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Distribution and Abundance of Birds in the Loess Hills of Western Iowa

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Recent investigations have provided a good understanding of the distribution and abundance of birds in the Loess Hills. Surveys have been conducted during natural history forays sponsored by the State Preserves Advisory Board and by our quantitative investigation during 1982-83. Fifteen stations covering the entire length of Iowa's Loess Hills landform were visited. Three habitats were sampled at each station: native grassland, agricultural (brome or alfalfa) field, and forest. This paper describes typical bird communities of each habitat and compares species composition within and between stations.

Grassland bird communities tend to be richer in the northern Loess Hills; the opposite is true for forest bird communities. Cultivated grasslands generally support a greater diversity of species than do native prairies. A notable exception occurs in Plymouth County, where extensive tracts of prairie are inhabited by a relatively diverse assemblage of grassland birds. We propose that small area, steepness of slope, and other factors render today's prairie remnants poorly suited for grassland birds. The best quality grasslands in the Loess Hills probably occurred in lowlands or on gentle slopes, which today have been converted to agriculture.

The richest diversities of birds in the Loess Hills occur in forests, a habitat type that was not extensive at the time of settlement.
INDEX DESCRIPTORS: birds, Loess Hills, habitat selection, biogeography, communities, grassland, ecology, avifauna, distribution

The purpose of this paper is to describe the distribution and relative abundance of breeding birds in western Iowa's Loess Hills. We will examine the association of Loess Hills birds with major habitat types, particularly native grassland, the dominant vegetation at the time of European settlement (Roosa 1982). We hope that our results will provide a better understanding of the region's biological significance as well as its conservation needs.

The boundaries and environmental characteristics of the Loess Hills are described elsewhere in this issue. Birds of the region are treated generally by Johnsgard (1979), Dinsmore et al. (1984) and earlier state publications (Anderson 1907, DuMont 1933, and Brown 1971). Recent surveys by Iowa and Nebraska naturalists have led to a more detailed description of birds in the Loess Hills. Especially notable is a series of natural history expeditions or "forays" sponsored by the Iowa State Preserves Advisory Board (Roosa 1977, Silcock 1977). This report incorporates results from the forays as well as data from a quantitative study conducted during 1982-83.

The Loess Hills occupy a narrow (mostly < 10 km) region bordered to the west by the intensively farmed Missouri River valley and to the east by a gently rolling agricultural landscape. Relatively large areas of native grasslands, the dominant vegetation prior to European settlement, have escaped cultivation in steeper portions of the Loess Hills. Original land survey records reveal that forests, although present locally at the time of settlement, have become more widespread in the Loess Hills since the mid-1800's (Howe et al. 1984).

Our analysis compares birds among the 3 major habitat types in today's Loess Hills: native grasslands, agricultural fields, and forests. Our goals are to provide a more specific description of today's bird distributions and to provide a starting point for future studies of Loess Hills birds. Our comparison of birds in native grasslands and agricultural fields, in particular, may help reveal the nature of avian responses to post-settlement changes in the landscape.

METHODS

We derived information about Loess Hills birds from 3 major sources: 1) Dinsmore et al.'s 1984 review of historical observations, particularly those from *Iowa Bird Life,* the state ornithological journal; 2) recent surveys conducted by a variety of observers during the natural history "forays", sponsored by the State Preserves Advisory Board; and 3) results from a special field investigation conducted by the authors in Loess Hills during 1982 and 1983.

The major objective of the State Preserves Board's annual "forays" is to determine the distribution of animals and plants in selected parts of Iowa. Participants include both professional and amateur naturalists. Four of the first 8 annual forays and a related "follow-up" foray have focused on the Loess Hills. Results from the 1977 foray in Fremont County were reported by Roosa (1977) and Silcock (1977). Silcock (1979) reported observations from a follow-up survey 1 year later. This paper summarizes unpublished data from forays in Plymouth and Woodbury Counties (1981), Monona and Harrison Counties (1982), and Pottawattamie, Mills, and Fremont Counties (1983).

Our 1982 and 1983 investigation focused on 14 localities between the northernmost and southernmost Loess Hills in Iowa and a 15th locality in Missouri, approximately 55 km south of Iowa (Table 1). Three habitat types were sampled at each locality: 1) native grassland, 2) agricultural field (brome or alfalfa), and 3) forest.

Native grassland sites were the largest and least disturbed grasslands at each locality. Virtually all have been grazed by livestock during the past, although eight now are publicly-owned and no longer are grazed regularly. Dominant grasses mainly were little bluestem (*Andropogon scoparius* Michx.) and side-oats grama (*Bouteloua curtipendula* Michx.), with varying abundances of big bluestem (*Andropogon gerardi* Vitman), introduced pasture grasses (*Poa praetensis* L. and *Bromus* sp.), and other species. Large, treeless prairie patches were not available at several localities, particularly in the southern Loess Hills. Study areas at these sites consisted of narrow (<100 m wide) prairie ridges surrounded by woodlands. Red cedars (*Juniperus virginiana* L.) and woody shrubs (*Cornus drummondii* Mey. and *Rhus glabra* L.) were scattered within many of the sites, particularly in ravines and along sheltered slopes.

Agricultural fields were mainly brome hayfields, but in several cases alfalfa fields were the only large open sites available. Forest sites were dominated by oaks (especially *Quercus macrocarpa* L.). A greater variety of forest tree species occurred in the southern sites.

Each visit to a given habitat consisted of a 30 minute walking survey, covering approximately 400 m in open habitats and 200 m in forests. Visits were conducted between sunrise and 1000 hr between 3 June and 11 July. Ten of the localities were visited 3 times, while the others were visited only once (Table 1). During each visit we recorded all birds seen or heard during the 30 minute period. In addition, we conducted 3 stationary point counts at the beginning, middle, and end of our route. Count durations were 3 minutes in native prairies and agricultural fields, and 5 minutes in forests. During the point

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counts, birds observed in the habitat of interest were distinguished from those of nearby habitats.

Surveys were conducted between sunrise and approximately mid-morning during favorable weather conditions. Because the results are compiled from different observers at different locations, this report will focus mainly on the presence or absence of species in each visit. This approach avoids biases in estimates of individual numbers. All 4 observers are experienced ornithologists who were previously familiar with birds of the region.

Original data records and a complete description of localities have been placed on file with the Iowa Natural Areas Inventory, a program of the Iowa Conservation Commission in Des Moines.

RESULTS

Typical Loess Hills Birds

Forests, shrubby thickets, open grasslands, and disturbed habitats form a complex mosaic in today's Loess Hills landscape. Many birds move freely between these habitat types, making habitat-specific "bird communities" nearly impossible to define. Still, relatively large contiguous areas of native grasslands, agricultural fields, and forests occur in many parts of the Loess Hills. Here we describe the typical assemblages of birds in these major habitat categories.

By far the most common bird in native Loess Hills grasslands is the Field Sparrow (scientific names given in Appendix), a species typical of eastern North American grasslands with scattered shrubs or young trees (Bent 1968). Field Sparrows in the Loess Hills usually occur along the edges of woody ravines and on grassy slopes with scattered red cedars. The frequency of Field Sparrows illustrates the prevalence of shrubs and small trees in today's Loess Hills. Other birds that were relatively common in Loess Hills native grasslands (Lark Sparrow, Eastern Kingbird, and Mourning Dove) also use shrubs and small trees for feeding or perching. Indeed, no exclusively open country species was observed in native grasslands during more than 60% of our counts (Table 2). When all species are considered (Table 3), including birds from adjacent habitats and birds far from the count points, non-grassland species (e.g., Blue Jay, Brown Thrasher, House Wren) are even more prominent.

Higher frequencies of grassland species were recorded in agricultural sites (brome/alfalfa fields) than in native grasslands (Table 2). The 3 most common species in agricultural fields (Dickcissel, Grasshopper Sparrow, and Western Meadowlark) are typical open country birds. Of the species recorded most frequently (> 30% of counts) in agricultural fields, only the Field Sparrow was more common in native grasslands. In addition to the species mentioned above, Lark Sparrow, Brown-headed Cowbird, Barn Swallow, Red-winged Blackbird, Northern Rough-winged Swallow, and Common Yellowthroat all were recorded more frequently in agricultural fields than in nearby native grasslands (Table 2).

Several large or conspicuous species frequently were recorded in our counts of native grasslands and agricultural fields, even though we seldom observed them directly in these habitats. Northern Bobwhite and Ring-necked Pheasant, for example, were encountered (usually heard) during more than 80% of the visits in native grasslands and agricultural fields (Table 3). Blue Jay, American Crow, Red-headed Woodpecker, Northern Flicker, and Common Grackle also were observed commonly during these visits. Species of forest-edge or shrub habitats (House Wren, Indigo Bunting, Rose-breasted Grosbeak, Northern Cardinal, Yellow-billed Cuckoo, Rufous-sided Towhee, Brown Thrasher, Northern Oriole, Great Crested Flycatcher, Gray Catbird, and American Goldfinch) were recorded during many of our counts, although they rarely ventured far from trees or shrubs. Two aerial feeders, Barn Swallow and Northern Rough-winged Swallow, were conspicuous in the open Loess Hills habitats. Both were recorded more frequently at agricultural fields than at native grasslands.

Birds of Loess Hills forests are essentially the same species that occur in oak forests and woodlands throughout western Iowa. Rose-breasted Grosbeak and House Wren were recorded in all of our point counts; Blue Jays were recorded in all but 1 (Table 3). Other common species included forest-edge birds like Mourning Dove, Northern Cardinal, Red-headed Woodpecker, Brown-headed Cowbird, Northern Flicker, Brown Thrasher, Rufous-sided Towhee, Northern Oriole, American Crow, Gray Catbird, Indigo Bunting, and Yellow-billed Cuckoo. Many of these forest-edge species were found well within the interior of Loess Hills forests. A few interior species also were common, including Black-capped Chickadee, White-breasted Nuthatch, Eastern Wood-Pewee, Great Crested Flycatcher, Red-bellied Woodpecker, Downy Woodpecker, and Hairy Woodpecker.

Habitat Comparisons

On average, we encountered more species at agricultural fields than at either of the other habitat types (Table 4). This result does not mean, however, that agricultural fields were the richest habitat type, because totals also include species that were heard in adjacent habitat types. A more meaningful comparison of birds observed directly in the respective habitats (Table 4) suggests that avian species diversities

Table 1. Legal descriptions of sites used for quantitative surveys during 1982-1983. Localities that were visited 3 times are marked with an asterisk (*); all others were visited only once. (T = Township, R = Range, S = Section)

County	Native Grassland	Agricultural Field	Forest
1. *Plymouth	T91N R49W S 12 T91N R48W S 7	T91N R49W S 12	T91N R48W S 29
2. *Plymouth	T91N R49W S 13	T91N R49W S 13	T91N R48W S 20
3. *Plymouth	T91N R48W S 20	T91N R48W S 21	T91N R48W S 20
4. *Plymouth	T91N R48W S 21	T91N R48W S 21	T91N R48W S 21
5. *Plymouth	T91N R48W S 29	T91N R49W S 12	T91N R48W S 29
6. *Plymouth	T91N R48W S 20	T91N R49W S 13	T91N R48W S 20
7. *Monona/Woodbury	T85N R44W S 18	T86N R45W S 36	T85N R44W S 17
8. *Monona	T84N R44W S 9	T84N R44W S 9	T84N R44W S 9
9. *Monona	T84N R44W S 21	T84N R44W S 28	T84N R44W S 21
10. *Harrison	T80N R44W S 9	T80N R44W S 3	T81N R45W S 30
11. Pottawattamie	T76N R44W S 11-12	T76N R44W S 1 T77N R44W S 25-26	T76N R44W S 26
12. Mills	T73N R43W S 4	T73N R43W S 16	T73N R43W S 10
13. Fremont	T69N R43W S 13, 24	T69N R42W S 18	T69N R43W S 13
14. Fremont	T68N R42W S 29	T69N R42W S 10, 21-2	T68N R42W S 29
15. Holt (MO)	T61N T38W	T61N R38W	T61N R38W

Table 2. Relative frequencies of bird species using native grasslands and agricultural fields during at least 10% of our surveys (visits). Frequencies are based on 12 visits to 8 sites: 7, 8 (1 visit only), 10, 11, 12, 13, 14, and 15. Lists were compiled by the same observers making the same number of visits to each habitat. Twenty-three surveys were excluded from this analysis because the distinctions between all birds observed and birds using the habitat were not made for agricultural fields.

Native Grassland		Agricultural Field	
Species	% of surveys n = 12	Species	% of surveys n = 12
Field Sparrow	92	Dickcissel	92
Western Meadowlark	59	Grasshopper Sparrow	83
Grasshopper Sparrow	42	Western Meadowlark	75
Eastern Kingbird	33	Lark Sparrow	67
Lark Sparrow	25	Field Sparrow	58
Mourning Dove	25	Brown-headed Cowbird	58
Great Horned Owl	25	Barn Swallow	58
Barn Swallow	25	Eastern Kingbird	50
Brown Thrasher	25	Common Yellowthroat	42
Brown-headed Cowbird	25	Red-winged Blackbird	42
N. Rough-winged Swallow	17	N. Rough-winged Swallow	33
Gray Catbird	17	Mourning Dove	33
Northern Cardinal	17	American Goldfinch	33
American Goldfinch	17	House Sparrow	25
Rufous-sided Towhee	17	Vester Sparrow	25
		Eastern Meadowlark	25
		Northern Oriole	25
		Brown Thrasher	25
		Red-tailed Hawk	17
		Ring-necked Pheasant	17
		American Robin	17
		Indigo Bunting	17

are richest in Loess Hills forests.

Frequencies of grassland birds (defined in Appendix) in native grasslands and agricultural fields can be compared statistically by a simple sign test (Conover 1980). Sites where more grassland birds were counted within 200 m (by the same observer) in agricultural fields than in native grasslands receive an "+"; sites where the opposite is true receive a "−". Results show that the frequency of encountering grassland birds was significantly higher in agricultural fields ($p = .0065$, one-tailed test with $n = 14$, excluding 1 tie). Similar comparisons between open habitats and forests are not possible, because the count periods were not equal and the areas within which birds could be detected were considerably less in forests.

Geographical Trends

Our results suggest that the distributions of several species vary geographically (north-south) in the Loess Hills. In general, bird distributions correspond to distributions of habitat types. The southern Loess Hills tend to be more heavily forested than the northern Loess Hills, whereas large, unbroken native grasslands are more widespread in the northern Loess Hills. Selection of our study sites was necessarily constrained by these circumstances. Native grassland sites in the northern Loess Hills were associated with largest adjacent grassland areas; forest sites in the southern Loess Hills were part of the largest contiguous forest areas.

Upland Sandpiper, Horned Lark, and Killdeer (all open country species) were recorded only in large, open grasslands in Plymouth County, the northernmost of our study areas. Grasshopper Sparrow and Dickcissel were found throughout the Loess Hills in agricultural fields, but they were recorded in native grasslands only in these extensive northern sites. Particularly notable is a large, relatively treeless prairie/pasture north of Sioux City (T91N R49W Sections 11,12,13, and T91N R48W Sections 7,18), where eight grassland bird species were regularly observed ($\bar{x} = 7.0$ for 2 sites). Other open country species such as the American Goldfinch and introduced Ring-necked Pheasant also were recorded. The same observer (JPS) recorded a mean of only 3.0 open country species in nearby native grasslands of the Five Ridge Prairie Preserve, where prairies are narrower and confined to ridgetops.

The number of grassland species in our other study sites ranged from 1 to 5 ($\bar{x} = 3.1$). Numbers were at least roughly correlated with size of the contiguous grassland, which itself is associated with slope, intensity of disturbance, and other factors. No strictly grassland species were recorded in our southernmost sites. The ubiquitous Field Sparrow and American Goldfinch were present, but these species are more typical of brushy or interrupted fields than they are of treeless prairies.

Several forest species (Acadian Flycatcher, Tufted Titmouse, Red-eyed Vireo, and Wood Thrush) were recorded exclusively or nearly exclusively (all but once) in relatively moist and extensive forest tracts south of Monona County.

A few species showed geographical trends that did not conform to obvious habitat gradients. Hairy Woodpeckers were recorded at 7 forest sites (16 counts) north of Harrison County, but only once to the south. Cedar Waxwings showed a similar trend; we recorded them at 6 sites (11 counts) north of Harrison County, but only once in the southern Loess Hills. Eastern Meadowlarks, by contrast, were observed only south of Harrison County (3 sites, 4 counts).

Rare or Endangered Species

The Iowa range of no bird species is restricted to the Loess Hills (Dinsmore et al. 1984). A few, however, may reach their peak Iowa abundances here, particularly species whose primary ranges lie to the south and west of the state. Bell's Vireo currently is listed on the National Audubon Society's "Blue List" of declining or special concern species (Tate and Tate 1982). While not common in the Loess Hills, Bell's Vireos occur locally in the Loess Hills and adjacent Missouri River valley. Roosa (1977) reported 29 singing males in a 7 mile stretch during the 1977 foray in Fremont County. We observed Bell's Vireos infrequently but consistently (10 of 15 localities) in shrubby ravines during our 1982 surveys.

Extensive populations of Dickcissels, Lark Sparrows, and Grasshopper Sparrows still exist in the Loess Hills, particularly in agricultural areas (Table 2). Dickcissels and Grasshopper Sparrows are listed on the 1982 Blue List. Lark Sparrows are locally distributed in Iowa (Dinsmore et al. 1984) and might be more common in the Loess Hills than in other parts of the state. We have no indication that Dickcissels and Grasshopper Sparrows are more common in the Loess Hills than in other parts of Iowa. Indeed, given their low abundances in native grasslands (we observed them during fewer than 50% of our counts), these species might be less common in the Loess Hills than in other parts of western Iowa.

Other Loess Hills species on the 1982 Blue List include Upland Sandpiper, Ruby-throated Hummingbird, Hairy Woodpecker, Eastern Bluebird, Eastern Meadowlark, and Yellow Warbler. None of these species is common in the Loess Hills. The state threatened Broad-winged Hawk was observed regularly in the Loess Hills during the forays and during our 1982 surveys. This species might breed occasionally in the Loess Hills, but it is not well-established. The same might be true for the Sharp-shinned Hawk, a species considered to be extirpated in Iowa. Steve Dueker (in Dinsmore et al. 1984) reported 2 immature Sharp-shinned Hawks in Monona County during 1978. DMR observed a Cooper's Hawk (state endangered) in Pottawattamie County during our 1982 surveys. This *Accipiter* is more likely to be a regular nester in the Loess Hills. No state or federally endangered bird species is known to breed in the Loess Hills.

Table 3. Relative frequencies of all bird species observed during more than 33% of our surveys (visits). Species are included even if they were seen or heard in adjacent habitats. Frequencies are based on 35 visits to 15 sites (Table 1).

Native Grassland		Agricultural Field		Forest	
Species	% of surveys n = 35	Species	% of surveys n = 35	Species	% of surveys n = 35
Blue Jay	97	Mourning Dove	100	Rose-breasted Grosbeak	100
Brown-headed Cowbird	97	Brown-headed Cowbird	100	House Wren	100
Field Sparrow	94	Eastern Kingbird	94	Blue Jay	100
Mourning Dove	94	Dickcissel	94	Mourning Dove	97
Eastern Kingbird	94	Northern Bobwhite	94	Black-capped Chickadee	97
Western Meadowlark	94	Northern Oriole	94	Eastern Wood-Pewee	97
Brown Thrasher	91	Western Meadowlark	91	Brown-headed Cowbird	94
House Wren	91	Blue Jay	91	Red-headed Woodpecker	91
Northern Bobwhite	89	Red-headed Woodpecker	89	White-breasted Nuthatch	91
Indigo Bunting	86	Indigo Bunting	89	Northern Cardinal	89
Ring-necked Pheasant	86	American Goldfinch	86	Northern Flicker	89
Rose-breasted Grosbeak	86	Ring-necked Pheasant	83	Great Crested Flycatcher	89
Red-headed Woodpecker	86	House Wren	83	Rufous-sided Towhee	86
Northern Cardinal	83	Barn Swallow	80	Northern Oriole	86
American Crow	80	Northern Cardinal	80	Brown Thrasher	83
Northern Flicker	74	Grasshopper Sparrow	77	Field Sparrow	83
Yellow-billed Cuckoo	71	Red-winged Blackbird	77	Gray Catbird	77
Rufous-sided Towhee	71	European Starling	77	Indigo Bunting	77
American Goldfinch	71	Field Sparrow	74	American Crow	74
Northern Oriole	69	Brown Thrasher	74	Eastern Kingbird	71
Black-capped Chickadee	66	Northern Flicker	71	Downy Woodpecker	71
Great Crested Flycatcher	66	Orchard Oriole	71	Ring-necked Pheasant	69
Barn Swallow	63	Yellow-billed Cuckoo	69	Yellow-billed Cuckoo	69
Red-bellied Woodpecker	63	American Crow	66	Red-bellied Woodpecker	69
Dickcissel	60	N. Rough-winged Swallow	66	Western Meadowlark	66
Gray Catbird	57	Rose-breasted Grosbeak	63	American Goldfinch	51
N. Rough-winged Swallow	57	House Sparrow	60	Hairy Woodpecker	46
Downy Woodpecker	54	American Robin	60	Northern Bobwhite	43
Lark Sparrow	51	Lark Sparrow	57	Scarlet Tanager	34
House Sparrow	49	Gray Catbird	54		
Orchard Oriole	49	Common Grackle	54		
European Starling	49	Common Yellowthroat	43		
Eastern Wood-Pewee	43	Black-capped Chickadee	37		
Grasshopper Sparrow	40	Red-bellied Woodpecker	37		
Common Grackle	40	Downy Woodpecker	37		
American Robin	37				
Whip-poor-will	37				
Common Yellowthroat	34				
Bell's Vireo	34				

Several species known from the southern Loess Hills are rare or absent elsewhere in Iowa. Chuck-will's-widow has been heard by reliable observers as far north as Mills County and perhaps Pottawattamie County. This southern species is known recently from scattered localities in southeastern Iowa, but otherwise it is very rare in the state. Individuals were heard in Fremont County during the 1977 and 1982 forays. Other southern birds that have been recorded in the southern Loess Hills (particularly in the vicinity of Waubonsie State Park) include Bewick's Wren, Summer Tanager, White-eyed Vireo, Worm-eating Warbler, and Louisiana Waterthrush. A Northern Mockingbird, uncommon in Iowa, was observed by RWH in southern Woodbury County during our 1982 surveys. Black-and-white Warbler, a rare Iowa breeding species, has been recorded recently in Waubonsie State Park (Silcock 1977) and by JPS in Plymouth County; it could be a regular member of the Loess Hills avifauna.

Two western species, uncommon in Iowa, occur sporadically in the Loess Hills. Western Kingbird and Blue Grosbeak were observed rarely during our 1982 surveys; indeed, both appear to be more common in the adjoining Missouri River floodplain. Both are seen occasionally farther east, but the Loess Hills probably represents one of their easternmost regular breeding habitats in the northern United States.

Three species that once were extirpated from Iowa have been reintroduced into the Loess Hills. Wild Turkeys have successfully established populations in the southern Loess Hills and in the Loess Hills Wildlife Area of Monona County. The Greater Prairie-Chicken was reintroduced near the Loess Hills Wildlife Area in 1981 (Wooley 1984). Birds have been observed near the release site as recently as 1984, but the experiment does not appear to have been successful. A more recent effort to re-establish the state endangered Common Barn-Owl has included release sites in the Loess Hills. The success of this project cannot yet be determined.

DISCUSSION

Before settlement, most of the Loess Hills landform was covered with tallgrass or mid-grass prairie (U.S.G.S. land survey notes). Hence, one might expect that birds of today's prairie remnants will

most closely resemble the original Loess Hills avifauna. Yet results of our surveys suggest that remnant Loess Hills prairies are inhabited by fewer species than the region's two other major habitat types. Even non-native grasslands or alfalfa fields supported a higher diversity of bird species. Does this imply that the Loess Hills avifauna was depauperate even at the time of settlement?

We propose that, indeed, the bird species richness at many remnant prairie sites always has been rather low. Mid-North American grasslands, in general, are characterized by few endemic species and low species diversities (Wiens and Dyer 1975, Kantrud and Kologiski 1983). Other studies (Birkenholz 1972) have shown that grassland birds do not necessarily favor native prairies over nearby agricultural habitats. In the Loess Hills, sites that have escaped cultivation or destructive grazing typically are the region's least fertile, least accessible, and steepest sites. Woodlands have taken over other sites on gentler slopes. Today's remnant prairies in the Loess Hills are probably marginal habitats for grassland birds. Steep, exposed slopes and ridges undoubtedly limit the suitability of these sites for ground nesters (e.g., Dickcissel, Grasshopper Sparrow) and birds that favor broad, uninterrupted landscapes (e.g., Killdeer). Steep terrain also may explain the failure of Greater Prairie-Chickens to establish populations near the Loess Hills Wildlife Area in Monona County. Most of the introduced birds seem to have moved into lowlands of the surrounding Missouri River valley (Wooley 1984).

The richest prairie sites in our study occurred in northern Plymouth County where slopes were less steep than elsewhere, and where grasslands (although non-native) extended into lowlands. These considerations suggest that protection of native prairies on gentle slopes or reestablishment of prairies in disturbed valleys should be a high conservation priority for the Loess Hills, at least for birds.

Habitat size, slope, and other geographic variables are difficult to evaluate for the highly dissected Loess Hills prairies. Given this difficulty and the fact that birds at different sites were sampled by different observers, we report here only a qualitative analysis of the relationship between Loess Hills birds and environmental variables. One important environmental factor, steepness of slope, was mentioned in the previous paragraph. Samson (1983) has shown that size of a prairie tract (area) also influences the diversity of grassland bird species. A qualitative comparison of our study sites suggests that area clearly is an important environmental variable in the Loess Hills. Native grassland sites with the lowest richness (2 or fewer species) of exclusively grassland birds (Sites #5, 6, 10, 12, 13, 14 and 15) were associated with relatively small contiguous grassland areas, usually narrow prairie ridges. Native grassland sites with more than 3 grassland bird species (Sites #1, 2, 7, and 11) all were part of large, unbroken prairie tracts. (All other sites had 2 or 3 grassland bird species.) Unfortunately for the sake of this analysis, other factors were strongly correlated with area. The smallest prairie sites tended to be the steepest. Most of the small sites were in the southern Loess Hills; the largest were at the northernmost localities. Habitat area in the Loess Hills is itself difficult to measure, because prairies tend to occur as long, sinuous tracts, and non-native grasslands often intergrade with native prairie/pastures. The richest prairie sites in our analysis were adjacent to large areas of non-native grasslands. Future studies will be needed to determine which environmental factors are directly important to Loess Hills birds.

The most conspicuous difference between birds of Loess Hills prairies and those of other western Iowa grasslands is the absence (in the Loess Hills) of birds adapted to mesic or wet habitats. Low density and height of vegetation may be proximate factors that restrict the occurrence of these species in the Loess Hills (Wiens 1969). Red-winged Blackbird and Common Yellowthroat, for example, were consistently more abundant in our lowland (agricultural) sites than in native grasslands. Bobolink, a species of mesic grasslands (Birkenholz 1972) and Song Sparrow, a species of moist, shrubby habitats (Bent 1968), were seen very rarely during our systematic surveys. These and other birds of moist grasslands (e.g., Sedge Wren) commonly are recorded in other western Iowa prairies (Kendeigh 1941, Brennan 1969, Wilson 1983, Lowther 1984a, Laubach 1984).

Table 4. Mean numbers of bird species observed during 30 minute surveys of major Loess Hills habitats. Standard deviations are given in parentheses. Distinctions between all birds observed and those using the habitat were made for 12 counts at 8 sites (Table 2).

	Native Grassland	Agricultural Field	Forest
All species (n = 35)	19.22 (6.9)	23.11 (4.8)	20.82 (4.7)
Species using habitat (n = 12)	5.2 (3.4)	9.3 (3.2)	17.6 (1.9)

Lowther (1984b) recently described the birds in a section of farmland near the Loess Hills in Woodbury County. His results are not strictly comparable to ours, but they do permit a general analysis of relative abundances. Killdeer, Horned Lark, and Bobolink all were found by Lowther. These open country birds were rarely observed by us in the Loess Hills. On the other hand, Northern Bobwhite, Lark Sparrow, and perhaps Dickcissel appear to be more abundant in the Loess Hills than in Lowther's site. Dickcissels appear to have declined dramatically in Lowther's study area; earlier studies of the same site (1916 and 1926) recorded more than ten times the number of individuals. The most conspicuous difference between Lowther's study area and the Loess Hills is the paucity of forest species in the former. Red-bellied Woodpecker, Great Crested Flycatcher, Eastern Wood-Pewee, White-breasted Nuthatch, and Northern Cardinal, for example, were not recorded at all by Lowther. These birds commonly were encountered during our surveys, and probably are present in most sections of the Loess Hills.

Bird species richness in the Loess Hills is highest in forest or woodland (Table 4), a habitat type that was not extensive at the time of European settlement. Many wooded valleys and slopes in the Loess Hills have not been greatly disturbed during recent years. These places support a variety of forest birds, including Hairy Woodpecker, Red-eyed Vireo, Ovenbird, Scarlet Tanager, and other species typical of more extensive forest regions in eastern North America. Waubonsie State Park, due to its southern location and large forested area, is one of Iowa's most interesting birding areas. A few species in and near the park (e.g., Chuck-will's Widow, Summer Tanager) are rare or absent elsewhere in the state.

Several species such as American Kestrel (Dinsmore et al. 1984), Turkey Vulture, Bell's Vireo, Orchard Oriole, and the peripheral species mentioned earlier probably reach their highest Iowa densities in the Loess Hills. The rugged landscape and western location of the Loess Hills helps maintain suitable habitats for these and other birds that are otherwise poorly represented in the state.

Our study has considered only breeding birds. Data presented by Koenig (1975), Roosa and Bartelt (1977), and subsequent reports suggest that the Loess Hills landform is an important area for wintering or migrating raptors. The importance of the Loess Hills as a migration corridor for these and other species needs to be explored.

In summary, birds of today's Loess Hills prairies probably represent a depauperate component of the original avifauna. Large species such as the Greater Prairie-Chicken, Long-billed Curlew, and Short-eared Owl probably were present in the Loess Hills prior to settlement, but viable breeding populations of these birds are gone from virtually all of Iowa (Dinsmore et al. 1984). Small grassland birds seem to have adapted much better to today's modified landscape. Indeed, non-native grasslands and other agricultural habitats in the Loess Hills

appear to support richer bird assemblages than remnant native grasslands. We suggest that localities containing today's prairie remnants probably never have supported a rich assemblage of grassland birds, due perhaps to their steep topography and other extreme environmental conditions. The most diverse and interesting of today's Loess Hills bird communities occur in forests and shrubby ravines, habitats that are maintained (in the absence of fire) by the unique topography of this landform.

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APPENDIX

Annotated list of breeding birds of the Loess Hills. Scientific names are from the American Ornithologists' Union Check-list of North American Birds (1983). Grassland birds are indicated by an asterisk. NG = frequency of occurrence in native grasslands, AG = frequency of occurrence in agricultural (brome/alfalfa) fields, and FO = frequency of occurrence in forests. Frequencies indicate the number of stations where the species was recorded during our 1982-83 investigation (maximum = 15). Abbreviations for status are: C = common (likely to be seen in appropriate habitat during any visit to the Loess Hills), U = uncommon (resident but not likely to be seen during all visits to the Loess Hills), R = rare (resident but locally distributed and rarely encountered in the Loess Hills), O = occasional (possibly a resident during some years or present occasionally during summer as a non-breeder).

Common Name	*Scientific Name*	Status	NG	AG	FO	Comments
Green-backed Heron	*Butorides striatus*	R	1			Observed locally near small impoundments and other artificial wetlands. Might also occur along natural watercourses.
Wood Duck	*Aix sponsa*	R			1	Occurs locally along watercourses and artificial wetlands. Probable resident.
Mallard	*Anas platyrhynchos*	R				Observed occasionally in artificial wetlands. Probable resident.
Blue-winged Teal	*Anas discors*	O				Observed occasionally in artificial wetlands. Possible resident, but status in Loess Hills is uncertain.
Turkey Vulture	*Cathartes aura*	U	3	2	3	Common during late spring and early summer. Less common during mid-summer but apparently breeds in Loess Hills.
Cooper's Hawk	*Accipiter cooperii*	O		1		Possibly a rare resident in forests.
Sharp-shinned Hawk	*Accipiter striatus*	O				Not likely a resident, although 2 immature birds were observed in Loess Hills of Monona County during 1978 (Dinsmore et al. 1984).
Broad-winged Hawk	*Buteo platypterus*	O			1	Seen several times during Monona/Harrison County foray and in Plymouth County. Nesting has been reported from Monona and Pottawattamie Counties (Dinsmore et al. 1984). Might be a rare resident in Loess Hills.
Red-tailed Hawk	*Buteo jamaicensis*	U	6	6	2	Most common raptor in Loess Hills. Loess bluffs may be an important migration route.
American Kestrel	*Falco sparverius*	R	1		1	Breeds locally. Occasionally uses cavities in vertical (man-caused) loess "cliffs".
Ring-necked Pheasant	*Phasianus colchicus*	C	12	13	11	Heard in most areas during spring and early summer. Rarely observed in Loess Hills prairies, but occurs in nearby lowlands and cultivated fields.
Greater Prairie-Chicken*	*Tympanuchus cupido*	R				Re-introduced to Loess Hills Wildlife Area in Monona County during 1980 and 1982. Might be establishing population in nearby Missouri River valley.
Wild Turkey	*Meleagris gallopavo*	R	1	0	1	Following re-introduction, occurs locally in Loess Hills Wildlife Area, in vicinity of Waubonsie State Park, and probably elsewhere in Loess Hills. Adults with young were recorded in Monona County during 1982 foray.
Northern Bobwhite	*Colinus virginianus*	C	13	15	9	Common in open habitats throughout Loess Hills.
Killdeer*	*Charadrius vociferus*	U	2	6		Abundant in Missouri River valley, but rarely observed in Loess Hills. Recorded only in large prairie/pastures of Plymouth County and along roadsides.
Upland Sandpiper*	*Bartramia longicauda*	R	4	1		Found only in large open pastures and prairies in northern Loess Hills (Plymouth Co.). Recorded more frequently in nearby Missouri River valley.
American Woodcock	*Scolopax minor*	R				Observed during 1983 foray in Fremont County. Probably a very rare resident in moist ravines of Loess Hills.
Rock Dove	*Columba livia*	U	1	2		Common around farm buildings and in agricultural fields, especially in Missouri River valley. Rare or absent in native grasslands.

Mourning Dove	*Zenaida macroura*	A	13	15	14	One of most conspicuouis birds in Loess Hills. Nests in open prairies as well as in other non-forested habitats.
Black-billed Cuckoo	*Coccyzus erythropthalmus*	U	5	3	2	Less common than Yellow-billed Cuckoo in Loess Hills. Seems to be most common in forested regions of southern Loess Hills.
Yellow-billed Cuckoo	*Coccyzus americanus*	C	11	13	14	Common in woodlands and along forest edges. Regularly seen in both disturbed and undisturbed habitats.
Eastern Screech-Owl	*Otus asio*	R				Heard several times during 1982 foray in Monona County; recorded once during 1983 foray in Mills County. Probably a rare resident.
Great Horned Owl	*Bubo virginianus*	U	9	2	2	Most common owl in Loess Hills. Densities appear to be as great or greater than elsewhere in Iowa.
Burrowing Owl*	*Athene cunicularia*	O				Not reported from Loess Hills landform, but nesting has been documented in nearby Missouri River valley.
Barred Owl	*Strix varia*	R	1			Breeding observed in Loess Hills Wildlife Area during 1982. Probably present in low numbers in large forested tracts.
Common Nighthawk	*Chordeiles minor*	U				Observed near towns and occasionally elsewhere in Loess Hills.
Chuck-will's-widow	*Caprimulgus carolinensis*	R				Present locally in southern Loess Hills; absent or very rare north of Mills County.
Whip-poor-will	*Caprimulgus vociferus*	C	6	0	4	Commonly heard after dusk in woodland habitats.
Chimney Swift	*Chaetura pelagica*	U	8	5	6	Most commonly seen in and around towns; rare elsewhere in Loess Hills.
Ruby-throated Hummingbird	*Archilochus colubris*	R	2			Seen only rarely during Loess Hills studies. Was observed feeding on *Penstemon grandiflorus* in Monona County during 1982.
Belted Kingfisher	*Ceryle alcyon*	R	0	1	1	Occurs near watercourses and artifical ponds. Rare but definitely present in Loess Hills landform.
Red-headed Woodpecker	*Melanerpes erythrocephalus*	C	13	13	13	One of most conspicuous birds in Loess Hills. Recorded in all major habitat types.
Red-bellied Woodpecker	*Melanerpes carolinus*	C	12	7	11	Most common in forests, but also seen along edges and in open areas.
Downy Woodpecker	*Picoides pubescens*	C	12	8	13	Most abundant in forests, but also fairly common in wooded ravines and near farmlands.
Hairy Woodpecker	*Picoides villosus*	U	6	4	8	More restricted to forest habitat than Downy Woodpecker. Apparently more abundant in northern Loess Hills than in southern Loess Hills.
Northern Flicker	*Colaptes auratus*	C	11	12	13	Common and widespread. Recorded in steep loess bluffs as well as in agricultural areas.
Eastern Wood-Pewee	*Contopus virens*	C	7	5	14	Common in forests; seldom encountered in open habitats.
Acadian Flycatcher	*Empidonax virescens*	R	0	1	2	Present only in southern portion of Loess Hills landform, where it is not common. Breeding has been documented in Waubonsie State Park (Silcock 1977).
Willow Flycatcher	*Empidonax trallii*	R	0	1	1	Like its wetland habitat, very local and rare in Loess Hills landform.
Eastern Phoebe	*Sayornis phoebe*	R	0	1	1	Very locally distributed. Nesting has been observed under bridges in heart of Loess Hills landform.

Great Crested Flycatcher	*Myiarchus crinitus*	C	12	7	15	Common in forests and in ravines near native grasslands. Considerably less common in vicinity of agricultural fields.
Western Kingbird	*Tyrannus verticalis*	R		3		Locally distributed and rare in Loess Hills. Perhaps most common at base of loess bluffs in Missouri River floodplain.
Eastern Kingbird	*Tyrannus tyrannus*	C	13	14	10	One of most conspicuous birds in sparsely wooded habitats. Often occurs in red cedars or other woody plants that have invaded prairies.
Horned Lark*	*Eremophila alpestris*	R	1	2	0	Absent from most of Loess Hills except for large open prairie/pastures in Plymouth County.
Purple Martin	*Progne subis*	R	2	2	1	Locally distributed but observed in a variety of habitats, including Loess hills prairies.
Tree Swallow	*Tachycineta bicolor*	O				Resident in Missouri River valley and in wetlands near Loess Hills, but not verified as a resident of Loess Hills landform.
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	C	10	12	5	Common in Loess Hills prairies and agricultural areas, though not as abundant as Barn Swallow.
Bank Swallow	*Riparia riparia*	U	0	1	1	Nesting colonies occur locally throughout Loess Hills landform, often in loess "cliffs" formed by roadcuts.
Cliff Swallow	*Hirundo pyrrhonota*	R				Nests locally under bridges, mainly in Missouri River valley but also in Loess Hills.
Barn Swallow	*Hirundo rustica*	C	12	12	3	Common in both prairies and agricultural areas, though more abundant in the latter.
Blue Jay	*Cyanocitta cristata*	C	15	14	15	Common in all types of habitat. One of most conspicuous birds in Loess hills.
American Crow	*Corvus brachyrhynchos*	C	13	12	11	Conspicuous in all major habitat types.
Black-capped Chickadee	*Parus atricapillus*	C	11	8	15	Most common in forests, but also fairly common in wooded ravines near native grasslands. Considerably less abundant in agricultural areas.
Tufted Titmouse	*Parus bicolor*	R	1	0	3	Recorded only in southern half of Loess Hills landform; most commonly observed in southernmost sites.
White-breasted Nuthatch	*Sitta carolinensis*	C	6	6	13	Present in most sizeable (>5 ha) forest tracts, but rarely observed in other habitats.
Bewick's Wren	*Thryomanes bewickii*	O				Not observed during forays or 1982-83 study, but reported from Waubonsie State Park during May, 1984 (American Birds 38:919).
House Wren	*Troglodytes aedon*	C	13	13	15	Common in all major habitat types. Perhaps most abundant bird in Loess Hills forests.
Blue-gray Gnatcatcher	*Polioptila caerulea*	R	0	0	5	Recorded locally in forests of both northern and southern Loess Hills.
Eastern Bluebird	*Sialia sialis*	U	6	7	6	Locally distributed in open woodlands and near forest edges.
Wood Thrush	*Hylocichla mustelina*	R	1	1	5	Present in forest tracts throughout Loess Hills, though more common toward south.
American Robin	*Turdus migratorius*	U	8	12	6	Most common in agricultural habitats. Undoubtedly less common in Loess Hills than in most other parts of Iowa.
Gray Catbird	*Dumetella carolinensis*	C	11	10	12	Found in all woody habitats, but most common in forests.

Northern Mockingbird	*Mimus polyglottos*	R	0	1	0	Seen during mid-summer in agricultural habitat in Monona County. Recorded twice during 1983 foray. Probably breeds locally in Loess Hills.
Brown Thrasher	*Toxostoma rufum*	C	12	11	11	Common in all major habitat types, particularly in shrubbby ravines near Loess Hills prairies. Less abundant, though common, in agricultural areas.
Cedar Waxwing	*Bombycilla cedrorum*	U	5	2	4	Locally distributed; large flocks have been observed during summer near red cedar trees.
Loggerhead Shrike	*Lanius ludovicianus*	R				Present in very small numbers in Loess Hills. Observed occasionally during forays, but breeding status is not certain.
European Starling	*Sturnus vulgaris*	C	10	11	6	Fairly common in vicinity of human dwellings and agricultural fields.
White-eyed Vireo	*Vireo griseus*	R				One singing male was observed repeatedly in Fremont Co. during 1982 foray. If a regular part of Loess Hills avifauna, this species is very rare and local.
Bell's Vireo	*Vireo bellii*	U	6	4	3	Favors shrubby ravines in Loess Hills prairies. Also occurs frequently in nearby Missouri River valley.
Yellow-throated Vireo	*Vireo flavifrons*	R	1	0	0	Observed very rarely; might not be a regular inhabitant of Loess Hills.
Warbling Vireo	*Vireo gilvus*	R	4	3	1	Very common in Missouri River valley; much less abundant in Loess Hills.
Red-eyed Vireo	*Vireo olivaceous*	U	2	0	5	Rare or absent in all but southern ⅓ of area studied, where individuals were observed regularly in forests.
Blue-winged Warbler	*Vermivora pinus*	O				Singing males have been recorded at Waubonsie State Park, but breeding status is unlikely.
Yellow Warbler	*Dendroica petechia*	R	2			Locally distributed near water. Probably has benefitted from construction of artificial ponds.
Black-and-white Warbler	*Mniotilta varia*	R				Individuals have been observed during early summer in Waubonsie State Park, including an adult feeding young (Silcock 1977). Schaufenbuel also observed one in Plymouth County during summer of 1982. Might be a rare or irregular breeder in Loess Hills.
Worm-eating Warbler	*Helmitheros vermivorus*	O				Observed in Waubonsie State Park during 1977 foray, but very rare, if regularly present at all.
Ovenbird	*Seiurus aurocapillus*	R	0	0	1	Present locally throughout Loess Hills, but apparently more common toward south.
Northern Cardinal	*Cardinalis cardinalis*	C	14	13	15	Common in all habitat types, particularly forests. One of most conspicuous Loess Hills birds.
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	C	14	11	15	One of most common forest birds in Loess Hills. Also common in shrubby ravines near native grasslands; less common but regular in agricultural areas.
Blue Grosbeak	*Guiraca caerulea*	R	2	4	0	Very rare in Loess Hills landform, although regular in large prairie/pastures of Plymouth Co. Considerably more common in nearby Missouri River valley.
Indigo Bunting	*Passerina cyanea*	C	14	13	14	Common in all habitat types. Particularly frequent along woodland edges or in shrubby ravines near native grasslands.

Dickcissel*	*Spiza americana*	C	9	15	7	One of most abundant grassland birds in alfalfa and brome fields. Less common in native grasslands, but occurs regularly in large, open sites.
Louisiana Waterthrush	*Seiurus motacilla*	R				Small population was observed in Waubonsie State Park during 1977 foray. Breeding was implied by adult feeding young (Silcock 1977).
Kentucky Warbler	*Oporornis formosus*	I				Has bred historically in Waubonsie State Park (Dinsmore et al. 1984). Might still be present in small numbers.
Common Yellowthroat	*Geothlypis trichas*	C	6	9	2	Fairly common though not abundant in shrubby ravines, especially near water.
Yellow-breasted Chat	*Icteria virens*	O				Has been sighted historically in Waubonsie State Park (Silcock 1977), but was not observed during recent surveys.
Summer Tanager	*Piranga rubra*	R				Resident, presumably breeding in small numbers, at Waubonsie State Park. Two or three singing males were located during 1977 foray (Silcock 1977).
Scarlet Tanager	*Piranga olivacea*	U	4	3	9	Widespread but not common in Loess Hills forests.
Rufous-sided Towhee	*Pipilo erythrophthalmus*	C	12	8	12	Common along forest edges and shrubby ravines. Uncommon in agricultural areas.
Chipping Sparrow	*Spizella passerina*	U	2	4	0	Observed rarely during 1982-83 field study, but regularly recorded during forays. Occurs most commonly near agricultural areas.
Field Sparrow	*Spizella pusilla*	C	14	13	11	Most ubiquitous bird in Loess Hills prairies, though most activities are confined to vicinity of shrubs and red cedars. Also common along forest edges and in agricultural areas.
Vesper Sparrow*	*Pooecetes gramineus*	U	5	4	0	Locally distributed. Seems to avoid steep loess bluffs.
Lark Sparrow*	*Chondestes grammacus*	U	9	11	3	Widespread but locally distributed. Occurs in native pastures and in agricultural habitats.
Grasshopper Sparrow*	*Ammodramus savannarum*	C	6	13	1	Fairly common, especially in brome and alfalfa fields. Generally avoids steep loess bluffs.
Song Sparrow	*Melospiza melodia*	R	2	1	0	Occasionally observed in moist habitats. Not recorded during 1982-83 field studies.
Bobolink*	*Dolichonyx oryzivorus*	R				Very rare in Loess Hills. Seen only occasionally along eastern portions; avoids steep hills.
Red-winged Blackbird	*Agelaius phoeniceus*	C	7	12	5	Rarely seen in native grasslands of Loess Hills, but common in agricultural areas.
Eastern Meadowlark*	*Sturnella magna*	U	1	3	0	Occurs locally in southern Loess Hills.
Western Meadowlark*	*Sturnella neglecta*	C	11	12	9	Easily the most common meadowlark in Loess Hills. Nests in remnant prairies, even on rather steep slopes, but is more abundant in agricultural habitats.
Common Grackle	*Quiscalus quiscula*	C	9	10	6	Fairly common but not abundant in open habitats of Loess Hills.
Brown-headed Cowbird	*Molothrus ater*	C	14	15	14	One of the most abundant birds of Loess Hills. Found in virtually all habitats.

Orchard Oriole	*Icterus spurius*	C	10	11	8	Less common than Northern Oriole, especially in or near forested areas. More abundant in agricultural areas than in vicinity of native grasslands.
Northern Oriole	*Icterus galbula*	C	12	14	13	Common in all habitat types, especially in agricultural areas.
American Goldfinch	*Carduelis tristis*	C	11	13	8	Fairly common, especially in non-native grasslands.
House Sparrow	*Passer domesticus*	C	8	12	5	Common around buildings and in cultivated fields. Rarely seen in native grasslands unless buildings are nearby.