**BIRD USAGE OF
HYBRID POPLAR PLANTATIONS
ANNUAL and FINAL PROGRESS REPORT 1997**

OR22051

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Bird usage of hybrid poplar plantations: 1997 annual progress report. February 1998. by JoAnn M. Hanowski and Gerald J. Niemi Center for Water and the Environment, Natural Resources Research Institute, University of Minnesota-Duluth, 5013 Miller Trunk Highway, Duluth, MN 55811.

SUMMARY

We continued to collect baseline data on the large plantations that have been established in the Alexandria area. Three sites have been surveyed for four years, six sites for three years, and four sites for two years. We continued to see a general pattern of an increase in species diversity and overall abundance as plantations have aged from one to five years. Older plantations (six and seven years) had fewer individuals than age five plantations, but this could be attributed to the fewer number of plantations that we have surveyed in the older age categories.

Individual species observed on plantations indicated that open country birds continued to dominate the younger plantation community and early-successional species were most common on the three to five year old sites. Forest edge species were present on two older plantations but were also recorded on several four year old plantations. Very few forest species were observed in plantations of any age.

Species turnover rates for individual sites indicated that community composition is unstable. Turnover was generally lower on sites after they have reached age five and higher on sites up to age four. The relatively high rate for the Belle River site from 1996 to 1997 is difficult to interpret, but could indicate that the community is changing from an early- successional species composition to a community that has more forest birds. Additional data are needed to confirm this observation.

The highest proportion of individuals observed in the plantations of all ages were seed and insect eaters that feed on the ground. Based on the habitat guild summaries, it is evident that birds that prefer open fields and meadows dominated the bird community from ages 1 to 4. Bird species that prefer wet shrub, open wetland, or aquatic habitats were present in small numbers in plantations of all ages. The presence of these bird species on plantations were likely due to the influence of surrounding landuse types or by small wetland inclusions within the plantations. At age five and six a few species that occupy deciduous forests began to colonize the plantations. The largest proportion of bird species that occurred on plantations in the first six years were short-distance migrants. Very few resident birds were found in plantations at any age.

Data collected on predation rates this past summer indicate that predation rates are independent of habitat type (including the plantation). For example, predation rates in plantations averaged 20% and the adjacent CRP rate was 10%. In addition, average rate for forests adjacent to plantations was 25% compared to 20% in the plantations.

We have developed a geographic information system (GIS) that includes land cover types within a 2-3 mile radius of each plantation in the Alexandria area. Information gathered on birds over the past six years will be used as inputs for a geographical model to predict bird responses to plantation development. Initial values for bird species to be implemented into the model were calculated. Landuse change simulation models will be run to predict bird changes in response to plantation development and growth in this region.

GOALS AND OBJECTIVES

- (1) Based on breeding bird surveys, to test the null hypothesis that there are no differences in bird communities and species composition (numbers of species, individuals, and presence or absence of edge species, forest interior species, and Brown-headed cowbirds) between plantations and agricultural row crops, haylands/pastures, or wildlands.
- (2) Relative to number 1, to test the null hypothesis that there are no differences in bird communities and species composition among plantations with different structural characteristics (size, shape, age, and surrounding habitat types).
- (3) Based on breeding bird surveys, to test the null hypothesis that there will be no difference in bird communities and species composition if CRP lands are replaced with either plantations or croplands.
- (4) To test the null hypothesis that occurrence of parasitism by Brown-headed Cowbirds does not decrease reproductive success of nesting birds within plantations.
- (5) To test the null hypothesis that there are no differences in species turnover rates between plantations and row crops, hayland/pastures, or wildlands.
- (6) In concert with the gross and microhabitat data collected by the small mammal studies, to test the hypothesis that there are no relationships between plantation habitat variables and bird species community composition or species presence in plantations.
- (7) Collect baseline bird community data for 6 large plantation blocks that were established within a 50 mile radius of Alexandria in the spring of 1994. With these larger blocks of plantation we will be able to address several hypotheses relative to the suitability of these areas for open prairie birds in the early stages of succession and later as interior forest habitat for forest birds.
- (8) To assess the status of information gathered over the past three years as inputs for a geographical model to predict bird and small mammal responses to plantation development in a range of landscape contexts, sizes, shapes, and successional periods.
- (9) Collect additional baseline data on new plantations as they are established in the Alexandria area. Four additional sites were added in 1995.
- (10) Conduct studies on predation rates of artificial bird nests to test the hypothesis that predation rates in forests, wetlands, and grasslands adjacent to plantations are not affected by distance to the edge of the plantation. In addition, to test the hypothesis that predation rates in plantations are not different than rates in adjacent habitat.
- (11) Develop a geographic information system (GIS) that includes land cover types within a 2-3 mile radius of each plantation in the Alexandria area. This information is required for objective 8 (above).
- (12) Determine habitat requirements for Loggerhead Shrikes and develop a plan to enhance habitat for this and other species requiring similar habitat features.

ACCOMPLISHMENTS

(1) We collected bird community data for 6 large plantation blocks that were established in the spring of 1994, 4 large plantations established in 1995, and three other large plantations in the Alexandria area. With these larger blocks of plantation we are addressing hypotheses relative to the suitability of these areas for open prairie birds in the early stages of succession and later as interior forest habitat for forest birds.

(2) We developed preliminary probability models for individual bird species in plantations ages 1-9 and five additional habitat types (non-hay crop, forest and shrub, other non-wild, other wild, and hay and pasture). This information will be used in models to predict bird response to changes in landscape as plantations are planted, grow and are harvested. Additional work is required to refine these models.

(3) Artificial nests were placed in habitats (CRP or forest) adjacent to and within two plantations.

INTRODUCTION

The overall objective of our study is to understand the relative contributions that different land-use types have to the regional avian biodiversity in western Minnesota and how these patterns may change if hybrid poplar plantations replace existing land-use types. The land-use types of interest are CRP (Conservation Reserve Program), grassland, and agricultural crops including both cultivated and non-cultivated fields. It is anticipated that in Minnesota and in adjacent states, CRP lands will be the most likely sites for establishment of dedicated energy crops. Extensive development of hybrid poplar plantations could result in shifts in the habitat currently available for birds in these areas and it is critical to understand how major land-use changes may impact regional avian biodiversity. This work is being completed by JoAnn M. Hanowski and Gerald J. Niemi both with the Center for Water and the Environment of the Natural Resources Research Institute. The Institute is a department of the University of Minnesota, Duluth and it has a mission to develop the natural resources of Minnesota in an environmentally sound manner.

METHODS

Study areas. A total of 13 plantations were surveyed for birds in 1997 (Table 1). For four sites, 1997 represented the third year of sampling, six sites were surveyed for four years, and three sites have been monitored for the past five years. One site (Nelson) was dropped from the analyses because it has completely failed and there are no plans to establish it as a plantation. Tree heights within plantations were estimated and areas of trees with different heights were calculated for each site with a planimeter.

Bird Surveys. We did one breeding bird survey in June on each plantation and the surrounding habitats with the same method used to survey plantations in the previous three years (Hanowski et al. 1993). We used the line transect technique to conduct surveys by walking lines through the plantation and surrounding landscapes while recording all birds heard and seen on a schematic drawing of the study area. The bird counts were conducted only in good weather (no or very light precipitation and winds < 15mph) and during the period in the morning from one half hour before and four hours after sunrise when they were most actively singing.

Artificial nest study. Artificial nests baited with two quail eggs were placed in the plantation and adjacent CRP or forest habitat. All nests were placed on the ground during the last week in May and left in the field for a period of 14 days.

Data compilation and analyses. Bird data were compiled separately for each site and habitat type. Number of acres of all habitat types were grouped into categories including non-hay cropland, plantation, forest and shrub, other non-wildland, other wildland, and hay and pasture. These values were used with the bird census data to calculate number of birds/acre in each habitat type as well as to standardize numbers of species and individuals observed in each habitat with the rarefaction method (James and Rathbun 1981). We measured community stability by calculating species turnover rates for each plantation as it aged (Helle and Monkkonen 1985). Each bird species observed during the surveys was assigned to a guild based on its habitat, food preference and migration status. This information was used to calculate both the percentage of all individuals, or percentage of all species observed within plantations that belonged to certain habitat, food or migration guild.

Table 1. Name, age (in 1997), size and number of years each plantation was surveyed for birds.

Plantation Name	Age in 1997	Size in acres	Years surveyed
Belle River	6	47	5
Alexandria	5	74	5
Belgrade	7	41	5
Erickson	4	84	4
Durst	4	161	4
Swanson	4	105	4
Nelson dropped from analyses	4	130	4
Kreyer	4	121	4
Sheets	4	88	4
Krause	3	108	3
Bagley/Roguske	3	310	3
Dittes	3	304	3
Sonstegaard	3	203	3

Species probability values. We calculated the probability that a species would occur within plantations of all ages (1 to 7 years) and all other habitat types. This was done by counting the number of times a species occurred on a site in any year and then dividing the total number by the number of combinations. These numbers will be the initial values used to develop the landscape models.

RESULTS AND DISCUSSION

Objectives 7 and 9. We continued to see a general pattern of an increase in species diversity and overall abundance as plantations have aged from one to five years (Figure 1). Older plantations (six and seven years) had fewer individuals than age five plantations, but this could be attributed to the fewer number of plantations that we have surveyed in the older age categories. For example, only one plantation is age seven and we have data for two plantations of age six. We might expect to see a change in this pattern when we have additional data for older plantations.

Individual species observed on plantations indicated that open country birds continued to dominate the younger plantation community (killdeer, horned lark, vesper and savannah sparrows, and red-winged blackbird) (Appendix 1). In contrast, early-successional species (common yellowthroat, clay-colored sparrow, song sparrow, and American goldfinch) were most common on the three to five year old sites. Forest edge species (American robin, indigo bunting, chipping sparrow) were present on two older plantations (Belgrade and Belle River), but were also recorded on several four year old plantations (Kreyer, Dittes, Durst, BRS, Swanson). Very few forest species were observed in plantations of any age. The exception was the occurrence of the red-eyed vireo on the Alexandria and Kreyer plantations (Appendix 1).

Figure 1. Number of species and individuals per 2.5 ha on plantations from age 1 to 7.

Species turnover rates for individual sites indicated that community composition is unstable (Table 2). Turnover was generally lower on sites after they have reached age five (e.g., Belgrade, Belle River and Alexandria) and higher on sites up to age four. The relatively high rate for the Belle River site from 1996 to 1997 is difficult to interpret, but could indicate that the community is changing from an early-successional species composition to a community that has more forest birds. Additional data are needed to confirm this observation.

Table 2. Annual percent species turnover on plantations from 1994 to 1997.

Plantation	1994 to 1995	1995 to 1996	1996 to 1997
Belgrade	34.2	25.6	28.8
Alexandria	30.9	28.3	13.5
Belle River	32.5	31.6	51.0
Erickson	78.9	57.9	43.2
Durst	72.6	58.2	43.1
Swanson	42.9	65.6	45.3
Kreyer	52.9	46.9	38.6
Sheets	58.8	52.7	56.7
Krause	-	43.8	48.1
BRS	-	59.2	37.1
Dittes	-	44.3	50.6

Figure 2. Percent of individuals within six feeding guilds in plantations from age 1 to 7.

Figure 3. Percent of individuals within three migration guilds in plantations from age 1 to 7.

We have followed the succession of bird communities within plantations over time with measures of diversity, turnover rates, and by looking at single species changes in abundance over time. Another method to track succession is to document percentage of species within plantations over time that belong to different habitat or feeding guilds, or that have different migratory strategies. The highest proportion of individuals observed in the plantations of all ages were seed and insect eaters that feed on the ground (Figure 2). Based on the habitat guild summaries, it is evident that birds that prefer open fields and meadows dominated the bird community from ages 1 to 4 (Figure 4). Bird species that prefer wet shrub, open wetland, or aquatic habitats were present in small numbers in plantations of all ages. The presence of these bird species on plantations were likely due to the influence of surrounding landuse types or by small wetland inclusions within the plantations. At age five and six a few species that occupy deciduous forests began to colonize the plantations. The largest proportion of bird species that occurred on plantations in the first six years were short-distance migrants (Figure 3). These species included primarily sparrows and blackbirds that winter in the southern United States. Numbers of species that migrate long-distances to Central and South America increased slightly as the plantations grow. These species included warblers, vireos, and swallows. Very few resident birds (woodpeckers, chickadees, jays) were found in plantations at any age.

Figure 4. Percent of species within five habitat guilds within plantations from age 1 to 7.

Objective 10. We conducted studies on predation rates of artificial bird nests to test the hypothesis that predation rates in forests or CRP adjacent to plantations were not different than predation rates within the plantations. Data collected on predation rates this past summer support the alternative hypothesis that predation rates are independent of habitat type (including the plantation). For example, predation rates in plantations averaged 20% and the adjacent CRP rate was 10%. In addition, average rate for forests adjacent to plantations was 25% compared to 20% in the plantations.

Objective 11. We have developed a geographic information system (GIS) that includes land cover types within a 2-3 mile radius of each plantation in the Alexandria area (for details see small mammal report). Information gathered on birds over the past six years will be used as inputs for a geographical model to predict bird responses to plantation development. Initial values for bird species that will be implemented into the model were calculated (Appendix 2). Landuse change simulation models will be run to predict bird changes in response to plantation development and growth in this region.

FINANCIAL SUMMARY

Approximate expenditures by category estimated through the end of contract period (September 1997).

Salaries and fringe	23,300
Supplies	700
Travel	2,000
Total	26,000

No equipment has been purchased on this project.

LIST OF PUBLICATIONS

- 1997 Christian, D.P., P.T. Collins, J.M. Hanowski, and G.J. Niemi. Preliminary studies of birds and small mammals inhabiting hybrid poplar plantations in the north-central United States. Proc. Poplar Council of Canada.
- 1997 Christian, D.P., P. T. Collins, and G.J. Niemi. Bird and small mammal use of short-rotation hybrid poplar plantations. J. Wildlife Manage. 61: 171-182.
- 1997 Hanowski, J. M., G.J. Niemi, and D.P. Christian. Influence of within-plantation heterogeneity and surrounding landscape composition on avian communities in hybrid poplar plantations. Conservation Biology 11: 936-944.
- 1997 Tolbert, V.R., J. M. Hanowski, W. Hoffman, A. Schiller, D. Christian and J. Lindberg. Changes in bird community composition in response to growth changes in short-rotation woody crop plantings. In: R.P Overend and E. Chornet (editors). Proc. Of the 3rd Biomass Conference of the Americas. Montreal, Quebec Canada 1997. Pergamon

Species	Belgrade	Alexandria	Belle River	Erickson	Durst	Swanson	Nelson	Kreyer	Sheets	BRS	Krause	Dittes
Sedge Wren	-	1	-	-	-	-	22	-	-	2	-	-
Marsh Wren	-	-	-	-	-	-	3	-	-	-	-	-
American Robin	4	-	2	-	2	-	-	-	-	5	-	1
Gray Catbird	-	-	-	-	-	-	-	-	-	-	-	1
Cedar Waxwing	-	1	-	-	-	-	1	-	-	-	-	1
Red-eyed Vireo	-	2	-	-	-	-	1	-	-	-	-	-
Yellow Warbler	-	-	-	-	-	-	-	-	-	-	-	2
Common Yellow-throat	4	23	-	5	-	7	27	1	1	3	-	2
Indigo Bunting	-	-	1	-	-	1	-	1	-	-	-	2
Chipping Sparrow	-	-	2	-	-	-	-	7	-	-	-	5
Clay-colored Sparrow	14	16	2	7	9	12	14	7	12	7	1	2
Vesper Sparrow	-	-	-	11	9	5	-	30	8	21	9	22
Savannah Sparrow	-	-	-	1	14	-	3	-	2	11	6	1
Grasshopper Sparrow	-	-	-	-	1	-	4	-	-	2	-	9
Song Sparrow	7	32	5	10	1	20	8	-	2	12	-	-
Swamp Sparrow	-	-	-	-	-	-	9	-	-	-	-	-
Bobolink	-	-	-	-	-	1	5	-	-	4	-	-
Red-winged Blackbird	6	7	-	2	9	7	48	-	-	34	-	5
Yellow-headed Blackbird	-	-	-	-	-	-	-	-	-	-	-	1
Brewer's Blackbird	-	-	-	-	-	-	-	-	1	21	-	2
Common Grackle	-	-	-	1	5	-	22	-	1	2	-	4

Species	Belgrade	Alexandria	Belle River	Erickson	Durst	Swanson	Nelson	Kreyer	Sheets	BRS	Krause	Dittes
Brown-headed Cowbird	2	2	-	1	12	4	2	1	9	16	-	3
American Goldfinch	-	13	1	6	8	4	3	6	10	15	1	12
Unidentified	2	-	4	3	4	-	-	8	5	3	1	1

Appendix 2. Proportion of sites in which species was present in plantations by age.

	Age of plantation									Total
	1	2	3	4	5	6	7	8	9	
Number of samples	10	11	14	10	7	12	9	6	1	80
Great Egret	0.100	-	-	-	-	-	-	-	-	0.013
Canada Goose	0.100	-	-	-	-	-	-	-	-	0.013
Mallard	0.100	0.273	0.071	-	0.143	0.167	-	-	-	0.100
Northern Pintail	-	-	-	-	-	0.083	-	-	-	0.013
Blue-winged Teal	0.100	0.364	0.071	0.100	-	-	-	-	-	0.088
Northern Harrier	-	0.091	0.071	-	-	-	-	-	-	0.025
Sharp-shinned Hawk	-	-	0.071	-	-	-	-	-	-	0.013
Cooper's Hawk	-	0.091	-	-	-	-	-	-	-	0.013
Red-tailed Hawk	-	0.091	-	-	-	-	-	-	-	0.013
Ring-necked Pheasant	0.100	0.273	0.286	0.100	0.286	0.167	-	-	-	0.163
Sora	-	0.091	-	-	-	-	-	-	-	0.013
Sandhill Crane	0.100	-	-	-	-	-	-	-	-	0.013
Killdeer	0.800	0.818	0.429	0.200	-	-	-	-	-	0.313
Spotted Sandpiper	-	0.091	0.071	-	-	-	-	-	-	0.025
Upland Sandpiper	0.100	-	0.071	-	-	-	-	-	-	0.025
Common Snipe	-	0.091	-	-	-	-	-	-	-	0.013
Herring Gull	-	-	-	-	-	0.083	-	-	-	0.013
Rock Dove	0.200	-	-	-	-	-	-	-	-	0.025
Mourning Dove	0.100	0.727	0.714	0.300	0.143	0.167	0.333	0.333	-	0.375
Black-billed Cuckoo	-	-	0.071	-	-	0.083	-	-	-	0.025
Yellow-billed Cuckoo	-	-	-	-	-	0.083	-	-	-	0.013
Chimney Swift	-	0.091	-	-	-	-	-	-	-	0.013
Northern Flicker	-	0.091	-	-	-	-	-	-	-	0.013
Eastern Wood-Pewee	-	-	-	-	-	0.083	-	-	-	0.013
Willow Flycatcher	-	-	-	0.100	0.143	0.083	0.222	0.167	1.000	0.088
Least Flycatcher	-	-	-	-	-	-	0.111	0.167	-	0.025
Great Crested Flycatcher	-	0.091	-	-	-	0.083	-	-	-	0.025
Eastern Kingbird	0.200	0.273	0.143	0.100	0.143	-	0.111	-	-	0.125
Horned Lark	1.000	0.818	0.429	0.200	-	-	-	-	-	0.338
Purple Martin	-	-	0.071	0.200	-	-	-	-	-	0.038
Tree Swallow	0.300	0.636	0.214	0.400	-	-	-	0.167	-	0.225
No. Rough-winged Swallow	-	0.091	-	-	-	-	-	-	-	0.013
Bank Swallow	-	-	0.143	-	-	-	-	-	-	0.025
Cliff Swallow	0.100	0.182	0.071	-	-	-	-	-	-	0.050
Barn Swallow	0.300	0.818	0.500	0.300	-	0.083	0.111	-	-	0.300
Blue Jay	-	-	-	-	0.286	0.167	0.333	-	-	0.088
American Crow	0.100	-	-	-	-	0.083	-	-	-	0.025
Sedge Wren	-	0.091	0.143	0.100	0.143	0.167	0.111	-	-	0.100
Marsh Wren	-	0.091	-	0.100	-	-	-	-	-	0.025
Eastern Bluebird	0.100	0.182	0.143	-	-	-	-	-	-	0.063
American Robin	0.500	0.364	0.286	0.300	0.571	0.583	0.778	0.500	1.000	0.475
Gray Catbird	-	0.091	0.071	0.100	-	0.167	0.111	0.333	-	0.100
Brown Thrasher	0.100	-	-	-	0.286	0.250	0.222	0.167	-	0.113
Cedar Waxwing	-	-	0.071	0.200	0.143	0.167	0.111	0.167	-	0.100
European Starling	-	0.182	-	-	-	-	0.111	0.167	-	0.050
Warbling Vireo	-	-	-	-	-	0.167	0.333	-	-	0.063
Red-eyed Vireo	-	-	-	0.100	0.143	0.167	-	-	-	0.050
Blue-winged Warbler	-	-	-	-	-	-	0.111	-	-	0.013
Golden-winged Warbler	-	-	-	-	-	0.083	-	-	-	0.013
Nashville Warbler	-	-	-	-	-	-	0.111	-	-	0.013
Yellow Warbler	-	-	0.143	0.100	-	0.083	0.111	-	-	0.063
Chestnut-sided Warbler	-	-	0.071	-	-	-	-	-	-	0.013
American Redstart	-	-	-	-	-	-	0.111	0.167	-	0.025
Mourning Warbler	-	-	-	-	-	0.083	0.111	-	-	0.025
Common Yellowthroat	0.200	0.545	0.714	0.900	0.429	0.667	0.444	0.333	-	0.550
Northern Cardinal	-	-	-	-	-	0.083	0.111	-	-	0.025
Rose-breasted Grosbeak	-	-	-	-	0.143	0.083	-	0.167	-	0.038

Proportion of sites in which species was present by plantation age.

	Age of plantation									Total
	1	2	3	4	5	6	7	8	9	
Number of samples	10	11	14	10	7	12	9	6	1	80
Indigo Bunting	-	-	0.143	0.300	0.286	0.083	0.222	0.167	-	0.138
Dickcissel	-	0.091	0.071	-	-	-	-	-	-	0.025
Chipping Sparrow	0.100	0.091	0.143	0.100	-	-	0.111	-	-	0.075
Clay-colored Sparrow	0.200	0.545	0.929	1.000	0.857	0.583	0.333	0.167	-	0.600
Vesper Sparrow	0.800	0.909	0.786	0.700	0.429	0.333	0.111	-	-	0.550
Savannah Sparrow	0.600	0.818	0.714	0.400	0.143	0.167	-	-	-	0.400
Grasshopper Sparrow	0.200	0.455	0.357	0.300	-	-	-	-	-	0.188
Song Sparrow	0.200	0.727	0.929	0.900	0.857	0.750	0.889	0.667	1.000	0.750
Swamp Sparrow	-	0.091	0.071	0.200	-	-	-	-	-	0.050
Bobolink	-	0.636	0.286	0.200	-	-	-	-	-	0.163
Red-winged Blackbird	0.600	0.909	0.571	0.600	0.143	0.167	0.556	0.167	1.000	0.500
Eastern Meadowlark	-	0.091	-	-	-	-	-	-	-	0.013
Western Meadowlark	-	0.273	0.071	-	-	0.083	-	-	-	0.063
Yellow-headed Blackbird	0.100	0.273	0.071	-	-	0.167	0.111	-	-	0.100
Brewer's Blackbird	0.300	0.364	0.357	0.200	-	-	0.111	-	-	0.188
Common Grackle	0.100	0.182	0.357	0.500	0.143	0.167	0.333	0.167	1.000	0.263
Brown-headed Cowbird	0.400	0.636	0.714	0.800	0.571	0.750	0.556	0.667	1.000	0.650
Orchard Oriole	-	-	-	-	-	0.083	-	-	-	0.013
Northern Oriole	-	-	-	-	0.143	0.083	0.333	-	-	0.063
Pine Siskin	-	-	-	0.100	-	-	-	-	-	0.013
House Sparrow	-	-	-	-	-	0.083	-	-	-	0.013

Appendix 3. Proportion of sites in which species was present on non-plantation habitats.

	Non-hay crop	Forest & Shrub	Other non-wild	Other wild	Hay & Pasture
number of site*yr combinations	63	62	41	80	49
number of sites	23	24	21	28	23
Red-necked Grebe	-	-	-	0.013	-
Common Loon	0.016	-	-	0.050	-
Pied-billed Grebe	-	-	-	0.075	-
Double-crested Cormorant	-	-	-	0.050	-
American Bittern	-	-	-	0.038	-
Great Blue Heron	0.016	-	-	0.063	-
Great Egret	-	-	-	0.063	0.020
Snowy Egret	-	-	-	0.013	-
Green-backed Heron	-	-	-	0.013	-
Canada Goose	0.032	-	-	0.100	0.041
Wood Duck	-	-	-	0.138	-
Green-winged Teal	-	-	-	0.050	-
Mallard	0.079	0.016	-	0.363	0.122
Northern Pintail	-	-	-	0.025	-
Blue-winged Teal	0.032	-	-	0.213	0.041
Northern Shoveler	0.016	-	-	0.025	-
Gadwall	-	-	-	0.025	0.020
American Wigeon	-	-	-	0.013	-
Redhead	-	-	-	0.050	-
Ring-necked Duck	-	-	-	0.025	-
Ruddy Duck	-	-	-	0.025	-
Bald Eagle	-	-	-	0.013	-
Northern Harrier	-	-	-	0.025	0.041
Cooper's Hawk	0.016	0.016	-	-	-
Red-Shouldered Hawk	-	0.016	-	-	-
Broad-winged Hawk	-	0.016	-	-	-
Red-tailed Hawk	-	0.129	-	0.013	0.020
American Kestrel	-	0.016	-	0.025	-
Gray Partridge	-	-	0.049	-	-
Ring-necked Pheasant	0.095	0.081	0.024	0.238	0.102
Ruffed Grouse	-	0.048	-	-	-
Virginia Rail	-	-	-	0.013	-
Sora	-	-	-	0.175	-
Pectoral Sandpiper	-	-	-	0.013	-
American Coot	-	-	-	0.175	-
Sandhill Crane	0.048	-	-	0.013	-
Buff-breasted Sandpiper	0.016	-	-	-	-
Killdeer	0.508	-	0.024	0.163	0.286
Lesser Yellowlegs	-	-	-	0.013	-
Solitary Sandpiper	0.016	-	-	0.013	-
Spotted Sandpiper	-	-	-	0.013	-
Upland Sandpiper	-	-	-	0.038	0.082
Common Snipe	-	-	-	0.050	-
Herring Gull	0.016	0.016	-	-	0.020
Black Tern	-	-	-	0.100	0.020
Rock Dove	0.048	-	0.122	-	-
Mourning Dove	0.222	0.500	0.317	0.275	0.102
Black-billed Cuckoo	-	0.145	-	0.050	-
Yellow-billed Cuckoo	-	0.016	-	-	-
Great Horned Owl	-	0.065	0.024	-	-
Short-eared Owl	-	-	-	0.013	-
Common Nighthawk	-	0.016	-	-	-
Chimney Swift	-	-	0.024	-	-
Ruby-throated Hummingbird	-	0.016	-	0.013	-
Belted Kingfisher	-	-	-	0.025	-
Red-headed Woodpecker	-	0.097	0.073	-	0.020
Red-bellied Woodpecker	-	0.048	-	-	-
Yellow-bellied Sapsucker	-	0.097	-	0.013	-

Proportion of sites in which species was present on non-plantation habitats.

	Non-hay crop	Forest & Shrub	Other non-wild	Other wild	Hay & Pasture
number of site*yr combinations	63	62	41	80	49
number of sites	23	24	21	28	23
Downy Woodpecker	-	0.113	-	0.013	-
Hairy Woodpecker	-	0.113	-	-	-
Northern Flicker	-	0.161	0.073	0.025	0.041
Pileated Woodpecker	-	0.113	-	-	-
Eastern Wood-Pewee	-	0.452	0.049	-	-
Alder Flycatcher	-	0.032	-	-	0.020
Willow Flycatcher	-	0.081	-	0.175	-
Least Flycatcher	-	0.419	-	0.088	-
Eastern Phoebe	0.016	0.129	0.073	0.038	0.020
Great Crested Flycatcher	-	0.548	0.073	0.050	-
Western Kingbird	-	0.032	-	-	0.020
Eastern Kingbird	0.095	0.274	0.024	0.150	0.082
Horned Lark	0.571	-	-	-	0.204
Purple Martin	-	-	0.024	-	-
Tree Swallow	0.063	0.113	0.122	0.238	0.061
Northern Rough-winged Swallow	-	-	-	0.013	-
Bank Swallow	-	0.016	0.049	0.050	-
Cliff Swallow	0.048	-	0.049	0.063	0.041
Barn Swallow	0.111	0.065	0.146	0.200	0.184
Blue Jay	0.016	0.500	0.073	0.038	-
American Crow	0.063	0.339	0.049	0.063	0.041
Black-capped Chickadee	-	0.323	-	0.013	-
White-breasted Nuthatch	-	0.274	0.024	-	-
House Wren	-	0.677	0.317	0.100	-
Sedge Wren	0.079	0.016	-	0.488	0.082
Marsh Wren	-	-	-	0.200	0.020
Blue-gray Gnatcatcher	-	0.048	-	-	-
Eastern Bluebird	0.016	0.081	0.122	0.100	0.020
Veery	-	0.097	-	-	-
Swainson's Thrush	-	-	-	0.013	-
Wood Thrush	-	0.032	-	-	-
American Robin	0.127	0.484	0.341	0.200	0.122
Gray Catbird	0.016	0.435	0.073	0.263	-
Brown Thrasher	0.016	0.290	0.073	0.075	-
Cedar Waxwing	0.016	0.226	0.024	0.038	-
European Starling	0.016	0.032	0.195	0.063	0.102
Bell's Vireo	-	0.016	-	0.025	-
Yellow-throated Vireo	-	0.371	-	-	-
Warbling Vireo	0.016	0.339	0.073	0.088	-
Red-eyed Vireo	-	0.597	0.073	0.025	-
Blue-winged Warbler	-	-	-	0.025	-
Golden-winged Warbler	-	0.032	-	0.013	-
Nashville Warbler	-	0.016	-	0.013	-
Yellow Warbler	-	0.500	0.073	0.363	-
Chestnut-sided Warbler	-	0.194	-	0.013	-
Black-and-white Warbler	-	0.032	-	-	-
American Redstart	-	0.258	-	-	-
Ovenbird	-	0.194	-	-	-
Connecticut Warbler	-	0.016	-	-	-
Mourning Warbler	-	0.032	0.024	-	-
Common Yellowthroat	0.127	0.726	0.171	0.900	0.204
Scarlet Tanager	-	0.081	-	-	-
Northern Cardinal	-	0.048	0.024	-	-
Rose-breasted Grosbeak	-	0.419	0.024	0.050	-
Indigo Bunting	0.016	0.516	0.098	0.063	0.020
Dickcissel	0.016	-	-	0.025	-
Rufous-sided Towhee	-	0.016	-	-	-
Chipping Sparrow	0.016	0.355	0.195	0.038	0.061

Proportion of sites in which species was present on non-plantation habitats.

	Non-hay crop	Forest & Shrub	Other non-wild	Other wild	Hay & Pasture
number of site*yr combinations	63	62	41	80	49
number of sites	23	24	21	28	23
Clay-colored Sparrow	0.175	0.387	0.122	0.588	0.204
Field Sparrow	-	0.129	-	0.050	-
Vesper Sparrow	0.698	0.226	0.049	0.200	0.388
Savannah Sparrow	0.317	0.081	0.024	0.488	0.429
Grasshopper Sparrow	0.032	-	-	0.200	0.143
Le Conte's Sparrow	0.016	-	-	0.088	0.041
Song Sparrow	0.111	0.806	0.293	0.738	0.143
Swamp Sparrow	-	0.016	-	0.238	-
White-throated Sparrow	-	-	-	0.013	-
Bobolink	0.143	0.016	-	0.488	0.347
Red-winged Blackbird	0.365	0.226	0.171	0.850	0.204
Eastern Meadowlark	0.016	0.016	-	-	0.020
Western Meadowlark	0.190	0.032	0.024	0.313	0.184
Yellow-headed Blackbird	0.032	0.016	-	0.313	0.082
Brewer's Blackbird	0.159	-	-	0.075	0.061
Common Grackle	0.159	0.129	0.073	0.263	0.122
Brown-headed Cowbird	0.302	0.613	0.244	0.488	0.306
Northern Oriole	-	0.306	0.195	0.050	-
House Finch	-	-	0.024	0.013	-
American Goldfinch	0.159	0.484	0.122	0.313	0.122
House Sparrow	-	0.032	0.171	-	0.061