

Effects of Afforestation of Pastures on Bird Abundance

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ABSTRACT

Paul Douglas Forest Preserve (a.k.a. Grassy Ridge Meadow) in northwestern Cook County, Illinois has a mixture of grassland, remnant and afforested woodland habitats. In 2000, the birds of those three habitats were inventoried using point-counts. Fewer birds were seen in the afforested area (113) than in the grassland (201) or the remnant woods (168) despite the fact that there were more points in the afforested habitat: 6, 5 and 3 points, respectively. Overall less than half as many birds were detected a points in the afforested habitat than either other habitat. Ranks of counts in the afforested habitat were significantly ($P < 0.05$) lower (Mann-Whitney U-test) on one out of 5 comparisons with the grassland habitat and on 4 out of 5 comparisons with the remnant woodland. The total number of species observed in the afforested, grassland and remnant woodland habitats were similar: 32, 32 and 39, respectively. Among species found exclusively in a single habitat, the grassland had more than the afforested and woodland combined. The low abundance of birds in a fairly mature afforested area suggests that the known negative impact on grassland birds of planting trees in pastures is not offset by a substantial benefit to woodland birds.

Key words: afforestation, avian diversity, reforestation, grassland bird decline and point counts.

INTRODUCTION

Afforestation, the planting of trees on land that had not previously been forested, is currently being promoted as a way to sequester carbon produced by the burning of fossil fuels (Cathcart 2000). Reforestation (and afforestation) has been a common practice of the Forest Preserve District of Cook County, Illinois (FPDCC) for many years as part of its goal to "preserve and restore the flora and fauna." The Paul H. Douglas Forest Preserve (FPDCC), which is primarily known for its grassland birds, has large afforested and

grassland areas as well as remnant woods (Carpenter and Greenberg 1999). While exploring this site in anticipation of a Bird Conservation Network (BCN) breeding census, we noticed that the more mature, remnant woods abounded with bird activity in comparison to the significantly quieter, younger-aged, afforested woods. Kwok and Corlett (2000) had similarly reported the relative silence of birds in monoculture plantations and, thus, we decided to study the effects of afforestation on avian abundance and diversity at the Paul Douglas Forest Preserve where afforested tracts, remnant forests and grasslands exist in proximity.

In Illinois, grassland bird species declines coincide with the loss of habitat from reductions in area of pasture and hayfields due to changing agricultural practices and/or invasions of grasslands by woody vegetation (Herkert 1991, 1997). O'Leary and Nyberg (2000) found the amount of woody vegetation and the nearness of woody vegetation were the most important factors affecting grassland bird abundance in a complex of fields. Afforestation of pastures clearly decreases the amount of grassland habitat, but how well do and how long before afforested habitats provide birds a habitat close to natural forests are the questions we hope to contribute to.

Our objective was to compare avian density and diversity in two pairs of habitats, both pairs involving the afforested woods. The first comparison was that of birds in the afforested woods with those in a remnant woodland, which had larger trees and a more complex physiognomy, to determine how closely the afforested area resembled nearby natural woodland. The second comparison was that of birds in the afforested area with its neighboring grassland habitat to see what effects tree planting had on grassland and other types of birds.

STUDY AREA

Paul Douglas Forest Preserve is 400 ha of grassland matrix with patches of afforested and natural woods and wetlands. Aerial photographs of the Northeastern Illinois Planning Commission (NIPC), and 1961 and 1990 U.S. Geological Survey Topographic Maps - Palatine, Illinois Quadrangle helped define patch area and habitat history. All study points were in the south half of section 31 T42NR10E, a 129 ha area that was predominantly grassland. Using the parking area named "Grassy Ridge Meadow" as a base (approximately 42° 04'N and 88° 07'W), we sampled an 11.6 ha patch of afforested land along the western edge of the section. The grassland points were between the parking area and the afforested patch. The remnant woodland patch of 3.7 ha was northeast of the parking area. A wetland associated with Poplar Creek was between the parking area and the woodland.

Both the size of the trees and U. S. Geological Survey topographic maps provided information regarding the time of the afforestation. The 1961 map shows both the current grassland and the afforested area as treeless but the 1990 map shows the reforested area as wooded. Currently, there are many trees in the reforested area greater than 25 cm dbh (diameter at breast height). Therefore, it is probable that the trees were planted shortly before 1961, probably about 1955.

MATERIALS AND METHODS

We initially planned to have 6 points 150m apart in each of the three habitats. The remnant woodland was not large and only 3 points greater than 100 m apart could be established in that habitat. One of our initial 6 grassland points proved to be inconvenient to access and was not studied.

A 10-minute point-count protocol was used to monitor birds (Verner 1988). Point-count visits were made on nine days between 6:45 AM and noon. All statistical comparison are based on the five visits (17 & 26 June, 8 & 29 July and 12 August 2000) on which all 14 points were inventoried. The order in which the stations were observed was varied so that each habitat was visited first on at least one trip. Four field guide resources -- books and cassettes (Bull and Farrand 1994; Coe 1994; Peterson 1980; Lang and Stokes 1997) were used to identify birds.

Two procedures were used to evaluate the hypothesis that the abundance of birds in the afforested community was less than that in the other two habitats. First we ranked (by count) each point in the two habitats on a given day. Using the Mann-Whitney U-test (Sokal and Rohlf 1969) we determined if the ranks were significantly different between the two habitats. Second, we used a sign test (Sokal and Rohlf 1969). The total number of birds observed at all of the habitat's points on a given day was used to order the habitats on each day. The afforested habitat always had less total birds even though it had more points than either other habitat so we made no adjustment for the different number of points. We then tested the hypothesis the habitats were equal by calculating the probability of observing the afforested habitat as having the lowest abundance on all five comparisons if they were equal, namely $\frac{1}{2^5}$ or 0.03. Community species similarity used the Jaccard index of similarity (Curtis 1959), namely twice the number of shared species divided by the sum of the total number of species in each habitat.

Quantitative vegetational characterization of the study areas was done in August. At each point, we estimated the percentage cover of herbaceous vegetation, the density of large trees, small trees, and shrubs (e. g. Curtis 1959). The percentage of herbaceous cover was an estimate of the ground that was hidden by plants as one looked down at the ground around the point. All large trees, which we defined as those greater than 25 cm diameter at breast height (dbh) within 12 m of the point, were identified and measured. Small trees, those between 10 and 25 cm dbh, within 5 m of the point were identified and measured as well. To estimate the density of shrubs, which we defined as woody vegetation less than 10 cm dbh and greater than 1 m high, we counted the number within 5 m of the point. All estimates were expressed as a number per hectare.

RESULTS

A total of 723 birds with a total of 69 species were identified in all three habitats during all visits. On the five days all fourteen points were visited 113 birds of 32 species were observed in the afforested woods, 201 birds of 32 species were observed in the grassland region, and 168 birds of 39 species were observed in the remnant woods (Table 1). The most frequently observed species were the bobolink (*Dolichonyx oryzivorus*) with 79 birds -- many were fledglings, the red-winged blackbird (*Agelaius phoeniceus*) (68), the

American robin (*Turdus migratorius*) (59), the black-capped chickadee (*Parus atricapillus*) (53), the blue jay (*Cyanocitta cristata*) (45) and the barn swallow (*Hirundo rustica*) (44). Not surprisingly, certain species were much more abundant in one particular habitat.

A total of 62 species were identified on the five days that all 14 points were studied. Table 2 presents the information on the overlap of species among habitats; ten species were seen in all 3 habitats, 17 were seen only in the grassland, 9 only in the remnant woodland and 5 only in the reforested woodland (Table 2). The reforested habitat and the remnant had the highest similarity (73%); while the similarity of the grassland with the woodlands was between 34 and 39%. Each habitat had some species observed only in that habitat, but less than 10% were identified in only the reforested woods (Table 2). The average number of birds per station per visit was largest in the remnant woods (11.2), the average for the grassland habitat was 8.4 birds, while the reforested woods had a much smaller average of 3.8 birds (Table 1).

On each of the days that all five grassland and all six reforested woodland stations were visited, more birds were observed in the grassland. On each of the five days that all remnant woodland and all reforested woodland stations were visited, more birds were observed at the three remnant woodland stations than at all six reforested stations. Thus in both comparisons we reject the hypothesis that the habitats have equal abundance of birds, as the probability that the sign of the comparison would always be the same is less than 5%. A more stringent test asks if the counts at individual points differ by habitat. Points within the afforested habitat (on the same observation day) were significantly less than the counts at the grassland points (Mann-Whitney U-test) on one out of five days. The remnant woods had a significantly higher count of birds per point than the afforested woods on four out of five days.

The Vegetation

One grassland point was in a regularly mowed area at the edge of a soccer field. The other four grassland sites were typical of abandoned hayfields. Grass was 5-8 dm tall, thick and covered over 90% of the ground. Only four forb species were noticed and no woody vegetation taller than the grass was detected within 15 m of the point (Table 3).

Five of the six reforested points were in a relatively mature afforestation; the other point had trees remaining from a former homesite. Many of the planted trees were greater than 25 cm diameter at breast height (dbh). Ten of the fourteen tree species that were planted were native to Cook County, Illinois, including three species of oak (*Quercus* sp.). The six reforested sites had an average density of 111 trees >25 cm dbh per ha, but did not have any trees >50 cm dbh. The density of trees taller than 3 m high and <25 cm dbh was 615 stems/ha. The density of shrubs (woody vegetation <3 m high) was 2,419 stems/ha, though over half the total counts were at a single station. Excluding that particular station, the shrub estimate would be 1,350 stems/ha in the afforested area. The herbaceous layer in the reforested tract covered an average of 31% of the ground (Table 3).

All three remnant woodland stations were associated with a moderately steep ridge that dropped down to a wetland. The herbaceous layer only covered 17% of the ground, but included classic woodland species and a higher number of total species than the refor-

ested area. The shrub layer had an average density of 1,188 stems/ha, while the trees <25 cm dbh had a density of 891 stems/ha. The trees >25 cm dbh had a density of 162 stems/ha, with oak (*Quercus*) species most abundant. There were also many more trees with dead limbs in the remnant tract as well as containing some trees which were >50 cm dbh.

DISCUSSION

The planting of trees has long been an environmental mantra. In addition to long standing reasons for promoting tree planting, currently afforestation is being promoted as a way to soak up carbon in the atmosphere (Herbohn et al. 2000). The adverse effect of afforestation on grassland birds is obvious. We observed seventeen species solely in the grassland. Bobolinks, meadowlarks (*Sturnella magna*), and other grassland birds disappear sometime after a field is planted with trees and are replaced by birds species that find the new environment with small woody vegetation attractive. As the afforested area further matures theoretically one expects birds of mature forests. Our study demonstrates that even when large tree density in an afforested patch is comparable to that of a natural woodland, the abundance of birds in the afforested area is much less than a remnant woodland. Afforestation is not comparable to successional changes following strip-mining where vegetation growth increased avian diversity (Karr 1968), because in mining situations the bare ground that immediately follows mining has very few nesting species. In the case of afforestation, an existing grassland guild with a moderate number of species is displaced by the planting of trees.

Studies of avian changes following logging (e. g. Hagan et al. 1997) show that certain species benefit from the habitat that follows logging (but not the grassland guild) and that diversity can often be maximized by different age patches. Logging a natural forest typically results in a temporary flourishing of understory herbs and shrubs before eventually being displaced by trees. In the situation we studied, the understory of the afforested woods had pasture plants and mostly exotic shrubs (albeit at high density) rather than woodland plants. Reforestation of land recently occupied by a forest not only is likely to develop a rich understory, but also differs from afforestation in that reforestation does not involve the displacement of an existing grassland bird guild.

Our main finding was the distinctly lower abundance of birds in afforested areas compared to either the grassland or the natural forest. Other studies examining avian life in tree plantations also found lower abundance and diversity in such areas than in more natural, remnant woods. Probst et al. (1992) suggests that bird populations were highest in mature stands because of their greater structural complexity. Christian et al. (1997) found avian abundance and diversity considerably lower on plantations when compared to forests and non-wooded wildlands and Kwok and Corlett (2000) offered lower food abundance as an explanation. Ericsson et al. (2000) attribute the lower avifaunal diversity of reforested woods to the lack of natural floral diversity of these forests' ecosystems.

Management Implications

Ways that seem likely to increase avian diversity in existing afforested areas include creating deadwood within them and getting the understory vegetation closer to that of forests. If grassland birds occupy an area proposed for afforestation, the afforestation should not be undertaken. It will be very difficult, if at all possible, to ever recover the avian diversity displaced.

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Table 1. Number of species and birds observed by habitat*.

Variable	-----Habitat-----			Total
	Grassland	Reforested	Remnant Woods	
Number of Points per habitat	5	6	3	14
Species Total	32	32	39	62
Total Birds	201	113	168	482
Average number of birds per point per visit	8.4	3.8	11.2	

* Using five dates on which all 14 points were visited

Table 2. Overlap of species among habitats.

Part A. Numbers of species				
Habitats where found:	Grassland	Reforested	Remnant Woods	
All	10	10		10
Grassland & Reforested	1	1		
Grassland & Remnant	4			4
Reforested & Remnant		16		16
Grassland only	17			
Reforested only		5		
Remnant only				9
Total in habitat	32	32		39
Proportion of total species (62) found in habitat	0.52	0.52		0.63
Proportion of total species (62) exclusive to habitat	0.27	0.08		0.15
Part B. Jaccard's Index of Similarity				
Reforested	0.34			
Remnant	0.39	0.73		

Table 3. Vegetation characteristics of habitats.

	Grassland	Reforested	Remnant Woods
Herbaceous Cover	100%	31%	17%
Woody vegetation	Number per hectare	Number per hectare	Number per hectare
Shrubs	14	2419	1188
Trees <25 cm dbh	0	615	891
Trees >25 cm dbh	0	111	162