LOCATING WILDLIFE UNDERPASSES PRIOR TO EXPANSION OF HIGHWAY 64 IN NORTH CAROLINA

Brian K. Scheick and Mark D. Jones

North Carolina Wildlife Resources Commission

Plymouth and Bridgeton, North Carolina

Abstract

North Carolina=s U.S. Highway 64 (US64) is currently being expanded from a two-lane road to a four-lane divided highway from Raleigh to the Outer Banks. This expansion has the potential to improve the local economy and increase the efficiency of hurricane evacuations. However, US64 may also inhibit the movement of wildlife and increase the incidence of vehicle-animal collisions. Our research will determine the optimal locations for three wildlife underpasses along a section of US64 in Washington County. This section will be built across forest and farmland rather than on the existing 2-lane roadbed. Our research differs from other highway projects because it is being conducted before the road is built rather than simply mitigating after-effects. We will base recommended underpass locations on landscape composition and movement patterns of black bear (*Ursus americanus*), white-tailed deer (*Odocoileus virginianus*), and red wolves (*Canis rufus*). We are determining movement patterns using infrared cameras, surveys of tracks and ditch crossings, and GIS analysis of landscape scale corridors. Because this study is ongoing, this paper will primarily cover our methods, and include limited discussion of spring season data. Of 8 species documented, deer and bear tracks were the most prevalent. Deer accounted for 955 tracks and 39 trails, and bear accounted for 41 tracks and 18 trails. Wolf tracks have not been found in the study area. Six other meso-mammal tracks have been found including bobcat (*Lynx rufus*), coyote (*Canis latrans*), domestic dog (*Canis familiaris*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), and opossum (*Didelphis virginiana*). Additional analyses of summer and fall animal movement patterns will be required before underpass locations are selected.

Introduction

Highways impact wildlife through avoidance, fragmentation, direct and indirect loss of habitat, and mortality (Ruediger 1996, 1998). While many taxa, including insects, herpetofauna, birds, and mammals, suffer vehicle-caused mortality, it is the larger species which damage vehicles and cause human injury and death. Conover et al. (1995), extrapolating from a variety of sources across the United States, estimated 726,000 deer-vehicle collisions annually cost drivers $1.1 billion, injure 29,000 people, and cause 211 human fatalities. In contrast to the relatively low human death rate (~3%), deer were killed by collisions 92% of the time. Studies have also identified short-term negative impacts on black bears (Brody and Pelton 1989, Beringer et al. 1990), grizzly bears (*Ursus arctos*) (Mattson et al. 1987), gray wolves (*Canis lupus)* (Paquet and Callaghan 1996), and other carnivores (Gibeau and Heuer 1996). North Carolina Wildlife Resources Commission data indicate that a minimum of 50-100 black bear are killed in central and northeastern North Carolina by automobiles yearly (unpubl. data). There is a clear need for management actions that reduce the incidence of vehicle-wildlife collisions for large mammals.

The section of US64 we are studying deviates from the original 2-lane roadbed for approximately 23 km and crosses an expanse of forest and agricultural lands inhabited by populations of black bear and white-tailed deer. Individuals from a reintroduced red wolf population may also inhabit the area. The North Carolina Department of Transportation (NCDOT) has decided to build three wildlife underpasses along this segment. These concrete forms will measure at least 38 m wide and 2.4 - 3.0 m high and extend approximately 100 m. Chain-link fencing (2.4 - 3.0 m high) will run from the underpass entrance along the highway for at least 500 m in each direction to assist in funneling animals. Various studies suggest that these dimensions should be adequate for large mammals as long as underpass locations are located in travel corridors (Reed 1981, Ward 1982, Foster and Humphrey 1995, Clevenger and Waltho *In press*).

Our goal is to determine optimal underpass locations based on animal movement patterns and landscape features. The locations for most wildlife passageways are based on historic roadkill data, known migratory pathways, or crossing points determined by radio telemetry (Reed et al. 1975, Foster and Humphrey 1995, Roof and Wooding 1996). Historic roadkill data are not available in our study area because no road exists along this proposed route. Furthermore, no seasonal migrations (for species of interest) occur in the area, and time constraints presented to us by NCDOT prevented the use of radio-telemetry. Due to these limitations, we will use a variety of methods to identify high use areas and travel corridors.

Study Area

The US64 study area is located on the Albemarle/Pamlico peninsula (APP) in northeastern North Carolina (Figure 1). Climate on the APP is humid and temperate. Summer is generally hot and humid with temperatures often exceeding daily highs of 38? C; afternoon thunderstorms are common. Winters are cool and moist; temperatures rarely drop below freezing, and rain occurs frequently. Dominant vegetation in pine plantations includes a Loblolly pine overstory with a midstory of red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), yellow poplar (*Liriodendron tulipifera*) and various evergreen shrubs. Black gum (*Nyssa sylvatica*), various oaks (*Quercus* spp.), red maple, sweetgum, and yellow poplar dominate hardwood stands.

Primary crops include corn, cotton, soybeans, tobacco, and wheat. This area was heavily drained for agriculture, and although ditches and canals are common, few natural creeks remain. The entire area can be characterized by flat, low topography, most of which lies between 3.1 m and 6.1 m above sea level.

Methods

Without an existing road on which to document crossing points, we have based our methods on the premise that areas currently used most heavily are potential locations for underpasses. Methods used to determine these areas are: 1) track count surveys, 2) ditch crossing surveys, 3) monitoring trails with infrared cameras, and 4) GIS modeling to identify likely wildlife travel corridors at the landscape level. Our definition of seasons follows the results of telemetry monitoring of black bears by Jones (1996) who found that wheat, corn, and soybean crops influenced bear movements from den emergence until den entry. The harvest of wheat and the presence of maturing corn divided spring from summer. The harvest of corn and the maturing of soybeans served to divide summer from fall. Our seasons are: Spring = April to end of June, Summer = July to end of September, Fall = October to end of December. January through March will not be surveyed due to time constraints and because bears are typically denning during this period.

Track surveys are conducted as close as possible to the proposed highway using selected timber and farm roads as well as a power line right-of-way. Route substrate is smoothed and cleared of old tracks using a harrow drag one day prior to the survey. Tracks are located from an ATV. We identify the species, note the direction of travel (cardinal direction), whether it is entering, exiting, crossing or walking along the road, and collect the position with a differentially correctable GPS. All medium to large species are included if their tracks are identifiable. Animal tracks often correspond with the survey route creating a line that can be followed. Several GPS positions are taken from these tracks and later connected in ArcView to form a trail. Trails running for less than 50 m and tracks crossing the route are categorized with individual tracks. Widths of bear tracks are measured, and canid track lengths are measured if species identification is uncertain. An index of the road condition and the number of days since heavy rain is noted for each survey. These data are entered into an ArcView file and spatially analyzed for clusters of activity by species. Surveys will be conducted twice per month for a total of six per season.

Much of the proposed route has plantation pine to the north with large farms to the south. Because these farms lack suitable roads that parallel the proposed route, most of the survey routes are north of the highway corridor in the forest. To counter this bias, we will search the south side of the ditch forming the forest-farmland boundary for crossing points of deer or bear. To distinguish between beaver-otter slides, erosion, etc., cleared sections at ditch edges are only considered crossings if both sides had a trail within view or visible deer or bear tracks. Crossing surveys give a general view of which areas are used most during a given season. Ditch crossings will be collected with the differential GPS and entered into ArcView and analyzed in the same manner as are tracks. These surveys will be conducted once per season.

Unlike the surveys, which are conducted to find travel corridors, infrared trail monitors attached to cameras (both active and passive models) have been set up on features already identified as corridors. These include trails and creeks that run perpendicular to the proposed route. By monitoring suspected travel corridors with cameras, we can document which species use them and how often. Each site will be monitored as long as current land use allows.

Because results from surveys, monitors, and modeling cannot be statistically analyzed together, each method will be analyzed separately using bivariate statistics and other methods to rank potential underpass sites. Results will then be compared, and sites selected by multiple methods will be given more weight in determining the final three underpass locations. A protocol for assigning weight to individual methods has not yet been developed. We will also consider human settlement patterns and attempt to account for future development in areas of likely underpass placement.

Results

Track surveys conducted during the spring season identified 1,335 tracks of eight species: black bear, deer, bobcat, coyote, domestic dog, gray fox, raccoon, and opossum (Table 1). Separate bear tracks were found 41 times with 18 additional trails, and deer left 955 individual tracks and made 39 trails. No wolf tracks were documented. The remaining 6 species identified were: coyote - 25 tracks and 9 trails, domestic dog - 8 tracks and 3 trails, gray fox - 37 tracks and 6 trails, raccoon - 19 tracks and 3 trails, bobcat B 5 tracks and 0 trails, and opossum - 22 tracks and 0 trails. We found 192 crossing points across the major canal ditches during the spring season. Based on tracks and frequent sightings, these crossings are used mainly by deer, although bear and raccoon sign has been found as well.

We continue to operate infrared trail monitors, but these results only include data collected by 4 monitors during the spring season. Cameras were set with a two-minute delay to prevent repeated exposures of animals already photographed. Events within 2 minutes of an animal photograph were assumed to be either the same animal or a second animal of the same species. Excluding false triggers, these monitors have yielded 18 photographs of animals and 23 additional events assumed to be animals (Table 2.). Of this total, 12 photographs documented 14 deer (2 pictures had multiple animals) with 11 events assumed to be additional deer. Six bears were caught in 5 photographs with 12 additional events attributed to bears. One gray fox was photographed at the lower edge of the picture, and such small mammals may account for several empty photographs recorded by cameras. All camera locations provided photographs of both deer and bear. GIS landscape analyses have not been conducted to date.

Discussion

We recognize limitations to how well underpass locations can be located within one year. Additionally, crop rotation patterns, harvesting-thinning on timberlands, altered landscape by the construction of the road itself, and development will all impact future animal movements. We have assumed that the highway construction will not be so disruptive as to cause animals to significantly change their movements from the travel routes identified in this study.

Various sources of bias, discovered during data collection, may affect our ability to document where animals have traveled. Weather affects road conditions because tracks are easier to see after rains than after prolonged dry spells. We compensate for this problem by altering the order of surveys. Activity by the timber company also alters road conditions. Road improvements by the timber company cover tracking substrate, and the increased traffic and activity possibly alter animal movements.

Various sources (Reed 1981, Ward 1982, Foster and Humphrey 1995, Clevenger and Waltho *In press*) have indicated that large mammals will use underpasses of appropriate dimensions. From these available data, we are confident that black bear, deer, red wolves, and other local species will use the US64 underpasses if they are properly located. Results attained from our first season support our assumption that such locations can be determined before the highway is built. Building underpasses during road construction has several benefits: 1) underpasses will be in place when the road is opened, reducing both human and animal injury and death from the outset, 2) impacts on wildlife populations should be reduced, and 3) the cost of building the underpasses is lower than installing them post-construction. Our methods to locate underpass sites, while not as elaborate as radio-telemetry, are quick and less expensive and do not suffer from low sample sizes. In addition, multiple species can be examined at one time. Further work is needed to improve these methods so that more wildlife passage structures are included at the early stages of highway planing nationwide.

Acknowledgments

This project would not be possible without funding and support from the North Carolina Department of Transportation and the North Carolina Wildlife Resources Commission.

References Cited

Beringer, J. J., S.G. Seibert, and M.R. Pelton. 1990. Incidence of road crossing by black bears on Pisgah National Forest, North Carolina. Int. Conf. Bear Res. and Manage. 8:85-92.

Brody, A. J and M.R. Pelton. 1989. Effects of roads on black bear movements in Western North Carolina. Wildl. Soc. Bull. 17(1):5-10.

Clevenger, A.P. and N. Waltho. *In press*. Factors influencing the effectiveness of wildlife underpasses in Banff National Park, Alberta, Canada. Conservation Biology 14 .

Conover, M. R., W.C. Pitt, K.K. Kessler, T.J. DuBow, and W.A. Sanborn. 1995. Review of human injuries, illnesses, and economic losses caused by wildlife in the United States. Wildl. Soc. Bull. 23(3):407-414.

Foster, M. L. and S.R. Humphrey. 1995. Use of highway underpasses by Florida panthers and other wildlife. Wildl. Soc. Bull. 23(1):95-100.

Gibeau, M. L. and K. Heuer. 1996. Effects of transportation corridors on large carnivores in the Bow River Valley, Alberta. 13pp. *in* Evink, G. L., P. Garrett, D. Zeigler, and J. Berry, eds. Trends in addressing transportation related wildlife mortality, Proceedings of the Transportation Related Wildlife Mortality Seminar, April 30, May 1 & 2, 1996. Orlando, Florida.

Jones, M. D. 1996. Black bear use of forest and agricultural environments in coastal North Carolina. Masters Thesis. University of Tennessee, Knoxville.

Mattson, D.J., R.R. Knight, and V.M. Blanchard. 1987. The effects of development and primary roads on grizzly bear habitat use in Yellowstone National Park, Wyoming. Int. Conf. Bear Res. and Manage. 7:259-273.

Paquet, P. C. and C. Callaghan. 1996. Effects of linear developments on winter movements of gray wolves in Bow River valley of Banff National Park, Alberta. 21pp. *in* Evink, G. L., P. Garrett, D. Zeigler, and J. Berry, eds. Trends in addressing transportation related wildlife mortality, Proceedings of the Transportation Related Wildlife Mortality Seminar, April 30, May 1 & 2, 1996. Orlando, Florida.

Reed, D. F. 1981. Mule deer behavior at a highway underpass exit. Journal of Wildlife Management 45(2):542-543.

., T.N. Woodard, and T.M. Pojar. 1975. Behavioral response of mule deer to a highway underpass. Journal of Wildlife Management 39(2):361-367.

Roof, J. C. and J.B. Wooding. 1996. Evaluation of S.R. 46 Wildlife Crossing. Florida Cooperative Fish and Wildlife Research Unit, Gainesville, Florida Technical Report #54. 36 pages.

Ruediger, B. 1996. The relationship between rare carnivores and highways. 17pp. *in* Evink, G. L., P. Garrett, D. Zeigler, and J. Berry, eds. Trends in addressing transportation related wildlife mortality, Proceedings of the Transportation Related Wildlife Mortality Seminar, April 30, May 1 & 2, 1996. Orlando, Florida.

. 1998. Rare carnivores and highways - moving into the 21st century. Pages 10-16. *in* Evink, G. L., P. Garrett, D. Zeigler, and J. Berry, eds. Proceedings of the International Conference on Wildlife Ecology and Transportation, February 10-12, 1998. Ft. Meyers, Florida. 263pp.

Ward, A.L. 1982. Mule deer behavior in relation to fencing and underpasses on Interstate 80 in Wyoming. Transp. Res. Rec. 859:8-13

Table 1. Results of spring track surveys from the Highway 64 expansion underpass placement study, Washington County, North Carolina.

Species	**Number of Trails**	**Number of Individual Tracks**
Black bear	18	41
White-tailed Deer	39	955
Coyote	9	25
Dog	3	8
Gray Fox	6	37
Raccoon	3	19
Opossum	---	22
Bobcat	---	5

Table 2. Results of infrared monitors and cameras from the Highway 64 expansion underpass placement study, Washington County, North Carolina.

Subject	**Photographs**	**Events**
White-tailed Deer	12	11
Black Bear	5	12
Gray Fox	1	0
Researcher (Check set up)	6	2
Empty	8	0
Total	32	25

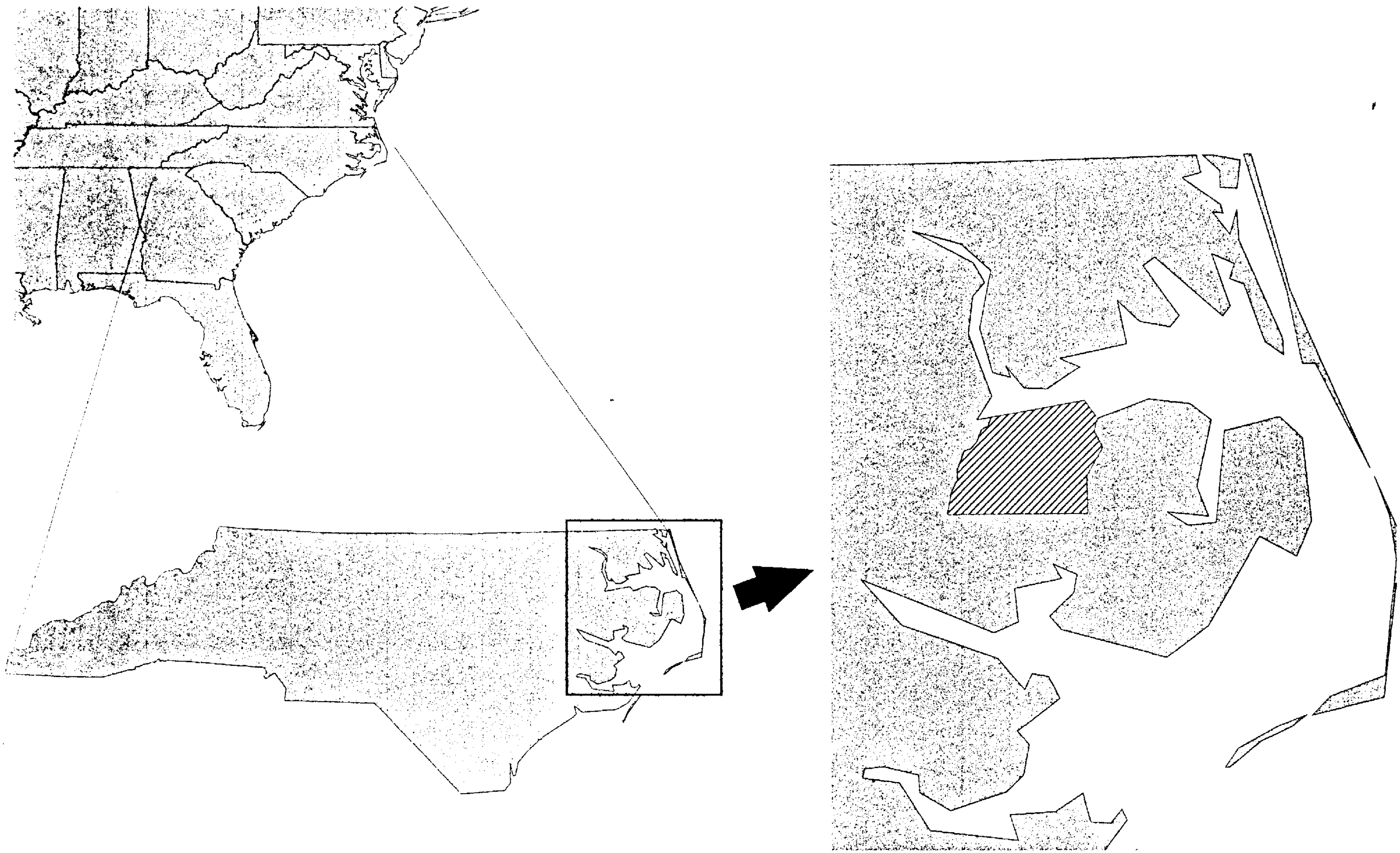

Figure 1. Geographical location of the Highway 64 expansion underpass placement study, Washington County, North Carolina.