

Effects Of Roadside Management Practices On Bird Richness And Reproduction

James D. Paruk¹
Northern Illinois University
Department of Biological Sciences
DeKalb, IL 60115

¹Present address
Yosemite Institute
P.O. Box 487
Yosemite, CA 95389

ABSTRACT

More attention is being given to managing highway rights-of-ways (ROW) for wildlife in Illinois as most of the remaining natural habitats have been greatly altered or eliminated. The Illinois Department of Conservation (IDOC) established a Roadsides for Wildlife Program to enhance the use of roadsides by wildlife (primarily nesting pheasants). The IDOC and Illinois Department of Transportation agreed to cooperate in some areas of the state to improve conditions for wildlife by reducing roadside mowing, by planting shrubs and trees and/or seeding brome/alfalfa within the ROW. The objectives of this study were to: 1) compare avifauna richness, nesting density and reproductive success among managed and unmanaged ROW areas; 2) determine the effect woody vegetation plantings have on avifaunal parameters and 3) compare densities among managed and unmanaged ROW's with previously reported values for similar habitat types (grasslands, fencerows) to assess the importance of ROW's as avifauna habitat.

Nine species of birds were recorded in the ROW. Of these, only one, the red-winged blackbird (*Agelaius phoeniceus*) was abundant. Managed plots (brome/alfalfa) have more birds (albeit red-winged blackbirds), greater species richness, and higher nesting densities than unmanaged (fescue) plots. Woody

vegetation within the ROW's increased abundance and nesting densities, but not species richness. Six species of birds nested in the ROW, however, 92.9% of all nests were red-winged blackbirds. Managed plots had a significantly higher nesting density than unmanaged plots. There was no difference in rates of reproductive success rates of birds in managed and unmanaged areas.

The roadside wildlife management practices initiated by IDOT have benefitted avifauna to a limited extent. In terms of wildlife habitat ROW's are not the panacea for loss of habitats throughout the state, and more efforts are needed to aid the declining songbird populations in the state. At present, only the red-winged blackbird, a generalist, is adapting to this relatively young evolutionary ecological niche.

INTRODUCTION

There is growing interest on the part of both public and government groups regarding both the harmful and beneficial effects of highway rights-of-way (ROW) and their management. Several authors (Joselyn et al. 1968, Leedy 1975, Michael et al. 1976, Adams and Geis 1981) have concluded that most people, including some wildlife biologists, do not recognize or appreciate the potential value of ROW's as wildlife habitat.

The exact amount of land used by highway ROW's in the United States is unknown, but a minimum estimate is around 20 million acres (8.4 million ha) (Leedy and Adams 1982). Nationwide there is an area nearly equal to the state of Illinois in highway ROW's. An area this large is worthy of serious consideration in wildlife management, but we must know which species will be benefitted or unaffected by the availability of roadside habitat.

Little effort has been directed at managing ROW vegetation specifically for wildlife (Leedy 1975, Machan 1975). Traditional maintenance procedures consist primarily of mowing, herbicidal spraying (Voorhees and Cassel 1980) and removal of woody vegetation. These procedures are selected primarily on the basis of their vehicle safety and "beautification." More imaginative roadside management practices, however, consider wildlife and advocate no or delayed mowing, seeding wildlife ground covers, and planting small trees and shrubs within the ROW. A complete management plan, however, should take into account both the public's safety and augmentation of habitat available to wildlife. Few studies have examined the effects different ground covers and shrub/tree plantings have on songbird populations within the ROW. The purpose of this study was to determine to what extent birds use ROW with differing wildlife cover.

STUDY AREA

The study area is located in northwestern Illinois (Whiteside County) along Interstate Highway 88 (I-88) between the cities of Rock Falls and Erie. I-88 is a 4-lane divided highway that extends east-west across the northern state. Construction of the highway in Whiteside county began in 1973 and was completed in 1976. The study area, however, was opened to traffic in 1975.

Managed plots were seeded (1973-1976) to a hungarian brome (*Bromis inermis*) /alfalfa (*Medicago sativa*) mixture and unmanaged plots were seeded

(1973-1976) to tall fescue (*Festuca elatior*) (D. Wandell, IDOT, pers. comm.). Eight effective height measurements were taken randomly from each plot in May and August of both years and averaged. The average effective height (a measure of height density, Wiens 1969) was 36.1 cm and 8.8 cm for brome/alfalfa and fescue plots, respectively. Trees, shrubs and woody vines were planted between the entire I-88 ROW from Rock Falls to Erie from 1976 through 1985 (except 1977-79 and 1984) by IDOT personnel. The major species planted in decreasing order of abundance during those years included honeysuckle (*Lonicera* sp.; N=8,300), autumn olive (*Elaeagnus umbellata*; N=5,500), red pine (*Pinus resinosa*; N=3,500), gray dogwood (*Cornus racemosa*; N=3,000), and wild grape (*Vitis riparia*; 3,000). These woody coverings, however, were not equally represented in my study area. Shrubs were present in 6 of the 15 ROW plots (40%). The dominant (over 90%) shrub/tree within the ROW was honeysuckle. It made up less than 15% of the total cover in plots in which it occurred. The plantings were in double rows spaced approximately 2 m apart (east to west) and 1.5 m (north to south). Most of the honeysuckle was mature between 2 and 3 m tall. Wild grape was common along fencerows, but other woody vegetation plantings were in low abundance. Since the initial seeding, the ROW has not been mowed, with the exception of a 3.3 m wide (2 mower swaths) strip closest to the road edge.

The commonest adjacent habitat type was agriculture. Approximately 90% of the adjacent habitats between Rock Falls and Erie were rowcropped for either corn (*Zea mays*) or soybeans (*Glycine max*), much of it fall plowed. Three other habitat types were also categorized: wooded, brush seral, and wetland. The wooded habitat consisted of a long narrow (30 m) wide tract of abandoned railroad ROW (RROW) consisting of relatively young (< 50 yrs) woody trees. Black locust (*Robinia pseudoacacia*), hackberry (*Celtis occidentalis*) and black cherry (*Prunus serotina*) were the dominant tree species. Behind this RROW was an extensive rowcrop of corn. Brush seral was covered with shrubs (honeysuckle and hawthorn (*Crataegus* spp.)) with intermittent areas of grass (fescue and bluegrass (*Poa* spp.) and mature trees (boxelder (*Acer negundo*) and white ash (*Fraxinus americanus*). These areas were 60 m and 100 m wide, (perpendicular to the ROW) respectively. Fields behind these areas were seeded to corn. Wetland was characterized by borrow pits with shoreline covered with willows (*Salix* spp.), but usually having emergent vegetation such as cattails (*Typha* spp.) and sedges (*Carex* spp.).

METHODS

A total of 6,710 m of roadside was studied (8.5 ha managed and 6.7 ha unmanaged). Fifteen linear plots from the road edge to the fence line, (which was used to delineate the ROW from the adjacent habitat) along I-88 were surveyed for avifauna use between 3 April and 2 August in 1985 and 1986. This period included the peak nesting months for nearly all bird species likely to use roadsides (Graber and Graber 1963).

Plot lengths ranged from 120 to 900 m ($x_{avg}=447$). These lengths were chosen so as to correspond with associated adjacent habitat types. For example,

in the entire study area brush seral habitat bordered the ROW in only two locations (300 and 120 m long, respectively). Thus, brush seral total coverage was 420 m long. Similarly, wooded and wetland sections were selected (850 m and 1840 m, respectively). The majority of the plots were adjacent to agriculture (3,600 m) because it was the dominant adjacent habitat. Plot width (range 19.0-28.4 m, $x_{avg}=22.5$) varied according to the width of the ROW.

Bird Survey

The author conducted bird surveys 2-3 days each week from 3 April through 14 July and, thereafter, once a week until 2 August 1985 and 1986. Surveys were conducted by walking slowly along a transect line within the ROW, halfway between the road edge and fence line. Frequent stops were made to record data or to look and listen. All birds seen, heard or both, regardless of distance from the ROW, (estimates of distances were made of birds in adjacent habitat) were recorded if I thought they were using the roadside or adjacent habitat. Birds flying overhead were not counted unless I thought they were entering or leaving the adjacent habitat. Three-minute stops were taken at 75 m intervals to give shy birds a chance to be detected. Counts were made under conditions of good visibility, little or no precipitation, and winds < 19 km/hr. Surveys (92%) began within 15 minutes of local sunrise and continued for 4-4.5 hours (time required to complete at least half of the study plots).

Birds recorded on more than 3 censuses (after 1 May of both years) within the ROW or the adjacent habitats were considered as using either the adjacent habitat, the ROW, or both as nesting or foraging habitat. This procedure (i.e., using > 3 censuses after 1 May to establish residency) was arbitrarily chosen to exclude infrequent visitors or transients from the list of breeding or potentially breeding species.

Nest Survey

The entire area between the road edge and fence line (ROW) was thoroughly searched for bird nests once or twice a week from 26 April through 1 August of both years with the aid of a field assistant(s). Nests were identified, the location plotted, nesting success rates were calculated, and the types of nest substrate recorded.

RESULTS

Number of Species

Thirty-nine bird species (Table 1) were recorded on more than 3 censuses after 1 May of both years and were considered to be breeding, foraging, or both in the ROW or adjacent habitats. The ROW plots had fewer species ($N=9$, 23.1%) than the adjacent habitats during the 2-year study ($N=39$; 100.0%.; Table 1).

Managed plots without woody cover ($n=4$) had more species ($N=9$) than unmanaged plots ($n=3$; $N=4$) (Table 2). These differences though were not significant ($t=1.281$, $df=5$, $p>0.10$). There was no significant difference ($t=0.696$, $df=9$, $p>0.50$) in number of species between plots with and without woody vegetation. Managed ($n=3$) and unmanaged ($n=1$) plots with shrubs had 9 and 3 species, respectively. These differences were not statistically tested as there was no replicate for fescue plots. It appears that the presence of woody vegetation increases the number of species within ROW.

Number of species/1000 m ROW surveyed was greater in adjacent habitats which had more vertical structuring. Although adjacent agricultural habitat had 18 species (wooded 25, brush seral 16, wetland 14) (Table 1) this I believe was due to a more intensive sampling effort (53.6% of all adjacent habitats were agricultural in contrast to 27.4% wetland, 12.7% wooded, and 6.3% brush seral). When the number of species is calculated per 1000 m of ROW surveyed brush seral and wooded habitats had significantly greater species diversity ($x_{avg}=5.0$ and 3.7 species, respectively) than wetland ($x_{avg}=1.6$) or agricultural $x_{avg}=0.8$) adjacent habitats (Student-Newman Keuls, $p=0.05$).

Numerical Abundance

Of the nine species of birds recorded in the ROW habitat, only the red-winged blackbird (*Agelaius phoeniceus*) was abundant (28 individuals/1000 m ROW). The other 8 species recorded the ROW were in low abundance, i.e., < 3 individuals per 1000 m ROW (Table 2).

Managed plots had significantly ($t=3.371$, $df=7$, $p<0.01$) more ($x_{avg}=19.3$) individuals per 1000 m of ROW's censused than unmanaged ($x_{avg}=5.3$) plots (Table 2). Similarly, plots with woody cover had significantly ($t=5.356$, $df=11$, $p<0.01$) more individuals (all species, but predominantly red-winged blackbirds) per 1000 m ROW's censused ($x_{avg}=16.0$) than non-woody plots ($x_{avg}=10.0$).

Six species of birds were recorded as having high abundance and were positively influenced (i.e., located within 20 m of ROW) by the edge habitat created between the ROW and the adjacent habitats. These species include the red-winged blackbird, common grackle (*Quiscalus quiscula*), song sparrow, (*Melospiza melodia*), american robin (*Turdus migratorius*), common yellowthroat (*Geothlypis trichas*), and indigo bunting (*Passerina cyanea*) (Table 1). The red-winged blackbird was by far the most abundant bird in the study area (Table 1).

Nest Survey

During the 2-year investigation, 383 nests with at least 1 egg were found. The majority of all nests (84.5%) were found beyond 15.1 m of the roadedge. Ninety-percent of all nests in woody vegetation were in honeysuckle. Eleven other woody species were used for nest construction. Only 6 species of birds nested in the ROW in 1985, and 5 of these (83.3%) nested there again in 1986. Of these, only 1 species, the red-winged blackbird, used the ROW

extensively (Table 3). There were significantly ($X^2=25.504$, $p<0.01$) more red-winged blackbird nests ($N=356$, 92.9%) within the ROW during the 2-year period than all other species combined.

Managed plots had significantly ($t=3.78$, $df=14$, $p<0.01$) more nest/ha than unmanaged plots (9.1 vs. 0.7, respectively; Table 3). Plots with woody cover had significantly ($t=3.13$, $df=26$, $p<0.01$) more nests/ha than non-woody plots ($N=17.7$ vs. 7.0, respectively). Moreover, shrub plots also had a greater diversity of nesting species ($N=6$) than grass plots ($N=3$).

Because the sampling sites were small for all bird species except red-winged blackbirds, reproductive success rates were calculated for the latter only. Reproductive success as defined by Smith (1943:195) is the ratio of young fledged to eggs laid. There was no statistical difference ($p<0.10$) in reproductive success between red-wings nesting in woody vegetation (55.4%) or grass substrates (51.8%). Reproductive success could not be compared between managed and unmanaged plots as only 2 red-winged blackbird nests were found in the latter.

DISCUSSION

Number of Species

Previous roadside studies (Machan 1975, Roach and Kirkpatrick 1985) demonstrated that woody plantings within highway ROW's increase bird species diversity. Moreover, they showed that managed highway ROW's (i.e., with shrub and tree plantings) have greater species diversity than unmanaged roadsides. Machan (1975) observed 34 bird species in managed wooded plots in contrast to 20 species in grass plots along an Indiana ROW. Similarly, Roach and Kirkpatrick (1985) in Indiana observed 25 and 17 species in wooded and grass plots, respectively. In this study, however, shrub plots, which are the equivalent of managed plots, did not have significantly more species ($N=9$) than grass plots ($N=7$). The major reason for this discrepancy may be the lack of suitable adjacent cover in the study area. As mentioned previously, approximately 90% of the adjacent habitats in the study area were intensively rowcropped. The other studies did not have as much adjacent agricultural habitat and this may be why they were able to detect a difference. I suspect poor quality adjacent habitat is the main reason I did not detect any differences in number of species between managed and unmanaged plots.

Numerical Abundance

Plots with woody vegetation had significantly more birds than grass plots (Table 2). Several investigators have reported similar findings (Wandall 1948, Machan 1975, Arnold 1983, Best 1983, Roach and Kirkpatrick 1985). Machan (1975) and Roach and Kirkpatrick (1985) had 3.2 and 2.4 times more birds in woody than grass plots, respectively. My results agree with these previous studies as I found 1.6 times more birds in woody than grass plots. Thus, shrub

plantings within the ROW do increase the numerical abundance of birds (albeit mostly red-winged blackbirds) using this habitat.

In the absence of woody vegetation, managed plots had 3.6 times more birds than unmanaged plots. Similar findings have been reported by Warner (1985). Fescue is a traditional grass that many highway departments use to seed new sections of ROW. It is used because of its low cost, ease of establishment and erosion control benefits. Fescue is not a very dense growing grass; its average effective height was only 8.8 cm as compared to 36.1 for brome/alfalfa. Evidence from this study and those cited above document that fescue does not provide suitable avifauna cover. Roadside managers should discontinue seeding fescue along new sections of highway, and search for ways to attract birds in sections which have already been established to fescue (perhaps reseeding to brome/alfalfa).

Nest Survey

Only 6 species of birds nested in the ROW during the 2-year study. Previous investigators (Hengenrader 1962, Machan 1975, David and Warner 1981, Roach and Kirkpatrick 1985), however, reported at least 16 additional species of birds nesting within ROW's. In addition, at least 6 species of waterfowl (Oetting and Cassell 1971) and the Ring-necked Pheasant (Joselyn et al. 1968) are known to nest in ROW habitats. The above results indicate that managed highway ROW's can attract a relatively large diversity of nesting songbird species. I suspect the main reason for low diversity of nesting birds in my area was due to adjacent habitats largely being agricultural rowcrops. This leads me to believe that species abundance and diversity in ROW's are largely a function of the quality of adjacent habitat. Warner (1979) recognized that ROW management for wildlife in Illinois may depend on whether suitable adjacent cover, such as small grain or hay is present. It would be interesting to see if nesting diversity is correlated with quality of adjacent habitat.

For example, red-winged blackbird nests comprised 92.9% of all nests found during the 2-year study. Warner (1980, 1981) found that 85-95% of the songbird nests along two interstate ROW's adjacent to rowcrops in east-central Illinois were those of red-winged blackbirds. Roach and Kirkpatrick (1985) reported approximately 60% of the songbird nests in an Indiana ROW were red-winged blackbirds. Based on the above studies, it appears that only the red-winged blackbird will utilize ROW habitat extensively for nesting.

I found 383 nests of 6 species of birds. Plots with woody vegetation averaged 17.7 nests/ha (16.1 nests/ha by red-winged blackbirds). Grass plots seeded to brome/alfalfa or fescue averaged 9.1 and 0.7 nests/ha, respectively (8.9 and 0.5 nests/ha by red-winged blackbirds). Narrow corridors can potentially harbor high densities of nesting birds (Shalaway 1985). Shalaway (1985) reported 43.5 nests/ha in fencerow habitat in Michigan. Yahner (1982) reported 93.4 nests/ha in Minnesota shelterbelts; however, colonially nesting common grackles dominated those shelterbelts (50.5 nests/ha). In contrast to narrow corridors, Nolan (1963) reported 4.2 nests/ha in a natural deciduous shrub habitat in Indiana. Dambach and Good (1940) reported 1.2 breeding pairs/ha in pastures. Basore et al. (1986) reported 0.36 nests/ha in no-tilled fields and 0.04

in tilled fields in Iowa. My results corroborate Dow's (1969) conclusion that narrow habitat types, such as ROW's, can support relatively high densities of nesting birds. In my study area the results clearly show that only the red-winged blackbird is nesting in the ROW to any significant extent.

Extensive areas of narrow man-made ROW's have only been in existence for a brief period relative to the evolutionary time-scale. Therefore, perhaps these man-made situations are unrepresentative of the ecological niche in which most edge species have evolved (Gates and Gysel 1978), and thus they may be poorly adapted to cope with the linearly arranged habitat, increased noise and wind levels, and increased predation. Despite attempts to make ROW's attractive to birds it appears at present that only a generalist, such as the red-winged blackbird, is capable of nesting under these constraint conditions with any type of success.

Although it is difficult to generalize about the beneficial aspects of highway ROW's for avifauna it would appear that ROW's productivity is correlated with the quality of adjacent habitats. If adjacent habitats are sustaining healthy bird populations then there is little point in managing ROW's for avifauna adjacent to these areas. If, on the other hand, adjacent habitats are uncondusive for supporting healthy bird populations, such as intensive rowcropping, then it would appear that managing ROW's for avifauna in these areas may not be maximized as most species cannot adapt to the narrow and linear dimensions that ROW's offer. Wildlife management must be analyzed case by case. In my study, I conclude that unless farming practices in this area change radically, managing and investing money into programs to aid birds within ROW's along I-88 can be better spent elsewhere.

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Table 1. Comparative numerical abundance (No. birds/1000 m ROW) for bird species considered breeding, foraging, or both, within the ROW or adjacent habitats.

Species ¹	Habitat									
	ROW		Agricultural		Wetland		Brush Seral		Wooded	
	1985	1986	1985	1986	1985	1986	1985	1986	1985	1986
Red-winged Blackbird	31.1	24.9	34.1	33.6	45.6	57.4	54.4	50.9	77.0	73.7
Common Grackle			0.7	0.9	7.5	8.0	9.8	8.2	14.2	15.1
Song Sparrow	0.2	0.1	3.7	1.8	8.6	10.9	10.4	13.1	12.2	11.4
American Robin	0.2	0.7	0.6	0.8	1.7	2.4	5.2	6.1	9.1	9.3
Common Yellowthroat					3.9	1.9	9.1	9.6	6.4	7.0
Indigo Bunting					4.2	3.8	8.5	9.2	3.1	5.2
Rock Dove									5.6	6.5
Gray Catbird							1.7	0.8	3.7	6.5
Cedar Waxwing									3.1	6.2
Tree Swallow					4.0	6.1			1.2	1.7
Barn Swallow			1.2	1.7	3.5	4.3	5.2	5.6	4.6	4.3
Blue Jay									5.5	2.9
Yellow Warbler					0.2	0.5	2.6	3.6	2.9	4.6
Northern Flicker							4.1	3.7		
Mallard	0.1	0.1	0.1		3.6	4.1				
Black-capped Chickadee									1.7	3.9
Northern Cardinal									2.6	3.5
Horned Lark			2.8	3.3			3.0	1.6		
Eastern Kingbird										
Brown-headed Cowbird			0.4					2.1	0.8	2.9
House Sparrow	0.2	0.2	1.1	0.6					1.4	2.5
Mourning Dove							2.5		1.5	2.2

Table 1. Continued

Species ¹	Habitat											
	ROW		Agricultural		Wetland		Brush Seral		Wooded			
	1985	1986	1985	1986	1985	1986	1985	1986	1985	1986		
European Starling									2.2	1.5		
American Goldfinch			0.5	0.3	2.2				1.9			
Brown Thrasher												
Great Blue Heron			0.2	1.7			0.4					
Chimney Swift			0.1						1.5	1.4		
Dickcissel	0.1	0.2	1.5	1.4								
Rose-breasted Grosbeak									1.5			
Red-eyed Vireo									1.5			
Northern Oriole									1.2	1.0		
Western Meadowlark		1.1			0.4							
Killdeer			0.6	1.0								
Eastern Meadowlark	0.5		0.3	0.2								
American Crow			0.3				0.5		0.4			
Swamp Sparrow					0.2							
Field Sparrow			0.2	<0.1	0.1							
Ring-necked Pheasant			0.1									
Chukar Partridge					0.1							
Subtotals by Year	7	8	15	12	14	12	14	14	25	21		
Combined Totals	9		18		14		16		25			

¹Listed in order of declining abundance.

Table 2. List of avifauna in order of declining abundance (No. birds/1000 m ROW) that were recorded in shrub vs. grass ROW's having either brome/alfalfa or fescue as the dominant ground cover type.

<u>Species</u>	ROW Habitat			
	----- Woody -----		----- Non-Woody -----	
	<u>Brome/ Alfalfa</u>	<u>Fescue</u>	<u>Brome/ Alfalfa</u>	<u>Fescue</u>
Red-winged Blackbird	29.9	10.9	25.2	9.4
Western Meadowlark	0.6	0.3	1.4	0.4
American Robin	1.4	--	---	--
Eastern Medowlark	0.4	0.3	0.3	0.1
Mallard	0.1	--	0.1	0.1
Song Sparrow	0.1	--	0.1	--
Dickcissel	0.1	---	0.1	---
Ring-necked pheasant	0.1	--	0.1	--
House Sparrow	0.1	--	---	---
Total No. of Species	9	3	7	4

Table 3. Bird nesting density by species within an interstate ROW in northwestern Illinois.

<u>Species</u>	ROW Habitat Type (#, nests/ha)		
	Shrub	Grass Type	
		<u>Brome/Alfalfa</u>	<u>Fescue</u>
Red-winged Blackbird	237 (16.1)	117 (8.9)	2 (0.5)
American Robin	16 (1.1)	0 (0.0)	0 (0.0)
Mallard	2 (0.1)	1 (0.1)	1 (0.2)
Common Grackle	3 (0.2)	0 (0.0)	0 (0.0)
Song Sparrow	2 (0.1)	1 (0.1)	0 (0.0)
Field Sparrow	1 (0.1)	0 (0.0)	0 (0.0)
Total	261 (17.7)	119 (9.1)	3 (0.7)