THE EDGE EFFECT ON A FOREST BIRD COMMUNITY IN NORTH FLORIDA*

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Abstract: Literature addressing the concept of edge effect on wildlife species, as defined by Leopold (1933), is scanty, contradictory, and inconclusive. To investigate the presence of an edge effect on a breeding bird community in north Florida, 2 types of edge, cypress/clearcut and cypress/planted pine, were studied. Within the 20 m wide edges, the number of breeding bird species and individuals of a species were no greater than in respective bordering habitats for both edge types studied. However, density of species and individuals within the edge were significantly greater ($P < 0.01$) for both types of edge, indicating an edge effect. A species replacement phenomenon was observed which further distinguished the edge from the interiors of adjoining habitats.

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The concept of edge effect is a basic principle of wildlife management. Usually attributed to Leopold (1933) it states that a greater number of animals and animal species will be found along the edge of adjoining vegetative communities than within the vegetative communities per se.

Lay (1938), who defined edge as a 55 m (150 feet) strip between forest and adjacent clearing, found 41 percent more species and 95 percent more individual birds on the edges of forest stands than in their interiors. Similarly, Johnston (1947), who studied the edge between oak-maple (*Quercus* spp. - *Acer* spp.) forest and grassland in Illinois, reported 67 percent more birds and 26 percent more species in the edges than in the interior. She concluded the edge to be a distinct ecological community.

Barick (1950), however, concluded that the edge effect was considerably overrated with respect to ruffed grouse (*Bonasa umbellus*) and white-tailed deer (*Odocoileus virginianus*) populations in the Adirondacks. Ambrose (1975) found no distinct bird community associated with forest-clearing edges in Tennessee, although 7 of 23 species observed showed a high preference for edge.

This study was initiated to determine: 1) if there is an edge effect as stated by Leopold (1933), and 2) if so, is it evident in different types of edge. Edge is here defined as a 20 m wide strip extending 10 m into each of the adjoining communities.
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STUDY AREA

Intermingled throughout the pine (*Pinus* spp.) flatwoods of north Florida are small depressions dominated by pond cypress (*Taxodium distichum*). Though they comprise about 30 percent of the landscape, these cypress ponds are typically left uncut; forestry concerns harvest and reforest the surrounding pinelands only. As the regenerated forest matures, a range of edge types is created between it and the cypress ponds, thus presenting an excellent oportunity to study the edge effect.

Within this range of cypress/clearcut to cypress/mature pine edges, 2 extremes of edge type were chosen for initial study: cypress ponds surrounded by clearcut; and cypress ponds surrounded by slash pine (*P. elliottii*), 13 years old. Three replicated cypress ponds and an equal area of surrounding clearcut constituted the cypress/clearcut edge type. Similarly, 3 replicated ponds and an equal area of slash pine plantation comprised the cypress/pine edge type. Study sites, each consisting of a cypress pond and surrounding habitat, averaged 5.7 ha and 17.0 ha for the cypress/clearcut and cypress/pine, respectively. All sites were located approximately 37 km north of Gainesville, in Bradford County, Florida.

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The cypress-pond vegetation consisted of an overstory of cypress, black gum (*Nyssa biflora*), and scattered pond pine (*P. serotina*) with an understory of fetterbush (*Lyonia lucida*) and bamboo briar (*Smilax laurifolia*). The 3 ponds of the cypress/pine sites also had sweetbay (*Magnolia virginiana*) in the understory.

The cypress/clearcut sites were created by harvesting the mixed pine forest in February 1977. Site preparation, by roller chopper, reduced the remaining vegetation and logging slash to ground level. The resulting edge was a sharp abutment of cypress pond vegetation with unvegetated clearcut.

The pine plantation vegetation of the cypress/pine sites consisted of slash pines, 7 m in height, with an understory of wax myrtle (*Myrica cerifera*), saw palmetto (*Serenoa repens*), and gallberry (*Ilex glabra*). The corresponding edge was a mixture of plant species from each of the 2 adjacent habitats, with no unique species being present within the edges.

METHODS

Accurate measures of animal response were needed to study edge effect effectively within the narrow edge-zones. The use of the territory-mapping technique for breeding birds (Williams 1936) provided this accuracy, and was therefore utilized (c.f. Emlen 1977). A series of parallel, east-west transects at 50 m intervals was established on each of the study sites. Listening stations were located at 50 m intervals along each transect. At each listening station, bird locations were plotted by species on a map of the area, noting specific activities such as singing, calling, or movement (Robbins 1970). A minimum of 3 singing observations in a restricted locale was necessary to establish an individual's territory, although other observed activities were used to aid determination (Hall 1964). Six counts were conducted in each of the 6 study sites during the first 3 hours after sunrise, 12 April through 24 May 1977. Three evening counts were also made per site from 15 May through 10 June 1977 in order to map nocturnally active birds, such as chuck-will's widow (*Caprimulgus carolinensis*).

RESULTS AND DISCUSSION

Breeding territories were determined for 11 species of birds in the cypress/clearcut sites (Table 1). Eight of these species occurred in the cypress interior, 9 in the edge,

Table 1. Mean number of breeding birds (3 replications) within each habitat by species for cypress/clearcut and cypress/pine sites.

	Cypress/Clearcut			*Cypress/Pine*		
Species	*Cypress*	*Edge*	*Clearcut*	*Cypress*	*Edge*	*Pine*
Great crested flycatcher (*Myiarchus crinitus*)	6	8	—	9	8	3
Red-bellied woodpecker (*Centurus carolinus*)	4	1	—	6	1	—
Carolina wren (*Thyrothorus ludovicianus*)	13	1	—	8	10	—
Cardinal (*Richmondena cardinalis*)	4	6	—	12	18	2
Blue-grey gnatcatcher (*Polioptila caerulea*)	2	4	—	—	—	—
Prothonotary warbler	4	—	—	—	—	—
Rufous-sided towhee	—	18	—	—	22	15
Common yellowthroat	—	9	—	—	7	4
Chuck-will's-widow	—	4	—	—	—	—
Northern parula warbler (*Parula americana*)	11	2	—	29	8	—
White-eyed vireo	6	—	—	17	15	—
Blue jay (*Cyanocitta cristata*)	—	—	—	1.5	3.5	.5
Tufted titmouse (*Parus bicolor*)	—	—	—	7.5	2.5	2.5
Crow (*Corvus* spp.)	—	—	—	2	2	2
Pileated woodpecker	—	—	—	3	—	—
Yellow-billed cuckoo	—	—	—	2	—	—

and none in the surrounding clearcut (Table 2). Fifty-three birds were recorded in the cypress and 53 in the clearcut edge. Similar trends were exhibited in the cypress/pine sites (Table 2). Of 13 species present, 97 birds representing 11 species were found in the cypress, 97 birds of 11 species in the pine edge, and 29 birds of 7 species in the pine plantation.

Table 2. Average number and density of breeding bird species and individuals for cypress/clearcut and cypress/pine sites in each of 3 habitats. Both sites show significantly different species density and bird density within the edge habitat.

	Cypress/Clearcut			*Cypress/Pine*		
	Cypress	*Edge*	*Clearcut*	*Cypress*	*Edge*	*Pine*
No. Species	8	9	0	11	11	7
No. Birds	53	53	0	97	97	29
Species/ha	3.1	6.3[a]	0	1.6	3.9[a]	0.9
Birds/ha	20.2	37.3[a]	0	14.5	34.7[a]	3.9

[a]Significantly different ($P < .001$, paired t-test).

No edge effect on breeding bird populations was apparent if the absolute number of species and birds was the sole evaluation criterion. However, despite their use by earlier investigators as evidence for the edge effect, absolute numbers are inappropriate for such a comparison. Differences in habitat size must be considered. Therefore, density parameters for the edge and adjoining habitats should be the basis of comparisons. (It should be noted that Leopold stated the edge effect principle in terms of numbers, but most wildlife biologists now interpret his meaning in terms of density.)

For the cypress/clearcut sites, species densities were 3.1, 6.3, and 0.0 per hectare in the cypress, edge, and clearcut, respectively (Table 2). Species density in the edge was significantly greater (paired t-test, $P < 0.01$) than in adjacent cypress or clearcut. Density of birds, in the cypress/clearcut, was 20.2, 37.3, and 0.0 per ha for cypress, edge, and clearcut, respectively, revealing significantly greater (paired t-test, $P < 0.01$) bird density in the edge than in the adjoining habitats.

In the cypress/pine sites, species densities were 1.6, 3.9, and 0.9 per ha for the cypress, edge, and pine, respectively (Table 2). As in the cypress/clearcut sites, species density in the edge was significantly greater (paired t-test, $P < 0.01$) than adjacent cypress or pine. Bird densities in the cypres/pine were 14.5, 34.7, and 3.9 per ha indicating a significantly greater (paired t-test, $P < 0.01$) bird density in the edge than in adjacent cypress or pine.

Distinct from this species and bird density edge effect, I observed a species replacement phenomenon characterized by a change in the species composition of birds among habitats. In the cypress/clearcut sites, cypress interior and edge had a similar number of species, 8 and 9, respectively (Table 1). However, 2 species, prothonotary warbler (*Protonotaria citrea*) and white-eyed vireo (*Vireo griseus*) occurred only in the cypress, and 3 species, rufous-sided towhee (*Pipilo erythrophthalmus*) common yellowthroat (*Geothlypis trichas*), and chuck-will's widow, occurred only in the edge. In the cypress/pine sites both the pileated woodpecker (*Dryocopus pileatus*) and the yellow-billed cuckoo (*Coccyzus americanus*) occurred only in the cypress interior. Though not restricted to the edge, 60 percent of the rufous-sided towhees occurred in the edge. This represented a further distinction between the edge and adjoining habitats; not only did the edge have a greater density of species and birds but also a different species composition.

It is logical, as a final step, to compare density values of cypress/clearcut edge and cypress/pine edge. However, caution should be used when comparing densities derived from study areas of disparate size, for differences may reflect habitat size differences and not actual density differences. Galli et al. (1976) demonstrated that for New Jersey terrestrial-island habitats, greater individual bird densities can be expected in smaller habitats than in larger ones. Thus, observed differences between density values of cypress/clearcut and cypress/pine may represent differences due to cypress pond size and not edge type.

In summary, *both density* of *species* and of *individual* birds of a species were significantly greater in the edge than in adjoining habitats, demonstrating a preference by breeding birds for both types of edge examined. The species replacement phenomenon, marked by unique edge species, further distinguishes the edge from adjoining habitats.

LITERATURE CITED

Ambrose, R. E. 1975. The effect of small-tract clearcutting on populations of birds and small animals. Ph.D. Thesis. Univ. of Tennessee, Knoxville. 287 pp.

Barick, F. B. 1950. The edge effect of the lesser vegetation of certain Adirondack forest types with particular reference to deer and grouse. Roosevelt Wildl. For. Exp. Sta. Bull. 9(1). 146 pp.

Emlen, J. T. 1977. Estimating breeding season bird densities from transcet counts. Auk 94:455-468.

Galli, A. C., C. F. Leck, and R. T. T. Forman. 1976. Avian distribution patterns in forest islands of different sizes in central New Jersey. Auk 93:356-364.

Hall, G. A. 1964. Breeding bird censuses, why and how. Audubon Field Notes 18:413-416.

Johnston, V. R. 1947. Breeding birds of the forest edge in Illinois. Condor 49(2):45-53.

Lay, D. W. 1938. How valuable are woodland clearings to birdlife? Wilson Bull. 50:254-256.

Leopold, A. 1933. Game management. Chas. Scribner's Sons, New York. 481 pp.

Robbins, C. S. ed. 1970. An international standard of a mapping method in bird census work recommended by the International Bird Census Committee. Audubon Field Notes 24:723-726.

Williams, A. B. 1936. The composition and dynamics of a beech-maple climax community. Ecol. Monogr. 6:317-408.