WINTER BIRD COMMUNITIES IN AFFORESTATION: SHOULD WE SPEED UP OR SLOW DOWN ECOLOGICAL SUCCESSION?

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Abstract—Recent assessments of afforestation on agricultural lands in the Mississippi Alluvial Valley imply the importance of quickly developing vertical forest structure to benefit wildlife. Examining this assumption, we find that mammals and birds occur through the full successional sere as targets of proactive management and control. Different species of animals thrive in structures available at different times during succession. Thus, forest managers' choices of strategies favor species' success differentially. Early successional species, particularly those avian communities occurring during winter, have heretofore been considered only in passing. However, because they occur in areas where herbaceous plants dominate vegetation structure, these communities include species otherwise rare or absent from the landscape. Extensive afforestation in the Mississippi Alluvial Valley provides ephemeral habitat for birds that winter in herbaceous areas. To provide habitat for winter birds, managers may wish to consider maintaining large tracts in herbaceous vegetation similar to that occurring 3 to 7 years after cessation of farming activities.

INTRODUCTION

Recent assessments of afforestation of agricultural lands in the Mississippi Alluvial Valley (MAV), particularly the Delta area of Mississippi, have stressed the importance of quickly attaining the physical structure and stature of forests (Schweitzer and others 1997). Implementation of land management plans designed for neotropical migratory birds in the Lower MAV (LMAV) (Mueller and others 1995) will benefit from dependable, rapid afforestation as well. Benefits of afforestation include provision of habitat for middle and late successional birds, production of pulpwood, production of sawtimber wood products, and erosion control, as well as carbon sequestration and accumulation of soil organic matter. All these benefits are positively associated with the speed with which afforestation occurs. Rapid afforestation implies swift accumulation on the landscape of the physical structure and stature of forest. It is a means of carbon sequestration (Cannell 1999b, Chang 1999) and of land rehabilitation in Amazonia (Bauch and others 1999) and elsewhere (Harrington 1999). Fast development of vertical forest structure is implicit in the environmental (Joslin and Schoenholtz 1997) and economic (Pande and others 1999, Scholtens 1998) analyses of afforestation.

Afforestation, including rapid afforestation, is assumed to be beneficial to wildlife (Boyle 1999, Cannell 1999a, Helmer 1999, Weaver and Pelton 1994, Weaver and others 1990, Willoughby and McDonald 1999). On the other hand, certain native wildlife and grazing animals can hinder afforestation efforts (Anderson and Katz 1993, Houston 1991, Niyaz and others 1999).

Vegetation structure is an important determinant of bird species occurrence and community composition (DeGraaf 1987, DeGraaf and others 1992, James 1971). Hamel (1992) associates birds with combinations of vegetation structure, such as trees, shrubs, and herbaceous vegetation. Afforestation yields unusual elements in secondary succession, such as tall cottonwood (*Populus* L. spp.) trees and herbaceous vegetation with little woody understory. A first hypothesis is that the bird community developing in afforestation will reflect vegetation structure.

Wintering birds use the early successional herbaceous community. During rapid afforestation, the early successional periods are shorter than during natural succession. Our second hypothesis is that early successional species may not benefit from rapid afforestation of agricultural fields as much as from natural succession.

To examine the assumptions that rapid afforestation is beneficial to wildlife and that bird species occurrence is a function of vegetation structure, we consider the presence or absence of particular bird species and their communities rather than the rate of development of ecological function. As hawks and owls prey on mammals, then succession of mammal species is, in turn, dependent on bird community dynamics.[2]

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A review of literature provides a summary of expected responses of birds and small mammals to early successional habitats in MAV landscapes. Empirical observations compare responses of early successional wildlife species to four different afforestation treatments. Our primary data set involves winter bird populations in the first few years after abandonment of agricultural lands. Nuttle (1997) investigated bird communities at afforested sites of different ages in the LMAV that were established by planting oak (*Quercus* L. spp.) seedlings. Nuttle (1997) and Nuttle and Burger (1995) summarize breeding bird communities in oak plantations, some of which were 30 years old. However, we have too few data to demonstrate what happens to species during middle successional conditions occurring 20 to 60 years after initial afforestation.

METHODS

In a comparison of bird occurrence among different methods of affortestation, we focus on total abundance, density of individuals, and species richness.

Literature Analysis

The National Council of the Paper Industry for Air and Stream Improvement, Inc. (NCASI) has published annotated bibliographies on wildlife, forestry, and habitat in the East (NCASI 1993, 1999). A keyword search yielded papers dealing with wildlife response to afforestation, reforestation, forest restoration, and old-field succession in bottomland landscapes in the Southeastern United States. However, few publications treat responses to afforestation in the MAV. Studies done in other landscapes and regions can contribute insights as similar species respond to different conditions.

Empirical Observations of Winter Bird Communities

Between late October and late April from 1996 to 2000, Broerman surveyed 8 bird species on 59 afforestation sites in 9 Mississippi counties. The sites were all former agricultural land 2 to 9 years after cessation of farming activities. Some had been planted with tree seedlings, principally Nuttall oak (*Quercus nuttallii* Palmer), green ash (*Fraxinus pennsylvanica* Marshall), willow oak (Q. *phellos* L.), or water oak (*Q. nigra* L.); some had not. Herbaceous vegetation on these sites exceeded the height of woody vegetation. The survey involved using a four-wheeler to flush birds from herb or grass-dominated vegetation. During this survey he made 273 trips to the sites. Of these, 271 trips to 57 sites took place in 7 counties.

In 1999 to 2000, Hamel conducted Winter Bird Populations Studies (WBPS) (Kolb 1965) on the treatment plots in the Sharkey large-scale restoration experiment near Anguilla, Sharkey County, MS (Sharkey Site) (Schweitzer and others 1997). Hamel and Woodson made additional observations on these plots in 1998 and 1999. As a comparison of afforestation methods, the design of the Sharkey Site was randomized complete blocks design, involving three replicates each of three afforestation treatments and a natural succession and regeneration control (NAT). The treatments were: (1) sown Nuttall oak acorns (SOW), 2,500 per hectare; (2) planted Nuttall oak seedlings (PLN), 750 per hectare; and (3) planted cottonwood stem cuttings (NUR), 750 per hectare, followed by underplanting of Nuttall oak seedlings, 375 per hectare, 2 years later. Individual treatment plots were approximately 8 ha in extent. Initial establishment of the treatments was in spring 1995, with the underplanting in the NUR plots conducted in spring 1997.

Hamel conducted a WBPS on each of the 12 plots on the Sharkey Site. His WBPS counts were 30 minutes during the morning hours on 8 days from December 1999 to March 2000. He recorded all birds seen or heard in the vegetation of the plot, or actively foraging over the plot. He visited 1 of 12 plots in a random sequence. He summarized these results as average number of individuals encountered per species per hectare.

We test the hypothesis that early successional species may not benefit from rapid afforestation as much as from natural succession. Our null hypothesis for this test is that bird species dependent on herbaceous vegetation will be found in the faster growing cottonwood plantations as well as in other treatments that are accumulating woody structure more slowly. Our data for this test consist of the abundance and occurrence of the individual species recorded on the WBPS in the different treatment plots of the Sharkey Site.

We test the hypothesis that the bird community that develops in afforestation areas reflects the presence of separate elements of vegetation structure. We compare the occurrence of bird species among the treatments on the Sharkey Site in terms of their foraging preferences from Hamel (1992) for this test. The null hypothesis for this examination is that no association between foraging substrate and occurrence by treatment will be apparent among the birds.

We test the hypothesis that accumulating vegetation structure determines the occurrence of birds in afforestation treatments. Physical vegetation structure accumulates on the experimental treatments at a predictable sequence, measured by the height of the woody vegetation, NUR>PLN>SOW>NAT. Using the data on species richness and density of individual species among treatments from the Sharkey Site, we conduct analysis of variance (ANOVA).

Our analysis uses PROC GLM or PROC ANOVA, as a randomized complete block design with treatment or block and treatment as main effects (SAS Institute Inc. 1989). Significance was accepted at $p < 0.05$; means testing was conducted using Duncan's multiple comparison of means. For tests of the difference of abundance of individual species among treatments, we accepted significance at $p < 0.10$ experiment wide with sequential Bonferroni correction.

RESULTS AND DISCUSSION

Literature Analysis

Of 38 papers in the literature search (citations in table 1), 13 deal exclusively with single species response to habitat restoration, 6 with songbirds in general, 2 with waterfowl, 3 with general vertebrate response to reforestation, 3 with effects of streamside restoration on aquatic communities, 3 with effects of fire on habitat restoration, and 4 with the

Table 1—Literature review of wildlife responses to afforestation, reforestation, and forest restoration

Category	Citation
Single species responses to restoration	
Black bear (*Ursus americanus* Pallas)	Weaver and others 1990, Weaver and Pelton 1994
Red-cockaded woodpecker [*Picoides borealis* (Vieillot)]	Cantrell and others 1995, Conner and Rudolph 1995, Gaines and others 1995, Watson and others 1995, Wilson and others 1995
American woodcock (*Scolopax minor* Gmelin)	Sepik and Blumenstock 1993
Wild turkey (*Meleagris gallopavo* L.)	Dickson 1992
Florida scrub-jay [*Aphelocoma coerulescens* (Bosc)]	Root and others 1995; Schmalzer 1993, 1994; Schmalzer and others 1994
Beaver pond reforestation	Houston 1991
Deer browse affect on reforestation	Anderson and Katz 1993
Songbirds in general	Bielefeldt and Rosenfield 1994, Nuttle and Burger 1995, Ribbeck and Hunter 1994, Tomlinson 1977, Wesley and others 1976
Restoration for songbirds	Ribbeck and Hunter 1994
Reforestation and waterfowl	Kaminski and others 1993, Reinecke 1994
Bird dispersal of fruiting plants into restoration areas	Robinson and Handel 1993
General vertebrate response to reforestation	Askins and Philbrick 1987, Litvaitis 1993
Using vertebrates to assess cumulative impacts	Croonquist and Brooks 1991
Land management planning	McCullough 1994
Forest restoration of streamside zones, effect on aquatic species	Flebbe and Dolloff 1995, O'Brien-White and Thomason 1995, Sweeney 1993
Fire effects in restoration	Fitzgerald and Tanner 1992, Provencher and others 1995, Simberloff 1993
Old-growth forest restoration, biodiversity conservation	Harris and Scheck 1991; Mladenoff and others 1993, 1994; Vora 1994
Clearcuts	Hurst and Bourland 1996, Mitchell 1989

importance of reforestation to the maintenance of old-growth conditions on the landscape. Three papers discuss the role of animals, specifically beaver (*Castor canadensis* Kuhl), white-tailed deer [*Odocoileus virginianus* (Zimmermann)], and fruit-eating birds as agents modifying plant community composition. Predetermined objectives are essential in restoration planning, as in all other land management, a point made by a single paper (McCullough 1994). No paper explicitly treats early secondary succession on abandoned farmland in the MAV. The greater proportion of the papers indicate that restoration that proceeds faster from open ground to closed-canopy forest is more effective than that which proceeds more slowly.

Twelve of the papers treat bottomland hardwood or other lowland forest types. Among these, Ribbeck and Hunter

(1994) note that many bird species of highest conservation priority in the MAV are late successional species; therefore, rapid afforestation will benefit them.

Wesley and others (1976) studied winter birds in 44 cottonwood plantations aged 4, 5, or 6 years old, within primarily forested landscapes in the MAV. In an associated study, Tomlinson (1977) conducted WBPS on five plots, including three on two cottonwood plantations and two mature hardwood controls. Six species preferred the cottonwood plantations, 4 showed no preference, and 15 preferred the natural stands (Tomlinson 1977, Wesley and others 1976). Wesley and others (1976) compared bird communities in plantations to those in nearby mature natural stands, but not in plowed or harvested agricultural fields. The winter bird community of agricultural fields in the MAV is a simple one (table 2).

In 1994, Twedt conducted three WBPS in planted cottonwoods surrounded by agricultural fields on Fitler Managed Plantation, near Fitler, MS.[3] He found 35 species on the plots, 4 of which were not found by Tomlinson (1977) or Wesley and others (1976): red-shouldered hawk, northern bobwhite, chipping sparrow, and Lincoln's sparrow.

Litvaitis (1993) and Sepik and Blumenstock (1993) note that as landscapes change from primarily agricultural to primarily forested settings, species of early successional vegetation benefit in the short term and ultimately decline to the point that specific manipulative action is required to maintain their populations on the landscape. This test does not refute the hypothesis that early successional species will benefit less from afforestation than later successional species.

Empirical Observations

Survey—Table 2 lists the winter bird community Twedt observed in agricultural fields in the MAV. In his surveys of early successional habitats, Broerman tracked occurrence of eight species of birds (table 3). These species are relatively rare in the MAV and of specific conservation interest. Two species—sedge wren and Le Conte's sparrow—occurred on more than half of the surveyed sites (table 3). Each species is associated with grasslands or with herbaceous vegetation in the earliest stages of forest succession (Hamel 1992); neither appears in the cottonwood plantations studied by Wesley and others (1976), Tomlinson (1977), or Twedt.[4]

Experimental test-species occurrence—Vegetation structure on the plots at Sharkey Site differs by treatment at 5 years after establishment. On the NUR treatments, cottonwood trees approach 10 m or more in height. Nuttall oak seedlings are approximately 3 to 4 m tall in the PLN and 1 to 3 m tall in the SOW. On the NAT, few woody stems exceed the 1- to 3-m height of the herbaceous vegetation. These differences in structure are consistent with the

[3] Twedt, Daniel. 1999. Unpublished data. On file with: U.S. Department of the Interior, Geological Survey, Patuxent Wildlife Research Center, 2524 South Frontage Road, Vicksburg, MS.

[4] Twedt, Daniel. 1994. Unpublished data. On file with: U.S. Department of the Interior, Geological Survey, Patuxent Wildlife Research Center, 2524 South Frontage Road, Vicksburg, MS.

Table 2—Bird species commonly found in fallow agricultural fields in the Mississippi Delta in the winter from three Winter Bird Populations Studies conducted in 1994[a]

Common and scientific names	Bird density[b]		
	Per km²		
Great blue heron			
Ardea herodias Linn.	0.1	±	0.1
Northern harrier			
Circus cyaneus (L.)	.4	±	.2
Cooper's hawk			
Accipiter cooperii (Bonaparte)	.4	±	.4
Red-tailed hawk			
Buteo jamaicensis (Gmelin)	.7	±	.3
American kestrel			
Falco sparverius L.	.1	±	.1
Killdeer			
Charadrius vociferus L.	23.6	±	21.0
Common snipe			
Gallinago gallinago (L.)	.1	±	.1
Rock dove			
Columba livia Gmelin	9.7	±	9.7
Mourning dove			
Zenaida macroura (L.)	17.1	±	11.1
Red-bellied woodpecker			
Melanerpes carolinus (L.)	.2	±	.1
Loggerhead shrike			
Lanius ludovicianus L.	1.9	±	1.3
Blue jay			
Cyanocitta cristata (L.)	.9	±	.7
Horned lark			
Eremophila alpestris (L.)	17.3	±	12.1
European starling			
Sturnus vulgaris L.	189.0	±	189.0
Vesper sparrow			
Pooecetes gramineus (Gmelin)	.4	±	.4
Savannah sparrow			
Passerculus sandwichensis (Gmelin)	61.9	±	57.7
Song sparrow			
Melospiza melodia (Wilson)	3.8	±	2.7
White-throated sparrow			
Zonotrichia albicollis (Gmelin)	10.2	±	9.5
White-crowned sparrow			
Z. leucophrys (Forster)	.7	±	.7
Dark-eyed junco			
Junco hyemalis (L.)	.1	±	.1
Northern cardinal			
Cardinalis cardinalis (L.)	8.2	±	7.1
Red-winged blackbird			
Agelaius phoeniceus (L.)	2.3	±	1.4
Eastern meadowlark			
Sturnella magna (L.)	1.2	±	1.2
Mean density	350.4	±	210.9
Mean species richness	13.3	±	2.8

[a] Twedt, Daniel. 1994. Unpublished field notes. On file with: U.S. Department of Interior, Geological Survey, Patuxent Wildlife Research Center, 2524 South Frontage Road, Vicksburg, MS.
[b] Plus or minus standard error.

Table 3—Bird species observed on 273 trips to 59 afforestation sites in 9 counties in Mississippi from October 17, 1996 to April 24, 2000, by F. Broerman

Common and scientific names [a]	Sites	Birds/trip
	- - - - *Number* - - - -	
American bittern		
Botaurus lentiginosus (Rackett)	14	2.3
Yellow rail		
Coturnicops noveboracensis (Gmelin)	4	1.0
Sora		
Porzana carolina (L.)	16	5.1
Short-eared owl		
Asio flammeus (Pontoppidan)	21	5.6
Sedge wren		
Cistothorus platensis (Latham)	33	2.5
Marsh wren		
C. palustris (Wilson)	20	2.4
Field sparrow		
Spizella pusilla (Wilson)	10	3.1
Le Conte's sparrow		
Ammodramus leconteii (Audubon)	36	4.5

[a] In addition to the species listed, Broerman did not count individuals of savannah, swamp, and song sparrows, or of eastern meadowlarks, all of which were numerous on the surveyed sites.

intensity of the management of the plots at establishment, with the age of the propagules when planted, and with the growth rates of the different species planted. Vegetation structure has accumulated more rapidly in plots in which more intense effort was made to establish woody vegetation.

Hamel found a total of 51 bird species in the 1999 to 2000 WBPS at the Sharkey Site (table 4). We examine the occurrence of individual species as a function of their association with vegetation structure, as well as with respect to their conservation priority. The ANOVA of species richness among treatments revealed that significantly more species (30 plus or minus 4.6 S.D. vs. 11.7 plus or minus 1.8 S.D.) occurred in the NUR treatment than in the others ($F = 54.2$, d.f. = 5,6, $P<0.0001$ (table 4). The ANOVA of total abundance was similar among treatments ($F = 1.13$, d.f. = 5,6, $P<0.43$ (table 4). Thus 5 years after establishment, the treatment with the greatest development of vegetation structure (NUR) harbored the greatest number of bird species, although it did not harbor a greater number of individuals than the other treatments. Among the 28 species found only in the NUR treatment, 12 foraged on trees (Hamel 1992). Four of the five species never found in the NUR foraged on the ground or herbaceous vegetation. These results are consistent with the hypothesis that bird species occurrence reflects physical vegetation structure.

As vegetation structure develops, avian species appear that are associated with that structure, such as Eastern phoebe and yellow-rumped warbler. These birds, which forage from trees or at variable heights, were recorded only in the NUR plots in 1998 to 1999. In 1999 to 2000, these birds occurred rarely in the emerging woody vegetation of the other treatments, particularly the PLN. In both years, species associated primarily with open vegetation also occurred beneath the trees in the NUR, notably song sparrow, swamp sparrow, and red-winged blackbird.

Other species associated with open habitats, such as Northern harrier, sedge wren, savannah sparrow, Le Conte's sparrow, and eastern meadowlark rarely occurred in the NUR treatment. For example, sedge wren was found regularly in all open habitats (54 of 72 visits), but in the NUR only once (of 24 visits) in a very open spot near the edge where flooding had killed some of the planted cottonwoods. An association between occurrence and physical vegetation structure does not explain why Le Conte's sparrow occurred primarily in one spot overlapping the border of a NAT and a PLN plot. The distribution of this bird does not seem to be a straightforward response to the afforestation treatments in this experiment.

Experimental test-species conservation priority—The Partners in Flight (PIF) offers a generally accepted system for recording bird species conservation priority (Partners in Flight 2000). The PIF system gives each species a priority ranking score based on several aspects of occurrence, abundance, and threats to its population. These priority scores are recorded for physiographic areas in which a species breeds, but not for areas where it only winters (Colorado Bird Observatory 1999); the maximum possible score is 35 the minimum is 7 (Carter and others 2000). When possible, we used the PIF conservation priority scores from the MAV for this analysis; where scores were unavailable for the MAV, we used the score from a representative physiographic region in the breeding range of the species. Nuttle and others (2000) have used PIF concern scores similarly.

While bird species richness increases with vegetation structure in the Sharkey Site, conservation priority of individual species does not (table 4). Using the PIF priority rankings, several observations are suggestive. First, the average conservation priority of all 51 species recorded on the WBPS is 15.2. The average ranking of all species found in common among all treatments is a similar 15.5. Second, 28 species that were unique to the NUR treatment average 14.6, a slightly lower value. Third, 5 species not found in the NUR average 16.6, a value higher than the average. When the sedge wren is included in this group, average priority ranking of species found in the other treatments increases to 17.3. Fourth, among the six species of highest conservation priority, two never occurred in the NUR and one occurred only in the NUR. Therefore, rapid afforestation provides winter habitat for a number of species quickly, at the expense of a few high-priority species found in early successional habitats.

CONCLUSIONS

Extensive restoration of forests in the MAV may provide demonstrable, albeit unintended, benefits to birds that winter within afforested sites in early successional stages. This data set illustrates that bird species composition in the MAV

Table 4—Foraging site, abundance on different afforestation treatments, and conservation priority of bird species recorded on four afforestation treatments during winter 1999 to 2000 at the Sharkey Large-Scale Demonstration Project, Sharkey County, Mississippi

Common and scientific names	Foraging site[e]	Abundance in treatment[d]				Conservation priority rating[f]
		NAT	SOW	PLN	NUR	
Northern harrier						
Circus cyaneus (L.)	G, H	13	13	13	1	21[aa]
Red-tailed hawk						
Buteo jamaicensis (Gmelin)	G, H	2.1	9.9	2.6	2.1	12
American kestrel						
Falco sparverius L.	G	.5	0	0	.5	12
Northern bobwhite						
Colinus virginianus (L.)	G	1	0	0	0	20
Common snipe						
Gallinago gallinago (L.)	W	2.1	1	.5	0	13[aa]
American woodcock						
Scolopax minor Gmelin	G	0	0	.5	.5	19
Mourning dove						
Zenaida macroura (L.)	G	0	0	0	2.6	14
Great horned owl						
Bubo virginianus (Gmelin)	G	0	0	0	.5	12
Barred owl						
Strix varia Barton	V	0	0	0	2.6	16
Red-bellied woodpecker[a]						
Melanerpes carolinus (L.)	T	0	0	0	2.1	17
Yellow-bellied sapsucker[a]						
Sphyrapicus varius (L.)	T	0	0	0	1	16[aa]
Downy woodpecker[a]						
Picoides pubescens (L.)	T, B	0	0	0	14.6	14
Hairy woodpecker[a]						
P. villosus (L.)	T	0	0	0	1.6	14
Northern flicker[a]						
Colaptes auratus (L.)	G, T	0	0	0	**7.8**	16
Eastern phoebe						
Sayornis phoebe (Latham)	V	.5	0	2.1	**19.3**	15
Loggerhead shrike						
Lanius ludovicianus L.	G	4.7	3.1	8.3	.5	19
Blue jay						
Cyanocitta cristata (L.)	T	0	0	0	2.1	13
American crow						
Corvus brachyrhynchos Brehm	G	0	0	0	.5	10
Carolina chickadee[a]						
Poecile carolinensis (Audubon)	T	0	0	0	13	20
Tufted titmouse[b]						
Baeolophus bicolor (L.)	T	0	0	0	.5	14
Carolina wren[b]						
Thryothorus ludovicianus (Latham)	G, B	0	0	0	**9.9**	17
Winter wren[b]						
Troglodytes troglodytes (L.)	G	0	.5	0	8.8	14[bb]
Sedge wren						
Cistothorus platensis (Latham)	H	23.4	23.7	21.4	.5	21
Golden-crowned kinglet						
Regulus satrapa Lichtenstein	T	0	0	0	3.1	17[bb]

continued

Table 4—Foraging site, abundance on different afforestation treatments, and conservation priority of bird species recorded on four afforestation treatments during winter 1999 to 2000 at the Sharkey Large-Scale Demonstration Project, Sharkey County, Mississippi (continued)

Common and scientific names	Foraging site[e]	Abundance in treatment[d] NAT	SOW	PLN	NUR	Conservation priority rating[f]
Ruby-crowned kinglet[a]						
Regulus calendula (L.)	T, B	0	0	0	7.3	16[bb]
Eastern bluebird[a]						
Sialia sialis (L.)	G	0	0	0	2.1	14
Hermit thrush[a]						
Catharus guttatus (Pallas)	G, B	0	0	0	**3.1**	16[bb]
American robin[a]						
Turdus migratorius	G, B, T	0	0	0	13	9
Northern mockingbird						
Mimus polyglottos (L.)	G, B	0	0	.5	0	14
Brown thrasher						
Toxostoma rufum (L.)	G, B	0	0	0	.5	17
Cedar waxwing						
Bombycilla cedrorum Vieillot	B, T	0	0	0	2.1	12[aa]
Yellow-rumped warbler[a]						
Dendroica coronata (L.)	V, T	0	0	.5	**65.6**	16[bb]
Palm warbler						
Dendroica palmarum (Gmelin)	G, H, B	0	0	0	.5	16[cc]
Common yellowthroat						
Geothlypis trichas (L.)	H, B	.5	2.6	1	.5	16
Eastern towhee						
Pipilo erythrophthalmus (L.)	G, B	0	0	0	.5	15
Field sparrow						
Spizella pusilla (Wilson)	H	0	2.1	0	.5	20
Savannah sparrow						
Passerculus sandwichensis (Gmelin)	G, H	94.8	74.5	140.1	0	13[aa]
Le Conte’s sparrow						
Ammodramus leconteii (Audubon)	H	1.6	0	4.7	0	23[aa]
Fox sparrow						
Passerella iliaca (Merrem)	G	0	.5	.5	**15.1**	12[bb]
Song sparrow[c]						
Melospiza melodia (Wilson)	G, H	68.2	78.1	53.1	30.2	12
Swamp sparrow[c]						
M. georgiana (Latham)	H	78.6	86.4	124	55.2	16[aa]
White-throated sparrow[c]						
Zonotrichia albicollis (Gmelin)	G, B	0	0	0	43.2	14[cc]
White-crowned sparrow						
Z. leucophrys (Forster)	G, H	0	0	0	**2.1**	12[bb]
Dark-eyed junco[c]						
Junco hyemalis (L.)	G	0	0	0	10.4	14[cc]
Northern cardinal						
Cardinalis cardinalis (L.)	G, B	0	0	0	5.2	12
Red-winged blackbird[c]						
Agelaius phoeniceus (L.)	G, H	241.7	18.2	63.5	252.6	12
Eastern meadowlark						
Sturnella magna (L.)	G, H	50	47.9	61.5	4.2	17

continued

Table 4—Foraging site, abundance on different afforestation treatments, and conservation priority of bird species recorded on four afforestation treatments during winter 1999 to 2000 at the Sharkey Large-Scale Demonstration Project, Sharkey County, Mississippi (continued)

Common and scientific names	Foraging site[e]	Abundance in treatment[d] NAT	SOW	PLN	NUR	Conservation priority rating[f]
Rusty blackbird						
Euphagus carolinus (Müller)	G	0	0	0	8.3	16[cc]
Brewer's blackbird						
E. cyanocephalus (Wagler)	G	0	0	0	1.6	15[aa]
Common grackle						
Quiscalus quiscula (L.)	G	0	0	.5	**222.4**	16
American goldfinch[c]						
Carduelis tristis (L.)	V	3.6	0	3.1	16.7	12
Unknown species	NA	6.3	5.2	5.2	7.3	NA
Mean total density per treatment	NA	592.6	366.7	507.2	865.3	NA
Mean no. of species per treatment	NA	11	11	13	30	NA
Total species per treatment	NA	17	14	19	47	51
Unique species per treatment	NA	1	0	1	28	NA

NA = not applicable; NAT = natural succession and regeneration control; SOW = sown Nuttall oak acorns, 2500 per hectare; PLN = planted Nuttall oak seedlings, 750 per hectare; NUR = planted cottonwood stem cuttings, 750 per hectare, followed by underplanting of Nuttall oak seedlings, 375 per hectare, 2 years later.

[a] Species associated with cottonwood plantations, which are listed by Wesley and others (1976) as preferring natural stands.

[b] Species associated with cottonwood plantations, which are listed by Wesley and others (1976) as preferring neither plantations nor natural stands.

[c] Species listed by Wesley and others (1976) as preferring cottonwood plantations.

[d] Entries reflect mean abundance as birds per km^2. Boldfaced numbers indicate mean abundance different from other treatments by one-way analysis of variance with treatment as main effect, adjusted for an experiment-wide error rate of 0.10 using sequential Bonferroni correction. Standard error values available on request from Hamel (lead author of publication).

[e] Foraging sites listed as B = bush, G = ground, H = herbaceous vegetation, T = tree, V = various heights, W = water (Hamel 1992).

[f] Conservation priority ratings are the Partners in Flight Concern Scores (Colorado Bird Observatory 1999) for the Mississippi Alluvial Valley, with the exception of [aa] = Drift Prairie, [bb] = Central Rocky Mountains, and [cc] = Great Lakes Transition physiographic regions.

follows vegetation structure and development rate in afforestation of abandoned agricultural lands. However, as woody vegetation develops, some bird species of herbaceous vegetation disappear. Perhaps more importantly, the early successional avian species that specialize on herbaceous vegetation are of higher than average conservation priority among the birds found in afforestation areas.

Different species of mammals and birds respond positively to the structure available at different times during succession. Thus, managers must decide on the species and communities they wish to favor. Winter avian communities of early successional stages have been considered heretofore only in passing. However, because birds occur in areas where vegetation structure is dominated by nonagricultural herbaceous plants, they include species otherwise rare or absent from the MAV landscape. To provide bird habitat through the full successional sere, proactive managers may wish to dedicate certain areas to natural succession or to maintenance of herbaceous vegetation.

Forest land managers and biodiversity preservationists make clear the essential relationship between management practices and management objectives (McCullough 1994, Noss 1999). Management (1) is a conscious, goal-directed activity with goals specified in advance, and (2) employs practices to achieve goals within an acceptable period of time. Managers can apply a variety of afforestation methods under different conditions to achieve different management objectives. Managerial discretion influences the rate of structural development of afforestation efforts. Inclusion of management goals to produce habitats in afforestation for early successional species is certainly possible, as is inclusion of management goals to maximize the rate of development of forest vegetation structure and the birds associated with it.

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