SUCCESS IN A SECONDARY HABITAT: THE DICKCISSEL IN THE TALLGRASS PRAIRIE

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Abstract. The dickcissel (*Spiza americana*) is the most abundant species in the breeding-season community of the tallgrass prairie in the Flint Hills of Kansas. Yet prairie is not the most preferred habitat; nesting density is as much as 5 times greater in mature oldfield communities. As a result of low nest density, prairie dickcissels suffer a significantly higher frequency as well as intensity of parasitism by the brown-headed cowbird (*Molothrus ater*), which reduces the production of young because of the removal of host eggs by the female cowbird. Prairie populations with low nest density, on the other hand, have a decreased chance of nests being destroyed by predators. Thus there is an offsetting balance between the 2 major factors affecting nest success so that the daily survival rate and the production of young in a prairie nest are no different from a nest in the oldfield community.

INTRODUCTION

The diversity of birds in grassland communities during the breeding season is low (Cody 1966). Furthermore, there are few unique grassland bird species. In the tallgrass prairie of North America, only the greater prairie-chicken is limited to that community, while other bird species in the prairie occur in a variety of other habitats. The dickcissel is abundant on the prairie but is present in higher densities in oldfield communities (Zimmerman 1971). The purposes of this paper are to relate dickcissel population size to that of other species present during the breeding season on the Konza Prairie Research Natural Area, Riley and Geary Counties, Kansas, and to compare the effects of factors affecting dickcissel productivity in the prairie with those in the oldfield community.

STUDY AREA

Konza Prairie is a 3486-ha tract of bluestem (*Androgogon-Panicum-Sorghastrum*) prairie and associated gallery forest in the Flint Hills Upland of Kansas. The area is unglaciated and heavily dissected with steep-sided hills exposing limestone and shale layers. The ridges are typically flat with shallow, rocky soils, while the larger, wider valleys have deeper, more permeable soil.

Until its acquisition (in 2 parcels, 1971 and 1977) by The Nature Conservancy, Konza Prairie was a working cattle ranch maintained in good to excellent range conditions. Konza Prairie is now managed in an attempt to ascertain the pre-settlement ecosystem through a factorial experimental design that provides several intervals of burning (including unburned tracts) and different intensities of grazing. At the present time, however, neither native large herbivore (e.g., *Bison, Cervus, Antilocapra*) or domestic cattle grazing treatments have been implemented.

METHODS

During the breeding seasons of 1972-1974 and 1976-1978, bird populations were estimated by the spot-map method (Williams 1936) on an annually burned tract of 12.2 ha and on an unburned area of 28.8 ha. The data for 1979 are from Knodel (1980) and involved 2 annually burned and 2 unburned plots. In 1981 and 1982, population data were collected using a variable distance transect (Burnham et al. 1980) on 2 annually burned plots, 3 plots burned every 4 years, and 3 unburned areas. None of the areas studied has been grazed by cattle since 1971. For each year the data from all areas censused have been combined, and the relative frequency for each species computed by dividing the total individuals for each species across all plots by the total for all species.

In 1979, weekly nest densities of dickcissels were determined on the 12.2-ha burned plot and the 28.8-ha unburned plot. These values were added to dickcissel nest density data from 3 oldfields and used to relate the weekly incidence of brown-headed cowbird parasitism to the density of nests in the construction and egg-laying stages. Nests in the egg-laying, incubation, and brooding phases of the nesting cycle were used to calculate nest densities that were in turn correlated with predation rates determined by the exposure method (Mayfield 1961, 1975).

RESULTS AND DISCUSSION

Thirty-one species have been detected on censuses during the breeding season in ungrazed sites of the Konza Prairie Research Natural Area (Table 1). Only 12 of these species, however, have a mean relative frequency of over 1 percent, and just 4—dickcissel, brown-headed cowbird, eastern meadowlark and grasshopper sparrow—together contribute over two-thirds (68.2%) of the individuals present. The only tallgrass prairie sites studied by Cody (1968) and Wiens (1973) were grazed and they either ignored cowbirds or, because of the method used, could not evaluate the abundance of brown-headed cowbirds. Thus these data have little value for comparison with the data from Konza Prairie presented here except to support the generalization of low bird-species richness in grasslands. The presence of horned larks in the community studied by Cody is worth noting as it resulted from the inclusion of a heavily grazed area within his study plots (Zimmerman, personal observation). As Table 1 indicates, horned larks are not present on ungrazed tallgrass prairie sites.

In 7 of the 9 years the dickcissel was the most abundant species in the ungrazed grasslands of Konza Prairie and, on the average, was almost twice as abundant as any other species. Yet prairie is not the preferred habitat. The density of male dickcissels, frequency of polygyny (Zimmerman 1971), and mean weekly density of nests (Table 2) were higher in mature oldfield habitats than in the prairie. The higher densities in oldfields suggests greater suitability of this habitat (Fretwell and Lucas 1969). While this is true for the male, it is not true for the female (Zimmerman 1982). Both the production of young per nest (0.72 in oldfields,

TABLE 1. Relative frequency (%) of breeding season birds in the tallgrass prairie of Konza Prairie Research Natural Area, Kansas.

Species	Year									Mean
	1972	1973	1974	1976	1977	1978	1979	1981	1982	
Dickcissel	18	24	38	23	38	26	23	31	14	26.1
Brown-headed cowbird	20	17	11	17	16	17	7	13	15	14.7
Eastern meadowlark	18	10	11	17	11	14	13	15	18	14.1
Grasshopper sparrow	20	14	11	11	4	10	22	14	14	13.3
Red-winged blackbird	8	14	11	6	9	10	8	2	6	8.2
Mourning dove	5	7	4	9	4	7	6	5	7	6.0
Upland sandpiper	6	7	5	6	7	7	6	6	3	5.9
Henslow's sparrow	0	0	7	8	2	2	4	4	2	3.2
Common nighthawk	2	5	2	2	4	2	5	0.4	0.4	2.5
Northern bobwhite	2	2	0	2	2	2	0	0	2	1.3
Eastern kingbird	0	0	0	0	0	0	5	2	3	1.1
Common yellowthroat	0	0	0	0	2	2	1	1	3	1.0

Species present < 1% frequency: northern harrier, American kestrel, greater prairie-chicken, ring-necked pheasant, killdeer, yellow-billed cuckoo, great horned owl, red-headed woodpecker, northern flicker, northern rough-winged swallow, house wren, sedge wren, gray catbird, brown thrasher, Bell's vireo, common grackle, orchard oriole, northern oriole, American goldfinch (See Appendix for scientific names).

0.87 in prairie) and the daily survival rates of the nests (0.14 in oldfield, 0.14 in prairie) are the same in both habitats.

The equity between the 2 habitats for the female is a function of the difference in the primary causes for nest loss between the mature oldfields and the prairie. The 2 major factors affecting nesting success of dickcissels are loss of 1 to 2 eggs per nest due to host egg removal by the brown-headed cowbird (Zimmerman 1983) or predation, causing the loss of whole clutches. The low density of dickcissel nests on the prairie results in a high incidence of nest parasitism by cowbirds (Elliott 1978), since both the frequency (Spearman $R = -0.77$, $N = 26$, $P < 0.01$) and the intensity (Spearman $R = -0.84$, $N = 22$, $P < 0.01$) of nest parasitism are inversely related to nest density (Zimmerman 1983). Daily predation rates in the prairie, on the other hand, are low in comparison to those in oldfields (Zimmerman MS). For example, on any day during the 12-day incubation period, the chance of an oldfield nest being depredated is 6.4% while it is only 3.8% on the prairie ($F = 2.13$, df = 24,136, $P < 0.01$). If daily predation rates across the whole nesting period from egg-laying to fledging are compared between these 2 habitats, the probability for loss from predation is 104 times greater in oldfields than in prairies. This difference appears not to be a density-dependent association between nest density and daily predation rates, but rather a reflection of the higher density of predators in oldfield communities (Zimmerman MS).

While parasitism is high in the prairie, predation rates are low. In the oldfield, however, parasitism is low and predation rates are high. Thus when these 2 populations are compared, the 2 major factors affecting nest survival tend to offset one another so that daily nest survival probabilities are similar.

TABLE 2. Weekly dickcissel nest densities (nests per ha) and other features of study sites.

Feature	Oldfields[1]			Prairies	
	1 yr. old	3 yr. old	5+ yr. old	Unburned	Burned
Total area (ha)	22.7	22.7	30.4	28.8	12 2
Mean density	**0.22**	**0.78**	**0.64**	**0.15**	**0.23**
Standard error	0.050	0.191	0.115	0.023	0.052
Number	10	13	14	13	10

[1]Oldfield sites were located in Riley Co., KS on the Ft. Riley Military Reservation; see Zimmerman (1971) for vegetation structure.

ACKNOWLEDGMENTS

We thank the Director, Konza Prairie Research Natural Area, Division of Biology, Kansas State University for his permission and cooperation in conducting this research. Partial support for this study was provided by a grant to Finck from the Chapman Memorial Fund of the American Museum of Natural History, New York, NY, while data from 1981 and 1982 were collected as part of the Long Term Ecological Research program at Konza Prairie funded by NSF grant DEB 8012166.

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APPENDIX 1. SCIENTIFIC NAMES OF BIRD SPECIES MENTIONED IN TEXT AND TABLES.

Northern harrier	*Circus cyaneus*
American kestrel	*Falco sparverius*
Ring-necked pheasant	*Phasianus colchicus*
Greater prairie-chicken	*Tympanuchus cupido*
Northern bobwhite	*Colinus virginianus*
Killdeer	*Charadrius vociferus*
Upland sandpiper	*Bartramia longicauda*
Mourning dove	*Zenaida macroura*
Yellow-billed cuckoo	*Coccyzus americanus*
Great horned owl	*Bubo virginianus*
Common nighthawk	*Chordeiles minor*
Red-headed woodpecker	*Melanerpes erythrocephalus*
Northern flicker	*Colaptes auratus*
Eastern kingbird	*Tyrannus tyrannus*
Horned lark	*Eremophila alpestris*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
House wren	*Troglodytes aedon*
Sedge wren	*Cistothorus platensis*
Gray catbird	*Dumetella carolinensis*
Brown thrasher	*Toxostoma rufum*
Bell's vireo	*Vireo bellii*
Common yellowthroat	*Geothlypis trichas*
Dickcissel	*Spiza americana*
Grasshopper sparrow	*Ammodramus savannarum*
Henslow's sparrow	*Ammodramus henslowii*
Red-winged blackbird	*Agelaius phoeniceus*
Eastern meadowlark	*Sturnella magna*
Common grackle	*Quiscalus quiscula*
Brown-headed cowbird	*Molothrus ater*
Orchard oriole	*Icterus spurius*
Northern oriole	*Icterus galbula*
American goldfinch	*Carduelis tristis*

HABITAT SELECTION OF SMALL MAMMALS IN BURNED AND UNBURNED TALLGRASS PRAIRIE

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Abstract. During the spring and summer of 1981, live-trapping techniques were used to determine habitat selection of small mammals in a restored tallgrass prairie in western Illinois. Differences in small mammal composition of burned and unburned prairie were emphasized. Data were collected from 4 neighboring grids, 2 being located in freshly burned prairie and 2 in unburned prairie. Although 9 species of small mammals were captured, only 4—*Microtus ochrogaster* (prairie vole), *M. pennsylvanicus* (meadow vole), *Peromyscus maniculatus* (prairie deer mouse), and *P. leucopus* (white-footed mouse)—occurred in abundance. *M. ochrogaster* occurred in both burned and unburned prairie but was most abundant in the burned prairie. *M. pennsylvanicus* was caught primarily in unburned prairie. Both *P. maniculatus* and *P. leucopus* were caught almost exclusively in burned prairie. The habitat selection of these mammals is thought to be influenced primarily by the presence or absence of litter and secondarily by interspecific competition. Other species encountered were *Reithrodontomys megalotis* (western harvest mouse), *Zapus hudsonius* (meadow jumping mouse), *Blarina brevicauda* (short-tailed shrew), *Mus musculus* (house mouse), and *Sorex cinereus* (masked shrew).

INTRODUCTION

This paper reports part of a continuing, long-term study of small mammals in a restored tallgrass prairie in west-central Illinois. Studies on the effects of fire on animals, particularly birds and mammals, have been carried out over the past 17 years in the restored prairies at the Knox College Biological Field Station, 20 miles east of Galesburg, Illinois.

Fire has long been recognized as a natural element of grassland ecosystems. During periods of intermittent drought or dry, windy weather in autumn and spring, prairie was especially susceptible to fire (Jackson 1965). Lightning was a common natural cause of grass fires (Komarek 1964) and early man often started them to influence the presence, movements, and capture of large game animals (Risser et al. 1981). Before the continuity of the prairie was interrupted by white settlers, there were few barriers to the movement of fire once it started (Sauer 1950). Consequently, a single fire might spread over many square miles before dying out.

Many studies have shown that fire brings about abrupt changes in prairie habitat. Old (1969) and Hulbert (1969) demonstrated that fire may result in partial or complete removal of standing dead plant material and accumulated litter. Moreover, it may result in the complete removal of all vegetative cover which, in turn, causes changes in microclimatic conditions near the soil. Daubenmire (1968) recorded significantly greater diurnal temperature extremes near the soil after a fire than before. Although the immediate effects of fire are destructive, prairie vegetation is adapted to fire and in the long run is not harmed by it. Hadley and Kieckhefer (1963) found total plant biomass production and flowering in an Illinois prairie to increase after an early spring fire. The results of other studies suggest that these effects are due primarily to the removal of accumulated litter (Curtis and Partch 1950, Weaver and Rowland 1952, Hulbert 1969, and Old 1969). The recovery