

## BREEDING BIRDS ON BOTTOMLAND HARDWOOD REGENERATION AREAS ON THE DELTA NATIONAL FOREST

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**Abstract.**—Information on effects of clear-cutting and different methods of site preparation to regenerate bottomland hardwood forests on breeding bird densities is scarce. Therefore, a preliminary study was conducted of breeding bird density during spring-summer of 1975 on a  $\geq 50$ -yr-old bottomland hardwood forest and on three 4–5-yr-old hardwood regeneration areas, on the Delta National Forest, Mississippi. Following clear-cutting, the three sites were prepared for regeneration by either hand-injecting all residual trees with an herbicide, injecting most trees but leaving some desirable species, or by mechanically shearing all residual trees at ground level. Number of breeding species in the mature forest ( $n = 13$ ) was similar to that in a 4-yr-old regeneration area that had been hand-injected ( $n = 10$ ), and a 5-yr-old regeneration area that had been hand-injected but had residual trees ( $n = 12$ ). A 4-yr-old regeneration area that had been mechanically sheared had only four breeding bird species. Indices of similarity of species composition, compared to the mature forest, were 59% for hand-injected, 56% for hand-injected with residual trees, and 19% for the sheared area. Indices for hand-injected and hand-injected with residual trees were similar (86%) and were dissimilar to the sheared area, 21% and 20%, respectively. Highest breeding bird densities (pairs/40 ha) occurred on the hand-injected with residual trees (239) and hand-injected (228) areas, followed by mature forest (172) and sheared (66) areas.

### REPRODUCCIÓN DE LAS AVES EN ÁREAS DE MADERAS DURAS REGENERADAS EN EL BOSQUE NACIONAL DELTA

**Sinopsis.**—Es muy poca la información disponible sobre efecto del método de cosecho total de madera en la diversidad de aves residentes y los diferentes métodos en la preparación del lugar para que se regenere el bosque. A tono con esto, durante la primavera y el verano de 1975, se condujo un estudio preliminar sobre la densidad de aves residentes en un bosque de maderas duras (de mas de 50 años de edad) y en tres áreas regeneradas con maderas duras (de edad de 4–5 años) en el Bosque Nacional Delta, Mississippi. Luego de haberse cosechado los árboles, las tres localidades fueron tratadas de diferente manera. A saber: removiendo mecánicamente toda la vegetación residual, inyectando manualmente todos los árboles residuales con yerbicida y en tercer lugar, inyectando con yerbicida la mayoría de los árboles, a excepción de especies deseables. El número de especies de aves que se reprodujeron en el bosque maduro utilizado como control ( $n = 13$ ) fue similar al área de bosque regenerado de 4 años que había sido tratado a mano con yerbicida ( $n = 10$ ) y al bosque de 5 años en donde se dejaron especies deseables. En el bosque de 4 años, que fue tratado mecánicamente, tan solo se encontraron 4 especies de pájaros reproduciéndose. El índice de similaridad de la composición de especies (tomando como base el área control), fue de 59% para el área tratada a mano con yerbicida, 56% para el área tratada (en donde se dejaron especies deseables) y 19% para las áreas tratadas mecánicamente. Los índices de similaridad para las dos áreas tratadas con yerbicidas fue similar (86%) y diferente para el área tratada mecánicamente. La densidad de aves reproduciéndose (pájaros/40 ha) fue mayor en las áreas tratadas en donde se dejaron especies deseables (239), seguido de las áreas

tratadas (228), basque maduro (172) y estos a su vez por las áreas tratadas mecánicamente (66).

Interest in effects of forest management on birds has increased, and concurrently, most bottomland hardwood forests of the Mississippi River alluvial system have been converted to agricultural fields (Gosselink and Lee 1987, Harris 1984). Deleterious effects of forest removal on wildlife have been documented (Yancey 1969), but information on effects of hardwood regeneration methods on breeding birds of southern bottomland hardwood forests is scarce (Dickson 1978, Wesley et al. 1976).

The Delta National Forest (DNF), in the lower part of the Mississippi Delta, is occupied by bottomland hardwood forests. The DNF is managed for sawtimber and veneer hardwood on an 80-year rotation. At the time of the study, regeneration of hardwood forests was accomplished by sprouts from stumps (i.e., coppice management). However, there was no policy on what site-preparation method to use to achieve the best regeneration results. Site preparation entails preparing a harvested-site for regeneration of the next forest. In the 1970s, the Forest Service conducted experiments on site-preparation methods and hardwood sapling density, which offered an opportunity to study the impacts of clear-cutting and site-preparation methods on breeding birds (Bourland 1978).

#### STUDY AREA

Land for the DNF was purchased in 1935 and was given national forest status in 1961. The DNF contains 23,950 ha and is located in Sharkey and Issaquena counties, Mississippi (90°40'N, 32°40'W). Large fires and frequent flooding occurred during the 1920s with smaller fires during the 1930s–1950s. Much of the timber was harvested in this same 40-yr period. Winter and spring flooding varies in depth and duration and is a major factor affecting forest conditions and wildlife. Near total inundation of the DNF in late winter and spring is common.

Terrain is flat, and the soils are highly plastic clays. The sites (ridges, flats, and low flats) are similar and contain three forest types, sweetgum-nuttall oak-willow oak, sugarberry-American elm-green ash, and overcup oak-water hickory, depending on elevation (Table 2). Average height of mature trees was 27.45–30.5 m.

Even-aged management of stands began in the 1960s, and a total of 3903 ha had been regenerated by 1978. The management plan dictated an 80-yr rotation and a maximum clearcut size of 81 ha. During the 1980s, the maximum clearcut size was reduced to 16 ha.

Breeding bird usage was assessed in a  $\geq 50$ -yr-old mature forest (MF) and three regeneration areas. The MF was a sweetgum-nuttall oak-willow oak type on a ridge site. The MF was non-uniform in growth stages, multi-layered and had some small openings that contained low shrubs and vines. The herbaceous layer was sparse and basal area was 18 m<sup>2</sup>/ha. Stand size was 405 ha (Bourland 1978).

One regeneration area was on a low, flat site, and site preparation consisted of shear blading (SB) or mechanical shearing with a "V" blade of

TABLE 1. Breeding bird density (pairs/40 ha) in a mature bottomland hardwood forest and in three regeneration areas with different site preparation methods and age (yr), Delta National Forest, Mississippi, 1975.

Species	Mature forest (50+)	Hand-injected (4)	RBA <sup>a</sup> (5)	Sheared <sup>b</sup> (4)
Northern Cardinal	28	38	56	6
Rufous-sided Towhee	12	12	8	—
Indigo Bunting	6	24	46	—
White-eyed Vireo	—	18	24	—
Yellow-throated Vireo	4	—	—	—
Red-eyed Vireo	10	—	—	—
Prothonotary Warbler	14	32	16	—
Yellow-throated Warbler	—	—	4	—
Hooded Warbler	12	—	—	—
Yellow-breasted Chat	—	54	48	—
Red-bellied Woodpecker	26	10	—	—
Red-headed Woodpecker	—	14	8	—
Downy Woodpecker	4	—	—	—
Wood Thrush	26	—	—	—
Blue-gray Gnatcatcher	—	18	12	—
Tufted Titmouse	14	8	8	—
Carolina Wren	—	—	8	—
Red-winged Blackbird	—	—	—	52
Orchard Oriole	4	—	—	4
Yellow-billed Cuckoo	12	—	1	—
Summer Tanager	12	—	—	—
Total	172	228	239	66

<sup>a</sup> Residual basal area, some trees were not injected.

<sup>b</sup> All stems were mechanically sheared at ground level.

all residual stems above ground level (except a few wildlife priority trees or protected species). All slash was left on the ground and was not burned. The area was 32 ha, and the vegetation was in its fourth growing season when sampled for bird use. Stand profile was limited to one stratum, 0–1.5 m in height.

The second regeneration area of 28.8 ha was on a ridge site. Site preparation consisted of hand-injecting (HI) a herbicide into residual stems greater than 5 cm diameter at breast height (dbh). Vegetation was in its fourth year of growth, and hardwood reproduction (saplings) was evenly distributed over the area. The stand had low brush and a sparse midstory strata. Snags were not counted but were numerous.

The third regeneration area of 45 ha was on a flat site and site preparation was hand-injection (HIR); however, a residual basal area (20 m<sup>2</sup>/ha) was retained. Isolated trees or clumps of desirable oak stems with a dbh less than sawtimber size (25.4 cm) were not injected. This site was in its fifth growing season and had low brush and sparse midstory and overstory strata. Amount of edge was not measured, but this site had the greatest forest structural diversity. Snags were numerous, but there were

not as many as on the other hand-injected site. Mature forest surrounded the regeneration areas.

#### METHODS

To estimate breeding bird density, we used the territorial mapping method (Hall 1964, Samson 1979). Breeding males, detected either visually or audibly, were recorded by species and number on field maps. Presence and location of each bird thought to be non-breeding or transient were noted. A 10-ha rectangular census grid was established in the center of each area at least 100 m from any edge.

Twenty-four census stations were created on grid lines at corners and intersections in each area. Censusing was conducted by T. Bourland from 21 May to 3 Jul. 1975. Four censuses were conducted on the MF, HI, and SB areas; five censuses were conducted on the HIR. Censusing began at 0600 hours CDST and was conducted only when weather conditions were acceptable (e.g., calm winds and not raining). Length of a census period varied (average 2 h) according to number of birds observed, vegetation and ground conditions. Dense vegetation made observation of birds difficult and more time-consuming. Flooding was a problem, but had dropped by 20 May on the MF. The HI area was 90% flooded during the first two censuses.

#### RESULTS

A total of 34 species of birds was observed. Total number of species observed, including visitors, by area was: MF = 24, HI = 21, HIR = 21, and SB = 7. Number of breeding bird species was similar in MF (13), HI (10), and HIR (12), but was lower in SB (4). The index of similarity of species composition (Jaccard 1912) for MF compared with HI was 59%, compared with HIR was 56% and compared with SB was 19%. Indices for HI and HIR were similar (86%), but both were dissimilar to SB, 21% and 20%, respectively. Highest breeding bird densities (pairs/40 ha) occurred on the HIR (239) and HI (228), followed by MF (172) and SB (66) (Table 1).

Abundant species on the MF were Northern Cardinal, Red-bellied Woodpecker, Wood Thrush, and Prothonotary Warbler (see Table 2 for scientific names). Six species (Yellow-throated Vireo, Red-eyed Vireo, Hooded Warbler, Wood Thrush, Downy Woodpecker, and Summer Tanager) were observed as breeding species only on the MF. Single sightings of Acadian Flycatcher and Wild Turkey were made on the MF.

On the HI area, four species (Yellow-breasted Chat, Red-headed Woodpecker, Prothonotary Warbler, and Blue-gray Gnatcatcher) attained their highest densities. Single observations of Northern Flicker, Great-crested Flycatcher, and Red-shouldered Hawk were made on this area.

Observations on the HIR area were similar to HI, except that woodpeckers were less abundant. Northern Cardinals, Indigo Buntings, and White-eyed Vireos, however, achieved their highest densities on the HIR area. Yellow-throated Warblers confined their activities to mature bald

TABLE 2. Scientific names of birds and plants in the text.

Common name	Scientific name
Northern Cardinal	<i>Cardinalis cardinalis</i>
Carolina Wren	<i>Troglodytes ludovicianus</i>
Tufted Titmouse	<i>Parus bicolor</i>
Carolina Chickadee	<i>P. carolinensis</i>
Blue Jay	<i>Cyanocitta cristata</i>
Summer Tanager	<i>Piranga rubra</i>
Pileated Woodpecker	<i>Dryocopus pileatus</i>
American Crow	<i>Corvus brachyrhynchos</i>
White-eyed Vireo	<i>Vireo griseus</i>
Red-eyed Vireo	<i>V. olivaceus</i>
Yellow-throated Vireo	<i>V. flavifrons</i>
Mourning Dove	<i>Zenaidura macroura</i>
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>
Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>
Red-bellied Woodpecker	<i>M. carolinus</i>
Downy Woodpecker	<i>Picoides pubescens</i>
Wild Turkey	<i>Meleagris gallopavo</i>
Wood Thrush	<i>Hylocichla mustelina</i>
Red-shouldered Hawk	<i>Buteo lineatus</i>
Blue-gray Gnatcatcher	<i>Poliopitila caerulea</i>
Prothonotary Warbler	<i>Protonotaria citrea</i>
Yellow-throated Warbler	<i>Dendroica dominica</i>
Common Yellowthroat	<i>Geothlypis trichas</i>
Ruby-throated Hummingbird	<i>Archilochus colubris</i>
Rufous-sided Towhee	<i>Pipilo erythrophthalmus</i>
Indigo Bunting	<i>Passerina cyanea</i>
Acadian Flycatcher	<i>Empidonax virescens</i>
Blue Grosbeak	<i>Guiraca caerulea</i>
Yellow-breasted Chat	<i>Icteria virens</i>
Red-winged Blackbird	<i>Agelaius phoeniceus</i>
Northern Flicker	<i>Colaptes auratus</i>
American Redstart	<i>Setophaga ruticilla</i>
Great-crested Flycatcher	<i>Myiarchus crinitus</i>
Sweetgum	<i>Liquidambar styraciflua</i>
Sugarberry	<i>Celtis laevigata</i>
Green ash	<i>Fraxinus pennsylvanica</i>
American elm	<i>Ulmus americana</i>
Nuttall oak	<i>Quercus nuttallii</i>
Willow oak	<i>Q. phellos</i>
Overcup oak	<i>Q. lyrata</i>
Water hickory	<i>Carya aquatica</i>

cypress trees left in the HIR area. The American Redstart was observed only on the HIR area.

The Red-winged Blackbird accounted for 78% of the observations on the SB area. Species seen only on the SB were Common Yellowthroat and Blue Grosbeak. Three species (White-eyed Vireo, Yellow-breasted Chat, and Red-headed Woodpecker) were recorded as breeding birds only on regeneration areas. Species observed in all habitats were: Blue Jay, Amer-

ican Crow, Pileated Woodpecker, Carolina Chickadee, Mourning Dove, and Ruby-throated Hummingbird.

#### DISCUSSION

Clear-cutting followed by site preparation affected breeding bird species composition and density. Although the number of breeding bird species observed on the MF site (13) was similar to those on HI (10) and HIR (12) areas, it was much greater than on the SB area (4). Species composition was similar (86%) on HI and HIR, but was different (average 57% overlap) compared with MF and SB. The SB area had few species and composition was different than on the other areas.

We observed fewer breeding bird species than reported for mature oak-gum-cypress forests in Louisiana (16) and Texas (22) (Dickson 1978). Also, more breeding bird species, 17–18 (1975) and 22–23 (1976), were found on two mature, riverfront bottomland hardwood forests in the Mississippi Delta (Wesley et al. 1976).

Of the six species listed as being abundant in mature oak-gum-cypress forests by Dickson et al. (1980) and Dickson (1991), only the Northern Cardinal, Red-eyed Vireo, and Tufted Titmouse were found to be abundant on our mature gum-oak forest. The Acadian Flycatcher was reported to be abundant (Dickson 1991) in bottomland hardwood forests, but we only observed a single bird.

Breeding bird densities were highest on hand-injected areas. Patchiness and presence of snags probably contributed to the increased breeding bird densities (Dickson 1978). The shear-bladed area had few breeding bird species (mostly Red-winged Blackbird). The Forest Service no longer uses shearing as a site preparation method on the DNF. The site preparation method used is felling of residual stems by chainsaw following clear-cutting. Some residual stems (snags, den trees, and desirable species) are left standing on the site.

Wesley et al. (1976) found the total number of territories/40 ha ranged from 224 to 296 on riverfront, bottomland hardwood forests in Mississippi. This density is similar to our finding of 228 and 239 breeding pairs/40 ha observed on young regeneration areas. The 172 breeding pairs/40 ha on a  $\geq 50$ -yr-old bottomland hardwood forest was less than that found on riverfront forests. Considerable variation in number of individual birds and number of species can be expected between areas and years (Smith et al. 1993).

Patchiness, structural diversity and snags contribute to bird species diversity and density (Dickson 1978, Harris et al. 1979). Management practices on the DNF now include a maximum size of a regeneration area of 16 ha and hand-injection of residual stems to form snags. In addition, special wildlife trees (e.g., cavity or den trees) and protected species are retained on a harvested stand, which should provide the desired structural diversity. Effects of forest fragmentation on plants of southern bottomland hardwoods and on breeding bird composition or densities in the Mississippi Delta need further study, however (Rudis 1993).

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