

THE BIRD POPULATION OF A TRANSMISSION RIGHT-OF-WAY MAINTAINED BY HERBICIDES

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Abstract: A census was made of the bird population on an electric transmission right-of-way (ROW) and the adjoining forest in central Pennsylvania in July, 1982. The ROW had been maintained for 30 years by herbicide sprays with hand-cutting as a control. A large and diverse bird population of 31 species, which averaged 6.4 birds per hectare per census day, had developed on the ROW. The common species were typical of shrublands and open areas. In the adjoining forest, an average of 3.4 birds per hectare were counted per day; and the population contained 27 species. There was no significant difference at the 0.05 level between the number of birds on handcut- and herbicide-maintained ROW areas; the number of birds was significantly less in the forest than on the ROW. Immature birds made up 8% of the total ROW count.

The purpose of this paper is to describe the bird population of a 58m-wide electric transmission right-of-way (ROW) that was maintained by herbicides over a period of 30 years. In particular, it is to answer the questions, "what species are now present on the ROW and in the adjoining forest?" and, "what is their relative abundance?" In addition, a comparison in bird populations is made between ROW areas maintained by herbicides and by handcutting.

The effect of ROW clearance on birds has been described by several investigators. Anderson (1979) has shown that ROW clearance in Tennessee caused a decrease in breeding forest birds that was balanced by appearance of new shrubland species. Species diversity index decreased, however, for 4 years from 1.92 to 1.60. On a cleared 30.5m-wide ROW there were 17 bird species recorded as compared to 11 species on a 12m-wide ROW (Anderson, Mann and Shugart, 1977). More breeding birds were recorded on the ROW than in the forest. After ROW clearance in North Carolina, an edge of tree saplings was used more by birds than the center portion, although 3 species used the center almost exclusively and 4 species were foraging and feeding on the low center strip (LeGrand, 1971). Selective clearance of a ROW in Georgia caused an increase in bird populations for 2

seasons (Meyers and Provost, 1979).

Maintenance of a ROW in Maryland by annual mowing failed to produce use by grassland birds; and several shrubland species were found only where thickets of blackberry were retained (Chasko and Gates, 1979). In contrast, a shrubby ROW maintained by selective herbicide sprays provided excellent overall habitat. Also in Maryland, a selectively sprayed ROW was used by 35 to 43 breeding males per hectare for 4 years during which time the birds were not noticeably affected by vegetation changes (Longcore, 1976). A ROW in Pennsylvania maintained by selective applications of herbicides was found to support a population of 14 species of songbirds (Bramble, 1974). Selective spraying of herbicides on ROW in 4 eastern states produced a better habitat for breeding male songbirds than broadcast spraying; with a similar number of species (12 to 16) present on all ROW regardless of the type of maintenance used (Carvell and Johnston, 1978).

Background

The history of the ROW used in this research, which was located in the Allegheny mountains of central Pennsylvania, has been well documented (Bramble and Byrnes, 1982). The following brief account outlines the maintenance of the ROW from 1951 to 1982:

1951-52	The ROW was clearcut during capital construction through an upland oak-hickory forest.
1953	Five herbicide treatments and handcutting were each replicated 4 times on 20 ROW units along a 5 km segment. Chemicals used were 2,4-D, 2,4,5-T, and ammonium sulphamate.
1954	A follow-up selective basal spray of 2,4-D + 2,4,5-T was applied to one-half of each herbicide treatment area.
1958	Handcut units were clearcut.
1966	A selective basal spray, stump spray and stem-foliage spray of 2,4-D + 2,4,5-T was applied to the entire 5 km segment as needed.
1967	Handcut units were clearcut.
1976	Handcut units were clearcut.
1982	A bird census was carried out in July just prior to application of new ROW maintenance treatments.

Plant Cover Present

The original oak-hickory forest, clearcut in 1951-52 to construct the ROW, was replaced by a dense plant cover dominated by shrubs (Figure 1). This community has been described as a proclimax type maintained in an arrested stage of plant succession by removal of trees and tall shrubs in ROW maintenance (Bramble and Byrnes, 1982).

The complex mixture of plant species present on the ROW in 1982 was derived from an early community that had been dominated by species common in the ground layer of the oak-hickory forest: blueberry (*Vaccinium angustifolium* and *V. vacillans*), bracken (*Pteridium aquilinum*), vernal sedge (*Carex Pensylvanica*), and whorled loosestrife (*Lysimachia quadrifolia*). This community was gradually altered by development of species typical of openings and open areas, particularly blackberry (*Rubus allegheniensis*), which had become the dominant species by 1982 and occurred in large patches or extensive populations over most of the ROW. The other important shrubs in 1982 were blueberry, huckleberry

(*Gaylussacia baccata*), dewberry (*Rubus hispidus*), sweetfern (*Comptonia peregrina*), bear oak (*Quercus ilicifolia*), witch hazel (*Hamamelis virginiana*), and teaberry (*Gaultheria procumbens*). These were intermingled with herbaceous species, the most common being goldenrod (*Solidago graminifolia* and *S. rugosa*), bracken, vernal sedge, hayscented fern (*Dennstaedtia punctilobula*), tall meadow fescue (*Festuca elatior*), sheep sorrel (*Rumex Acetosella*), and wild sarsaparilla (*Aralia nudicaulis*).

The adjoining oak-hickory forest was a 2- to 3-layered community which consisted of various combinations of a tree layer, 12 to 18 M tall, several shrub layers, and an herb layer (Figure 2). Many openings had been created through dying of trees; mostly as a result of insect attacks. Dense tree reproduction was present in both shrub and herb layers. Typical shrubs in the forest were witch-hazel, blueberry, and teaberry with sparse bear oak and sweetfern in the larger openings. Very little fruiting of shrubs occurred in the forest in marked contrast to abundant fruiting on the ROW.



Figure 1. A ROW sample unit, maintained with herbicides, with a high population of 11.2 birds per hectare counted per census day. A shrub-herb-fern-grass plant cover along with resurgent trees was present.



Figure 2. Typical oak-hickory forest adjacent to the ROW. The forest was two-layered with a 1 M-tall herb layer and a 12 to 18 M tree layer.

Census Method

The census method used was designed to accomplish the specific objectives of the research, namely, to determine the bird species present and their relative abundance on the ROW and in the adjoining forest. It was adapted to the dense tall plant cover, dominated by blackberry up to 7 feet tall, which made small plot counts and line transects too time-consuming and inaccurate. The intent was to cover the entire ROW and its edges for each of 10 units in each daily census. Although the method included some of the techniques of a breeding male census, it emphasized identification and count of all birds seen or heard. The results obtained indicate that an acceptable sample of species present and their relative abundance was obtained.

The census was carried out for 6 consecutive days from July 12 to July 17, 1982. Each sample unit was censused by an observer and a spot-mapper walking slowly along an established access road each day with frequent stops. Careful checking by each person reduced the error caused by counting the same bird twice. All birds seen or heard were recorded on field tally sheets and spotted on ROW maps. Species, sex, and activity were noted and immature birds were recorded.

Ten ROW units were selected for the census (2 handcut and 8 herbicide-maintained units) from 30 that had been laid out for ROW maintenance treatments later in 1982. These units were selected so as to sample the major variations in plant cover typical of the ROW. Each unit included the entire ROW plus 10m of ROW-forest edge and averaged 1.09 hectares in area. An adjoining forest unit (10 units in total) that paralleled each ROW unit on one side was also censused by walking along a line 45m from the forest edge to cover a 90m-wide strip, exclusive of the 10m ROW-forest edge.

The census, which covered all 10 ROW and forest units each day, began at 5:00 a.m. and continued until 11:30 a.m. A different beginning point was used each day so that each unit was censused at least 4 times during early morning hours. No adverse weather conditions were encountered and bird activity continued high through the daily census period with some of the higher

bird counts obtained as late as 11:30 a.m.

Results

Number of birds. A total of 521 birds were counted on the ROW and its forest edges in 6 consecutive daily counts; 269 birds were counted in the adjoining forest. Average number of birds counted per hectare per day was 5.5 on ROW units maintained by handcutting, 6.4 on ROW units maintained by herbicide sprays, and 3.4 on the adjoining forest units (Table 1). This is within the 3.8 to 8.1 birds per census per hectare reported for 3 ROW maintained by herbicides in other states (Carvell and Johnston, 1978). When subjected to a t-test and a Wilcoxon two-sample non-parametric test for significance between sample means, birds per hectare on ROW-handcut and ROW-herbicide maintained were not significantly different at the 0.05 level (Table 1). However, number of birds per hectare on both the ROW-handcut and ROW-herbicide were significantly greater than those in the adjoining forest.

Therefore, it is apparent that an abundant population of birds was present on the ROW after 30 years of maintenance by both herbicides and handcutting.

Species of birds on the ROW. A total of 31 species of birds were recorded on the ROW and its forest edges (Table 2). Twenty-three species were migratory and 15 are usually described as forest-inhabiting (Peterson, 1980). Seventeen species were common (0.7 or more per ha) either

Table 1. Number of birds counted per hectare per day on ROW and forest sample units for the 6-day census in July, 1982.

Census date July	Number of birds per hectare		
	ROW-herbicide	ROW-handcut	Adjoining forest
12	5.7	4.7	3.1
13	8.4	5.7	5.0
14	6.8	5.6	3.1
15	6.3	7.1	2.9
16	6.5	4.9	3.4
17	4.8	4.8	2.8
Mean	6.4	5.5	3.4
Std. Dev.	1.2	0.9	0.8

on the ROW or in the adjoining forest (Table 2). The 5 most common species on the herbicide-maintained ROW were yellowthroat, rufous-sided towhee, gray catbird, field sparrow, and indigo bunting. All of these species are migratory. Other common ROW species were black-capped chickadee, chestnut-sided warbler, American goldfinch, downy woodpecker, American redstart, and American robin. All 11 species are typical of shrubland, edges, thickets, and open areas and together made up 87% of the total bird count. Twenty other species have been recorded as occasional on the herbicide-maintained ROW with 5 of them found only in the ROW-forest edges.

The mutual similarity between bird species composition on the ROW and the adjoining forest was quite high, as 21 of the total of 31 species recorded on the ROW were also found in the forest (Table 2). This produced a similarity quotient (Sorensen, 1948) of 64%. Two of the 5 most common bird species on the ROW, yellowthroat and towhee, were also among the top 5 in the forest.

The most common species on the handcut ROW included 4 of those common on the herbicide-maintained ROW, namely, yellowthroat, gray catbird, indigo bunting, and towhee. However, chestnut-sided warbler and redstart replaced field sparrow as common species. The dense sapling cover present on the handcut ROW is typical habitat of those two species.

Of particular interest was the presence of a number of immature songbirds which made up 8% of the total ROW bird count. This indicates that songbirds were able to reproduce and use the ROW in raising their young.

The type of plant cover on the ROW appeared to have a marked effect on the species and number of birds present. For example, sample areas with counts of 6.2 birds per hectare per day, or higher, possessed a dominant shrub cover which occupied 62.8 to 85.3% of the ROW and was composed predominantly of witch-hazel and blackberry. Gray catbird, chestnut-sided warbler, and redstart were most numerous on handcut ROW areas where dense tree thickets had developed. On the other hand, yellowthroat, towhee, and field sparrow were more numerous on herbicide-sprayed areas with a dominant

shrub-herb cover. Where there was an extensive herbaceous cover over 55.2 to 100% of the ROW area, field sparrow counts were relatively high.

Species of birds in the adjoining forest. A total of 27 species of birds were recorded in the adjoining forest. Eighteen species were migratory and are usually described as forest-inhabiting (Peterson, 1980). The 5 most common species were rufous-sided towhee, red-eyed vireo, common yellowthroat, wood thrush, and ovenbird (Table 2). All of these species are migratory. Also common were black-capped chickadee, scarlet tanager, downy woodpecker, white-breasted nuthatch, eastern pewee, and American redstart. Sixteen other species were recorded as occasional.

Of the 27 species in the adjoining forest, only 6 were not observed on the ROW or its edges, namely, eastern pewee, worm-eating warbler, broadwing hawk, yellow-shafted flicker, northern cardinal, and great horned owl.

Bird species diversity. The number of bird species on the ROW (31) and in the forest (27) can be used as a simple and informative measure of diversity which is usually referred to as species richness. However, this does not take species abundance and evenness into account, i.e., the number of individuals per species and their distribution among species. To remedy this, a species diversity index (Simpson, 1949) was used to describe the present structure of the bird population and can be used to follow any future changes. The formula used was $D = 1 - E(p_i)^2$; where D = diversity index and p_i = proportion of individuals in each species. The maximum possible evenness is calculated by: maximum = $1 - (1/s)$, where s = the number of species.

The species diversity index for the 11 most common species on both the handcut units and on herbicide-treated units was 0.83 with a maximum possible evenness of 0.91. The 11 common species were used as the distribution among those species was of most interest in this study, and rare birds have little effect on index. This means that the individuals were well distributed among the common species on the ROW. For comparison with other bird censuses, the Shannon-Wiener index was also calculated and averaged 2.94 for the ROW. This is similar to the

Table 2. Number of individual birds recorded in 6 census days (July 12-17, 1982) on the ROW and in the adjoining forest. Species names are from Person (1980) and the most common species are marked with an asterisk.

Species	No. birds per hectare		
	ROW-herbicide	ROW-handcut	Adjoining forest
Most common on ROW			
Common yellowthroat, <i>Geothlypis trichas</i>	10.4*	9.3*	1.6*
Rufous-sided towhee, <i>Pipilo erythrophthalmus</i>	6.1*	1.9*	2.8*
Field sparrow, <i>Spizella pusilla</i>	4.2*	0.7	0.1
Indigo bunting, <i>Passerina cyanea</i>	3.5*	3.0*	0.1
Gray catbird, <i>Dumetella carolinensis</i>	3.1*	5.9*	0.1
Common on ROW			
Black-capped chickadee, <i>Parus atricapillus</i>	1.8	1.5	1.0
Chestnut-sided warbler, <i>Dendroica pensylvanica</i>	1.5	2.2*	0.2
American goldfinch, <i>Carduelis tristis</i>	1.2	0.4	—
Downy woodpecker, <i>Picoides pubescens</i>	0.9	0.4	0.8
American robin, <i>Turdus migratorius</i>	0.5	0.7	0.2
White-breasted nuthatch, <i>Sitta carolinensis</i>	0.5	—	0.7
Occasional on ROW			
American redstart, <i>Setophaga ruticilla</i>	0.4	1.9*	0.6
Brown-headed cowbird, <i>Molothrus ater</i>	0.4	0.7	—
Red-eyed vireo, <i>Vireo olivaceus</i>	0.4	0.7	2.6*
Scarlet tanager, <i>Piranga olivacea</i>	0.4	0.4	0.9
Song sparrow, <i>Melospiza melodia</i>	0.4	—	—
Rose-breasted grosbeak, <i>Pheucticus ludovicianus</i>	0.3	—	0.1
Black-and-white warbler, <i>Mniotilta varia</i>	0.3	1.1	—
Blue-gray gnatcatcher, <i>Polioptila caerulea</i>	0.3	0.4	—
Cedar waxwing, <i>Bombycilla cedrorum</i>	0.3	—	—
Great crested flycatcher, <i>Myiarchus crinitus</i>	0.3	—	0.2
Wood thrush, <i>Hylocichla mustelina</i>	0.3	—	1.3*
Black-billed cuckoo, <i>Coccyzus erythrophthalmus</i>	0.2	—	—

Species	No. birds per hectare		
	ROW-herbicide	ROW-handcut	Adjoining forest
Least flycatcher, <i>Empidonax minimus</i>	0.2	—	0.1
Yellow-rumped warbler, <i>Dendroica coronata</i>	0.2	—	0.1
Brown creeper, <i>Certhia familiaris</i>	0.1	—	—
Canada warbler, <i>Wilsonia canadensis</i>	0.1	—	—
American crow, <i>Corvus brachyrhynchos</i>	0.1	—	—
Golden-winged warbler, <i>Vermivora chrysoptera</i>	0.1	—	0.1
Ruffed grouse, <i>Bonasa umbellus</i>	0.1	—	0.1
Ovenbird, <i>Seiurus aurocapillus</i>	—	0.4	1.2*
Eastern pewee, <i>Contopus virens</i>	—	—	0.7
Worm-eating warbler, <i>Helminthos vermivorus</i>	—	—	0.4
Broad-winged hawk, <i>Buteo platypterus</i>	—	—	0.2
Common (yellow-shafted) flicker, <i>Colaptes auratus</i>	—	—	0.1
Northern cardinal, <i>Cardinalis cardinalis</i>	—	—	0.1
Great horned owl, <i>Bubo virginianus</i>	—	—	0.1

Shannon-Wiener index of 2.30, 2.86, and 3.05 obtained for summer bird populations over three successive years in hedgerows in Wisconsin (Dumke, 1982). For a further comparison, the Shannon-Wiener index of a bird population on four ROWs in an oak-hickory forest in Tennessee ranged from 1.86 to 2.43 (Anderson et al., 1977).

The Simpson diversity index for the common bird species in the adjoining forest was 0.88 with a maximum possible of 0.91. The Shannon-Wiener index was 3.25 which is slightly higher than the general index of 3.14 reported for deciduous forest on the Allegheny Plateau (Temple et al., 1979). This indicates that the bird population was more evenly distributed among common species in the adjoining forest than on the ROW, although fewer individuals were present.

Spot mapping of birds. The location of each bird was spotted on a ROW map at the time it was

counted. This gave a useful and important picture of how birds were distributed over the sample areas and composite maps could be made of common species distribution. When the ROW was divided into a 60-foot-wide center zone and two 60-foot-wide border zones, 14 individual birds were recorded in the center and 28.4 on each border (Figure 3). Definite concentrations of certain species occurred along the borders of the ROW (Figure 4). For example, there were 6 towhee in the center zone and 20 in the border zones; 3 yellowthroat in the center zone as compared with 13 in the border zones. For catbird there were 3 individuals in the center zone and 9 in the border zones. Bird concentrations usually occurred where shrub cover values were high, 77.9 to 85.3% of the ROW area; and where witch-hazel and blackberry were dominant shrubs.

Bird activities on the ROW. When each bird was counted, a note was taken of its activity (Figure 5). Although these were undoubtedly biased by the presence of the census takers, they did indicate that many normal activities were taking place. Singing and calling amounted to 68% of the total activities. The next most common activity was fleeing and seeking cover (13% of the total), probably owing to disturbance by the census operation. Foraging and feeding made up 8%; while 7% were observed perching and roosting. Five percent were observed flying across the ROW.

Discussion

Although a summer bird census in July was different and probably more difficult than the usual breeding bird census in the spring, it did result in documentation of the presence of a large and diverse bird population on the ROW which compares favorably with reports in the literature. The effect of both handcutting and herbicide spraying over a period of 30 years evidently was favorable to the development of an excellent songbird habitat.

A few forest bird species were moved from the ROW for certain of their needs such as tree cavities. However, 18 species used both the forest and the ROW on occasions, the importance of which was known only to the bird involved. Wood thrush were observed fleeing and seeking

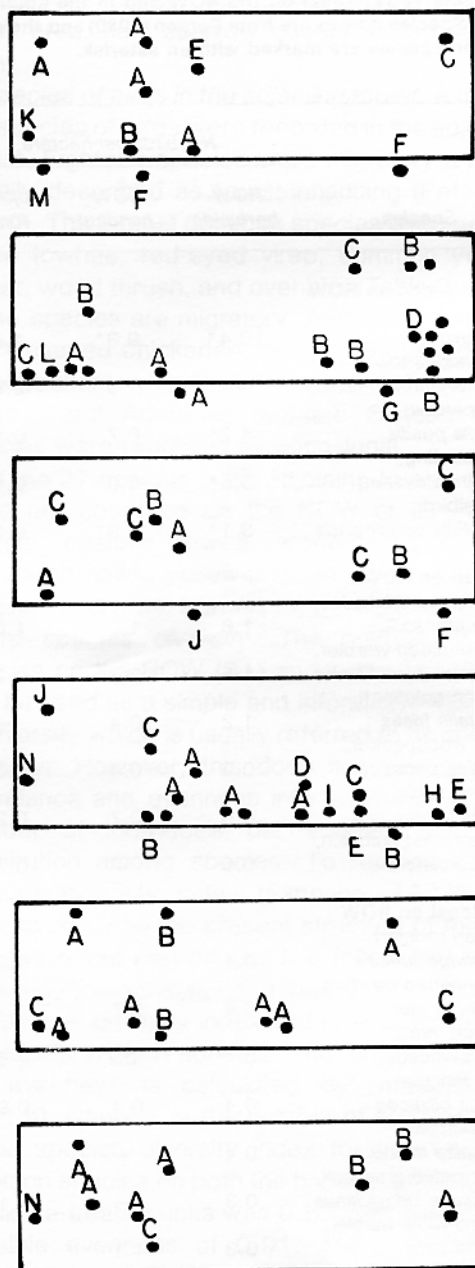


Figure 3. Spot maps for 6 consecutive census days on a ROW sample unit (d-3), 1.1 ha in area, with a population of 11.2 birds counted per ha per census day. Key to species: A = towhee, B = yellowthroat, C = catbird, D = field sparrow, E = goldfinch, F = downy woodpecker, G = black and white warbler, H = cedar waxwing, I = goldenwinged warbler, J = least flycatcher, K = myrtle warbler, L = rose-breasted grosbeak, M = white-breasted nuthatch, N = cowbird. Each dot represents an individual bird.

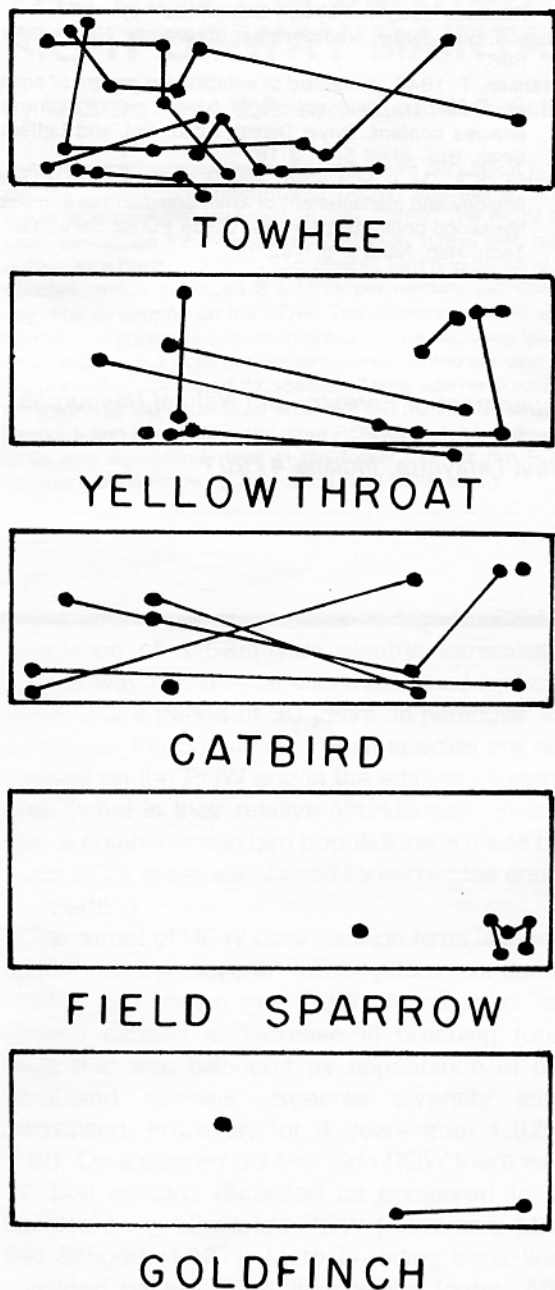


Figure 4. Composite spot maps of the distribution of the 5 most common bird species on a ROW sample unit, 1.1 ha in area, with a population of 11.2 birds counted per ha per census day. Lines connect birds counted on the same day; each dot represents an individual bird.



Figure 5. An immature yellowthroat feeding on the ROW. This was the most common species on the ROW.

cover on the ROW and singing on the edge; an ovenbird was observed foraging on the ROW. Red-eyed vireo were also foraging on the ROW and singing on the edge. Scarlet tanager were observed singing on the ROW-forest edge. White-breasted nuthatch were climbing and calling on the ROW. Downy woodpecker were calling and foraging on the ROW and climbing and foraging on the edge. Great crested flycatcher were observed calling and singing on the edge. The net effect of the ROW appeared to be an increase in the diversity of habitat in the forested area through which it passed by acting in effect as a shrub-herbaceous opening in the forest that was used by both shrubland and forest bird species.

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