

incorrect report of *S. ovalis* as a new state record (Taylor, 1967).

Spiranthes ovalis has been found in Middle Tennessee (Chester & Wert, 1968) and in two West Tennessee county surveys (Warrington, 1970; Beardsley, 1973, as *S. vernalis* Engelm. & Gray). The collections reported here add three more West Tennessee stations. The collection data are:

Madison Co.: Tompkins property on Norton Hill, Hwy. 45, south of Jackson, R. Beardsley 711, 15 September 1970 (MEM).

McNairy Co.: springs near the house on Lipford property, about 2 mi northeast of Bethel Springs, V. Bates 3777, 2 October 1982 (TENN).

Tipton Co.: Deciduous woods on south side of Indian Creek drainage canal across IC railroad from US 51 North, just north of Brighton (canal is 11.0 mi north of Shelby County line), S. Warrington 511, 14 September 1969 (MEM).

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BREEDING BIRDS AND VEGETATION ALONG THE DUCK RIVER IN MIDDLE TENNESSEE

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ABSTRACT

The avifauna and vegetation along a 13 km section of the Duck River were surveyed in June 1982. Of 62 differ-

ent species of birds recorded during the census, the indigo bunting (*Passerina cyanea*), acadian flycatcher (*Empidonax vireescens*), common grackle (*Quiscalus quiscula*), northern

cardinal (*Cardinalis cardinalis*), and Carolina chickadee (*Parus carolinensis*) were highest in density and frequency of occurrence. The narrow riverine corridor, which was bordered on both sides by land predominantly in agricultural uses, was used extensively by birds of adjacent lands. During the vegetation survey, 37 different species of ground cover plants, 21 species of shrubs, and 20 different species of trees were recorded in sample plots along the Duck River.

INTRODUCTION

The Duck River lies within the Nashville Basin portion of the Western Mesophytic Forest Region (Braun 1950) in middle Tennessee. Bailey (1978) has more recently classified this region as the Oak-Hickory Forest of the Eastern Deciduous Forest Province. The Duck River originates in Coffee County and flows 465 km westward through Bedford, Marshall, Maury, Hickman, Perry, and Humphreys Counties to its confluence with the Tennessee River at Kentucky Reservoir (Tennessee River mile 110.7). Elevations range from 109 m at the mouth to 411 m near the headwaters.

Much of the Duck River is bordered by a narrow riparian zone which consists of mixed hardwood forest, occasional limestone outcroppings dominated by eastern redcedar (*Juniperus virginiana*), and steep rock bluffs. This wooded corridor would have probably been cleared a long time ago for agricultural purposes if not for the steep terrain and thin, limestone soils. Riparian zones are known to be fragile and to be used disproportionately more than any other type of habitat by wildlife (Beidelman, 1954; Wooding, 1973; Bottorff, 1974). Although the fish and macroinvertebrate fauna of the Duck River are relatively well known (Ortman, 1924; Isom and Yokley, 1968; and Ahlstedt, 1980), we could find no published information on the avifauna or vegetation along this river. This information is of particular interest since completion of the partially constructed Columbia Dam (Duck River mile 136.9) would inundate a large portion of the riverine habitat along the Duck River. This paper quantitatively describes the avifauna and vegetation along a segment of the Duck River that will be inundated upon completion of the Columbia Dam.

METHODS

The section of river selected for study extends from 13 km above Hardison Mill (Duck River mile 172) to just below Carpenter's Bridge (Duck River mile 162). This riverine segment has not been disturbed by TVA construction activities and is representative of conditions prior to initiation of the Duck River Project.

A modified version of the technique described by James and Shugart (1970) was used to sample ground cover, understory, and overstory along the Duck River. Eight 0.04 ha acre circular plots were randomly located along the wooded riverine corridor. Two perpendicular transects, 22.6 m in length, were established within each circle. Ground cover was identified within five 1-m² plots located along each transect (10 plots per circle) and percentage of each plot occupied by each plant species was estimated. Percentage ground cover was measured with a comb-like, point count apparatus having 10 teeth (76 cm long) spaced 8 cm apart (Mueller-Dombois and Ellenberg, 1974). The instrument was placed perpendicular to the ground at five

sampling stations along each side of the transects and a reading was made (20 readings per circle).

All shrubs were identified and counted within 1 m of each transect. A shrub was defined as any woody plant greater than 0.5 m in height and less than 8 cm (3-in.) diameter at breast height (DBH). All trees (woody plants greater than 8 cm DBH) were identified and DBH was measured. Canopy height was measured using a clinometer and percentage canopy cover was visually estimated within each circular plot.

Breeding birds were surveyed from 7-11 June 1982 along eight 0.8 km (0.5 mile) segments of the Duck River. Stretches of river to be sampled were located at alternate 0.8 km intervals from Hardison Mill to Carpenter's Bridge, a distance of approximately 13 km. Each morning from 0545 to 1030 hours CST all eight sections were floated in a 4 m flat-bottom boat, and all birds seen or heard were recorded. One observer was responsible for maneuvering the boat and another for recording observations. An electric trolling motor was used to expedite travel along the more sluggish sections of the river while a 15-HP outboard motor was used for travel between study float segments. Each 0.8 km float took an average of 21 minutes.

RESULTS AND DISCUSSION

Ground Cover

Thirty-seven different species of ground cover plants were identified from 80 1-m² plots (Table 1). Overall, grass (Gramineae) and stinging nettle (*Urtica dioica*) were the most important ground cover plants, with the highest combined frequency and dominance values. All other ground cover plants occurred in less than 10 percent of the plots and had dominance values of 1 percent or less. Ten species occurred only on the riverine cedar plot. Average percent ground cover for the study site was 83 percent.

Understory

The understory in most of the study plots was characterized by a low shrub density and dominated by a few moist-site adapted species. Of 21 different species of shrubs identified within the 16 study transects (Table 1), 15 species were found only on riverine cedar forest plot. Box elder (*Acer negundo*) and ash (*Fraxinus* sp.) were the most densely occurring shrubs on all study plots except the riverine cedar forest plot, where coralberry (*Symphoricarpos orbiculatus*) and upland forestiera (*Forestiera ligustrina*) dominated. Fourteen transects were located in the floodplain and contained from 0 to 7 total shrub stems per transect. In contrast, there were 159 shrub stems within the two transects located in the cedar forest plot. However, this plot was located at the top of a limestone river bluff well out of the floodplain. An average shrub density of 2,903 shrubs/ha was calculated for the eight circular plots sampled.

Overstory

Of twenty different tree species identified within the riverine habitat plots (Table 1), box elder was the most frequently occurring and had the highest density. Red maple (*Acer rubrum*) and ash also formed a significant portion of the riverine overstory. Because of heavy rains prior to our study, many of the large sycamore trees (*Platanus occidentalis*) at the immediate edge of the water were partially submerged and could not be sampled. Therefore,

TABLE 1. The 10 most frequently occurring (%), dominant (%), and dense (plants/ha) ground cover plants, shrubs, and trees within sample plots along the Duck River.

Species	Frequency	Dominance	Density
GROUND COVER			
GRASS (Gramineae)	95	57	—
<i>Urtica dioica</i> (Stinging nettle)	33	14	—
<i>Polygonum</i> sp. (Smartweed)	25	3	—
<i>Pilea pumila</i> (Clearweed)	23	2	—
<i>Iresine rhizomatosa</i> (Bloodleaf)	19	3	—
<i>Aster</i> sp. (Aster)	16	3	—
<i>Tovara virginiana</i> (Virginia jumpseed)	14	1	—
<i>Vernonia noveboracensis</i> (New York ironweed)	13	2	—
<i>Vesbesina occidentalis</i> (Small yellow crownbeard)	11	1	—
<i>Lysimachia nummularia</i> (Moneywort)	11	1	—
SHRUBS			
* <i>Symphoricarpos orbiculatus</i> (Coralberry)	—	—	556
* <i>Forestiera ligustrina</i> (Upland forestiera)	—	—	494
<i>Ulmus americana</i> (American elm)	—	—	385
* <i>Rhus aromatica</i> (Fragrant sumac)	—	—	341
<i>Acer negundo</i> (Box elder)	—	—	232
<i>Fraxinus</i> sp. (Ash)	—	—	217
* <i>Ostrya virginiana</i> (E. hophornbean)	—	—	109
* <i>Acer saccharum</i> (Sugar maple)	—	—	108
<i>Maclura pomifera</i> (Osage-orange)	—	—	77
* <i>Carya</i> sp. (Hickory)	—	—	77
TREES			
<i>Acer negundo</i> (Box elder)	88	31	151
<i>Fraxinus</i> sp. (Ash)	50	2	47
<i>Acer rubrum</i> (Red maple)	63	34	35
<i>Ailanthus altissima</i> (Tree-of-heaven)	13	1	22
<i>Catalpa speciosa</i> (N. catalpa)	25	4	22
<i>Celtis occidentalis</i> (Hackberry)	38	3	22
<i>Acer saccharinum</i> (Silver maple)	13	1	20
<i>Ulmus americana</i> (American elm)	38	4	15
<i>U. rubra</i> (Slippery elm)	38	4	15
<i>Juniperus virginiana</i> (E. redcedar)	13	1	10

*Found only on plot 6, a cedar forest.

estimates for this species of tree have probably been underestimated.

Most trees were in the 8 to 15 cm DBH range (185 tree/ha) followed by trees in the 23 to 38 cm (74 trees/ha) and 53 to 101 cm ranges (27 trees/ha). Total tree density was estimated at 403 trees/ha. Trees within the 38- to 53-cm size class were the most dominant (31 percent), followed by trees within the 23- to 38-cm size class (19 percent). The largest trees recorded were two red maples of 93 and 100 cm DBH. Overstory height averaged 20 m and ranged from 18 to 21 m. Canopy cover ranged from 50 to 90 percent and averaged 76 percent.

Breeding Birds

During the 5-day census period, 62 species of breeding birds were recorded along the riverine corridor (Table 2). While some of these species such as the green-backed heron (*Butorides striatus*), wood duck (*Aix sponsa*), belted kingfisher (*Ceryle alcyon*), and Louisiana waterthrush (*Seiurus motacilla*) were strictly associated with the river,

TABLE 2. Breeding birds recorded on a June 1982 census of eight 0.8 km segments of the Duck River.

Species	\bar{x} No. birds detected per 0.8 river km	Freq. occurrence (%) per 0.8 river km
Green-backed heron (<i>Butorides striatus</i>)	0.18	18
Wood duck (<i>Aix sponsa</i>)	0.08	8
Black vulture (<i>Coragyps atratus</i>)	0.15	8
Turkey vulture (<i>Cathartes aura</i>)	0.03	3
Broad-winged hawk (<i>B. platypterus</i>)	0.13	13
Red-tailed hawk (<i>Buteo jamaicensis</i>)	0.08	8
Northern bobwhite (<i>Colinus virginianus</i>)	1.35	80
Rock dove (<i>Columba livia</i>)	0.13	5
Mourning dove (<i>Zenaidura macroura</i>)	0.70	38
Yellow-billed cuckoo (<i>Coccyzus americanus</i>)	0.83	65
Eastern screech-owl (<i>Otus asio</i>)	0.10	8
Great horned owl (<i>Bubo virginianus</i>)	0.18	15
Common nighthawk (<i>Chordeiles minor</i>)	0.03	3
Ruby-throated hummingbird (<i>Archilochus colubris</i>)	0.13	13
Belted kingfisher (<i>Ceryle alcyon</i>)	0.85	48
Red-headed woodpecker (<i>Melanerpes erythrocephalus</i>)	0.08	5
Red-bellied woodpecker (<i>M. carolinus</i>)	1.20	73
Downy woodpecker (<i>Picoides pubescens</i>)	1.05	73
Northern flicker (<i>Colaptes auratus</i>)	0.60	58
Pileated woodpecker (<i>Dryocopus pileatus</i>)	0.28	28
Eastern wood-pewee (<i>Contopus virens</i>)	0.80	65
Acadian flycatcher (<i>Empidonax virens</i>)	2.03	78
Eastern phoebe (<i>Sayornis phoebe</i>)	0.25	20
Great crested flycatcher (<i>Myiarchus crinitus</i>)	0.98	70
Eastern kingbird (<i>Tyrannus tyrannus</i>)	0.03	3
Northern rough-winged swallow (<i>Stelgidopteryx serripennis</i>)	0.85	43
Barn swallow (<i>Hirundo rustica</i>)	0.05	5
Blue jay (<i>Cyanocitta cristata</i>)	1.68	73
American crow (<i>Corvus brachyrhynchos</i>)	0.30	18
Carolina chickadee (<i>Parus carolinensis</i>)	1.88	85
Tufted titmouse (<i>P. bicolor</i>)	0.65	53
Carolina wren (<i>Thryothorus ludovicianus</i>)	1.13	78
Blue-gray gnatcatcher (<i>Poliophtila caerulea</i>)	0.68	50
Wood thrush (<i>Hylocichla mustelina</i>)	0.50	35
Gray catbird (<i>Dumetella carolinensis</i>)	0.45	35
Brown thrasher (<i>Toxostoma rufum</i>)	0.03	3
European starling (<i>Sturnus vulgaris</i>)	0.08	8
White-eyed vireo (<i>Vireo griseus</i>)	0.10	10
Yellow-throated vireo (<i>V. flavifrons</i>)	0.15	15
Red-eyed vireo (<i>V. olivaceus</i>)	0.40	33
Northern parula (<i>Parula americana</i>)	0.58	43
Yellow-throated warbler (<i>Dendroica dominica</i>)	0.10	8
Prairie warbler (<i>D. discolor</i>)	0.25	23
Prothonotary warbler (<i>Protonotaria citrea</i>)	0.90	65
Ovenbird (<i>Seiurus aurocapillus</i>)	0.03	3
Louisiana waterthrush (<i>S. motacilla</i>)	0.65	45
Kentucky warbler (<i>Opornis formosus</i>)	0.15	15
Common yellowthroat (<i>Geothlypis trichas</i>)	1.18	80
Yellow-breasted chat (<i>Icteria virens</i>)	0.55	43
Summer tanager (<i>Piranga rubra</i>)	0.13	13
Scarlet tanager (<i>P. olivacea</i>)	0.08	8
Northern cardinal (<i>Cardinalis cardinalis</i>)	2.00	80
Blue grosbeak (<i>Guiraca caerulea</i>)	0.18	18
Indigo bunting (<i>Passerina cyanea</i>)	2.58	98
Rufous-sided towhee (<i>Pipilo erythrophthalmus</i>)	0.38	30
Field sparrow (<i>Spizella pusilla</i>)	0.63	58
Red-winged blackbird (<i>Agelaius phoeniceus</i>)	0.03	3
Eastern meadowlark (<i>Sturnella magna</i>)	0.30	23
Common grackle (<i>Quiscalus quiscula</i>)	2.33	70
Brown-headed cowbird (<i>Molothrus ater</i>)	0.73	48
Orchard oriole (<i>Icterus spurius</i>)	0.15	10
American goldfinch (<i>Carduelis tristis</i>)	0.75	53

other species such as the northern bobwhite (*Colinus virginianus*) and eastern kingbird (*Tyrannus tyrannus*) were closely tied to adjoining agricultural lands.

The most numerous (3.2 birds per 0.8 river km) and most frequently occurring (98 percent) bird along the river was the indigo bunting (*Passerina cyanea*). The indigo bunting is characteristic of ecotones where medium to large-sized trees are available for calling and shrubby bushes are present for nesting. Both of these conditions are abundant along the riverine zone of the Duck River. Next in frequency of occurrence were the Carolina chickadee, *Parus carolinensis*, (85 percent); northern bobwhite (80 percent); common yellowthroat, *Geothlypis trichas*, (80 percent); northern cardinal, *Cardinalis cardinalis*, (80 percent); and acadian flycatcher, *Empidonax virescens*, (78 percent). Birds with the highest densities (birds per 0.8 river km) were the common grackle, *Quiscalus quiscula*, (2.33); acadian flycatcher (2.00); Carolina chickadee (1.88); blue jay, *Cyanocitta cristata* (1.68); and northern bobwhite (1.35).

The structurally complex habitat along the riverine corridor provided some or all of the life requisites for many different species of birds. Although the tree canopy averaged 76 percent closure on the riverine study segment, there was good sunlight penetration from both sides of the narrow riverine corridor to the forest floor. This resulted in a dense ground cover (83 percent) and a midstory with trees predominantly in the 8 to 15 cm DBH range, which provided nesting and escape cover for a variety of birds. Large numbers of cavity trees along the river provided nesting sites for the eastern screech-owl (*Otus asio*), wood duck, prothonotary warbler (*Protonotaria citrea*), great crested flycatcher (*Myiarchus crinitus*), Carolina chickadees, tufted titmouse (*Parus bicolor*), and five species of woodpeckers recorded during our census. Feeding barn (*Hirundo rustica*) and northern rough-winged swallows (*Stelgidopteryx serripennis*) were attracted to the frequent insect hatches along the river. American crows (*Corvus brachyrhynchos*), black (*Coragyps atratus*) and turkey vultures (*Cathartes aura*) scavenged on the dead fish that were found on the river banks. Northern bobwhites, mourning doves (*Zenaida macroura*), and other birds were observed drinking or bathing at the water's edge during the census.

The diverse avifauna recorded during the census can also be attributed to the variety of habitat types traversed by the narrow, wooded riverine corridor, which created a continuous edge effect. Cover type maps prepared from aerial photographs (Tennessee Valley Authority, 1966) re-

vealed that lands abutting the riverine study corridor consisted of 43 percent pasture and abandoned agricultural lands, 21 percent cropland, 18 percent upland hardwood forest, 17 percent mixed cedar-hardwood forest, and 1 percent cedar forest. Thus, 64 percent of the lands immediately adjacent to the riparian zone were in some type of agricultural use with limited tree and shrub cover. Most of the forested land that abutts the corridor was located in very steep terrain or contained frequent outcroppings of limestone rock, thereby making this land unsuitable for agricultural purposes.

When considered alone, the avifauna of abutting lands was much less diverse than that of the riverine corridor. For example, breeding bird censuses conducted on abandoned agricultural land, upland hardwood forest (Fowler and Fowler, 1983) and cedar forest sites (Fowler and Fowler, 1984) in the Duck River Project area revealed an average of 12 species on upland hardwood forest and abandoned agricultural land sites and 18 species on cedar forest sites. Pasture and cropland, which abutt much of the riverine corridor, were not censused but undoubtedly support an even less diverse avifauna. In summary the narrow riparian zone which lines the Duck River provides foraging, nesting, escape, and roosting cover for many birds which would otherwise not be there.

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A VEGETATION-HABITAT STUDY ALONG A PORTION OF THE NORTH FORK-FORKED DEER RIVER IN WEST TENNESSEE

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ABSTRACT

A series of 24 vegetation-habitat study quadrats was established along and near the northern side of the North Fork-Forked Deer River approximately 5-6 miles east of

Dyersburg, Tennessee. There are three distinct physical and structural habitats: bottomland forest habitat, savanna habitat and marsh habitat depending on the drainage pattern of the areas into the river. Species presence, species