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DOES PREDATOR ASSEMBLAGE AFFECT REPRODUCTIVE SUCCESS IN SONGBIRDS?[1]

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Various factors affect nest success in altricial birds, although predation is usually the most important cause of reproductive failure (Nice 1957; Ricklefs 1969; Martin 1992a; Martin, in Press). Nest predation may be influenced by various factors including nest density, concealment, type (open cavity), location (ground, arboreal), distribution (clumped, dispersed), and defense by adults. In addition, predator type (bird, mammal, reptile) can also play an important role in nest-success rates (Martin 1987, Clark and Nudds 1991).

During a three-year study on nesting Savannah Sparrows (*Passerculus sandwichensis*) in central Alaska, 129 of 130 nesting attempts were successful. The almost complete absence of nest predation in a ground-nesting Passerine for which a relatively large number of nests were found during a multi-year study is atypical (Nice 1957, Ricklefs 1969, Martin 1992a). We suggest that the type of predators found in our area may explain this low rate of nest predation.

METHODS

We conducted our study during the summers (25 May–25 July) of 1990–1992 on the Delta Agriculture Project which covers approximately 44,500 ha and is located south of the Tanana River, extending approximately 150 km east of Delta Junction, Alaska (64°00′ N 145°20′ W). The Delta Agriculture Project is a mosaic of different-aged fields cleared from the surrounding forest of black spruce (*Picea mariana*), white spruce (*Picea glauca*), and aspen (*Populus tremuloides*). Cereals (mainly barley), grass seed, and hay are grown on approximately 8,900 ha; the remainder is idle or in government set-aside programs. We selected two idle sites, each comprising approximately 150 ha, and representative of the area's non-agricultural grassland vegetation. Although Sharp-tailed Grouse (*Tympanuchus phasianellus*), White-crowned Sparrows (*Zonotrichia leucophrys*), and Lincoln's Sparrows (*Melospiza lincolnii*) utilized the forest/grassland edge, we found only Savannah Sparrows nesting in the grassland interiors (Miller 1993).

Nests were located by dragging a heavy rope over the grass or incidentally while walking through the area and flushing adults from nests. Following discovery nests were visited daily until the first egg hatched then revisited four and seven days later. Nestlings typically fledged 8–9 days posthatch. A nest was considered successful if at least one nestling fledged from that nest. As a basis for comparison with our findings we reviewed the literature for North American studies which reported nesting success of open-nesting Passerines, predation rates, and potential nest predators (Table 1). Nest predation rates were computed as the number of nests depredated/total nests observed. Potential predators in our study area were determined from sightings and previous research (MacDonald, unpubl. report).

RESULTS

We had only one instance of nest predation during the three-year study (99% nests successful). Our literature review indicated how variable predation rates of Passerines in temperate areas can be (Table 1). The absence of certain predators, most conspicuously snakes and raccoons (*Procyon lotor*), coincided with studies which reported low (<25%) nest-predation rates. Although our study area had a diverse array of potential nest predators, snakes and raccoons did not occur (Table 1).

DISCUSSION

Ground-nesting Passerines in shrub and grassland habitats experience greater nest predation than birds with other nest-site placements and in other nesting habitats (Martin, in press). In addition, as forests become fragmented and intermixed with agricultural lands, nest predation is expected to increase (Angelstam 1986, Andrén 1992, Martin 1992b). In spite of these two generalizations, Savannah Sparrows in our three-year study were nearly exempt from nest predation even with a diverse avian and mammalian predator assemblage. We suggest two reasons for our findings. First, the predator assemblage in our study did not include species which are normally associated with high nest-predation rates (e.g., snakes, raccoons, corvids). Second, the boreal forest predators in our region do not normally forage in large grassland openings. For example, Common Ravens (*Corvus corax*) in boreal forest ecosystems are mainly restricted to foraging in large woodlands (Angelstam 1986, Andrén 1992).

The divergent findings we report corroborate what others have said regarding the importance of under-

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TABLE 1. Predation rates of passerines and associated predator assemblages.[1]

Source	Species	% Predation (*n*)[2]	Habitat	Raptor spp.	Gull spp.	Owl spp.	Blue Jay	Crow spp.	Raven	Snake spp.	Opossum	Raccoon	Mustelidae	Fox spp.	Wolf, coyote	House cat	Squirrel spp.	Mouse, vole	Other
Rotenberry and Weins 1989	Brewer's Sparrow	100.0 (4)	sagebrush						X	X			X				X		
	Spizella breweri	11.4 (35)[3]							X				X				X		
Rotenberry and Weins 1989	Sage Sparrow	92.0 (11)	sagebrush						X	X			X				X		
	Amphispiza belli	40.0 (15)							X	X			X				X		
		0.0 (11)[3]							X				X				X		
Nolan 1963	Yellow-breasted Chat	89.5 (19)	grass/shrub				X	X		X	X	X	X	X			X	X	
	Icteria virens																		
Nolan 1963	Cardinal	80.0 (10)	grass/shrub				X	X		X	X	X	X	X			X	X	
	Cardinalis cardinalis																		
Best 1978	Field Sparrow	76.2 (112)	grassland							X	X	X		X		X			X
	Spizella pusilla																		
Nolan 1963	Field Sparrow	69.7 (33)	grass/shrub				X	X		X	X	X	X	X			X	X	
	Spizella pusilla																		
Nolan 1963	American Goldfinch	66.7 (24)	grass/shrub				X	X		X	X	X	X	X			X	X	
	Carduelis tristis																		
Nolan 1963	Indigo Bunting	60.0 (10)	grass/shrub				X	X		X	X	X	X	X			X	X	
	Passerina cyanea																		
Strehl and White 1986	Red-winged Blackbird	57.0 (384)	marsh							X		X					X		
	Agelaius phoeniceus																		
Wray et al. 1982	Grasshopper Sparrow	56.9 (51)	grassland					X		X									
	Ammodramus savannarum																		
Wray et al. 1982	Vesper Sparrow	54.3 (70)	grassland					X		X									
	Pooecetes gramineus																		
Dixon 1978	Savannah Sparrow	50.5 (398)	grassland		X			X											
	Passerculus sandwichensis																		
Shipley 1979	Red-winged Blackbird	50.5 (194)	marsh							X		X	X						
	Agelaius phoeniceus																		
Nolan 1963	Prairie Warbler	45.5 (55)	grass/shrub				X	X		X	X	X	X	X			X	X	
	Dendroica discolor																		
Joern and Jackson 1983	Mockingbird	43.5 (108)	grass/shrub				X	X		X	X	X				X	X		
	Mimus polyglottos																		

TABLE 1. Continued.

Source	Species	% Predation (n)[2]	Habitat	Raptor spp.	Gull spp.	Owl spp.	Blue Jay	Crow spp.	Raven	Snake spp.	Opossum	Raccoon	Mustelidae	Fox spp.	Wolf, coyote	House cat	Squirrel spp.	Mouse, vole	Other
Wray et al. 1982	Savannah Sparrow *Passerculus sandwichensis*	36.6 (41)	grassland					X		X									
Wray et al. 1982	Field Sparrow *Spizella pusilla*	34.8 (23)	grassland					X		X									
Robertson 1972	Red-winged Blackbird *Agelaius phoeniceus*	32.9 (900)	marsh	X			X	X		X	X	X	X	X		X			X
Smith and Anderson 1982	Dark-eyed Junco *Junco hyemalis*	32.4 (74)	subalpine meadow/ forest										X				X	X	
LaPointe and Bédard 1986	Savannah Sparrow *Passerculus sandwichensis*	22.4 (214)	marsh/grassland					X					X			X			
Holmes et al. 1992	Black-throated Blue Warbler *Dendroica caerulescens*	22.0 (125)	forest				X										X		
Marshall and Reinert 1990	Seaside Sparrow *Ammodramus maritimus*	11.0 (60)	marsh					X											X
Ross 1980	Savannah Sparrow *Passerculus sandwichensis*	4.8 (156)	grassland		X														X
This study	Savannah Sparrow *Passerculus sandwichensis*	1.0 (130)	grassland	X		X			X				X	X	X			X	

[1] Scientific names of predator species listed in the table; *Cyanocitta cristata, Corvus corax, Didelphis virginiana, Procyon lotor, Felis silvestris.*
[2] Number of nests observed.
[3] This study site had no snakes.

standing life-history traits to fully assess the vulnerability of species to regional differences in land-use patterns (Martin, in press; Hansen and Urban 1992).

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LITERATURE CITED

ANDRÉN, H. 1992. Corvid density and nest predation in relation to forest fragmentation: a landscape perspective. Ecology 73:794–804.

ANGELSTAM, P. 1986. Predation on ground-nesting birds' nests in relation to predator densities and habitat edge. Oikos 47:365–373.

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

CLARK, R. G., AND T. D. NUDDS. 1991. Habitat patch size and duck nesting success: the crucial experiments have not been performed. Wildl. Soc. Bull. 19:534–543.

DIXON, C. L. 1978. Breeding biology of the Savannah Sparrow on Kent Island. Auk 95:235–246.

HANSEN, A. J., AND D. L. URBAN. 1992. Avian responses to landscape pattern: The role of species' life histories. Land. Ecol. 7:163–180.

HOLMES, R. T., T. W. SHERRY, P. P. MARRA, AND K. E. PETIT. 1992. Multiple brooding and productivity of a neotropical migrant, the Black-throated Blue Warbler (*Dendrocia caerulescens*), in an unfragmented temperate forest. Auk 109:321–333.

JOERN, W. T., AND J. F. JACKSON. 1983. Homogeneity of vegetational cover around the nest and avoidance of nest predation in Mockingbirds. Auk 100: 497–499.

LAPOINTE, G., AND J. BÉDARD. 1986. Savannah Sparrow, *Passerculus sandwichensis,* reproductive success. Can. Field Nat. 100:264–267.

MARSHALL, R. M., AND S. E. REINERT. 1990. Breeding ecology of Seaside Sparrows in a massachusetts salt marsh. Wilson Bull. 102:501–513.

MARTIN, T. E. 1987. Artificial nest experiments: effects of nest appearance and type of predator. Condor 89:925–928.

MARTIN, T. E. 1992a. Breeding productivity considerations: What are the appropriate habitat features for management? *In* J. M. Hagan and D. W. Johnston [eds.], Ecology and conservation of neotropical migrant landbirds. Smithsonian Institution Press, Washington, DC.

MARTIN, T. E. 1992b. Landscape considerations for viable populations and biological diversity. Trans. N. Am. Wildl. Nat. Res. Conf. 57:283–291.

MARTIN, T. E. In Press. Nest predation among vegetation layers and habitat types: revising the dogma. Amer. Nat.

MILLER, C. K. 1993. Responses of nesting Savannah Sparrows to fluctuations in grasshopper densities in interior Alaska. M.S. thesis. Colorado State Univ. Fort Collins, CO.

NICE, M. M. 1957. Nesting success in altricial birds. Auk 74:305–321.

NOLAN, V., JR. 1963. Reproductive success of birds in a deciduous scrub habitat. Ecology 44:305–313.

RICKLEFS, R. E. 1969. An analysis of nesting mortality in birds. Smithsonian Contributions in Zoology 9:1–48.

ROBERTSON, R. J. 1972. Optimal niche space of the Red-winged Blackbird (*Agelaius phoeniceus*). I. Nesting success in marsh and upland habitat. Can. J. Zool. 50:247–263.

ROSS, H. A. 1980. The reproductive rates of yearling and older Ipswich Sparrows, *Passerculus sandwichensis princeps.* Can. J. Zool. 58:1557–1563.

ROTENBERRY, J. T., AND J. A. WIENS. 1989. Reproductive biology of shrubsteppe passerine birds: geographical and temporal variation in clutch size, brood size, and fledging success. Condor 91:1–14.

SHIPLEY, F. S. 1979. Predation on Red-winged Blackbird eggs and nestlings. Wilson Bull. 91:426–433.

SMITH, K. G., AND D. C. ANDERSEN. 1982. Food, predation, and reproductive ecology of the Dark-eyed Junco in northern Utah. Auk 99:650–661.

STREHL, C. E., AND J. WHITE. 1986. Effects of superabundant food on breeding success and behavior of the Red-winged Blackbird. Oecologia 70:178–186.

WRAY, T., II, K. A. STRAIT, AND R. C. WHITMORE. 1982. Reproductive success of grassland sparrows on a reclaimed surface mine in West Virginia. Auk 99:157–164.