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RESEARCH PROGRAMS

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Evaluation of Wildlife Crossing Structures on US 93 in Montana's Bitterroot Valley

http://www.mdt.mt.gov/research/projects/env/us93_wildlife.shtml

Introduction

Collisions between wild animals and automobiles are a problem for some wildlife populations and a safety issue for motorists in Montana and across North America. Wildlife crossing structures with wildlife exclusion fencing is the most effective method to reduce wildlife-vehicle collisions (WVC) and allow animals to safely move across roads. The Montana Department of Transportation (MDT) installed 19 wildlife crossing structures for large animals within a suburban-wildland setting along US 93 between Florence and Hamilton from 2004 to 2012. The purpose of this research was to evaluate the effectiveness of these wildlife crossing structures for white-tailed deer.

What We Did

White-tailed deer were monitored at pre-construction sites, control sites, and post-construction wildlife crossing structures with motion activated cameras. Unique individual deer movements were categorized (success, repellency, or parallel), tallied, and use rates were calculated. The use rates from pre-construction and control sites were used as performance measures to evaluate the use rates at post-construction wildlife crossing structures.

The differences in white-tailed deer use rates between wildlife crossing structure types (bridges and culverts) were assessed. The research team also assessed the relationships between use rates of wildlife crossing structures and the following explanatory variables: height, width, length, openness, fence length, guardrail length, human presence, grass, forbs, shrubs, trees, bare ground, water, and deer fecal pellets.

Statistical analyses were used to determine if there were differences in the means of each of the explanatory variables (excluding guardrail length because only bridges had guardrail) between bridges and culverts.

A statistical graphing program was used to compute and map smooth representations of the variations in intensities of WVC carcasses and WVC crashes over a 15-year period relative to wildlife crossing structure locations.

Before-After-Control-Intervention (BACI) design analysis was used to evaluate changes in WVC crash rates between pre-construction and post-construction of wildlife crossing structures.

What We Found

During pre-construction monitoring, the success rate for white-tailed deer attempting to cross US 93 was 64 percent, and the rate of repellency was 10 percent. The success rate for white-tailed deer trying to cross County Road 370, a control site, was 63 percent and the rate of repellency was five percent. Based on these pre-construction and control site monitoring rates, the research team established performance measures of 60 percent or greater success rate and 10

percent or less rate of repellency to evaluate post-construction use rates of wildlife crossing structures. In other words, at the wildlife crossing structures, US 93 should be at least as permeable for white-tailed deer as it was before the structures were installed.

Post-construction monitoring cameras recorded white-tailed deer successfully moving through the wildlife crossing structures on 24,878 occasions. Six wildlife crossing structures (five bridges and one large culvert) had success rates greater than 90 percent. Nine wildlife crossing structures (eight bridges and one culvert) exceeded the performance measures. Ten structures (four bridges, six culverts) did not exceed the performance measures.

The white-tailed deer success rate was higher for bridges than for culverts, counter-balanced by a lower parallel rate for bridges than for culverts. There was no significant difference in rate of repellency between bridges and culverts.

Success rates for wildlife crossing structures increased with increasing width, openness, guardrail length, and shrub cover. Success rates decreased as structure length (the distance a deer moved through the structure) increased. Lower rates of repellency were strongly related to increased height, width, openness, guardrail length, and shrub cover. Parallel rates for wildlife crossing structures decreased with increasing width, openness, and guardrail length. Parallel rates increased as structure length increased. There was little to no evidence that fence length, human presence, grass, forbs, trees, bare ground, water, and fecal pellets were related to white-tailed deer use rates of wildlife crossing structures.

Statistical analyses were used to determine if there were differences in the means of the explanatory variables between bridges and culverts. There was a statistically significant difference in width, length, openness, and human use between bridges and culverts. Bridges were wider, shorter in length, more open, and had higher human use than culverts. There was no statistical difference in height, fence length, grass, forbs, shrubs, trees, bare ground, water, and pellets between bridges and culverts.

A map of the intensities of WVC carcasses and the map of WVC crashes (Figure 1) over a 15-year period illustrates temporary increases after the construction of most of the wildlife crossing structures. These temporary increases have two possible explanations. They may represent white-tailed deer adaptations to the structures, four lanes rather than two, and increases in traffic speed following an entire season of construction. It is also possible that the temporary increases were not related to the construction of wildlife crossing structures. WVC intensities at many given locations appear to increase and decrease over time, before and after the construction of wildlife crossing structures. The map representations do not provide statistical evidence for or against a relationship between WVC rates and wildlife crossing structures. They simply display variations in WVC intensities over space and time relative to wildlife crossing structure locations. However, these representations become more powerful for observing WVC patterns over the long term.

The BACI analysis found that none of the 19 wildlife crossing structures had a statistically significant effect on WVC crash rates. However, substantial relative reductions and increases in WVC crash rates did occur at wildlife crossing structures. The largest

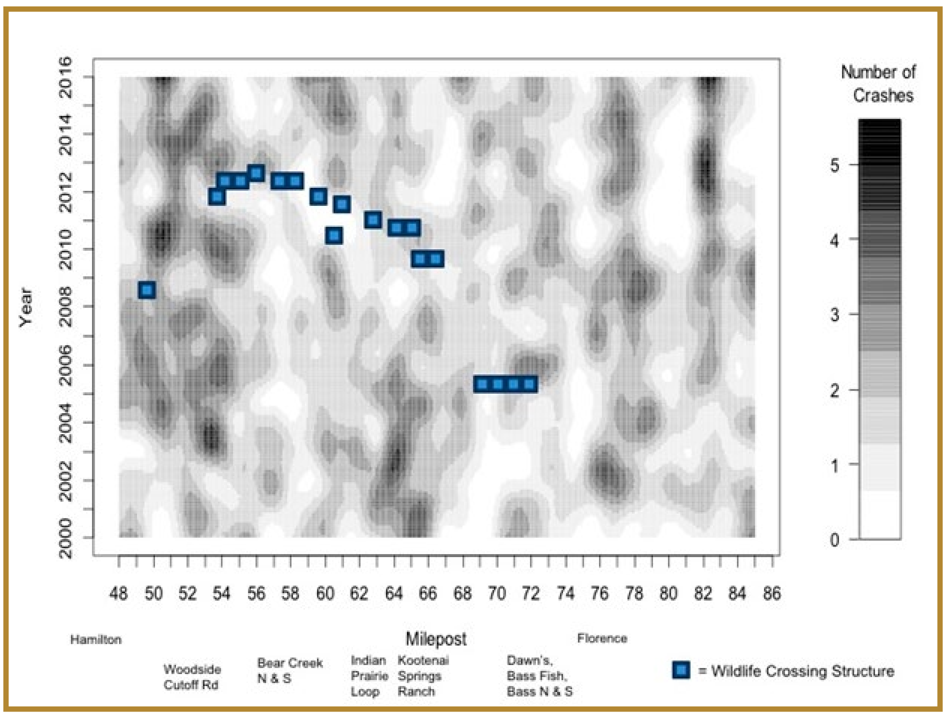


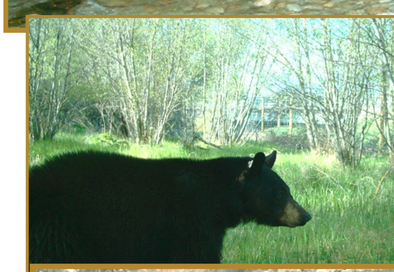
Figure 1: Representation of WVC Crash Intensity, US 93, MP 48 to 85, 2000 Through 2015.

reduction in WVC crash rate, relative to the change in WVC crash rate at a control section, was -2.6 crashes per mile per year. The largest relative increase in WVC crash rate was 1.4 crashes per year per mile.
The relative changes in WVC crash rates did not appear to be related to fence length of wildlife crossing structures. Decreases and increases in crash rates occurred at wildlife crossing structures with short and long fence lengths.

Crash rates have been shown to be a function of variables such as deer abundance, traffic volume, highway configuration, and adjacent land use. With the exception of deer abundance, it appeared these variables were well controlled in the BACI analysis. Overall, it appeared that white-tailed deer abundance in the vicinity of each wildlife crossing structure may have been the most dynamic and important variable affecting WVC crash rates.

What the Researchers Recommend

- WVC carcass data collection and management should be complete, accurate, and consistent within MDT. All records and sources of WVC carcass data should be rectified.
- Carcass data should be located, input, and managed in a smart phone application or other Global Positioning System (GPS) based format that uploads carcass locations to an on-line user-interfaced map. Carcass data and locations that are available in real-time may provide quick solutions to many WVC situations, and assist with the planning of future transportation projects.
- There were very strong relationships between openness ratio (height multiplied by width (span) divided by length) and use rates in this study. Wildlife crossing structures should be designed to maximize openness ratio. High openness ratios are easier to achieve with bridges than with culverts.
- Width (span) should be maximized for wildlife crossing structures, length should be minimized, and height should be maximized. These recommendations for structure dimensions should be prioritized in the order they are listed. In this study bridges were wider than culverts, and culverts were longer than bridges.
- In suburban-wildland settings, extended sections of wildlife exclusion fence are not recommended as a means to improve the use of wildlife crossing structures by white-tailed deer. However, extended sections of fence may have an effect on the relative reduction of WVC crash rate at wildlife crossing structures.
- Wildlife crossing structures are recommended in suburban-wildland settings. In this study, several highly successful structures were located in close proximity to humans and their infrastructure. Puma, wolf, and black bear were observed successfully utilizing these structures, in addition to white-tailed deer.
- Future transportation planning should continue to include consultation with Montana Fish Wildlife and Parks to consider multiple wildlife species in the area under consideration. Species such as moose and elk require specifically designed wildlife crossing structures.
- Pre-construction monitoring of future wildlife crossing structure sites, and monitoring of control sites are recommended. In this study, monitoring of pre-construction sites and control locations provided performance measures used to evaluate post-construction use rates of wildlife crossing structures.
- Right of way cameras should be installed whenever possible during pre-construction monitoring. In this study they provided success rates, repel rates, and quantified the permeability of US 93 across two lanes of traffic for white-tailed deer and elk.
- In addition to post-construction monitoring, wildlife crossing structures and wildlife exclusion fence should be regularly inspected and adaptively managed.



For More Details . . .

The research is documented in Report FHWA/MT-17-003/8194, http://www.mdt.mt.gov/research/projects/env/us93_wildlife.shtml.

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MDT Implementation Status: January 2017

MDT is developing a wildlife accommodations process through a separate research project. For more information on this project, visit the project website.

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