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Wildlife Habitat Function of Bottomland Hardwood Wetlands, Cache River, Arkansas

PURPOSE: This technical note provides an overview of field research and presents a model for assessing the wildlife community in bottomland hardwoods (BLH).

BACKGROUND: The Wetland Evaluation Technique (WET) (Adamus and others 1987), a technique designed to assess the functions and values of the wetlands in the United States, is currently being used by personnel from the US Army Corps of Engineers, Federal Highway Administration (FHWA), US Environmental Protection Agency (EPA), other federal and state agencies, and the private sector. Under the WRP the WET continues to undergo review and revision. In addition, versions of the WET are being developed for specific wetland types, such as BLH (Adamus, Smith, and Muir in preparation). The research being conducted at the Cache River, Arkansas, is designed to provide the detailed information necessary to develop quantitative models for assessing the biological functions of BLH.

INTRODUCTION: The objective of the wildlife habitat research at the Cache River was to define the relationship between wildlife species composition and environmental features across a topographic gradient. Understanding this relationship contributed to the development of a wildlife community habitat model for BLH. This technical note discusses sampling design, data collection results, and the wildlife habitat community model developed using this information.

The Cache River is located in northeastern Arkansas and originates just north of the Arkansas-Missouri state line. The river flows 203 miles to its confluence with the White River near Clarendon, Arkansas. The river basin is approximately 2,018 square miles in area and is 143 miles long with a maximum width of 18 miles. In the vicinity of the study area the forested floodplain ranges from 1 to 2 miles in width. The main channel of the river has meandered across the floodplain creating numerous cutoffs, side channels, and abandoned channels. Extensive areas of cypress/tupelo backswamp exist along the river. More detailed information about the study site can be found in Clairain and Kleiss (1989).

Wildlife habitat research is being conducted on the floodplain of a fourth-order reach of the Cache River near Gregory, Arkansas (Figure 1). This lower reach of the Cache River supports some of the largest contiguous tracts of BLH remaining in the Lower Mississippi River Valley (Cache River Basin Task Force 1978, US Army Corps of Engineers 1974). Much of the area is publicly owned and is managed jointly by the Arkansas Game and Fish Commission and the US Fish and Wildlife Service.

MAMMAL, REPTILE, AND AMPHIBIAN SAMPLING: Wildlife species composition of the BLH community was determined using 52 sampling arrays installed on transects A and C in May 1988 (Figure 1). Thirty of the arrays included 3 drift fences, 4 pitfall traps, 1 elevated trap platform with a trap set, and 2 ground trap sets consisting of a Sherman live trap and a Museum Special snap trap. Twenty-two of the arrays included all of the above with the exception of pitfalls and drift fences, which could not be installed due to a high water table. Traps were baited with a mixture of horse feed and peanut butter rolled in oatmeal.

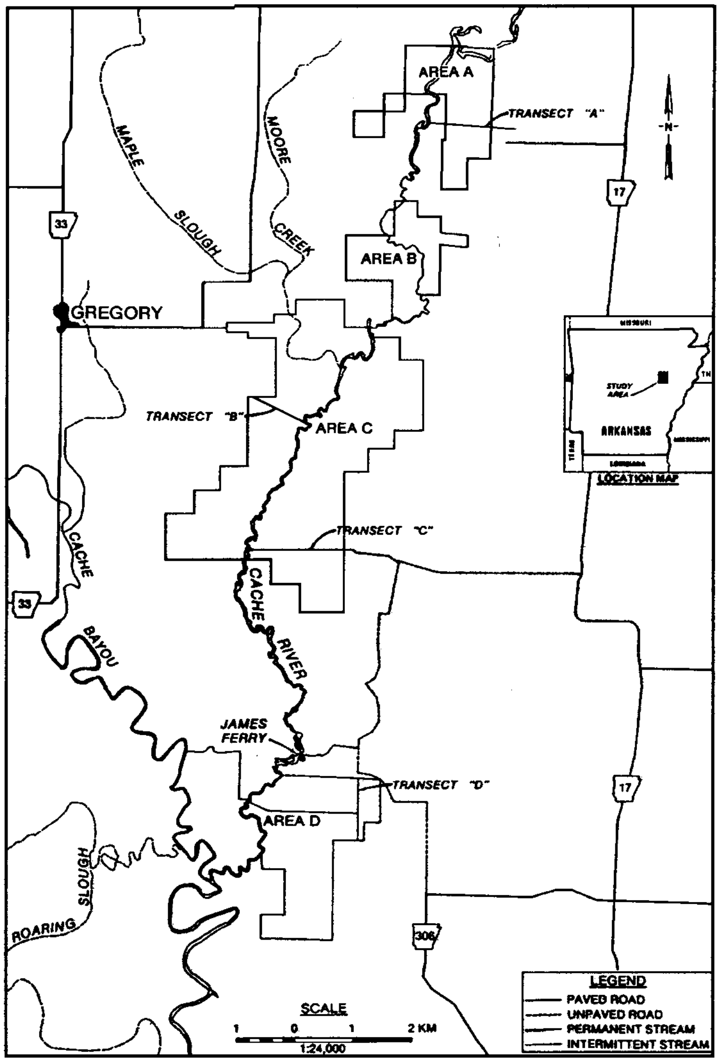

Figure 1. Cache River study areas

Traps in all arrays were run for a total of 22 days during May, August, and November 1988, and 29 days during June, August, October, and November 1990. Sampling periods were selected to represent a variety of seasons and water level conditions.

Over both years, 1,466 individuals were captured. A total of 11 mammal, 13 amphibian, and 6 reptile species were represented. Of these, 5 mammal, 10 amphibian, and 3 reptile species were captured in both 1988 and 1990.

During the three trapping periods of 1988, 810 individuals were captured. This included 9 mammal, 10 amphibian, and 5 reptile species. Live traps and snap traps provided 94 and 86 individuals, respectively, with all but 3 of these mammals. Seventeen percent of the small mammal captures were in traps on platforms in trees (38 individuals out of 223). Trap results for mammals were dominated by two species, the white-footed mouse (*Peromyscus leucopus*) and the cotton mouse (*P. gossypinus*). Pitfall traps yielded 630 individuals, primarily amphibians. Of the 810 total captures, 284 individuals were amphibians caught during May. The most commonly captured amphibians were the marbled salamander (*Ambystoma opacum*), green frog (*Rana clamitans*), and American toad (*Bufo americanus*). The most common reptile was the five-lined skink (*Eumeces fasciatus*).

Analysis of the 1990 data is not yet complete, but preliminary species lists have been compiled. There were 656 individual reptiles and amphibians captured, including 13 amphibian and 5 reptile species. In addition, there were 7 mammal species (plus unidentified *Peromyscus* and *Reithrodontomys*) captured. The southern leopard frog (*Rana sphenocephela*), green frog, and Woodhouse's toad (*Bufo woodhousei*) were the most common amphibians, and the five-lined skink was again the most common reptile.

Seasonal and yearly differences were seen in number of captures of some species of amphibians. For example, the marbled salamander was the dominant species captured in May and November 1988. They were absent in August 1988, June 1990, and August 1990, and only 12 were captured in November 1990. During both years, the green frog was more than twice as abundant in November than in other months. While rare in 1988, the southern leopard frog was the most common amphibian in 1990. The American toad was the most common toad in 1988, yet was greatly outnumbered by Woodhouse's toad in 1990.

BIRD SAMPLING: Bird surveys were conducted during the spring of 1988 and the winter of 1988-89. Two spring surveys were conducted on transects A and C, one in early April and another in mid to late May. The surveys were conducted approximately a month apart in order to examine use of the bottomland hardwood area by breeding resident species as well as early and late migrants. Each survey consisted of a count of birds within contiguous 60- by 80-m plots along the main and secondary (parallel) transects. There were 52 plots on the A transect and 58 on the C transect.

Two winter surveys were run only on the A transect. Sampling was conducted during mid-December, a period of low water, and during early March, a period of very high water. Approximately 75 percent of the plots were under water at the time of the March survey and much of the transect was surveyed using a canoe.

On most days, surveys were begun at or shortly after sunrise and lasted until midmorning. Some winter surveys were not begun until approximately an hour after sunrise when bird activity had increased. Surveys were conducted by slowly moving along each transect and tallying all birds present within the plot boundaries. The observers typically followed the center line of the transects; however, it was sometimes necessary to move throughout the plots to identify species or to determine a bird's location. Species were identified both visually and by calls. In some cases, identification to species was not possible and the genus (for example, *Empidonax*) or general group (for example, blackbirds (*Icteridae*)) was used.

Eighty-five species were identified during the study. There was considerable seasonal variation in the number of species; 68 species (plus unidentified *Empidonax*) were recorded during spring, but only 28 (plus unidentified blackbirds) were present during winter. Of those present during spring, 44 were considered to be resident breeders while 24 were migrants that breed in more northerly latitudes. Of the 44 resident species, 3, including the eastern kingbird (*Tyrannus tyrannus*), black-and-white warbler (*Mniotilta varia*), and red-winged blackbird (*Agelaius phoeniceus*), are not commonly found in bottomland hardwoods (James and Neal 1986). Most of the species identified from the site during winter, all but the Canada goose (*Branta canadensis*) and turkey vulture (*Cathares aura*), are considered to be winter residents of bottomland hardwoods in Arkansas (James and Neal 1986). Most of the species recorded during the spring and winter surveys were members of the order Passeriformes.

Numbers of species and individuals per plot varied widely. During spring the number of species per plot ranged from 7 to 21, while the number of individuals ranged from 9 to 34. Fewer species per plot were recorded during winter (range = 3-12) although, in some cases, the number of individuals per plot was much higher. For example, 3 plots contained over 200 individuals, primarily blackbirds.

WILDLIFE COMMUNITY HABITAT MODEL FOR BLH: Data from wildlife research on the Cache River were used to define the potential range of conditions for model variables, determine relative weights of each model variable, and refine the relationship between specific variable values and habitat quality. This is done through the analysis of habitat, wildlife, and hydrologic data. For example, the number of species whose occurrence is related to a specific moisture regime will help determine the weight given to that variable.

The draft wildlife community habitat model is designed to rate the quality of wildlife habitat in BLH and wooded swamps in the southeastern United States. Model output is a score ranging between 0.0 and 1.0, with a score of 1.0 corresponding with the habitat that supports the maximum species richness of birds, mammals, reptiles, and amphibians in BLH communities.

Optimum habitat is a large, relatively mature forest stand, with inherent diversity of stand types and variability in cover of various strata and tree sizes because of gaps, hydrologic variation, and topographic changes. The stand is subjected to a natural flooding cycle of water free of contaminants and comprises an unbroken tract of land bounded by nonurban land uses and largely undisturbed by human influence.

The range of conditions required by all species is expressed by variables at the plot and tract scale. Plot variables assess microhabitat and provide sample data for assessing internal conditions of the tract. Tract variables assess characteristics of the larger tract of BLH.

PLOT VARIABLES: Variables 1-8 are measured in the field on 0.04-ha plots. The number of plots is determined by the size of the tract and degree of homogeneity within the tract, and by the user's requirements for reliability of data. The following are plot variables.

- PV1 - Tree diameter. Average diameter of trees in the stand, with higher averages rated higher.
- PV2 - Overstory cover. Percent cover of live vegetation greater than 6 m tall in the overstory layer.
- PV3 - Mast types and variety. The diversity of tree species that produce hard and soft mast.
- PV4 - Old-growth elements. The number of items present in the plot that are found in old-growth forest stands; items are defined as objects or conditions that add structure and complexity to the habitat. The items are large trees, snags, large dead branches, trees with a basal or upper hollow, cavities, canopy vines, and epiphytes.
- PV5 - Moisture regime. An indication of the hydrologic zone, based on shrub species composition.
- PV6 - Understory cover. The percent cover of live vegetation between 1 and 6 m above the surface. This is the shrub layer, which includes species of trees that are less than 6 m tall.
- PV7 - Ground layer elements. The number of items present in a plot within 1 m of the surface; items are defined as objects or conditions that add structure and complexity to the ground layer. The items are leaf litter, woody debris, stumps, logs, live vegetation, root masses and brush piles, temporary water, and burrows.
- PV8 - Interspersion of moisture regimes. This is the degree of change across the tract (between plots) from wet to dry conditions, measured as distance to a topographic change.

TRACT VARIABLES: Variables 1-5 are measured based on the characteristics of the BLH tract and the surrounding area.

- TV1 - Core area factor. The area of an individual tract that is 100 m or more from a tract boundary that is bordered by nonforested habitat.

- TV2 - Isolation factor. A combination of two factors: permeability of the edge of a tract,that is, how different the adjacent cover types are, with upland deciduous forest being the most similar; and relative acreage of bottomland hardwoods in the vicinity. TV2 is calculated as the product of its two components.
- TV3 - Effective area. The measured area of the tract modified by the fragmentation factors for core area and isolation.
- TV4 - Water quality. The probability of poor water quality because of upstream or surrounding agricultural, industrial, or urban activities.
- TV5 - Disturbance. The probability of human disturbance lowering the quality of otherwise suitable habitat.

CALCULATIONS: The plot variables are converted to a Suitability Index (SI) on a scale of 0 to 1.0:

$$\frac{(PV1 \times PV2 \times PV3)^{1/2}}{3} + \frac{(PV4 \times PV6 \times PV7)^{1/2}}{3} + \frac{(PV5 \times PV8)^{1/2}}{3}$$

Each of the three components of the plot is considered necessary and weighted equally: tree layer (tree size, cover, and mast), additional structure (old-growth, understory, and ground elements), and hydrology (moisture regime, interspersion of wet and dry areas). No component may total greater than 0.34. Within each component, variables are weighted equally and can compensate for each other to some extent.

The tract SI is determined by modifying the Effective Area (TV3) SI by the adjustment factors for Water Quality (TV4) and Disturbance (TV5), as follows:

$$Tract\ SI = Effective\ Area\ SI \times Water\ Quality\ factor \times Disturbance\ factor$$

The Habitat Suitability Index (HSI) for the tract is the product of the tract and plot SIs.

The next step is to multiply area by HSI to obtain habitat units (HUs). HUs are determined for each of the five separate size classes of bottomland forests. This is necessary to prevent unintentional trade-off of large parcels for one or more smaller ones.

USE OF THE WILDLIFE COMMUNITY HABITAT MODEL IN BLH-WET: This approach to the wildlife function in BLH-WET is similar to the other functions in looking at the system holistically. The community model recognizes the importance of BLH to a large number of species and all vertebrate groups. It does not preclude application of HSI models for individual species or groups of species, if the user desires.

The output of 0 to 1.0 assumes a linear relationship between habitat quality and the number of species present in the evaluation area. The output should not be interpreted in relation to abundance of individuals, although it is generally true that as the number of species increases, so does the abundance of many individual species. The 0 to 1.0 scale can be reduced to classes (for example, low, moderate, and high), but there is a concurrent loss of information.

The model is structured to be flexible in its use. Some applications, such as a low-resolution comparison among tracts, can be done using just the tract-level variables, or using measured area with the appropriate tract size class SI curve. Data at the plot level can be measured or estimated, depending on the required precision of the answer.

The community model will be published as a Biological Report in the blue book HSI model series of the US Fish and Wildlife Service and as a miscellaneous paper of the WRP. It will be available to replace or supplement the wildlife function in WET-BLH.

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