

## **Neotropical Migratory Bird Communities in a Developing Pine Plantation**

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**Abstract:** Birds were censused annually from 4 250- × 80-m transects in a young pine plantation from age 2 to 17 to assess changes in the bird community. Bird abundance was low and the bird community was the least diverse when the pine plantation was sparsely vegetated at age 2. As the plantation developed rapidly into the shrub stage, the bird community became more abundant and diverse. Bird abundance increased consistently until plantation age 6, but then declined as the pine canopy closed and shaded out lower deciduous vegetation. Bird species diversity increased gradually during the early years, was highest at plantation age 10 and 11, then decreased. In the latter stages (age 12–17) early successional avian species were virtually gone, a few shrub-associated species persisted, and some species associated with older stands had invaded the plantation. The bird community in this latter canopy-closure stage, was related directly to the presence of hardwood shrubs and trees in the pine-dominated stand.

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Because of high demand for southern pines, many older and slower growing pine-hardwood stands are being harvested and replaced by faster growing pine plantations with relatively short harvest rotations of 20 to 30 years. In 1986, 9% of all midsouth timberland was planted pine and this does not include stands planted to pine but dominated by hardwoods (Birdsey and McWilliams 1986). This land use change constitutes a drastic wildlife habitat alteration. For example, information about how neotropical migratory bird communities respond to these habitat

changes is incomplete, but there is evidence of substantial declines of some populations of neotropical migratory birds and concern for their future (Wilcove 1985).

Breeding bird communities in southern forest stands of different ages and vegetative composition have been documented in several studies (e.g., Johnston and Odum 1956, Shugart and James 1973, Conner and Adkisson 1975, Dickson and Segelquist 1979). In general, during the development of a forest stand, breeding bird diversity and density are both relatively low in the grass-forb stage of a stand and then increase in the shrub-sapling stage as vegetation structure becomes more complex. Later, bird diversity and density usually decrease as trees reach pole size, become dominant, and shade out lower vegetation; then increase once again as the stand matures and opens up, allowing several levels of vegetation (Johnston and Odum 1956, Shugart and James 1973, Conner and Adkisson 1975, Dickson and Segelquist 1979).

In this study we document annually the neotropical migratory breeding bird community in a large, relatively homogeneous developing pine plantation to trace changes in the rapidly developing stand. Earlier results from this study for the entire bird community for plantation ages 2–11 were reported in Dickson et al. (1984, 1993). In this paper we treat the neotropical migratory bird community from plantation ages 2–17.

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## Study Area and Methods

The study was conducted on a large pine plantation (~5 km<sup>2</sup>) in Nacogdoches County, Texas, near the western edge of the Southern Coastal Plain. Soils on the study area are classified as Tenaha loamy fine sand and Cuthbert fine sandy loam. The area is generally rolling upland with a few intermittent streams. Pine and hardwood trees on the area had been harvested and the remaining vegetation cleared and burned in 1975. The site was planted in the winter of 1975–76 with loblolly pine (*Pinus taeda*) seedlings at a spacing of about 1.8 by 3.7 m. The area adjoining the pine plantation was mostly mixed pine-hardwood stands.

In 1977, 4 80- by 250-m transects (2 ha each) were established in the pine plantation with a 100-m buffer zone with adjoining woods or other transects. Transects were similar in topography and representative of the total plantation. Birds on each transect were censused 9 times, an equal number of times by each of 3 census takers. Total number of birds detected on the 8 ha of transects were extrapolated to number per km<sup>2</sup> to facilitate comparison with other studies. Annual censuses by the same people were conducted during May each year from plantation age 2 (1977) through plantation age 17 (1992). All birds within a 40-m lateral distance from the transect mid-line detected by sight or sound were plotted on each transect map while each census taker slowly traversed the midline of each transect (Conner and Dickson 1980). Censusing of each transect took from 12 to 20 minutes; the extra time on some plots was used for identifying and recording birds. All censusing was

completed within 3 hours after sunrise. Censusing was avoided during high winds (>19 kph) or substantial rain. Neotropical migratory bird abundance and bird species diversity were calculated for all transects each year. Bird species diversity was calculated from the information theory formula (MacArthur and MacArthur 1961).

Low vegetation on each of the 4 transects was sampled each growing season on 6 4.05-m<sup>2</sup> circular plots randomly located each year at least 1 m away from each transect midline. Percentage of horizontal surface area to the nearest 5% was estimated for each plant species ≤2 m high. Foliage density was measured horizontally at 1-m height intervals to 6 m with a 0.5- x 0.5-m square checkered board (MacArthur and MacArthur 1961, Conner and O'Halloran 1986) from plantation age 2 through 10 (Fig. 1). After age 10 the plantation height precluded higher horizontal measurements. Beginning at age 8 when the stand was sufficiently developed for measurement, woody vegetation was sampled from 6 200-m<sup>2</sup> circular plots on each transect (Table 1). Stem density and basal area were determined from measurement of individual stems and height of dominant trees measured with a vertical pole.

## Results and Discussion

The low grass-forb vegetation present during the second season after planting supported a low number of birds (163/km<sup>2</sup>) and the least diverse bird community (bird species diversity = 1.56, Fig. 2). The indigo bunting (*Passerina cyanea*), yellow-breasted chat (*Icteria virens*), blue grosbeak (*Guiraca caerulea*), prairie warbler (*Dendroica discolor*), and mourning dove (*Zenaida macroura*) were the most abundant species. These birds typically occupy early successional stands throughout the South (Johnston and Odum 1956, Shugart and James 1973, Conner and Adkisson 1975, Conner et al. 1979, Dickson and Segelquist 1979, Dickson et al. 1984).

After plantation age 2 the vegetative community increased consistently in height and complexity (Fig. 1). The bird community increased in abundance and complexity consistently for several years in response to this vegetational change (Fig. 2). Bird density increased from 163/km<sup>2</sup> the second year after establishment to 350 birds/km<sup>2</sup> at plantation age 6 (Table 2). Bird species diversity increased slightly from year 2 to 9. Other investigators also have found increases in bird density and diversity as stands grow from the grass/forb to the shrub stage and increase in structural complexity (Johnston and Odum 1956, Conner and Adkisson 1975, Dickson and Segelquist 1979).

During this early seral phase, species associated with early successional habitat generally increased. Painted buntings (*Passerina ciris*), prairie warblers, and yellow-breasted chats increased in abundance from plantation age 2 to 3 as the study area became dominated by shrubby vegetation. Painted buntings were relatively abundant from age 3 through 7, then declined rapidly. Prairie warblers were relatively abundant through age 8. Chat abundance peaked at ages 5–7, then gradu-

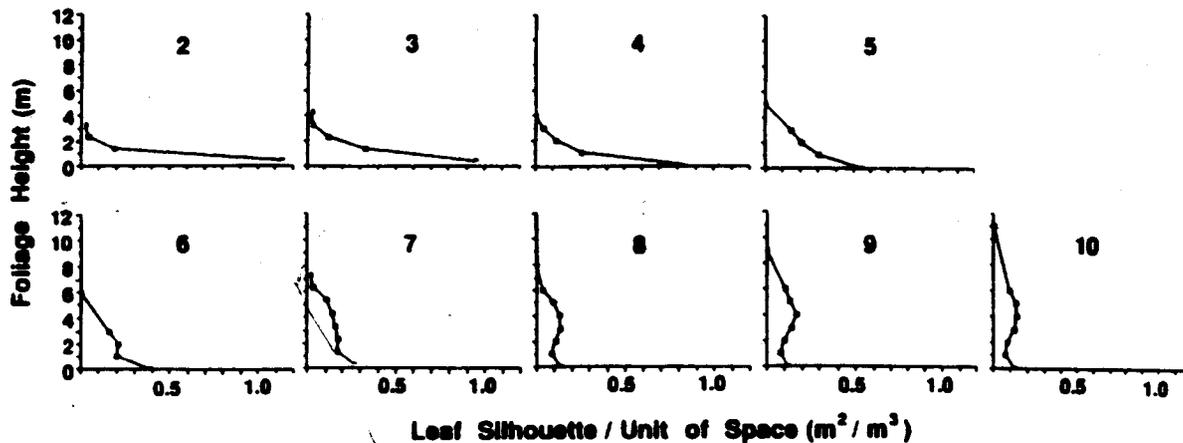


Figure 1. Foliage profiles (MacArthur and MacArthur 1961) of a developing pine plantation in eastern Texas. Numbers represent years since planting.

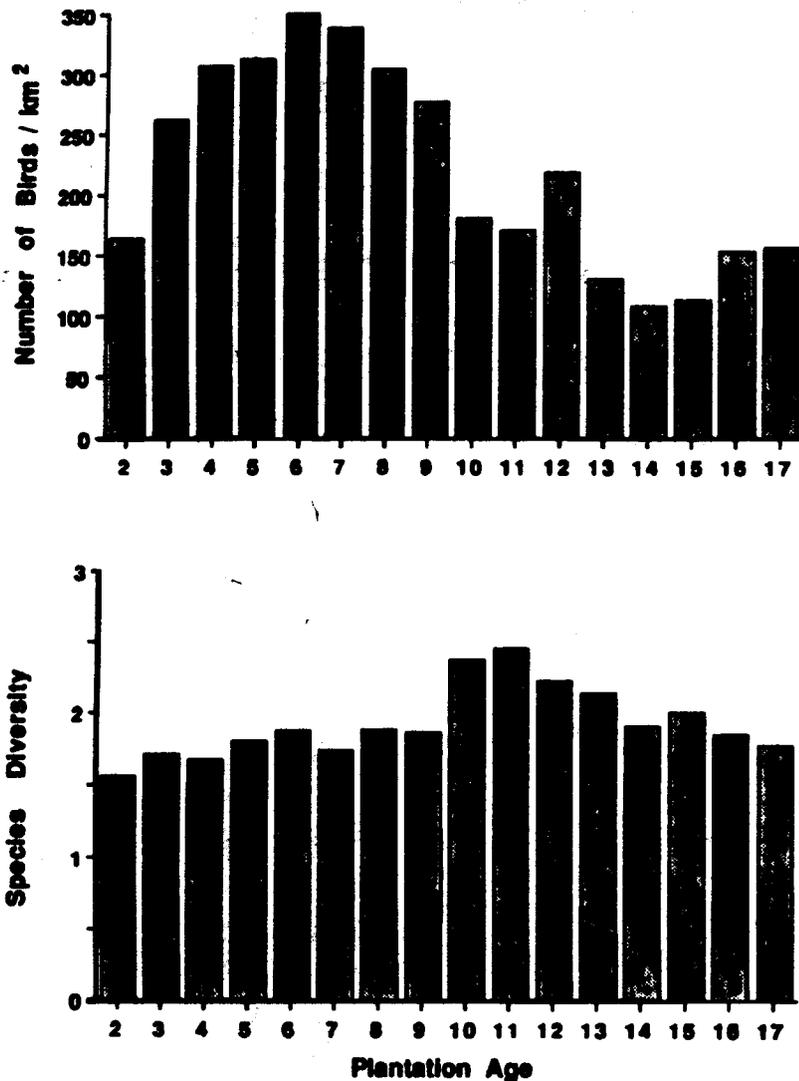
ally declined. Indigo buntings were abundant throughout this period. The white-eyed vireo (*Vireo griseus*), a shrub level species (Dickson and Noble 1978), invaded the bushy stand, a few mourning doves were present, and an occasional yellow-billed cuckoo (*Coccyzus americanus*) and red-eyed vireo (*Vireo olivaceus*) (species normally associated with older stands) were detected. The species in this young plantation usually were common inhabitants of young brushy pine stands in this region (Dickson and Segelquist 1979).

During this period of rapid vegetative development, some species associated with early succession dwindled rapidly. Blue grosbeaks were abundant the first 3 years, but declined afterwards and were gone after age 7. Field sparrows (*Spizella pusilla*) were abundant age 5 through 7 and then disappeared from the plantation.

From about ages 7 to 11 the plantation changed rapidly. Deciduous shrub vegetation yielded dominance to the rapidly growing pines. The canopy of the pine plantation began to close and shade out forbs and hardwood shrubs. From years 8

Table 1. Mean Vegetative Characteristics of a Pine Plantation Determined from 24 200 m<sup>2</sup> Circular Plots.

Characteristic	Plantation age in years									
	8	9	10	11	12	13	14	15	16	17
Height (m)										
Pine	7.3	8.9	10.2	11.3	12.8	13.5	14.3	14.7	16.0	16.8
Hardwood	5.3	6.9	7.9	8.6	9.3	10.4	10.8	11.4	11.6	12.6
Basal area (m <sup>2</sup> /ha)										
Pine	10.3	11.7	15.9	17.9	21.2	22.5	25.0	27.9	28.5	30.3
Hardwood	0.6	0.6	0.7	1.0	1.2	1.2	1.7	1.6	1.9	1.6
No. stems/ha (≥ 5cm)										
Pine	1087	1081	1135	1096	1135	1116	1083	1162	1029	1017
Hardwood	180	203	211	292	283	271	366	319	354	283



**Figure 2.** Neotropical migratory breeding bird abundance (number/km<sup>2</sup>) and diversity in a developing pine plantation.

to 11, pine basal area increased from 10 to 18 m<sup>2</sup>/ha (Table 1). From ages 7 to 11, the percentage of area covered by hardwood foliage <2 m tall declined from 50 to 32, and the area covered by forb foliage declined from 65% to 25% coverage. This changing habitat apparently declined in its capability to support neotropical migratory birds. Bird abundance declined to less than 200 per km<sup>2</sup> by 11 years after establishment. Total bird density often declines in dense pole stage stands where vegetation heterogeneity is not high (Johnston and Odum 1956, Meyers and Johnston 1978, Conner and Adkisson 1975, Dickson and Segelquist 1979).

In this study, painted bunting and prairie warbler populations dwindled rapidly after about age 8 and were gone after age 10. Indigo bunting abundance peaked at age 4 and yellow-breasted chat abundance peaked at ages 6 and 7. Both species declined in abundance as shrub vegetation was replaced by pines.

In this pine plantation, occasional hardwoods grew from sprouts, and shrubs and hardwoods that grew in small windrows and in spots where pines had died created some vegetative heterogeneity. Number of species detected and bird species diversity (Fig. 2) was highest at plantation ages 10-11 because the patches of differ-

Table 2. Number of birds per km<sup>2</sup> detected from transect counts in a pine plantation.

Species	Plantation age															
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Blue grosbeak																
<i>Guitaca caerules</i>	16	14	15	1	3	6										
Field sparrow																
<i>Spizella pusilla</i>		1		12	25	11										
Painted bunting																
<i>Passerina ciris</i>	3	17	18	18	15	14	6	1								
Prairie warbler																
<i>Dendroica discolor</i>	8	33	47	54	46	57	46	25	14							
Yellow-breasted chat																
<i>Icteria virens</i>	39	78	86	104	124	124	97	94	39	17	12	3				
Indigo bunting																
<i>Passerina cyanea</i>	78	96	111	68	69	64	69	51	29	22	40	11	7			
White-eyed vireo																
<i>Vireo griseus</i>	2	3	14	37	43	49	36	42	28	29	18	6	8	1	4	
Mourning dove																
<i>Zenaidura macroura</i>	8	1	4	4	12	1	4		1	10				1	3	1
Yellow-billed cuckoo																
<i>Coccyzus americanus</i>		3	8		1		21	25	10	12	11	11	1		17	
Red-eyed vireo																
<i>Vireo olivaceus</i>	3	3	1	3				4	8	12	37	29	19	25	47	56
Black and white warbler																
<i>Mniotilta varia</i>						3	3	8	18	18	31	18	12	18	14	18
Kentucky warbler																
<i>Opornis formosus</i>						6	12	22	10	17	19	11	12	6	10	6
Hooded warbler																
<i>Wilsonia citrina</i>									6	12	26	26	31	19	33	40
Worm-eating warbler																
<i>Helminthos vermivorus</i>									3	4	12	11	19	26	24	19
Uncommon birds <sup>a</sup>	9	12	3	11	12	3	10	6	15	18	12	6	7	11	6	12
Total	163	261	307	312	350	338	304	277	182	171	218	132	109	114	154	156

<sup>a</sup> Chuck-will's-widow (*Caprimulgus carolinensis*), Chimney swift (*Chaerula pelagica*), Ruby-throated hummingbird (*Archilochus colubris*), Eastern kingbird (*Tyrannus tyrannus*), Great crested flycatcher (*Myiarchus cinerascens*), Eastern wood pewee (*C. virens*), Purple martin (*Progne subis*), Gray catbird (*Dumetella carolinensis*), Brown thrasher (*Toxostoma rufum*), Wood thrush (*Hylocichla ustulata*), Common yellowthroat (*Geothlypis trichas*), Summer tanager (*Piranga rubra*).

ent vegetation were common. The small openings were inhabited by a few early successional species. For example, the few indigo buntings and yellow-breasted chats in the plantation were found mostly in small windrow openings. Sufficient hardwood shrub patches also remained to support species associated with the shrub successional stage, such as white-eyed vireos. The few volunteer hardwood trees in the stand also were sufficiently developed (Table 1) to permit colonization by species such as Kentucky warblers (*Oporornis formosus*) and hooded warblers (*Wilsonia citrina*), normally associated with the understory of mature stands, and a few canopy dwelling species such as yellow-billed cuckoos, red-eyed vireos and black-and-white warblers (*Mniotilta varia*). In a pine-hardwood sapling stand in eastern Texas, yellow-breasted chats, white-eyed vireos, and indigo buntings were the most abundant species (Dickson and Segelquist 1979).

From age 12 to 17 years planted pines grew rapidly and dominated the stand (basal area increased from 21 to 30 m<sup>2</sup>/ha). In response to this change the neotropical breeding bird community decreased in complexity. Species diversity of neotropical migrants declined and their abundance remained low. Yellow-breasted chat and indigo bunting populations dwindled and disappeared as the few openings were overtopped by pines. White-eyed vireo numbers declined sharply as deciduous shrub vegetation disappeared. Some late successional species (Dickson and Segelquist 1979) had invaded the stand in low densities, however. For example, some red-eyed vireos and black-and-white warblers inhabited the canopy of the remnant hardwood trees. Some hooded warblers and a few Kentucky warblers and worm-eating warblers (*Helmitheros vermivorus*) were present in the shaded understories.

Bird species presence and abundance appeared to be directly dependent on habitat conditions during this 16-year study. In this pine dominated stand, the bird community was related primarily to the presence of deciduous shrubs and trees. In a pine pole stand with no hardwoods in eastern Texas, there were few birds of any species (Dickson and Segelquist 1979). In this study the species were similar to those of a pine-hardwood pole stand in eastern Texas, with the exceptions that white-eyed vireos and yellow-billed cuckoos were more common in the pine-hardwood pole stand, but hooded and worm-eating warblers were more abundant in this stand.

The bird community composition in this large plantation (~5 km<sup>2</sup>) may differ from that of small stands with substantial edge and different adjacent land uses. The productivity and population viability in this and most other stands remains unknown.

Young shrubby pine plantations provide good habitat on a landscape scale for some neotropical migratory species associated with early successional stands. Disturbance and openings with low vegetation appear to have been a regular feature of pre-colonial forests. For example, William Bartram, in his travels in the 1700s through the South, makes frequent reference to the blue linnet (indigo bunting) (Van Doren 1928). But value of pine plantations for birds generally is proportional to non-pine vegetation in a stand and decreases as pines dominate.

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