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FOREST HABITAT USE BY WHITE-TAILED DEER IN THE ARKANSAS COASTAL PLAIN

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ABSTRACT

Forest habitat use by five radio-equipped white-tailed deer *(Odocoileus virginianus)* was monitored in the Arknasas Coastal Plain during 1982-84. The deer were located 821 times. Use of forest types was compared to expected use as calculated from availability. The study area was also divided into 491 two-hectare cells for which timber characteristics and number of deer locations were determined. Pine sawtimber was the most heavily used forest type in all seasons and was used more often than expected during spring. Also used more than expected were brushy areas (clearcut but not site prepared) during spring, summer and fall and openings (grass fields and a site-prepared clearcut) during summer. Hardwood stands were used less often than expected during every season. Also used less than expected were pine pulpwood stands in summer and pine-hardwood stands during spring and summer. A significant ($P < 0.001$) discriminant function correctly classified 74% of the two-hectare cells as used (1 + locations) or not used (0 locations). Used cells often had less hardwood pulpwood and sawtimber and more pine sawtimber than nonused cells. Use by deer of cells containing stand edges did not differ from use of cells without edges.

INTRODUCTION

The white-tailed deer *(Odocoileus virginianus)* is an important natural resource in Arkansas. In Arkansas, an estimated 66,000 deer were harvested during the 1983-84 season by 217,600 hunters (Cartwright, 1984). Forty-eight percent of the 1983-84 Arkansas deer harvest was from the Coastal Plain region (Cartwright, 1984).

Forests provide most of the habitat for white-tailed deer and much of the area used for deer hunting. About one-half of Arkansas is forested. The Coastal Plain, the region of the state most heavily used for deer hunting, is 73% forested (USDA Forest Service, 1979).

In 1984, Arkansas produced about 4% of total United States wood products (Kluender *et al.*, 1988). To meet the needs of the Arkansas forest industry, large areas of Coastal Plain forest are intensively managed. Therefore, large areas of deer habitat in Arkansas are influenced by forest management. The objective of this study was to determine forest habitat use by white-tailed deer in the Arkansas Coastal Plain.

METHODS

This study was conducted on the 285-ha University of Arkansas at Monticello Forest and about 190 ha of surrounding forest owned by Georgia-Pacific Corporation. The area is located about 5 km east of Monticello in Drew County, Arkansas, and is typical of the Coastal Plain physiographic region of the southeastern United States. Even-aged stands of loblolly *(Pinus taeda)* and shortleaf *(P. echinata)* pine (20 to 45 years old), and unevenaged pine, hardwood and mixed pine-hardwood stands dominate the area (Table 1). Also present are brushy areas (clearcut but not site-prepared) and openings such as a site-prepared, unplanted clearcut and grassy fields (Table 1). Dominant hardwood species are sweetgum *(Liquidambar styraciflua)*, hickories (*Carya* spp.), southern red oak *(Quercus falcata)*, water oak *(Q. nigra)* and willow oak *(Q. phellos)*. Ground-level woody vegetation is characterized by American beauty-berry *(Callicarpa americana)*, blueberry (*Vaccinium* spp.), greenbriar (*Simlax* spp.), Japanese honeysuckle *(Lonicera japonica)* and blackberry (*Rubus* spp.).

Timber inventory data routinely collected on the study area were used. Data available for hardwood and pine, and pulpwood and sawtimber included basal area (BA), diameter at breast height (dbh), volume and the number of stems per acre. Pine trees from 15.2 to 25.1 cm dbh and hardwood trees from 15.2 to 30.2 cm dbh were classed as pulpwood. Trees with larger dbhs were termed sawtimber. Stands were classed as pulpwood or sawtimber stands if the average dbh of all trees was within these specified ranges. Stands were categorized as pine if > 75% of the BA was in pine, as hardwood if > 75% of the BA was in hardwood and as pine-hardwood if pine and hardwood each accounted for 25-75% of the BA. The term total, as used in this study, refers to timber characteristics of all trees.

Table 1. White-tailed deer use of Arkansas Coastal Plain forest stands by forest type and season, 1982-84.

Forest Type	% of Study Area	% of Locations[a,b] Spring	Summer	Fall	Winter	Total
No. locations		103	113	372	233	821
Pine Sawtimber	28	53+	29	34	30	35+
Pine Pulpwood	10	5	1-	14	11	10
Hardwood	24	12-	14-	12-	12-	12-
Pine-Hdwd	22	9-	11-	21	24	19
Sweetgum Plantation	1	1	3	1	1	1
Brush	4	11+	19+	9+	7	10+
Open	11	9	23+	9	15	13

[a] Symbols indicate use significantly ($P < 0.05$) more (+) or less (-) than expected, based on availability.

[b] Spring = Mar-May, Summer = Jun-Aug, Fall = Sep-Nov, Winter = Dec-Feb.

Five white-tailed deer (three 1.5-year-old males and two 1.5-year-old females) were captured on the study area during 1982 to 1983 using box traps. Each deer was fitted with a collar-mounted radio transmitter operating in the 151 MHz range and released at the capture-site. The deer were located at randomly-selected times from 20 October 1982 to 15 October 1984. Locations were determined using two bearings that differed by 45-90 degrees and were taken less than 10 minutes apart and less than 0.40 km from the deer.

The number of locations in each habitat type on the study area was determined, and habitat use and availability were compared using the Bonferroni z-statistic (Neu *et al.*, 1974). All forest stands on the study area were assumed to be available to the deer. The expected number of locations in each forest type was calculated as the product of the total number of deer locations and the proportion of the study area in that forest type (Neu *et al.*, 1974). The terms preference, preferred, or greater than expected, as used in this study, indicate statistically

greater use of a forest type than the calculated expected value. The terms avoided or less than expected indicate use statistically less than the expected value.

A map of the study area was divided into 2-ha square cells, and timber inventory data were determined for each cell. For cells containing the edges of 2 or more stands, the timber inventory data for the predominant stand were used. The degree of contrast in each timber characteristic along stand edges occurring in the cells were also measured. For cells with no stand edges, values of 0 were assigned to the difference variables.

The number of deer locations was counted for each 2-ha cell and cells were classified as used (1 + deer location) or not used (0 location) for each season and for the entire study period. Timber characteristics of used and nonused cells were analyzed using discriminant analysis (Norusis, 1988). Two stepwise discriminant analyses were used to minimize multicollinearity (Sanathanan, 1975). Minimization of Wilks' lambda was the variable selection criteria. The average values of timber characteristics selected for the discriminant functions were compared between used and nonused cells using an F-test. Contingency table analysis was used to test for preferential use of 2-ha cells containing stand edges. Significance was accepted at the 0.05 probability level.

RESULTS AND DISCUSSION

The deer were located 821 times over the study period. Pine sawtimber was the most heavily used forest type (Table 1) and was used more than expected during spring and over the entire study period. Brusy areas were preferred habitat during spring, summer and fall, and for the entire study period. Openings were used more than expected during summer.

Three forest types were used less than expected based on their availability. Although 12% of all locations were in hardwood stands, this habitat type was used less than expected during every season and over the entire study period (Table 1). Pine-hardwood stands were avoided during spring and summer, and pine pulpwood stands were used less than expected during summer (Table 1).

Seventeen stand characteristics were chosen for the function discriminating between used and nonused 2-ha cells (Table 2). The function correctly classified 74% of all cells and 82% of used cells. Two-hectare cells that were used by deer had more basal area and volume in pine pulpwood than cells that were not used. Used cells also had more pine sawtimber basal area, a greater pine sawtimber dbh, more sawtimber (pine and hardwood) stems and basal area and a greater total dbh than nonused cells. Used cells were located in stands with less perimeter (km of edge) length and more area than stands in which nonused cells were located.

Cells containing stand edges were not used at a rate different from cells without edges during any season or over the entire study period. Thirty-nine percent of all 2-ha cells contained edges of 2 or more stands. Of used cells, 42% contained stand edges. Cells containing high-contrast edges (a difference of > 25 sawtimber stems/ha), however, were used more often (56% vs. 41%) than cells with less contrast in number of sawtimber stems ($\chi^2 = 8.86$, 1 df, $P = 0.003$). Used cells had less contrast across edges in hardwood pulpwood basal area and volume (Table 2).

We feel that the preferential use of pine sawtimber stands, brushy areas and openings was related to the abundance of ground-level vegetation in these habitats. Although the diet of white-tailed deer in Coastal Plain forests is highly variable and changes seasonally (Newsome, 1984), forbs and the leaves and succulent twig tips of woody plants are preferred foods (Blair and Brunett, 1980). Thill (1984) found in Louisiana that about 90% of deer diet was woody browse, ranging from 85% in winter to 92% in fall. Forb usage varied from 6% in fall to 14% in winter. Hard and soft masts comprised less than 1% of deer diet in all seasons except in fall when they accounted for about 10%.

The production of these foods in southern forests has been related in other studies to overstory characteristics (Halls, 1970; Blair and Brunett, 1977; Wiggers *et al.*, 1978; Hurst *et al.*, 1979; Fenwood *et al.*, 1984). Browse, forb and grass production is inversely related to basal area and number of forest layers (Halls and Schuster, 1965; Blair, 1967; Blair and Enghardt, 1976; Wiggers *et al.*, 1978; Hurst *et al.*, 1979). Soft and hard mast yields may also decrease as stand density increases (Blair, 1969).

Table 2. Standardized discriminant function coefficients and average values for forest characteristics of 2-ha cells used (1 + location) and not used (0 locations) by white-tailed deer in the Arkansas Coastal Plain, 1982-1984.

Stand Characteristic[a]	Standardized Discr. Func. Coefficients	Mean Used	Mean Not Used	P
No. of cells		224	267	
Stand Area	0.634	14.0	12.1	0.002
Stand Perimeter	-0.752	2.0	2.3	0.006
Pine Pulpwood BA	1.982	3.4	1.7	<0.001
Pine Pulpwood Volume	-1.361	23.7	12.6	<0.001
Pine Sawtimber BA	3.154	4.6	2.3	<0.001
Pine Sawtimber dbh	-0.316	19.1	14.9	0.014
Hdwd Sawtimber Volume	2.162	3.1	3.9	0.105
Sawtimber BA	-1.772	6.6	5.3	0.013
Sawtimber Stems	-0.904	62.2	51.6	0.046
Total dbh	-0.556	22.5	19.3	0.006
Contrast across stand edges within cells in:				
Pine Sawtimber dbh	0.300	9.2	6.8	0.082
Hdwd Pulpwood BA	1.641	1.1	2.1	0.010
Hdwd Pulpwood Volume	-1.888	6.6	14.5	0.005
Pulpwood dbh	-0.686	4.3	4.2	0.863
Sawtimber BA	-1.084	3.0	2.5	0.240
Sawtimber Stems	0.703	37.8	24.9	0.035
Total dbh	0.808	5.8	4.7	0.192

[a] Units of measure are: area (ha), perimeter (km), BA (m^2/ha), pulpwood volume (m^3/ha), sawtimber volume (m^3/ha), stems (trees/ha), and dbh (cm).

In most southern forests, a dense multilayered midstory of hardwoods inhibits forage growth (Schuster and Halls, 1963; Blair, 1969; Blair and Enghardt, 1976; Blair and Feduccia, 1977). A dense hardwood midstory may also cause undesirable changes in forage production by decreasing total number of species, the number of palatable species and plant vigor (Schuster and Halls, 1963; Blair, 1967). In older stands with little hardwood midstory, more light reaches the forest floor than in stands with a midstory or in younger stands with low, dense canopies (Blair, 1969).

Used 2-ha cells and preferred forested habitats in this study usually had an open pine sawtimber overstory, little hardwood mistory and abundant browse available. Eighty-one percent of the locations in forested habitats were in stands with less than 25% of standing volume in hardwood pulpwood. Fifty-seven percent of locations in forested habitats were in stands in which hardwood comprised less than 25% of the pulpwood basal area. Brushy and open areas also had abundant deciduous browse such as Japanese honeysuckle, American beautyberry, blackberries, oaks and red maple *(Acer rubrum)* that remained available into late fall.

Conversely, habitats used less than expected often had a dense hardwood midstory that shaded forage. For example, 2-ha cells that were not used during spring had more stems, basal area and volume in hardwood sawtimber than cells that were used. Cells not used during spring and summer had more stems and basal area in hardwood pulpwood than used cells. The pine pulpwood stands used less than expected were without a hardwood midstory but typically had low, closed canopies and less forage than sawtimber stands.

CONCLUSIONS

Habitat use by white-tailed deer in the Arkansas Coastal Plain is complex and explainable only by simultaneous consideration of many habitat charcteristics. The results of this study, however, suggest that forest characteristics influence habitat use. Openings and pine sawtimber stands with little hardwood midstory were preferred, probably becuse these characteristics are usually associated with increased forage production.

Cultural practices that reduce overstory density and minimize hardwood midstory formation will ensure adequate light to the understory

and enhance habitat quality (Blair, 1969). Hardwood control should be used when making routine thinnings in managed stands to avoid development of a dense midstory (Blair and Feduccia, 1977). Preferential edge use by white-tailed deer has been reported (Williamson and Hirth, 1985). However, only edges offering high contrast in the number of sawtimber stems were preferentially used by deer in this study.

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