Breeding Bird Community Changes in a Bald Cypress–tupelo Wetland Following Timber Harvesting

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Abstract: We determined immediate impacts of clearcutting on breeding bird communities of a tidally-influenced bald cypress (*Taxodium distichum*)-tupelo (*Nyssa* spp.) wetland located in the Mobile-Tensaw River Delta, Baldwin County, Alabama, April–June 1987. Seventeen of 45 species detected in first-year clearcuts, forest-clearcut edges, and 70-year-old reference stands demonstrated significant ($P < 0.05$) differences in abundance across habitat type. Three species preferred forest interior, 5 preferred edge, 7 preferred interior and edge over clearcut, and 1 preferred clearcut and edge ($P < 0.05$). Species richness (S) from known sample size decreased from edge (36) to forest interior (27) to clearcut (21). Twice as many detections were made in a clearcut with snags retained, as in a more complete clearcut. We recommend retention of snags and den trees, especially relict bald cypress, within clearcuts and implementation of silvicultural practices that promote early and vigorous reforestation of these ecosystems.

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Bottomland hardwoods are diverse forest assemblages covering 21 million ha in the continental United States (Burns 1983). Fifty-five percent of the commercially valuable forested bottomlands are located in the southeast, primarily in broad floodplains along major rivers (Turner et al. 1981). Numerous authors have described the values of these productive ecosystems (Brinson et al. 1981; Clark and Benforado 1981; Harris and Gooselink 1984, unpubl. rep., Cumulative impacts of bottomland hardwood conversion on hydrology, water quality, and terrestrial wildlife, Environ. Protection Agency, Washington, D.C.). In particular, Brinson et al. (1981) and Howard and Allen (1988) discuss the numerous

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attributes of riparian ecosystems that make them valuable to fish and wildlife. Diverse bird communities are characteristic of forested wetlands because of abundance of snags and den trees (McComb et al. 1986), soil moisture levels and proximity to water, year-round presence of arthropods and fruits and seeds (mast), and presence of ecotones.

Blem and Blem (1975), Dickson (1978), Stauffer and Best (1980), and others report higher bird species abundance and diversity in floodplain forests than upland forests. Bottomlands provide important habitat for numerous insectivorous species, many of which are dependent on closed-canopy forests during the breeding season and may experience decline as a result of forest fragmentation (Robbins 1979). Some species, such as the prothonotary and northern parula warblers, have specialized nesting habitat requirements that are associated with wet forests. (See Table 1 for scientific names of the birds mentioned in this paper).

In the southeastern United States, the bottomland hardwood resource has an estimated stumpage sale value of $131.7 million annually (Lea 1988). Of the 19 SAF forest cover types comprising this assemblage, 1 of the most prevalent and commercially important is bald cypress-tupelo (Eyre 1980). The majority of stocking in this type is comprised of bald cypress (*Taxodium distichum*) together with water tupelo (*Nyssa aquatica*) and/or swamp black gun (*Nyssa sylvatica* var. *biflora*).

Ongoing debate centers around how functions and values provided by bottomland hardwood ecosystems are affected by certain uses or disruptions. Gosselink and Lee (1987) review the biological consequences of incremental loss of bottomland hardwoods. Referring to the use of bottomlands for timber production, Gosselink and Lee (1987) state that timber harvest need not cause habitat deterioration and cite reforestation as an acceptable means of mitigation.

Several studies have described the avifauna of bald cypress-tupelo forests (Kennedy 1977, Harris and Vickers 1984, Hamel 1986). However, we found no previous research that addressed effects of timber management activities on these bird communities. The objective of this study was to quantify these effects and to assist wetland policy-making and regulatory agencies developing best management practices in these systems.

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Table 1. Scientific names of birds referred to in text and tables.

Common name	Scientific name
Great egret	*Casmerodius albus*
Snowy egret	*Egretta thula*
Little blue heron	*Egretta caerula*
Green-backed heron	*Butoides striatus*
Yellow-crowned night heron	*Nycticorax violaceus*
White ibis	*Eudocimus albus*
Wood duck	*Aix sponsa*
Osprey	*Pandion haliaetus*
American swallow-tailed kite	*Elanoides forficatus*
Red-shouldered hawk	*Buteo lineatus*
Northern bobwhite	*Colinus virginianus*
Solitary sandpiper	*Tringas solitaria*
Yellow-billed cuckoo	*Coccyzus americanus*
Barred owl	*Strix varia*
Ruby-throated hummingbird	*Archilochus colubris*
Red-bellied woodpecker	*Melanerpes carolinus*
Downy woodpecker	*Picoides pubescens*
Hairy woodpecker	*Picoides villosus*
Pileated woodpecker	*Drycopus pileatus*
Eastern wood peewee	*Contopus virens*
Acadian flycatcher	*Empidonax virescens*
Great crested flycatcher	*Myiarchus crinitis*
Eastern kingbird	*Tyrannus tyrannus*
Blue jay	*Cyanocitta cristata*
Fish crow	*Corvus ossifragus*
Carolina chickadee	*Parus carolinenesis*
Tufted titmouse	*Parus bicolor*
Carolina wren	*Thryothorus ludovicanus*
Blue-gray gnatcatcher	*Polioptera caerula*
Wood thrush	*Hylocichla mustelina*
Water pipit	*Anthus spinoletta*
White-eyed vireo	*Vireo griseus*
Yellow-throated vireo	*Vireo flavifrons*
Red-eyed vireo	*Vireo olivaceous*
Northern parula warbler	*Parula americana*
Yellow-rumped warbler	*Dendroica coronata*
Yellow-throated warbler	*Dendroica dominica*
American redstart	*Setophaga ruticilla*
Prothonotary warbler	*Protonotaria citrea*
Hooded warbler	*Wilsonia citrina*
Summer tanager	*Piranga rubra*
Northern cardinal	*Cardinalis cardinalis*
Indigo bunting	*Passerina cyanea*
American goldfinch	*Carduelis tristis*
Red-winged blackbird	*Agelaius phoeniceus*
Common grackle	*Quiscalus quiscula*
Brown-headed cowbird	*Molothrus ater*

Methods

Study Sites

The two study sites (Squirrel Bayou and Maple Bayou) were located on the western bank of the Tensaw River, Baldwin County, Alabama, within the Mobile-Tensaw River Delta. Diurnal tides affect soil water table fluctuations and water levels in the Delta's channels. Soils are deep, level, poorly-drained clayey alluvium (MacBride 1964).

The study sites were located in bald cypress-swamp black gum-water tupelo palustrine wetlands. The prevalent midstory species was Carolina ash (*Fraxinus caroliniana*). Major understory components included water willow (*Justicia ovata*), greenbrier (*Smilax walteri, S. laurifolia*), arrow arum (*Peltandra virginica*), spider-lily (*Hymenocallis crassifolia*), Virginia willow (*Itea virginiana*), and lizard's tail (*Saururus cernuus*). Disturbed areas were dominated by red-root flatsedge (*Cyperus erythrorhizos*), bamboo (*Smilax laurifolia*), and gum-tupelo stump sprouts. Canopy cover of mature forest stands reached 100% during the study. Average basal areas based on 12 plots centered at count stations were 56.6 m^2/ha for Squirrel Bayou (80% water tupelo, 15% bald cypress, 5% ash spp.) and 43.1 m^2/ha for Maple Bayou (47% water tupelo, 27% swamp black gum, 16% bald cypress, 8% ash spp., 2% other).

Most stands within the area were harvested with pullboats between 1895 and 1950 (Mancil 1980). Reference stands at the 2 study sites were comprised of 60- to 70-year-old trees, with some 130-year-old trees present. Clearcut treatments were logged in October 1986. All live stems >5 cm dbh were felled and merchantable stems were flown by helicopter to a landing adjacent to the Tensaw River. Several relict bald cypress (trees left standing from 1 to several previous harvests) were retained at the Squirrel Bayou site; snag retention was noticeably higher at this site as well. Clearcut sizes for Squirrel and Maple bayous were 23.0 and 17.2 ha, respectively.

Bird Counts

We used Hutto et al.'s (1986) fixed radius point-count method for assessing breeding bird communities. This method resulted in 3 indices of bird abundance: 1) the mean number of detections within 25 m of the observer (mean), 2) the frequency of detections within 25 m of the observer [f(25)], and 3) the frequency of detections regardless of distance from the observer [f(u)]. All counts were 10 minutes in duration and were conducted between sunrise and 1030 hours C 20 April 1987 through 16 June 1987.

At each study site, count stations were installed at 50 m intervals along 2 lines paralleling the Tensaw River. The lines ran lengthwise through rectangle-shaped clearcuts and were 200 m apart. One line at each site traversed a stand of uncut 60- to 70-year-old timber and the forest-clearcut edge farthest from the Tensaw River; a second line traversed the same 60- to 70-year-old stand and first-growing-season clearcut. Edge points were located on the physical forest-clearcut edge; thus, half the sampling "disk" lay within the clearcut and half lay within the forest. Clearcut count stations were located at least 25 m from forest edge, a necessary compromise to ensure adequate sample size in terms of number of count stations while achieving independent sampling in a narrow clearcut (see Data Analysis below). Count stations in the older reference stand were located ≥100 m from forest edge. Care was taken to ensure that detections of birds outside of the habitat of interest were excluded. Each site by habitat type combination was represented by 12 count stations and 84–89 point counts.

Data Analysis

A 3-factor design with repeated measures on 1 factor (repeated counts or "visits" at count stations or "points") was used as follows:

Source	*df*
Site	1
Habitat type	2
Site *habitat type	2
Point (Site*habitat type)	67
Visit	8
Site*visit	8
Habitat type*visit	14
Site*habitat type*visit	13

Because count stations are viewed as the experimental units nested within site and habitat type (forest interior, forest edge, and first-year clearcut), the assumption was made that point counts conducted at different count stations were independent samples (Hutto et al. 1986). The dependent variables (number of detections of a single species/point count within 25 m of observer) were rank transformed to equalize sample variances (Conover and Iman 1981). The ANOVA tested the principal null hypothesis that species means were equal across all habitat types. For species demonstrating significant habitat differences ($P < 0.05$), mean separation was accomplished using Fisher's protected least significant difference at an alpha level of 0.05 (Steel and Torrie 1980).

Frequency data, both 25 m and unlimited radius counts, were analyzed using a model II R x C contingency table (Sokal and Rohlf 1981:731–747). Classification variables were habitat type and species presence/absence. The null hypothesis is one of independence of the variables, i.e., species presence/absence is independent of habitat type (for detailed discussion of frequency data analysis and results, see Mitchell 1989).

Total number of detections are presented as a measure of community abundance as well.

Guild Analyses

Two additional analyses were performed on guilds, the first on neotropical migrants and the second on cavity-nesting species. Individual species means for all neotropical migrants present were determined; the ranked means were then subjected to an ANOVA and means separation tests (described above) to test for habitat type differences in abundance. This analysis was duplicated for all cavity-nesting species present in the study.

Diversity Indices

Bird species diversity was measured in several ways using 25 m radius data only (known sample size). Indices chosen included the Shannon-Weiner index H' (Shannon 1948), species richness S (number of species), and species equitability J' (Lloyd and Ghelardi 1964). Diversity indices were averaged over sites to give a single index for each habitat type.

Results and Discussion

Habitat Type Differences

Species abundance differed ($P < 0.05$) across the 3 habitat types (Table 2). Three species (acadian flycatcher, prothonotary warbler, and red-eyed vireo) preferred forest interior. These neotropical migrants typically require extensive forested areas and/or forest interior conditions (Robbins 1979). The acadian flycatcher showed strongest affinity for forest interior, was not detected in any clearcut point count, and was only detected in 10/518 edge point counts (25 m radius data).

Five species preferred forest/clearcut edges. These included species preferring dense shrub thickets (white-eyed vireo, northern cardinal, Carolina wren) and the American redstart, a species that often inhabits forest edge or open woodland. The other, the Carolina chickadee, is a permanent resident considered to be a habitat generalist. The northern cardinal was essentially absent from Squirrel Bayou and may have preferred thick understory vegetation present at Maple Bayou edge points rather than physical edge itself.

Seven species (great-crested flycatcher, yellow-throated vireo, downy woodpecker, red-bellied woodpecker, northern parula warbler, tufted titmouse, and summer tanager) preferred edge and forest interior over clearcut. The great-crested flycatcher and yellow-throated vireo typically prefer open woods or forest edge; however, preference for edge seems limited to edge immediately adjacent to a large contiguous forest block (Squirrel Bayou) as opposed to a narrow forested natural levee (Maple Bayou). The northern parula warbler and summer tanager also are known to prefer extensive open woods. The interior and edge habitats provided more cavities/unit area for woodpeckers, tufted titmouse, and other cavity nesters (Conner 1978).

Indigo buntings preferred clearcut and forest edge habitat over forest interior. Males often used snags in the clearcut and trees along the forest edge as perches for singing. These birds are known to prefer woods margins, particularly open deciduous vegetation (Hamel et al. 1982).

Species such as the yellow-billed cuckoo, pileated woodpecker, barred owl,

Table 2. Mean number of detections/25 m radius point count and probability levels associated with ANOVA tests for differences across habitat types.

Species	Forest		Edge		Clearcut		P value
	Squirrel	Maple	Squirrel	Maple	Squirrel	Maple	
Prothonotary warbler	2.68a[a]	1.73a	1.63b	0.75b	0.28c	0.11c	0.000
Red-bellied woodpecker	0.46a	0.33a	0.42a	0.18a	0.24b	0.05b	0.034
Downy woodpecker	0.40a	0.17a	0.36a	0.14a	0.11b	0.02b	0.004
Acadian flycatcher	0.33a	0.57a	0.01b	0.10b	0.00b	0.00b	0.000
Blue-gray gnatcatcher	0.30b	0.43a	0.68a	0.35b	0.04c	0.02c	0.000
Northern parula warbler	0.25a	0.64a	0.56a	0.44a	0.00b	0.00b	0.000
Red-eyed vireo	0.24a	0.43a	0.29b	0.13b	0.01c	0.00c	0.000
Tufted titmouse	0.21a	0.27a	0.32a	0.19a	0.07b	0.08b	0.005
Great crested flycatcher	0.16a	0.20a	0.29a	0.08a	0.00b	0.00b	0.004
Yellow-throated vireo	0.15a	0.17a	0.24a	0.01a	0.00b	0.00b	0.002
Summer tanager	0.10a	0.05a	0.06a	0.14a	0.04b	0.00b	0.013
Carolina wren	0.09b	0.30b	0.40a	0.58a	0.22b	0.20b	0.000
Yellow-billed cuckoo	0.08	0.02	0.04	0.07	0.00	0.00	0.185
Hairy woodpecker	0.07	0.05	0.07	0.00	0.07	0.00	0.512
Common grackle	0.07	0.01	0.04	0.19	0.46	0.07	0.100
Carolina chickadee	0.07b	0.09b	0.31a	0.26a	0.08b	0.09b	0.010
Blue Jay	0.06	0.06	0.05	0.05	0.00	0.00	0.087
Northern cardinal	0.05b	0.22b	0.04a	0.50a	0.07b	0.11b	0.005
Red-shouldered hawk	0.02	0.00	0.01	0.00	0.00	0.00	
Pileated woodpecker	0.02	0.01	0.04	0.01	0.00	0.00	0.393
Wood thrush	0.01	0.00	0.00	0.02	0.00	0.00	
Green-backed heron	0.01	0.00	0.00	0.00	0.01	0.00	
Barred owl	0.01	0.02	0.01	0.01	0.00	0.00	
Hooded warbler	0.00	0.11	0.00	0.08	0.00	0.00	0.167
Yellow-crowned night heron	0.00	0.01	0.00	0.00	0.00	0.00	
White-eyed vireo	0.00b	0.01b	0.00a	0.44a	0.00c	0.00c	0.000
Ruby-throated hummingbird	0.00	0.01	0.00	0.05	0.00	0.00	
Fish crow	0.00	0.01	0.00	0.00	0.00	0.01	
American redstart	0.00b	0.01b	0.01a	0.14a	0.00b	0.01b	0.006
Indigo bunting	0.00b	0.00b	0.08a	0.13a	0.08a	0.15a	0.006
Yellow-rumped warbler	0.00	0.00	0.04	0.00	0.00	0.00	
Water pipit	0.00	0.00	0.02	0.00	0.01	0.01	
Yellow-throated warbler	0.00	0.00	0.01	0.01	0.00	0.00	
Solitary sandpiper	0.00	0.00	0.01	0.00	0.06	0.00	
Red-winged blackbird	0.00	0.00	0.01	0.00	0.00	0.00	
Little blue heron	0.00	0.00	0.01	0.00	0.00	0.00	
American goldfinch	0.00	0.00	0.00	0.02	0.00	0.01	
Eastern kingbird	0.00	0.00	0.01	0.01	0.00	0.00	
Eastern wood pewee	0.00	0.00	0.00	0.00	0.01	0.00	
Brown-headed cowbird	0.00	0.00	0.00	0.00	0.01	0.00	

[a] Observations with different letters within rows are significantly different based on Fisher's protected least significant difference (indicates habitat-type differences based on ANOVA's which combine sites). $N = 518$ point counts.

and common grackle differed in abundance ($P < 0.05$) across habitat types in unlimited radius counts, but not in fixed-radius counts. These species were detected relatively frequently beyond 25 m, but were rarely detected within 25 m, of the observer. The former 3 were somewhat rare in the study but produced long-range vocalizations, and the common grackle is a large-bodied bird easily detected from considerable distances while perching in snags left in the clearcuts.

Community Descriptions

Forest interior and edge communities were dominated by the prothonotary warbler, but to a lesser degree in edge. Abundance of this species seemed closely linked with poorly-developed understory, a characteristic that is related to site hydrology. Prothonotary warblers were present in 99% of all forest interior point counts and in 91% of edge counts. Key habitat requirements for the prothonotary are swamps or bottomlands with standing water and cavities in stumps, stubs, dead trees, and bald cypress knees (Hamel et al. 1982). Snails, insects, spiders, and amphibians were abundant food items in these habitats.

Bird communities of the first-year clearcuts demonstrated few dominant species; they were instead used by many uncommon or infrequent visitors for feeding or perching. Clearcut community composition seemed to vary with availability of snags. Relict bald cypress and smaller snags provided nesting sites for the 3 smaller woodpecker species present and provided perching sites for the common grackle, little blue heron, great egret, snowy egret, and osprey. Cowbirds were observed feeding in clearcuts and using exposed perches along edges for displays and host searches. Mudflats and shallow pools formed as seasonal floodwaters receded and provided foraging areas for the water pipit, solitary sandpiper, wood duck, and little blue heron. Many forest residents gleaned insects from logging slash in the clearcut.

Flyover data (Mitchell 1989) indicate that although not frequently detected in point counts, colonial nesting waterbirds such as the yellow-crowned night heron and white ibis are important in this forest type.

Additional species were observed infrequently in the study area, but deserve mention. Lingering migrants detected in early April included the water pipit, American goldfinch, and yellow-rumped warbler. Migratory transients, such as the solitary sandpiper, were rare. The ruby-throated hummingbird occurred most frequently in edges where trumpet vine (*Campsis radicans*) was present.

Swallow-tailed kites were occasionally seen foraging along forest edges and in openings in the canopy over streams. Over the past century, the breeding range of the swallow-tailed kite has been progressively restricted and fragmented to its present range along the southern U.S. Coastal Plain. This breeding range decline may be associated with loss and alteration of wetland forests (Gosselink and Lee 1987). Cely and Sorrow (1990) estimate that 50 breeding pairs exist in Alabama, primarily in the Mobile-Tensaw Delta, and discuss management implications for this species of concern.

Site Differences

The degree and periodicity of flooding and the intensity of light penetrating the canopy have been recognized as important variables regulating understory development in this forest type. Complexity of the shrub and herb layers in turn has an important impact on the bird communities present (Hamel et al. 1982). Eight species differed (P <0.05) between sites. Five (acadian flycatcher, American redstart, hooded warbler, northern cardinal, white-eyed vireo) were more abundant at Maple Bayou; 3 (prothonotary warbler, red-bellied woodpecker, yellow-throated vireo) were more abundant at Squirrel Bayou.

The hooded warbler, northern cardinal, and white-eyed vireo were more abundant in the well-developed shrub/vine understory at Maple Bayou. Higher means of the prothonotary warbler and red-bellied woodpecker at Squirrel Bayou may have been related to preference of relatively sparse understory (Hamel 1981) or higher number of snags/unit area (Conner 1978). The yellow-throated vireo was more abundant at Squirrel Bayou edge than Maple Bayou edge, which may reflect that species' preference for larger tracts of contiguous forest. Some edge count stations at Maple Bayou were located in narrower forested strips along the natural levee. The American redstart is known to nest near water, and this may explain higher abundances at Maple Bayou; some count stations were in closer proximity to stream channels at this site.

Nine species showed a significant (P <0.05) site-by-habitat type interaction, indicating that the magnitude of the simple effect of habitat type was dependent on site. This occurred for species (white-eyed vireo, American redstart, yellow-throated vireo) that were uncommon at 1 site and relatively abundant at the other, and for species that were much more abundant in a single habitat type (blue-gray gnatcatcher, northern cardinal, northern parula warbler—edge; prothonotary warbler, red-eyed vireo—forest) at 1 of the sites. The great-crested flycatcher showed variable habitat preference depending on site, strongly preferring forest interior at Maple Bayou where some edge count stations were located on a relatively narrow forested levee.

Time Differences

Abundance over time (among repeated measures at a given point station) changed as the breeding season progressed, and differed significantly for 3 species: downy woodpecker (P = 0.010), white-eyed vireo (P = 0.036), and prothonotary warbler (P = 0.040). Downy woodpecker densities increased steadily throughout the study, which may reflect fledging young. Dependent young were likely present throughout the study (Imhof 1976). The white-eyed vireo was a relatively minor community component, and fluctuations in abundance seemed erratic. The prothonotary warbler increased in abundance to peak numbers between late April and late May, followed by a slight decline. This may be due to decreased conspicuousness as male territory advertisement of this relatively early migrant declined. Forest interior detections of prothonotary warblers at Squirrel Bayou, where this species was most numerous, continued to increase after late May, which may have resulted from detections of fledglings.

Guild Analyses

Neotropical migrants breeding in this forest type included the American redstart, eastern kingbird, great crested flycatcher, hooded warbler, indigo bunting, northern parula warbler, prothonotary warbler, red-eyed vireo, ruby-throated hummingbird, summer tanager, wood thrush, yellow-billed cuckoo, yellow-throated vireo, and yellow-throated warbler. The mean number of detections for these species considered as a group differed across habitat types ($P = 0.010$). Neotropical migrants were more commonly found in forest and forest edge habitats than in first-year clearcuts. These migrants are primarily foliage gleaning or aerial insectivores that forage and nest at various heights.

Cavity-nesting species included the Carolina chickadee, Carolina wren, downy woodpecker, great crested flycatcher, hairy woodpecker, tufted titmouse, pileated woodpecker, prothonotary warbler, and red-bellied woodpecker. The mean number of detections of cavity nesters was again greater in forest and forest edge habitats than in those of clearcut ($P = 0.050$).

Diversity Indices

Both species richness and species diversity were highest in forest edges. Species richness decreased from edge (36) to forest interior (27) to first-year clearcut (21). Species diversity (H') decreased from forest edge (2.72) to clearcut (2.36) to forest interior (2.34). Numbers of birds were less evenly distributed among species in forest interior (J' = 0.74) than in edges (J' = 0.81) or clearcuts (J' = 0.85). Bird communities in forest interior were dominated by a smaller number of abundant species, whereas those of edge and clearcut were characterized by a few common species and a much higher number of uncommon visitors.

The retention of small snags and relict bald cypress in clearcuts appeared to increase both species richness and total number of detections. Twice as many detections (25-m radius data) were made in a clearcut with snags and relicts retained (Squirrel Bayou, 162) as in a clearcut where these features were essentially absent (Maple Bayou, 81).

Summary

At the time this study was conducted, the Mobile-Tensaw Delta was a very large tract of mature, contiguous forest interspersed with relatively small recent clearcuts along major stream channels. Most clearings in this forest type were ≤40 ha, although some were considerably larger. Helicopter logging continues on a grid system basis. Clearcutting increased between-habitat diversity and increased the number of bird species using the area. A concern for the future will be retaining an adequate land base of mature bald cypress-tupelo forest to conserve the breeding bird communities native to this forest type. The brown-headed cowbird, an obligate brood parasite, was not abundant at the time of the study, but has potential to expand in the area (Brittingham and Temple 1983).

Overall, many ecological functions provided by bald cypress-tupelo wetlands are able to recover rapidly following disturbance when proper forest management practices are applied (Aust 1989, Mader et al. 1989, Mader 1990, Mitchell et al. 1991). These practices include minimizing soil and site degradation associated with trafficking and time of harvest, timing harvests to promote seed deposition by floodwaters, and minimizing stump heights to promote vigorous sprouting. The extent that rapid regeneration of forested wetlands moderates habitat loss for birds is a subject for further investigation.

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