Wildlife Populations Utilizing Right-of-Way Habitat Along Interstate 95 in Northern Maine

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ABSTRACT

From 1975 to 1982 the impact of the construction of Interstate 95 in northern Maine on the distribution, abundance, and diversity of birds, rodents, and other mammals was assessed. Populations and activities of breeding birds and mammals were examined before, during, and after construction of I-95 along sections adjacent to various forest habitat types. Movements and densities of birds and mammals adjacent to and away from I-95 did not differ significantly during and after construction. The use and avoidance of newly created edges by some species was examined. Immediate losses of habitats for breeding birds were noted, and the long-term effects on populations of birds and mammals are discussed.

Construction of the Interstate highway system has provided many benefits. It has minimized travel time, increased driving safety, and created additional economic opportunities for many areas. When construction of the Interstate began in 1957, the effects on the surrounding environment apparently were not always considered because of the lack of available information. Recently, additional emphasis has been placed on environmental considerations as a result of a growing awareness of the problem presented by construction of the Interstate, which in turn has generated public concern. This concern is exemplified by the National Environmental Policy Act of 1970 and amendments to the Federal Fish and Wildlife Coordination Act of 1934, which requires highway agencies to reevaluate the environmental impact of highway construction and maintenance. Until recently there have been few scientific studies relative to the impact of highways on adjacent vegetation and existing wildlife.

This study was the first of its kind in the northeast and is one of the few long-term studies of this nature on highways. The sites studied along I-95 in Penobscot County, Maine, were ideal because they involved construction through forests heavily populated with both hardwoods and softwoods (Figure 1). Future new construction will, in many instances, be an encroachment similar to the one studied on this highway.

The impact of I-95 in northern Maine on wildlife before, during, and after construction was studied from 1975 to 1982. The objectives of the study were to assess the impact, both positive and negative, of I-95 on the distribution, abundance, and diversity of birds, rodents, and mammals, with particular emphasis on rodents or small mammals as indicator species.

Beginning in 1975 during the preconstruction phase of the study, the status of songbirds, small- to medium-sized mammals, and white-tailed deer (Odocoileus virginianus) were investigated. From 1977 to 1980 the study concentrated on the behavioral responses of songbirds to construction activities while continuing to monitor mammal populations and activities. The final phase of the study or postconstruction evaluation was conducted in 1981 and 1982.

The study was conducted along two 15-km sections

FIGURE 1 Location of study areas.

of I-95. The southern section, representing a control area, was completed before the study, whereas two southbound lanes, that constituted the experimental area, were completed in the northern section during the study. The distance between north and south lane fences or right-of-way (ROW) boundaries was about 150 m, with a 30-m wide residual median strip separating north and southbound lanes.

Sample plots for softwood stands were comprised of balsam fir (Abies balsamea), red and white spruce (Picea rubens and P. glauca), eastern hemlock (Tsuga canadensis), eastern white pine (Pinus strobus), and northern white cedar (Thuja occidentalis) 40 to 100 years old. Hardwood plots along the southern section contained aspen (Populus tremoloides and P. grandidentata), gray and paper birch (Betula populifolia and B. papyrifera), American beech (Fagus grandifolia), and red maple (Acer rubrum) 20 to 40 years old. Hardwood plots adjacent to the northern section

were principally American beech, sugar maple (Acer saccharum), and eastern hophornbeam (Ostrya virginiana) 20 to 120 years old.

SONGBIRDS

Preconstruction Phase

The status of birds residing in the forest was determined by examining species abundance and composition of populations at increasing distances from the highway (1). A census was conducted of numbers of breeding birds by spot-mapping (2) on 12 study plots, each 200 x 400 m (8 ha), oriented at right angles to the highway beginning at the ROW edge (Figure 2). A census was conducted of each plot along four 400-m transects spaced 50 m apart. Censuses were conducted during early morning hours from late May through early July 1975-1977. Three replicates in each cover type (hardwood and softwood) were placed adjacent to the highway in both northern and southern sections. Plots were located in patches of uniform habitat to minimize variation within plots (Figure 3).

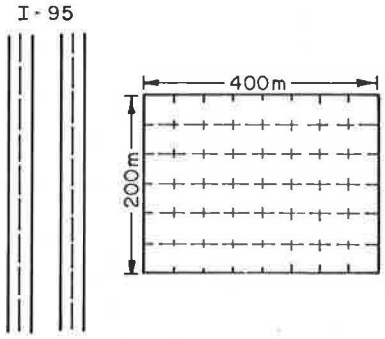

FIGURE 2 Plot showing transects.

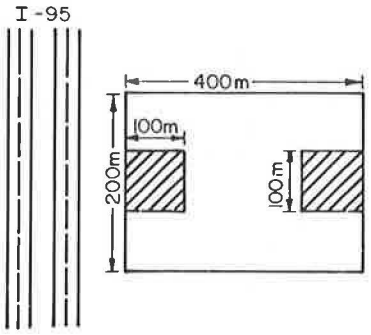

FIGURE 3 Study plot with small mammal trapping grids.

Habitat Characteristics

Breeding and Wintering Birds

Slight differences in habitat within a census plot could affect the distribution of birds and possibly mask any effects caused by the highway. Consequently, an intensive analysis of vegetation composition and structure was undertaken to measure such variation and isolate the influence of the highway on individual species. The analysis involved measuring several habitat variables within 0.04-ha circular plots located at each of the grid reference points. Breeding pairs of each species were then correlated with those measurements.

This sampling scheme is shown in Figure 4. Within the large circle closest to each territory, all trees were recorded by species and 2.5-cm diameter classes; dead trees were recorded separately by the same classes. Woody stems less than 1.25 cm in diameter were counted within the four 0.004-ha circular plots and recorded only as deciduous or coniferous. Percentage of the ground covered by moss, ferns, herbs or by litter (needles, leaves, sticks, rocks) was estimated on 0.0004-ha circular plots nested within the medium-sized plots. At four locations within the large plot (one in each quarter), canopy height was measured with a Speigel Relaskop,

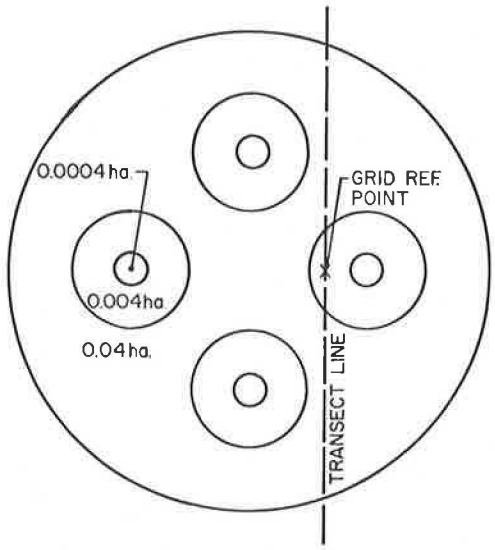

FIGURE 4 Vegetation sampling scheme.

and percent canopy closure was estimated with a spherical densiometer.

At each of 21 stations along ROW transects, measurements were taken of several characteristics of the ROW and edge to quantify development of edge vegetation and to correlate vegetation characteristics with numbers and species composition of breeding birds. The width of the strip maintained in grass, from the berm to the beginning of woody vegetation associated with the forest edge, and the width of the edge from the maintained area to the residual forest line were measured.

During-Construction Phase

To examine the effects of construction on individual breeding songbirds, an intensive study investigating behavioral response to daily construction activity was designed. Two sites were chosen: the experimental area was an active gravel pit and the control area was an unused, 12 year old gravel pit located 1 to 2 km away and surrounded by vegetation similar to the experimental site.

In each area the singing behavior of five male rose-breasted grosbeaks (Pheucticus cianus) was monitored from dawn until 10:00 a.m., when singing stopped. The relative amount of time individual birds spend singing in each area was recorded.

Postconstruction Phase

Using the methods previously described, a census was conducted again of the four plots examined during the preconstruction phase in the northern study area. Breeding bird populations were examined within successive 100-m intervals using analysis of variance.

Results

Total numbers of breeding pairs and species including both edge and forest species along the forest edge did not appear to change with time since construction. Within the median strip, the number of edge species remained similar; however, the number of forest species decreased from 8.2 to 4.2 species per transect.

Although total numbers of breeding pairs were not related to time since construction, the proportion of edge to forest species comprising the total breeding population increased. Along the 5 year old forest edge, edge species comprised only 23 percent of the total population, whereas forest species comprised 77 percent. Along the 18 year old forest edge, however, edge species comprised 42 percent of the total population and forest species comprised 5 percent.

As expected the median strip contained a larger component of edge species than the forest edge. Edge species comprised 42 percent and 68 percent of the total population for the 5 and 10 year old median strips. Correspondingly, forest species comprised 58 percent and 36 percent, respectively.

The forest edge and median strip supported similar but still different communities of breeding birds. Twenty-seven forest and 15 edge species were found to be breeding along the forest edge. Within the median strip 21 forest and 17 edge species were observed. Nine forest species bred only along the forest edge. However, all edge species breeding along the forest edge also bred in the median strip. Edge species appeared to be less-habitat-specific than forest species.

Total populations of breeding birds within the median did not differ from those along the oldest edge. This would be expected because the median was created (at least one side) at the time the first lane was constructed. However, the median strip was not as high in pairs of true "edge" species as was the ROW, but species richness was comparable.

The relationship between development of edge vegetation and the breeding bird populations was examined using least squares regression analysis. Both the numbers of breeding birds and the number of species were correlated with the cross-sectional area of the edge (see Figures 5 and 6; r = 0.85 and r = 0.87, respectively).

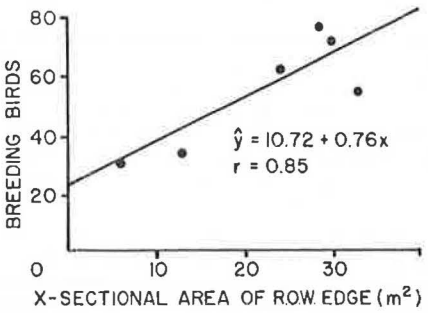

FIGURE 5 Number of breeding birds.

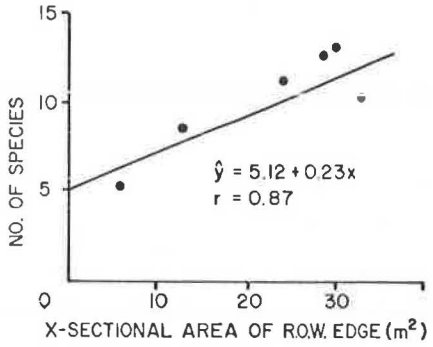

FIGURE 6 Number of breeding species.

Species diversity did not change with time since construction along the forest edge and median strip. Diversity in the forest edge was similar to that in the median strip.

Discussion

The increase in abundance of edge species was associated with the development and encroachment of vegetation outward from the forest edge and median strip to the mowed grassy shoulder (1). Generally, as the forest edge and median strip became older, there was an increase in edge species and a corresponding decrease in forest species. This decrease in abundance of forest species was believed to be a result of competition with edge species, which are better adapted to use these edge and open habitats.

Populations of breeding birds 100 to 400 m from the forest edge in relatively undisturbed habitat were found to contain only 0.6 percent edge species with the remainder comprised of forest species (3). The edge species found in the adjacent forest were associated with small clearings and openings in the forest canopy. With the creation of ROW habitat, there was a substantial increase in the edge species previously found in the adjacent forest as well as in new edge species uncommon in the area before the ROW.

This study indicated that ROW habitats might lead to a greater variety of birds in a region when considered with the total bird populations in the adjacent forest. Some forest species decreased in abundance within the highway ROW, but most edge species increased. However, the total region should be considered when assessing the impact of ROW habitats on breeding songbirds. Given the large amount of forest land that I-95 bisects, ROW habitats probably are beneficial in maintaining the rich and diverse bird population characteristic of northern Maine.

SONGBIRDS USING BRIDGES

A census was conducted of breeding birds with nests beneath bridges that intersect the ROW on June 15 and July 6, 1981. A census was conducted of 40 bridges.

A total of 387 active nests of 3 edge species, barn swallow, cliff swallow, and rock dove, were found. Bridges over water with I-beam flanges on the undersides were most commonly used as nest sites.

CROWS AND RAVENS IN THE ROW

A census was conducted of crows and ravens along the highway. Roadkills, including those being eaten by crows and ravens, were also recorded.

The census indicated that crows, an edge species, and ravens, a forest species, were common along the ROW. Crows were more abundant than ravens between March and October. Of 59 roadkills recorded, 8 were directly observed being eaten by a crow or raven. It was assumed, however, that more roadkills existed in the ROW than were recorded because of the difficulty in locating them.

SMALL MAMMALS

As with breeding songbirds, small mammals select areas on the basis of habitat. Within the ROW, the forested residual median strip contains habitat suitable for small mammal (mice, voles, and shrews) communities to exist. However, because of separation from the adjacent forest by the highway pavement and grassy shoulder, and because of habitat alteration, it is uncertain whether population structures within the median strip are similar to those in the adjacent forest. It is also uncertain whether these populations are related to the age of the median strip.

Preconstruction Phase

Populations of small mammals (includes Cricetidae, Zapodidae, Soricidae, and Talpidae) were sampled during the preconstruction phase on census plots used for birds described previously (1). Two trapping grids measuring 100 x 100 m were placed in each study plot sampled for a total of 16 grids; one was placed in the forest adjacent to the ROW boundary, the other was placed 300 to 400 m distant from the ROW boundary (Figure 3). Grids close to the highway represented experimental samples whereas those farthest from the highway represented controls.

Each grid contained 121 trap stations spaced 10 m apart in an 11 x 11 arrangement. Two Victor snap traps baited with peanut butter were placed within 2 m of each station. Every third station had a pitfall trap containing 3 to 5 cm water because shrews were underestimated using snap traps alone. Each grid was trapped for three consecutive nights over three periods during the summer.

During Construction and Postconstruction Phases

Small mammals were sampled during construction in the summers of 1978 and 1979 and during 1980 for the postconstruction phase. Four study plots located in the northern study area were resampled using 50 x 50 m trapping grids. Each grid contained 36 trap stations spaced 10 m apart in a 6 x 6 configuration. Trapping was carried out the same as during the preconstruction phase. Results of small mammal trapping were analyzed statistically using a nested analysis of variance (ANOVA).

Results

A total of 190 small mammals were caught in 1,920 trap nights; a ratio of 9.90 animals per 100 trap nights. Catches from the median and control transects were similar with 8.23 and 11.56 per 100 trap nights, respectively.

Red-backed voles in the 10-year section were found to be significantly more abundant in control transects than in median strip transects. For the 5 year old highway section there were no significant differences between median strip and control transects, although more were caught in the control transects.

Cover type had a significant effect on the number of red-backed voles caught in the 5 year old highway section, with more captures in softwoods. There was no significant difference in the number caught between cover types in the 10 year old section, although more were found in softwoods.

Deer mice within both the 10 and 5 year old median strips were found to occur in similar numbers as in the control transects, with slightly more occurring in the median strip. There were no differences related to cover type and trapping period.

Catches of short-tailed shrews were too small to draw conclusions about their populations; however, the abundance of shrews on median strip and control transects appeared similar.

The number of small mammals in the total catch was similar for the two cover types sampled within the 5 year old section, but was significantly different within the 10 year old section. In the latter section, more total captures were obtained in softwood transects. There were no differences detected for transect location and trapping period within both areas.

Discussion

The greater abundance of red-backed voles in the 10 year old median strip as compared with the control transect was apparently related to differences in habitat. The median strip generally contained a greater amount of ground vegetation than the control transect. Red-backed voles may also be indirectly affected by a competing species such as the meadow vole.

For the 5 year old median strip, the ground vegetation was not well developed. As with the adjacent forest (control), it apparently provided a more suitable habitat for red-backed voles than the 10 year old median strip. Because red-backed voles are predominantly forest dwellers, it was not surprising to find no significant differences in abundance between the 5 year old median strip and control transects. In time, however, with the development of ground vegetation within the median strip, red-backed voles may become less common.

Because red-backed voles are known to chiefly inhabit mesic coniferous and mixed forests, it was also not surprising to find more of them caught in softwood than in hardwood cover types within the 5 year old section. The lack of difference in numbers caught between the two cover types in the 10 year old section is unclear.

Deer mice for both the 5 and 10 year old median strips were not affected by transect location, cover type, or trapping period. The use of a wide variety of habitat types by this less-habitat-specific animal has been documented by numerous researchers. The roadside grids in these studies began at the forest edge and did not include the ROW.

In summary, the altered habitat for a 5 and a 10 year old median strip within the ROW were found to support similar small mammal populations, with the exception of red-backed voles. However, it should be understood that with time through plant succession, ROW maintenance practices, and other unknown factors, trends in small mammal populations could change.

MEDIUM-SIZED MAMMALS AND WHITE-TAILED DEER

Preconstruction Phase

The distribution and relative abundance of medium and large-sized mammals were determined by counting

tracks in relation to distance from the highway during the winters of 1975-1976 and 1976-1977 (4). Signs were recorded for mammals common to the study areas. Insufficient data were accumulated for analyses, however, for moose (Alces alces), black bear (Ursus americanus), bobcat (Lynx rufus), and marten (Martes americana). Counts were conducted within 2 to 6 days following snowfall on the two outer 400-m transects within each plot because most animals walked parallel to the highway when crossing all four transects. At least 7 separate counts were conducted on each of the 12 plots. All tracks and other animal signs were recorded on maps of the study plots. Transects were marked at 50-m intervals to aid location of individual tracks.

The distribution of white-tailed deer in relation to the highway was examined using pellet group counts. Counts were conducted in early spring soon after snowmelt and in early autumn, before leaf-fall. Pellet groups were counted on the same plots as winter tracks. Pellet groups within 1 m of the transect line were counted and destroyed or removed to prevent recounting later.

During Construction and Postconstruction Phases

Using the methodology described previously, approximately four separate snow track surveys were conducted on the six northern plots during the winters of 1978-1979 and 1979-1980 during construction. Deer pellet group counts were conducted on the same plots during spring and fall for both phases.

Data were analyzed using a chi-square test (5). Each 400-m transect was divided into eight 50-m sections; the number of tracks or pellet groups in the four sections farthest from the highway were averaged to determine the expected value and compared with the actual value of each section. If the expected chi-square value was less than 5, adjacent sections were lumped and tested as four 100 m sections.

Results

Mammals crossing the ROW were recorded by counting snow tracks along a 14-mile section of highway including both north- and south-bound lanes. Although the ROW probably acts as a barrier to some mammals, 71 individual tracks were recorded along 70 miles of ROW.

In the median strip, snowshoe hares, red squirrels, weasels, and coyotes were surveyed by counting tracks within six plots (three softwood, three hardwood cover types). Two parallel 400-m transects, located on either side of the median strip center, were run in each plot. As with songbirds and small mammals, the median strip provided suitable habitat for some medium-sized mammals.

CONCLUSIONS

The impact of I-95 on birds and mammals in forest ecosystems in Maine was examined from 1975 to 1982. Baseline data were collected. These data imply that the effect on breeding birds and small, medium, and large mammal populations has been limited to immediate loss of habitat. The extent of the effect of this habitat loss on populations as a whole in the vicinity of the highway is as yet unknown, but is probably insignificant for those species studied to date. Clearly the effects of the highway as a physical barrier to movement, particularly of small mammals, are not understood.

Some species have, however, adapted to or have taken advantage of habitats created by the construction of I-95. Chipping sparrows, yellowthroats, chestnut-sided warblers, crows, ravens, meadow voles and red foxes, to name a few, are using the newly created ROW, whereas species adapted to forest habitats such as bay-breasted warblers, red-backed voles, and fishers appear to be avoiding it. To what extent the use of the ROW affects populations of species now found there is also unknown. Some species, particularly crows and ravens, use the highway itself as available habitat.

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