PROCEEDINGS OF THE CONTRIBUTED PAPERS SESSION OF THE SECOND ANNUAL SYMPOSIUM ON THE NATURAL HISTORY OF LOWER TENNESSEE AND CUMBERLAND RIVER VALLEYS

Held at Brandon Spring Group Camp
Land Between The Lakes
4 March 1989

Sponsored by:

Center for Field Biology of Land Between The Lakes,
Austin Peay State University, Clarksville, Tennessee

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Tennessee Valley Authority-Land Between The Lakes
Golden Pond, Kentucky

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PREFACE

On 3 and 4 March 1989, the second annual symposium on the natural history of lower Tennessee and Cumberland river valleys was held at Brandon Spring Group Camp in Land Between The Lakes. Sponsors of the symposium included Austin Peay State University's Center for Field Biology of Land Between The Lakes, Tennessee Valley Authority's Land Between The Lakes, and the Tennessee Academy of Science.

The first day's presentations constituted a special invited papers session dealing with the vegetation and flora of Tennessee. Twenty-eight papers from this session were later published as a special issue (Vol. 64, No. 3, July 1989) of the *Journal of the Tennessee Academy of Science.*

The second day of the symposium was devoted to contributed papers covering a broad spectrum of topics. Speakers in this session were given the option of submitting for publication either a manuscript with an abstract, or an abstract only. Six papers, complete with abstract, and 10 abstracts only were submitted. Those papers (each refereed by at least one reviewer) and abstracts are published here.

The style and format used herein follows that established in the proceedings of the first annual symposium (Snyder, David H. (ed.). 1988. Proceedings of the first annual symposium on the natural history of lower Tennessee and Cumberland river valleys. The Center for Field Biology of Land Between The Lakes, Austin Peay State University, Clarksville, Tenn.). Journal abbreviations used in literature cited follow that given in *Serial Sources for the Biosis Data Base*, Volume 1987, printed and distributed in the calendar year 1988 by BIOSIS, 2100 Arch Street, Philadelphia, PA 19103-1399.

A. Floyd Scott
August 1989

ACKNOWLEDGMENTS

My job as editor of this volume was made easier by several people whom I wish to acknowledge, either collectively or individually. To those anonymous reviewers who acted as referees for the complete papers, I thank you. For reformatting several of the manuscripts and typing all material, I am indebted to Ms. Donna Davis. For advice and guidance on general editorial matters, gratitude is extended to Dr. David H. Snyder. For help with compilation of the list of symposium registrants, appreciation goes to Ms. Debbie Young. For aid in proofing the manuscripts, I thank Ms. Kristen Page and Dr. Ed Irwin. And for making the contributed papers session possible, a collective sentiment of gratitude goes to all participants whose papers and abstracts chronicle the research reported herein.

SYMPOSIUM REGISTRANTS

Following in alphabetical order is a list of those individuals who registered at the 1989 symposium. Institutional affiliation (when available), city (of the person's institution or home), and state are also given.

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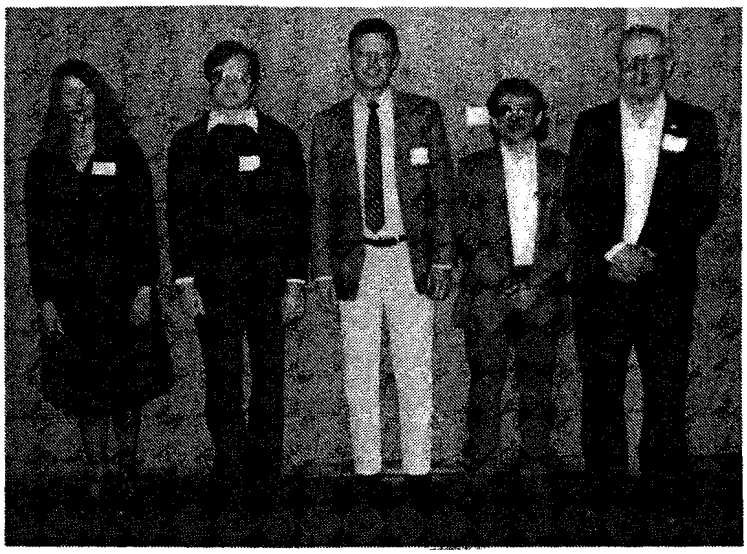

Presenting papers in the Contributed Papers Session I of the LBL symposium were (from left) Susan F. Weber, University of Alabama at Huntsville; R.K. Clements, Georgetown College; Gary E. Dillard, Western Kentucky University; Mike Lee, Tennessee Department of Transportation; H.R. DeSelm, University of Tennessee at Knoxville.

Presenting papers in the Contributed Papers Session II of the LBL symposium were (row 1) Jodie Richter, SIU-Carbondale; Debbie L. Gillis, APSU; Ann Phillippi, SIU-Carbondale; Floyd Scott, APSU; (row 2) Denise Decker, Memphis State; Ray D. Burkett, Shelby State Community College; Ellen M. Twombly, APSU; (row 3) Terrence R. Tiersch, Memphis State; Chester R. Figiel, Jr., Memphis State; David A. Easterla, Northwest Missouri; Steven W. Hamilton, APSU; Curtis L. Waggoner, Southeast Missouri State: George A. Feldhammer, SIU-Carbondale.

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CONTRIBUTED PAPERS

SESSION I: BOTANY

Saturday 4 March 1989

Moderated by:

William H. Ellis
Austin Peay State University

Notes on Some Infrequently Reported Freshwater Algae of the Southeastern United States

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ABSTRACT

In the southeastern United States, as well as elsewhere, there occur a number of freshwater algae which are infrequently reported in the literature. When found, such taxa are often referred to as being "rare." I prefer the descriptor, "infrequently reported," to "rare" as it has been my experience that often the apparent "rareness" of freshwater algae is due to something other than an intrinsic biological feature. I would prefer that "rareness" be reserved for those taxa which, after extensive study, have been shown to have such narrowly defined ecological requirements that appropriate microhabitats capable of supporting their populations are themselves uncommon. Such organisms are, of course, those which are most susceptible to environmental perturbation.

Others have offered explanations for the apparent rareness of particular freshwater algae. Generally, these may be enumerated as individual cases, or combinations, of the following: (1) Some occur in very low numbers within a given community and are easily overlooked; (2) Some are very small in size and easily overlooked; (3) Some, particularly those that are epiphytic, epizoic or epilithic, are characteristic components of microhabitats which are seldom carefully examined; (4) Some are structurally so delicate that they disintegrate or are destroyed by preservatives, thus losing their identity, before being examined; (5) Some achieve vegetative development during cold weather, a time when field phycologists are relatively inactive; (6) Some are ephemeral and are often missed by all but experienced collectors; (7) Some are stenoecious; only these may be truly rare; and, finally, (8) The apparent rareness of many taxa may be due largely to the rareness of competent field phycologists whose disjunctive distribution leads to corresponding disjunctions in reported algal distributions.

Illustrations of some infrequently reported freshwater algae will be presented along with distributional notes and comments on their ecology. Included are the chlorophytes, *Staurastrum brasiliense* v. *lundellii* West & West, *Cosmocladium saxonicum* DeBary, *Spirotaenia condensata* Brebisson, *Triploceras gracile* Bailey, *Tetmemorus brebissonii* (Meneghini) Ralfs, *Phymatodocis nordstedtiana* Wolle, *Radiofilum conjunctivum* Schmidle, *Gloeotaenium loitelsbergerianum* Hansgirg, *Helicodictyon planctonicum* Whitford & Schumacher, and **Pachycladella umbrina* (G.M. Smith) P. Silva; the xanthophytes,

Chadefaudiothrix gallica Bourrelly, *Gloeopodium rivulare* Whitford & Schumacher, *Tetraedriella regularis* (Kuetzing) Fott, and *Peroniella planctonica* G.M. Smith; the chrysophytes, *Eirmodesmus phaeotilus* Whitford, *Chrysodidymus synuroides* Prowse [includes *C. gracilis* Prowse], *Cyclonexis annularis* Stokes, *Chrysostephanosphaera globulifera* Scherffel, *Chrysosphaerella longispina* Lauterborn, Phaeoplaca *thallosa* Chodat, *Tetrasporopsis perforata* (Whitford) Bourrelly, and *Bourrellia skujae* Dillard; the rhodophyte, **Boldia erythrosiphon* Herndon; and the glaucophyte, **Glaucocystis nostochinearum* Itzigsohn.

*Reported from Tennessee.

The Barrens of West Tennessee

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ABSTRACT

Six barrens in West Tennessee have been examined; four are on loess or sand-derived soils along railroad rights of way, one is on soil derived from sandy Cretaceous deposits, and one is on clayey calcareous soil at the northern end of the Black Belt of Alabama-Mississippi. A total of 283 native vascular plant taxa have been collected on the West Tennessee barrens--four of these are listed as threatened or of special concern in Tennessee. The native flora is closely related to the barrens flora of the western Highland Rim. Most of the area of each of these barrens is dominated by *Schizachyrium scoparium* but other tall grasses, forbs, low grasses and forbs, and woody plants also occur.

INTRODUCTION

Southeastern United States exhibits a system of barrens vegetation that was once a conspicuous feature of the landscape. Extensive openings included the Kentucky Barrens and the Black Belt of Alabama-Mississippi. This vegetation resembles tallgrass prairie, but the term barrens has been used locally to describe these grassy openings as well as low density woodland, thickets, savanna and woodland with grass understory (Michaux 1793-96, Safford 1869, Killebrew and Safford 1874, and others). The extent that open barrens seen in the eighteenth and nineteenth centuries were the result of Amerind land use is not fully known. The relationship between present-day remnants and modern land use is still being examined (DeSelm et al. 1969). Appropriate regional studies of barrens include DeSelm et al. (1969) and DeSelm et al. (1973); reviews of the problem include DeSelm (1981, 1986), DeSelm and Murdock in review, DeSelm (1988), Chester (1988), and Bryant (1977, 1981).

This paper characterizes the open barrens of West Tennessee both floristically and physiognomically. Barrens vegetation is of interest because of its floristic and physiognomic relationship to both the grasslands of the Middle West and the grasslands of the southeastern United States. In a forested region, the historical and environmental factors that maintain grassland in spite of forest succession has long been of interest to ecologists.

THE STUDY AREA

Geology and Soils

West Tennessee is part of the East Gulf Coastal Plain (Fenneman 1938). The eastern edge of this Coastal Plain in Tennessee occurs on the Cretaceous-Paleozoic boundary (figure 1). The Plain extends west on Cretaceous, and finally on progressively younger Tertiary deposits, to the Mississippi Alluvial Plain. Of particular interest are the Cretaceous substrates. These include the McNairy Sand which is predominantly sand but in places is interbedded with silty clays, and the Dermopolis Formation of marl and calcareous clay. Also of significance to this study are the Tertiary Claiborne and Wilcox Formations of sand with local beds of clay, silty clay, lignitic clay, and lignite. Topography is flat to rolling (Cushing et al. 1964, Hardeman 1966). Four barrens occur on sites chiefly on uplands over loess of Pleistocene Wisconsin (Peorian) age (Leighton and Willman 1950, Krinitzky and Turnbull 1967). The two McNairy County sites (figure 1) are on rolling topography; New Hope Barren is over the Dermopolis Formation and the Ramer Barren is on the McNairy Sand (Wildemuth et al. 1958, Hardeman 1966).

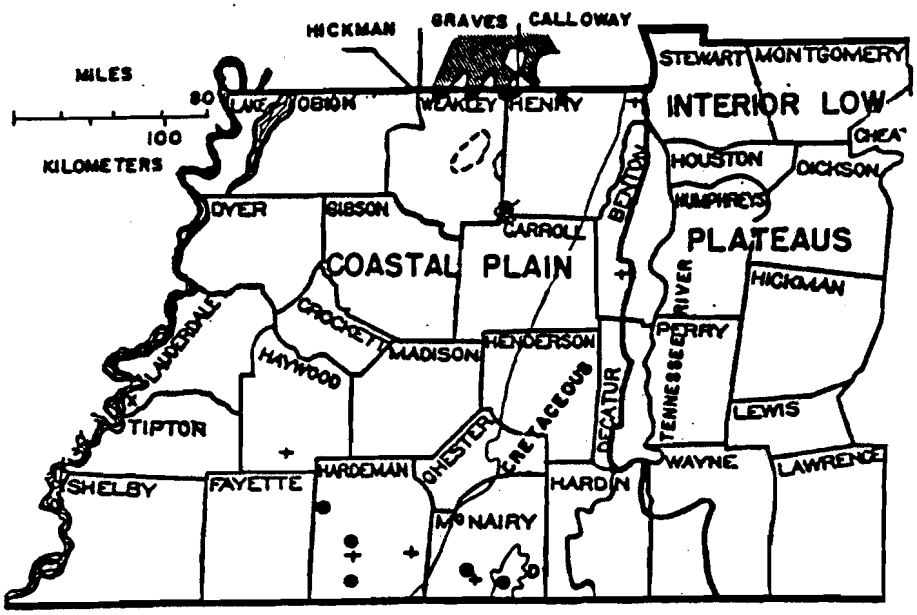

Figure 1. Physiographic areas and barrens of West Tennessee. Areas shown within the Coastal Plain are the Cretaceous Dermopolis Formation (outliers to the north not shown). Dots are barrens, +'s are streams with prairie as part of the name, X's are open areas at the time of settlement, dash-outlined areas in Weakley County were barrens vide Gardner, barred area is southern end of Kentucky barrens vide Loughridge, black areas are Kentucky barrens in Tennessee vide Transeau. See text for discussion and references.

The upland, chiefly loess, soils are silt loams but vary to clay loam and loamy sand. Several have pans which impede water drainage in the wet season. There are Alfisols: Thermic, Typic and Aquic Fragiudalf, Typic Fragiaqualf, Typic Paleudalf, and Ultic Hapludalf; and Ultisols: Glossaquic Fragiudult, Typic Hapludult and Arenic Paleudult. At Ramer there is a fine sandy loam which is a Thermic Typic Hapludult and at New Hope a silty clay loam--a thermic Rendollic Eutrochrept (Inceptisol) (Wildemuth et al. 1958, U.S.D.A. Soil Series descriptions, personal communication with Ed Lewis).

Climate

The climate of West Tennessee is a humid mesothermal with seasonal water deficiencies "none to moderate" (Thornthwaite 1948). Maximum temperatures average 8-11^{o}C (January) to 32-33^{o}C (July); minimums average -2-2^{o}C (January) to 20-23^{o}C (July). Precipitation average 122-132 cm per year (Dickson 1960). Between 1931 and 1969, 21 droughts extending through 38 percent of the 468 months occurred; half were moderate, severe or extreme (Vaiksnoras and Palmer 1973). Probabilities (Safley and Parks 1974) indicate that, in a 2.5 cm water holding capacity soil (June-October), a seven-day drought had a 13 to 33 percent chance of occurrence. For shorter periods or on shallower soils, the probabilities increase.

Vegetation

West Tennessee is part of the Mississippi Embayment physiographic-floristic area of Shanks (1958) who showed the "Barrens of the southwestern Rim" transgressing the Coastal Plain boundary westward into southwestern Wayne and adjacent Hardin counties. The area lies within the Western Mesophytic Forest region of Braun (1950) who noted the prairies there. The flora of the entire area has been recently summarized by Heineke (1987) and the whole vegetation matrix by Braun (1950) and Heineke (1987).

Human History

West Tennessee and surrounding area was the living and/or hunting area of a succession of Amerind cultures who arrived late in the Pleistocene. Paleoindian artifacts, Archaic settlements, Woodland and Mississippian mounds occur there (Lewis and Kneberg 1958, Swanton 1946, Hudson 1976). For at least three centuries the land was chiefly a hunting ground, and for the century preceding white occupancy it was under the control of the Chickasaw tribes. Intrusions by Spanish, French and American explorers were confined chiefly to the border of the area along the Mississippi River. The Chickasaw Bluffs were important sites for forts designed to control the river. The long hunters, who assiduously hunted big game from eastern and central Tennessee and Kentucky beginning ca. 1760, may have hunted also in West Tennessee (Haywood 1823,

Williams 1930, Goodspeed 1887). Of particular interest is the description by Hutchins in Imlay (1797), of the barrens of the Jackson Purchase of Kentucky (bordering the study area), ". . . near the mouth of the Tennessee. . . . It is covered with a long grass, having little or no timber except a small growth on the watercourses. . . ."

The area was opened to settlement following purchase from the Chickasaws in 1818. The first settlers found an area almost completely covered by forests of oak (*Quercus* spp.), tuliptree (*Liriodendron*), and a wide variety of other taxa with an understory of cane (*Arundinaria gigantea* (Walt.) Muhl.) and peavine or hog peanut (*Amphicarpa* spp.). Trees were large on the uplands and particularly so in the bottoms where cypress (*Taxodium distichum* (L.) Richard) dominated large tracts. Some historical accounts mention the large animals seen by the early settlers, but buffalo and elk, to be expected on grasslands, were not mentioned. Possibly they had been eliminated by the long hunters. Settlement involved land clearing, extensive cultivation of uplands, and drainage of lowlands and cultivation there. Forests were cut for local use and some product shipment, or they were grazed, and the understory was burned periodically (Williams 1930, Marshall 1941, Williams 1946, Harbert 1947, Baggett and Cooper 1973, Smith 1979, Vaughan 1983).

The Barrens in Local Literature

Indian village sites have been reported on the south border of the area in Wayne County at Piney Grove, Walnut Grove, and Pickwick (Harbert 1947), but it is not known whether these were short-term hunting camps or more permanent centers of agriculture. The site of Fulton (Lauderdale County) at the time of settlement was ". . . a part of a cleared field" (Peters 1957). Another area described as a barren includes the present site of McKenzie, Carroll County (Booklet Committee 1972). Also noted in this county is "Barren Springs" northeast of Huntingdon (Booklet Committee 1972), but the reason for the use of the term "barren" in this case is not known. An early settler, John Gardner (Gardner 1963) knew of barrens in Weakley County; I have located these areas from his descriptions (figure 1). In various parts of West Tennessee, five streams are called Prairie Branch or Creek (figure 1). One in Benton County, a branch of Cypress Creek, and one in Henry County, a branch of another Cypress Creek, are in dissected topography and may have been named for marsh vegetation near their mouths, now under Kentucky Lake. Another Prairie Branch flows into Muddy Creek just southeast of Ramer, McNairy County, near the Ramer Barren sample used here. A Prairie Branch, Hardeman County, is south-flowing in a wide, flat bottom of the Hatchie River; another Prairie Creek, Haywood County, flows in a wide, flat bottom north to the Hatchie Bottom. I am unable to determine whether these streams are named from juxtaposed prairie or marsh vegetation, or for vegetation of nearby uplands through which the stream valley cuts.

Barrens of West Tennessee first were reported in the scientific literature by Safford (1869) who noted in McNairy, Hardin and Henderson counties: "bald hills" or "bald places" on green sand or marl which ". . . are often destitute of vegetation, with the exception of occasional thickets. . . . A meagre growth of grass sometimes covers them. When not relieved by this, they have a grayish or ashen aspect." He was speaking of the northern extension of the vegetation of the Black Belt of Alabama and Mississippi on the Dermopolis Formation. Killebrew and Safford (1874) also mention the hickory barrens, blackjack barrens, and post oak and hickory barrens on some lands east of Dresden, Weakley County. This was repeated by Safford (1884). Hickory barrens are also reported in Henry County (Inman 1976) as are "post oak glades" in the eastern part of the Henry County 24th civil district (Safford 1884). The various barrens and glades mentioned above were small tree successional stands resulting from tree invasion of the barrens and are described by Killebrew and Safford (1874), by McInteer (1946), and noted in Carroll County (Booklet Committee 1972).

The discussion of barrens in the Jackson Purchase region of Kentucky and the map of their distribution (Loughridge 1888) are pertinent since the barrens are shown extending to the Tennessee state line in three places in Weakley County. The map by Transeau (1935) shows the prairie extending only slightly into Tennessee (figure 1).

While noting some barrens species, as *Physostegia virginiana* (L.) Benth., as occurring "over the state," Gattinger (1901) cited no specific nor general location for barrens in West Tennessee. But, he listed *Spartina cynosuroides* (L.) Willd. from Brownsville, Haywood County. This is doubtless a synonym for the wet prairie dominant *S. pectinata* Link., now known only in Henry County in West Tennessee. Thus, there is little evidence that Gattinger himself collected widely on West Tennessee barrens.

METHODS

During the periods 1957-60 and 1978-81 parts of West Tennessee were road-reconnaissanced for barrens vegetation. Particular attention was given to those areas which were noted as barrens by the Shanks and Sharp teams in 1948-49. In 1977, collection records from the herbarium of the Botany Department at The University of Tennessee, Knoxville, were incorporated into these records. Floristic lists were compiled for each site and the ranges of native taxa were determined using Fernald 1950, Little 1971, 1977, and Pennell 1935. Nomenclature generally follows Gleason and Cronquist (1963). Sites and groups of sites were compared using the Jaccard coefficient of community (Mueller-Dombois and Ellenburg 1974): coefficient= $2c/a + b \times 100$ where "a" is the flora of site a, "b" is the flora of site b and "c" is the group of shared species.

Study Sites

Six samples of barrens have been used to characterize the community in West Tennessee.

New Hope Barren: McNairy County, Guys Quadrangle, Dermopolis Formation under Sumter silty clay loam on a gentle upper north-facing slope with alkaline A and B horizons, and a cambic B. Seen four times 1958-59, 1988 and located 1.6 km east of Route 45 on an unnamed road which extends east from Guys. It is about 0.1 ha in size. Appendix, Site 1.

Ramer Barren: McNairy County, Chewalla Quadrangle; site noted as, "Oak barrens on sandy uplands northwest of Ramer," 16 October 1949, by R. E. Shanks, E. H. Cooley and F. W. Woods. Uplands are underlain by the McNairy Sand (Russell and Larson 1967). Upper slope soils are the Smithdale sandy loam, a friable, strongly acid, well-drained soil. The location is believed to be about 2.4 km due north of Cypress Creek near Friendship Cemetery. Attempts to locate this barren in 1958 and 1988 were unsuccessful. Appendix, Site 2.

Whiteville Barren: Hardeman County, Whiteville Quadrangle, Claiborne and Wilcox Formations, chiefly overlain by loess in which five soil series have developed. Four of these are silt loams (two with pans); they have moderate to slow drainage and are medium to very strongly acid. The series are the Adaton, Lexington, Loring and Providence; a small area of the sandy, well-drained Smithdale also occurs. This site is about 0.8 ha, and lies between Route 64 and the railroad just west of Whiteville. It was seen several times 1957-60. Appendix, Site 3.

Hickory Valley Barren: Hardeman County, Hickory Valley Quadrangle where the site is underlain by the Claiborne-Wilcox Formations on which, in the superficial loess, three soil series have developed. The series are the Adaton, Lexington, and Deanburg. The topography is flat to gently sloping, and the soils are poorly to well drained with slow to moderate runoff, slow to moderate permeability, and are medium to very strongly acid. The Adaton and Lexington series are silt loams, the Deanburg is a clay loam. This site is between Route 18 and the railroad just north of Middleton; it is about 0.1 ha and was seen 17 September 1960. Appendix, Site 4.

Saulsbury Barren: Hardeman County, Saulsbury Quadrangle. The site is underlain by the Claiborne-Wilcox Formations in which the Smithdale and Lucy soil series have developed. These are both strongly acid sandy loams, or loamy sands; they are well drained with variable runoff and moderate permeability. The site is about 0.12 ha and was seen 1 July 1948 by S. Fairchild, E. Clebsch, and A. J. Sharp. It is 4.8 km east of Saulsbury between Route 57 and the railroad. The site could not be relocated in 1958. Appendix, Site 5.

Puryear Barren: Henry County, Puryear Quadrangle is between US 641 and the railroad extending north about 0.75 km from an intersection which is 3.9 km north of Puryear. It is 2.3 ha and is on gently sloping loess overlying old Pleistocene terraces (Parks and Wilson 1976). The soils are strongly to very strongly acid, infertile Granada, Calloway and Henry silt loams; all have both slow surface and internal drainage and hardpans (Wildermuth et al. 1958). The author has visited the site several times between 1978 and 1981. A post oak forest occurs at the north end of this barren and a swamp forest at the south end. The open vegetation varies from patches of *Schizachyrium scoparium* on dry sites to marshy vegetation bordering two ponds. This site was located for me by Dr. David Webb of the Tennessee Valley Authority, Muscle Shoals, Alabama. Appendix, Site 6.

RESULTS AND DISCUSSION

Three hundred and eighteen vascular plant taxa occur on the six West Tennessee barrens; 283 of them are native. Sixty-six plant families are represented. The largest families are Asteraceace 18 percent, Poaceae 17.7 percent, Fabaceae 7.8 percent and Cyperaceae 7.1 percent of the native plants. These percentages are similar to those seen on the Tennessee barrens flora as a whole (DeSelm unpublished) and are similar to Big Clifty Prairie (Bryant 1977). Nineteen percent of the taxa are woody.

Four taxa are in different states of endangerment in Tennessee. They are: *Aster ericoides* L. - State, threatened, *Didiplis diandra* (DC.) Wood - State, threatened, *Polytaenia nuttallii* DC - State threatened (Tennessee Department of Conservation 1986), and *Tridens chapmanii* (Small) Chase - State, special concern (Committee for Tennessee Rare Plants 1978).

The native flora as a whole was related to other native floristic lists using Jaccard's Coefficient. The highest relationship was with the barrens of the western Highland Rim (40.4 percent). Other nearby floras compared at greater than 20 percent: cedar glade (mainly Central Basin) herbs at 20.2 percent (Baskin et al. 1968, Baskin and Baskin 1975), Oak Ridge barrens (DeSelm et al. 1969) at 17.4 percent, and "plants of prairie habitats" of the Black Belt of Hale County, Alabama (Maginness 1967) at 22.7 percent. Prairies from the west and north were related at percentages lower than 20: Roth Prairie, Arkansas, 11.8; Konecny Prairie, Arkansas, 11.1 (Irving and Brenholts 1977); Friendly Prairie, Missouri, 5.8 percent (Hurd and Christisen 1975); prairies in Calloway County, Missouri, at 16.2 percent (Drew 1947); Illinois Prairie, 12.9 percent (Sampson 1921); Ohio Prairie at 10 percent (Jones 1944, 1945; Dobbins 1937); and Kentucky 8.8 percent (Baskin and Baskin 1981). This illustrates that Tennessee barrens, while related by their dominant plants to the Prairie Peninsula prairies of the west and north, have strong local Tennessee and southern floristic relationships.

Two hundred and fifty-five native taxa occur on the five loess or sand derived soil sites; 73 native taxa occur on the Dermopolis chalk at New Hope. Numbers of species on the five sites vary: Ramer 40, Whiteville 49, Hickory Valley 22, Saulsbury 34, Puryear 197. Totals vary with numbers of visits, size of the study site, and whether it had a forest border. Ranges of the native plants were compared using the separate floras--New Hope versus all others: regional intraneous 68.4 versus 58.7 percent, southern 19.7 versus 23.6 percent, northern 5.3 versus 6.7 percent, western 2.6 versus 5.9 percent, and local intraneous 3.9 versus 1.2 percent. The paired percentages for regional intraneous, southern, and northern are quite close. However, western and local intraneous percentages are different. There is a higher percentage of western taxa on loess and sand than on limestone as was seen on the western Highland Rim (DeSelm 1988). However, all kinds of prairie substrates, loess, sand and limestone, are present in Missouri and Arkansas (Nelson 1985, Dale 1986) which could have been the propagule sources. Transeau (1935) mapped the Kentucky Barrens as part of the Prairie Peninsula, the main body of which is of Hypsithermal age. But the age of prairie south of the glacial border (as in Kentucky and Tennessee) is open to question (Braun 1928, DeSelm 1981) as is the source and time of arrival of the western element of the flora. Local intraneous percentages are higher on limestone (the Dermopolis at New Hope) than on other sites but the number of taxa represented is so low that inferences about origin seem ill-advised.

VEGETATION

Physiognomically, these barrens are much like others in Tennessee, especially those on the western Rim. They are dominated by a closed stand of *Schizachyrium scoparium* (50-90 percent cover) with taller grass such as *Andropogon* spp., *Sorghastrum* and tall and low panicums, *Aristida* spp., forbs, and woody plants interspersed. Four of the six barrens occurred between the highway and a parallel railway suggesting that mowing and/or periodic fire has been responsible for their maintenance. In those I have seen, woody plants, seedlings, sprouts and indeed trees were prominent. The New Hope site on the clayey Dermopolis formation may have been held open by periodic drought (such a mechanism is postulated as a maintenance factor in the Prairie Peninsula, Transeau 1935). The other barrens occur on deep loess or sand with more abundant soil moisture where invasion by forest is a constant threat to the existence of grassland.

Fire is often ascribed to be the factor which maintains grassland by killing or burning back woody shoots (Vogl 1974, Komárek 1974). The early travellers and later authors who summarized their stories believed that the Amerinds were responsible for the fires which they saw evidence for on the Kentucky Barrens and which, they believed, had eliminated the forest (Michaux 1805, Bourne 1820, Shaler 1885).

The Hypsithermal was a time of migration of western taxa eastward and the establishment of the prairie peninsula eastward from Iowa into Ohio and perhaps farther east (Transeau 1935, Lovell 1965, DeSelm 1984, Cain et al. 1937). The following paragraphs examine the probability of this being the period of the establishment of Tennessee grassland.

Astronomical precession predicts solar insolation maxima in May-June at 12000 YBP, during July-August at 10000 YBP and during September-October at 5000 YBP (Davis 1984). This variety of dates suggests a possible explanation for the various dates ascribed to Hypsithermal dessication, and to suggestive elements of certain pollen diagrams. In the midwestern United States, Webb et al. (1983) found the prairie peninsula non-existent at 10000 YBP; however, by 9000 YBP it was fully formed, and by 8000 the prairie forbs had reached Illinois with isolated populations in Indiana, Ohio and Michigan. Delcourt and Delcourt (1985) date the Hypsithermal in the Southeast at 8500-4000 YBP; at Old Field, Missouri, it was dated 8700-5000 YBP (King and Allen 1977). These are similar dates to the warming and drying trend inferred from the fossils at Anderson Pond, Tennessee, at 8000-5000 YBP (Delcourt 1979), and less effective precipitation after 10000 YBP at Cahaba Pond, St. Clair County, Alabama (Delcourt et al. 1983). Jackson Pond, Larue County, Kentucky, on the border of the Kentucky Barrens (Wilkins 1985), had no grass pollen surge until ca 1000 YBP. At Anderson Pond, Delcourt (1979) found periods of increased grass pollen at 12000-9000 YBP, and at Mingo Pond 14000-12500 YBP, but it is not known whether these were the result of regional climatic events or local marsh succession. *Petalostemum* (a genus that includes forbs characteristics of prairies and barrens) appeared in the Mingo Pond a little after 14000 YBP and at Anderson Pond at 1000 YBP. *Hypoxis* pollen (one species, *H. hirsuta*, is common on barrens) appears at Anderson during the 7000-5000 YBP period.

The above variety of dates suggests not only the difficulty of our interpretation of the evidence of the Hypsithermal, but also the chronologic/geographic variety of its expression. Such variety is mapped by Thornthwaite (1941) for the years of 1900 to 1939, but pertinent here are the years 1930 through 1938 during which time droughts of different levels of intensity affected various parts of the eastern and central United States. Perhaps, during the Hypsithermal, droughts of decades to centuries in length moved from place to place in the prairie peninsula and its periphery (including Kentucky and Tennessee). In such places, one might expect the expansion of such xerophytic vegetation as dry-phase oaks (such as post oak and blackjack oak) and oak-pine and/or oak-eastern red cedar. Such vegetation today often has the dominants of the barrens in its understory. With lightning or Amerind-mediated crown fires or understory fires, the stage would have been set for the replacement of forests by grass-dominated vegetation. Certainly the movements of various Amerind populations would have changed fire frequency just as the variability of drought intensity would have changed desiccation-fire interaction; some sites might have moved in and out of their

drought/fire stress vegetation condition. During the woodlot grazing period of settlers, annual fires again would have allowed the remaining barrens and grassy forest understory to expand. Some of these may have persisted in fire-prone sites such as railroad rights-of-way (such as those seen in this study; see Barrens Sites).

SUMMARY AND CONCLUSIONS

The sites at Fulton and McKenzie reported in early literature and the barrens seen in Weakly County by Gardner were grass-covered at the time of settlement; Barren Springs and five Prairie Creek or Prairie Branch stream names occur in West Tennessee. These all suggest Amerind occupancy or the occurrence of fire (for which there is abundant early evidence in nearby Kentucky), or climatic change, i.e., the Hypsithermal when the prairie vegetation moved into the eastern Middle West (Transeau 1935, Wright 1971).

Six barrens sites in West Tennessee have a total native vascular plant flora of 283 taxa--the largest floras of individual sites are on the largest areas, those seen most often, and those with forest borders. The flora is related most closely to the barrens of the western Highland Rim. Comparing floristic element percentages of the Dermopolis limestone New Hope site with all others demonstrates that intraneous, southern, northern and local intraneous floristic elements appear to be about equal. The higher percentage of western taxa on loess and sand than on limestone places in question whether one xeric period (the Holocene Hypsithermal) would differentially enrich the barrens floras. This question was also raised about the flora of the western Rim, but there is no satisfactory answer to it (DeSelm 1988). Summer droughty soils result in dominance on most of all areas by *Schizachyrium scoparium*, in which tall and low forbs, other grasses and woody plants are interspersed. Factors preventing tree invasion into the grassland are not known, but drought and periodic fire may play a role.

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APPENDIX

Vascular Plants of West Tennessee Barrens[1,2]

Cupressaceae
- *Juniperus virginiana* L.--I,1,6

Acanthaceae
- *Ruellia carolinensis* (Walt.) Steud.--S,2,6
- *R. humilis* Nutt.--S,1

Aceraceae
- *Acer negundo* L.--I,6
- *A. rubrum* L.--I,6

Amarylidaceae
- *Manfreda virginica* (L.) Salis.--S,3

Anacardiaceae
- *Rhus aromatica* Aiton--I,1
- *R. copallina* L.--I,3,6
- *R. glabra* Britt.--I,1,3,4,6
- *R. radicans* L.--I,6

Apocynaceae
- *Apocynum cannabinum* L.--I,6

Araliaceae
- *Apocynum spinosa* L.--S,6

Asclepiadaceae
- *Asclepias tuberosa* L.--I,6
- *A. viridiflora* Raf.--W,5

Berberidaceae
- *Podophyllum peltatum* L.--I,6

Betulaceae
- *Corylus americana* Walt.--N,6

Bignoniaceae
- *Campsis radicans* (L.) Seem--S,6

Boraginaceae
- *Lithospermum arvense* L.--X,6
- *L. canescens* (Michx.) Lehm.--I,1
- *Myosotis verna* Nutt.--I,6

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[1]Floristic element abbreviations are: I intraneous (regional), S southern, W western, N northern, L intraneous (local), X introduced.

[2]Sites are: 1 New Hope, 2 Ramer, 3 Whiteville, 4 Hickory Valley, 5 Saulsbury, 6 Puryear.

Callitrichaceae

Callitriche deflexa A. Braun--I,6

C. heterophylla Pursh--I,6

Campanulaceae

Triodanis biflora (R. and P.) Greene--S,6

T. perfoliata (L.) Nieuwl.--I,6

Caprifoliaceae

Lonicera japonica Thunb.--X,6

Sambucus canadensis L.--I,6

Symphoricarpos orbiculatus Moench--I,1

Viburnum rufidulum Raf.--S,1

Caryophyllaceae

Cerastium glomeratum Thuillier--X,6

Dianthus armeria L.--X,6

Paronychia fastigiata (Raf.) Fernald--I,6

Stellaria media (L.) Cyrillo--X,6

Cistaceae

Lechea tenuifolia Michx.--I,6

Commelinaceae

Commelina communis L.--X,6

Compositae

Achillea millifolium L.--X,6

Ambrosia artimisiifolia L.--I,1,3,6

A. trifida L.--I,6

Aster concolor L.--I,2,5

A. dumosus L.--S,1,5

A. ericoides L.--N,1

A. hemisphericus A. J. Alex.--S,2,3

A. patens Ait.--I,1,2,3,4,5

A. pilosus Willd.--I,1,4,5,6

A. solidagineus Michx.--I,1

A. undulatus L.--I,1,2

Boltonia diffusa Ell.--S,3,6

Chrysanthemem leucanthemum L.--X,6

Chrysopsis mariana (L.) Ell.--S,2

Coreopsis major Walt.--S,5

Echinacea purpurea (L.) Moench--I,1

Eclipta alba (L.) Hasskarl--I,6

Erigeron strigosus Muhl.--I,1,6

Eupatorium altissimum L.--S,6

E. aromaticum L.--I,2

E. hypssopifolium L.--S,6

E. perfoliatum L.--I,6
E. serotinum Michx.--I,3
Euthamia graminifolia (L.) Nutt.--N,6
Gnaphalium obtusifolium L.--I,3,4
G. purpureum L.--I,6
Helianthus angustifolius L.--S,1,3,6
H. hirsutus Raf.--L,1,4,6
H. mollis Lam.--I,3,4,6
H. silphioides Nutt.--W,2
Iva ciliata Willd.--X,6
Krigia virginica (L.) Willd.--I,6
Kuhnia eupatorioides L.--S,1,3,4
Lactuca canadensis L.--I,6
Liatris squarrosa (L.) Michx.--S,5
Pluchea camphorata (L.) DC.--I,6
Pyrrhopappus carolinianus (Walt.) DC.--S,1,5,6
Ratibida pinnata (Vent.) Barnh.--N,1
Rudbeckia fulgida Ait.--L,1
R. hirta L.--I,4
R. hirta L. var. *pulcherrima* Farw.--I,6
Silphium integrifolium Michx.--W,1,3
S. trifoliatum L. var. *latifolium* A. Gray--L,1,3
Solidago bicolor L.--I,2
S. canadensis L. var. *scabra* T. and G.--I,3,4
S. juncea Ait.--N,1
S. missouriensis Nutt.--W,6
S. nemoralis Ait.--I,1,2,3,4,5,6
S. speciosa Nutt. var. *rigidiscula* T. and G.--W,2
S. ulmifolia Muhl.--I,1,2,6
Sonchus asper (L.) Hill--X,6
Verbesina helianthoides Michx.--W,6
Vernonia baldwinii Torr.--W,6
V. gigantea (Walter) Trelease ex Branner and Coville--I,1,6
V. missurica Raf.--W,6

Convolvulaceae

Ipomoea hederacea (L.) Jacq.--X,6

Cornaceae

Cornus florida L.--I,6

Cruciferae

Cardamine pensylvanica Muhl.--I,6
Draba brachycarpa Nutt. ex T. and G.--S,6
Lepidium virginicum L.--X,6

Cyperaceae

Carex annectens Bichn.--N,6
C. blanda Dew.--I,1
C. bushii Mackenz.--I,6
C. complanata Torr. and Hook.--S,6
C. festucacea Schk.--I,6
C. floccosperma Dew.--I,6
C. hirsutella Mackenz.--I,1,6
C. muhlenbergii Schkuhr. var. *enervis* Boott.--I,6
C. scoparia Schk.--N,6
C. squarrosa L.--N,6
Cyperus ovularis (Michx.) Torr.--I,6
C. pseudovegetus Steud.--I,6
C. strigosus L.--I,6
Eleocharis obtusa (Willd.) Schultes--I,6
E. tenuis (Willd.) Schultes--N,6
Fimbristylis autumnalis (L.) R. and S.--N,6
Rhynchospora corniculata (Lam.) Gray-- S,6
Scirpus atrovirens Willd.--N,6
Scleria triglomerata Michx.--I,2

Ebenaceae

Diospyros virginiana L.--I,1,4,6

Ericaceae

Rhododendron nudiflorum (L.) Torr.--N,2

Euphorbiaceae

Acalypha virginica L.--S,3,6
Croton glandulosus L.--S,6
C. monanthogynus Michx.--S,4
Crotonopsis elliptica Willd.--S,6
Euphorbia corollata L.--I,3,4,5,6
E. maculata L.--I,6

Fagaceae

Quercus alba L.--I,6
Q. falcata Michx.--S,6
Q. muhlenbergii Engelm.--I,1
Q. palustris Muenchh.--I,6
Q. phellos L.--S,6
Q. stellata Wang.--I,1,6
Q. velutina Lam.--I,6

Gentianaceae

Frasera caroliniensis Walt.--I,1
Sabattia angularis (L.) Pursh--I,1

S. brachiata Ell.--S,1

Geraniaceae

Geranium carolinianum L.--I,6

Gramineae

Agrostis alba L.--X,7
A. hyemalis (Walt.) B.S.P.--I,6
Alopecuris carolinianus Walt.--I,6
Andropoogon gyrans Ashe--S,1,6
A. gerardii Vitman--I,1,3,4,5,6
A. glomeratus (Walt.) B.S.P.--S,1
A. ternarius Michx.--S,3,5,6
A. virginicus L.--I,5,6
Aristida curtissii (Gray) Nash--I,3
A. dichotoma Michx.--I,3,5,
A. lanosa Muhl.--S,2
A. oligantha Michx.--I,1,3,5
A. purpurescens Poir.--I,2
A. virgata Trin.--S,2
Bromus japonicus Thunb.--X,6
B. racemosus L.-- X,6
B. tectorum L.--X,6
Cinna arundinacea L.--I,6
Danthonia spicata (L.) Beauv.--I,1,6
Echinochloa crus-galli (L.) Beav.--X,6
Elymus virginicus L. var. *glabriflorus* (Vasey) Bush--I,6
Eragrostis frankii C. A. Mey.--I,1
E. spectabilis (Pursh) Steud.--I,1,2,3,5,6
Erianthus alopecuroides (L.) Ell.--S,2
Festuca arundinacea Schreb.--X,6
Glyceria striata (Lam.) Hitchc.--I,6
Gymnopogon ambiguus (Michx.) B.S.P,--S,2
Hordeum pusillum Nutt.--S,6
Leersia virginica Willd.--I,6
Panicum anceps Michx.--S,1,2,3,6
P. boscii Poir.--I,1
P. capillare L.--I,3
P. commutatum Schult.--I,2
P. depauperatum Muhl.--I,6
P. dichotomum L.--I,1,2
P. lanuginosum Ell.--I,1,3,6
P. lindheimeri Nash.--I,5,6
P. malacophyllum Nash.--I,5,6

P. meridionale Ashe--N,1,6
P. microcarpon Muhl.--I,6
P. ravenellii Scribn. and Merr.--S,2
P. scoparium Lam.--I,6
P. sphaerocarpon Ell.--I,6
P. stipitatum Nash--I,6
P. virgatum L.--I,1,2
Paspalum floridanum Michx.--S,4
P. floridanum Michx. var. *glabratum* Engelm.--S,3,5
P. laeve Michx.--S,1,3,5,6
P. setaceum Michx. var. *ciliatifolium* (Michx.) Vasey--S,6
Poa annua L.--X,6
P. compressa L.--X,6
P. pratensis L.--X,6
Schizachyrium scoparium (Michx.) Nash--I,1,3,4,6
Setaria geniculata (Lam.) Beauv.--S,3,6
Sorghastrum nutans (L.) Nash--I,1,2,3,4,5,6
Sorghum halepense (L.) Pers.--X,1,3
Sphenopholis nitida (Biehler) Scribn.--I,6
Sporobolus asper (Michx.) Kunth--I1
Tridens chapmani (Small) Chase--S,2
T. flavus (L.) Hitchc.--I,1,3,5,6
Vulpia octoflora (Watt.) Rydb.--S,6

Hypericaceae

Hypericum denticulatum Walt. var. *recognitum* Fern. and Schub.--L,5
H. gentianoides (L.) B.S.P.--I,1,6
H. gymnanthum Engel. and Gray--S,6
H. mutilum L.--I,6
H. punctatum Lam.--I,6

Hamamelidaceae

Liquidambar styraciflua L.--I,1,6

Iridaceae

Sisyrinchium graminoides Bickn.--I,6

Juglandaceae

Carya tomentosa Nutt.--I,6

Juncaceae

Juncus acuminatus Michx.--I,6
J. biflorus Ell.--I,6
J. brachycarpus Engelm.--I,6
J. diffusissimus Buckl.--S,6
J. dudleyi Wieg.--N,6
J. effusus L. var. *solutus* Fern. and Wieg.--I,6

J. interior Wieg.--W,6
J. cf. nodatus L.--S,6
J. secundus Beauv.--N,6
J. tenuis Willd.--I,6
J. torreyi Coville--W,6

Labiatae

Prunella vulgaris L. var. *lanceolata* (Bart.) Fern.--N,1,6
Pycnanthemum loomisii Nutt.--S,2
P. tenuifolium Schrad.--S,3,6
Salvia lyrata L.--I,1
Scutellaria australis Epl.--I,6

Lauraceae

Sassafras albidum (Nutt.) Nees--I,3,4,6

Leguminosae

Amphicarpa bracteata (L.) Fern.--I,2
Apios americana Medic.--I,3
Cassia fasciculata Michx.--I,1,4,5,6
C. nictitans L.--I,2,3,6
Clitoria mariana L.--S,5
Crotalaria sagittalis L.--I,1,2,6
Desmodium ciliare (Muhl.) DC.--I,1,3,5,6
D. marilandicum (L.) DC.--N,6
D. paniculatum (L.) DC.--I,1,3,6
D. sessilifolium (Torr.) T. and G.--I,4,5,6
D. viridiflorum (L.) DC.--S,6
Galactia volubilis (L.) Britt.--S,1,2,6
Lespedeza cuneata (Dumont) G. Don.--X,5
L. intermedia (S. Wats.) Britt.--I,1
L. procumbens Michx.--I,6
L. repens (L.) Bart.--I,1
L. stipulacea Maxim.--X,1,6
L. striata (Thunb.) H. and A.--X,3,6
L. virginica (L.) Britt.--I,3,4,5,6
Medicago lupulina L.--X,1
M. sativa L.--X,1
Melilotus alba Desr.--X,1
Rhynchosia tomentosa (L.) H. and A.--S,2
Strophostyles leiosperma (T. and G.) Piper--W,6
S. umbellata (Muhl.) Britt.--S,5,6
Stylosanthes biflora (L.) B.S.P.--S,6
Tephrosia virginiana (L.) Pers.--I,2,5
Trifolium pretense L.--X,1

Lemnaceae
Wolffia basiliensis Weddell--I,6
Lilaceae
Allium vinale L.--X,1,6
Smilax glauca Walt.--S,6
S. rotundifolia L.--I,6
Linaceae
Linum medium (Planchon) Britt.--I,5,6
Lobeliaceae
Lobelia puberula Michx.--S,2
L. spicata Lam.--S,1
Lythraceae
Lythrum alatum Pursh--I,6
Didiplis diandra (Nutt.) Wood--S,6
Rotala ramosior (L.) Koehne--I,6
Malvaceae
Hibiscus moscheutos L.--S,6
Melastomataceae
Rhexia mariana L.--S,6
Moraceae
Morus rubra L.--I,6
Nyssaceae
Nyssa sylvatica Marsh.--I,6
Oleaceae
Fraxinus americana L.--I,6
Onagraceae
Ludwigia alternifolia L--I,3,6
Oenothera biennis L.--N,3,6
O. fruticosa L. ssp. *glauca* (Michx.) Straley--I,6
Oxalidaceae
Oxalis stricta L.--I,6
O. violacea L.--I,6
Passifloraceae
Passiflora incarnata L.--S,6
Plantaginaceae
Plantago aristata Michx.--W,6
P. virginica L.--I,6
Polygalaceae
Polygala curtisii Gray--S,6
P. verticillata L. var. *ambigua* (Nutt.) Wood--I,5
Polygonaceae
Polygonum caespitosum Blume var. *longisetum* (DeBruyn) Stewart--X,6

P. hydropiperoides Michx.--I,6
P. cf. pensylvanicum L.--I,6
Rumex acetocella L.--X,6

Ranunculaceae
Anemone virginica L.--I,1
Myosurus minimus L.--I,6
Ranunculus pusillus Poir.--S,6

Rosaceae
Gillenia stipulacea (Muhl.) Baill.--I,5
Potentilla simplex Michx.--I,1,3,6
Prunus angustifolia Marsh.--S,5
P. serotina Ehrh.--I,3,6
Rosa carolina L.--I,1,6

Rubiaceae
Cephalanthus occidentalis L.--I,6
Diodia teres Walt.--S,6
D. virginiana L.--S,3,6
Galium pilosum Ait.--I,5,6
Houstonia purpurea L. var. *calycosa* Gray--I,1
H. pusilla Schoepf--S,6

Salicaceae
Salix humilis Marsh.--I,6

Scrophulariaceae
Gerardia fasciculata Ell.--S,2
G. gattingeri Small-W,2
G. pectinata (Nutt.) Benth.--S,2
G. tenuifolia Vahl.--I,1,3
G. tenuifolia Vahl. var. *macrophylla* Benth.--W,2
Gratiola neglecta Torr.--I,6
Lindernia dubia (L.) Pennell--I,6
Penstemon laevigatus Ait.--S,6
Veronica arvensis L.--X,6
V. officinalis L.--N,6
V. perigrina L.--I,6
V. serpyllifolia L.--X,6

Solanaceae
Physalis pruinosa L.--I,6
Solanum caroliniense L.--I,6

Ulmaceae
Ulmus alata Michx.--S,1
U. americana L.--I,6

Umbelliferae

Chaerophyllum tainturieri Hook.--S,6
Cicuta maculata L.--I,6
Daucus carota L.--X,5,6
Eryngium yuccifolium Michx.--I,2,3
Polytaenia nuttallii DC.--W,1
Sanicula canadensis L.--I,1

Valerianaceae

Valerianella radiata (L.) Dufr.--I,6

Verbenaceae

Verbena hastata L.--I,6

Violaceae

Viola rafinesquii Greene--X,6
V. sagittata Ait.--I,6

Vitaceae

Parthenocissus quinquefolia (L.) Planch.--I,6
Vitis aestivalis Michx.--I,6

Wetland Impacts: Two Five-Year Monitoring Programs to Determine the Effects of Highway Fills on Wetland Vegetation Characteristics

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ABSTRACT

Wetland vegetation characteristics of two Palustrine forested wetlands, the Middle Fork Forked Deer in Crockett County and Beaver Creek in Carroll County, Tennessee, were sampled from May 1987 through August 1987. The methodology for conducting the monitoring programs closely followed the procedures of the U.S. Army Corps of Engineers Wetland Delineation Manual. The baselines were established parallel to each major watercourse while transects, observation points, and drift pin sites were established at regular intervals with some modifications to include each community type and to ensure that at least one would be in proximity to the highway fill.

First year field studies involved the characterization of three vegetative layers: trees (DBH> 7.62 cm), saplings/shrubs (height> 8.13 cm; DBH< 7.62 cm), and herbaceous/ground cover, at each observation point along the transects. Two years and five years after completion of each highway project vegetation characteristics will again be analyzed to determine if any alterations have occurred.

Transect sampling from the first year monitoring program at Beaver Creek in Carroll County reveals a total of 27 species identified from a sample of 671 trees. The average basal area was 316.41 cm^2. *Nyssa aquatica* was the most dominant species (138 trees; $\bar{x}$ = 321.05 cm^2) followed by *Liquidambar styraciflua* (132 trees; $\bar{x}$ = 321.05 cm^2) and *Acer rubrum* (90 trees; $\bar{x}$ = 406.86 cm^2). The sapling/shrub layer was dominated by *Acer rubrum*, *Alnus serrulata*, and *Nyssa aquatica*. They represented approximately 50% of the height dominance in this layer. The herbaceous/ground cover consisted of 38 species of which *Leersia oryzoides*, *Polygonum arifolium*, and *Bidens tripartita* represented 31% of the total percent cover.

The Middle Fork Forked Deer wetland survey yielded 24 species from a sample of 907 trees. *Nyssa aquatica* was the dominant species (494 trees; $\bar{x}$ = 261.18 cm^2). *Taxodium distichum* (200 trees; $\bar{x}$ = 381.12 cm^2) *Fraxinus pennsylvanica* (63 trees; $\bar{x}$ = 310.47 cm^2) were the second and third most common species. Although 24 species were identified, *Nyssa aquatica* and *Taxodium distichum* represented a relative species density of 77% with a frequency occurrence of 82% and 74%, respectively. The sapling/shrub layer was heavily dominated by *Cephalanthus occidentalis* and *Planera*

aquatica where collectively they represent approximately 90% of the height dominance. Twenty-eight species were identified from the herbaceous/ground cover layer. *Boehmeria cylindrica* and *Polgonum* sp. were found to be 30% of the total percent cover.

Initial results reveal that both systems are dominated by species known to have a high frequency of occurrence in wetlands, that the species sampled follow a discernible pattern of occurrence allowing for delineation of more hydric vs. less hydric habitats within each wetland, and that each wetland appears to be a viable, sustaining system under no apparent course of alteration.

Population Structure of *Cotinus obovatus* Raf.: an Ecologically Narrow, Endemic Tree of Cedar Woodlands of the Southern Cumberland Plateau

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ABSTRACT

The metapopulation of *Cotinus obovatus* Raf. consists of an archipelago of wholly or partially isolated local populations, primarily on shelving limestone outcrops on south-facing slopes and steep bluffs. A permanent surveyed and gridded study site was established in the summer of 1988 at ca 380 m asl of a southern exposure at the edge of low bluffs of Bangor Limestone at Burritt Museum on Monte Sano Mountain, Madison County, Ala. *Cotinus obovatus* is an abundant understory tree in this habitat. We located, mapped, and measured heights and dbh of all 210 *Cotinus obovatus* on the plot and identified and measured heights of all plants over *Cotinus obovatus* and over random points.

Disturbance history is typical of rocky upland cedar woodlands in the area. Past disturbances of the site include natural windthrows, fire, cedar logging, and use of a wagon road. The spatial dispersion of *Cotinus obovatus* appears to be influenced by disturbance, and the interplay among topography, forest structure, and composition. Seedlings and saplings were more evident in the highest elevation portion of the study site. Taller *Cotinus* were associated with terrain changes along limestone outcrops. Fewer and proportionately more dead *Cotinus* were among taller trees in a lower-elevation ravine, where *Ostrya virginiana* was frequently found as an understory tree.

Principal canopy trees over all size classes of *Cotinus obovatus* were *Fraxinus americana* and *Quercus velutina*. *Juniperus virginiana*, also a major component of the study site, was prominent over *Cotinus* <2 m in height. Understory and herbaceous vegetation were typical of cedar glades found over other xeric limestone sites in the Southeast.

The individual growth form of *Cotinus obovatus* is frequently multiple-stemmed, with a spreading form in senescence. Basal burls were found as ground-level structures on 92 of the trees. A number of age-classes of ramets arise from epicormic buds on the burl and stem as a result of damage to the trunk or burl. Analyses of several large burls >100 years old suggest that burls may sustain individuals through droughts, tree fall, and even fires severe enough to topkill the tree.

Vascular Flora of Wolf Cove, Franklin County, Tennessee

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ABSTRACT

Wolf Cove is a gorge on the Cumberland Plateau in Franklin County, Tennessee. The vascular flora of the gorge and surrounding plateau surface was sampled for two full growing seasons in 1985 and 1986. A total of 812 collections was made comprising 576 species and lesser taxa in 327 genera and 107 families. Two hundred fourteen county records were established. Nine taxa are listed as Threatened or Special Concern in Tennessee. Three of these taxa are federally listed in Category 2. Status reports on each of these taxa were prepared.

Distributions of the taxa were determined and the floristic elements ascertained. The flora has a strong influence of southern intraneous taxa and northern extraneous taxa, leading to insights on the Cumberland Plateau's role as a major pathway in Pleistocene plant migrations.

The Wolf Cove study area has been under consideration for acquisition by the State of Tennessee as a State Natural Area. The current landowners have designated it as part of the Carter Mountain Wildlife Management Area, a private holding utilized by hunters and trail bike riders. It is expected that this study will be useful in determining the future status of the study area.

CONTRIBUTED PAPERS

SESSION II: ZOOLOGY

Saturday 4 March 1989

Moderated by:

Tom Forsythe
Tennessee Valley Authority
Land Between The Lakes

Taxonomic Status of the Genus *Blarina* at Land Between The Lakes

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ABSTRACT

To assess the taxonomic status of the genus *Blarina* (short-tailed shrews) at Land Between The Lakes (LBL), the relationship of 12 adult animals from LBL was compared to known groups of the southern short-tailed shrew (*B. carolinensis*) and northern short-tailed shrew (*B. brevicauda*) using multivariate statistical analyses. Seventeen skull measurements were used in the assessment. Results established the presence of *B. brevicauda* at LBL and suggested the possible occurrence of *B. carolinensis* as well.

INTRODUCTION

Genoways and Choate (1972) elevated *Blarina brevicauda carolinensis* to the level of species (*B. carolinensis*, southern short-tailed shrew). Ellis et al. (1978), Tate et al.

(1980), French (1981), Braun and Kennedy (1983), George et al. (1986), and others have also recognized *B. carolinensis* as a species distinct from *B. brevicauda* (northern short-tailed shrew). This systematic revision has resulted in two species of *Blarina* (*B. carolinensis* and *B. brevicauda*) occurring in Tennessee and Kentucky. Both forms are similar, differing primarily in chromosome number (George et al. 1986) and body size (Braun and Kennedy 1983).

In a karyotypic assessment of the genus *Blarina*, George et al. (1982) reported *B. carolinensis* with a fundamental number (FN) of 44 or 45 (2N = 46, 39, 38, or 37) and *B. brevicauda* with a FN of 48 (2N = 50, 49, or 48). They reported karyotypes of Tennessee specimens from Shelby County (*B. carolinensis*) and Marshall County (*B. brevicauda*). Their results verified the presence of two species of *Blarina* in the state. Additionally, Braun and Kennedy (1983) discussed size variation of the genus *Blarina* in Tennessee and adjacent areas and also reported the presence of two distinct taxa in Tennessee. A large form, *B. brevicauda*, was found in the Appalachian Mountains westward to middle Tennessee. Within this group, two size forms were revealed which differed only in the averages of the characters studied; the large form occurred in the Appalachian Mountains and the smaller form occurred in other parts of eastern Tennessee and in middle Tennessee. A form smaller than *B. brevicauda* (*B. carolinensis*) occupied western Tennessee and adjacent western and southern states. In Tennessee, the zone of contact between the two taxa appeared to be an area slightly east of the Tennessee River (Braun and Kennedy 1983). George et al. (1986) called the large form of *B. brevicauda* occurring in Tennessee *B. b. churchi* and the small form *B. b. kirtlandi*. They reported *B. b. churchi* occurring in the Appalachian Mountains and *B. b. kirtlandi* in parts of eastern and middle Tennessee. Their distribution map shows *B. b. kirtlandi* with a distribution extending westward to about the Tennessee River where it would come into contact with *B. carolinensis*. Because *B. carolinensis* and *B. b. kirtlandi* are similar morphologically (Braun and Kennedy 1983), identification of these taxa at the species level is difficult in areas of contact.

Since the zone of contact for species of *Blarina* in Tennessee has only been generally described by Braun and Kennedy (1983), the taxonomic status of *Blarina* occurring in the proposed contact zone, which includes Land Between The Lakes (LBL), is unclear. The purpose of this study was to assess the taxonomic status of *Blarina* at LBL and, therefore, clarify the occurrence of soricid species in this area of Tennessee and Kentucky.

MATERIALS AND METHODS

We recorded 17 skull measurements from 12 adult *Blarina* from LBL (Trigg County, Kentucky), 41 known *B. kirtlandi* from Shelby County, Tennessee, and 41 known *B. b. brevicauda* from Campbell County, Tennessee. Measurements were taken

with digital calipers to the nearest 0.01 mm. For detailed descriptions of all characters, see Braun (1982) and Braun and Kennedy (1983). Because previous studies (e.g. Guilday 1957, Rippy 1967, Kirkland 1978, Moncrief et al. 1982, Braun and Kennedy 1983, Baumgardner and McPherson 1985) have indicated little sexual dimorphism in *Blarina*, we pooled males and females in all analyses. Adult ages were determined following Choate (1972). All known *Blarina* were examined at the Memphis State University Museum of Zoology and represented individuals from geographic areas where only the target species was known to occur. *Blarina* from LBL are housed in the Museum of Zoology at Austin Peay State University (MZAPSU) and Department of Biology, Northwest Missouri State University (NMSU). Localities at LBL from which specimens were examined, and sample sizes were as follows (localities for specimens housed in the MZAPSU are by latitude, given first, and longitude): MZAPSU--36°41'00"N, 87°55'15"W (n = 1); 36°40'45"N, 87°54'55"W (n = 1); 36°41'00"N, 87°55'15"W (n = 6); 36°40'50"N, 87°55'40"W (n = 1); 36°41'00"N, 87°55'15"W (n = 1). NMSU--0.75 mile from Long Creek Pond Waterfowl Refuge (n = 2).

Multivariate biometric routines were used to examine cranial characters. Cluster analysis (using character means) was conducted with the unweighted pair group method using arithmetic averages (UPGMA) on an average taxonomic distance matrix; we utilized the Numerical Taxonomy System programs (NT-SYS) of Rohlf et al. (1982). This analysis grouped most similar operational taxonomic units. Step-wise discriminant-function analysis was performed using the subprogram DISCRIMINANT (Nie et al. 1975) to maximally separate designated groups (*B. carolinensis* and *B. brevicauda*) and to assign *Blarina* from LBL to one of these groups. A matrix of correlations among characters was computed, and a phenogram was generated (UPGMA) using NT-SYS (Rohlf et al. 1982). This analysis was conducted to elucidate the relationships among characters.

RESULTS

A distance phenogram (figure 1) was prepared using samples of *B. carolinensis, B. brevicauda*, and *Blarina* from LBL. Results show LBL *Blarina* grouping most closely with *B. brevicauda*. *B. carolinensis* clustered independently of the other groups.

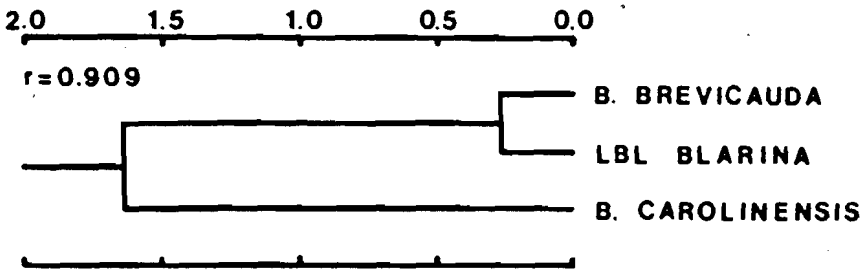

Figure 1. Phenogram showing the systematic relationship of *Blarina* from Land Between The Lakes with *B. carolinensis* and *B. brevicauda*.

Using *B. carolinensis* and *B. brevicauda* as knowns and LBL *Blarina* as unknowns in a discriminant-function analysis (Test A), 17 characters in combination were found to be useful discriminators (table 1). For the first function, occipito-premaxillary length, interorbital width, cranial depth, foramen magnum width, cranial width, mandible height, and zygomatic width were found to be the most heavily weighted based upon standardized discriminant-function coefficients (table 1). A histogram of these results is shown in figure 2. All known *B. carolinensis* and *B. brevicauda* were correctly classified. Of the LBL shrews, 41.7% (n = 5) were grouped with *B. carolinensis* and 58.3% (n = 7) were classified as *B. brevicauda*.

Table 1. Standardized canonical discriminant-function coefficients of *Blarina* skull characteristics.

Character	Test A[1]	Test B[2]		Test C[3]
	Function 1	Function 1	Function 2	Function 1
Occipito-premaxillary length	0.72979	0.64614	-1.17538	0.13209
Greatest length	-0.05120	-0.00951	0.42657	0.17297
Nasal length	-0.12728	-0.01438	0.84069	0.32393
Post-palatal length	0.00569	-0.09519	-0.08215	-0.12007
Cranial width	0.22209	0.08444	-0.08301	0.04546
Occipital width	-0.06079	-0.09750	-0.14985	-0.15346
Maxillary arch spread	0.17266	0.33688	-0.41928	0.14446
Interorbital width	-0.36453	-0.35972	0.05226	-0.29239
Least interorbital width	0.17132	0.13953	0.11217	0.16450
Foramen magnum width	-0.26255	-0.18625	-0.12707	-0.21335
Cranial depth	0.27143	0.29269	-0.20189	0.19847
Zygomatic width	0.20651	0.21872	0.17345	0.25770
Nasal width	0.12868	0.11021	-0.16382	0.03298
Intermaxillary width	-0.06570	-0.25638	0.72898	0.05624
Palatal length	0.09057	0.07555	0.45992	0.24633
Mandible length	0.11548	0.15927	-0.03698	0.13385
Mandible height	0.21840	0.28702	0.25355	0.36149

[1]Analysis with known *Blarina carolinensis* and known *B. brevicauda* and *Blarina* from Land Between The Lakes as unknowns.

[2]Analysis using *B. carolinensis, B. brevicauda*, and *Blarina* from Land Between The Lakes as known groups.

[3]Analysis using *B. carolinensis* as one known group and *B. brevicauda* pooled with *Blarina* from Land Between The Lakes as a second known group.

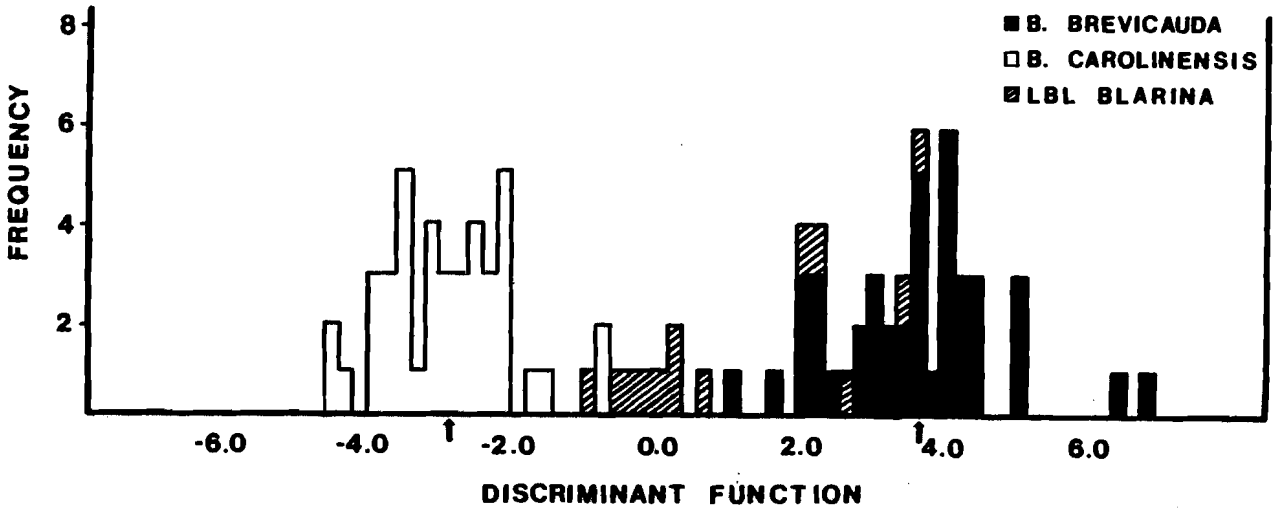

Figure 2. Discriminant-function analysis comparing *Blarina* from Land Between The Lakes with *B. carolinensis* and *B. brevicauda*. Samples of *B. carolinensis* and *B. brevicauda* were entered as known and specimens from Land Between The Lakes as unknowns. Arrows represent placement of group centroids.

When treating *B. carolinensis, B. brevicauda,* and LBL *Blarina* as known groups in discriminant analysis (Test B), 17 characters in combination were found to be useful discriminators (table 1). For the first function, occipito-premaxillary length, least interorbital width, maxillary arch spread, cranial depth, intermaxillary width, and zygomatic width were found to be the most heavily weighted based upon standardized discriminant-function coefficients. Occipito-premaxillary length, nasal length, intermaxillary width, palatal width, maxillary arch spread, and greatest length were the most heavily weighted for function 2 (table 1). A plot of these results is given as figure 3. All (n = 41) *B. brevicauda* grouped together; 97.6% (n = 40) of the *B. brevicanda* were correctly classified while one animal (2.4%) grouped with LBL *Blarina*. Of the LBL *Blarina*, 83.3% (n = 10) clustered as LBL *Blarina*, 8.3% (n = 1) as *B. carolinensis*, and 8.3% (n = 1) as *B. brevicauda*.

Results using *B. carolinensis* as a known group and *B. brevicauda* and LBL *Blarina* combined as a known group (Test C) are shown in figure 4. Seventeen characters in combination were found to be useful discriminators (table 1). For the first function, mandible height, nasal length, interorbital width, zygomatic width, palatal width, and foramen magnum width were the most heavily weighted based upon standardized discriminant-function coefficients. A plot of these results is given in figure 4. All (n = 41) *B. carolinensis* group together; 98.1% (n = 53) of the *B. brevicauda*-

LBL *Blarina* sample clustered together while one animal (1.9%) grouped as *B. carolinensis*.

A phenogram was constructed from a matrix of correlations among characters and is presented as figure 5. Results indicated two major clusters. Zygomatic width, palatal width, and intermaxillary width made up one cluster. All other characters grouped together to form a second cluster. Overall, most characters were highly correlated.

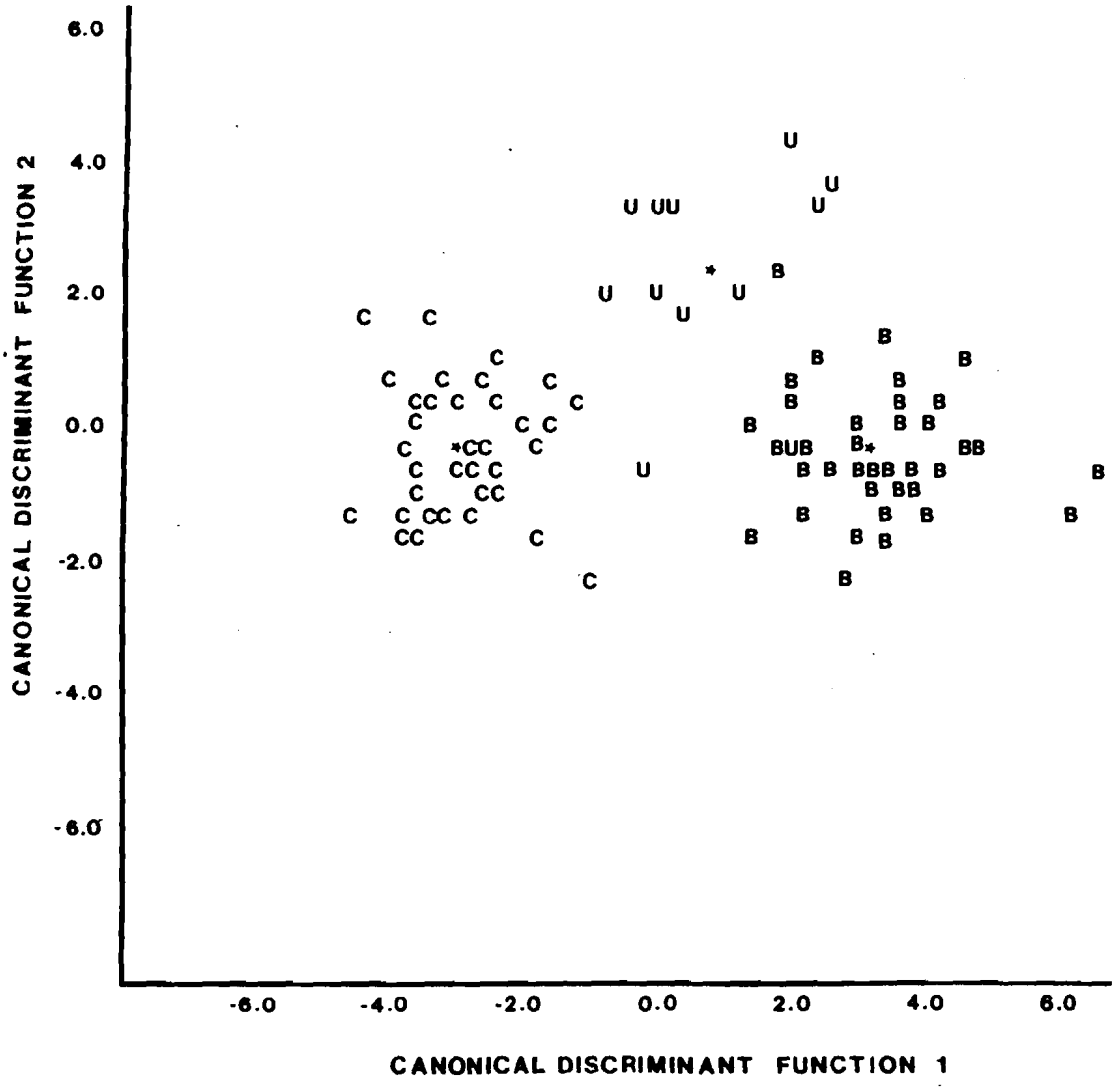

Figure 3. Discriminant-function analysis comparing *Blarina* from Land Between The Lakes with *B. carolinensis* and *B. brevicauda*. Each sample was entered as a known group. Stars represent placement of group centroids.

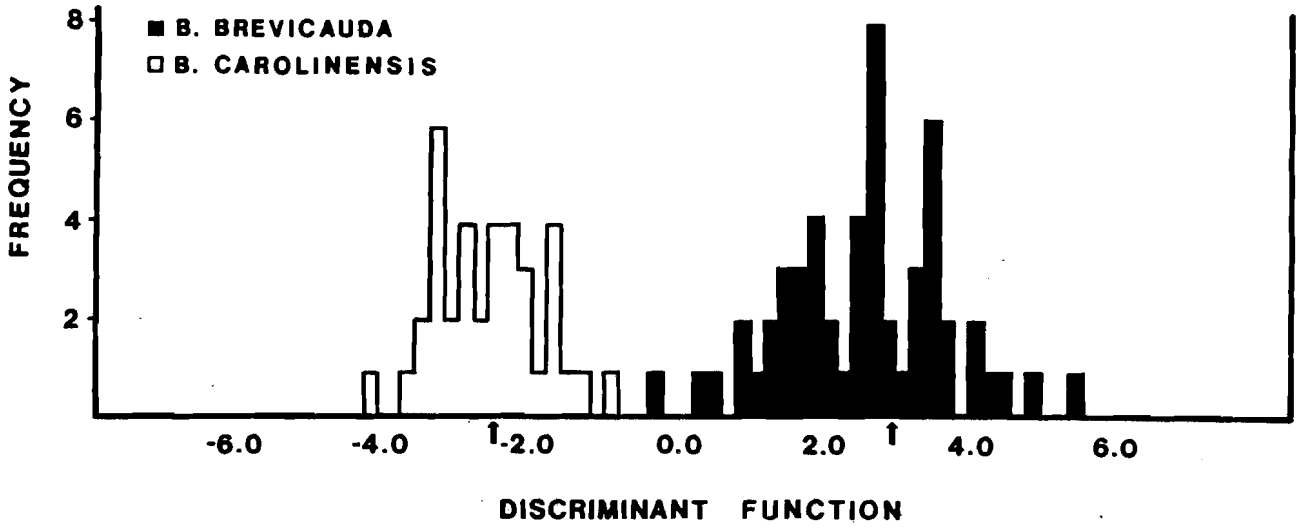

Figure 4. Discriminant-function analysis comparing *Blarina* from Land Between The Lakes (pooled with *B. brevicauda*) with *B. carolinensis*. Arrows represent placement of group centroids.

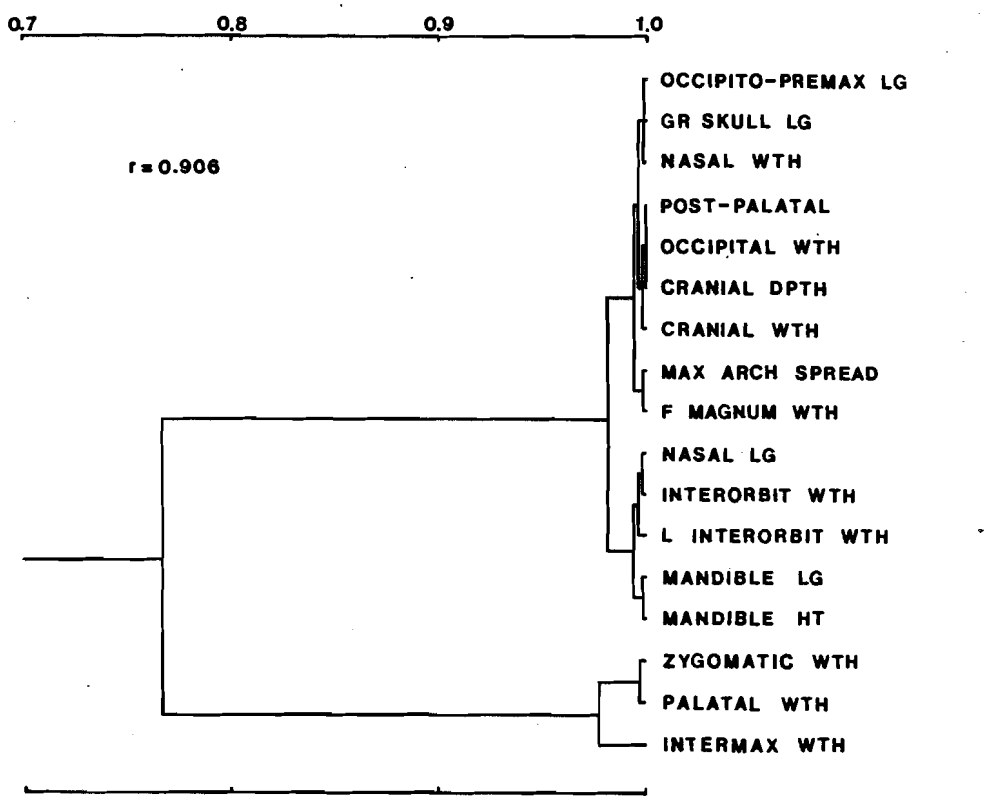

Figure 5. Phenogram that summarizes the variation among characters for *Blarina*.

DISCUSSION

Results of the present study support the conclusions of Braun and Kennedy (1983) that the zone of contact between *B. carolinensis* and *B. brevicauda* occurs slightly east of the Tennessee River in the Western Valley and western Highland Rim physiographic regions of western and middle Tennessee. Where *B. carolinensis* and *B. brevicauda* occur in sympatry, there have been reports (e.g. Genoways and Choate 1972, Tate et al. 1980) that suggested possible hybridization in isolated cases. French (1981) indicated that the possibility of hybridization or intergradation between these forms of *Blarina* should not be ruled out in central Tennessee. Two of our discriminant-function plots (figures 2 & 3) showed some animals from LBL to group intermediate between *B. carolinensis* and *B. brevicauda*, and these results could be interpreted to represent hybrids between the two taxa. However, probability values for assignment into either of the reference groups were high for all individuals, thus providing only weak support for possible hybridization. Based on genetic information, hybrids of *B. carolinensis* and *B. brevicauda* have not been reported. Genoways and Choate (1972) reported that *B. carolinensis* and *B. brevicauda* behaved as good biological species where their ranges were contiguous in southern Nebraska. Tate et al. (1980) found no evidence of hybridization, intergradation, or convergence in characters of these taxa in Virginia. Given the chromosome numbers reported by George et al. (1982), hybrids of the taxa are unlikely in natural populations. The median position of individuals in figure 2 and figure 3 is probably best explained by the geographic location of the specimens. Braun and Kennedy (1983) reported *B. brevicauda* shows an increase in size from the southwestern to the northeastern part of its range in Tennessee; *B. carolinensis* increased slightly in size from west to east within Tennessee and Kentucky. Specimens from LBL probably represent the small form of *B. brevicauda* and the larger *B. carolinensis* which are similar morphologically and somewhat intermediate in size between the known samples (specimens from Shelby and Campbell counties).

While results of the present study indicate the presence of *B. brevicauda*, the occurrence of *B. carolinensis* is less clear. One analysis grouped five *Blarina* from LBL as southern short-tailed shrews, and two other analyses placed only one animal from LBL as *B. carolinensis*. While these results are confusing, they suggest that *B. carolinensis* is present at LBL. Identifying either one or five *Blarina* from LBL as *B. carolinensis* places this species in approximately the same geographic area as *B. brevicauda*. Both species have been reported to occur at the same site in areas of sympatry (Genoways and Choate 1972, Tate et al. 1980). However, the ecology and behavior of these species in zones of contact are unknown.

Our results support the assessment of Braun and Kennedy (1983) which indicated that cranial measurements of *Blarina* were highly correlated. Few attempts have been made to examine the relationships among characters in this genus. Results of the

present study indicated that several characteristics clustered together in a manner which suggested a degree of redundancy. Many of the characteristics probably represent adaptive complexes. However, our study supports past works which indicate that multivariate statistical procedures can be useful in identifying soricid specimens.

Other studies (see Braun and Kennedy 1983, George et al. 1986) have identified size as the primary difference between southern and northern short-tailed shrews, *B. brevicauda* being larger for most characters. Our findings are similar. However, species could not be separated by single characters; several characters in combination were required to distinguish between the two forms. Moncrief (1981) reported considerable mensural overlap in characters of specimens from geographic areas in which *B. hylophaga* and *B. brevicauda* were sympatric. Because sample sizes are small in the present study and the status of *B. carolinensis* is unclear, additional studies are needed at LBL to more clearly understand the systematics of *Blarina* in this area. We recommend that future studies of these taxa in areas of sympatry include karyotypic, DNA, and electrophoretic techniques as well as morphometric procedures. Morphometric studies which include both length and width characters should be the most productive.

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A Summer Trapping Survey of Small Mammals in Land Between The Lakes

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ABSTRACT

During June 1987, 4277 trap-nights were involved in trapping 299 small mammals of nine species, for an overall trapping success rate of seven percent. By far the most abundant species taken was *Peromyscus leucopus* followed by (in descending order of total numbers trapped) *Microtus ochrogaster*, *Microtus pinetorum*, *Mus musculus*, *Blarina* sp., *Zapus hudsonius*, *Oryzomys palustris*, *Cryptotis parva*, and *Sigmodon hispidus*. Snap-traps were more successful than either Sherman live-traps or gallon can pit-traps; traps baited with peanut butter were slightly more effective than those baited with either liver or commercial catfish bait. Six major habitats were sampled: loblolly pine, upland old-field broom sedge succession, upland old-field native grassland, marsh, lowland floodplain old-field succession, and woodland-edge. *Peromyscus leucopus* was the only species taken in all six habitats. Upland old-field native grassland habitat revealed the most small mammal species (seven); loblolly pine habitat produced only one species. All species trapped were within their expected ranges. Three species expected to occur in LBL but not yet reported and not taken in this study were *Peromyscus gossypinus*, *Neotoma floridana*, and *Synaptomys cooperi*.

INTRODUCTION

This study is based on data collected in a project whose primary purpose was to investigate the taxonomy of the short-tail shrews (*Blarina* spp.) that occur in Land Between The Lakes (LBL), a 69,000 ha peninsula of federal, multi-use property located between Kentucky and Barkley lakes in parts of Stewart County, Tennessee and Trigg and Lyon counties, Kentucky. In trapping for *Blarina*, it became apparent that a variety of small mammal species occurred in LBL in a diversity of habitats. Since few small mammal survey results have been reported from LBL, we present herein data on the

small mammal species we encountered, their abundance, and preferred habitat, based upon trapping.

Two earlier LBL small mammal studies have been conducted. Lange (personal communication) trapped 17 sites in a variety of habitats from 18 June 1986 to 25 July 1986 using only Sherman live-traps and gallon can pit-traps. Lange's pit-trapping effort was unsuccessful (zero catches in 110 total pit-trap nights). Lange's overall trapping success rate was 11% (based on a total of 883 trap-nights); he took 97 mammals, (of which 64 were salvaged) representing three species (*Peromyscus leucopus*, 54; *Microtus ochrogaster*, 9; and *Sigmodon hispidus*, 1).

Robinson (1967) trapped three LBL habitats (floodplain, meadow, and woodland) during the summers from 1965-67 for a total of 10,281 trap-nights. Unfortunately, the type(s) of traps used, bait(s) used, and sites trapped were not mentioned. He reported ten species, including three not taken by us (*Reithrodontomys humulis*, *Rattus norvegicus*, and *Peromyscus maniculatus*). Surprisingly, they did not record *Microtus pinetorum* or *Blarina*.

METHODS AND MATERIALS

Small mammals were trapped using a variety of traps (Museum Special and regular Victor snap-traps, Sherman live-traps, and gallon-can pit-traps); the most successful trapping method (snap-traps) was eventually used the most, to maximize our trapping success. A variety of baits were used (peanut butter, liver, and commercial catfish bait), in the hope of attracting as many small mammal species as possible. To provide maximum sampling of small mammal diversity, we sampled as many major habitats as we could. Traps were placed approximately 3-10 feet apart in a "rough" line to facilitate easy relocation. Traps were baited in the evening and checked in the morning.

The six major habitats sampled and the common plants in each were: (1) loblolly pine (*Pinus taeda*); (2) upland old-field broom sedge succession--blackberry (*Rubus* sp.), sericea lespedeza (*Lespedeza cuneata*), broom sedge (*Andropogon virginicus*), sassafras (*Sassafras albidum*), wild rose (*Rosa* sp.), coral berry (*Symphoricarpos orbiculatus*), greenbrier (*Smilax* sp.), fescue (*Festuca* sp.), persimmon (*Diospyros virginiana*), and sumac (*Rhus* sp.); (3) upland old-field native grassland--Indian grass (*Sorghastrum nutans*), bluestems (*Andropogon* spp.), gama grass (*Tripsacum dactyloides*), and switch grass (*Panicum virgatum*); (4) marsh--mainly spike rush (*Eleocharis* sp.); (5) lowland floodplain old-field succession--dewberry (*Rubus* sp.), cheet grass (*Bromus* sp.), sericea lespedeza, blackberry, and fescue; and (6) woodland-edge--climax woodland species including oak and hickory (*Quercus* and *Carya*), sweetgum (*Liquidambar stryraciflua*) giant cane (*Arundinaria gigantea*), greenbrier, nettles (*Urtica* and *Laportea*), wild grape (*Vitis* sp.), pawpaw (*Asiminia triloba*), and blackberry.

RESULTS AND DISCUSSION

During June 1987, 4277 trap-nights were involved in trapping 299 small mammals of nine species, for an overall trapping success rate of seven percent. Heavy rain sometimes set off many traps reducing trapping success considerably. By far the most abundant species taken was *Peromyscus leucopus* with a trapping success rate of 3.8 percent (162 individuals trapped). It was followed by *Microtus ochrogaster* with a trapping success rate of 1.9 percent (83 individuals taken). Other species trapped, in descending order of their total numbers taken are listed in table 1. Of the three major types of traps used, snap-traps (Museum Special and regular Victor) were more successful for small mammals than Sherman live-traps and gallon-can pit-traps. Of the three baits used, peanut butter was slightly more attractive to small mammals than fresh liver or commercial catfish bait; *Blarina* was attracted to all three types of bait.

Table 1. Species, numbers of individuals, and trapping success rates for small mammals trapped in Land Between The Lakes during June 1987.

Species	No.	Success rate*
Peromyscus leucopus	162	3.79
Microtus ochrogaster	83	1.94
Microtus pinetorum	21	0.50
Mus musculus	15	0.35
Blarina sp.	6	0.14
Zapus hudsonius	5	0.12
Oryzomys palustris	4	0.09
Cryptotis parva	2	0.05
Sigmodon hispidus	1	0.02
Totals	299	7.00

*Trapping success rate expressed as percent of total trap nights.

Table 2 shows the major habitats trapped in LBL and their associated small mammal species. *Peromyscus leucopus* was taken in all six habitats; *Microtus ochrogaster* was taken in all three old-field habitats plus marsh and woodland-edge. *Cryptotis parva* was taken only in the two upland old-field habitats, and *Zapus hudsonius* was taken only in lowland floodplain old-field succession. *Sigmodon hispidus* was taken only in upland

old-field native grassland, and *Oryzomys palustris* was taken in both Marsh (lowland) and, surprisingly, in upland old-field native grassland habitat (two individuals) containing a pond with a marshy margin. Upland old-field native grassland habitat revealed the most small mammal species (7), followed by upland old-field broom sedge succession with six species; loblolly pine produced only one species.

Table 2. The six major habitats trapped in Land Between The Lakes during June 1987 and their associated small mammal species.

	Habitats*					
Species	A	B	C	D	E	F
Peromyscus leucopus	X	X	X	X	X	X
Microtus ochrogaster		X	X	X	X	X
Microtus pinetorum		X	X		X	X
Mus musculus		X	X	X		
Blarina sp.		X			X	X
Zapus hudsonius					X	
Oryzomys palustris			X	X		
Cryptotis parva		X	X			
Sigmodon hispidus			X			

* A - Loblolly pine
B - Upland old-field broom sedge succession
C - Upland old-field native grassland
D - Marsh
E - Lowland floodplain old-field succession
F - Woodland edge

Blarina was captured in only three of the six major habitats (upland old-field broom sedge succession, lowland floodplain old-field succession and woodland-edge). However, *Blarina* probably occurs in all major habitats in Land Between The Lakes. Despite Barbour's and Davis' statement (1974, p. 39) that "This is perhaps the most abundant mammal in Kentucky,...", we found it to be rare in comparison to several other small mammals; perhaps the *Blarina* population was exceptionally low during our study. *Blarina* was not reported in previous LBL small-mammal studies.

Though one *Zapus hudsonius* had a white-tipped tail, skull examination revealed four rather than three upper cheek teeth on each side providing positive identification and distinguishing it from *Napaeozapus insignis*.

Three small mammal species expected to occur in LBL, but not yet reported, are *Peromyscus gossypinus*, *Neotoma floridana*, and *Synaptomys cooperi*. We also recorded sight observations and/or signs of *Scalopus aquaticus* and *Tamias striatus*. Recently an *Ochrotomys nuttalli* and several *Sorex longirostris* were taken by Floyd Scott in pit-traps along a drift fence surrounding a woodland pond in LBL (*S. longirostris* is nearly impossible to snap-trap). All species of small mammals we recorded were within their expected range (Barbour and Davis 1974, Kennedy and Harvey 1979).

ACKNOWLEDGMENTS

Appreciation is extended to Dr. Floyd Scott for providing data on LBL captured *Sorex longirostris* and *Ochrotomys nutalli*. Appreciation is also extended to the LBL personnel for housing and general support. Financial and overall logistical support of this research project was provided by The Center of Excellence for Field Biology of LBL, Austin Peay State University, Clarksville, Tennessee. The total commitment of Dr. Benjamin Stone and The Center to this project is greatly appreciated. Voucher specimens (study skins and skulls) from this study were deposited in the Museum of Zoology at Austin Peay State University.

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Acorn Yield and Body Weight of Immature White-tailed Deer on LBL: Cumulative Effects of Winter Climate

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ABSTRACT

The effects of cumulative winter climate (December, January, February) on acorn yield, spring population density, and body weight of fawn and yearling white-tailed deer (*Odocoileus virginianus*) were examined at Land Between the Lakes, Tennessee. Acorn yield from 1976 through 1986 was directly correlated with the cumulative number of days with greater than 0.25 cm of precipitation the previous 3 winters ($r^2 = 0.33$; $P < 0.03$), and 4 winters ($r^2 = 0.47$; $P < 0.01$). There was a significant inverse correlation between spring population density and cumulative number of days with precipitation the previous 3 winters ($r^2 = 0.54$; $P < 0.01$). Body weight of male and female fawns and yearlings was directly correlated with acorn yield the previous year, and inversely correlated with estimated spring population density from 1977 through 1987. Acorn yields, population density, and associated body weights were not correlated with the total amount of precipitation, presumably because of the relatively steep topography, low available moisture capacity, high rock content, and subsequent rapid runoff of precipitation on the study area. Cumulative effects of climate on deer populations rarely have been investigated.

A Survey of the Herpetofauna of Ponds in Land Between The Lakes: A Preliminary Report

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ABSTRACT

Land Between The Lakes (LBL), a 68,000-hectare peninsula of land located between the impounded Cumberland and Tennessee rivers, contains many small ponds of diverse character. Twenty-seven of these ponds were studied to determine the composition of their herptile communities. Data were also obtained on pond size, bottom type, fish populations, aquatic plants, nature of surroundings, plus the following physical characteristics: temperature, dissolved oxygen, pH and conductivity. Preliminary results include data from summer and fall 1988 collections. Qualitative sampling involved seining, dip netting, hand collecting and use of minnow traps. Sightings were also recorded. Thus far, the most frequently encountered species were *Rana catesbeiana*, *Rana sphenocephala*, *Rana clamitans*, *Gastrophryne carolinensis*, *Acris crepitans*, *Bufo woodhousei*, *Ambystoma maculatum*, *Ambystoma tigrinum*, *Notophthalmus viridescens*, *Nerodia sipedon*, and *Nerodia erythrogaster*. Final results of this study should add to an understanding of the following concerning pond-based herptile communities in LBL: species composition, relative abundance, variability associated with such factors as seasonal changes, surrounding cover, bottom type, cohabitant fish populations, and type and extent of aquatic vegetation.

Terrestrial Activity of Amphibians Around Woodland and Old-Field Ponds in Land Between The Lakes

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ABSTRACT

Terrestrial activity of amphibians at a woodland and a nearby old-field pond in TVA's Land Between The Lakes (KY/TN) was studied from 1 July 1987 through 30 June 1988. Drift fences and pitfall traps were used to monitor movements. Fifteen species (most the same) were encountered at each pond; 17 species were represented overall. The same six species accounted for over 90 percent (91% and 94%, respectively) of the total captures (2787 and 2352, respectively) at each pond. However, the relative importance of these six differed at each pond. Activity was detected during every month of the year and followed the same pattern at both ponds: lowest during midwinter and highest during late winter and midsummer. Directional movements were balanced throughout most of the year. However, significantly more outward than inward movements were detected at both ponds during summer and early fall and at the old-field pond during late spring. Egression of recently metamorphosed *Ambystoma maculatum*, *Gastrophryne carolinensis* and *Hyla chrysoscelis* accounted for the summer and fall imbalance while outward bound metamorphs of *Rana sphenocephala* were the cause of the late spring imbalance.

Status of Diploid/Tetraploid Gray Treefrogs (*Hyla chrysoscelis-Hyla versicolor*) in the Mid-South

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ABSTRACT

Two previously published maps indicated that the boundary of the range of both species of gray treefrog came into contact at Land Between The Lakes, with *Hyla chrysoscelis* occurring primarily to the south and west, and *Hyla versicolor* to the north and east. Specimens were examined from LBL and the surrounding counties to determine distribution patterns of the two species. Preserved specimens were distinguished by cytological examination; *Hyla chrysoscelis* is diploid and has one or two nucleoli per cell, while *Hyla versicolor* is tetraploid and has three or four nucleoli in at least 40% of cells.

Specimens representing most counties in western Tennessee and western Kentucky in the collections at MSU and APSU were examined and found to be *Hyla chrysoscelis*. One *Hyla chrysoscelis* also was found in Clay County, North Carolina, and one in Fannin County, Georgia. Since *Hyla versicolor* was not found in areas where it was believed to occur, specimens from eastern Tennessee (UTK) were examined, but also were identified as *Hyla chrysoscelis*. The only geographic area of Tennessee not examined is the region to the north and east of a line running from Pickett to Knox counties. The UTK collection also contained two samples with both species present, representing McDonough and Monroe counties, Illinois, both of which were indicated to be areas of sympatry, according to the most recently published map.

The findings reported herein extend the known range of *Hyla chrysoscelis* throughout all of Kentucky, Georgia, and South Carolina, and most of Tennessee, North Carolina, and Virginia.

INTRODUCTION

Recognition of two call types (fast-trill and slow-trill) of gray treefrogs within the nominal species *H. versicolor* (Blair 1958), eventually led to the discovery of reproductive isolation between the two types, as has been documented by Johnson (1959, 1963) and Littlejohn et al. (1960). Subsequently, Johnson (1966) designated the slow-trill species *H. versicolor*, and named the fast-trill species *H. chrysoscelis*. Ralin (1968, 1976a, 1976b) further confirmed genetic incompatibility between the two species. Bogart and Wasserman (1972) identified *H. chrysoscelis* as diploid, and *H. versicolor* as

tetraploid, and proposed possible evolutionary mechanisms for speciation within this group. This species pair is unique in being the only known diploid-tetraploid pair of amphibians in North America.

Numerous additional studies have been conducted to determine intraspecific and interspecific differences in morphological, cytological, biochemical, and ecological characteristics (Bachmann and Bogart 1975; Jaslow and Vogt 1977; Maxson, Pepper, and Maxson 1977; Ralin 1977; Cash and Bogart 1978; Bogart and Jaslow 1979; Ralin and Rogers 1979; Ralin and Selander 1979; Green 1980). Considerable geographic variation occurs within both species, making most morphological differences of use only in limited areas. However, the number of nucleoli appears to be the only characteristic that readily distinguishes preserved specimens of the two species. Martoff, Palmer, Bailey, and Harrison (1980) stated that the chromosomal difference between the two species is readily revealed by microscopic examination of the inner eyelid. *H. chrysoscelis* has one or two nucleoli per cell, while *H. versicolor* has three to four nucleoli in at least 40% of its cells, and has two in almost all other cells.

Early studies on distribution of the two species indicated that *H. versicolor* occupied most of the northern portion of the range of the two species, as well as a narrow strip from southeastern Kansas through eastern Oklahoma and eastern Texas into southwestern Louisiana (Ralin 1968). *H. chrysoscelis* occupies the western part of the range from Texas into Minnesota, and also most of the southern states. The distribution in central Missouri and parts of Illinois, Indiana, Kentucky, Tennessee, Georgia, and North Carolina, however, remained in question. Brown and Brown (1972) reported on distribution of both species in Illinois, but found no areas of sympatry. Romano, Ralin, Guttman, and Skillings (1987) revised the distribution map by connecting the ranges of *H. versicolor* across central Missouri, thus dividing the range of *H. chrysoscelis*, and by modifying parts of the previously proposed range in Illinois, Indiana, and Kentucky. However, they were unaware of the study by Little (1983), who studied distribution in the central Appalachians, and believed that *H. chrysoscelis* inhabited much of the Mid-South.

The original purpose of this study was to determine the specific status of gray treefrogs at Land Between The Lakes, since the distribution maps indicated that the ranges of the two species came into contact in western Tennessee. However, after preliminary investigations indicated that *H. chrysoscelis* occupied many areas believed to have been occupied by *H. versicolor*, the study was expanded to include the entire Mid-South.

METHODS

Palpebrae of preserved frogs were removed, placed on a microscope slide, and stained with a drop of either methylene blue or toluidine blue, and covered with a

cover slip. Methylene blue was used in the early part of the study, but was replaced with toluidine blue. The toluidine blue stain was found to stain nucleoli best when mixed with deionized water. Under high power magnification (400X), it was possible to examine and count nucleoli. Museum specimens had been fixed in formaldehyde and preserved in either ethyl alcohol or isopropyl alcohol for periods of a few days to more than forty years. In a few instances, the specific status of some specimens was impossible to determine, presumably because the specimen had not been fixed properly soon after death. Cellular degeneration was such that the nucleus and nucleoli did not stain.

Specimens were examined in the collections at Memphis State University, Austin Peay State University, and the University of Tennessee at Knoxville. Due to time constraints, every individual was not examined in each collection, but representatives were examined from each county in order to establish a pattern of distribution for each species. In addition, frogs were listened to, or recorded at Meeman Shelby Forest State Park, near Memphis, and at several locations at Land Between The Lakes in Stewart County, Tennessee, and Lyon County, Kentucky.

RESULTS AND DISCUSSION

All specimens examined from Tennessee were found to be *H. chrysoscelis*, as were those from adjacent counties in Kentucky, Georgia, and North Carolina. In addition, Mr. John McGregor, a biologist with the Kentucky Department of Fish and Wildlife Resources, reported that *H. chrysoscelis* occurs in all counties of Kentucky; Breckenridge, Hardin, and Meade counties also contain *H. versicolor* (personal communication). *H. chrysoscelis* is also found throughout the Cumberland Plateau in West Virginia, but the two species are sympatric in the panhandle of West Virginia, and *H. versicolor* is found in the Blue Ridge Mountains of Virginia (Little 1983). Thus, if *H. versicolor* occurs at all in East Tennessee and North Carolina, it probably will be found only at higher elevations in the Smoky Mountains (figure 1).

In the summer of 1988, a single *H. versicolor* was recorded at the MSU research station in northwestern Shelby County, Tennessee (M. Ritke, personal communication). Identification was confirmed by Jaslow (personal communication), who believes that *H. versicolor* is more widespread than generally believed, but is restricted in activity to more humid conditions. The pattern of distribution of these two species raises questions concerning interspecific ecological relationships that cause them to remain allopatric over a broad range, yet allow sympatry in many other areas. However, considerable additional research is required to establish the actual range of both species.

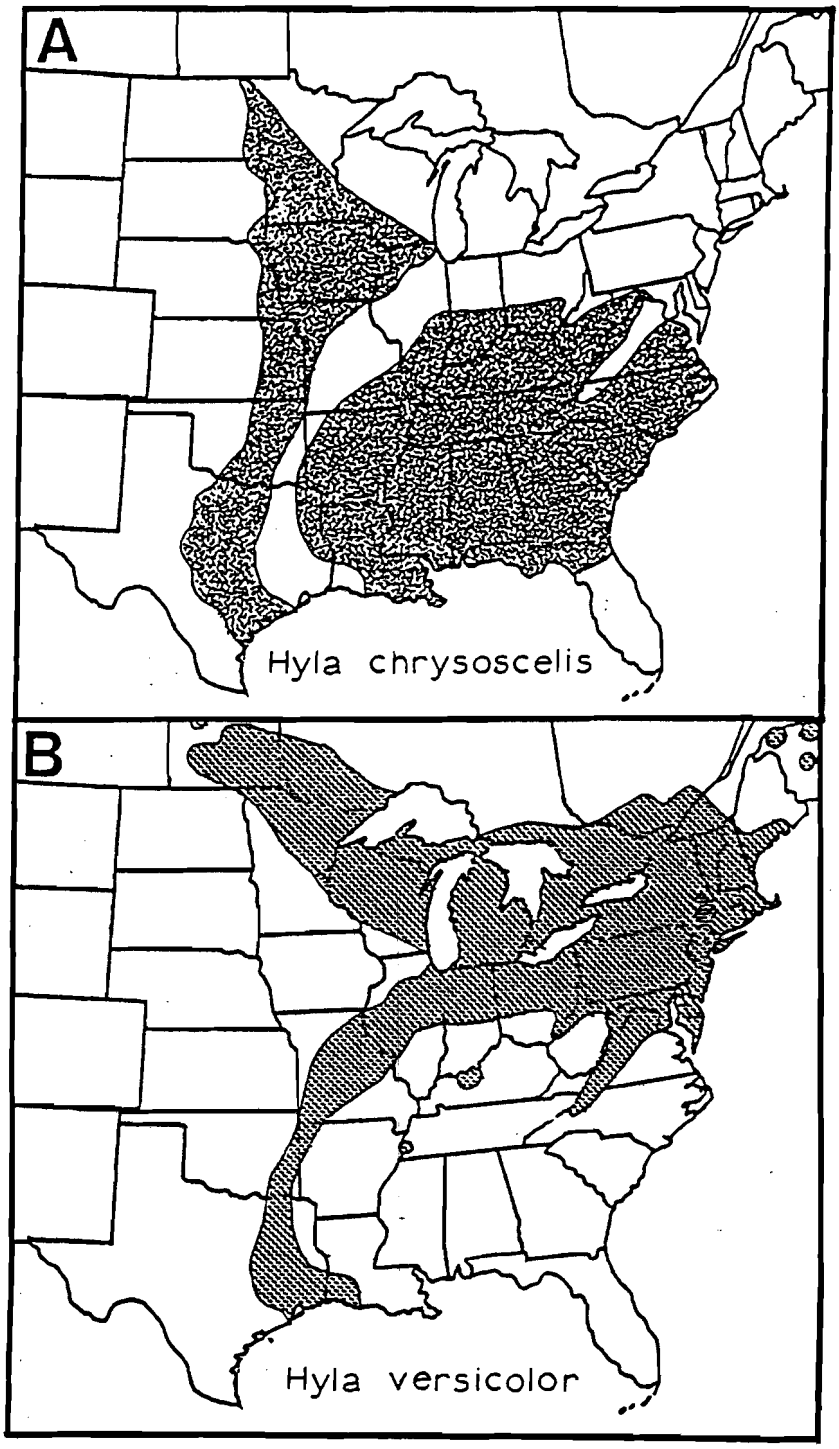

Figure 1. Tentative distributions of *Hyla chrysoscelis* (A) and *Hyla versicolor* (B). The northern edge of the range of *H. versicolor* is based on Conant (1975), while the rest of it and all of the range of *H. chrysoscelis* represent modifications of Romano's et al. (1987) maps. Ranges as proposed here are based on my data and information provided by Little (1983) and McGregor (personal communication).

SPECIMENS EXAMINED

Hyla chrysoscelis
TENNESSEE: Bledsoe Co.- UTK 6537; Cheatham Co.- APSU 3568; Chester Co.- UTK 3811, 3812, MSU 107; Crockett Co.- UTK 5595; Davidson Co.- APSU 3763; Dickson Co.- APSU 2564, 3165 (6 specimens), 2718, 3158; Franklin Co.- UTK 4039, 4043; Grundy Co.-UTK 4063, 4069; Hamilton Co.- UTK 4678, 4681; Hardeman Co.- MSU 291, 292, 293; Hardin Co.- MSU A2040; Knox Co.- UTK 3930-31; Lewis Co.- APSU 3572; Marion Co.-UTK 3966, 3967; McMinn Co.- UTK 6542; McNairy Co.- Personal observation (breeding calls); Monroe Co.- UTK 2327; Montgomery Co.- APSU 1787, 1792 (4 specimens), 1803, 1806, 1807, 1812 (2 specimens), 1815, 1819, 1821, 2709, 2747, 2896, 3025, 3425 (2 specimens), 2427, 3445, 3519; Obion Co.- APSU 3215, 3217; Perry Co.- MSU A-684; Pickett Co.- UTK 6193, 6194; Polk Co.- UTK 3150; Robertson Co.- APSU 2882; Shelby Co.- MSU, personal recordings; Stewart Co.- LBL 143, 154, 468, 479, 505, 520, 660, 680, 3550, 3697-99, 3764; Van Buren Co.- UTK 4608, 6200; White Co.- MSU. **GEORGIA:** Fannin Co.- APSU 2787. **KENTUCKY:** Caldwell Co.- APSU 3647; Christian Co.- APSU 3625; Logan Co.- APSU 3648; Lyon Co.- LBL 880719-02, -03, -04 (5 specimens); Todd Co.- APSU 2855, 3626; Trigg Co.- LBL 272, 306, 3778. **NORTH CAROLINA:** Clay Co.- MSU (no number). **ILLINOIS:** McDonough Co.- UTK 5447, 5448; Monroe Co.- UTK 5445. **INDIANA:** Harrison Co.- UTK 1110-1113.

Hyla versicolor
ILLINOIS: McDonough Co.- UTK 5449; Monroe Co.- UTK 5446.

ACKNOWLEDGMENTS

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Success of Amphibian Larvae Along a Gradient of Pond Types

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ABSTRACT

Breeding ponds available to amphibians represent a gradient of pond types, from ephemeral to permanent. Amphibian larvae may be exposed to extreme abiotic factors (i.e. pond drying) or biotic factors (i.e. predator presence) that may determine the number of individuals and diversity of species. To identify factors that may determine the success of amphibians colonizing and maintaining viable populations, 15 natural ponds at TVA's Land Between The Lakes, Stewart County, Tennessee were sampled between 11 March and 18 June 1988. Eleven of these ponds (6 permanent and 5 ephemeral) were sampled with a 0.5-m metal drop box to determine species composition of fish and larval amphibian populations and characterized by the mean number of individuals per meter. Sampling indicated that ponds containing fish had a reduced number of *Ambystoma maculatum* larvae as well as other amphibian larvae. Effects of fish presence or absence on *Ambystoma maculatum* larval growth, survival, and metamorphosis were subsequently tested in an artificial pond experiment. The presence of fish significantly reduced larval snout vent length and body mass, traits which can directly influence reproductive potential and mating success.

Macroinvertebrate Community Structure in Four Stream Microhabitats: A Preliminary Report

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ABSTRACT

Biomass, numbers of individuals, and species composition of the macroinvertebrate communities inhabiting four stream microhabitats (riffles, natural leaf packs, root mats, and gravel/sand bars) are being investigated to determine differences in community structure. Four sites were selected on each of two streams (Bear Creek and Panther Creek) located at the southern end of Land Between The Lakes, Tennessee. During the droughty summer of 1988, both streams were impounded in their midreaches by beaver dams. The impoundments served to sustain downstream flow; however, upstream reaches consisted of isolated pools. Two sites were located above each impoundment and two below. Each site consisted of a pool and associated upstream riffle. Samples were taken from each microhabitat at each site at six-week intervals beginning in July and ending in December 1988 (five dates). Riffles were sampled using a Surber net (0.01 sq m). Within the pool habitats, gravel/sand bars were sampled using a Needham net, leaf packs were collected by hand, and root mats were cut from the stream banks. Preliminary analyses of the July and August samples from Bear Creek indicate there are no significant differences ($p<0.05$) in faunal biomass between root mats (gm/sq mm), leaf packs (gm/sq cm), or gravel/sand bars (gm/sample) above and below the impoundments. There were substantial differences in the number of individuals within each microhabitat when sites above and below the impoundment were compared. The upstream sites harbored the greatest percentage of total number of individuals: 70% in leaf packs and gravel/sand bars, and 58% in root mats. Qualitative differences in species composition also are apparent. Analysis of additional sampling dates and other aspects of community structure are ongoing and may serve to further elucidate the effects of impoundment and allow additional comparisons of microhabitats. **This research is supported by the Center for Field Biology of Land Between The Lakes at Austin Peay State University, Clarksville, Tennessee. Field assistance was provided by personnel of the Tennessee Valley Authority at Land Between The Lakes.**

Drift of Benthic Macroinvertebrates in Two Stenothermal First Order Streams in Land Between The Lakes

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ABSTRACT

As part of an ongoing study on the macroinvertebrate community structure of two first order spring brooks in the Land Between The Lakes, the 24-hour drift activity was studied during the fall and winter for each. Lost Creek Spring (LCS), in the southwest corner of LBL, had a discharge of ca. 400 m^3/hr and an average temperature of 15^oC. Pryor Creek Spring (PCS), on the east side of LBL just south of the Kentucky border, had a discharge of ca. 55 m^3/hr and an average temperature of 13.5^oC.

The first 24-hour study was made in the upper reaches of LCS and PCS between September 24th and 25th. A standard nylon mesh drift net was placed in the spring brook and the captured specimens were removed every two hours over the 24-hour period. The second 24-hour study undertaken between December 18th and 20th incorporated the lower reaches of the spring brooks in addition to the upper reaches.

During the two sampling periods (Sept. and Dec.) minimally 39 taxa of aquatic macroinvertebrates were captured in drift at LCS (up and down). *Lirceus fontinalis* (Isopoda) was the dominant invertebrate in the LCS upstream drift (Sept. = 57%, Dec. = 40%). *Gammarus pseudolimnaeus* (Amphipoda) was the dominant invertebrate in the LCS downstream drift (= 47%). The drift for the two sample dates at PCS yielded a minimum of 19 taxa with *G. pseudolimnaeus* the dominant taxon upstream (Sept. = 98%, Dec. = 65%) and downstream (= 44%).

At LCS nighttime drift was significantly greater than daytime drift at the upstream site in September ($p<0.01$) and in the December downstream site ($p<0.05$). Day and night drift was not significantly different at the upstream site in the December sample. This lack of significance was the apparent result of an extremely high daytime sample corresponding to the initial placement of the drift net. When this first sample was excluded from the analysis, night drift was significantly greater than day drift ($p<0.01$).

The PCS upstream samples for September and December showed significantly greater drift at night versus day ($p<0.01$, $p<0.05$, respectively). In the PCS downstream sample, night drift was not significantly different than day drift.

Twenty-four-hour drift density (24 = HDD estimated number of individuals drifting within 100 m^3 of water during a 24-hour period) was greater in the September samples (LCS = 98.2, PCS = 1484.8) than the December upstream samples (LCS = 72.1, PCS = 130.3). The 24 HDDs of the December LCS and PCS upstream sites were greater than the respective downstream sites (LCS = 42.6, PCS = 26.5).

Future drift samples in March and June of 1989 will provide further information on patterns of seasonal and diurnal drift of the benthic macroinvertebrate fauna of these two spring brooks.

Herbivory Rates in the Understory of Two Southeast Missouri Oak-Hickory Communities

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ABSTRACT

This paper reports the results of a preliminary study of herbivory rates suffered by tree species in two of the understory communities within the Oak-Hickory Association representing the Eastern Deciduous Forest Biome of Southeast Missouri. Seasonal leaf losses due to herbivory increased from <20% at mid-season (May-June) to as much as 50% or more by late-season (Sept.-Oct.). Significant variability in herbivory rates was exhibited among sites, species, and trees within species. A significant site-species interaction was also evident. These results are compared with equivalent data for other forest ecosystems.

INTRODUCTION

The consequences of plant-insect interactions constitute an important component of both ecological and evolutionary studies of terrestrial ecosystems. If herbivory influences vary among plant species within a community, ecological consequences in terms of succession and species composition might be expected. If herbivory rates vary within individuals of a species due to plant genotype, evolutionary consequences will be expected. Before either ecological or evolutionary questions can be addressed, it is necessary to obtain evidence on overall consumption and on possible differential herbivory within and among species in a community. One fundamental question that researchers have investigated is how much insects are consuming.

Invertebrate herbivory occurs in virtually every type of terrestrial ecosystem. Just as the variation in ecosystems is large, so is the amount of invertebrate herbivory that occurs. It has been reported that cool temperate and montane grasslands in Europe and North America lose approximately 1-3% (Crawley 1983), tropical forests lose approximately 9% (Janzen 1970), and coniferous forests in Japan lose approximately 2% (Crawley 1983). More complete reviews of herbivory in different ecosystems can be found in Crawley (1983) and Hodkinson and Hughes (1982).

In forest ecosystems, estimates range from 3-60%, depending on the forest association (Fox and Morrow 1983). Gosz et al. (1972) reported that in a mature northern hardwood forest (beech-maple) of New Hampshire, consumption rates vary from 1.8-10.7% of total leaf production. However, insect activity varied with elevation

within a tree species, and there was a definite preference for beech over sugar maple (Gosz et al. 1972). Reichle et al. (1973) indicated that a tulip-poplar forest of Tennessee suffered a 2.6% loss of net primary production over a three-year period, which represents an annual loss of 7.7% of the total leaf area. In a xeric upland oak forest in Canada, insect consumption ranged from 7.4-12.4% (Bray 1964). Bray (1964) also reported that insect consumption ranged from 4.2-7.75% in a moist lowland maple-beech forest.

Several studies on the Eucalypt forest communities in Australia indicate herbivory rates may be higher than north temperate forests. Fox and Morrow (1983) found that 44 Eucalypt species from a variety of habitats have a 15% overall average of leaf area loss due to herbivory, with a range of 5-44%. Damage was found to vary considerably among species, sites, and years sampled (Fox and Morrow 1983). Journet (1981) reported herbivory rates as high as 60% for woodlands in Australia. Insect herbivores in Eucalypt forests may be more important in regulating primary productivity and nutrient cycling than in north temperate forests (Ohmart et al. 1983).

The objectives of this preliminary study were to 1) determine the amount of leaf area loss due to insect herbivory in the understory of oak-hickory forests of Southeast Missouri, and 2) identify where variations in herbivory rates exist. Our primary hypothesis was that herbivory rates in the understory of oak-hickory forests of Southeast Missouri are comparable with reported herbivory rates in other north temperate deciduous forests and thus lower than that experienced by Australian Eucalypt forests. Our secondary hypothesis is that there is variation in herbivory rates among and within species and communities.

MATERIALS AND METHODS

Of the three study sites, two dry mesic limestone forest communities (Nelson 1987) were located in Cape Girardeau County. This identification was based on the following characteristics: limestone bedrock, moderately steep slopes, soil of the Menfro association, dominant vegetation consisting of oak-hickory with maple interspersion, other characteristic plants (shagbark hickory, slippery elm, and eastern hophornbeam), tall canopy, and well developed understory. The third site was in Bollinger County and is identified as a dry chert forest (Nelson 1987), characterized by chert substrata, gentle to moderately steep slopes, soil of the Union-Wilderness association, dominant vegetation consisting of mixed oak-hickory forest with pine interspersions, other characteristic plants (dogwood, black gum, sassafras, reindeer lichen), short tree canopy with shrubs sometimes dominating, and a poorly developed understory.

Mid-season and late-season data on foliage losses due to consumption were collected at the three sites on 10 tree species with foliage in the understory. However, due to limitations in the number of individuals and in identification, the white oaks, red

oaks, hickories, and maples were grouped. Of these species, only four were common to all three sites: white oaks (*Quercus* spp.), hickory (*Carya glabra* and *Carya ovata*), maple (*Acer saccharinum* and *Acer nigrum*), and flowering dogwood (*Cornus florida*). The status of trees as immature overstory species or genuine understory species is given in table 1.

At each site, eight individual trees per species or group and three limbs per tree were selected. The following information was recorded for each limb: date, year, season, species, designated tree number, designated limb number, number of leaves present, and the estimated leaf area loss. Since methods for determining leaf losses vary considerably we employed a method similar to that described by Journet (1981) and Fox and Morrow (1983) on Eucalypts in Australia. This study used categories of 0, 25, 50, 75, and 100% leaf loss for each leaf, their values then being calculated and summed for all leaves on each designated limb. Percentages represent the ratio between the number of leaves present and the sum of the estimated leaf loss. These data were collected in mid-season (May-June) and late-season (Sept.-Oct.).

Total leaf areas were not estimated. The problem that some component of the estimate represents leaf area loss of unexpanded foliage which has later expanded, remains. The data, then, represent area lost as a result of consumption, not the area itself consumed. Leaves totally consumed or aborted due to consumption were not counted at mid-season, but were counted at late-season, since information on leaves present per limb in mid-season was available. These data, therefore, represent an underestimate of leaf area loss at mid-season, but may represent overestimates during late-season.

Comparisons within and among species in each site were based on analysis of variance of the arcsin transformed data of the trees present. Arcsin transformations were performed on all percentages since a normal distribution cannot be assumed. Comparison among sites was based on the four species common to all sites. An analysis of variance (ANOVA) was used on foliage loss among the four common species among all sites (communities). Tukey's test of Honest Significant Difference was used to compare species within each of the three sites, to compare sites (communities) among the four common species, and to compare the four common tree species among all three sites.

RESULTS AND DISCUSSION

Table 1 shows that the percent of mean leaf loss among all species and sites had a range of 2.62-24.41% during the mid-season. Tukey's test of Honest Significance (indicated by the lower case letters) indicates that there was variation among species within each of the communities. Data for site 1 indicate that the red oak group exhibited a mean leaf loss which is not significantly different from any of the other

species. However, the white oak group exhibited a significantly higher leaf area loss than sassafras, maple, slippery elm, and dogwood. The hickory group and the eastern hophornbeam also exhibited significantly more leaf loss than dogwood. This may indicate that immature overstory trees tend to suffer higher levels of leaf area loss due to herbivory than the understory species. Site 2 data indicate an herbivory pattern with a great deal of overlap though a similar trend among species. Site 3 data also indicate significant difference among species, with immature overstory trees species suffering higher rates of leaf area loss than the understory dominants. In this site, the red oak group, white oak group, and sassafras had significantly higher rates of leaf area loss than the hickory group, the maple group, dogwood, and black gum with losses exceeding 20%.

Table 1. Mid-season leaf losses (expressed as percent of total for each site) due to herbivory and significant groupings as determined by Tukey's Test of Honest Significance conducted separately for sites. Comparison of means based on arcsin transformed data. For each site, species with same letter are not significantly different.

	Sites		
	Dry Mesic Limestone Forest		Dry Chert Forest
Species	1	2	3
White Oak (O)	13.96 a	12.52 ab	20.22 ab
Red Oak (O)	8.30 abc	-	24.41 a
Hickory (O)	12.03 ab	6.53 bc	12.32 c
E. Hophornbeam (O)	9.21 ab	6.90 bc	-
Sassafras (O)	6.70 bc	-	22.08 ab
Maples (U)	5.14 bc	8.07 ab	15.90 bc
Slippery Elm (O)	4.44 bc	3.38 c	-
Dogwood (U)	2.62 c	6.70 bc	13.65 c
Redbud (U)	-	14.80 a	-
Black Gum (O)	-	-	5.58 d

U - understory
O - immature overstory

These data indicate that there is variation in herbivory rate among species in all three sites. They also suggest that there may be variation within the same species across sites. Variation in herbivory rates within species among sites may correlate with a difference in community structure and the relative dominance or abundance of the species in the communities. Data on this question were not collected.

Leaf loss ranged from 16.95-91.45% in the late-season estimates (table 2). The extraordinarily high percentages of leaf loss are possibly due to leaf abscission. Entire leaves were absent in comparison to the earlier count on the same limb. This may be due to general fall leaf abscission or abscission due to herbivory. However, not all species were experiencing abscission. This was determined by examination of leaf scars on each limb. White oak, red oak, maple, and redbud, for example, showed no sign of leaf abscission at the time of data collection. By late season, the patterns seen earlier seem to be lost. The herbivory rates of the overstory white oak group, the red oak group, and the understory maple group, and redbud ranged from 16.95-40.28%. This range is consistent with the ranges given by Ohmart et al. (1983), Fox and Morrow (1983), and Journet (1981) for the upper canopy of Eucalypt forests. It is much higher than studies on north temperate forest which were conducted in the upper canopy (Gosz et al. 1972, Reichle et al. 1973, Bray 1964), with ranges of 1.8-10.7%, 7.7%, 7.4-12.4%, and 4.2-7.7%, respectively. This could indicate that understory foliage of immature overstory trees is more favorable than mature overstory and mature understory trees for consumption.

Table 2. Late season leaf losses due to herbivory as percentages. Comparison of means based on arcsin transformed data. Underlined values indicate species not undergoing abscission.

	Sites		
	Dry Mesic Limestone Forest		Dry Chert Forest
Species	1	2	3
White Oak	40.28	34.52	38.73
Red Oak	26.94	-	41.22
Hickory	91.45	56.96	78.27
E. Hophornbeam	52.64	48.29	-
Sassafras	57.84	-	57.63
Maples	16.95	17.69	30.00
Slippery Elm	46.32	55.32	-
Dogwood	35.86	42.04	43.26
Redbud	-	37.86	-
Black Gum	-	-	85.64

Since not all species were present in all three sites, we used the herbivory rates of the four species common to all three sites to determine variation among sites, species, trees within species, and any site-species interactions (table 3). Table 3 presents the results of the analysis of variance. The ANOVA indicates that there is a significant difference according to the model ($F = 4.29$; $p < .0001$). Upon breaking the model into the component parts, we find that there is a significant difference among sites ($F = 18.6$; $p < .0001$), species ($F = 11.01$; $p < .0001$), trees within species ($F = 2.96$; $p < .0314$). We found that differences existed among species and sites, which is important for any ecological consequences and that differences existed among trees within species, which has evolutionary significance. This supports our secondary hypothesis that there is variation among species and sites.

Table 3. Analysis of variance (ANOVA) of mean leaf loss due to herbivory among the four common species (Dogwood, Maple, White Oak, and Hickory) and among sites.

Source	DF	SS	Mean Square	F	Prob>F
Model	39	1.5318	0.0393	4.29	0.0001
Error	416	3.812	0.0092		
Total	455	5.3447			

Source	DF	SS	F	Prob>F
Site	2	0.3409	18.60	0.0001
Species	3	0.3026	11.01	0.0001
Trees within species	28	0.7598	2.96	0.0001
Site-species interaction	6	0.1285	2.34	0.0314

Analysis of variance was conducted on leaf area loss of the four species common to all three sites. Tukey's Test of Honest Significance indicated that these understory tree species of the dry chert forest are significantly greater (15.07%) than those of the dry mesic limestone forest (8.63% site 1 and 1.62 fr site 2). This variation may be due to resource availability, since the understory of the dry chert forest was not as well developed as the understory of the dry mesic forest.

Analysis of variance of the four common tree species/groups at mid-season revealed that the white oak group (13.96%) had significantly higher herbivory rates than the maple group (5.14%) and dogwood (2.62%). The hickory group (12.03%), however, did not have significantly different herbivory rates from any of the other species/groups. This again indicated that immature overstory trees suffer higher herbivory rates than mature understory trees, regardless of site.

CONCLUSIONS

In this study, we reported ranges of herbivory rates in the understory of oak-hickory forests that are much higher than herbivory rates in the upper canopy of north temperate forests, but are comparable to the upper canopy of Eucalypt forests of Australia. Ohmart et al. (1984) attributed the differences in herbivory rates between Eucalypts and north temperate upper canopy trees to insect herbivores having a more dominant role in regulating primary productivity and nutrient cycling in Eucalypt forests. It may be that the understory of oak-hickory forests suffers higher herbivory rates than the upper canopy. Such may be a consequence of insect herbivores having a foliage preference for immature overstory tree species rather than mature upper canopy trees. Nonetheless, the study does indicate that there is significant variation in herbivory among species, within and among sites, and among trees within species. This supports our second hypothesis. Significant variation in trees within species has evolutionary implications, while significant variation among species has community composition (or ecological) implications. That immature overstory trees appear favorable to insects may have significant consequences for community composition. These implications remain to be addressed in the oak-hickory forests of Southeast Missouri.

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The Birds of Stewart County, Tennessee

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ABSTRACT

An annotated checklist of the birds of Stewart County, Tennessee, was prepared utilizing information from published and unpublished sources. Sight records of questionable validity are omitted from the text. A general history of Stewart County is given, and 11 primary birding sites within the county are described. Past ornithological work in the county, dating back to at least 1936, is summarized. Individual species accounts are used to quantitatively describe the 284 species that have been identified in the county, and the data are current through 15 June 1988. Status Codes are defined and one code is assigned to each species as follows: Permanent Resident (52 species); Summer Resident (55 species); Winter Resident (53 species); Transient (88 species); Vagrant (33 species); Extirpated (1 species); and Hypothetical (2 species). Special codes are used to distinguish species that breed, species that are suspected of breeding, and species for which there are usually fewer than 10 records although habitat is apparently available. The abundance of each species (except Vagrant, Hypothetical, and Extirpated species) is indicated by one of the following terms: Common, Fairly Common, Uncommon, Rare, or Extremely Rare.

INTRODUCTION

This paper presents an annotated checklist of the birds of Stewart County, Tennessee. In compiling this list, we have relied on the following sources of information: personal published and unpublished sight records (based on a combined total of 15 years of ornithological field work in the county), unpublished records of other reliable ornithologists, published records in *American Birds* and the state ornithological journal, *The Migrant*, and records contained in the office files of Cross Creeks National Wildlife Refuge. Certain records, the validities of which we questioned, have been omitted.

LOCATION AND CHARACTER OF THE COUNTY

Stewart County lies in the extreme northwest corner of Middle Tennessee, about 100 km northwest of Nashville. It encompasses approximately 1287 square km of the Western Highland Rim geologic division of Tennessee. Mississippian period limestones, chert, shale, and sandstone dominate the uppermost geologic strata. The elevation of the land surface ranges from 108 to 225 m above sea level. Most of the county consists of an old upland plain which has been incised by the Tennessee and Cumberland rivers and their tributaries into narrow, steep-sloped ridges with intervening wide valleys. A small section in the northeast part of the county includes the southwesternmost portion of the Pennyroyal Plain, an area of almost level to smoothly rolling upland. Forests cover approximately 62% of the county.

PAST ORNITHOLOGICAL WORK

Published records for the county prior to 1970 are rare. In 1936, the first nesting colony of Cliff Swallows in Tennessee was found at the Dover lock and dam on the Cumberland River (Ganier and Weakley 1936). The only sighting of a Red-cockaded Woodpecker for the county occurred in 1937 (Ganier 1962, Wetmore 1939) when W. M. Perrygo led a collecting expedition for the U.S. National Museum through Stewart County on 24-31 October 1937. Ryan (1968) documented the only county record of a Fulvous Whistling-Duck, which was present at the Cross Creeks National Wildlife Refuge for over two months in 1965. Published records of bird sightings in the Stewart County area began to appear regularly in the state season report of *The Migrant* between 1968 and 1971. Christmas Bird Counts were conducted in the county from 1971 to 1978 (centered at Dover) and from 1985 through 1987 (centered at Bear Spring).

DESCRIPTIONS OF BIRDING AREAS

Although very little ornithological field work was conducted in Stewart County before 1970, the county provides some of the best bird habitat and perhaps the greatest habitat diversity to be found in Middle Tennessee. Essentially all habitats expected in Middle Tennessee--ranging from grasslands, abandoned fields, and forest clear-cuts, to upland and lowland hardwood forests, pine forests, and marsh and lake aquatic habitats--can be found. This abundance and diversity of habitats have made possible the observation of a surprisingly large number of species during the past 25 years.

Sexton (1972) discussed where and when certain birds could be found in Stewart County, and briefly described four primary birding areas. A more complete list of birding areas is provided here:

Dover

Dover, the county seat, is on the western shore of the Cumberland River (Lake Barkley) and currently has a population of about 1200. Dover has a distinctly small-town or even rural character, thus providing many opportunities to observe birds.

Cumberland City Steam Plant

The steam plant is also located along the Cumberland River and encompasses about 202 ha. The two large ash settling ponds at the plant provide a unique habitat found nowhere else in the county.

Fort Donelson National Battlefield

Covering about 243 ha, the battlefield is the site of the surrender of Confederate troops to the Union Army at Fort Donelson in 1862. Oak-hickory upland forests and scattered, open fields dominate the 11 km of hiking trails in the park.

Stewart State Forest

This forest covers about 1780 ha set aside and purchased by the state in 1935. A multiple-use site, the main objective of this area is to promote the re-establishment of Tennessee's forest there.

Westvaco Timberlands Division

The Westvaco Timber Company owns about 17,806 ha of forestland in the county. Approximately 40% of this area is to be converted to pine forests over the next 15 years. Permits are not required for daytime use of these lands.

Fort Campbell Military Reservation

The reservation occupies approximately 10,522 ha in the northeastern section of the county. Pine forests, upland and lowland forests, open fields, and croplands are found throughout the reservation. This is a restricted access area, so permits from the U.S. Army's Fort Campbell office are required for proper entry.

Barkley Lake Wildlife Management Area

This wildlife management area is a federal public hunting area managed cooperatively by the Tennessee Wildlife Resources Agency and the U.S. Army Corps of Engineers since 1966. Encompassing 1460 ha, this area includes a large, open expanse of bottomland agricultural fields, part of which is known locally as "Dover Bottoms."

Barkley Lake

The Barkley Lake and Dam project was completed in 1966 to fulfill navigation, power generation, flood control, and recreational objectives along the lower reaches of the Cumberland River in Tennessee and Kentucky. The lake is normally maintained at elevations of 107 m and 109 m above sea level, in winter and summer, respectively.

Kentucky Lake

The Kentucky Lake and Dam project was completed in the 1940's by the Tennessee Valley Authority to fulfill navigation, power generation, and flood control objectives. Kentucky Lake, formed from impoundment of the Tennessee River, lies along the entire western side of Stewart County. Birds found on Kentucky Lake west of the old Tennessee River channel are actually in Henry County, Tennessee, or Calloway County, Kentucky.

Land Between The Lakes

Managed by the Tennessee Valley Authority, this national recreation area was established in 1963 for outdoor recreation and environmental education. It encompasses about 26,305 ha in Stewart County and offers more hiking and other recreational opportunities than any other public use area in the county. The Bear Creek Waterfowl Management Area is included.

Cross Creeks National Wildlife Refuge

Established in 1962 as a result of mitigation proceedings with the U.S. Army Corp of Engineers, Cross Creeks National Wildlife Refuge lies astride the Cumberland River. The Refuge covers 3586 ha and, as noted by Sexton (1972), is the best birding area in the county. Over 265 bird species have been recorded at the refuge.

CONVENTIONS, ABBREVIATIONS, AND DEFINITIONS

The following list of 284 bird species is intended to serve as a reference for future ornithologists studying Tennessee birds. The sequence and nomenclature of all species listed follow the 6th edition of the American Ornithologists' Union Check-list (1983). Data are current through 15 June 1988.

Abbreviations

The following abbreviations are used throughout the species list:
ad = adult, y = young, m = male, f = female, imm = immature
SP = Spring (1 March-31 May)

SU = Summer (1 June-31 July)
F = Fall (1 August-30 November)
W = Winter (1 December-29 February)
M.C. = Maximum Count
CCNWR = Cross Creeks National Wildlife Refuge
BCWMA = Bear Creek Waterfowl Management Area
FDB = Fort Donelson National Battlefield
LBL = Land Between The Lakes
CCSP = Cumberland City Steam Plant
WMA = Wildlife Management Area
WSB = Wiley's Springs Bay

Symbol Codes

Many codes, some of which have been adapted from Parmer et al. (1985), are used throughout the text and include the following:

^--species which is suspected of breeding in the county but for which no valid breeding records exist.
*--species for which valid breeding data exist.
¤--species for which there are usually fewer than 10 records; habitat is apparently available; species has possibly been overlooked.
[ ]--species whose occurrence in the county is of a hypothetical nature.

Residency Status Categories

Of the 284 species listed, the following categories are represented:

Permanent Resident--present throughout the year, but size of population may vary seasonally (52 species).
Summer Resident--present during summer, generally arriving in the spring and departing in the fall (55 species).
Winter Resident--present during winter, generally arriving in the fall and departing in the spring (53 species).
Transient--present during the spring and/or fall (88 species).
Vagrant--usually fewer than 10 records; species is outside its normal range of occurrence; little likelihood of recurrence (33 species).
Extirpated--species which no longer occurs in the county (1 species).
Hypothetical--species not documented beyond a reasonable doubt (2 species).

Summer Residents lacking the ^ or * symbol codes are considered to be non-breeding summer residents.

Abundance Categories

Common--seen on roughly 75-100% of field trips in the proper habitat.
Fairly Common--seen on roughly 25-75% of field trips in the proper habitat.
Uncommon--seen on roughly 5-25% of field trips in the proper habitat.
Rare--seen on less than 5% of field trips in the proper habitat.
Extremely Rare--seen once every few years on average.

THE LIST

1. Common Loon (*Gavia immer*)--Winter Resident (uncommon F and SP, rare W). Extreme dates: 15 Oct 1978 (10) CCNWR to 11 May 1988 (1) CCNWR. M.C.: 6 Nov 1986 (43) CCNWR. Note: most winter loons on Kentucky Lake are in Henry County.

2. Pied-billed Grebe (*Podilymbus podiceps*)--Winter Resident (fairly common F and SP, uncommon W). Extreme dates: 17 Aug 1987 (1) CCNWR to 24 May 1987 (1) BCWMA. M.C.: 11 Dec 1984 (23) CCNWR. One summer record: 28 June 1986 (2) BCWMA.

3. Horned Grebe (*Podiceps auritus*)--Winter Resident (uncommon F, W, and SP). Extreme dates: 26 Oct 1966 (1) to 20 Mar 1987 (1) CCNWR. M.C.: 17 Nov 1973 (25) CCNWR.

4. Double-crested Cormorant (*Phalacrocorax auritus*)--Transient (uncommon F and SP, rare W). Extreme dates: 13 Aug 1987 (1) CCNWR, and 5 Apr 1986 (13) to 19 May 1988 (1) CCNWR; late fall date obscured by presence of wintering birds. M.C.: 1 Nov 1984 (30) CCNWR. Winter records: 11 Dec 1983 (16), 11 Dec 1984 (2), 8 Dec 1985 (1), and 5 Dec 1987 to 18 Jan 1988 (1-4), all CCNWR.

5. [Anhinga (*Anhinga anhinga*)]--2-4 birds reported from 12 June to 27 Aug 1965 are mentioned without details in the same context of a bird sighted in Jan 1965. Due to the lack of substantiating details, these records are considered hypothetical.

6. American Bittern (*Botaurus lentiginosus*)--Transient (uncommon SP, extremely rare F, 1 winter record). Extreme dates: 12 Mar 1968 (2) to 19 May 1988 (1) and 24 Sept 1985 (1) to 19 Nov 1972 (1), all at CCNWR. M.C.: 4 May 1986 (4) BCWMA. Winter record: 11 Dec 1983 (1) CCNWR.

7. Least Bittern (*Ixobrychus exilis*)--Summer Resident (uncommon SP, extremely rare SU and F). Extreme dates: 1 May 1988 (1) BCWMA to 27 Aug 1965 (4) CCNWR. M.C.: 19 July 1965 (5) CCNWR.

8. Great Blue Heron (*Ardea herodias*)--Permanent Resident (common all seasons). M.C.: 29 Jan 1986 (127) CCNWR.

9. Great Egret (*Casmerodius albus*)--Summer Resident (fairly common SP, SU, and F, 3 winter records). Extreme dates: 24 Mar 1966 (2) CCNWR to 6 Nov 1986 (1) CCSP. M.C.: 31 Aug 1968 (55) CCNWR. Winter records: 18 Dec 1971 (2) Dover CBC, 19 Dec 1972 (1) CCNWR, and 21 Dec 1985 to 22 Mar 1986 (1-2) CCNWR.

10. Snowy Egret (*Egretta thula*)--Summer Resident (rare SP and F, uncommon SU). Extreme dates: 23 Apr 1985 (1) Barkley WMA to 20 Sept 1985 (1) CCNWR. M.C.: 30 July 1987 (4) CCNWR.

11. Little Blue Heron (*Egretta caerulea*)--Summer Resident (uncommon SP and F, fairly common SU). Extreme dates: 26 Mar 1966 (2) CCNWR to 22 Sept 1985 (1) Long Creek. M.C.: 31 Aug 1968 (330) CCNWR.

12. Tricolored Heron (*Egretta tricolor*)--Vagrant (1 record): 26 July to 4 Aug 1987 (1 imm) CCNWR.

13. Cattle Egret (*Bubulcus ibis*)--Transient (uncommon SP and F, rare SU). Extreme dates: 14 Apr 1972 (25) to 21 Nov 1970 (1) CCNWR. M.C.: 14 Apr 1972 (25) CCNWR.

*14. Green-backed Heron (*Butorides striatus*)--Summer Resident (common SP, SU, and F). Extreme dates: 26 Mar 1987 (1) WSB to 12 Nov 1971 (1) CCNWR. Nest record: 6 June 1988 (ad with recently fledged y) CCNWR. M.C.: 13 July 1985 (74) CCNWR.

15. Black-crowned Night-Heron (*Nycticorax nycticorax*)--Summer Resident (uncommon SP, common SU and F; 2 W records). Extreme dates: 30 Mar 1988 (2) to 22 Oct 1985 (3) CCNWR. M.C.: 23 July 1987 (42) CCNWR. Winter records: 21 Dec 1985 (1) CCNWR and 24 Dec 1981 (1) CCNWR.

*16. Yellow-crowned Night-Heron (*Nycticorax violaceus*)--Summer Resident (uncommon SP and SU, rare F). Extreme dates: 28 Mar 1987 (1) near WSB to 4 Oct 1984 (1) CCNWR. Nest record: summer, mid 1960s (2 nests) FDB. M.C.: 19 May 1988 (10) BCWMA. Two late fall dates: 19 Nov 1972 (5) and 21 Nov 1970 (1) CCNWR.

17. White Ibis (*Eudocimus albus*)--Vagrant (3 records): 19 Aug 1979 (2), 13-14 July 1985 (1 imm), and 20 July to 12 Aug 1987 (1 imm), all CCNWR.

18. Glossy Ibis (*Plegadis falcinellus*)--Vagrant (1 verified record): 10-11 May 1988 (1) Barkley WMA. On 4-7 May 1969 two birds were seen at CCNWR; a spring record, this sighting is probably valid, but details are lacking.

19. Wood Stork (*Mycteria americana*)--Vagrant (2 records): 25 May 1975 (1) U.S. 79 east of Dover and 26 July to 1 Sept 1983 (1-3) CCNWR. Note: diagnostic photographs were obtained of the 1983 birds.

20. Fulvous Whistling-Duck (*Dendrocygna bicolor*)--Vagrant (1 record): 4 Apr-20 June 1965 (1) CCNWR. Note: this individual was repeatedly caught in a swim-in trap and photographed.

21. Tundra Swan (*Cygnus columbianus*)--Winter Resident (extremely rare F, W, and SP). Extreme dates: 7 Nov 1971 (1) to 29 Mar 1970 (1) CCNWR. M.C.: 21 Dec 1985 (6) Lick Creek.

22. Mute Swan (*Cygnus olor*)--Vagrant (2 records): 16 Jan 1984 (1) CCNWR and 23 Jan-7 Feb 1988 (4--2 ad, 2 imm) Barkley WMA.

23. Greater White-fronted Goose (*Anser albifrons*)--Winter Resident (rare to extremely rare F, W, and SP). Extreme dates: 26 Oct 1984 (7--3 ad, 4 imm) to 9 Mar 1986 (9) CCNWR. Note: there are at least 11 records for the county.

24. Snow Goose (*Chen caerulescens*)--Winter Resident (uncommon F and W, rare SP). Extreme dates: 25 Sept 1986 (1) to 16 Mar 1984 (1) CCNWR. M.C.: 18 Oct 1972 (210) CCNWR.

25. Ross' Goose (*Chen rossii*)--Vagrant (2 records): 20 Nov 1986 (1) and 23 Dec 1987 to 24 Jan 1988 (1) CCNWR, both adults. Notes: both birds were initially discovered in winter wheat fields; medium-quality photographs of the 23 Dec 1987 sighting were obtained; the 1986 sighting represented the first state record.

26. Brant (*Branta bernicla*)--Vagrant (1 record): 17 Dec 1981 to 28 Feb 1982 (2) CCNWR; one bird lingered throughout 1982 and was last seen on 4 Jan 1983.

27. Barnacle Goose (*Branta leucopsis*)--Vagrant (1 record): 24-27 Jan 1976 (2) CCNWR.

*28. Canada Goose (*Branta canadensis*)--Permanent Resident (common F, W, and SP, fairly common SU). Nest record: 26 Apr 1986 (2 ad with downy y) BCWMA. M.C.: 4 Jan 1984 (45,000) CCNWR. Note: summer breeding population was initiated in 1967-1970 with 15 geese from Missouri and Illinois, and six Giant Canada Geese from Arkansas.

*29. Wood Duck (*Aix sponsa*)--Permanent Resident (fairly common SP, SU, and F, uncommon W). Nest record: 17 May 1986 (2 broods of 19 downy y) CCNWR. M.C.: 16 Mar 1969 (3500) CCNWR.

30. Green-winged Teal (*Anas crecca*)--Winter Resident (fairly common F, W, and SP). Extreme dates: 13 Aug 1986 (1) CCNWR to 20 Apr 1988 (2) Barkley WMA. M.C.: 28 Nov 1981 (3125) CCNWR. Summer record: 2-15 June 1988 (1 m) CCNWR.

*31. American Black Duck (*Anas rubripes*)--Winter Resident (common F, W, and SP). Extreme dates: 9 Aug 1987 (1) CCNWR to 27 Apr 1986 (1) Fort Campbell. Nest record: June 1967 (2 nests with 13 y hatched) CCNWR. M.C.: 26 Dec 1972 (14,000) CCNWR. Other summer record: 5 July 1987 (1) CCNWR.

*32. Mallard (*Anas platyrhynchos*)--Permanent Resident (common F, W, and SP, uncommon SU). Nest record: 11 July 1983 (4 y) BCWMA. M.C.: 5 Feb 1965 (90,000) CCNWR.

33. Northern Pintail *Anas acuta*)--Winter Resident (fairly common F and SP, common W). Extreme dates: 28 Aug 1983 (1) CCNWR to 20 Mar 1988 (3) Barkley WMA. M.C.: 8 Jan 1966 (4500) CCNWR.

34. Blue-winged Teal (*Anas discors*)--Transient (fairly common SP and F, 3 winter records). Extreme dates: 25 Feb 1986 (1) to 10 June 1988 (2) CCNWR, and 2 Aug 1985 (1) to 9 Oct 1987 (7) CCNWR. M.C.: 10 Apr 1966 (6250) CCNWR. Winter records: 18 Jan 1985 (3), 1 Jan 1987 (1), and 3 Feb 1983 (1), all CCNWR.

35. Cinnamon Teal (*Anas cyanoptera*)--Vagrant (1 record): 26 Mar 1974 (1 ad m) CCNWR. Bierly (1980) noted that this individual lingered on the refuge for approximately 1 month.

36. Northern Shoveler (*Anas clypeata*)--Winter Resident (uncommon F and W, fairly common SP). Extreme dates: 20 Aug 1987 (1) CCNWR to 13 May 1979 (3) Barkley WMA. M.C.: 19 Mar 1967 (3200) CCNWR.

37. Gadwall (*Anas strepera*)--Winter Resident (fairly common F and SP, common W). Extreme dates: 19 Sept 1987 (1) CCNWR to 10 May 1988 (1) Barkley WMA. M.C.: 26 Dec 1965 (4025) CCNWR.

38. Eurasian Wigeon (*Anas penelope*)--Vagrant (5 records): 8-20 Mar 1983 (1), 30 Dec 1983 to 16 Jan 1984 (1), 19 Oct to 25 Nov 1984, 22 Jan 1985 (1), 22-25 Jan 1986 (1), and 21 Nov to 27 Dec 1987 (1), all at CCNWR.

39. American Wigeon (*Anas americana*)--Winter Resident (fairly common F and SP, common W). Extreme dates: 20 Sept 1987 (1) to 30 May 1987 (1) CCNWR. M.C.: 4 Jan 1977 (7500) CCNWR.

40. Canvasback (*Aythya valisineria*)--Winter Resident (uncommon F and SP, fairly common W). Extreme dates: 3 Nov 1985 (2) CCNWR to 6 Apr 1986 (1) Kentucky Lake. M.C.: 28 Jan 1988 (725) CCNWR.

41. Redhead (*Aythya americana*)--Winter Resident (uncommon F, W, and SP). Extreme dates: 12 Oct 1985 (1 m) CCNWR to 17 Apr 1988 (1 f) CCNWR. M.C.: 4 Apr 1965 (525) CCNWR.

42. Ring-necked Duck (*Aythya collaris*)--Winter Resident (common F and W, fairly common SP; 1 SU record). Extreme dates: 1 Oct 1984 (1) CCNWR to 26 Apr 1986 (1) BCWMA. M.C.: 12 Dec 1983 (5810) CCNWR. Summer record: 29 May to 24 July 1966 (1-2) CCNWR.

¤43. Greater Scaup (*Aythya marila*)--Transient (1 record): 23 Nov 1981 (1 m) CCNWR.

44. Lesser Scaup (*Aythya affinis*)--Winter Resident (uncommon F, W, and SP; 1 SU record). Extreme dates: 12 Oct 1966 (1) to 21 Apr 1987 (1) CCNWR. M.C.: 28 Mar 1965 (8200) CCNWR. Summer record: 29 May to 24 July 1966 (2-3) CCNWR.

45. Oldsquaw (*Clangula hyemalis*)--Vagrant (3 records): 28 Nov 1971 (6) CCNWR, Dec 1972 (8, all shot) Barkley WMA, and 10 Dec 1983 (1) Bard's Lake, LBL.

46. Black Scoter (*Melanitta nigra*)--Vagrant (1 record): 19 Apr 1985 (20) Cumberland River.

47. Surf Scoter (*Melanitta perspicillata*)--Vagrant (1 record): 20 Dec 1984 (2, shot) near Cumberland City.

48. White-winged Scoter (*Melanitta fusca*)--Vagrant (1 record): 15 Nov 1985 (1) South Cross Creek Reservoir, CCNWR.

49. Common Goldeneye (*Bucephala clangula*)--Winter Resident (rare F, uncommon W; 1 SP record). Extreme dates: 25 Nov 1987 (2) CCNWR to 22 Mar 1979 (1) Fort Campbell. M.C.: 4 Jan 1970 (250) CCNWR.

50. Bufflehead (*Bucephala albeola*)--Winter Resident (rare F, W, and SP). Extreme dates: 5 Nov 1987 (2) to 21 Apr 1987 (2) CCNWR. M.C.: 7 Feb 1965 (125)

CCNWR. Note: most wintering birds on Kentucky Lake are in Henry County; formerly more abundant in Stewart County.

^51. Hooded Merganser (*Lophodytes cucullatus*)--Winter Resident (fairly common F and W, uncommon SP). Extreme dates: 29 Oct 1985 (12) to 6 May 1986 (1) CCNWR. Nest record: Bellrose (1976) listed the species as nesting in Wood Duck boxes at CCNWR, but no data in refuge files support this statement. M.C.: 12 Dec 1979 (750) CCNWR. Two summer records: 4-5 June 1988 (1-2) CCNWR and 12 June 1988 (1 ad m) BCWMA.

52. Common Merganser (*Mergus merganser*)--Winter Resident (extremely rare F, rare W). Extreme dates: 30 Nov 1986 (19) to 14 Feb 1988 (2) CCNWR.

53. Red-breasted Merganser (*Mergus serrator*)--Transient (uncommon F and SP, rare W). Extreme dates: 8 Nov 1985 (1) CCNWR, and 1 Mar 1987 (5) to 6 May 1986 (1) CCNWR; late fall date obscured by presence of wintering birds. M.C.: 12 Nov 1984 (24) LBL.

54. Ruddy Duck (*Oxyura jamaicensis*)--Winter Resident (uncommon F, rare W and SP). Extreme dates: 17 Oct 1987 (1) to 31 Mar 1982 (2) CCNWR. M.C.: 28 Nov 1965 (75) CCNWR.

*55. Black Vulture (*Coragyps atratus*)--Permanent Resident (fairly common all seasons). Nest record: 10-30 June 1987 (nest with y) LBL. M.C.: 19 Dec 1976 (200) Dover CBC.

^56. Turkey Vulture (*Cathartes aura*)--Permanent Resident (fairly common SP, SU, and F, uncommon W). M.C.: 20 Nov 1985 (300) Neville Bay, LBL.

57. Osprey (*Pandion haliaetus*)--Transient (uncommon SP and F; 1 W record). Extreme dates: 2 Apr 1986 (1) to 2 June 1988 (1) CCNWR, and 17 Aug 1985 (1) BCWMA to 3 Nov 1985 (1) CCNWR. Winter record: 31 Dec 1966 (1) CCNWR.

58. Mississippi Kite (*Ictinia mississippiensis*)--Vagrant (1 record): 26 Aug to 13 Oct 1983 (1 imm) CCNWR. Notes: this individual was photographed; the latter date represents the latest this species has been observed in the fall in Tennessee.

*59. Bald Eagle (*Haliaeetus leucocephalus*)--Permanent Resident (uncommon F and W, rare SP and SU). Nest records: one nest in a northern red oak (*Quercus rubra*) tree 0.8 km south of the Kentucky state line and 140 m from Kentucky Lake produced one eaglet in 1948 and in 1949 (Delime 1949); one nest near the CCNWR has successfully fledged 11 y since 1983; another nest near CCNWR successfully fledged 1 y

in 1987 and 2 y in 1988; and a nest in LBL has successfully fledged 6 y from 1984 to 1988. M.C.: 11 Feb 1988 (29--12 ad, 17 imm) LBL.

60. Northern Harrier (*Circus cyaneus*)--Winter Resident (uncommon F, W, and SP). Extreme dates: 27 Aug 1987 (1) CCNWR to 4 May 1986 (1) BCWMA. M.C.: 21 Dec 1985 (12) CCNWR CBC.

61. Sharp-shinned Hawk (*Accipiter striatus*)--Permanent Resident (uncommon F, W, and SP, rare SU). M.C.: 21 Dec 1986 (6) CCNWR CBC and 12 Sept 1987 (6) Fort Campbell.

^62. Cooper's Hawk (*Accipiter cooperii*)--Permanent Resident (uncommon all seasons). Nest record: 15 July 1986 (ad feeding y) LBL.

63. Northern Goshawk (*Accipiter gentilis*)--Vagrant (2 records): 20 Dec 1972 (1 ad) LBL and 24 Nov to 27 Dec 1984 (1 imm) CCNWR.

^64. Red-shouldered Hawk (*Buteo lineatus*)--Permanent Resident (uncommon all seasons). M.C.: 21 Dec 1986 (14) CCNWR CBC.

*65. Broad-winged Hawk (*Buteo platypterus*)--Summer Resident (uncommon SP, SU, and F). Extreme dates: 2 Apr 1985 (1) LBL to 29 Sept 1985 (2) CCNWR. Nest record: 6 June 1987 (nest attended by ad) Long Creek. M.C.: 24 Sept 1983 (30) WSB.

*66. Red-tailed Hawk (*Buteo jamaicensis*)--Permanent Resident (fairly common all seasons). Nest record: 20 May 1986 (1 ad at nest with 2 recently fledged y) CCNWR. M.C.: 20 Dec 1987 (33) CCNWR CBC. Note: 1-3 dark phase birds have appeared annually at CCNWR during the winter period, beginning with the 1984-85 winter.

67. Rough-legged Hawk (*Buteo lagopus*)--Winter Resident (extremely rare F, W, and SP). Extreme dates: 13 Nov 1966/1985 (1/1) CCNWR/LBL to 9 Mar 1985 (1) CCNWR. Note: 1 dark phase bird was found on 2 Jan 1987 at LBL; no fewer than 14 records exist for the county, beginning with the 1966 sighting listed above.

68. Golden Eagle (*Aquila chrysaetos*)--Winter Resident (rare to extremely rare F, W, and SP). Extreme dates: 15 Oct 1985 (1 ad) WSB to 5 Apr 1986 (1) Model Fire Tower, LBL. M.C.: 16 Jan 1984 (3) CCNWR.

^69. American Kestrel (*Falco sparverius*)--Permanent Resident (fairly common F, W, and SP, uncommon SU). M.C.: 21 Dec 1986 (11) CCNWR CBC.

70. Merlin (*Falco columbarius*)--Transient (9 records): 6 Sept 1986 (1), 27 Oct 1984 (1), 8 Nov 1986 (1), 26 Dec 1971 (1), and 26 Apr 1987 (1), all at CCNWR; 30 Sept 1986 (1) Bumpus Mills, 13 Jan 1982 (1) Cumberland River, 26 Nov 1984 (1) CCSP, and 27 Mar 1986 (1) LBL.

71. Peregrine Falcon (*Falco peregrinus*)--Transient (8 records): 24 Oct 1984 (1) and 13 Mar, 5 May, and 15 May 1986 (1 each date), all at CCNWR; 9 May 1983 (1) Dover, 25 Aug 1987 (1) BCWMA, 20 Nov 1987 (1) near WSB, and 5 May 1988 (1) Barkley WMA.

72. [Ring-necked Pheasant (*Phasianus colchicus*)]--Reports of 1-2 birds at CCNWR from Sept 1963 throughout 1964 were most likely of birds released in the area by state game agency officials; breeding was never documented for the county.

73. Ruffed Grouse (*Bonasa umbellus*)--Extirpated. Known from historical reports and observations made by residents of the Stewart County area from 1915 to 1952. Birds were reported at Blue Spring Creek, Fort Henry, near Indian Mound, and near Bumpus Mills (Schultz 1953). No valid sight records have occurred within the last three decades.

*74. Wild Turkey (*Meleagris gallopavo*)--Permanent Resident (rare all seasons). Nest records: 3 June 1983 (1 ad with 3 y) LBL; and 25 July 1987 (5 ad with 3 partly-grown y) Fort Campbell. M.C.: 4 Nov 1980 (60) BCWMA. Note: the species is concentrated along the Pool 4, Pool 5, and Elk Reservoir areas of CCNWR, at LBL, and at Fort Campbell.

*75. Northern Bobwhite (*Colinus virginianus*)--Permanent Resident (fairly common SP, SU, and F, uncommon W). Nest record: 22 May 1987 (nest with eggs) Taylor Chapel. M.C.: 20 Dec 1987 (47) CCNWR CBC.

¤76. Yellow Rail (*Coturnicops noveboracensis*)--Transient (1 record): 4-17 Oct 1987 (1) CCNWR. Note: this bird frequented a dry field dominated by nutsedge (*Cyperus*) in a drained, man-made impoundment.

¤*77. King Rail (*Rallus elegans*)--Summer Resident (1 record): 1 May 1971 (2) CCNWR, with a nest and 11 eggs being found at CCNWR on 22 May 1971.

78. Virginia Rail (*Rallus limicola*)--Transient (rare to extremely rare SP and F; 2 W records). Extreme dates: 1 May 1988 (1) to 14 May 1988 (1) BCWMA; only published fall date: 24 Sept 1985 (1) CCNWR. Winter records: 1, 4, and 25 Jan 1986 (1-2) CCSP, and 21 Dec 1986 (1) CCNWR. Note: due to the species' secretive nature, its presence is probably underestimated during the spring and fall.

79. Sora (*Porzana carolina*)--Transient (uncommon SP and F, 2 W records). Extreme dates: 9 Mar 1986 (1) CCNWR to 26 May 1988 (1) Barkley WMA, and 24 Aug 1985 (1) to 5 Oct 1987 (1) CCNWR. M.C.: 6 May 1988 (37) Barkley WMA and CCNWR. Winter records: 21 Dec 1985 (1) CCNWR, and 28 Dec 1985 to 25 Jan 1986 (1) CCSP.

80. Purple Gallinule (*Porphyrula martinica*)--Vagrant (1 record): 18 May to 4 June 1986 (1) BCWMA.

¤81. Common Moorhen (*Gallinula chloropus*)--Transient (5 records): 1-6 May 1988 (1) BCWMA and Barkley WMA, 7 May 1965 (5) CCNWR, 17 May 1987 (1) BCWMA, 31 May 1986 (1) CCNWR, and 20 Aug 1965 (2) CCNWR.

82. American Coot (*Fulica americana*)--Winter Resident (fairly common F, W, and SP; 1 SU record). Extreme dates: 24 Sept 1985 (1) CCNWR to 30 May 1986 (1) BCWMA. M.C.: 10 Jan 1988 (1035) Kentucky Lake. Summer record: 15 June 1978 (1) near Bumpus Mills.

¤83. Sandhill Crane (*Grus canadensis*)--Transient (4 records): 11 Dec 1982 (7) BCWMA, 3 Nov 1985 (9) CCNWR, 13 Jan 1986 (1) CCNWR, and 20 Dec 1987 (8) Barkley WMA.

¤84. Black-bellied Plover (*Pluvialis squatarola*)--Transient (extremely rare F; 1 SP record). Extreme dates: 5 May 1988 (1) Barkley WMA, and 20 Sept 1987 (1) to 3 Nov 1985 (1) CCNWR. Note: very few records have been published for the county.

85. Lesser Golden-Plover (*Pluvialis dominica*)--Transient (uncommon SP, rare to extremely rare F). Extreme dates: 3 Mar 1973 (2) CCNWR to 13 Apr 1986 (1) CCSP, and 22 July 1986 (1) CCNWR to 6 Nov 1986 (2) CCSP and Long Creek. M.C.: 14 Mar 1986 (60) CCNWR.

86. Semipalmated Plover (*Charadrius semipalmatus*)--Transient (uncommon SP and F). Extreme dates: 21 Apr 1987 (3) CCSP to 29 May 1988 (1) CCNWR, and 20 July 1986 (1) CCNWR to 16 Oct 1985 (2) CCNWR. M.C.: 10 May 1987 (34) CCNWR.

¤87. Piping Plover (*Charadrius melodus*)--Transient (1 record): 3-15 Aug 1987 (1) CCNWR.

*88. Killdeer (*Charadrius vociferus*)--Permanent Resident (common all seasons). Nest record: 15 June 1987 (nest with 3 eggs) CCNWR. M.C.: 2 Mar 1988 (368) CCNWR.

89. Black-necked Stilt (*Himantopus mexicanus*)--Vagrant (1 record): 2-4 Nov 1985 (1 imm) CCSP. Note: this individual appeared immediately after the passage of Hurricane Juan in late Oct to early Nov.

¤90. American Avocet (*Recurvirostra americana*)--Transient (6 records): 9 July 1987 (1), 20-21 July 1985 (2), 21 Sept 1985 (1), 24 Sept to 1 Oct 1972 (1), 6 Oct to 26 Nov 1968 (1), and 19 Oct 1979 (3), all at CCNWR.

91. Greater Yellowlegs (*Tringa melanoleuca*)--Transient (fairly common SP and F). Extreme dates: 9 Mar 1986 (2) to 27 May 1988 (1) CCNWR, and 5 July 1980 (1) Barkley WMA to 22 Nov 1986 (1) CCNWR. M.C.: 26 Apr 1987 (28) CCNWR and Barkley WMA.

92. Lesser Yellowlegs (*Tringa flavipes*)--Transient (fairly common SP and F). Extreme dates: 8 Mar 1987 (1) to 30 May 1988 (1) CCNWR, and 5 July 1987 (2) to 13 Nov 1981 (1) CCNWR. M.C.: 3 May 1987 (57) CCNWR. Note: two June records: 19 June 1987 (2) CCSP and 26 June 1987 (3) CCNWR.

93. Solitary Sandpiper (*Tringa solitaria*)--Transient (fairly common SP and F). Extreme dates: 26 Mar 1988 (2) CCNWR to 15 May 1988 (4) Barkley WMA, and 9 July 1972 (2) to 4 Oct 1966 (2) CCNWR. M.C.: 6 May 1988 (36) CCNWR and Barkley WMA.

94. Willet (*Catoptrophorus semipalmatus*)--Transient (extremely rare SP and F). Extreme dates: 12 Apr 1965 (6) to 25 May 1971 (1) CCNWR, and 9 July 1987 (1) to 1 Sept 1981 (1) CCNWR. M.C.: 28 Apr 1969 (30) CCNWR.

95. Spotted Sandpiper (*Actitis macularia*)--Transient (fairly common SP and F). Extreme dates: 1 Apr 1988 (1) Barkley WMA to 2 June 1988 (1) CCNWR, and 7 July 1986 (1) to 25 Oct 1986 (2) CCNWR. M.C.: 5 May 1988 (22) Barkley WMA. Note: four June records exist for the CCSP, ranging from 15-26 June; no nests or y were found.

96. Upland Sandpiper (*Bartramia longicauda*)--Transient (rare SP and F). Extreme dates: 21 Apr 1987 (2) to 27 Apr 1986 (1) near Carlisle, and 1 Aug 1987 (1) to 17 Aug 1987 (1) CCNWR. Note: no published records prior to 1985.

97. Marbled Godwit (*Limosa fedoa*)--Vagrant (1 record): 2-4 Aug 1985 (1) CCNWR.

98. Sanderling (*Calidris alba*)--Transient (rare F). Extreme dates: 22 July 1987 (1) to 6 Oct 1985 (1) CCNWR. M.C.: 5 Sept 1983 (10) CCNWR.

99. Semipalmated Sandpiper (*Calidris pusilla*)--Transient (fairly common SP and F). Extreme dates: 27 Apr 1986 (1) CCSP to 1 June 1988 (8) CCNWR, and 12 July 1987 (1) to 1 Oct 1984 (2) CCNWR. M.C.: 17 May 1986 (105) CCSP.

100. Western Sandpiper (*Calidris mauri*)--Transient (extremely rare SP, uncommon F). Extreme dates: 1 May 1985 (7) to 10 May 1987 (1) CCNWR, and 13 July 1987 (5) to 28 Aug 1983 (8) CCNWR. M.C.: 22 July 1987 (15) CCNWR. One Nov record: 21 Nov 1971 (1) CCNWR.

101. Least Sandpiper (*Calidris minutilla*)--Transient (fairly common SP and F, 2 W records). Extreme dates: 25 May 1988 (2) CCNWR and 10 July 1987 (1) CCNWR; early SP and late F dates obscured by presence of wintering birds. M.C.: 10 May 1987 (78) CCNWR. Winter records: 14 Dec 1985 to 1 Jan 1986 (1) CCSP, and 21 Dec 1986 to 2 Mar 1987 (2-3) CCSP.

102. White-rumped Sandpiper (*Calidris fuscicollis*)--Transient (uncommon SP, extremely rare F). Extreme dates: 4 May 1987 (1) to 15 June 1988 (1) CCNWR, and 20 Aug 1984 (2) to 13 Sept 1984 (1) CCNWR. M.C.: 31 May 1975 and 24 May 1988 (25) CCNWR.

103. Baird's Sandpiper (*Calidris bairdii*)--Transient (extremely rare F). Extreme dates: 10 Aug 1983 (1) to 13 Sept 1987 (1) CCNWR. Note: very few published records exist.

104. Pectoral Sandpiper (*Calidris melanotos*)--Transient (fairly common SP, common F). Extreme dates: 2 Mar 1988 (2) CCNWR to 26 May 1988 (2) Barkley WMA, and 10 July 1987 (1) CCNWR to 26 Nov 1986 (1) CCSP. M.C.: 9 Aug 1987 (164) CCNWR. One winter record: 28 Jan 1987 (1) Barkley WMA.

105. Dunlin (*Calidris alpina*)--Transient (uncommon F). Extreme dates: 9 Aug 1985 (1) CCNWR to 26 Nov 1986 (3) CCSP. M.C.: 1 Nov 1987 (28) CCSP. Notes: no published spring records; one winter record: 14 Dec 1987 (15) Long Creek.

106. Stilt Sandpiper (*Calidris himantopus*)--Transient (1 SP record, fairly common F). Extreme dates: 14 Apr 1987 (5) CCNWR, and 14 July 1985 (1) to 26 Oct 1982 (1) CCNWR. M.C.: 16 Oct 1985 (9) CCNWR.

107. Buff-breasted Sandpiper (*Tryngites subruficollis*)--Transient (rare to extremely rare F). Extreme dates: 2 Aug 1986 (1) to 13 Sept 1984 (3) CCNWR. M.C.: 6 Sept 1980 (21) CCNWR.

108. Short-billed Dowitcher (*Limnodromus griseus*)--Transient (rare SP, uncommon F). Extreme dates: 23 Apr 1988 (5) to 16 May 1986 (4) CCNWR, and 5

July 1987 (1) CCNWR to 15 Oct 1982 (1) CCNWR. M.C.: 9 May 1988 (12) Barkley WMA.

¤109. Long-billed Dowitcher (*Limnodromus scolopaceus*)--Transient (2 records): 30 July 1986 (1) and 8 Oct 1987 (1) CCNWR.

110. Common Snipe (*Gallinago gallinago*)--Winter Resident (fairly common F, W, and SP). Extreme dates: 12 Aug 1987 (1) CCNWR to 11 May 1988 (2) Barkley WMA. M.C.: 12 Apr 1986 (77) CCNWR.

*111. American Woodcock (*Scolopax minor*)--Permanent Resident (uncommon SP and SU, rare F and W). Nest record: Apr 1979 (nest with eggs) Crockett's Creek, LBL. M.C.: 6 Mar 1987 (8) Fort Campbell.

¤112. Wilson's Phalarope (*Phalaropus tricolor*)--Transient (6 records): 11 May 1988 (1), 29 July 1987 (1), 2 Sept 1984 (1), 4 Sept 1983 (1), 6 Sept 1980 (1), and 7 Sept 1975 (2), all at CCNWR.

113. Red-necked Phalarope (*Phalaropus lobatus*)--Vagrant (1 record): 27 Aug 1976 (1) CCNWR.

114. Franklin's Gull (*Larus pipixcan*)--Vagrant (3 records): 13-20 Mar 1988 (1 ad, breeding plumage) Dover. Other, invalidated, records include: 24-31 Dec 1966 (4) CCNWR and 2-12 Jan 1968 (3) CCNWR.

115. Bonaparte's Gull (*Larus philadelphia*)--Transient (uncommon SP, F, and W). Extreme dates: 8 Nov 1985 (1) unknown location to 4 May 1987 (3) CCNWR. M.C.: 16 Nov 1987 (45) Long Creek.

116. Ring-billed Gull (*Larus delawarensis*)--Winter Resident (uncommon F, common W, and fairly common SP). Extreme dates: 22 Sept 1987 (2) Lick Creek to 4 May 1987 (2) CCNWR. M.C.: 24 Dec 1981 (350) CCNWR.

117. Herring Gull (*Larus argentatus*)--Winter Resident (rare F, W, and SP). Extreme dates: 23 Aug 1986 (1) CCSP to 17 Apr 1987 (5) Kentucky Lake. M.C.: 1 Jan 1969 (100) CCNWR.

118. Great Black-backed Gull (*Larus marinus*)--Vagrant (1 record): 20 Feb 1984 (1, 1st year plumage) Kentucky Lake.

119. Black-legged Kittiwake (*Rissa tridactyla*)--Vagrant (1 record: 10-12 Dec 1983 (1 imm) Bard's Lake, LBL.

120. Caspian Tern (*Sterna caspia*)--Transient (uncommon SP and F). Extreme dates: 3 Apr 1988 (1) Kentucky Lake to 20 May 1986 (1) CCNWR, and 9 July 1987 (1) to 5 Oct 1985 (1) CCNWR. M.C.: 22 Aug 1986 (8) CCNWR. One June record: 11 June 1986 (2) CCNWR.

¤121. Common Tern (*Sterna hirundo*)--Transient (1 record): 13 July 1986 (2 ad) CCNWR. Note: no published records prior to 1986.

122. Forster's Tern (*Sterna forsteri*)--Transient (uncommon SP and F). Extreme dates: 9 Apr 1986 (4) LBL to 23 May 1988 (3) CCNWR, and 18 July 1986 (4) Cumberland City to 28 Oct 1984 (3) western Stewart Co. M.C.: 2 May 1986 (19) CCNWR.

123. Least Tern (*Sterna antillarum*)--Transient (extremely rare SP and SU, 1 F record). Extreme dates: 18 May 1986 (3) to 27 Aug 1965 (12) CCNWR. Note: all known records are from CCNWR.

124. Black Tern (*Chlidonias niger*)--Transient (rare SP, uncommon F). Extreme dates: 24 Apr 1971 (1) to 18 May 1986 (5) CCNWR, and 30 June 1987 (8) CCNWR to 31 Aug 1980 (1) BCWMA. M.C.: 9 July 1987 (11) CCNWR.

*125. Rock Dove (*Columba livia*)--Permanent Resident (fairly common all seasons). Nest record: 14 May 1988 (nest with 2 y) CCSP. Concentration areas are the Dover bridge and water tower and the CCSP.

*126. Mourning Dove (*Zenaida macroura*)--Permanent Resident (common all seasons). Nest record: 11 Apr 1987 (1 ad with half-grown y) near Kentucky Lake. M.C.: late Dec 1965 (1600) CCNWR.

127. Common Ground-Dove (*Columbina passerina*)--Vagrant (1 verified record): 3 Nov 1985 (1) CCNWR; appeared immediately after the passage of Hurricane Juan. An unpublished observation of 2 birds at the Barkley WMA on 29 Dec 1972 includes good written details but was never verified.

128. Black-billed Cuckoo (*Coccyzus erythropthalmus*)--Transient (uncommon SP, extremely rare F). Extreme dates: 3 May 1987 (1) LBL to 21 May 1986 (1) Bumpus Mills, and 8 Sept 1987 (1) near Long Creek to 29 Sept 1985 (1) CCNWR.

*129. Yellow-billed Cuckoo (*Coccyzus americanus*)--Summer Resident (uncommon SP, common SU, and fairly common F). Extreme dates: 1 May 1988 (1) BCWMA to 8 Nov 1985 (1) CCNWR. Nest record: 20 July 1985 (ad feeding y) BCWMA. M.C.: 29 May 1988 (16) LBL and CCNWR.

*130. Eastern Screech-Owl (*Otus asio*)--Permanent Resident (uncommon all seasons). Nest record: 13 May 1988 (nest with 3 y in Wood Duck box) CCNWR. M.C.: 20 Dec 1987 (6) CCNWR CBC. Note: only 1 gray phase owl has been recently reported in the county.

*131. Great Horned Owl (*Bubo virginianus*)--Permanent Resident (uncommon all seasons). Nest record: 24 Apr 1987 (nest with recently fledged y) WSB. M.C.: 21 Dec 1986 (11) CCNWR CBC.

132. Snowy Owl (*Nyctea scandiaca*)--Vagrant (1 record): 5 Jan to 6 Feb 1987 (1 imm) Barkley WMA.

*133. Barred Owl (*Strix varia*)--Permanent Resident (fairly common all seasons). Nest record: 20 May 1987 (recently fledged y) Carlisle. M.C.: 21 Dec 1985 (13) CCNWR CBC.

¤134. Short-eared Owl (*Asio flammeus*)--Transient (1 record): 16 Nov 1986 (1) CCNWR. Note: no published records prior to 1986 despite abundance of apparently suitable habitat.

135. Common Nighthawk (*Chordeiles minor*)--Transient (uncommon SP and F). Extreme dates: 26 Apr 1986 (2) Fort Campbell to 19 May 1988 (2) near Dover, and 24 Aug 1986 (1) Fort Campbell to 19 Sept 1987 (2) CCNWR. M.C.: 8 Sept 1987 (105) Westvaco Timber Co. clear cut. Note: species may occur as a summer resident but very little breeding habitat currently exists.

^136. Chuck-will's-widow (*Caprimulgus carolinensis*)--Summer Resident (uncommon SP and SU). Extreme dates: 20 Apr 1987 (2) Fort Campbell to 27 June 1987 (1) Indian Mound. M.C.: 5 June 1987 (7) Taylor Chapel.

*137. Whip-poor-will (*Caprimulgus vociferus*)--Summer Resident (fairly common SP and SU, rare F). Extreme dates: 31 Mar 1986 (1) WSB to 13 Oct 1985 (1) Dover. Nest record: 23 May 1987 (nest with y) near Kentucky Lake. M.C.: 1 May 1988 (18) near Dover.

*138. Chimney Swift (*Chaetura pelagica*)--Summer Resident (common SP, SU, and F). Extreme dates: 30 Mar 1988 (1) to 21 Oct 1985 (2) CCNWR. Nest record: 6 June 1987 (ad at nest site) Carlisle. M.C.: 17 Sept 1984 (183) Dover.

*139. Ruby-throated Hummingbird (*Archilochus colubris*)--Summer Resident (fairly common SP, SU, and F). Extreme dates: 9 Apr 1986 (2) LBL to 1 Oct 1987 (1) WSB. Nest record: 10 May 1980 (ad at nest site) LBL. M.C.: 2 Sept 1985 (16) WSB.

*140. Belted Kingfisher (*Ceryle alcyon*)--Permanent Resident (fairly common all seasons). Nest record: 7 Mar 1987 (2 ad at nest cavity) Dover. M.C.: 21 Dec 1986 (28) CCNWR CBC.

*141. Red-headed Woodpecker (*Melanerpes erythrocephalus*)--Permanent Resident (uncommon all seasons). Nest record: 22 May 1987 (2 ad at nest cavity) Taylor Chapel. M.C.: 21 Dec 1985 (27) CCNWR CBC.

*142. Red-bellied Woodpecker (*Melanerpes carolinus*)--Permanent Resident (common all seasons). Nest record: 28 Apr 1984 (ad at nest cavity) WSB. M.C.: 21 Dec 1986 (59) CCNWR CBC.

143. Yellow-bellied Sapsucker (*Sphyrapicus varius*)--Winter Resident (uncommon F, W, and SP). Extreme dates: 28 Sept 1985 (1) LBL to 18 Apr 1986 (1) LBL. M.C.: 21 Dec 1985 (18) CCNWR CBC.

*144. Downy Woodpecker (*Picoides pubescens*)--Permanent Resident (common all seasons). Nest record: 16 May 1987 (2 ad with y at nest) Taylor Chapel. M.C.: 20 Dec 1987 (72) CCNWR CBC.

*145. Hairy Woodpecker (*Picoides villosus*)--Permanent Resident (fairly common all seasons). Nest record: 17 Apr 1986 (ad feeding y) WSB. M.C.: 20 Dec 1987 (13) CCNWR CBC.

146. Red-cockaded Woodpecker (*Picoides borealis*)--Vagrant (1 record): 30 Oct 1937 (1) 11.2 km north of Dover. Dr. Alex Wetmore reported this species in Stewart County during a museum collecting expedition (Ganier 1962).

*147. Northern Flicker (*Colaptes auratus*)--Permanent Resident (fairly common all seasons). Nest record: 18 May 1988 (recently fledged y) Stewart State Forest. M.C.: 20 Dec 1987 (43) CCNWR CBC.

*148. Pileated Woodpecker (*Dryocopus pileatus*)--Permanent Resident (fairly common all seasons). Nest record: 16 May 1988 (ad at nest with y) Stewart State Forest. M.C.: 21 Dec 1986 (17) CCNWR CBC.

149. Olive-sided Flycatcher (*Contopus borealis*)--Transient (rare SP and F). Extreme dates: 26 Apr 1986 (1) LBL to 22 May 1987 (1) Taylor Chapel, and 16 Sept 1987 (1) to 19 Sept 1987 (2) LBL.

*150. Eastern Wood-Pewee (*Contopus virens*)--Summer Resident (fairly common SP and F, common SU). Extreme dates: 22 Apr 1987 (2) LBL to 13 Oct 1985 (1)

FDB. Nest record: 10 July 1987 (ad on nest) Fort Donelson Shores. M.C.: 16 July 1987 (18) various locations.

¤151. Yellow-bellied Flycatcher (*Empidonax flaviventris*)--Transient (1 record) 7 May 1985 (1) BCWMA.

*152. Acadian Flycatcher (*Empidonax virescens*)--Summer Resident (common SP and SU, fairly common F). Extreme dates: 23 Apr 1988 (1) BCWMA to 28 Sept 1980 (1) WSB. Nest record: 17 June 1983 (nest with eggs) WSB. M.C.: 29 June 1986 (13) south of Dover.

¤153. Alder Flycatcher (*Empidonax alnorum*)--Transient (rare SP). Only 4 records for the county: 11 May 1988 (1), 19 May 1988 (1), 29 May 1988 (1), all at CCNWR; and 14 May 1988 (1) LBL. Species has probably been overlooked in previous years.

^154. Willow Flycatcher (*Empidonax traillii*)--Summer Resident (uncommon SP and SU). Extreme dates: 20 Apr 1986 (1) WSB to 31 July 1986 (1) CCNWR. M.C.: 30 May 1987 (11) CCNWR.

155. Least Flycatcher (*Empidonax minimus*)--Transient (uncommon SP). Extreme dates: 3 May 1985 (1) Dover to 16 May 1987 (1) LBL.

*156. Eastern Phoebe (*Sayornis phoebe*)--Permanent Resident (common SP and SU, fairly common F, uncommon W). Nest record: 15 Mar 1987 (used nests under bridges) LBL. M.C.: 15 Mar 1987 (29) Dover and LBL.

*157. Great Crested Flycatcher (*Myiarchus crinitus*)--Summer Resident (fairly common SP and SU, uncommon F). Extreme dates: 19 Apr 1987 (1) WSB to 19 Sept 1987 (1) LBL. Nest record: 6 June 1987 (ad at nest cavity) CCNWR. M.C.: 29 May 1988 (12) various locations.

*158. Eastern Kingbird (*Tyrannus tyrannus*)--Summer Resident (common SP, SU, and F). Extreme dates: 29 Mar 1987 (1) Long Creek to 30 Sept 1985 (1) CCNWR. Nest record: 11 June 1985 (ad feeding y) WSB. M.C.: 27 Aug 1987 (90) CCNWR.

159. Scissor-tailed Flycatcher (*Tyrannus forficatus*)--Vagrant (1 record): 1 June 1987 (1 ad, photographed) LBL.

^160. Horned Lark (*Eremophila alpestris*)--Winter Resident (fairly common F and W, uncommon SP). Extreme dates: 2 Oct 1985 (1) to 22 May 1987 (1) CCNWR. M.C.: 30 Dec 1983 (115) CCNWR. Note: a juvenile-plumaged bird and 2 ad were

found at CCNWR and Barkley WMA on 22-25 May 1988 and constitute a possible breeding record.

*161. Purple Martin (*Progne subis*)--Summer Resident (common SP, SU, and F). Extreme dates: 12 Mar 1986 (1) to 28 Sept 1985 (1) CCNWR. Nest record: 5 June 1987 (many ad at nest colony) Taylor Chapel. M.C.: 31 July 1986 (810) Dover.

*162. Tree Swallow (*Tachycineta bicolor*)--Summer Resident (fairly common SP and F, uncommon SU). Extreme dates: 20 Feb 1987 (1) to 26 Nov 1986 (1) CCNWR. Nest record: 17 May 1986 (2 ad entering nest cavity) CCNWR. M.C.: 23 Apr 1986 (60) CCNWR.

^163. Northern Rough-winged Swallow (*Stelgidopteryx serripennis*)--Summer Resident (fairly common SP, SU, and F). Extreme dates: 20 Mar 1982 (3) WSB to 25 Nov 1983 (1) CCNWR. M.C.: 24 June 1987 (28) CCNWR.

164. Bank Swallow (*Riparia riparia*)--Transient (uncommon SP and F). Extreme dates: 2 May 1986 (2) to 5 Sept 1987 (1) CCNWR; late SP and early F dates obscured by presence of summering birds. June records: 16 June 1983 (1) Dover, 16 June 1986, and 10 June 1988 (1-2) CCNWR.

*165. Cliff Swallow (*Hirundo pyrrhonota*)--Summer Resident (common SP and SU, uncommon F). Extreme dates: 17 Mar 1984 (1) CCNWR to 7 Oct 1984 (1) Dover. Nest records: 10 June 1987 (active nests at 5 colonies) CCSP, Dover, and Kentucky Lake; 24 May 1936 (1 colony) Dover. M.C.: 10 June 1987 (832) CCSP, Dover, and Kentucky Lake.

*166. Barn Swallow (*Hirundo rustica*)--Summer Resident (common SP, SU, and F). Extreme dates: 10 Mar 1983 (2) to 29 Oct 1987 (1) CCNWR. Nest record: 22 May 1987 (nest with eggs) Taylor Chapel. M.C.: 14 May 1988 (65) LBL and CCNWR.

*167. Blue Jay (*Cyanocitta cristata*)--Permanent Resident (common all seasons). Nest record: 23 June 1983 (nest with y) WSB. M.C.: 20 Dec 1987 (223) CCNWR CBC.

*168. American Crow (*Corvus brachyrhynchos*)--Permanent Resident (common all seasons). Nest record: 13 Apr 1984 (nest with y) WSB. M.C.: 21 Dec 1986 (303) CCNWR CBC.

*169. Carolina Chickadee (*Parus carolinensis*)--Permanent Resident (common all seasons). Nest record: 28 Apr 1984 (ad feeding y) WSB. M.C.: 18 Dec 1971 (126) Dover CBC.

*170. Tufted Titmouse (*Parus bicolor*)--Permanent Resident (common all seasons). Nest record: 10 Apr 1986 (nest with eggs) WSB. M.C.: 18 Dec 1971 and 21 Dec 1986 (114) Dover CBC and CCNWR CBC.

171. Red-breasted Nuthatch (*Sitta canadensis*)--Winter Resident (rare to uncommon F, W, and SP). Extreme dates: 29 Sept 1985 (1) to 27 Apr 1987 (1) CCNWR. M.C.: 21 Dec 1985 (5) CCNWR CBC.

*172. White-breasted Nuthatch (*Sitta carolinensis*)--Permanent Resident (fairly common all seasons). Nest record: 28 Apr 1984 (nest with eggs) WSB. M.C.: 18 Dec 1971 (34) Dover CBC.

173. Brown Creeper (*Certhia americana*)--Winter Resident (uncommon F, W, and SP). Extreme dates: 29 Sept 1985 (1) FDB to 22 Apr 1988 (1) WSB. M.C.: 23 Mar 1986 (8) WSB and LBL.

*174. Carolina Wren (*Thryothorus ludovicianus*)--Permanent Resident (common all seasons). Nest record: 27 May 1983 (nest with eggs) WSB. M.C.: 20 Dec 1987 (60) CCNWR CBC.

*175. Bewick's Wren (*Thryomanes bewickii*)--Summer Resident (rare SP, SU, and F). Extreme dates: 7 Apr 1986 (1) to 18 Sept 1987 (1) Dover. Nest record: 24 July 1987 (2 ad with recently fledged y) Westvaco Timber Co. land. M.C.: 24 July 1987 (10) Westvaco Timber Co. land at Hurricane Creek and Old Highway 18. Note: in 1987, 21 different individuals were found in slash piles on Westvaco Timber Co. clear cuts.

*176. House Wren (*Troglodytes aedon*)--Transient (uncommon SP and F, rare SU, extremely rare W; 1 breeding record). Extreme dates: 10 Apr 1987 (1) WSB to 9 Oct 1987 (1) CCNWR. Nest record: 3 May 1985 (ad feeding y) Fort Donelson Shores. Winter records: 25 Dec 1985 (1) Fort Campbell and 4 Jan 1987 (1) WSB.

177. Winter Wren (*Troglodytes troglodytes*)--Winter Resident (uncommon F, W, and SP). Extreme dates: 5 Oct 1987 (1) WSB to 18 Apr 1987 (1) Fort Campbell. M.C.: 20 Dec 1987 (9) CCNWR CBC.

178. Sedge Wren (*Cistothorus platensis*)--Transient (uncommon SP and F, 1 W record). Extreme dates: 14 Mar 1986 (1) CCNWR to 9 May 1984 (1) BCWMA, and 24 July 1985 (3) to 16 Oct 1987 (2) CCNWR. M.C.: 13 Aug 1984 (15) CCNWR. Winter record: 21 Dec 1985 (1) CCNWR CBC.

179. Marsh Wren (*Cistothorus palustris*)--Transient (uncommon SP and F, 2 W records). Extreme dates: 26 Apr 1986 (1) to 19 May 1988 (5) BCWMA, and 29 Sept

1987 (2) CCNWR to 11 Nov 1986 (1) BCWMA. Two winter records: 20 Dec 1985 to 4 Jan 1986 (1-3) CCSP and 1 Dec 1984 (1) CCNWR.

180. Golden-crowned Kinglet (*Regulus satrapa*)--Winter Resident (fairly common F, W, and SP). Extreme dates: 1 Oct 1987 (2) WSB to 17 Apr 1987 (6) LBL. M.C.: 20 Dec 1987 (33) CCNWR CBC.

181. Ruby-crowned Kinglet (*Regulus calendula*)--Winter Resident (fairly common F and SP, uncommon W). Extreme dates: 30 Sept 1984 (1) WSB to 26 Apr 1986 (1) LBL.

*182. Blue-gray Gnatcatcher (*Polioptila caerulea*)--Summer Resident (common SP, SU, and F). Extreme dates: 22 Mar 1986 (1) Barkley WMA to 27 Sept 1984 (2) WSB. Nest record: 22 May 1987 (ad feeding y at nest) Taylor Chapel.

*183. Eastern Bluebird (*Sialia sialis*)--Permanent Resident (common all seasons). Nest record: June 1987 (3 nests with y) CCNWR. M.C.: 21 Dec 1986 (90) CCNWR CBC.

184. Veery (*Catharus fuscescens*)--Transient (uncommon SP). Extreme dates: 25 Apr 1980 (1) to 14 May 1988 (1) LBL. Note: no published fall records exist.

185. Gray-cheeked Thrush (*Catharus minimus*)--Transient (uncommon SP; 1 F record). Extreme dates: 26 Apr 1986 (1) FDB to 24 May 1986 (1) WSB, and 19 Sept 1987 (2) CCNWR and LBL.

186. Swainson's Thrush (*Catharus ustulatus*)--Transient (fairly common SP, uncommon F). Extreme dates: 16 Apr 1981 (1) LBL to 23 May 1985 (1) WSB, and 11 Sept 1987 (1) WSB to 11 Oct 1984 (1) WSB.

187. Hermit Thrush (*Catharus guttatus*)--Winter Resident (uncommon F, W, and SP). Extreme dates: 25 Oct 1987 (2) CCNWR to 4 May 1984 (2) WSB. M.C.: 20 Dec 1987 (13) CCNWR CBC.

*188. Wood Thrush (*Hylocichla mustelina*)--Summer Resident (common SP and SU, fairly common F). Extreme dates: 5 Apr 1986 (1) WSB to 13 Oct 1985 (1) FDB. Nest record: 1 July 1983 (nest with y) WSB. M.C.: 26 Apr 1986 (19) FDB and LBL.

*189. American Robin (*Turdus migratorius*)--Permanent Resident (common all seasons). Nest record: 5 June 1987 (nest building) Taylor Chapel. M.C.: 21 Dec 1985 (1421) CCNWR CBC.

*190. Gray Catbird (*Dumetella carolinensis*)--Summer Resident (fairly common SP, SU, and F). Extreme dates: 19 Apr 1988 (1) Stewart State Forest to 23 Nov 1985 (1) WSB. Nest record: 6 June 1987 (ad feeding y) Long Creek.

*191. Northern Mockingbird (*Mimus polyglottos*)--Permanent Resident (common all seasons). Nest record: June 1987 (ad feeding y in nest) Dover. M.C.: 18 Dec 1971 (31) Dover CBC.

*192. Brown Thrasher (*Toxostoma rufum*)--Permanent Resident (common SP, SU, and F, uncommon W). Nest record: 22 May 1987 (ad with recently fledged y) Taylor Chapel.

193. Water Pipit (*Anthus spinoletta*)--Winter Resident (uncommon F, W, and SP). Extreme dates: 20 Oct 1985 (20) CCNWR to 8 May 1986 (1) CCSP. M.C.: 15 Nov 1981 (250) CCNWR.

*194. Cedar Waxwing (*Bombycilla cedrorum*)--Winter Resident (fairly common F and SP, uncommon W, rare SU). Arrival and departure dates obscured by presence of summering birds. Nest record: 30 May 1986 (ad on nest) LBL. M.C.: 20 Dec 1987 (319) CCNWR CBC.

*195. Loggerhead Shrike (*Lanius ludovicianus*)--Permanent Resident (fairly common all seasons). Nest record: 22 May 1987 (ad feeding recently fledged y) Taylor Chapel. M.C.: 18 Dec 1971 (26) Dover CBC.

*196. European Starling (*Sturnus vulgaris*)--Permanent Resident (common all seasons). Nest record: 22 May 1987 (ad feeding y in nest) Taylor Chapel. M.C.: 21 Dec 1985 (2040) CCNWR CBC.

*197. White-eyed Vireo (*Vireo griseus*)--Summer Resident (common SP, SU, and F). Extreme dates: 5 Apr 1986 (2) to 13 Oct 1985 (1) FDB. Nest record: 7 June 1987 (ad at nest) WSB. M.C.: 26 Apr 1986 (23) LBL and Dover.

198. Solitary Vireo (*Vireo solitarius*)--Transient (rare SP and F). Extreme dates: 8 Apr 1986 (1) WSB to 26 Apr 1985 (1) LBL, and 8 Sept 1979 (1) LBL to 7 Oct 1984 (1) CCNWR.

*199. Yellow-throated Vireo (*Vireo flavifrons*)--Summer Resident (common SP and SU, fairly common F). Extreme dates: 1 Apr 1986 (1) FDB to 30 Sept 1984 (1) WSB. Nest record: 28 June 1986 (2 ad at nest) Stewart/Montgomery County line. M.C.: 26 Apr 1986 (8) LBL.

^200. Warbling Vireo (*Vireo gilvus*)--Summer Resident (fairly common SP and SU, uncommon F). Extreme dates: 9 Apr 1986 (1) CCNWR to 20 Sept 1987 (1) FDB. M.C.: 5 June 1987 (6) CCNWR.

201. Philadelphia Vireo (*Vireo philadelphicus*)--Transient (rare SP and F). Extreme dates: 11 Apr 1985 (1) LBL to 17 May 1986 (1) CCNWR, and 7 Sept 1981 (1) WSB to 19 Oct 1987 (1) CCNWR.

^202. Red-eyed Vireo (*Vireo olivaceus*)--Summer Resident (common SP and SU, fairly common F). Extreme dates: 9 Apr 1986 (1) WSB to 19 Sept 1987 (3) LBL. M.C.: 16 May 1987 (27) various locations.

*203. Blue-winged Warbler (*Vermivora pinus*)--Summer Resident (fairly common SP and SU, uncommon F). Extreme dates: 6 Apr 1986 (3) LBL and CCNWR to 25 Sept 1985 (1) BCWMA. Nest record: 28 Apr 1984 (nest building) WSB. M.C.: 29 May 1988 (11) LBL.

204. Golden-winged Warbler (*Vermivora chrysoptera*)--Transient (uncommon SP and F). Extreme dates: 9 Apr 1986 (1) WSB to 6 May 1985 (1) BCWMA, and 24 Aug 1986 (1) Fort Campbell to 20 Sept 1987 (1) FDB.

205. Tennessee Warbler (*Vermivora peregrina*)--Transient (common SP, fairly common F). Extreme dates: 9 Apr 1986 (6) WSB to 26 May 1986 (1) BCWMA, and 24 Aug 1986 (1) BCWMA to 14 Oct 1985 (3) CCNWR. M.C.: 4 May 1986 (37) LBL.

¤206. Orange-crowned Warbler (*Vermivora celata*)--Transient (4 records): 28 Mar 1986 (1) Barkley WMA, 26 Apr 1987 (1) BCWMA, 4 May 1985 (1) WSB, and 26 Oct 1937 (1) Cumberland River.

207. Nashville Warbler (*Vermivora ruficapilla*)--Transient (fairly common SP and F). Extreme dates: 12 Apr 1986 (1) BCWMA to 12 May 1987 (3) various locations, and 1 Sept 1987 (1) CCNWR to 14 Oct 1985 (1) FDB.

^208. Northern Parula (*Parula americana*)--Summer Resident (fairly common SP and SU, uncommon F). Extreme dates: 3 Apr 1988 (2) CCNWR to 10 Oct 1984 (1) WSB.

^209. Yellow Warbler (*Dendroica petechia*)--Summer Resident (uncommon SP and SU, rare F). Extreme dates: 31 Mar 1977 (1) LBL to 21 Sept 1987 (1) CCNWR.

210. Chestnut-sided Warbler (*Dendroica pensylvanica*)--Transient (uncommon SP and F). Extreme dates: 17 Apr 1986 (1) WSB to 17 May 1988 (1) Stewart State Forest, and 24 Aug 1986 (2) Fort Campbell to 11 Oct 1987 (1) CCNWR.

211. Magnolia Warbler (*Dendroica magnolia*)--Transient (uncommon SP, fairly common F). Extreme dates: 14 Apr 1984 (1) CCNWR to 21 May 1986 (2) Bumpus Mills, and 8 Sept 1987 (1) to 14 Oct 1985 (4) FDB.

212. Cape May Warbler (*Dendroica tigrina*)--Transient (rare SP). Extreme dates: 19 Apr 1982 (1) CCNWR to 21 May 1986 (1) Bumpus Mills.

¤213. Black-throated Blue Warbler (*Dendroica caerulescens*)--Transient (2 records): 30 Apr 1966 (1 m) near Bumpus Mills and 13 Sept 1987 (1 f) WSB.

214. Yellow-rumped Warbler (*Dendroica coronata*)--Winter Resident (common F and SP, fairly common W). Extreme dates: 28 Aug 1987 (1) LBL to 10 May 1984 (3) WSB. M.C.: 4 May 1987 (48) various locations. Note: 1 bird of the Audubon's race was discovered at LBL on 15 Mar 1987.

215. Black-throated Green Warbler (*Dendroica virens*)--Transient (uncommon SP and F). Extreme dates: 13 Apr 1981 (1) WSB to 15 May 1988 (1) CCSP, and 3 Sept 1987 (1) WSB to 14 Oct 1985 (3) FDB.

216. Blackburnian Warbler (*Dendroica fusca*)--Transient (uncommon SP, rare F). Extreme dates: 30 Apr 1987 (1) FDB to 20 May 1986 (2) CCNWR, and 9 Sept 1982 (1) to 22 Sept 1987 (1) WSB.

^217. Yellow-throated Warbler (*Dendroica dominica*)--Summer Resident (fairly common SP and SU, uncommon F). Extreme dates: 25 Mar 1986 (1) WSB to 27 Sept 1981 (1) LBL.

*218. Pine Warbler (*Dendroica pinus*)--Permanent Resident (fairly common SP, SU, and F, rare W). Nest record: 22 May 1987 (ad feeding y) Taylor Chapel. M.C.: 24 Aug 1987 (10) Fort Campbell. Note: Dec and Jan records exist for CCNWR and Fort Campbell.

^219. Prairie Warbler (*Dendroica discolor*)--Summer Resident (common SP and SU, uncommon F). Extreme dates: 5 Apr 1988 (1) Old Highway 79 to 13 Oct 1986 (1) WSB. M.C.: 3 May 1987 (27) various locations.

220. Palm Warbler (*Dendroica palmarum*)--Transient (fairly common SP, uncommon F, 1 W record). Extreme dates: 5 Apr 1986 (2) CCNWR to 9 May 1987 (3) LBL, and 11 Sept 1987 (1) LBL to 14 Oct 1987 (2) CCNWR. M.C.: 27 Apr 1987 (26) Barkley WMA. Winter record: 7 Dec 1987 to 6 Jan 1988 (1) CCNWR.

221. Bay-breasted Warbler (*Dendroica castanea*)--Transient (uncommon SP, fairly common F). Extreme dates: 29 Apr 1981 (2) WSB to 18 May 1986 (4) FDB, and 13 Sept 1987 (1) LBL to 14 Oct 1985 (3) FDB. M.C.: 29 Sept 1985 (12) FDB and CCNWR.

222. Blackpoll Warbler (*Dendroica striata*)--Transient (uncommon SP, rare F). Extreme dates: 19 Apr 1982 (1) CCNWR to 15 May 1988 (1) CCSP, and 11 Sept 1987 (1) LBL to 27 Sept 1984 (1) WSB.

*223. Cerulean Warbler (*Dendroica cerulea*)--Summer Resident (fairly common SP and SU, rare F). Extreme dates: 23 Apr 1988 (1) BCWMA to 24 Aug 1986 (1) BCWMA. Nest record: May/June 1987 or 1988 (ad at nest) LBL.

224. Black-and-white Warbler (*Mniotilta varia*)--Transient (fairly common SP and F, extremely rare SU). Extreme dates: 8 Apr 1986 (1) FDB to 13 Oct 1985 (1) FDB.

225. American Redstart (*Setophaga ruticilla*)--Transient (uncommon SP and F, 2 SU records). Extreme dates: 27 Apr 1986 (1) to 17 May 1986 (1) CCNWR, and 13 Sept 1987 (1) Lick Creek to 14 Oct 1985 (1) CCNWR. Summer records: 6 June 1987 (1 singing m) CCNWR and 20 July 1984 (1) BCWMA.

*226. Prothonotary Warbler (*Protonotaria citrea*)--Summer Resident (common SP and SU, uncommon F, 1 W record). Extreme dates: 6 Apr 1986 (1) BCWMA to 3 Oct 1984 (1) Dover. Nest record: 6 July 1985 (nest with y) WSB. M.C.: 23 Apr 1988 (17) various locations. Winter record: 2 Dec 1985 (1) BCWMA.

^227. Worm-eating Warbler (*Helmitheros vermivorus*)--Summer Resident (fairly common SP and SU, uncommon F). Extreme dates: 9 Apr 1986 (2) LBL to 8 Sept 1987 (1) Lick Creek.

*228. Ovenbird (*Seiurus aurocapillus*)--Summer Resident (fairly common SP and SU, uncommon F). Extreme dates: 17 Apr 1987 (1) LBL to 27 Sept 1985 (2) LBL. Nest record: 22 June 1987 (1 ad giving distraction display) Stewart State Forest. M.C.: 17 May 1988 (11) Stewart State Forest.

229. Northern Waterthrush (*Seiurus noveboracensis*)--Transient (uncommon SP and F). Extreme dates: 26 Apr 1986 (1) BCWMA to 20 May 1986 (1) CCNWR, and 10 Sept 1987 (1) to 1 Oct 1987 (1) CCNWR.

*230. Louisiana Waterthrush (*Seiurus motacilla*)--Summer Resident (fairly common SP and SU, rare F). Extreme dates: 12 Mar 1988 (1) LBL to 16 Aug 1986 (1) CCNWR. Nest record: 4 June 1988 (2 recently fledged y) CCNWR.

*231. Kentucky Warbler (*Oporornis formosus*)--Summer Resident (common SP and SU, uncommon F). Extreme dates: 15 Apr 1986 (2) LBL to 11 Sept 1987 (1) LBL. Nest record: May-June 1988 (ad at nest site) WSB. M.C.: 3 May 1987 (15) various locations.

¤232. Connecticut Warbler (*Oporornis agilis*)--Transient (3 records): 19 Apr 1968 (2), 14 May 1988 (1 m), and 15 Oct 1985 (1), all at LBL.

¤233. Mourning Warbler (*Oporornis philadelphia*)--Transient (5 records): 21 Apr 1985 (1) WSB, 14 May 1988 (1 m) Old Highway 79, 23 May 1973 (1) unknown location, 30 May 1986 (1) LBL, and 18 Oct 1983 (1) WSB.

*234. Common Yellowthroat (*Geothlypis trichas*)--Summer Resident (common SP, SU, and F, 1 W record). Extreme dates: 28 Mar 1986 (1) Barkley WMA to 8 Nov 1986 (1) CCNWR. Nest record: 6 June 1987 (ad feeding y) Long Creek. M.C.: 3 May 1987 (55) various locations. Winter record: 28 Dec-25 Jan 1985-86 (1) CCSP.

^235. Hooded Warbler (*Wilsonia citrina*)--Summer Resident (uncommon SP and SU, rare F). Extreme dates: 6 Apr 1986 (1) LBL to 19 Sept 1987 (1) CCNWR. M.C.: 3 May 1987 (7) various locations.

236. Wilson's Warbler (*Wilsonia pusilla*)--Transient (uncommon SP and F). Extreme dates: 1 May 1988 (1) BCWMA to 20 May 1986 (1) CCNWR, and 9 Sept 1987 (2) to 3 Oct 1984 (1) WSB.

237. Canada Warbler (*Wilsonia canadensis*)--Transient (uncommon SP and F). Extreme dates: 1 May 1987 (1) LBL to 17 May 1985 (1) WSB, and 23 Aug 1986 (1) CCNWR to 19 Sept 1987 (1) LBL.

*238. Yellow-breasted Chat (*Icteria virens*)--Summer Resident (common SP and SU, uncommon F). Extreme dates: 18 Apr 1981 (2) LBL to 27 Sept 1983 (1) WSB. Nest record: 6 June 1987 (ad at nest) Long Creek. M.C.: 20 June 1987 (24) Fort Campbell.

*239. Summer Tanager (*Piranga rubra*)--Summer Resident (common SP and SU, fairly common F). Extreme dates: 15 Apr 1987 (1) Dover to 10 Oct 1984 (1) WSB. Nest record: 10 June 1988 (ad feeding y) Ginger Bay, Kentucky Lake. M.C.: 29 May 1988 (15) various locations.

*240. Scarlet Tanager (*Piranga olivacea*)--Summer Resident (fairly common SP, SU, and F). Extreme dates: 7 Apr 1988 (1) WSB to 13 Oct 1987 (1) LBL. Nest record: 10 June 1988 (ad carrying food) Ginger Bay, Kentucky Lake. M.C.: 26 Apr 1986 (13) LBL and FDB.

*241. Northern Cardinal (*Cardinalis cardinalis*)--Permanent Resident (common all seasons). Nest record: 22 May 1987 (nest with eggs) Taylor Chapel. M.C.: 18 Dec 1971 (355) Dover CBC.

242. Rose-breasted Grosbeak (*Pheucticus ludovicianus*)--Transient (fairly common SP and F). Extreme dates: 22 Apr 1987 (1) CCNWR to 14 May 1988 (10) LBL, and 13 Sept 1987 (2) to 14 Oct 1985 (3) LBL. M.C.: 4 Oct 1968 (200) LBL.

^243. Blue Grosbeak (*Guiraca caerulea*)--Summer Resident (fairly common SP, SU, and F). Extreme dates: 24 Apr 1982 (1) WSB to 2 Oct 1985 (1) CCNWR. M.C.: 31 May 1986 (8) CCNWR.

*244. Indigo Bunting (*Passerina cyanea*)--Summer Resident (common SP, SU, and F). Extreme dates: 14 Apr 1987 (1) to 25 Oct 1987 (2) CCNWR. Nest record: 20 May 1987 (ad at nest) Big Rock. M.C.: 16 May 1987 (87) various locations.

^245. Dickcissel (*Spiza americana*)--Summer Resident (uncommon SP, SU, and F). Extreme dates: 24 Apr 1985 (3) Barkley WMA to 31 Aug 1985 (1) CCNWR.

*246. Rufous-sided Towhee (*Pipilo erythrophthalmus*)--Permanent Resident (common all seasons). Nest record: 25 May 1987 (nest with eggs) Bear Spring. M.C.: 20 Dec 1987 (84) CCNWR CBC.

¤^247. Bachman's Sparrow (*Aimophila aestivalis*)--Summer Resident (4 records): 26-27 Apr 1986 (1 m, singing) Fort Campbell, 21 July to 9 Aug 1987 (2 males, singing) Westvaco Timber Co. clear cut, Old Highway 76, and 24 Apr 1988 and 14 May 1988 (1 m singing each date) Westvaco clear cuts on Old Highway 79.

248. American Tree Sparrow (*Spizella arborea*)--Winter Resident (rare W). Extreme dates: 3 Dec 1971 (1) CCNWR to 21 Feb 1985 (1) WSB. M.C.: 29 Jan 1984 (35) CCNWR.

*249. Chipping Sparrow (*Spizella passerina*)--Summer Resident (fairly common SP, SU, and F, 1 W record). Extreme dates: 13 Mar 1988 (5) Dover to 23 Nov 1987 (1) LBL. Nest record: 5 July 1987 (ad feeding y) Carlisle. Winter records: 17-19 Dec 1985 (1) Dover and 9 Dec 1987 (1) LBL.

*250. Field Sparrow (*Spizella pusilla*)--Permanent Resident (common all seasons). Nest record: 16 May 1987 (nest building) Taylor Chapel. M.C.: 20 Dec 1987 (230) CCNWR CBC.

251. Vesper Sparrow (*Pooecetes gramineus*)--Transient (fairly common SP and F, 2 W records). Extreme dates: 16 Mar 1988 (1) CCNWR to 29 Apr 1978/1987 (5/1) CCNWR, and 2 Oct 1985 (1) CCNWR to 21 Nov 1987 (1) CCNWR. M.C.: 20 Mar 1983 (14) CCNWR. Winter records: 12-13 Feb 1985 (1) Dover and 12 Dec 1987 (1) CCNWR.

¤252. Lark Sparrow (*Chondestes grammacus*)--Transient (3 records): 3 May 1987 (1), 6 May 1986 (1), and 28 July 1987 (1), all CCNWR.

253. Savannah Sparrow (*Passerculus sandwichensis*)--Winter Resident (fairly common F, W, and SP). Extreme dates: 28 Sept 1985 (1) to 19 May 1988 (2) CCNWR. M.C.: 21 Dec 1985 (46) CCNWR CBC.

¤^254. Grasshopper Sparrow (*Ammodramus savannarum*)--Summer Resident (rare SP and SU). Only 3 known records: 27 Apr 1982 (1) LBL and 2 May 1981 (1) CCNWR. A colony consisting of at least 5 singing males was found on Old Highway 18 on 17-31 May 1988.

255. Le Conte's Sparrow (*Ammodramus leconteii*)--Winter Resident (rare F, W, and SP). Extreme dates: 16 Oct 1987 (2) to 9 Mar 1986 (1) CCNWR.

256. Sharp-tailed Sparrow (*Ammodramus caudacutus*)--Transient (1 SP record, rare F). All dates: 18 May 1986 (1) BCWMA; 1-2 Oct 1985 (1), 8 Nov 1986 (1), and 29 Sept-17 Oct 1987 (2), all CCNWR.

257. Fox Sparrow (*Passerella iliaca*)--Winter Resident (uncommon F, W, and SP). Extreme dates: 25 Oct 1987 (5) to 3 Apr 1986 (1) CCNWR.

^258. Song Sparrow (*Melospiza melodia*)--Permanent Resident (uncommon SU, common F, W, and SP). M.C.: 20 Dec 1987 (323) CCNWR CBC. Note: 2-4 singing, territorial males were observed in May, June, and July of 1985-1988 at CCNWR; and 1-2 territorial males were found at the Barkley WMA on 6-30 May 1988.

259. Lincoln's Sparrow (*Melospiza lincolnii*)--Transient (uncommon F and SP, extremely rare W). Extreme dates: 28 Mar 1986 (3) Barkley WMA to 17 May 1988 (1) Old Highway 18, and 22 Oct 1985 (1) to 23 Nov 1974 (1) CCNWR. Winter records: 9 Jan 1985 (1) Barkley WMA and 28 Jan 1986 (1) LBL.

260. Swamp Sparrow (*Melospiza georgiana*)--Winter Resident (common F, W, and SP). Extreme dates: 15 Sept 1983 (2) CCNWR to 19 May 1988 (1) BCWMA. M.C.: 20 Dec 1987 (349) CCNWR CBC.

261. White-throated Sparrow (*Zonotrichia albicollis*)--Winter Resident (common F, W, and SP). Extreme dates: 4 Oct 1982 (1) LBL to 17 May 1985 (1) WSB. M.C.: 21 Dec 1985 (521) CCNWR CBC.

262. White-crowned Sparrow (*Zonotrichia leucophrys*)--Winter Resident (uncommon F, W, and SP). Extreme dates: 19 Oct 1985 (4) CCNWR to 15 May 1988 (3) CCSP and CCNWR. M.C.: 18 Dec 1971 (25) Dover CBC.

263. Harris' Sparrow (*Zonotrichia querula*)--Vagrant (1 record): 5-6 Dec 1987 (1) BCWMA.

264. Dark-eyed Junco (*Junco hyemalis*)--Winter Resident (common F, W, and SP). Extreme dates: 24 Sept 1972 (1) CCNWR to 4 May 1987 (1) LBL. M.C.: 18 Dec 1971 (461) Dover CBC. Note: 24 Sept 1972 record at CCNWR was described as an "Oregon" Junco, but plumage details are not available.

265. Lapland Longspur (*Calcarius lapponicus*)--Winter Resident (rare F and W, 1 SP record). Extreme dates: 25 Oct 1987 (3) to 8 Mar 1986 (3) CCNWR. M.C.: 30 Dec 1983 (500) CCNWR.

266. Snow Bunting (*Plectrophenax nivalis*)--Vagrant (1 record): 30 Dec 1983 (1) CCNWR.

267. Bobolink (*Dolichonyx oryzivorus*)--Transient (fairly common SP, uncommon F; 2 SU records). Extreme dates: 21 Apr 1987 (8) CCNWR to 31 May 1980 (2) Barkley WMA, and 24 Aug 1985 (1) to 25 Oct 1987 (2) CCNWR. M.C.: 5 May 1988 (88) CCNWR. Summer records: 10 June 1988 (1 m) CCNWR and 21 June 1980 (2 m, 1 f) Barkley WMA.

*268. Red-winged Blackbird (*Agelaius phoeniceus*)--Permanent Resident (common all seasons). Nest record: 6 June 1987 (nest with eggs) CCNWR. M.C.: 19 Dec 1976 (3300) Dover CBC.

^269. Eastern Meadowlark (*Sturnella magna*)--Permanent Resident (common all seasons). M.C.: 18 Dec 1971 (241) Dover CBC.

270. Western Meadowlark (*Sturnella neglecta*)--Vagrant (2 records): 5 Mar 1988 (1, singing) CCNWR and 16 Feb 1985 (1) CCNWR. Note: the description of the 1985 bird is not diagnostically sufficient to identify it as this species.

271. Rusty Blackbird (*Euphagus carolinus*)--Winter Resident (uncommon W and SP, rare F). Extreme dates: 26 Oct 1937 (1) Cumberland River to 21 Mar 1986 (2) CCNWR. M.C.: 31 Dec 1974 (100) Dover CBC.

¤272. Brewer's Blackbird (*Euphagus cyanocephalus*)--Transient (3 records): 4 Jan 1979 (1 f) Dover CBC, 28 Feb 1984 (1) WSB, and 13 Apr 1987 (1 f) 1.2 km east of Carlisle.

*273. Common Grackle (*Quiscalus quiscula*)--Permanent Resident (fairly common all seasons). Nest record: 20 May 1987 (ad at nest) CCNWR. M.C.: 12 Jan 1982 (1100) Barkley WMA.

*274. Brown-headed Cowbird (*Molothrus ater*)--Permanent Resident (fairly common all seasons). Nest record: 5 June 1984 (y raised by Wood Thrush) WSB. M.C.: 21 Dec 1985 (415) CCNWR CBC.

*275. Orchard Oriole (*Icterus spurius*)--Summer Resident (common SP and SU, fairly common F). Extreme dates: 9 Apr 1986 (2) to 25 Sept 1984 (1) WSB. Nest record: June 1988 (nest with 5 y) CCNWR.

*276. Northern Oriole (*Icterus galbula*)--Transient (uncommon SP and F, 1 SU nest record). Extreme dates: 18 Apr 1981 (1) to 6 Oct 1987 (1) WSB. Nest record: 16 June 1985 (pair at nest) LBL.

277. Purple Finch (*Carpodacus purpureus*)--Winter Resident (uncommon to fairly common F, W, and SP). Extreme dates: 2 Oct 1985 (1) Indian Mound to 24 Apr 1987 (1) Dover. M.C.: 21 Dec 1985 (75) CCNWR CBC.

278. House Finch (*Carpodacus mexicanus*)--Winter Resident (uncommon F and W, rare SP). Extreme dates: 13 Nov 1987 (4) to 24 Apr 1988 (1) Dover. Summer record: 2-15 June 1988 (2) Dover. Note: population is increasing and nesting is likely.

279. Red Crossbill (*Loxia curvirostra*)--Vagrant (4 records): 16 Mar 1985 (20) Model Fire Tower, LBL, 1 Jan 1987 (2) Fort Campbell, 8 Nov 1987 (9) LBL, and 31 Mar 1987 (3) LBL.

280. Common Redpoll (*Carduelis flammea*)--Vagrant (1 record): 21 Jan 1985 (1 m) WSB.

281. Pine Siskin (*Carduelis pinus*)--Winter Resident (uncommon to fairly common F, W, and SP). Extreme dates: 13 Oct 1987 (1) CCNWR to 27 May 1986 (1) Dover. M.C.: 20 Dec 1987 (117) CCNWR CBC.

^282. American Goldfinch (*Carduelis tristis*)--Permanent resident (common F, W, and SP, fairly common SU). M.C.: 20 Dec 1987 (449) CCNWR CBC.

283. Evening Grosbeak (*Coccothraustes vespertinus*)--Winter Resident (rare to fairly common F, W, and SP). Extreme dates: 11 Nov 1985 (20) LBL to 9 May 1987 z(2) Dover. M.C.: 13 Nov 1975 (75) LBL.

*284. House Sparrow (*Passer domesticus*)--Permanent Resident (common all seasons). Nest record: 16 May 1987 (adults at nest site in Purple Martin box) Taylor Chapel. M.C.: 21 Dec 1986 (61) CCNWR CBC.

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