Montana US Highway 93 South Wildlife Crossings Research

MDT # HWY – 308445-RP

2014 First Quarter Progress Report

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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 Bridge and Bass Creek South Bridge. 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 based on carcass data and wildlife crossing structures over time and space.

This research began in 2008 and will be completed in 2015. This research is approximately 75% 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 Crossing Structures, US Highway 93 South, Montana.

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

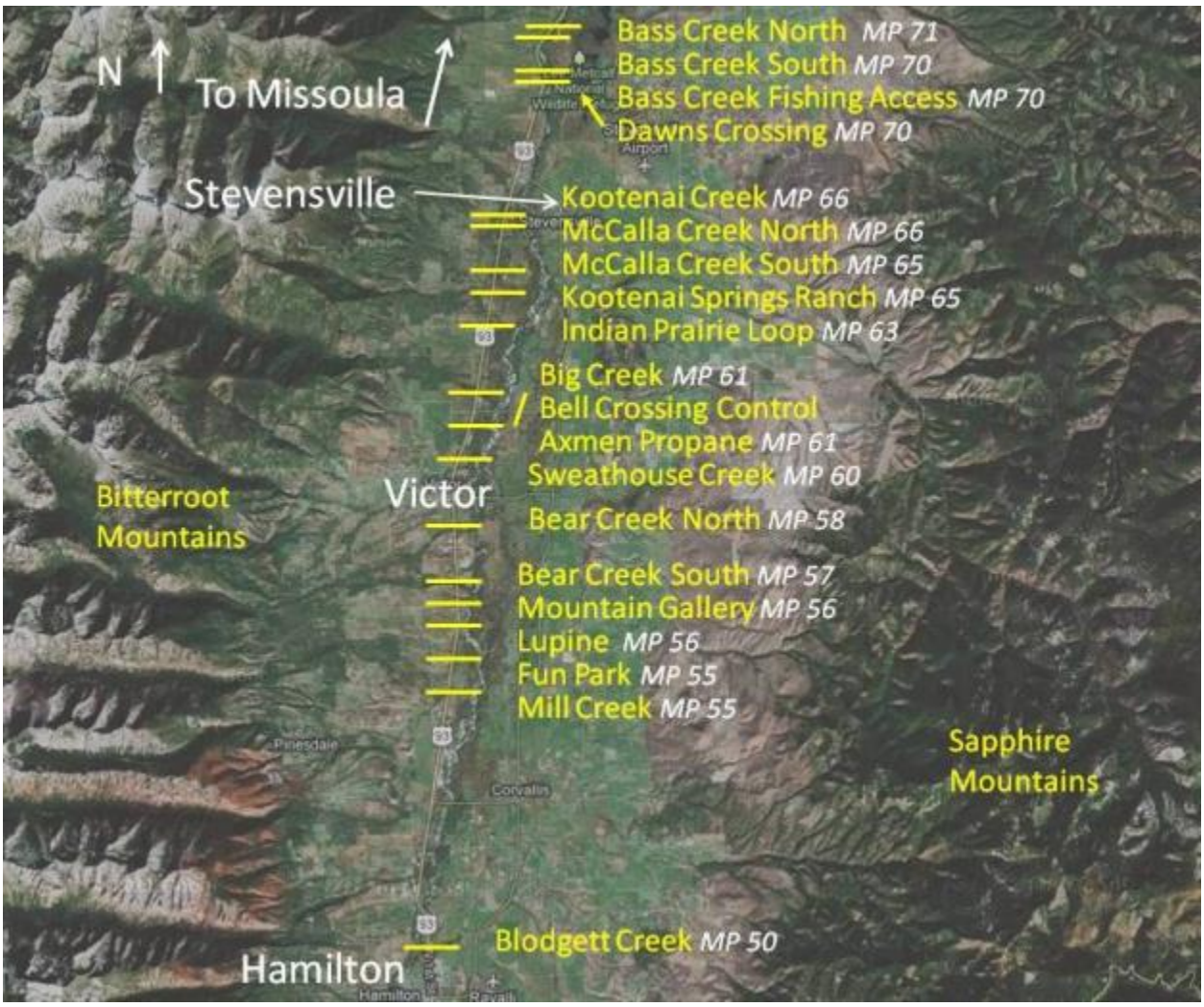

Figure 1. Map of US Highway 93 South Study Area, Montana.

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 Bridge (mp 71), Bass Creek South Bridge (mp 70), Bass Creek Fishing Access Culvert (mp 70), Dawns Crossing Bridge (mp 70), Kootenai Creek Bridge (mp 66), and Blodgett Creek Bridge (mp 50). Two cameras were installed, one near each entrance, of the following wildlife crossing structures: McCalla Creek North Bridge (mp 66), McCalla Creek South Bridge (mp 65), Kootenai Springs Ranch Culvert (mp 65), Indian Prairie Loop Culvert (mp 63), Axmen Propane Culvert (mp 61), Sweathouse Creek Bridge (mp 60), Bear Creek North Bridge (mp 58), Mountain Gallery Culvert (mp 56), Lupine Culvert (mp 56), Fun Park Culvert (mp 55), and Mill Creek Bridge (mp 55). Lupine Culvert (mp 56) was monitored with only one camera after September 13, 2012. Three cameras were installed at Bear Creek South Bridge (mp 57) and at Big Creek Bridge (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 Bridge is an exception). Structures completed during this study were monitored with two or more cameras (Lupine Culvert (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

This Quarter, approximately 33,000 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 and at Control Sites, Montana.

Camera Location	Approximate Mile Post	Date Installed
Bass Creek North Bridge	71	Oct 10, 2008
Bass Creek South Bridge	70	Nov 22, 2008
Bass Creek Fishing Access Culvert	70	Nov 22, 2008
Dawns Crossing Bridge	70	Nov 23, 2008
Kootenai Creek Bridge	66	Apr 21, 2009
McCalla Creek North Bridge (east camera)	66	Apr 22, 2009
McCalla Creek North Bridge (west camera)	66	Apr 22, 2009
McCalla Creek South Bridge (east camera)	65	July 30, 2010
McCalla Creek South Bridge (west camera)	65	Jun 16, 2010
McCalla Creek South (ramp camera)	65	Jun 16, 2010

Camera Location	Approximate Mile Post	Date Installed
Kootenai Springs Ranch Culvert (east camera)	65	Jun 10, 2010
Kootenai Springs Ranch Culvert (west camera)	65	July 29, 2010
Indian Prairie Loop Culvert (east camera)	63	Oct 25, 2011
Indian Prairie Loop Culvert (west camera)	63	Sept 27, 2010
Big Creek Bridge (northeast camera)	61	July 28, 2011
Big Creek Bridge (southeast camera)	61	July 29, 2011
Big Creek Bridge (southwest camera)	61	Aug 12, 2011
Big Creek (south camera, control)	61	Apr 21, 2009
Axmen Propane Culvert (east camera)	61	Sept 28, 2010
Axmen Propane Culvert (west camera)	61	April 25, 2012
Sweathouse Creek Bridge (east camera)	60	Dec 10, 2011
Sweathouse Creek Bridge (west camera)	60	Dec 10, 2011
Bear Creek North Bridge (east camera)	58	Jun 25, 2012
Bear Creek North Bridge (west camera)	58	Jun 25, 2012
Bear Creek South Bridge (east camera)	57	Jun 26, 2012
Bear Creek South Bridge (west camera)	57	Jun 26, 2012
Bear Creek South Bridge (birch camera)	57	Sept 14, 2012
Mountain Gallery Culvert (east camera)	56	April 25, 2012
Mountain Gallery Culvert (west camera)	56	Mar 2, 2012
Lupine Culvert (west camera)	56	Jun 26, 2012
Fun Park Culvert (east camera)	55	Mar 2, 2012
Fun Park Culvert (west camera)	55	April 25, 2012
Mill Creek Bridge (east camera)	55	Dec 10, 2011
Mill Creek Bridge (west camera)	55	Mar 2, 2012
Blodgett Creek Bridge	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 Culvert 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.

Structure Camera Location	**Mile Post**	**Camera Days**	**Deer Per Day**	**Successful Crossings**	**Success Rate (%)**	**Rate of Repellency (%)**	**Parallel Rate (%)**
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
Right of Way Camera Location	**Mile Post**	**Camera Days**	**Deer Per Day**	**Successful Crossings**	**Success Rate (%)**	**Rate of Repellency (%)**	**Parallel Rate (%)**
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

Right of Way Camera Location	Mile Post	Camera Days	Deer Per Day	Successful Crossings	Success Rate (%)	Rate of Repellency (%)	Parallel Rate (%)
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

Habitat Camera Location	Mile Post	Camera Days	Deer Per Day
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 March 13, 2014. During this study, cameras recorded individual white-tailed deer successfully moving through wildlife crossing structures on 20,334 occasions.

2.2.3. Control Monitoring

Control camera data were analyzed through March 13, 2014. At Bell Crossing (west camera, control) 4.0 deer per day were recorded. Deer successfully crossed County Road 370 on 3,933 occasions. The success rate was 63%, the rate of repellency was 6%, and the parallel rate was 31%. At Bell Crossing (east camera, control) 3.0 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 1.3 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 0.9 deer per day post-construction.

Table 4. White-Tailed Deer Use of Wildlife Crossing Structures.

Camera Location	Mile Post	Success Per Day	Successful Crossings	Success Rate (%)	Rate of Repellency (%)	Parallel Rate (%)
Bear Creek South Bridge	57	3.8	2390	95	1	4
Dawns Crossing Bridge	70	2.2	4155	97	1	2
Sweathouse Creek Bridge	60	2.1	1693	93	3	4
Big Creek Bridge	61	2.0	1890	84	8	8
Bass Creek Fishing Access Culvert	70	1.7	3063	96	3	1
Kootenai Creek Bridge	66	1.5	2446	91	4	5
McCalla Creek North Bridge	66	1.1	1815	82	6	12
Blodgett Creek Bridge	50	0.6	850	95	2	3
Indian Prairie Loop Culvert	63	0.6	756	36	9	55
Mill Creek Bridge	55	0.5	418	58	13	29
McCalla Creek South Bridge	65	0.2	275	41	18	41
Bass Creek North Bridge	71	0.1	254	54	7	39
Lupine Culvert	56	0.1	70	32	16	52
Axmen Propane Culvert	61	0.07	93	9	11	80
Kootenai Springs Ranch Culvert	65	0.07	95	4	13	83
Bear Creek North Bridge	58	0.06	35	47	18	35
Mountain Gallery Culvert	56	0.03	23	12	11	77
Bass Creek South Bridge	71	0.01	13	36	17	47
Fun Park Culvert	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 are related to 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) based on carcass data 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 carcass data would be incomplete because deer abundance and traffic volume change over time. The predicted AVC can be compared to actual AVC after wildlife crossing structures and fencing were completed.

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

In the first quarter of 2013, Ms. Gunson conducted an updated Kernel Density Analysis that indicated AVC carcass numbers over time and space (Figure 2). This updated KDA includes AVC carcass 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 when 2013 AVC carcass data are fully reported and understood as to changes in trends from 2012.

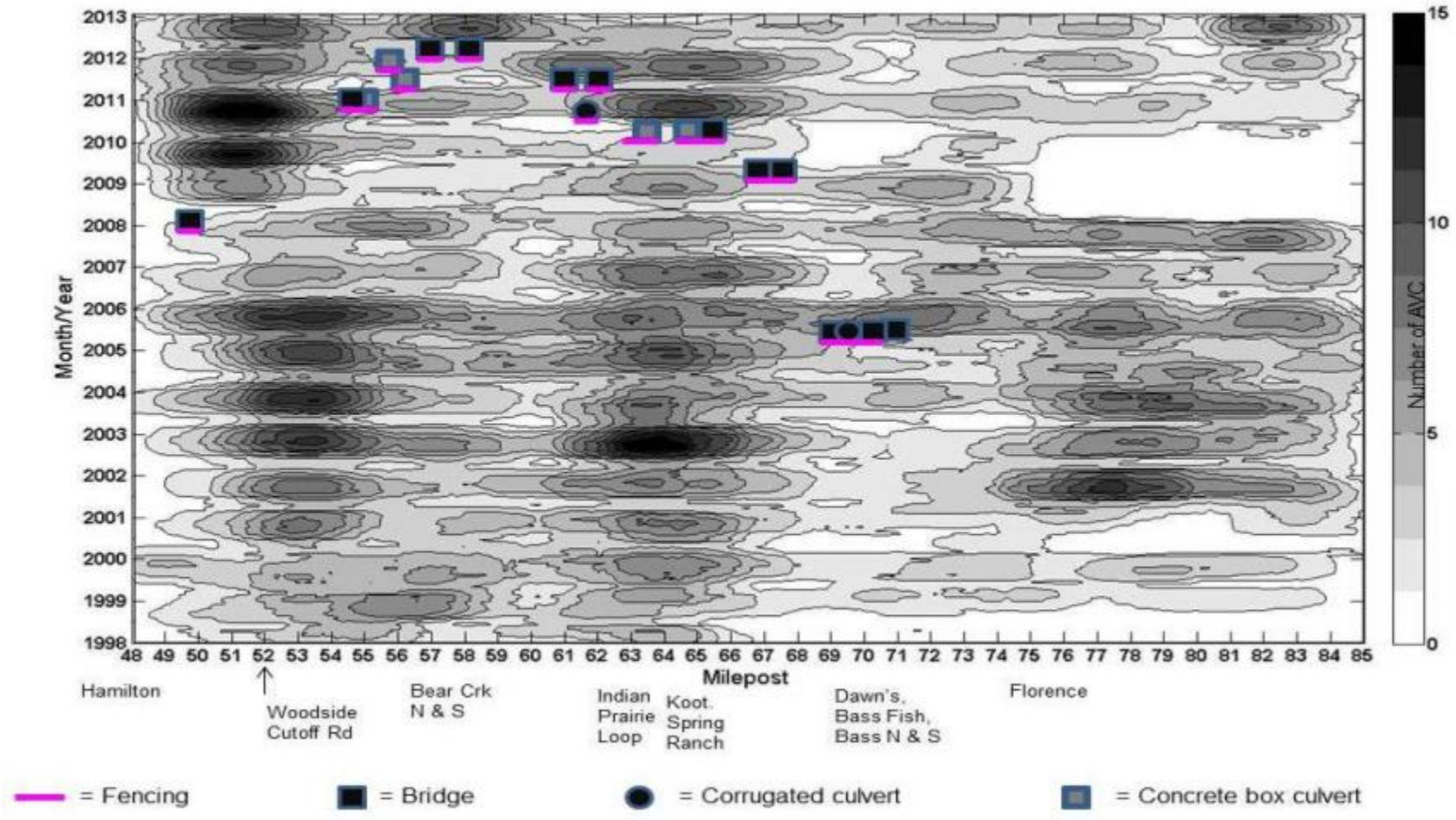

Figure 2. Kernel Density Analysis of AVC Carcass Data, US 9, MP 48 Through 85, 1998 to 2013. ***Darker spots reflect higher carcass counts at specific mile posts. Wildlife crossing structure type, location, date installed, and wildlife fencing are indicated. Wildlife crossing structure icons are not to scale of graph.***

Major Task Progress

Task	Description	Estimated Span of calendar years Estimated after kickoff	Cost	Total billed to date	Percentage complete: based on percentage complete & billed this report as a % of original budget
1	Task 1 Purchase equipment	Oct 1, 08 - Aug 31, 09	$49,650	48,850	98%
2	Task 2 Install equipment…	Oct 9, 08 – Aug 31, 09	6,300	6,300	100%
3	Task 3 Monitor wildlife movement	Nov 1 08 – May 1, 09, 6 months	18,105	18,105	100%
4	Task 4 Obtain & analyze current a-v-c	Fall, 08 - Aug 31, 09	8,520	8,520	100 %
5	Task 5 Hold public meeting	Summer 09	Not applicable	Not applicable	Not applicable
6	Task 6 Create a-v-c prediction models	Spring/ Summer/ Fall 09	9,880	3,700	37%
7	Task 7 Monitor wildlife	May 1, 09- April 30 ‘10	41,810	41,810	100%

Task	Description	Estimated Span of calendar years Estimated after kickoff	Cost	Total billed to date	Percentage complete: based on percentage complete & billed this report as a % of original budget
	movement	= 12 months			
8	Task 8 Create Interim Report	Aug 09	3,720	3,720	100%
9	Task 9 Hold public meeting	Summer ‘10	2,760	2,760	100%
10	Task 10 Monitor wildlife movement	May 1 10 – April 30 ’11 = 12 months	40,560	40,560	100%
11	Task 11 Create Interim Report	Jan 1 ’10- Dec 31 ‘10	3,720	3,720	100%
12	Task 12 Analyze pre-construction data	July ‘09 – June ‘10	13,360	6,694	50%
13	Task 13 Reinstall Equipment	June ‘10 – July ‘11	2,760	2,760	100%
14	Task 14 Monitor Wildlife	May ‘11 – April ‘30 12	40,560	40,560	100%

Task	Description	Estimated Span of calendar years Estimated after kickoff	Cost	Total billed to date	Percentage complete: based on percentage complete & billed this report as a % of original budget
	Movement				
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	May 1, 2013- April	40,560	37,180	92%

Task	Description	Estimated Span of calendar years Estimated after kickoff	Cost	Total billed to date	Percentage complete: based on percentage complete & billed this report as a % of original budget
	movement	30, 2014			
22	Task 22 Create Interim Report	Jan 1 2013 – Dec 31 2013	2,080	2,080	100%
23	Task 23 Hold public meeting	2014	2,760	na	Na
24	Task 24 Monitor wildlife movement	May 1, 2014- April 30, 2015	40,560	0	0
25	Task 25 Create Interim Report	Jan 1 2014 – Dec 31 2014	2,080	0	0
26	Task 26 Analyze avc data and compare results with expected	2014 - June 30, 2015	18,800	0	0
27	Task 27 Hold public meeting	2015	2,760	na	Na
28	Task 28 Submit draft final report	June 30 2015	16,520	0	0

Task	Description	Estimated Span of calendar years Estimated after kickoff	Cost	Total billed to date	Percentage complete: based on percentage complete & billed this report as a % of original budget
29	Task 29 Meet with MDT officials	Summer 2015	3,680	0	0
30	Task 30 Submit final report	Sept 30 2015	27,040	0	0
	Total		467,795	324,974	69%

* na = not applicable