Foundation natural areas totaling 1,637 acres. Several of the Foundation's natural areas are noted as type examples. In the terrestrial natural communities discussion of forests, a photo of Current River Natural Area shows at least four large white oak trees, each exceeding 20 inches in diameter. Hickory Canyons Natural Area is referenced as a representative example of both dry-mesic and mesic sandstone forest, and dry sandstone cliff; Rocky Hollow Natural Area is referenced as a representative example of both moist and dry sandstone cliff; Clifty Creek Natural Area is referenced as a representative example of gravel wash.

Nevins, R.B. 1953. Report of Missouri Natural Area Survey. Report to the Nature Conservancy. Columbia, MO: University of Missouri, Department of Horticulture. 12 p.

Nevins, a graduate student at the University of Missouri, took a list of 121 areas in Missouri prepared earlier by J.A. Steyermark, then during July and August of 1953 reviewed their potential for nature preserves. This listing included 57 sites, which were visited and assessed. This listing references the National Distilleries virgin hardwood stand, noting that the exact location for a preserve had not been determined. Nevins indicated its size was expected to be about 15-20 acres, surrounded by an appreciable buffer, and that some of the stands on this land are pure white oak, averaging 200 years of age. Nevins last entry for the National Distilleries site is that the contacts are Ed Woods and Charlie Kirk, both very interested in conservation.

This listing includes Bowles Pond and Vinson Pond, both on Pioneer land, and lily Pond, which has been acquired by the Nature Conservancy and is surrounded by Pioneer land.

This list is annotated with remarks and landowner names. This copy on file with Pioneer Forest was obtained from the collection of Steyermark's papers at the Missouri Botanical Garden, St. Louis, MO and has a handwritten note at the top, "Mr. Nevins Report". At least two other versions of the list were produced and distributed, each either containing less information or less specific information. One dated January 1954 is noted as an abridged report of Mr. Nevins findings and is titled Missouri Natural Area Survey and dated January 1954. Another abbreviated listing bears the title 'Missouri Areas in Need of Protection'.

Nigh, T.A. 1984. An ecological assessment of sugar maple in the upland oak-hickory forests of Missouri. Columbia, MO: University of Missouri. 191 p. MS Thesis.

Study includes three sites: Current River Natural Area (L-A-D Foundation), Sugar Tree Hollow, and West Fork of Black River (Pioneer Forest).

Nigh, T.A. 1988. Final report on the Missouri natural features inventory: Carter, Oregon, Ripley, and Shannon counties. U.S. Forest Service, Rolla, MO and Missouri Department of Conservation, Jefferson City, MO. 286 p.

Thompson Creek, Leatherwood Creek, Bay Creek, Cave Spring, others listed by county; properties of both Pioneer Forest and the L-A-D Foundation.

Nigh, T.A.; Pallardy, 5.64 Garrett, H.E. 1985. Sugar maple-environment relationships in the river hills and central Ozark Mountains of Missouri. American Midland Naturalist. 114: 235-251.

Study includes research sites on Pioneer Forest. Conclusions are that sugar maple is reproducing more rapidly than oak throughout the western portion of the eastern deciduous forest, even forests with a predominant oak canopy. Authors largely attribute this to reduced site disturbance and suggest that lack of oak regeneration on all but the driest sites will result in a profound shift in species composition within future forests of this region. Sites sampled include western, central, and southern Missouri.

Opton-Himmel, J. 2001. Black bear survey on Pioneer forest, Shannon County, Missouri. Unpublished report. 19 p. On file with: Pioneer Forest, Highway 19 N., Salem, MO 65560.

Summary report of a bait station survey modeled after Missouri Department of Conservation (MDC) surveys statewide. In 1992 the MDC statewide effort consisted of 1,062 stations where 13 confirmed black bear visits. Six of these 13 were from Pioneer Forest. However, for the past 3 years (1999 to 2001) no black bear visits have been reported from bait stations on Pioneer Forest. This study by Opton-Himmel used the same methodology to more intensively sample a roughly 80 square mile area of Pioneer Forest. The results confirmed the presence of black bear on the forest. Six percent (5) of the established stations (80+) from this work received visits and all of these were within a 4 square mile area.

Orr, L.S. 1990. The vascular flora of Grand Gulf State Park, Oregon County, Missouri. Springfield, MO: Southwest Missouri State University. 37 p. MS Thesis.

A floristics survey of the park's 160 acres, conducted from July 1987 through July 1990. The collections numbered 346 species from three plant communities. Voucher specimens are deposited in the Ozarks Regional Herbarium at Southwest Missouri State University.

Orzell, S.L. 1983. Natural area inventory and floristics analysis of fens in selected southeastern Missouri counties. Carbondale, MO: Southern Illinois University. 202 p. MS Thesis.

General overview of Missouri Ozark fen hydrology and especially floristics as well as community structure; contains information from specific localities on Pioneer Forest, although these are hard to pinpoint from looking at the thesis alone. From Shannon County site #40 is either Fishtrap Hollow Fen or Marshy Spring Hollow Fen, others from maps pages 58-73.

Owen, L.A. 1898. Cave regions of the Ozarks and Black Hills. Cincinnati, OH: The Editor Publishing Company. 228 p.

In the first chapter Owen compares the southern half of Missouri with the Black Hills of South Dakota as "delightful regions for the study of caves." She quotes geologists of her day in relating the complexities of cave formation and the diversity of their decoration. Owen also quotes Broadhead's report in Broadhead, Meek, and Shumard (1873) regarding "natural bridges worthy of special notice" and specifically Clifty Creek Natural Bridge west of the Gasconade. She quotes Broadhead's entire description of the bridge (see entry for Broadhead (1873) in this bibliography). Chapter 7 of Owen is about Grand Gulf. It is interesting, knowing that today the cave entrance is blocked by debris, that Owen reports walking perhaps 600 feet into the entrance before reaching "the end of dry land at an elbow of a silently flowing river". Owen reports using a boat to travel a channel no more than 6 feet wide and for some distance. Owen mentions visiting Mammoth Spring in Arkansas just 9 miles to the south.

Owen, L.A. 1968. Cave regions of the Ozarks. Missouri Speleology. 10(2): 22-86.

Reprint of part of the 1898 work pertaining to Missouri and including an introduction by J.D. Vineyard nicely describing the life and work of Owen.

Owen Gallery. 2000. Thomas Hart Benton, exhibition of paintings, October 14 - December 15, 2000. Notes and research by Andrew Austin Thompson. Owen Gallery. 104 p.

This nicely illustrated publication includes a written overview of Benton's career as an artist, including discussion of his earliest modern art period, the years during which he produced mural paintings, and the influences during his later work. There is also a Catalogue of the Exhibition, which appeared at the Owen Gallery in New York City in 2002, with 39 images of the work of Thomas Hart Benton. For each image there is documentary information including the title of the work, the year completed, size, materials used in creating each work, its provenance (source), and exhibition history. Benton's Cave Spring, completed in 1963, was part of this exhibition and is presented twice in this work, on page 28 (a close-up from the center of the painting) and pages 90-91. Although Benton frequented the Ozarks and floated both the Current River in Missouri and the Buffalo River in Arkansas, the actual location of the subject of this painting is misidentified here as being along the Buffalo River. Certain elements in the painting itself offer unmistakable evidence of the location of Cave Spring along the Current River in Missouri, one of the properties owned by the L-A-D Foundation.

Pallardy, S.G.; Nigh, T.A.; Garrett, H.E. 1991. Sugar maple invasion in oak forests of Missouri. In: Burger, G.V.; Ebinger, J.E.; Wilhelm, G.S., eds. Proceedings of the Oak Woods Management Workshop. Charleston, IL: Eastern Illinois University: 21-30.

Study sites include Pioneer Forest for the Ozark portion of the study, map included.

Panno, S.V.; Weibel, C.P.; Wicks, C.M.; Vandike, J.E. 1999. Geology, hydrology, and water quality of the karst regions of southwestern Illinois and southeastern Missouri. ISGS Guidebook 27. Champaign, IL: Illinois State Geological Survey.

Guidebook for a geological fieldtrip as part of the 33rd Annual Meeting of the North-Central Section of the Geological Society of America. Includes description of a stop at Ball Mill Resurgence in Perry County and photo (pages 34-35). Also notes that the cobbles lining the resurgence scoured the dolomite bluff in a manner similar to the bowl-shaped features of Illinois Caverns.

Powell, R.L. 1970. A guide to the selection of limestone caverns and springs in the United States as Natural Landmarks. Bloomington, IN: Indiana Geological Survey.

Brief mention of the collapse cavern structure of Grand Gulf and its association with Mammoth Spring, AR.

Pryor, R.R. 1980. Natural areas in Missouri—Report of the Missouri Natural Area Survey. L-A-D Foundation, St. Louis, MO. 381 p. On file with: Pioneer Forest, Highway 19 N., Salem, MO 95560.

Extensive report in two volumes covering 67 counties in Missouri listing noteworthy natural communities and geologic areas. Numerous sites are described. Includes illustrations of Grand Gulf and Clifty Creek and each of these areas is also described in the report.

Reiter, S.R. 1991. Woody invasion onto glades of the Ozark National Scenic Riverways, Missouri. Ames, IA: Iowa State University. 80 p. MS Thesis.

Includes Cave Spring Dolomite Glade where NPS/Pioneer Forest boundaries join. Study also includes some work on Jerktail Mountain, a rhyolite glade and Thompson Creek Dolomite Glade. Overall study results show loss of open area at 32.4 percent for Gasconade dolomite areas and 22.9 percent from rhyolite areas. Measurements were taken from aerial photographs from 1955, 1966, and 1984.

Rennicke, J. 1995. Wild at heart. Backpacker. April 1995: 48-56.

Featured trails from the Heartland of the Midwest; included among the 10 listings is the Ozark Trail, the description which highlights the Blair Creek section which "offers solitude, ridgewalking, Blair Creek's scenic deep valley, and great views of the Current River."

Rossiter, P. 1992. A living history of the Ozarks. Gretna, LA: Pelican Publishing Company. 487 p.

Discussion of Dillard Mill, pages 439-442, with specific mention of L-A-D Foundation, history of ownership and operation, with notes on the cultural importance of the mill.

Rothwell, T.W. 1993. Missouri pine. Missouri Conservationist. 54(6): 22-25.

Overview article, includes introductory mention of the "one-mile long virgin pine strip" indicative of "a common site before the turn of the century (photograph of the Virgin Pine accompanies the article). Discusses companies operating in the Ozarks around the turn of the century including Grandin Timber Company and the Missouri Lumber and Mining Company. Wildlife benefits are discussed. Young dense stands of pine are favored by Cooper's and sharp-shinned hawks; older pine trees provide cavity nesting for the red-cockaded woodpecker.

Rucker, B.H. 1993. With a little help from our friends. Missouri Resource Review. 10(1): 8-13.

This article presents an overview of philanthropic assistance to the Missouri State Park System, from organizations and businesses to individuals from across the state. Includes mention of L-A-D Foundation contributions with respect to Dillard Mill State Historic Site and Grand Gulf State Park; author notes that "Perhaps at opposite ends of the cultural-natural dichotomy, each is a masterpiece of its own genre."

Ryan, J.; Smith, T.E. 1991. Final report on the Missouri natural features inventory of Howell, Texas, and Wright counties. Missouri Department of Conservation, Jefferson City, MO and U.S. Forest Service, Rolla, MO. 149 p.

Records on Horseshoe Bend, Piney River Narrows, and Dripping Springs natural areas, each of these areas is owned by the L-A-D Foundation.

San Diego, N.M. 2001. Management regime, scale, and the diversity of leaflitter arthropod communities of an Ozark forest. St. Louis, MO: Saint Louis University. 56 p. MS Thesis.

Analysis of how various forest management practices have affected the community composition of leaflitter invertebrates over ecological time. This study characterized communities at each site, determined how changes in scale affect community parameters, and compared scaling effects, both within and among three management treatments. The three treatments were an area not subject to harvest (Current River Natural Area), an area subject to single-tree selection harvest (Pioneer Forest), and an area cleared of trees (Reiss Biological Station). The arthropod data suggests that communities are significantly impacted by the type of forest management practiced. Abiotic variables (percent canopy coverage, temperature, humidity) showed significant spatial patterns at the 5 x 5 meter grid level.

As for abiotic variables the scale in variance for the clearcut is one to two orders of magnitude greater than the same measures on Pioneer Forest or at Current River Natural Area.

Author uses an interesting window analogy (see pages 47) where the forest canopy is the window. Harvesting a significant number of trees (clearcut) is akin to opening the window wide. The result is that for the clearcut, a suite of disturbance effects sets in leaving a footprint which **is** still being felt (25 years after the disturbance), particularly in measures of increased relative humidity.

Results of this study indicate that single-tree selection harvests on Pioneer Forest generate a spatial gradient throughout the landscape creating conditions most suitable for diversity to be maximized.

santhuff, C. 1998. Noah's mill. Missouri Conservationist. January 1998: 9.

A look at the restoration and operation of Noah's early 1800's up-and-down sawmill. (see also McKee 1998).

Sarvis, W. 2000. Old eminent domain and new scenic easements: land acquisition for the Ozark National Scenic Riverways. Western Legal History. 13(1): 1-37.

Interesting historical analysis of the eminent domain concept and its use during creation of the Ozark National Scenic Riverways (ONSR). Sarvis points out that until the early 1960s, NPS acquisition practices had rarely required eminent domain (the 1961 establishment of Cape Cod National Seashore set an important precedent in this regard). Introduction to this essay portrays local sentiment squarely against establishment of the ONSR, thought of as taking of property rights. Much of the information in this area originates from papers of Leo A. Drey, collection no. 531, Western Historical Manuscript Collection, University of Missouri, St. Louis, MO.

There is also background on scenic easements beginning in California in the 1930s. The concept of using scenic easements for establishing the ONSR was introduced during the early 1960s, as one supporter put it to preserve "a living landscape" of bucolic beauty and as an alternative to fee simple title acquisition and certainly acquisition by eminent domain. With the power of eminent domain, land was acquired for the ONSR. Sarvis documents the complications and oftentimes unfairness in appraising property values and truthfully approaching the large number of landowners here with the acquisition and condemnation process.

Sarvis concludes by noting that further use of the scenic easement option was "the most successful broad-based phenomenon to arise out of ONSR land acquisition." Further stating "this innovative concept was admirable and remarkable for its adoption at such a relatively experimental stage...". It was the sort of bitter feelings generated by the ONSR condemnation experience that contributed to congressional reform in Public Law 91-646 (Uniform Relocation Assistance and Real Property Acquisition Policies Act) in 1971. The essay suggests that occurrences of the sort experienced here helped inspire the libertarian "property rights movement" of the 1980s and 1990s.

Sarvis, W. 2002. A difficult legacy: Creation of the Ozark National Scenic Riverways. The Public Historian. 24(1): 31-52.

An interesting and well-documented look at how the Ozark National Scenic Riverways was first proposed. Sarvis discusses at length the influence and feeling of the proposals' supporters as well as its opponents. He traces the discussion of the idea from its infancy, through its successful passage as federal law (Public Law 88-492). Sarvis documents his discussion with references to Leo's papers that are part of the Western Historical Manuscripts Collection, University of Missouri-St. Louis. Other individuals mentioned here are then acting NPS Director Hillory A. Tolson, Leonard Hall, Shannondale Mission Reverend Vincent Bucher, Sigurd F. Olson of Wilderness Society and National Parks and Conservation Association fame, and Richard Pogue then with the Natural Areas Council and later with The Nature Conservancy. Leo's role during this period and his opposition to the plan are a significant part of this discussion.

Sarvis mentions the September 1961 float trip down the Current River where Leonard Hall accompanied Secretary of the Interior Stewart Udall and NPS Director George Hartzog. Concluding the discussion are references to the many controversies which have arisen over the years, from the very beginning with local resistance to land acquisition (see Sarvis 2000) to canoe traffic, horsepower limits on motorboats, trapping, and most recently feral horses. An interesting contrast is offered recognizing the intrusion of the NPS into Ozark culture and society to their lasting service in documenting and preserving area history, ethnology, and folkways.

Schaper, J.; Wicks, C. 2004. Aqueous geochemical study of a calcite-depositing Ozark creek: Tufa Creek, Shannon County, Missouri. Columbia, MO: University of Missouri. Speleology. 42(3/4): 1-38. Senior Thesis Study.

With a calcareous ten providing year-round water, Tufa Creek becomes a tufa depositing cold-water stream. Tufa is a thin, soft, spongy, cellular or porous, semi-friable incrustation around or along a stream or spring. Analysis of six sample sites provided for such measurements as water temperature, chemistry, alkalinity, hardness, etc. from this small, spring-fed tributary to Current River. Carbon-dioxide off-gassing from agitation of stream water as it falls 25 m in elevation over a distance of 583 **m** is considered the mechanism for calcite deposition. By comparing nearby Ebb and Flow Spring and Thompson Creek, these authors suggest that sufficient stream mineralization and optimal stream geometry are necessary for freshwater calcite deposition.

Schnack, D. 1994. The Ozark Trail. Missouri Resource Review. 11(1): 28-31.

General write-up on the Ozark Trail. This article notes Pioneer Forest as members of the Ozark Trail Council; it also includes a descriptive section about the trail and mentions Blair Creek and Harper Spring.

Scott Consulting Engineers. 1988. Grand Gulf Cave, Interim Report, October 21, 1988. Project No. 10-799-9-0005. 10 p. + exhibits. Unpublished report. On file with: Scott Consulting Engineers, Springfield, MO 65806.

Discusses work and feasibility of opening the cave entrance at Grand Gulf State Park.

Scott Consulting Engineers. 1989. Grand Gulf Cave-Interim report, October 21, 1989. Project No. 10-799-9-0005. 10 p. + exhibits. Unpublished report. On file with: Scott Consulting Engineers, Springfield, MO 65806.

Discusses work and feasibility of opening the cave entrance at Grand Gulf State Park.

Scott Consulting Engineers. 1991. Grand Gulf State Park, Final Report-Cave exploration phase, February, 1991. Project No. 10799-9-0005. 12 p. + exhibits. Unpublished report. On file with: Scott Consulting Engineers, Springfield, MO 65806.

Companion to this report is a video-taped report prepared by team members **from** the High Pressure Water Jet Laboratory, University of Missouri, Rolla, MO.

Shanklin, J.F. 1955. Current River Natural Area. Journal of Forestry. 53(7): 532-536 (July 1955).

In the April 1952 issue of the Journal of Forestry the Society of American Foresters' Committee on Natural Areas issued a request for locations of virgin type associations. This note, published 3 years later, highlights negotiations begun with National Distillers Products Corporation of New York City and completed between the SAF and the new owner, Leo Drey. Area established in March 1955 to fill the need of all practicing foresters for a comprehensive knowledge of natural developments within virgin forest associations. The indenture is also printed as it was legally established.

By the agreement Leo granted to himself and John F. Shanklin (Chairman, Committee on Natural Areas) as Trustees for the administration of the natural area by "remise, release, and quitclaim" the area of approximately 10 acres.

Shanklin, J.F. 1960. Society of American Foresters Natural Areas. Journal of Forestry. 58(11): 905-917.

The third printing of the Society's approved natural areas. The first list was printed in the journal in 1949, another in 1952. One hundred and twenty-eight natural areas in 34 states and Puerto Rico are listed here; the Current River Natural Area is the only Missouri site.

Steyermark, J.A. 1963. Flora of Missouri. Ames, IA: Iowa State University Press. 1,728 p.

Notes occurrence of *Decodon verticillatus* at Lily Pond and Bowles Pond (page 1090). Also mentions Lily Pond as the only known location for *Potamogeton epihydrus* var. *nuttallii* "growing close to another sinkhole pond where *Decodon verticillatus,* also an isolated relict in Missouri, occurs" (page 54). On page 1,172 Steyermark notes *Hottonia inflata* from Vinson pond, remarkably isolated from where it is more common in swamps and low ground. Bowles Pond, Lily Pond, and Vinson Pond are all on Pioneer Forest land (Lily Pond is a Missouri Natural Area).

Still, M. 1983. Profile - Leo Drey: land magnate of the Ozarks. Missouri Resource Review. 2(1): 24-26.

Highlights the establishment of Pioneer Forest, style of land management, and formation of the L-A-D Foundation.

Stroh, E.D.; Struckhoff, M.A. 2002. Exotic species invasion and structural damage along horse trails in sensitive natural areas at Ozark National Scenic Riverways. 36 p. Unpublished research report. On file with: USGS Northern Prairie Wildlife Research Center, Missouri Field Station, University of Missouri, Columbia, MO 65211.

Two-year study with the first year sampling six vegetation communities in order to determine which had the greatest frequency of exotic species associated with horse trails. Of upland waterways, glades, south/southwest slopes, north/ northeast slopes, ridges/shoulder slopes, and river bottoms, the results reported here show that exotic species associated with horse traffic were more commonly recorded from river bottoms, upland waterways, and glades. Nine study sites were chosen and a total of 66 plots were sampled. A number of sample plots were located on Pioneer Forest lands including those around Eminence and the Sinks (WC01-02, WC01-03); Round Spring (RS01-05, RS01-06, RS01-03, R501-04, RS01-07, R501-01, and R501-02); Jerktail landing (JT01-17, JT01-18, JT01-19, JT01-20, JT01-21, and JT01-22), and Two Rivers (TR01-01 and TR01-03). The management recommendations include either eradicate or control the most troublesome exotic species (fescue, sweet clovers, garlic mustard, and Chinese yam) in the highest quality natural areas; monitor along horse trails for new infestations; monitor for leafy spurge, as yet unknown to the area; and utilize horse riders to help scout and monitor new occurrences.

Suggs, G.G. 1990. Water mills of the Missouri Ozarks. Norman, OK: University of Oklahoma Press. 204 p.

Discussion and illustrations (2) of Dillard Mill, pages 69-71.

Sutton, M.; House, R.S. 2003. Ozark National Scenic Riverways Bat Survey, Winter 2002-2003. 40 p. Unpublished Report. On file with: Cave Research Foundation, Missouri.

Report on the field inventory of 44 caves, including Medlock Cave on Foundation easement property and Wind Cave on Pioneer Forest. At one time reports of the gray bat population at Medlock had been estimated at 36,000, down as of this inventory to 5,000-9,000. With human visitation heavy, obvious trails developing, and controlling access difficult, the recommendation is that Medlock Cave be gated. Wind Cave had been noted as a minor summer site for gray bats, however, this inventory recognized increased guano accumulation leading to estimates of at least 26,500 bats and possibly double that depending on the occupation patterns of the bats. In either case it appears this is one of the largest summer gray bat colonies in the lower Ozarks. Gating the entrance is not recommended here, although blocking the road and obliterating the trace leading motorized vehicles to the site are recommended.

Taylor, R.L. 1977. Cookstove cave (SHN 018). Missouri Speleology. 17(1-2): 32-35. •

Description of Cookstove Cave in Shannon County, map, and discussion of geology and speleogenesis. From the article "there are 3,400 feet of mapped passage in the cave, with most of that passage having large dimensions...the passage is nearly 100 feet wide." Cookstove Cave is also known as Holmes, Stovepipe, Squaredance, and Big Dixon Cave. The conjecture is that Cookstove was once a major spring which flowed away from the cave's present entrance, generally to the northwest into Blair Creek.

Thom, R.H.; !Hag, G.F. 1985. Directory of Missouri natural areas. Jefferson City, MO: Missouri Natural Areas Committee. 115 p.

Specific listing and description of Clifty Creek, Rocky Hollow, Ball Mill Resurgence, Hickory Canyons, Current River, Pioneer, Piney River Narrows, Dripping Springs, and Horseshoe Bend natural areas.

Trammel, C.F. 1996. Pioneer Forest: a kinder, gentler way. International Journal of Ecoforestry. 12(2): 235-237.

Overview of history of the Ozarks and establishment of Pioneer Forest, the management system, and why uneven-aged harvest works.

U.S. Department of Agriculture, Forest Service. 2002. Draft Environmental Impact Statement, Pineknot woodland restoration. Carter County, MO: Doniphan/Eleven Point Ranger District, Mark Twain National Forest. 277 p. + appendices.

Proposal to develop a shortleaf pine woodland community similar to those known to exist in Missouri during the 1800's and known to exist at this particular site. Several stages of restoration are proposed. The area includes 10,831 acres of the Mark Twain National Forest. Our comments on this document are strongly supportive; of particular interest here is that lands of Pioneer Forest occur within the project area, to the far eastern edge of the site. In addition to being supportive we have suggested that our lands here be included with our role being a cooperating partner.

U.S. Department of the Interior. 1976. A recreation plan for Pioneer Forest, Missouri. Salem, MO: Mid-Continent Regional Office, Bureau of Outdoor Recreation. 41 p. + maps.

Report includes recommendations for trails, primitive camping facilities, retention of old growth forest, self-guiding auto tours, interpretive shelters, and various cooperative projects with Federal and State agencies whose lands join Pioneer Forest.

U.S. Department of the Interior. 1979. Executive summary, new area, study of alternatives—Grand Gulf, Missouri. May 1979. National Park Service 1420. 8 p. + map.

Broad overview of the significance, status, and alternatives for management of the site. At the time of the report the I.-A-0 Foundation had acquired the property. Management alternatives include continuing the sites unimproved state under foundation ownership, private/state administration, state ownership and administration, and federal administration. Costs for operation and maintenance are drawn from comparison with Timpanogos Cave National Monument located near American Fork, Utah and Elephant Rocks State Park here in Missouri.

U.S. Department of the Interior. 1979. Study of alternatives, new area—Grand Gulf, Missouri. May 1979. National Park Service, Denver Service Center. National Park Service 1421. 49 p.

Study of alternative strategies for the protection, interpretation, use, and management of Grand Gulf to the National Park System. Described here are the regional and local environment, cultural resources, recreational resources, significance of the resource (a superlative geological and ecological entity; comparisons to three other natural landmarks: Grassy Cove, TN, Germany Valley, WV, and Newsome Sinks, **AL**; comparison to Natural Bridge and Natural Tunnel in Virginia, neither are comparable in size or nature) (discusses limit of feasibility for development as a major park). This report details each of the four management alternatives listed in the Executive Summary (see listing above) keeping in mind the natural preserve concept, limited development, and interpretation of the geologic resource.

Vandike, J.E. 1985. Movement of shallow groundwater in the Perryville Karst Area, southeastern Missouri. Water Resources Report No. 40. Rolla, MO: Missouri Department of Natural Resources, Division of Geology and land Survey.

Detailed discussion of the intensely karstified Perryville sinkhole plain. No other area in Missouri contains more extensive karst development. Blue Spring Branch is the western boundary of this study area and within this watershed lays Ball Mill Resurgence. Several maps delineate Blue Spring Branch where Ball Mill Resurgence occurs along with the several perennial

springs and intermittent resurgences: Blue Spring, Keyhole Resurgence, Keyhole Spring, Blue Spring Resurgence, and Blue Spring. There is a brief discussion of the Moore Cave System and its relationship to the Features which overlie it. The specific recharge area for Ball Mill Resurgence was not established in this study.

Vandike, J.E. 1997. Karst in Missouri, an overview. MCKC Digest. 4(2): 32-42.

Part 1 of a series of articles which provide an overview of our state's caves, springs, sinkholes, losing streams, and the land and water that gives them form and function. Included here are a brief review of geology (illustrated by a three dimensional figure of the origin of geologic features of the landscape), karst features of Missouri, and map of Missouri's major karst regions. This article highlights karst features of the Salem Plateau, commonly considered Missouri's premier karst region. Interestingly Logan Creek is described as a classic example of an Ozark losing stream. Several areas of Pioneer Forest are within the upper watershed, between Highway 72 to the north and Highway 106 to the south. Perhaps for 10 or more miles, Pioneer Forest land lies directly adjacent to the creek on one or both sides, mostly in the section which is the gaining part of the creek. Below this, Logan Creek is a losing stream, with a gravel-filled channel which can be more than 200 feet wide.

In describing sinkholes, Grand Gulf is called the "Cadillac" of Missouri sinkholes, a spectacular center piece of Grand Gulf State Park. This article includes **two** photographs illustrating the natural bridge at Grand Gulf as well as an aerial view of the gulf itself.

Vandike, J.E. 2000. Southeast Missouri karst region. MCKC Digest. 7(2): 17-30.

Article contains specific information on this particular karst region, essentially within Franklin, St. Louis, Jefferson, Ste. Genevieve, Perry, and Cape Girardeau counties and the city of St. Louis. This author attributes this karst region with the most varied geology and hydrology. This review describes in some detail resurgences of eastern Perry County, including a good overview of the functioning of Ball Mill Resurgence. There is an interesting observation that Ball Mill Resurgence "can mutate from a dry, rock filled basin to a spring rivaling the first magnitude springs of the Salem Plateau in size."

Ver Hoeft, J.M. 1991. Statistical analysis of spatial pattern in ecological data. Ames, IA: Iowa State University. 147 p. Ph.D. dissertation.

Three-part study dealing with estimation and prediction for spatial processes, especially for ecological data using (1) variogram under aggregation, (2) estimation of average patch size for transect data, (3) simultaneous prediction of several variable types for a vector-valued process. Data collected from several Pioneer Forest Ozark glades including Cave Spring, Thompson Creek, and Jerktail Mountain.

Vineyard, J. 1958. The reservoir theory of spring flow. National Speleological Society. Bulletin 20: 46-50.

Describes Cave Spring, Wallace **Well,** and Devil's Well and presents results of dye-tracing from Wallace Well to Cave Spring which support theory of the supply system of submerged conduits and reservoirs (Wallace Well and Devil's Well), **the reservoirs** serving as settling basins, flood control agents, and storage for waters which ultimately empty into the Current River at Cave Spring.

Vineyard, J.D. 1963. Origin and development of Cave Spring, Shannon County, Missouri. Columbia, MO: University of Missouri. 81 p. MA Thesis.

Detailed investigation and discussion of the Cave Spring system including spring orifice (Cave Spring), Wallace Well, and Devil's Well. Discusses and maps subwater-table conduits and ongoing transition from the phreatic (deep, water-filled) to the vadose (above water, air-filled) zone. Initial development of Cave Spring was in a shallow, water-filled zone but the current deep, water-filled erosion cycle continues to enlarge the spring supply system. Estimates flow at 30 to 32 million gallons per day.

Vineyard, J.D. 1985. Guidebook to the geology of springs in the Ozarks of south-central Missouri. Viburnam, MO: Association of Missouri Geologists. 61 p.

See "Geology of Springs in the Jacks Fork-Current River Area, Day 2" pages 25-56. Mileage log from Salem including a note about the pair of sinkholes on Pioneer Forest immediately west of the Highway 19/KK junction; Devil's Well on the Ozark National Scenic Riverways and its role in the Cave Spring recharge system; and brief description of the Virgin Pine Forest.

Vineyard, J.D.; Feder, G.L. 1974. Springs of Missouri. Rolla, MO: Missouri Geological Survey and Water Resources. 266 p.

Extensive discussion of Cave Spring (pages 90-103), includes relationship to Devil's Well and nearby Wallace Well, the latter also on L-A-D Foundation property.

Ball Mill Resurgence, a L-A-D Foundation property in Perry County, is reviewed on pages 244, 246-247. Ball Mill Resurgence is a spring rise basin at the base of a steep hill along the south side of Blue Spring Branch. Figure 90 is a photo of Ball Mill and includes a close-up of the milling action which gives the resurgence its name. Review notes five such spring rise basins in the Blue Spring Branch.

Walter, MD.; Johnson, P.S. 2004. Sustainable silviculture for Missouri's oak forests. In: Flader, S.L., ed. Toward Sustainability for Missouri Forests. Gen. Tech. Rep. NC-239. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station: 173-192.

These authors present background on Missouri's oak forests and silvicultural prescriptions including reviewing uneven-aged silviculture and the single-tree selection and group selection methods. These authors note the experience with single-tree selection in Missouri oak forests shows the method is sustainable citing the research from Pioneer Forest (Larsen and others 1997, Larsen and others 1999, Loewenstein 1996, Wang 1997). They also suggest the method may be applied in other regions with similar oak forests. Walter and Johnson point out that the method is regaining some of its former prominence although it is widely misunderstood. These authors point to research from Ohio which suggests its use there has resulted in the displacement of oaks by more shade-tolerant species.

Wang, Z. 1997. Stability and predictability of diameter distributions in a managed uneven-aged oak forest. Columbia, MO: University of Missouri. 147 p. Ph.D. Dissertation.

Using two diameter-distribution models, the negative exponential model and the power function model, this study used information from the 40-year inventory records of Pioneer Forest. All data were averaged across the site and diameter distribution patterns were compared without consideration of site differences. Pioneer Forest data included measurements for all trees equal to or greater than 5 inches in diameter. Our forest-wide data clearly demonstrates the classic reverse J-shape curve. This study added measurements of all trees from 1.6 inches (white oak stems outnumber red oak stems in the smaller diameters by almost three-to-one) to the entire data set. Wang observed instability of diameter distributions explained by the effect of our minimum cutting threshold (11-inch diameter for oak species). Partial cutting initiates a steepening of the distribution curve, there is an increase in the number of trees below the threshold (i.e. reduced mortality of the small diameters, increase in recruitment rate of reproduction, and reduced density of trees above the threshold). Steepening of the curve eventually reverses as density of diameters above the threshold gradually rebounds.

Wang, Z.; Johnson, P.S.; Garrett, H.E.; Shifley, S.R. 1996. Stability of diameter distributions in a managed uneven-aged oak forest in the Ozark Highlands. Proceedings, Central Hardwood Forest Conference 11. Unpublished draft. 23 p.

Using the Pioneer Forest dataset, these authors assess the sustainability of the diameter distributions (the reverse-J curve) found on Pioneer to oak forests in the Ozark Highlands in Missouri. The single-tree selection system seems to be maintaining relatively high densities of white oak at or below 10 inches d.b.h. which may compensate for a decrease stocking of small-diameter red oaks; there may be a dynamic adjustment associated with the replacement of red oaks by white oaks as well as a relatively uneven spatial and temporal nature to that process. All evidence suggests that the system used on Pioneer Forest will sustain a balanced uneven-aged forest.

Weaver, D. 1990. Caves, Missouri's growing natural resource. Missouri Resource Review. 7(2): 16-21.

Brief note of Grand Gulf as mammoth breech in the earth, three-fourths of a mile long with walls 120 feet high. Collapse estimated at less than 10,000 years ago.

Weaver, N.D. 1992. The wilderness underground; caves of the Ozark Plateau. Columbia, MO: University of Missouri Press. 113 p.

Grand Gulf noted on page 11 as chasm on Salem Plateau. Also see page 27.

Weaver, H.D. 2000. The significant caves of Missouri. Missouri Caves and Karst Conservancy Digest. 7(1): 1-15.

Review of the project along with the alphabetical listing of unrestricted significant caves of Missouri, compiled by H.D. Weaver and J.B. Beard. The listing includes the following caves on Pioneer Forest and L-A-D Foundation properties: Cave Spring Cave, Cookstove (Squaredance) Cave, Flying W Cave, Grand Gulf Cave, Medlock Cave, Sugar Tree Hollow Cave, and Wind Cave.

Weigel, D.R.; Johnson, P.S. 1998. Stump sprouting probabilities for southern Indiana oaks. TB-NC-7. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station.

Regeneration of oaks in southern Indiana is largely limited to sprouts originating from stumps. Johnson's work (1977) in the Missouri Ozarks found that oak sprouting here was related to age and diameter as well as site quality. For the five species tested in Indiana, sprouting decreased with increasing age and d.b.h. of the parent tree and increased with increasing site index (site quality). The sprouting results reported here for five oak species were found to generally parallel sprouting probabilities for white oak and black oak in Missouri. Populations can be either even-aged or multi-aged. These authors reference the work of Loewenstein (1996) on Pioneer Forest where oaks form uneven-aged populations and where age and d.b.h. may be poorly correlated.

Wheeler, H. 1991. Along the Ozark Trail, notes from a backpacker's journal. Missouri Conservationist. October 1991: 10-13.

Journal from a hike in November 1990 along the Blair Creek section of the Ozark Trail. Article begins at Cedar Point which is part of Pioneer Forest, located just above Laxton Hollow.

White, C.M. 1985. Caves and canoes: managing cave resources in a recreational park. Missouri Speleology. 25(1-4): 191-200.

White provides a historical overview of cave management efforts at Ozark National Scenic Riverways. He reports on an earlier work (MS Thesis, University of Missouri, Columbia, MO) by Sutton (1976) which details floater impacts on the riverways, in particular Cave Spring and Pulltite Springs "which have become traditional stopping points for canoeists" and where "major change in the vegetation and soil have been caused at these landings". White also mentions the National Park Service brochure produced by the National Park Service in 1984 and that at the time of this writing, Wallace Well (L-A-D Foundation ownership) was among only four caves that had been gated.

White, L.C. 1993. Ozark hideaways: twenty-seven day trips for hiking and fishing. Columbia, MO: University of Missouri Press. 244 p.

The second edition of this book (1998) has been revised to omit reference to lands of Pioneer Forest, however, the first edition includes specific discussion of Pioneer Forest lands in these areas, although there is no mention of ownership: Upper Sinking Creek (pages 11-17, would include lands above The Sinks in Sections 14 and 23, T31N R4W which extend to Sinking Creek); Sinking Creek—Highway 19 to The Sinks (pages 18-24, routes users through Pioneer Forest, along the creek in Sections 4, 5, and 8 T3ON R4W); Big Creek Northeast of Eminence (pages 27-33, includes extensive sections of the forest along this entire section of the creek); Big Creek County Road 3710 to the Current River (pages 62-65, Sections 7, 8, 9, and 10 131N R6W focuses not only on Big Creek but routes users overland through lands in Section 15 to Current River and mentions an old school which is Bluff School and Medlock Cave); Leatherwood Creek (pages 73-80, essentially the entire ownership of Pioneer Forest along Leatherwood Creek).

Wilson, S. 1993. The lady was a caver. Missouri Conservationist. 54(3): 4-9.

Interesting sketch of Luella Agnes Owen, author of 1898 book "Cave Regions of the Ozarks and Black Hills". Article mentions her account of exploring the cave at Grand Gulf.

Wylie,). 1979. Devil's jump off. Missouri Conservationist. 40(7): 8-9.

Tall tale on the origin of Ball Mill Resurgence