

# Montana US Highway 93 South Wildlife Crossings Research

## MDT # HWY – 308445-RP

### 2013 Second Quarter Progress Report

Prepared by

Patricia Cramer, Principal Investigator [cramerwildlife@gmail.com](mailto:cramerwildlife@gmail.com)

Robert Hamlin, Research Assistant, [hamlinr@hotmail.com](mailto:hamlinr@hotmail.com)

With assistance from:

Kari E. Gunson, Research Assistant, [kegunson@eco-kare.com](mailto:kegunson@eco-kare.com)

Mark Greenwood, Statistical Consultant, [greenwood.stat@gmail.com](mailto:greenwood.stat@gmail.com)

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## 1. Study Area and Purpose

The Montana Department of Transportation (MDT) installed 19 large wildlife crossing structures along US Highway 93 South between Florence and Hamilton from 2004 to 2012. Wildlife exclusion fencing was installed during construction at 17 of these structures. This fencing is 8 feet high (2.3 meters) and extends various distances from the entrances of wildlife crossing structures. Fencing was not installed at Bass Creek North and Bass Creek South. Additional details of the 19 wildlife crossing structures are presented in Table 1. A map of the study area is presented in Figure 1.

The purpose of this research is to determine the effectiveness of wildlife crossing structures by investigating:

1. white-tailed deer (*Odocoileus virginianus*) use of wildlife crossing structures and wildlife crossing sites,
2. white-tailed deer usage rates of wildlife crossing structures by type and across types (including height, width, length, and material),
3. relationships between usage rates of wildlife crossing structures and landscape variables,
4. changes in animal-vehicle collisions between pre-construction and post-construction of wildlife crossing structures within a twenty-five mile stretch of US Highway 93 South, mile post (mp) 74 to mp 49, and,
5. relationships between animal-vehicle collisions and wildlife crossing structures over time and space.

This research began in 2008 and will be completed in 2015. This research is approximately 64% complete. This report presents preliminary results which preclude discussion and conclusion sections. The project is on time and on budget for all tasks.

**Table 1. Wildlife Crossings Structures, US Highway 93 South, Montana.**

<b>Structures</b>	<b>Year Completed</b>	<b>Approximate Mile Post</b>	<b>Structure Type</b>
Bass Creek North	2005	71	Bridge
Bass Creek South	2005	70	Bridge
Bass Creek Fishing Access	2005	70	Round Corrugated Steel Culvert
Dawn's Crossing	2005	70	Bridge
Kootenai Creek	2009	66	Bridge
McCalla Creek North	2009	66	Bridge
McCalla Creek South	2010	65	Bridge
Kootenai Springs Ranch	2010	65	Concrete Box Culvert
Indian Prairie Loop	2010	63	Concrete Box Culvert
Big Creek	2011	61	Bridge
Axmen Propane	2010	61	Round Corrugated Steel Culvert
Sweathouse Creek	2011	60	Bridge
Bear Creek North	2012	58	Bridge
Bear Creek South	2012	57	Bridge
Mountain Gallery	2011	56	Concrete Box Culvert
Lupine	2012	56	Concrete Box Culvert
Fun Park	2011	55	Concrete Box Culvert
Mill Creek	2011	55	Bridge
Blodgett Creek	2008	50	Bridge

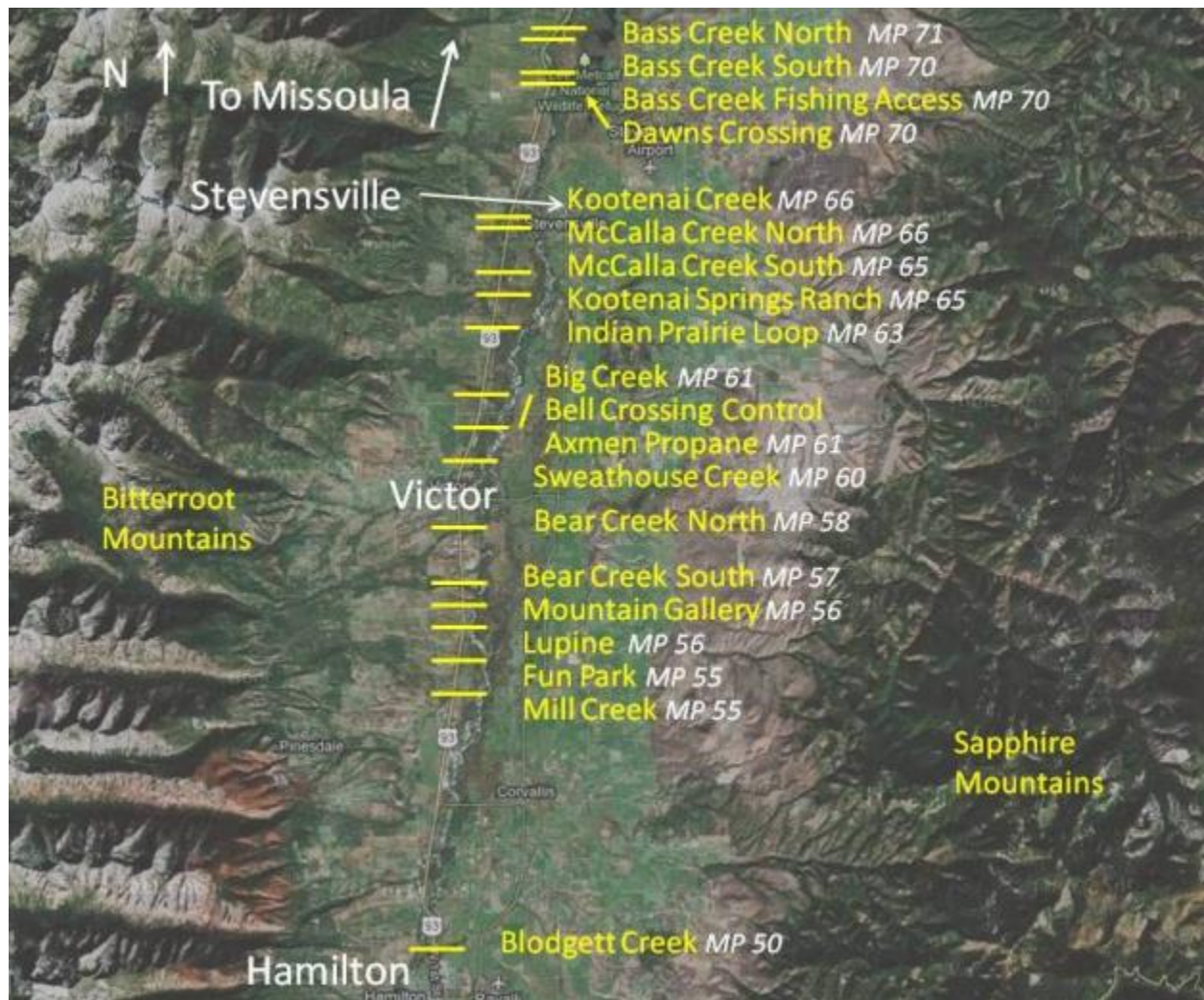


Figure 1. Map of US Highway 93 South Study Area, Montana.

## 2. White-tailed Deer Use of Wildlife Crossing Structure Sites and Wildlife Crossing Structures

### 2.1. Methods

White-tailed deer usage rates were determined by monitoring wildlife crossing structure sites and wildlife crossing structures with Reconyx Professional Cameras, Model PC85 and Model PC800. Cameras were triggered by motion and took pictures of large and small animals, day and night. Cameras were installed inside metal telephone-utility boxes or metal Reconyx Bear Boxes. Each telephone-utility box was secured by a cable locked to the camera on one end and buried in concrete at the other. Reconyx Bear Boxes were mounted on large fence posts or trees and secured with locked cables. All cameras were also secured by electronic code locks.

The following calculations were made for each camera location or wildlife crossing structure, where applicable:

- **deer per day** = the total number of deer observed divided by the number of days the camera was in operation
- **success per day** = the total number of deer observed successfully using a wildlife crossing structure divided by the number of days the camera was in operation
- **success rate** = the total number of deer moving through a wildlife crossing structure or onto the road right of way at a wildlife crossing structure site, divided by the total number of deer recorded at the structure or site
- **rate of repellency** = the total number of deer repelled at a wildlife crossing structure or the road right of way at a wildlife crossing structure site divided by the total number of deer recorded at the structure or site
- **parallel rate** = the total number of deer moving parallel to a structure or site right of way divided by the total number of deer recorded at the structure or site.

#### 2.1.1. Pre-construction Monitoring

Two cameras were installed at each of the wildlife crossing structure sites. One camera was placed as near as possible to any original bridge, or the proposed location of the

structure. These cameras were designated “structure cameras” if they recorded white-tailed deer use of the original bridges. A second camera was placed within 50 meters of the first camera at each site. These cameras were designated either “right of way cameras” or “habitat cameras.” Right of way cameras recorded animal movements as they approached or departed the road right of way. Habitat cameras recorded only parallel movements, calculated as deer per day. Pre-construction monitoring was completed in April, 2011.

### **2.1.2. Post-construction Monitoring**

A single camera was installed near one entrance of the following wildlife crossing structures: Bass Creek North (mp 71), Bass Creek South (mp 70), Bass Creek Fishing Access (mp 70), Dawn’s Crossing (mp 70), Kootenai Creek (mp 66), and Blodgett Creek (mp 50). Two cameras were installed, one near each entrance, of the following wildlife crossing structures: McCalla Creek North (mp 66), McCalla Creek South (mp 65), Kootenai Springs Ranch (mp 65), Indian Prairie Loop (mp 63), Axmen Propane (mp 61), Sweathouse Creek (mp 60), Bear Creek North (mp 58), Mountain Gallery (mp 56), Lupine (mp 56), Fun Park (mp 55), and Mill Creek (mp 55). Lupine (mp 56) was monitored with only one camera after September 13, 2012. Three cameras were installed at Bear Creek South (mp 57) and at Big Creek (mp 61). Cameras were placed near the entrances of wildlife crossing structures in order to record the number of white-tailed deer successfully using, moving parallel to, and repelled from the crossing structures. Structures completed prior to this study were monitored with one camera (McCalla Creek North is an exception). Structures completed during this study were monitored with two or more cameras (Lupine (mp 56) is an exception). Pre-construction monitoring data will be compared with post-construction monitoring data, where applicable.

### **2.1.3. Control Cameras**

Two cameras were installed at Bell Crossing (east and west cameras, control) near a bridge over an unnamed spring run on County Road 370, approximately one-quarter mile east of the Bitterroot River. The east camera is a “habitat camera” and the west

camera is a road “right of way camera.” This location was selected as a long-term control site to monitor white-tailed deer population and activity in an area where road construction, wildlife crossing structure construction, and wildlife exclusion fencing were not scheduled to occur. One camera was installed at McCalla Creek South (ramp camera, mp 65) to monitor the jump off ramp and to serve as a long-term control site. Big Creek (south camera, control, mp 61) was also selected as a long-term control site.

#### **2.1.4. Work this Quarter**

During this quarter, approximately 46,000 images were collected and analyzed. Locations, approximate mile posts, and installation dates of cameras currently monitoring post-construction wildlife activity at wildlife crossing structures, and cameras at control sites are presented in Table 2.

**Table 2. Cameras Currently Installed at Wildlife Crossing Structures on US Highway 93 South, Montana, and at Control Sites.**

<b>Camera Location</b>	<b>Approximate Mile Post</b>	<b>Date Installed</b>
Bass Creek North	71	Oct. 10, 2008
Bass Creek South	70	Nov 22, 2008
Bass Creek Fishing Access	70	Nov 22, 2008
Dawn’s Crossing	70	Nov 23, 2008
Kootenai Creek	66	Apr 21, 2009
McCalla Creek North (east camera)	66	Apr 22, 2009
McCalla Creek North (west camera)	66	Apr 22, 2009
McCalla Creek South (east camera)	65	July 30, 2010
McCalla Creek South (west camera)	65	June 16, 2010
McCalla Creek South (ramp camera)	65	June 16, 2010
Kootenai Springs Ranch (east camera)	65	June 10, 2010
Kootenai Springs Ranch (west camera)	65	July 29, 2010
Indian Prairie Loop (east camera)	63	Oct 25, 2011
Indian Prairie Loop (west camera)	63	Sept 27, 2010

<b>Camera Location</b>	<b>Approximate Mile Post</b>	<b>Date Installed</b>
Big Creek (northeast camera)	61	July 28, 2011
Big Creek (southeast camera)	61	July 29, 2011
Big Creek (southwest camera)	61	Aug 12, 2011
Big Creek (south camera, control)	61	Apr 21, 2009
Axmen Propane (east camera)	61	Sept 28, 2010
Axmen Propane (west camera)	61	April 25, 2012
Sweathouse Creek (east camera)	60	Dec 10, 2011
Sweathouse Creek (west camera)	60	Dec 10, 2011
Bear Creek North (east camera)	58	June 25, 2012
Bear Creek North (west camera)	58	June 25, 2012
Bear Creek South (east camera)	57	June 26, 2012
Bear Creek South (west camera)	57	June 26, 2012
Bear Creek South (birch camera)	57	Sept 14, 2012
Mountain Gallery (east camera)	56	April 25, 2012
Mountain Gallery (west camera)	56	Mar 2, 2012
Lupine (west camera)	56	June 26, 2012
Fun Park (east camera)	55	Mar 2, 2012
Fun Park (west camera)	55	April 25, 2012
Mill Creek (east camera)	55	Dec 10, 2011
Mill Creek (west camera)	55	Mar 2, 2012
Blodgett Creek	50	Mar 15, 2010
Bell Crossing (east camera, control)	CR 370	May 29, 2009
Bell Crossing (west camera, control)	CR 370	May 29, 2009

## **2.2. Results**

### **2.2.1. Pre-construction Monitoring**

Pre-construction monitoring was completed in April, 2011. Twenty-six pre-construction data sets are summarized by camera designation in Table 3. The order of camera locations is based on the number of deer per day photographed at each camera site. The pre-construction Bear Creek South bridge was functioning as a successful wildlife crossing structure, even though it was not designed as one (success rate 98%). The success rate for the other five structure cameras monitoring original bridges averaged 11%. For road right of way cameras, the average success rate was 59% and the average rate of repellency was 8% (n=10, excluding Lupine north right of way). The road right of way cameras recorded deer successfully crossing US Highway 93 on 1,755 occasions during pre-construction.

**Table 3. Summary of Complete Pre-construction Data Sets.**

<b>Structure Camera Location</b>	<b>Mile Post</b>	<b>Camera Days</b>	<b>Deer Per Day</b>	<b>Successful Crossings</b>	<b>Success Rate (%)</b>	<b>Rate of Repellency (%)</b>	<b>Parallel Rate (%)</b>
Bear Creek South (structure)	57	629	2.6	1662	98	1	1
McCalla Creek South (structure)	65	109	2.3	21	9	7	84
Sweathouse Creek (structure)	60	452	1.1	65	13	1	86
Big Creek (structure)	61	277	0.8	33	14	14	72
Mill Creek (structure)	55	599	0.07	1	3	0	97
Bear Creek North (structure)	58	536	0.03	2	14	14	72
<b>Right of Way Camera Location</b>	<b>Mile Post</b>	<b>Camera Days</b>	<b>Deer Per Day</b>	<b>Successful Crossings</b>	<b>Success Rate (%)</b>	<b>Rate of Repellency (%)</b>	<b>Parallel Rate (%)</b>
Kootenai Springs Ranch (east right of way)	65	107	2.1	78	32	8	60
Fun Park (east right of way)	55	490	1.5	606	79	11	10
Mill Creek (right of way)	55	566	1.2	525	70	15	15
Kootenai Springs Ranch (west right of way)	65	55	0.9	26	54	10	36
Sweathouse Creek (right of way)	60	503	0.8	219	52	4	44
Bear Creek South (right of way)	57	509	0.4	140	68	7	25
Mountain Gallery (north right of way)	56	440	0.3	64	45	4	51
Fun Park (west right of way)	55	556	0.2	57	52	3	45

<b>Right of Way Camera Location</b>	<b>Mile Post</b>	<b>Camera Days</b>	<b>Deer Per Day</b>	<b>Successful Crossings</b>	<b>Success Rate (%)</b>	<b>Rate of Repellency (%)</b>	<b>Parallel Rate (%)</b>
Lupine (south right of way)	56	172	0.1	16	80	15	5
Mountain Gallery (south right of way)	56	587	0.06	24	61	3	36
Lupine (north right of way)	56	204	0.005	0	0	100	0
<b>Habitat Camera Location</b>	<b>Mile Post</b>	<b>Camera Days</b>	<b>Deer Per Day</b>				
McCalla Creek South (habitat)	65	93	5.0				
Indian Prairie Loop (north habitat)	63	78	4.7				
Indian Prairie Loop (south habitat)	63	150	4.5				
Big Creek (habitat)	61	260	2.2				
Axmen Propane (north habitat)	61	212	1.5				
Lupine (west habitat)	56	382	1.3				
Bear Creek North (habitat)	58	454	0.6				
Lupine (east habitat)	56	385	0.6				
Axmen Propane (south habitat)	61	176	0.4				

### **2.2.2. Post-construction Monitoring**

Post-construction monitoring of the 19 wildlife crossing structures is ongoing. White-tailed deer use of wildlife crossing structures is presented in Table 4. The order of camera locations is based on success per day. Camera data reported were analyzed through May 15, 2013. During this study, cameras recorded individual white-tailed deer successfully moving through wildlife crossing structures on 16,359 occasions (this number includes pre-construction data reported in Table 3).

### **2.2.3. Control Monitoring**

Control camera data were analyzed through May 15, 2013. At Bell Crossing (west camera, control) 3.4 deer per day were recorded. Deer successfully crossed County Road 370 on 3,162 occasions. The success rate was 66%, the rate of repellency was 6%, and the parallel rate was 28%. At Bell Crossing (east camera, control) 2.5 deer per day were recorded. At Big Creek (south camera, control), there were 2.2 deer per day during pre-construction monitoring, 1.3 deer per day during construction, and 1.2 deer per day post-construction. At McCalla Creek South (ramp camera) 5 deer per day were recorded during pre-construction, 0.5 deer per day during construction, and 1.1 deer per day post-construction.

**Table 4. White-tailed Deer Use of Wildlife Crossing Structures.**

<b>Camera Location</b>	<b>Mile Post</b>	<b>Success Per Day</b>	<b>Successful Crossings</b>	<b>Success Rate (%)</b>	<b>Rate of Repellency (%)</b>	<b>Parallel Rate (%)</b>
Bear Creek South	57	4.3	1361	96	1	3
Dawn's Crossing	70	2.0	3190	96	1	3
Big Creek	61	1.9	1166	85	8	7
Sweathouse Creek	60	1.8	905	92	3	5
Kootenai Creek	66	1.5	2063	91	4	5
Bass Creek Fishing Access	70	1.4	2318	96	3	1
McCalla Creek North	66	1.2	1556	83	6	11
Indian Prairie Loop	63	0.7	476	29	8	63
Blodgett Creek	50	0.6	712	95	2	3
Mill Creek	55	0.4	178	49	14	37
Lupine	56	0.4	70	36	13	51
McCalla Creek South	65	0.2	219	40	17	43
Bass Creek North	71	0.15	231	52	7	41
Kootenai Springs Ranch	65	0.06	65	3	12	85
Axmen Propane	61	0.05	29	4	11	85
Mountain Gallery	56	0.04	18	18	17	65
Bear Creek North	58	0.02	5	14	26	60
Bass Creek South	71	0.01	13	50	15	35
Fun Park	55	0	0	0	9	91

### **3. White-Tailed Deer Usage Rates of Wildlife Crossing Structures by Type and Across Types**

A detailed statistical analysis of white-tailed deer usage rates of wildlife crossing structures by type and across types will be reported when data are compiled.

Multivariate statistics will be used to analyze how variables such as height, width, length, shape, construction material, presence or absence of wildlife exclusion fencing, length of fencing and guardrails, and human presence or other disturbances may affect usage rates.

### **4. Relationships among Wildlife Crossing Structures with Landscape Variables and Crossing Rates**

A methodology was developed to quantify landscape variables such as road, traffic, vegetation, topography, and deer fecal pellets at wildlife crossing structures and sites. Data were collected in 2010 at wildlife crossing structures, wildlife crossing structure sites, and control sites, except for the following: Indian Prairie Loop, Big Creek, and Axmen Propane. Construction activities were occurring at these three locations; and landscape variables there were drastically changed by the construction activities.

Landscape variables data were collected again in 2012 at all structures and control sites, with the exception of the east side of Lupine, where landowner permission could not be obtained.

In 2010 vegetation data were collected in 25 plots in a 25 meter grid, on each side of the structure or site (50 total plots, each 25 meters apart). Each plot was a circle with a 2 meter radius. Vegetation was categorized as trees, shrubs, or grasses/non-woody and the percentage cover (density) of each category was visually estimated. In 2012, five additional plots on each side of the structures were sampled (60 total plots).

Fecal pellets were counted in each plot at each structure or site as described above, and tabulated as number of piles (a pile was more than 10 pellets but less than 50 pellets) and number of scatters (a scatter was less than 10 pellets). Pellet counts will be analyzed to determine if they can be used as an index or estimate of deer abundance. Statistical analyses will also explore if pellet data correlate with vegetation and number of deer photographed at the structure or site.

Vegetation characteristics and deer abundance at each structure and control site may be analyzed in an Akaike Information Criterion (AIC). AIC-based statistics allow multiple statistical models to be built. The AIC software selects the most appropriate model that explains deer presence as related to the different landscape variables. The researchers will conduct a literature search to determine how other studies have used this analysis to predict animal presence. This is but one of several statistical analyses to be used.

## **5. Changes in Animal-Vehicle Collisions between Pre-construction and Post-construction of Wildlife Crossing Structures**

Generalized Additive Models (GAM) will be used to analyze changes in animal-vehicle collisions (AVC) between pre-construction and post-construction of wildlife crossing structures. Models developed for this study will determine how deer abundance and traffic volume influence AVC and may predict future AVC if there were no wildlife crossing structures, based on pre-construction data. A direct comparison of pre-construction and post-construction AVC would be incomplete because deer abundance and traffic volume change over time. The predicted AVC can be compared to actual AVC once wildlife crossing structures and fencing are completed.

## **6. Relationships between AVC Numbers and Wildlife Crossing Structures over Time and Space, Kernel Density Analysis**

Last quarter, Ms. Gunson conducted an updated Kernel Density Analysis that indicates AVC numbers over time and space (Figure 4). This updated KDA includes AVC data from 2012. Wildlife crossing structure type, location, date installed, wildlife fencing, and the names of key areas with high AVC concentrations are indicated. AVC decreased in 2012 from mp 60 to mp 67 compared to 2011. AVC increased in 2012 near mile posts 58 and 82. This analysis will continue.

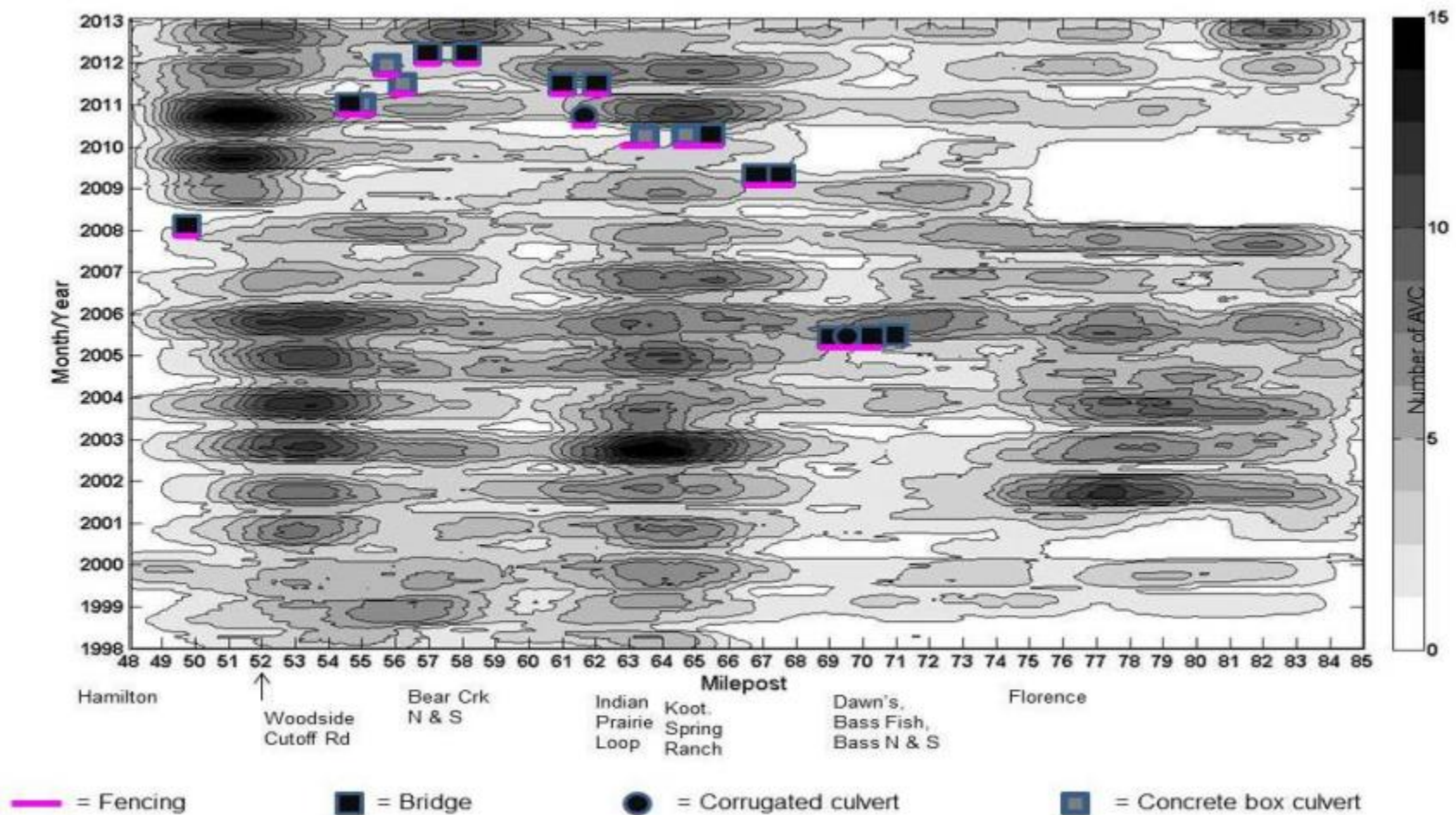


Figure 2. Kernel Density Analysis of AVC carcass data, US 93 South, mp 48 through 85, 1998 to 2013. Darker spots reflect higher carcass counts at specific mile posts. Wildlife crossing structure type,

location, date installed, and wildlife fencing are indicated. Wildlife crossing structure icons are not to scale of graph.

## Major Task Progress

<b>Task</b>	<b>Description</b>	<b>Estimated Span of calendar years Estimated after kickoff</b>	<b>Cost</b>	<b>Total billed to date</b>	<b>Percentage complete: based on percentage complete &amp; billed this report as a % of original budget</b>
<b>1</b>	<b>Task 1 Purchase equipment</b>	<b>Oct 1, 08 - Aug 31, 09</b>	<b>\$49,650</b>	<b>48,850</b>	<b>98%</b>
<b>2</b>	<b>Task 2 Install equipment...</b>	<b>Oct 9, 08 – Aug 31, 09</b>	<b>6,300</b>	<b>6,300</b>	<b>100%</b>
<b>3</b>	<b>Task 3 Monitor wildlife movement</b>	<b>Nov 1 08 – May 1, 09, 6 months</b>	<b>18,105</b>	<b>18,105</b>	<b>100%</b>
<b>4</b>	<b>Task 4 Obtain &amp; analyze current a-v-c</b>	<b>Fall, 08 - Aug 31, 09</b>	<b>8,520</b>	<b>8,520</b>	<b>100 %</b>
<b>5</b>	<b>Task 5 Hold public meeting</b>	<b>Summer 09</b>	<b>Not applicable</b>	<b>Not applicable</b>	<b>Not applicable</b>
<b>6</b>	<b>Task 6 Create a-v-c prediction models</b>	<b>Spring/ Summer/ Fall 09</b>	<b>9,880</b>	<b>3,403</b>	<b>34%</b>
<b>7</b>	<b>Task 7 Monitor wildlife movement</b>	<b>May 1, 09- April 30 '10 = 12 months</b>	<b>41,810</b>	<b>41,810</b>	<b>100%</b>
<b>8</b>	<b>Task 8 Create Interim Report</b>	<b>Aug 09</b>	<b>3,720</b>	<b>3,720</b>	<b>100%</b>
<b>9</b>	<b>Task 9 Hold public meeting</b>	<b>Summer '10</b>	<b>2,760</b>	<b>2,760</b>	<b>100%</b>
<b>10</b>	<b>Task 10 Monitor wildlife movement</b>	<b>May 1 10 – April 30 '11 = 12 months</b>	<b>40,560</b>	<b>40,560</b>	<b>100%</b>
<b>11</b>	<b>Task 11 Create Interim Report</b>	<b>Jan 1 '10- Dec 31 '10</b>	<b>3,720</b>	<b>3,720</b>	<b>100%</b>

<b>Task</b>	<b>Description</b>	<b>Estimated Span of calendar years Estimated after kickoff</b>	<b>Cost</b>	<b>Total billed to date</b>	<b>Percentage complete: based on percentage complete &amp; billed this report as a % of original budget</b>
12	Task 12 Analyze pre-construction data	July '09 – June '10	13,360	6,496	49%
13	Task 13 Reinstall Equipment	June '10 – July '11	2,760	2,760	100%
14	Task 14 Monitor Wildlife Movement	May '11 – April '30 12	40,560	40,560	100%
15	Task 15 Create Interim Report	Jan 1 '11 – Dec 31 '11	3,720	3,720	100%
16	Task 16 Analyze pre-construction data & compare to predicted	June 1 '12 – Dec 31 '13	14,800	0	0
17	Task 17 Hold public meeting- Changed to re-install cameras	2012	3,690	3,690	100%
18	Task 18 Monitor wildlife movement	May 1, 2012- April 30, 2013	40,560	40,560	100%
19	Task 19 Create Interim Report	Jan 1 2012 – Dec 31 2012	3,720	3,720	100%
20	Task 20 Hold public meeting	2013	2,760	2,760	100%
21	Task 21 Monitor wildlife movement	May 1, 2013- April 30, 2014	40,560	6,760	17%
22	Task 22 Create Interim Report	Jan 1 2013 – Dec 31	2,080	0	0

<b>Task</b>	<b>Description</b>	<b>Estimated Span of calendar years Estimated after kickoff</b>	<b>Cost</b>	<b>Total billed to date</b>	<b>Percentage complete: based on percentage complete &amp; billed this report as a % of original budget</b>
		<b>2013</b>			
<b>23</b>	<b>Task 23 Hold public meeting</b>	<b>2014</b>	<b>2,760</b>	<b>na</b>	<b>na</b>
<b>24</b>	<b>Task 24 Monitor wildlife movement</b>	<b>May 1, 2014- April 30, 2015</b>	<b>40,560</b>	<b>0</b>	<b>0</b>
<b>25</b>	<b>Task 25 Create Interim Report</b>	<b>Jan 1 2014 – Dec 31 2014</b>	<b>2,080</b>	<b>0</b>	<b>0</b>
<b>26</b>	<b>Task 26 Analyze avc data and compare results with expected</b>	<b>2014 - June 30, 2015</b>	<b>18,800</b>	<b>0</b>	<b>0</b>
<b>27</b>	<b>Task 27 Hold public meeting</b>	<b>2015</b>	<b>2,760</b>	<b>na</b>	<b>na</b>
<b>28</b>	<b>Task 28 Submit draft final report</b>	<b>June 30 2015</b>	<b>16,520</b>	<b>0</b>	<b>0</b>
<b>29</b>	<b>Task 29 Meet with MDT officials</b>	<b>Summer 2015</b>	<b>3,680</b>	<b>0</b>	<b>0</b>
<b>30</b>	<b>Task 30 Submit final report</b>	<b>Sept 30 2015</b>	<b>27,040</b>	<b>0</b>	<b>0</b>
	<b>Total</b>		<b>467,795</b>	<b>291,979</b>	<b>62%</b>

\* na = not applicable