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ILLINOIS FARMSTEADS: ISLANDS FOR BIRDS?

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ABSTRACT

Sixteen central Illinois farmsteads, mostly smaller than 1.5 ha, were censused to test whether birds colonize farmsteads as islands of habitat in otherwise hostile cropland. Compared to one farmstead in a wooded area, the small, isolated farmsteads seemed similar to each other, with few significant trends relating habitat and bird populations. Resident bird species correlated poorly with total farmstead area, but more highly with large deciduous trees and with an index of total deciduous tree area. The effect of farmstead area and tree area was greater on resident bird species than on residents plus transient species. The number of woodland species was unrelated to farmstead habitat parameters. Bird abundances were variable on farmsteads, but followed a log-series distribution. The farmsteads were dominated by several abundant, generalist species, and woodland species seemed unable to populate these farmsteads. Farmsteads poorly fit the habitat island concept for birds, and cannot be expected to preserve many woodland species in central Illinois.

INTRODUCTION

During the past half century, major trends in Illinois agriculture have been the removal of hedgerows and trees, reduction of farm animals, and an increase of corn and soybean acreage (Graber and Graber, 1963). In central and east Illinois, acreage devoted to row crops rose 42% from 1945 to 1974, while small grains and hay fell 75% (Moats, 1968; Kendall, 1975). Much of central and east Illinois are now denuded, except for trees along creeks and on scattered farmsteads. Graber and Graber (1963) documented numerous changes in Illinois bird populations due to these trends.

Recent studies on fragmentation of woods suggest that woodlot size affects the type and number of bird species found there (Forman et al., 1974; Moore and Hooper, 1975; Whitcomb et al. in press). MacArthur and Wilson (1967) developed a substantial theory relating the number of species on oceanic islands to island size and isolation. Culver (1970),

Vuilleumier (1970), and Brown (1971) applied the island concept to terrestrial habitats, and the above authors applied it for woodlots. The extension of island theory to habitats was not always successful, however. The fragmented nature of farmsteads in central Illinois led me to ask whether birds colonize these as islands. Do birds respond to area of farmsteads? Are most Illinois farmsteads below some threshhold, such as territory size of birds, and hence unusable by most birds? Are area of land, area of trees and shrubs, or variety of habitat types on a farmstead most important? Farmsteads in this study provided an opportunity to examine the above questions, and to evaluate the man-made effects of farmstead isolation on birds.

STUDY AREA AND METHODS

In this study a farmstead includes a set of farm buildings and the associated farmyard with grass, trees, and cowlots. Most farmsteads were surrounded by plowed fields during the study. One farmstead was surrounded by woods, considered part of the farmstead, and three had pastures (not included in the censuses) connected to them. Sixteen farmsteads were selected along the township roads outlining the E ½ of Section 30 and all of Sections 25-29 of T26N, R2W of the Third Principal Meridian, Tazewell and Woodford Counties, Illinois. Fifty farmsteads were along 25 km of roads in this area. A woods in excess of 80 ha was near the southeast corner of the study area. Another woods over 40 ha was within 400 m of the northeast corner, but off the area. One farmstead sampled included the woods at the southeast, but 14 farmsteads were over 1.6 km from a woods, and several were approximately 5 km from any woods. The precise farmstead locations in this study are available upon request.

All birds seen and heard on each farmstead were recorded for three minutes between 0629 and 1146, on each of May 16, May 17, and June 1, 1975. This sample time is that of the Breeding Bird Survey (Robbins and Van Velzen, 1969). The area of the farmsteads, the number and relative size of deciduous and evergreen trees and shrubs, the number and relative size of buildings, and the presence of livestock were recorded.

Variables are defined as follows: AREA is farmstead area in ha (correlations were computed using thousands of square feet); LGT is large trees over 14 m tall; SHRB is number of shrubs; LGE is number of large evergreens over 7 m tall; LBLD is number of major buildings over 70 m^2; CATGY is the number of habitat categories present on the farmstead (13 possible, consisting of shrubs, 4 sizes of deciduous trees and evergreens each, 2 building sizes, and 2 livestock types); HAB is a habitat diversity index, computed as LGT/3 + medium trees (over 9 m) /10 + small trees (over 3 m)/25 + SHRB/5 + LGE/5 + medium evergreens (over 4.5 m)/15 + 1 if cows or hogs were present + LBLD/5 + small buildings/10, where all values are truncated to whole numbers in computation; TREE is an estimate of deciduous tree area, computed as LGT + medium trees x 0.37 + small trees x 0.049 + tiny trees (1 m or less) x 0.0044 + SHRB x 0.0123; EVERG is an estimate of coniferous tree area, computed as LGE + medium evergreens x 0.3 + small evergreens (over 2 m) x 0.072 + tiny evergreens (about 0.6 m) x 0.012. NOSPT is the total species of

birds recorded on a farmstead; NOSPM is the mean species number recorded per census period on a farmstead; NOSP3 is the number of species recorded all 3 days on a farmstead; NOSPW is the number of species recorded on a farmstead, where nonforest species are excluded; ABUND is the mean bird abundance per farmstead. TREE and EVERG are designed to approximate the cross-section area of the trees. HAB is computed from natural history observations of farmsteads such that a value of 1 might represent a significant habitat to birds if isolated in a plowed field. For example, 3 large trees, 5 shrubs, or 10 small buildings in the center of a plowed field might harbor a bird species not otherwise found there, whereas one shrub or small building would probably not attract a new species to a plowed field.

RESULTS AND DISCUSSION

Pearson product-moment correlations were computed between habitat variables and the bird variables. Stepwise multiple regressions were performed, using bird variables as dependent variables. These analyses were performed on the data from the 16 farmsteads to test overall trends from small farmstead to farmstead in woods. Because the one farmstead in woods was more than an order of magnitude larger than any other, and had 18 species, whereas no other farmstead exceeded 10 species, I performed a second analysis with the wooded farmstead removed. This second analysis combined three pairs of farmsteads which were adjacent, using combined habitat descriptions and reduced 3-minute samples for each pair. The second analysis tested for trends found among smaller, isolated farmsteads (n=12).

The data for the 16 farmsteads, including NOSPT, ABUND, LGT, SHRB, TREE, LGE, LBLD, AREA, and HAB, are included in appendix. The species observed are listed, together with the number of farmstead occurrences. Table 1 presents the significant Pearson product-moment correlations between habitat and bird variables.

For the total number of species observed on the farmsteads, NOSPT, I computed the slope z of the species-area relation:

$$\log S = z \log A + \log C$$

where S is the number of species on a farmstead, A is the area of the farmstead, and C is a constant (MacArthur and Wilson, 1967). For NOSPT on the isolated farmsteads without woods, the species-area slope z was 0.00 $\pm$0.03 (95% confidence limit; r=0), and the species-tree area slope z was 0.09 $\pm$0.02 (r=+). When the wooded farmstead was included, the species-tree area slope z was .18 $\pm$0.02 (r=0.71). For the mean number of species seen per farmstead per census, NOSPM, the species-area slope (isolated farmsteads only) was 0.11 $\pm$0.05 (r= +), and the species-tree area slope was 0.17 $\pm$0.02 (r=0.73). For the resident number of species on farmsteads, NOSP3, the species-area slope (isolated farmsteads only) was 0.25 $\pm$0.13 (r= +), and the species-tree area slope was 0.34 $\pm$0.19 (r= +).

Of the 10 correlation sets listed in Table 1, the number of large trees and tree area exceeded farmstead area 10 times. Habitat diversity exceeded area 9 times. These differences are significant (Chi-square sign test), and AREA seems less important than LGT, TREE, or HAB. SHRB, LGE, and EVERG were significantly less correlated with bird variables

TABLE 1. Product-moment correlations between habitat and bird variables. The upper values are for the 16 farmsteads, including one with woods. The lower values are for 12 farmsteads (3 pairs are grouped; woods is omitted). Significant correlations are given, and correlations of absolute value less than .20 are indicated by 0. Variables are defined in text.

VARIABLE	AREA	LGT	SHRB	LGE	LBLD	CATGY	HAB	TREE	EVERG
With wooded farmstead									
NOSPT	.88	.89	.62	.76	.57	0	.90	.90	.76
NOSPM	.77	.84	.51	.63	.54	0	.80	.82	.61
NOSP3	+	+	0	+	+	.49	+	+	0
NOSPW	.92	.92	.71	.81	.52	-	.94	.93	.81
ABUND	0	+	0	0	+	.60	+	+	+
Without wooded farmstead									
NOSPT	0	+	0	0	0	-	+	+	0
NOSPM	+	.66	0	0	+	+	+	.62	0
NOSP3	+	.59	0	0	+	.75	.62	.59	0
NOSPW	0	0	0	0	0	-	+	+	0
ABUND	0	+	-	0	0	+	0	+	0

than AREA was (sign test).

The multiple regression on NOSPT (isolated farmsteads only) was NOSPT = 6.67 +0.12 (TREE) -0.03 (AREA) +0.48 (LBLD) R = 0.80 where all habitat parameters significantly contribute to the equation. The effects of TREE and AREA are codominant here, based on partial correlation. The multiple regression on NOSPM confirmed the dominance of TREE, and neither AREA nor other habitat variables added any additional significance. For resident birds on isolated farmsteads, NOSP3 = 0.62 (CATGY) +0.13 (HAB) - 2.22 R = 0.86 where both parameters significantly contribute to the regression. For woodland birds on isolated farmsteads, NOSPW = 2.48 -0.01 (AREA) +0.19 (medium evergreens) +0.14 (LGT) R =0.90 where all 3 parameters contribute significantly to the multiple regression. These equations confirm that habitat variety and vegetation are at least as, and often more, important than farmstead area alone in affecting bird species. MacArthur and Wilson (1967) suggested that the role of increased area in increasing the number of species was probably due to increased habitat diversity, but they gave no evidence for this.

On these 16 farmsteads, the species abundances were not significantly different from a log-series distribution ($P > .10$), as expected by May (1975). Six species were found on 11 or more farmsteads, and comprised 91.5% of all birds seen. Twenty-three other species were rarer. The house sparrow (Passer domesticus), starling (Sturnus vulgaris), and common grackle (Quiscalus quiscula) accounted for 79% of all birds seen. Of all Illinois habitats censused by Graber and Graber (1963), this bird community is most similar to urban residential areas, with high dominance

of a few species. House sparrows, starlings, common grackles, and American robins (Turdus migratorius) comprised 84% of the birds observed in this study, and these 4 species comprise 82 to 89% of 3 Chicago north side and suburban, poorly wooded, residential areas (Guth, unpublished). These same generalist, flocking species appear both in city and farm as abundant, dominant birds. A highly significant correlation existed between the number of farmstead occurrences and the mean abundance per occurrence ($r = 0.75$; $n = 29$ species).

Because the generalist species on farmsteads reached high and variable abundances, the correlations between habitat parameters and bird abundance were not significant, except for CATGY, the number of habitat types on a farmstead (Table 1). The significant correlations with CATGY of number of resident species and bird abundance suggest that with more habitat types, more birds can survive on a farmstead. Total abundance of woodland species showed no significant trends with habitat parameters on isolated farmsteads. The abundance of woodland birds was significantly correlated with the number of woodland species ($r = 0.75$), but for all species on the farmsteads, the correlation between abundance and number of species was 0.

DISCUSSION

Some species were seen on all three censuses, but others were seen only one or two times on a farmstead. The total species seen in the 3 days may be interpreted as the resident species plus transients. Resident species might be at equilibrium with their environment, with local immigrations and extinctions, and should follow the island model. Transients frequently use all farm area (farmsteads and cropland) more uniformly. Numerous small migrants stop in city residential areas, business districts, city parks, fencerows, or farmsteads (Guth, unpublished). In this study common grackles, barn swallows (Hirundo rustica), starlings, and other species flew out to feed in the land between farmsteads, and therefore I expect a low species-area slope for transients.

Total bird species (residents and transients) did have flat species-area and species-tree area slopes. The steeper slopes of resident species, NOSP3, approach values to be expected for islands, whereas the slopes of 0.00 or 0.09 are often expected in non-island situations (MacArthur and Wilson, 1967). The confidence intervals on the resident slopes were large, and the correlations were not significant for these species-area relations, perhaps due to small sample sizes. Because the total number of species, including transients, had a flat species-area slope, and the resident species did not show significant species-area slopes for these isolated farmsteads, there is little evidence for an island interpretation.

The decline in significant correlations (Table 1) when the wooded farmstead is removed provides additional evidence that isolated farmsteads are not colonized as islands by birds. The lack of significant correlations with NOSPW, the number of woodland species, confirms the unsuitability of these isolated farmsteads for birds. Total abundance of woodland species correlated significantly with AREA ($r = 0.82$) and TREE ($r =$

0.83), but also showed no significant trends on isolated, unwooded farmsteads. The unwooded farmsteads of this study, ranging in size from 0.27 ha to 2.94 ha (mean = 0.92), are too small or too denuded to attract many bird species other than edge species. Moore and Hooper (1975) computed $z = 0.271$ in their study of British woods, and showed that many species do not occupy very small woods, but will consistently occupy larger woods, indicating a threshhold effect. The flat species-area and species-tree area slopes further indicate that these farmsteads are below some threshhold.

Of the 29 species observed in this study, 18 were found on the one farmstead surrounded by woods, and 20 were found on the remaining 15 isolated, smaller farmsteads. Simberloff and Abele (1976) suggest that an archipelago of small islands will usually contain more species than a single large island of similar area. In this farmstead set, 15 farmsteads with a mean of 7.7 species out of possibly 29 species should have 28.7 species. These 15 farmsteads have only 20 species because not all species are equally likely to inhabit a farmstead as the Simberloff-Abele model assumes. This difference between the abundant, generalist farmstead birds, and forest birds which are rare on farmsteads, or found only in larger wooded areas, suggests a potential conservation problem. Generalist birds on farmsteads respond more to vegetation than to area, for farmsteads are structurally different from woodland. Farmsteads are not adequate habitat islands for most birds, and much larger wooded areas are needed to preserve birds on Illinois farms than the farmsteads alone.

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APPENDIX. Bird and habitat parameters for 16 Illinois farmsteads.

Farmstead Number	NOSPT	ABUND	LGT	SHRB	TREE	LGE	LBLD	AREA	HAB
1	7	30.0	4	8	8.7	7	3	.91	6
2	18	24.0	100	40	199.0	35	8	48.56	89
3	6	26.7	3	3	6.4	0	4	.60	2
4	9	15.7	3	10	17.9	1	1	.58	7
5	6	12.7	0	27	1.3	1	2	.58	5
6	9	7.7	7	2	10.0	0	5	.51	3
7	9	13.7	4	17	5.3	1	4	.79	4
8	9	23.7	0	4	10.2	0	6	.82	5
9	8	17.0	0	20	2.1	17	2	.27	7
10	10	26.7	22	9	26.9	0	3	.37	10
11	7	14.7	3	9	5.7	0	3	.53	3
12	7	11.0	3	3	5.3	0	2	.50	1
13	9	33.0	9	3	12.0	0	6	1.26	5
14	6	13.7	5	7	6.3	1	1	.36	2
15	6	18.0	14	9	20.2	0	5	1.26	7
16	7	18.0	8	7	19.6	8	6	1.68	9

Species observed on 16 Illinois farmsteads, with number of farmsteads of occurrence: Passer domesticus,16; Quiscalus quiscula,16; Sturnus vulgaris,14; Hirundo rustica,13; Turdus migratorius,13; Melospiza melodia,11; Vermivora peregrina,7; Agelaius phoeniceus,6; Passerina cyanea,6; Chaetura pelagica,4; Molothrus ater,4; Columba livia,2; Zenaida macroura,2; Troglodytes aedon,2; Spinus tristis,2; Mimus polyglottos,2; Centurus carolinus,1; Myiarchus crinitus,1; Cyanocitta cristata,1; Corvus brachyrhynchos,1; Parus bicolor,1; Sitta carolinensis,1; Dumetella carolinensis,1; Toxostoma rufum,1; Hylocichla mustelina,1; Sturnella magna,1; Icterus galbula,1; Cardinalis cardinalis,1; Spizella passerina,1.