Montana US 93 South Wildlife Crossings Research

MDT # HWY – 308445-RP

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Overview

Montana Department of Transportation (MDT) has installed several wildlife crossing structures along US 93 South of Missoula between Florence and Hamilton, with ongoing construction that will install additional crossings in the coming years. This research will be conducted from 2008 until 2015 along this stretch of US 93 to help determine the effectiveness of these crossings and associated fences. Through investigations in animal-vehicle collisions and animal crossing structure usage before and after construction, the level of efficacy of these measures will be evaluated. White-tailed deer is the species of concern for this investigation, but other animals' use and collisions will be analyzed as well.

Work Progress This Quarter

Wildlife Crossings and Cameras

At the beginning of this quarter four cameras were already installed along US 93 South at existing wildlife crossings. This quarter 11 more cameras were installed. The names of the camera sites are for the names of the crossings, usually for the streams they span. The table denotes camera locations with a coded name of the site, in order to protect the equipment and wildlife.

Camera Site	Date Installed
B Crossing	Oct. 10 08
B S Crossing	Nov 22 08
B C Crossing	Nov 22 08
D Crossing	Nov 23 08
K Crossing	Apr 21 09
M Crossing	Apr 22 09
M new	Mar 23 09
K S new	Apr 22 09
I S new	Apr 22 09
B C new	Apr 22 09

The new cameras are placed at existing crossings to monitor wildlife use at the entrances. The remaining eight cameras are located at the sites of new crossings.

Analyses of the data from six cameras that have been photographing wildlife this quarter show that the B, BS, and BC crossings have very limited deer use in the 64 days of this quarter's monitoring. Less than five deer passes occurred at all these sites combined. The D Crossing has maintained moderate deer activity, but the overall numbers have also declined since last quarter. A simple ratio of deer per day has been created to better compare deer numbers in front of the cameras each quarter. D crossing had a .90 deer per day ratio in the winter. This quarter the ratio is .78 deer per day. The two new cameras at future wildlife crossing sites have had heavy deer use. The M site camera recorded 34 deer in 27 days, for a ratio of 1.26 deer per day. The I S site cameras recorded 48 deer in 27 days for a ratio of 1.78 deer per day.

Animal-Vehicle Collision Data Analysis

Team member Kari Gunson prepared a preliminary report on a-v-c-carcass analysis-first stage. Through analyses looking at space and time separately, and then together in a kernel density analysis, Ms. Gunson give clear evidence as to the peaks in when deer were getting killed along US93 over the 10 years of data, and where the hotspots occur. Please see **Part II. Deer-Vehicle Collision Pre-mitigation Analysis** of this report, after the reporting of the camera data from the wildlife crossings.

Anticipated Work

Future work in the next quarter includes:

- monthly checking of current cameras and photograph analyses,
- installation of additional cameras,
- pellet group transects,

- meetings with MDT personnel to determine the schedules of future road projects in the study area,
- the taking of GPS coordinates of roadside and landscape features related to animal-vehicle collisions,
- and continued mapping and analyses of a-v-c data.

Preliminary Results of Crossing Monitoring

A detailed analysis of each crossing's photographed is presented below. The events are defined as photos beginning with a new trigger of the camera that results in an animal coming or going through the wildlife crossing structure. The new trigger is at least 5 minutes since the last trigger by what appears to be the same animal(s). If there is continued movement near the camera by the same animal or group of animals, this is considered one event, even it occurs for 15 minutes. When animals approach the crossing but are repelled, or are moving in what appears to be a parallel movement, this is not recorded as an event in the tables below. **The tables are only successful wildlife passes in the case of existing crossings. In areas of future crossings, all wildlife activity is presented.**

<u>B Crossing</u>

From February 15 through April 20, the camera was operable 64 days this quarter and 192 days total since installation.

There was little deer activity under B crossing this quarter. In 64 days, there was one deer event. Two does were photographed coming through the crossing in the stream from the east. This is the first event where does were photographed using the crossing structure rather than being repelled. Turkeys began appearing at the mouth of the crossing starting on April 8th. There were no house cats photographed during this period, which may have helped make the area more amiable to turkeys. The first bobcat was photographed in this quarter. There were three human urination events.

Two White-tailed deer does coming through creek. These are the first does photographed using the passage since camera was installed in October 2008. Others have been repelled.

Turkeys were photographed on four occasions in this quarter, at the mouth of the crossing. In every case they crossed the stream and did not venture into the crossing.

First bobcat photographed at B Crossing.

B S Crossing

B S camera operated from February 15 through April 20, 64 days this quarter, 148 days total.

There were no deer events recorded. There were 11 human events, all during the day, which included an apparent college-aged class field trip. One male urination occurred. A Turkey approached the creek from the sidewalk and flew over the stream. Raccoon use the crossing regularly.

		Turkey flying over creek

BC Crossing

BC camera operated from February 15 through April 20 for 64 days this quarter, and for a total of 148 days.

There was little deer movement recorded this quarter, only two deer events occurred, and were most likely the same doe coming back through one hour after the first event. A new species was recorded using the culvert, a muskrat.

		Female White-tailed deer
		Muskrat

<u>D Crossing</u>

The D Crossing camera operated from February 15 through April 20 this quarter for 64 days, 147 days in total.

There were 22 deer events in the 64 days of this quarter, recording the passage of 50 deer, none of which was repelled for more than a few minutes. This creates the ratio of 50 deer in 64 days, for a value of .78 deer per day. This is lower than last quarter's .90 deer per day. White-tailed deer used the crossing every week, with the exception of a two week period in Mid-February. There were 5 photographed events of an antlered (male) deer, (perhaps the same deer each time). The deer with the arrow in its side was photographed again, without antlers. Of the 22 deer events, 14 (63%) were from the east, 8 were from the west. There may be a bias in the camera, in that it more readily takes pictures if the action is from the east rather than the west. Four white-tailed deer events were during the day (18%), five were at dawn or dusk (23%), and the majority (13 – 59%) was at night. There was a higher incidence of human use of the area than in winter months, with six human events in the 64 days.

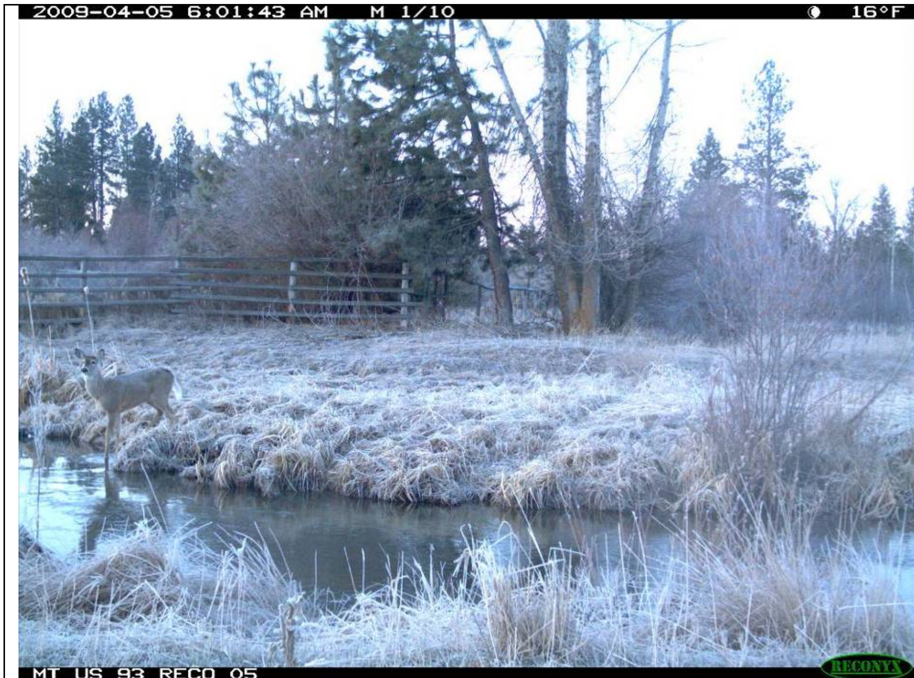
Buck with antlers still attached in March.

First coyote recorded at D Crossing.

Deer with arrow in its side, possibly the same buck photographed in December.

<u>M Site</u>

A camera was installed on March 24, and for this quarter, recorded events for 27 days. There were 20 deer events recorded, with a total of 34 individual deer photographed. The 34 deer in 27 days creates a deer per day ratio of 1.26 deer per day. This value will be helpful in evaluating the efficacy of the new crossing over time. The photos were predominantly of does and young of the year. There were no antlered deer. They came from every direction, and seven events were more of deer moving parallel to the road and crossing the stream. There was one event where four deer approached the area from the road way along the stream, and were almost certainly coming from a passage under the bridge. See picture below. The camera is picking up deer movement at night well beyond the usual 30-35 feet range for these conditions, see night picture below.

		Doe at dawn. This kind of movement is recorded as parallel to road.
		The camera is able to pick up deer movement across the stream in the dark. See doe and fawn.

This event was recorded as a pass beneath the roadway under the existing bridge, along the stream, due to road and landscape conditions that make it very difficult for deer to appear in this area by coming over the road.

<u>IS Site</u>

This camera was installed to the south and uphill from the future wildlife crossing at this site. There is an old trail-road bed that runs from this area to the road, and there are two deer road kill carcasses at the entrance of this old road at Highway 93. There appears to be much deer use of the area; there are bedding areas between this older trail-road and the highway, and pellet piles and tracks. The camera was situated to capture animals traveling up this trail-road bed to the highway. The camera was installed on March 24 and was working for 27 days this quarter. There were 20 deer events with 48 animals. The deer per day ratio is then 48/27 = 1.78, making it the mostly highly used area in front of cameras to date. There is a small herd of four and sometimes five deer that bed in the trees just between the camera and the road. They can be viewed coming up from this area some nights, and returning to it some mornings. This group helps to make this deer per day ratio as high as it is. There were also turkeys in the area, and other birds. A mystery carnivore was photographed, it may be a cat.

	This picture of turkeys allows the day time view of the camera's range. New crossings will be between the first high electric pole in view and road.
	These deer are regulars to the site. They bed down in the small grove of trees in front of the camera. The majority of pictures are of this herd of 4-5.
	This chickadee was attacking the camera, perhaps because she thought it was a viable nesting cavity.

Part II. Deer-Vehicle Collision Pre-mitigation Analysis

Introduction

A wildlife-vehicle collision (WVC) data set was received by the research team for the study area. This data comprised of 1620 records for white-tailed deer-vehicle collisions (DVC) from January 1998 to December 2007, from mile posts 49.1 to 74.3. This data was plotted in a GIS and imported in Matlab version 7.1 to complete a preliminary pre-mitigation WVC data analysis along Highway 93.

Methods

We used a kernel density function to determine hotspots of collisions in space, time and space-time combined. The kernel density function calculates a weighted density of events per unit area. This algorithm was adapted from Bailey and Gatrell (1995) to perform a weighted density per unit length-in this case length of road (Mountrakis and Gunson in press). The kernel function is unique to a density analysis because it calculates a **weighted** density value within a search distance from predefined distance or time markers along the road or timeline. The WVCs closest to the distance or time marker have the highest weight and it drops smoothly to a value of zero as the search distance is reached. The user specifies the search distance (e.g. kilometer or months) and kernel shape, and the interval step between distance markers. There is some trial and error in determining the best search distance, and the higher this value the more smooth the output is, i.e. there is less local variation in the density values. For further explanation on this methodology a copy of the manuscript Mountrakis & Gunson (in press) is available. These space time kernel analyses are only the first step (exploratory), and we hope to also apply other spatial statistics (Bayesian models) and avc collision analysis to determine road-related and landscape characteristics interacting with these hotspots.

Results

Space

We selected a search distance of 2 km for the kernel density analysis since this gave the most information and the data was relatively smooth, i.e. there wasn't a lot of noise. In addition 2 km is a scale that is typically used for transportation mitigation planning. At this search distance there were two major peaks at milepost 53.5 and 63.6.

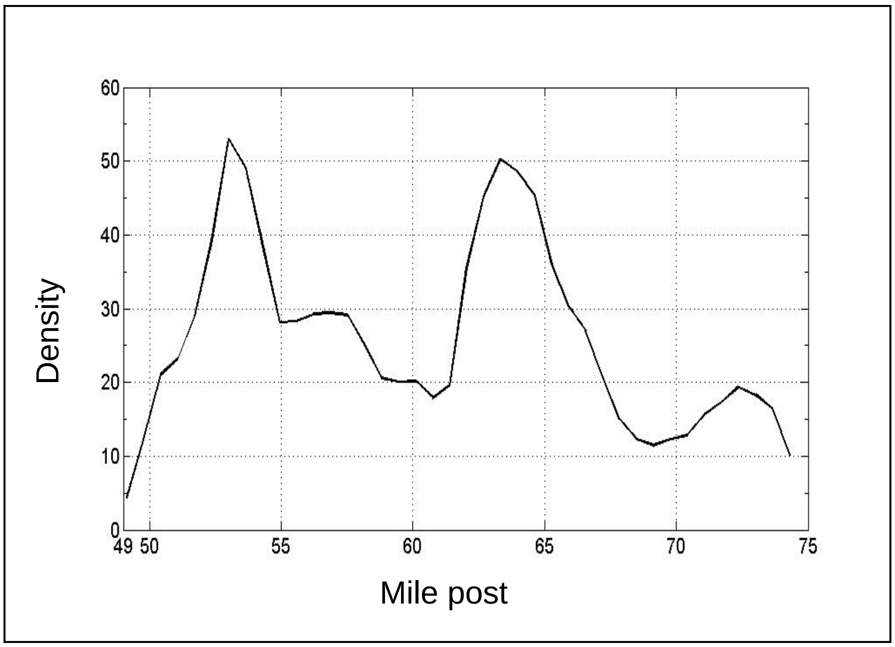


Figure 1. Kernel density spatial output for deer-vehicle collisions from mp 49.1 to 74.3, with two major peaks at 53.5 and 63.6.

Time

Figure 2 shows the output from the temporal kernel density analysis for the deer-vehicle collisions from January 1998 to December 2007. We selected a search distance of 4 months as this showed a smooth annual cyclic pattern for the collisions. Each annual peak corresponds to the following dates, December 1998, November 1999, November 2000, October 2001, November 2002, December 2003, November 2004, November 2005, November 2006, and October 2007. The highest peak in collisions was in November 2006, and a close second was in December 2003. It would be worth investigating why these two peaks occurred in these years, to determine if there was a higher sampling intensity or other environmental factors influenced these hotspots.

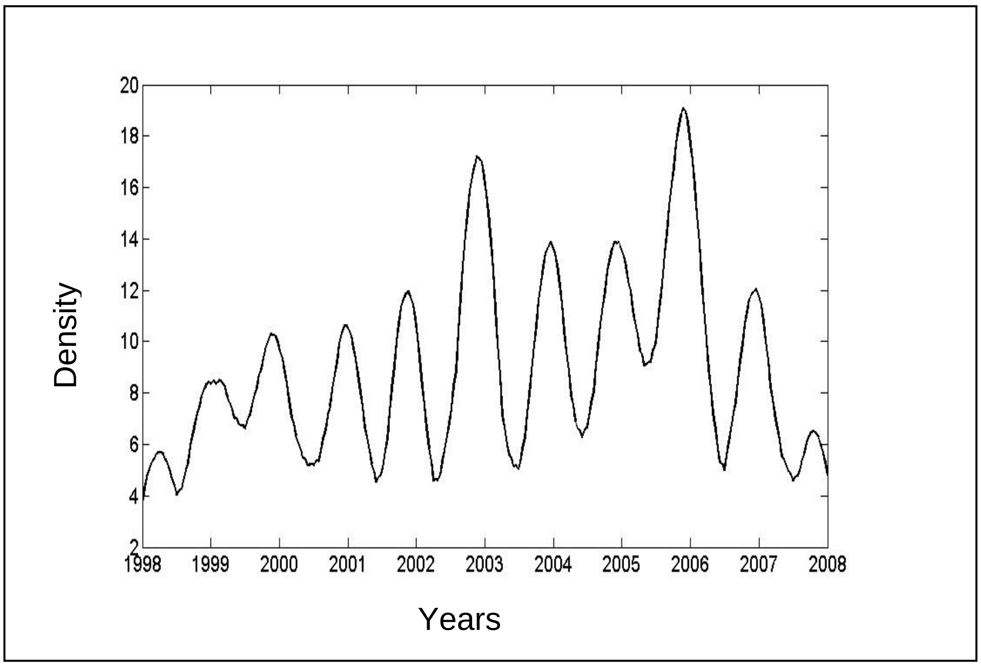


Figure 2. Kernel density temporal output for deer-vehicle collisions from January 1998 to December 2007. Annual peaks occurred between October and December each year.

Space and Time

Figure 3 shows that the highest density (~10 collisions) occurred in 2001 at the same mile locations (53.5 and 63.6) as the two major peaks described in the spatial density analysis. However, what is interesting is the spatio-temporal hotspots are not continuous in time at each spatial peak. At mile post 53.5 there are hotspots occurring in 2003, 2004, 2005, and 2006 which is new information that was not obtained from conducting the spatial and temporal analyses above. In addition, at milepost 63.6 the greatest number of kills occurred from the fall of 2002 to 2003.

The space-time analysis is an excellent tool to use in a project such as on highway 93 where mitigation structures are rapidly being implemented over a short space of time. Figure 3 represents a pre-analysis of deer-vehicle collisions, and assumes the data was collected consistently over space and time. Granted that the road-kill data collection will continue to be collected along the same route, the years can be added to the y axis to portray the changing dynamics of deer-collision hotspot from mitigation construction and post- mitigation construction.

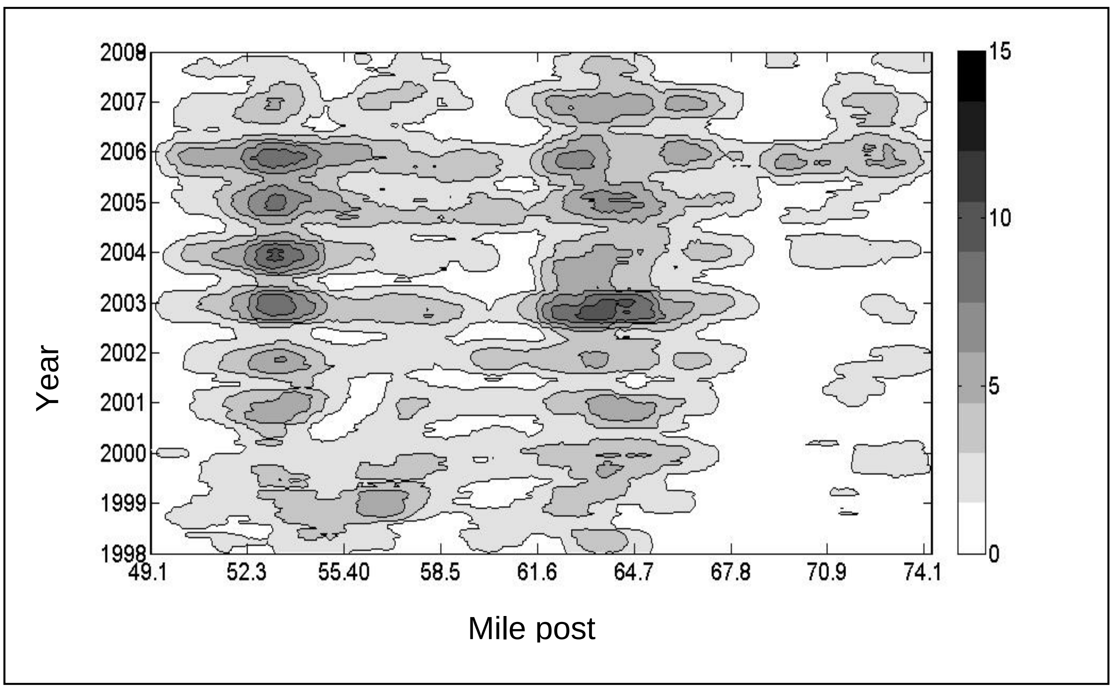


Figure 3. Kernel density space-time output for deer-vehicle collisions from January 1998 to December 2007 from mile posts 49.1 to 74.3.

References

Bailey, T.C., and Gatrell, A.C., 1995, Interactive Spatial Data Analysis. Longman Scientific and Technical, Essex, UK.

Mountraks, G., and Gunson, K.E. (in press), Multi-scale spatiotemporal statistical analyses of moose-vehicle collisions in Vermont. Environmental Management.