Am. Midl. Nat. 151:192–199

Edge Effects on Nesting Dickcissels (Spiza americana) in Relation to Edge Type of Remnant Tallgrass Prairie in Kansas

ABSTRACT.—Edge effects on grassland-nesting birds should be less pronounced or absent near cropland edges of grasslands that lack wooded-edge habitat often used by nest predators and brood parasites. We compared nest predation, brood parasitism and densities of dickcissel (*Spiza americana*) nests in relation to distance from woodland and cropland edges of Kansas tallgrass prairie. Daily nest predation rates did not differ ($P > 0.25$) among distance intervals ($\leq$50 m, 51–100 m, $\leq$100 m and $>$100 m) from either edge type or among 50-m intervals adjacent to each edge type. Brood parasitism rates by the brown-headed cowbird (*Molothrus ater*) were higher $\leq$100 m vs. $>$100 m from woodland edges ($P = 0.04$), being highest $\leq$50 m from woodland edges ($P = 0.09$). Parasitism rates were not related to distance from cropland edges, although parasitism rates $\leq$50 m from woodland and cropland edges were statistically similar ($P = 0.16$). Dickcissel nest densities were lower $\leq$50 m from woodland edges relative to farther distance intervals ($P = 0.004$), indicating dickcissel avoidance of this edge type. There was no similar pattern of nest density on cropland-edged sites, but nest densities $\leq$50 m from woodland and cropland edges were statistically similar ($P = 0.17$). Thus, some woodland edge effects on this grassland bird species were apparent but might vary geographically.

INTRODUCTION

Predation and brood parasitism on bird nests might be relatively high near habitat edges within fragmented habitats (Paton, 1994; Faaborg *et al.*, 1995). However, the severity of these edge effects might vary depending on edge habitat characteristics. For example, nest predation rates have been found to vary with differences in forest-edge structure (Ratti and Reese, 1988; Fenske-Crawford and Niemi, 1997; Suarez *et al.*, 1997). Such habitat-variation in edge effects likely is due to habitat affinities of predators and brood parasites. Realization of variation in edge effects is important when managing habitat for populations of concern in fragmented landscapes.

Nest predation and brood parasitism of grassland-nesting birds have been shown to be higher near ($<$45–60 m) wooded edges than in interiors of tallgrass prairie fragments in North America (Johnson and Temple, 1990; Burger *et al.*, 1994; Winter *et al.*, 2000). Winter *et al.* (2000) found that generalist mammalian predators were most active near wooded edges in tallgrass prairie remnants. Many others have found brood parasitism on grassland-nesting birds by brown-headed cowbirds (*Molothrus ater*, hereafter cowbird) to be more frequent near elevated perches (Wiens, 1963; Norman and Robertson, 1975; Best, 1978; Clotfelter, 1998; Hauber and Russo, 2000), such as those provided by wooded edges, suggesting the importance of surveillance perches to cowbirds in finding host nests. There is also evidence that some grassland-nesting species avoid nesting near wooded edges in tallgrass prairie (Johnson and Temple, 1986; O'Leary and Nyberg, 2000; Winter *et al.*, 2000). The expansion of woodlands in grassland ecosystems of North America (Bragg and Hulbert, 1976; Knopf, 1986; Knight *et al.*, 1994) may, therefore, contribute to the imperilment of declining grassland songbird populations in the Midwestern United States (Samson and Knopf, 1994; Herkert, 1995; Peterjohn and Sauer, 1999).

However, woodland edges are not characteristic of all borders of prairie fragments. Indeed, modern agriculture is largely responsible for the displacement of native prairie ecosystems in North America (Samson and Knopf, 1994). Cropland commonly surrounds prairie fragments in Midwestern agricultural landscapes, which creates grassland habitat patches without wooded borders. Prairie-cropland edges lacking wooded-edge habitat for predators and brood parasites also should lack associated edge effects on grassland-nesting birds.

Our objectives were to compare predation rates, brood parasitism rates and densities of dickcissel (*Spiza americana*) nests in relation to distance from woodand and cropland edges in eastern Kansas tallgrass prairie. The dickcissel was an ideal study species due to its great abundance relative to other grassland bird species in Kansas tallgrass prairie (Zimmerman, 1993). We predicted that nest predation and brood parasitism on dickcissel nests would be higher near woodland edges than in interiors of

TABLE 1.—Number of nest exposure days and nests used in analyses of daily nest predation rates and brood parasitism rates, respectively, among three distance intervals from woodland and cropland edges in Kansas tallgrass prairie

	Nest distance from woodland edge			Nest distance from cropland edge		
	≤50 m	51–100 m	>100 m	≤50 m	51–100 m	>100 m
Exposure days	37	142	476	76	40	218
Number of nests used in brood parasitism analyses	7	22	59	10	6	21

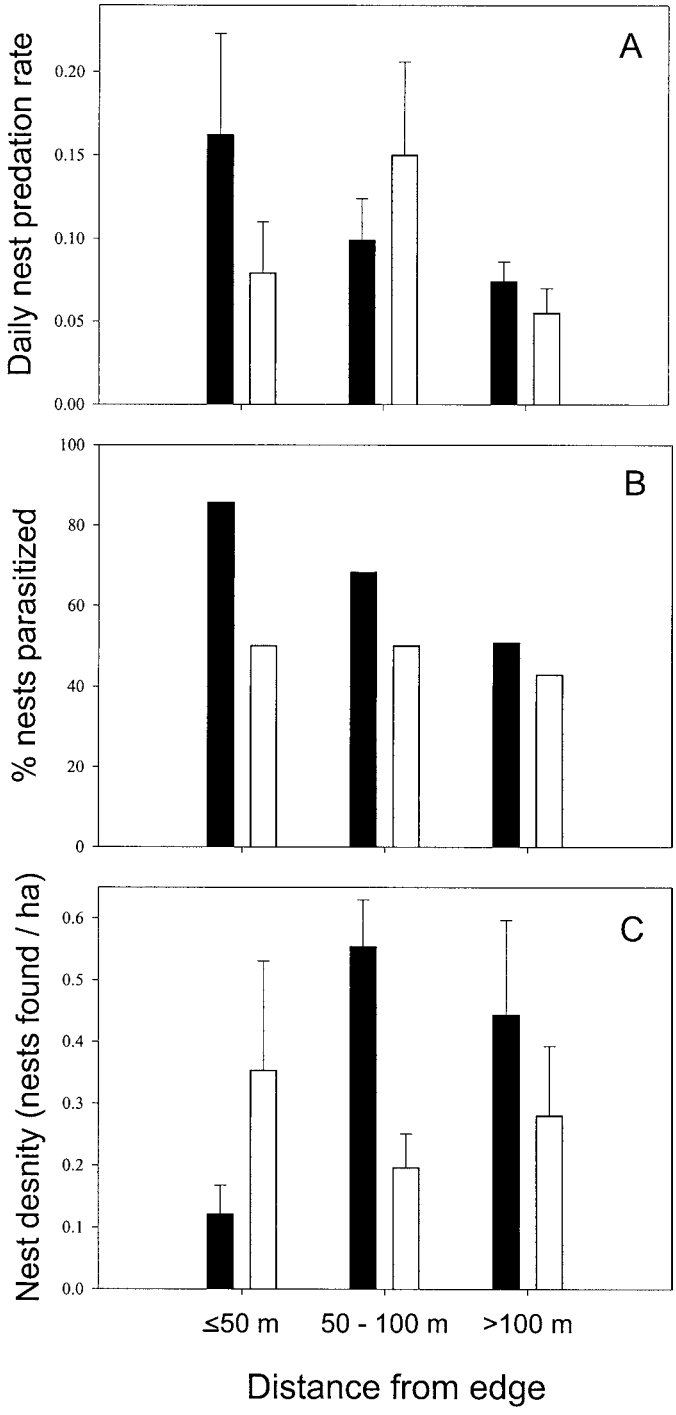
woodland-fragmented prairie, while no such edge effect patterns were expected on prairie fragmented solely by cropland. We also predicted that dickcissels would be likely to nest near less woodland edges than near cropland edges.

METHODS

The study area was located in the Flint Hills and Osage Cuestas regions of Kansas across Coffey, Greenwood and Lyon counties. Although much tallgrass prairie remains in this region (Steinauer and Collins, 1996), it is dissected by upland and riparian woodlands, hedgerows and cropland. Study sites were located on both privately and publicly-owned (Kansas Department of Wildlife and Parks) native tallgrass prairie managed with annual to biennial burning and cattle grazing or haying. Study sites ranged from 8 ha to 97 ha; however, this does not represent actual habitat patch area of some woodland-edged sites nested within contiguous grassland (this also would have been the condition of the largest cropland-edged sites if not dissected by roads). The prairie habitat edges of each study site were one of the defined edge types, either woodland or cropland (no site had both of these edge types), in addition to county-level roads or state highways on some sites. Four woodland-edged study sites and two cropland-edged study sites were used in 1997 and three study sites per edge type were used in 1998. Woodland edges were comprised of hedgerows and upland and riparian woodlands consisting of several trees >3 m in height with continuous canopy cover and a shrub understory abruptly abutting tallgrass prairie. These woodland edges were linear in shape, ranging approximately 5 m to 100 m in width. Only one site was surrounded completely by woodland edges as defined, while most other sites were quadrangular and bordered only on one side by woodland edges. Edges consisting solely of shrubs <3 m tall were not considered in our study because they were rare and isolated on our sites. Borders of cultivated fields, which formed abrupt cropland edges of tallgrass prairie, lacked woody vegetation and consisted of herbaceous plants with barbed-wire fences at edges of some pasture sites. Crop fields were planted with soybeans, sorghum or wheat and ranged from 14 ha to 77 ha.

We searched for nests from mid May to late July in 1997 and 1998 by using rope drags to flush incubating females and also by observing parental nesting behaviors. Nest searching effort was equal among distance-to-edge intervals from woodland and cropland edges, although some incidentally-found nests outside these areas of equal search effort were used in some analyses (*see* below). Small orange surveyor flags were placed 4 m north of each nest and nests were monitored every 3 to 4 d. Estimated nest losses other than predation (*i.e.,* desertion or trampling by cattle) or that occurred prior to incubation (Mayfield, 1975) were excluded from nest predation analyses to best approximate nest loss due to predation. Nests also were not included in nest predation analyses if they contained only cowbird nestlings when found. Nests were recorded as being parasitized by cowbirds if they contained cowbird eggs or nestlings. After the completion of each nesting attempt, the distance of each nest to the nearest edge was measured by using one or several lengths of a 100-m measuring tape.

We used distance-from-edge as a categorical—rather than continuous—variable for predation and parasitism analyses due to the observed avoidance of woodland edges by dickcissels (described below) (*i.e.,* if distance were treated as a continuous variable, the spatial scale of comparison near edges would have been biased among the edge types). Distance interval categories were used at fine scales of ≤50 m,


A
Daily nest predation rate
0.00
0.05
0.10
0.15
0.20
B
% nests parasitized
0
20
40
60
80
100
C
Nest desnity (nests found / ha)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
≤50 m
50 - 100 m
>100 m
Distance from edge

51–100 m and >100 m from edges and at coarser scales of ≤100 m and >100 m from edges for analyses of distance effects on predation and brood parasitism on woodland- and cropland-fragmented sites separately. Predation and parasitism rates also were compared between the 50-m edge intervals adjacent to woodland and cropland edges. The use of these categorical distance intervals also facilitated comparison with previous studies on edge effects on grassland birds (*e.g.,* Johnson and Temple, 1990; Winter *et al.*, 2000). Sample sizes of nests among distance intervals (*e.g.,* ±50 m from edges) on individual study sites were insufficient for use of separate study sites as experimental units. Therefore, observational units were individual days for daily nest predation analyses and individual nests for brood parasitism analyses, pooled across study sites and years (as in Johnson and Temple, 1990 and Winter *et al.*, 2000). Daily nest predation rates (Mayfield, 1975) were compared among distance intervals from each edge type by using the chi-square analysis of Johnson (1979). Proportions of cowbird-parasitized nests were compared among distance categories from each edge type by using one-tailed Fisher's Exact tests due to small samples in some contingency table cells.

Nest density estimates within the three finer-scaled distance intervals from edges (≤50 m, 51–100 m and >100 m) were used to test for edge avoidance. As sample-size constraints of nests within distance intervals per site are less crucial to nest density estimates, individual study sites could be used as replicated observational units. The habitat area (ha) sampled within each distance category per study site was measured from Digital Orthophoto Quadrangles by using ArcView (Environmental Systems Research Institute, Inc.). Nest density per distance interval per study site was estimated as the number of nests found per ha sampled. Different years were considered independent observational units for sites sampled in both years due to the very low inter-annual site fidelity observed in dickcissels in Kansas tallgrass prairie (EJF, pers. obs.). Nests found incidentally outside of areas of systematic sampling effort per site, although used in predation and parasitism analyses, were excluded from nest density estimates. Comparisons of nest density means among distance-from-edge intervals adjacent to each edge type separately were done by using complete block analysis of variance, where individual sites were blocks. Follow-up comparisons of nest density means were done by using Fisher's LSD tests. Mean nest density estimates also were compared among the 50-m edge intervals adjacent to woodland and cropland edges by using *t*-tests.

RESULTS

We found 127 dickcissel nests; 37 on cropland-edged sites edges and 90 on woodland-edged sites. Numbers of nest exposure days and nests per distance interval and edge type used in analyses of predation and parasitism rates, respectively, are given in Table 1. Daily nest predation rates of dickcissel nests became progressively lower from ≤50 m to >100 m from woodland edges, being more variable among distance intervals adjacent to cropland edges (Fig. 1). However, these differences were not statistically significant among the 50–m distance intervals or coarser 100 m distance intervals from either edge type (all $0.50 > P > 0.25$). Likewise, daily nest predation rates ≤50 m from woodland and cropland edges were statistically similar ($0.50 > P > 0.25$).

Of the 125 dickcissel nests usable for brood parasitism analyses, 56% were parasitized by cowbirds, with an average of 1.65 cowbird eggs per parasitized nest. There was a weak difference (at a liberal $\alpha = 0.10$) in brood parasitism rates among the ≤50 m vs. >100 m distance intervals from woodland edges ($P = 0.09$), but no significant differences in parasitism rates among the <50 m vs. 51–100 m ($P = 0.35$) or 51–100 m vs. >100 m ($P = 0.12$) intervals from woodland edges (Fig. 1). However, at coarser distance intervals, a significantly higher proportion of nests were parasitized by cowbirds ≤100 m compared to

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FIG. 1.—Daily nest predation rates (A), brood parasitism rates (B) and density estimates of dickcissel nests (C) among three distance intervals from woodland and cropland edges in Kansas tallgrass prairie. Dark bars represent distance intervals from woodland edges, open bars represent intervals adjacent to cropland edges. Nest density estimates are average numbers of nests found/ha sampled across study site years (n = 7 woodland-edged site*year replicates, n = 5 cropland-edged site*year replicates)

>100 m from woodland edges ($P = 0.04$). However, there were no significant differences in brood parasitism rates among all distance interval categories adjacent to cropland edges (all $P > 0.30$) (Fig. 1). Although the parasitism rate of nests ≤50 m of woodland edges was higher than the parasitism rate ≤50 m of cropland edges, this difference was not statistically significant ($P = 0.16$).

Dickcissel nest density was significantly lower ($F = 9.06$; $df = 2,12$; $P = 0.004$) ≤50 m from woodland edges compared to farther distance intervals from woodland edges (Fig. 1). However, nest densities were not significantly different (all $P > 0.50$) among the distance intervals adjacent to cropland edges (Fig. 1). Nest densities ≤50 m of woodland edges were lower than nest densities ≤50 m of cropland edges, but not significantly so ($t = 1.47$, $df = 10$, $P = 0.17$).

DISCUSSION

The statistical probabilities of daily nest mortality differing by chance among distance categories from both woodland and cropland edges were unacceptably high. Lack of statistical power due to insufficient sample sizes might explain this lack of statistical significance. However, Hughes *et al.* (1999) also did not find an effect of wooded edges on dickcissel nest success in Conservation Reserve Program (CRP) fields in Kansas. In Maine, Vickery *et al.* (1992) found no relationship between nest distance to forest edge and predation rates on grassland bird nests. An artificial nest study in Sweden also found no effects of forest edges on ground nests in grasslands (Soderstrom *et al.*, 1998). A review by Chalfoun *et al.* (2002) found much geographic variation in evidence for nest predator responses to habitat edges. Many of the predators of grassland songbird nests recorded by video camera in North Dakota (Pietz and Granfors, 2000) inhabit grassland interiors. Perhaps grassland-interior nest predators are more abundant in the grassland-dominated landscapes of eastern Kansas than in more fragmented prairie landscapes of Missouri (Winter *et al.*, 2000) and Minnesota (Johnson and Temple, 1990). Similar relationships were suggested for the lack of edge effects of predation on western shrub-steppe bird nests (Vander Haegen *et al.*, 2002) and lack of fragmentation effects on nest predation in shortgrass prairie (Howard *et al.*, 2001) and western forests (Tewksbury *et al.*, 1998).

Dickcissel nests were parasitized more heavily near woodland edges on woodland-fragmented sites, but not near cropland edges on cropland-fragmented sites. These results support other findings that cowbird parasitism is skewed toward woodland edges in grasslands (Mayfield, 1965; Johnson and Temple, 1990; Winter *et al.*, 2000). The lack of elevated perches, preferred woodland host species or high host densities (Barber and Martin, 1997) might explain why brood parasitism rates were not elevated near cropland edges. However, wooded edge effects on brood parasitism detected in our study seemed to extend farther into grassland interior, 100m reported elsewhere (Johnson and Temple, 1990; Winter *et al.*, 2000). Also, parasitism rates were statistically similar among the 50-m intervals adjacent to woodland and cropland edges. Indeed parasitism rates >100 m from woodland edges (51%) also were not trivial compared with the rarity of parasitism on grassland birds elsewhere in the Midwest (Strausberger and Ashley, 1997; Kershner and Bollinger, 1998; Robinson *et al.*, 1999; Winter, 1999). High cowbird density in the central Great Plains (Peterjohn *et al.*, 2000) might force cowbirds to a wider distribution of host habitats (Fretwell and Lucas, 1970). Herkert *et al.* (2003) found local brood parasitism rates on grassland birds to be related more to regional variation in cowbird abundance than prairie fragment size. If cowbirds prefer the most locally-common host species (Smith and Myers-Smith, 1998), the ubiquity of grassland-nesting birds in this region also might skew cowbird parasitism toward grassland interior.

Dickcissel nest density was lower near woodland edges, but not cropland edges. Hughes *et al.* (1999) found dickcissels to be more abundant in CRP fields with less woody vegetation at field borders. Similarly, O'Leary and Nyberg (2000) reported reduced densities of nests of many grassland bird species ≤50 m from treelines in Illinois. If dickcissels recognized conspicuous woodland edges as inferior habitat (*e.g.,* higher brood parasitism rates), this might explain why dickcissels did not avoid nesting near treeless cropland edges. However, dickcissels do not appear to avoid nesting near or in shrub edges (Winter *et al.*, 2000) where they were found to experience reduced nest success in Missouri (Winter *et al.*, 2000). The lack of statistically-significant differences in nest densities among the ≤50 m 'near edge' intervals of woodland and cropland edges appears to be partly explained by the high variability in dickcissel nest density adjacent to cropland edges (Fig. 1). No dickcissels were found nesting ≤50 m of woodland edges

on three sites, whereas a cropland-edged site had the highest nest density for any 50-m interval (0.986 nests/ha) and another with no nests found ≤50 m of a cropland edge. This variation might have been due to tractor activity near the cropland edge of the latter site that was not seen elsewhere.

Our results agree somewhat with previous findings on wooded edge effects on brood parasitism and nest placement of nesting grassland songbirds, but there were notable exceptions. Prairies dissected solely by cropland might provide more suitable grassland bird habitat than equivalently-sized woodland-fragmented prairies, and should remain a consideration in grassland bird management.

Acknowledgments.—We thank many individuals for assisting with data collection, especially J. R. Halstead, A. Richards, D. T. Ganey, D. A. Robinson, Jr and T. Hoerneman. We also thank landowners that allowed use of their properties. Helpful critiques of earlier drafts of our manuscript were given by J. F. Cully, Jr., D. H. Johnson, W. M. Giuliano, D. McCollin, P. W. C. Paton, J. W. Rivers and two anonymous reviewers. Funding and equipment were provided by an Emporia State University Faculty Research and Creativity Grant, the Ross Natural History Reservation, and the Kansas Department of Wildlife and Parks.

LITERATURE CITED

BARBER, D. R. AND T. E. MARTIN. 1997. Influence of alternate host densities on brown-headed cowbird parasitism rates in black-capped vireos. *Condor,* **99**:595–604.

BEST, L. B. 1978. Field sparrow reproductive success and nesting ecology. *Auk,* **95**:9–22.

BRAGG, T. B. AND L. C. HULBERT. 1976. Woody plant invasion of unburned Kansas bluestem prairie. *J. Range Manage.,* **29**:19–24.

BURGER, L. D., L. W. BURGER AND J. FAABORG. 1994. Effects of prairie fragmentation on predation on artificial nests. *J. Wildl. Manage.,* **58**:249–254.

CHALFOUN, A. D., F. R. THOMPSON III AND M. J. RATANSWAMY. 2002. Nest predators and fragmentation: a review and meta-analysis. *Conserv. Biol.,* **16**:306–318.

CLOTFELTER, E. D. 1998. What cues do brown-headed cowbirds use to locate red-winged blackbird host nests? *Anim. Behav.,* **55**:1181–1189.

FAABORG, J., M. BRITTINGHAM, T. DONOVAN AND J. BLAKE. 1995. Habitat fragmentation in the temperate zone, p. 357–380 *In:* T. E. Martin and D. M. Finch (eds.). Ecology and management of neotropical migrant birds: a synthesis and review of critical issues. Oxford University Press, Oxford. 489 p.

FENSKE-CRAWFORD, T. J. AND G. J. NIEMI. 1997. Predation of artificial ground nests at two types of edges in a forest-dominated landscape. *Condor,* **99**:14–24.

FRETWELL, S. D. AND H. L. LUCAS, JR. 1970. On territorial behavior and other factors influencing habitat distribution in birds. *Acta Biotheo.,* **19**:16–36.

HAUBER, M. E. AND S. A. RUSSO. 2000. Perch proximity correlates with higher rates of cowbird parasitism of ground nesting Song Sparrows. *Wilson Bull.,* **112**:150–153.

HERKERT, J. R. 1995. An analysis of Midwestern breeding bird population trends. *Am. Midl. Nat.,* **134**: 41–50.

HERKERT, J. R., D. L. REINKING, D. A. WIEDENFELD, M. WINTER, J. L. ZIMMERMAN, W. E. JENSEN, E. J. FINCK, R. R. KOFORD, D. H. WOLFE, S. K. SHERROD, M. A. JENKINS, J. FAABORG AND S. K. ROBINSON. 2003. Effects of prairie fragmentation on the nest success of breeding birds in the mid-continental United States. *Conserv. Biol.,* **17**:587–594.

HOWARD, M. N., S. K. SKAGEN AND P. L. KENNEDY. 2001. Does habitat fragmentation influence nest predation in the shortgrass prairie? *Condor,* **103**:530–536.

HUGHES, J. P., R. J. ROBEL, K. E. KEMP, AND J. L. ZIMMERMAN. 1999. Effects of habitat on dickcissel abundance and nest success in conservation reserve program fields in Kansas. *J. Wildl. Manage.,* **63**:523–529.

JOHNSON, D. H. 1979. Estimating nest success: the Mayfield method and an alternative. *Auk,* **96**:651–661.

JOHNSON, R. G. AND S. A. TEMPLE. 1986. Assessing habitat quality for birds nesting in fragmented tallgrass prairies, p. 245–249 *In:* J. Verner, M. L. Morrison and C. J. Ralph (eds.). Wildlife 2000:

modeling habitat relationships of terrestrial vertebrates. University of Wisconsin Press, Madison. 470 p.

——— AND ———. 1990. Nest predation and brood parasitism of tallgrass prairie birds. *J. Wildl. Manage.,* **54**:106–111.

KERSHNER, E. L. AND E. K. BOLLINGER. 1998. Low incidence of cowbird parasitism of grassland birds on Illinois airports. *Trans. Ill. State Acad. of Sci.,* **91**:103–107.

KNIGHT, C. L., J. M. BRIGGS AND M. D. NELLIS. 1994. Expansion of gallery forest on Konza Prairie Research Natural Area, Kansas, USA. *Land. Ecol.,* **9**:117–125.

KNOPF, F. L. 1986. Changing landscapes and the cosmopolitism of the eastern Colorado avifauna. *Wildl. Soc. Bull.,* **14**:132–142.

MAYFIELD, H. F. 1965. The brown-headed cowbird with old and new hosts. *Living Bird,* **4**:13–28.

———. 1975. Suggestions for calculating nest success. *Wilson Bull.,* **87**:456–466.

NORMON, R. F. AND R. J. ROBERTSON. 1975. Nest-searching behavior in the brown-headed cowbird. *Auk,* **92**:610–611.

O'LEARY, C. H. AND D. W. NYBERG. 2000. Treelines between fields reduce the density of grassland birds. *Nat. Areas J.,* **20**:243–249.

PATON, P. W. C. 1994. The effect of edge on avian nest success: how strong is the evidence? *Conserv. Biol.,* **8**:17–26.

PETERJOHN, B. G. AND J. R. SAUER. 1999. Population status of North American grassland birds from the North American Breeding Bird Survey, 1966–1996. *Stud. Avian Biol.,* **19**:27–44.

———, ——— AND S. SCHWARZ. 2000. Temporal and geographic patterns in population trends of brown-headed cowbirds, p. 21–34 *In:* J. N. M. Smith, T. L. Cook, S. I. Rothstein, S. K. Robinson and S. G. Sealy (eds.). Ecology and management of cowbirds and their hosts. University of Texas Press, Austin. 388 p.

PIETZ, P. J. AND D. A. GRANFORS. 2000. Identifying predators and fates of grassland passerine nests using miniature video cameras. *J. Wildl. Manage.,* **64**:71–87.

RATTI, J. T. AND K. P. REESE. 1988. Preliminary test of the ecological trap hypothesis. *J. Wildl. Manage.,* **52**:484–491.

ROBINSON, S. K., J. D. BRAWN, S. F. MORSE AND J. R. HERKERT. 1999. Use of different habitats by breeding brown-headed cowbirds in fragmented Midwestern landscapes. *Stud. Avian Biol.,* **18**:52–61.

SAMSON, F. B. AND F. L. KNOPF. 1994. Prairie conservation in North America. *BioSci.,* **44**:418–421.

SMITH, J. N. M. AND I. H. MYERS-SMITH. 1998. Spatial variation in parasitism of song sparrows by brown-headed cowbirds, p. 296–312 *In:* S. I. Rothstein and S. K. Robinson (eds.). Parasitic birds and their hosts: studies in coevolution. Oxford University Press, Oxford. 444 p.

SÖDERSTROM, B., T. PÄRT AND J. RYDÉN. 1998. Different nest predator faunas and nest predation risk on ground and shrub nests at forest ecotones: and experiment and a review. *Oecologia,* **117**: 108–118.

STEINAUER, E. M. AND S. L. COLLINS. 1996. Prairie ecology—the tallgrass prairie, p. 39–52 *In:* F. B. Samson and F. L. Knopf (eds.). Prairie conservation: preserving North America's most endangered ecosystem. Island Press, Washington, D. C. 339 p.

STRAUSBERGER, B. M. AND M. V. ASHLEY. 1997. Community-wide patterns of parasitism of a host "generalist" brood parasitic cowbird. *Oecologica,* **112**:254–262.

SUAREZ, A. V., K. S. PFENNIG AND S. K. ROBINSON. 1997. Nesting success of a disturbance-dependent songbird on different kinds of edges. *Conserv. Biol.,* **11**:928–935.

TEWKSBURY, J. J., S. J. HEJL AND T. E. MARTIN. 1998. Breeding productivity does not decline with increasing fragmentation in a western landscape. *Ecology,* **79**:2890–2903.

VANDER HAEGEN, W. M., M. A. SCHROEDER AND R. M. DEGRAAF. 2002. Predation on real and artificial nests in shrubsteppe landscapes fragmented by agriculture. *Condor,* **104**:496–506.

VICKERY, P. D., M. L. HUNTER, JR. AND J. V. WELLS. 1992. Evidence of incidental nest predation and its effects on nests of threatened grassland birds. *Oikos,* **63**:281–288.

WIENS, J. A. 1963. Aspects of cowbird parasitism in southern Oklahoma. *Wilson Bull.,* **75**:130–139.

WINTER, M. 1999. Nesting biology of dickcissels and Henslow's sparrows in southwestern Missouri prairie fragments. *Wilson Bull.,* **111**:515–527.

———, D. H. JOHNSON AND J. FAABORG. 2000. Evidence for edge effects on multiple levels in tallgrass prairie. *Condor,* **102**:256–266.

ZIMMERMAN, J. L. 1984. Nest predation and its relationship to habitat and nest density in dickcissels. *Condor,* **86**:68–72.

———. 1993. The birds of Konza: the avian ecology of the tallgrass prairie. University Press of Kansas, Lawrence. 186 p.

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