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Source: The Wilson Journal of Ornithology, 122(4):799-803. 2010.
Published By: The Wilson Ornithological Society
DOI: 10.1676/09-203.1
URL: http://www.bioone.org/doi/full/10.1676/09-203.1

The Wilson Journal of Ornithology 122(4):799–803, 2010

Snakes are Important Nest Predators of Dickcissels in an Agricultural Landscape

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ABSTRACT.—We used video cameras to monitor 33 Dickcissel (*Spiza americana*) nests during 2003–2004 in the highly-fragmented, agricultural ecosystem of eastern Nebraska and western Iowa. Nine nests fledged young, 20 were completely depredated, three were partially depredated, and one was abandoned due to ants. Nine snakes, six small mammals, six common raccoons (*Procyon lotor*), two Brown-headed Cowbirds (*Molothrus ater*), and one American mink (*Neovison vison*) were documented as nest predators. These results suggest a diversity of predators is responsible for depredation of Dickcissel nests with snake predation being an important cause of nest failure. *Received 21 December 2009. Accepted 24 May 2010.*

Nest predation is the leading cause of reproductive failure for many bird species across numerous regions and habitats (Martin 1993), and may be an important factor in avian population declines (Heske et al. 2001). Grassland birds are of special concern because they have undergone declines greater than any group of birds in North America (Knopf 1994) and have shown decreasing reproductive rates with increased habitat fragmentation (Herkert et al. 2003). Nearly 80% of grasslands in the Great Plains of North America have been converted to agricultural use, and <4% of the tallgrass prairie remains (Samson and Knopf 1994). Grassland birds nesting in the remaining grasslands often experience low reproductive success due to landscape features in agroecosystems that attract a diversity of nest predators (Bergin et al. 2000).

Previous studies have identified predators of grassland bird nests, but more studies are necessary to understand how predator communities differ among regions and what factors may contribute to these differences (Weatherhead and Blouin-Demers 2004). At least two video studies of nesting birds that have occurred in North American grasslands were in areas that could be considered tallgrass prairie, but were conducted at the edge of the historical tallgrass prairie range. Thompson and Burhans (2003) documented predators of shrub-nesting birds in old fields in Missouri, and Renfrew and Ribic (2003) documented predators of five grassland species in grazed pastures in the Driftless Area of Wisconsin; both studies were conducted along the ecotone with eastern deciduous forests. Pietz and Granfors (2000) studied nest predation on 10 species of grassland passerines and Grant et al. (2006) studied two passerine species in mixed-grass prairie in North Dakota. To date, no studies have been conducted in the highly fragmented, agricultural ecosystem in the core of the former tallgrass prairie biome. Our objective was to identify predators of Dickcissel (*Spiza americana*) nests within small grassland patches interspersed within intensive row crop agriculture. Dickcissels are of conservation concern and have shown

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TABLE 1. Nest predators recorded on video with corresponding number of Dickcissel nests depredated at incubation and nestling stages.

Predator	Incubation	Nestling	# Events
Snakes			
Fox snake (*Elaphe vulpina*)	3	2	5
Plains garter snake (*Thamnophis radix*)	0	2	2
Eastern yellowbelly racer (*Coluber constrictor flaviventris*)	0	1	1
Bullsnake (*Pituophis catenifer*)	1	0	1
Small mammals			
Thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*)	2	1	3
Franklin's ground squirrel (*S. franklinii*)	0	1	1
Cricetid rodent (*Peromyscus* spp.)	2	0	2
Mid-sized mammals			
Common raccoon (*Procyon lotor*)	4	2	6
Other			
Brown-headed cowbird (*Molothrus ater*)	1	1	2
American mink (*Neovison vison*)	0	1	1
Totals	13	11	24

population declines similar to other grassland passerines, but their predator community has not been documented on video. Dickcissels are an ideal model for understanding how nest predator communities vary among regions, landscapes, or habitat types because they inhabit marginal grasslands in extremely fragmented landscapes as well as relatively unfragmented landscapes.

METHODS

We monitored Dickcissel nests at DeSoto National Wildlife Refuge, Boyer Chute National Wildlife Refuge, Allwine Prairie Preserve, Cuming City Cemetery and Nature Preserve, and a privately owned Conservation Reserve Program (CRP) parcel in eastern Nebraska and western Iowa (Klug et al. 2009). The grasslands were managed with prescribed burning but no livestock grazing. Vegetation in the grasslands was either dominated by native warm-season grasses or by exotic cool-season grasses with variation in forb density (Klug 2005). We video-documented predators of Dickcissel nests in 15 grassland fragments ranging from 4 to 45 ha ($\bar{x} \pm$ SE = 20.3 $\pm$ 3.1). The landscape within 1,600 m of grassland fragments included six major land cover types based on the evaluation of orthophotographs in ArcMap GIS (scale of 1:1500) by Klug et al. (2009). We classified the landscape as an agroecosystem because 20–64% ($\bar{x} \pm$ SE = 52.5 $\pm$ 3.9) of the surrounding land was in crop production (e.g., corn or soybeans). Grasslands covered 2–43% ($\bar{x} \pm$ SE = 17.8 $\pm$ 2.5) and trees 6–42% ($\bar{x} \pm$ SE = 15.7 $\pm$ 2.5) of the landscape. Human development covered 0.5–22% ($\bar{x} \pm$ SE = 4.0 $\pm$ 1.7), and roads $<$2% ($\bar{x} \pm$ SE = 1.2 $\pm$ 0.1), whereas wetlands and water bodies covered 1–14% ($\bar{x} \pm$ SE = 5.4 $\pm$ 1.0) of the landscape.

We used 24-hr time-lapse video systems to monitor nests and identify predators removing or consuming eggs and nestlings. We constructed six battery-powered video systems, which included a camera (V-1214-IR Weatherproof Bullet Camera with infrared illumination, Marshall Electronics, El Segundo, CA, USA) attached to a time-lapse video recorder (SSC-960 Time Lapse VCR, Samsung Electronics America Inc., Ridgefield Park, NJ, USA) by 8.5 m of cable (buried under vegetation and litter) and powered by a sealed lead acid battery connected by a power converter (375w PowerVerter, Tripp-Lite World Headquarters, Chicago, IL, USA). The camera was attached to a wood dowel and placed within 10 cm of the nest so the camera was completely obscured by vegetation, but vegetation did not completely obscure the field of view. We minimized disturbance at the nest by setting up the system in $<$20 min between 1000 and 1600 CST, in dry, moderate temperatures. We set up systems during both incubation and nestling stages, but only after females had incubated for 3–5 days to minimize abandonment. Nest contents were checked re-

TABLE 2. Nest predators of grassland passerines documented on video in Nebraska/Iowa, North Dakota, Missouri, and Wisconsin.

Predator	Nebraska Iowa[a]	North Dakota[b]	North Dakota[c]	Missouri[d]	Wisconsin[e]
Snake (*Elaphe vulpina*, *E. obsoleta*, *Thamnophis* spp., *Coluber constrictor*, *Lampropeltis getula*, *L. calligaster*, *Pituophis catenifer*)	9		2	33	3
Common raccoon (*Procyon lotor*)	6		1	4	8
Squirrel (*Spermophilus tridecemlineatus*, *S. franklinii*, *Sciurus niger*)	4	13	11	1	4
Brown-headed Cowbird (*Molothrus ater*)	2	2	5	1	1
Mouse or vole (*Peromyscus* spp., *Zapus* spp., *Microtus* spp.)	2	2	3	2	
Long-tailed weasel/American mink (*Mustela frenata*, *Neovison vison*)	1	1		1	
American badger (*Taxidea taxus*)		2	3		2
Bird of prey (*Buteo* spp., *Circus cyaneus*, *Tyto alba*)		2	1	3	2
Red fox/coyote/domestic dog (*Vulpes vulpes*, *Canis latrans*, *C. lupus familiaris*)		2			1
Domestic cat (*Felis catus*)					1
Striped skunk (*Mephitis mephitis*)					1
Virginia opossum (*Didelphis virginiana*)					1
White-tailed deer (*Odocoileus virginianus*)		2	2		
Unidentified		1	2	1	
Totals	24	27	30	46	24

[a] This study.
[b] Pietz and Granfors (2000).
[c] Grant et al. (2006).
[d] Thompson and Burhans (2003).
[e] Renfrew and Ribic (2003).

motely by attaching a portable monitor to the system every 24 hrs given that the tape ran out after 24 hrs. We archived the tape to identify the predator using a high-resolution monitor and slow motion function if the contents differed from the previous day. We recorded time, nest stage, nest contents, and contents removed for each depredation event.

We estimated daily survival rates (DSR) for nests using Program MARK with the design matrix tools and the logit-link function (Dinsmore et al. 2002), and calculated variance using the Delta method (Powell 2007). We also estimated DSR for nests without video systems to better understand the influence of the equipment on nest survival. Means $\pm$ SE are presented.

RESULTS

We video-monitored 33 nests over 2 years (2003 = 15 nests, 2004 = 18 nests) for 287 observation days during incubation ($n = 148$ days) and nestling ($n = 139$ days) stages. Nests were monitored an average of 12.9 $\pm$ 1.0 days. We placed cameras at 19 nests that recorded both incubation and nestling stages, 11 nests during the incubation stage only, and three nests during the nestling stage only. The DSR of nests monitored with video was 0.946 $\pm$ 0.01 for an overall survival of 0.333 $\pm$ 0.07 if we extrapolated to a 20-day nesting cycle (i.e., the average length of a Dickcissel nesting cycle). The probability of predation for nests with cameras was similar to nests not monitored with video systems (DSR = 0.934 $\pm$ 0.005, overall survival rate = 0.255 $\pm$ 0.03). Twenty of the nests monitored completely failed due to depredation, three nests were partially depredated before eventual fledging of young, nine nests fledged young with no depredation, and one nest was abandoned after an ant infestation.

Nine snakes, six small mammals, six common raccoons (*Procyon lotor*), two Brown-headed Cowbirds (*Molothrus ater*), and one American mink (*Neovison vison*) were documented as nest predators (Table 1). We documented one instance of a multiple predation at one nest (i.e., a Brown-headed Cowbird removed three Dickcissel eggs prior to a thirteen-lined ground squirrel [*Spermophilus tridecemlineatus*] consuming the remaining 2 Brown-headed Cowbird and 1 Dickcissel egg). We documented partial predation by a fox snake (*Elaphe vulpina*) late in the nesting cycle at two nests, which caused the surviving nestlings to fledge prematurely. A fox snake at another nest was documented consuming one egg and leaving three, which later hatched and fledged. We observed one female Brown-headed Cowbird removing Dickcissel nestlings without laying eggs. We recorded 13 and 11 depredations at the incubation and nestling stages, respectively (Table 1). Depredation by cricetid rodents and raccoons were nocturnal, whereas depredation by ground squirrels, mink, and cowbirds were diurnal. All depredations by snakes were diurnal except two by fox snakes, which were nocturnal.

DISCUSSION

The potential predator community in agricultural systems is diverse; thus, the composition of the community, and identity of the dominant predator, will ultimately dictate nest predation risk (Klug et al. 2009). We found at least 10 species responsible for predation of Dickcissel nests, including both obligate grassland species (e.g., ground squirrels and snakes) and more wide-ranging habitat generalists (e.g., common raccoon and Brown-headed Cowbird; Table 1). Our sample size of video-monitored nests ($n = 33$) is consistent with other studies in the grasslands of North America (Table 2), but it is likely that additional predator species would be detected with a larger sample size. For example, striped skunk (*Mephitis mephitis*), Virginia opossum (*Didelphis virginiana*), American Crow (*Corvus brachyrhynchos*), and coyote (*Canis latrans*) have been documented as nest predators (Renfrew and Ribic 2003, Peterson et al. 2004, Staller et al. 2005), but were not documented at our study sites regardless of their presence on predator surveys (Klug et al. 2009). However, given the consistency of snake events across years, it is unlikely a larger sample would change our conclusion that snakes are among the most important nest predators for grassland birds in this region.

Information about the predator community is important for understanding variation in nest predation and to increase productivity of nesting birds (Lahti 2009). However, recognizing the importance of the predator community also brings challenges. Studies that document predation of grassland bird nests consistently discover wide-ranging generalist predators including Brown-headed Cowbird and common raccoon. Thus, efforts directed at increasing reproductive success of birds have often focused on decreasing the population size of species that have increased due to agricultural land use (Heske et al. 1999, Kosciuch and Sandercock 2008). Our study, and other nest predation studies in grassland habitats, has revealed considerable nest predation by snakes and ground squirrels, which are essential members of prairie communities (Table 2). Recommendations directed at decreasing the influence of resident predators in grasslands where birds are nesting are not straightforward given that many of these species are also targets of conservation. For example, fox snakes and Franklin's ground squirrels (*Spermophilus franklinii*) are native members of the tallgrass prairie (Martin et al. 2003) and efforts to control these predators to increase bird populations must proceed with caution.

ACKNOWLEDGMENTS

We thank the staff of Boyer Chute and DeSoto National Wildlife refuges for their support. We also thank the American Museum of Natural History Frank M. Chapman Memorial Fund, Sigma Xi Grants-In-Aid of Research, Center for Great Plains Studies Grant-In-Aid for Graduate Students, University of Nebraska at Omaha, USDA Biotechnology Risk Assessment Research Grants Program, and the U.S. Fish and Wildlife Service for financial support.

LITERATURE CITED

BERGIN, T. M., L. B. BEST, K. E. FREEMARK, AND K. J. KOEHLER. 2000. Effects of landscape structure on nest predation in roadsides of a midwestern agroecosystem: a multiscale analysis. Landscape Ecology 15:131–143.

DINSMORE, S. J., G. C. WHITE, AND F. L. KNOPF. 2002. Advanced techniques for modeling avian nest survival. Ecology 83:3476–3488.

GRANT, T. A., E. M. MADDEN, T. L. SHAFFER, P. J. PIETZ, G. B. BERKEY, AND N. J. KADRMAS. 2006. Nest survival of Clay-Colored and Vesper sparrows in relation to woodland edge in mixed-grass prairies. Journal of Wildlife Management 70:691–701.

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 midcontinental United States. Conservation Biology 17:587–594.

HESKE, E. J., S. K. ROBINSON, AND J. D. BRAWN. 1999. Predator activity and predation on songbird nests on forest-field edges in east-central Illinois. Landscape Ecology 14:345–354.

HESKE, E. J., S. K. ROBINSON, AND J. D. BRAWN. 2001. Nest predation and neotropical migrant songbirds: piecing together the fragments. Wildlife Society Bulletin 29:52–61.

KLUG, P. E. 2005. The effects of local grassland habitat and surrounding landscape composition on the predators of grassland bird nests. Thesis. University of Nebraska, Omaha, USA.

KLUG, P., L. L. WOLFENBARGER, AND J. P. MCCARTY. 2009. The nest predator community of grassland birds responds to agroecosystem habitat at multiple scales. Ecography 32:973–982.

KNOPF, F. L. 1994. Avian assemblages on altered grasslands. Studies in Avian Biology 15:247–257.

KOSCIUCH, K. L. AND B. K. SANDERCOCK. 2008. Cowbird removals unexpectedly increase productivity of a brood parasite and the songbird host. Ecological Applications 18:537–548.

LAHTI, D. 2009. Why we have been unable to generalize about bird nest predation. Animal Conservation 12:279–281.

MARTIN, J. M., E. J. HESKE, AND J. E. HOFMANN. 2003. Franklin's ground squirrel (*Spermophilus franklinii*) in Illinois: a declining prairie mammal? American Midland Naturalist 150:130–138.

MARTIN, T. E. 1993. Nest predation and nest sites. Bioscience 43:523–533.

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

PETERSON, B. L., B. E. KUS, AND D. H. DEUTSCHMAN. 2004. Determining nest predators of the Least Bell's Vireo through point counts, tracking stations, and videophotography. Journal of Field Ornithology 75:89–95.

POWELL, L. 2007. Approximating variance of demographic parameters using the delta method: a reference for avian biologists. Condor 109:949–954.

RENFREW, R. B. AND C. A. RIBIC. 2003. Grassland passerine nest predators near pasture edges identified on videotape. Auk 120:371–383.

SAMSON, F. AND F. KNOPF. 1994. Prairie conservation in North America. Bioscience 44:418–423.

STALLER, E., W. PALMER, J. CARROLL, R. THORNTON, AND D. SISSON. 2005. Identifying predators at Northern Bobwhite nests. Journal of Wildlife Management 69:124–132.

THOMPSON III, F. R. AND D. E. BURHANS. 2003. Predation of songbird nests differs by predator and between field and forest habitats. Journal of Wildlife Management 67:408–416.

WEATHERHEAD, P. J. AND G. BLOUIN-DEMERS. 2004. Understanding avian nest predation: why ornithologists should study snakes. Journal of Avian Biology 35:185–190.