US 93 North Post-Construction Wildlife-Vehicle Collision and Wildlife Crossing Monitoring and Research on the Flathead Indian Reservation between Evaro and Polson, Montana

Annual Report 2012

by

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EXECUTIVE SUMMARY

This third annual report contains a preliminary summary for work conducted in 2011 for the US Highway 93 North wildlife mitigation evaluation project on the Flathead Indian Reservation, Montana, United States of America. The mitigation measures along this section of US Highway 93 North consist of wildlife fencing combined with wildlife underpasses and an overpass, jump-outs, and wildlife guards at access roads. The research objectives relate to investigating the effect of the mitigation measures on human safety (an expected reduction in wildlife-vehicle collisions), habitat connectivity for wildlife (wildlife use of the crossing structures), and a cost-benefit analysis for the mitigation measures which will be conducted in the following years.

In the first year after the mitigation measures were implemented, the carcass removal and crash data for the Evaro, Ravalli Curves and Ravalli Hill areas combined suggest a 100% decline in the number of large mammal carcasses and the number of animal-vehicle crashes. However, this analysis only includes one year of data with mitigation measures present. A separate analysis for the Evaro area (one year of post-mitigation data) only showed a reduction of 100% for the carcass removal data and also for the crash data whereas the Ravalli Curves and Hill area combined (four years of post-mitigation data) only showed a reduction of 16.7% based on carcass removal data and 41.7% based on crash data. The absolute number of crashes was relatively low; both before and after the mitigation measures were implemented. This means that only one crash more or one crash less can have a substantial effect on the percentage reduction. Collecting data for longer and combining the data with those for other mitigated road sections will provide a more precise and robust estimate in the future. However, most of the post reconstruction carcasses in the Ravalli Curves and Ravalli Hill areas were located in the Ravalli Curves area (15 out of 18 carcasses), and there appears to be a concentration of carcasses between mile reference posts 24.1-24.3. The mitigation measures in this area (mi post 24.0-24.4) include wildlife fencing, a large mammal underpass (RC496), wildlife guards, gates, and wildlife jump-outs. The researchers inspected this road section for potential design or maintenance issues but could not identify obvious gaps that would allow deer to gain easy access into the fenced road corridor.

The number of fresh and old black pellet groups was variable through the years with high standard deviations. The data indicate that deer continue to be present in more or less similar numbers in the Evaro, Ravalli Curves and Ravalli Hill areas. However, the pellet group counts cannot detect subtle changes in population size as the standard deviations are high.

The wildlife crossing structures in the road sections with continuous fencing in Evaro, Ravalli Curves and Ravalli Hill, as well as the selected isolated structures appear to receive substantial use by a wide variety of wildlife species (at least 23 species), especially white-tailed deer and mule deer, domestic dogs and cats, and birds. Raccoon, black bear, coyote, red fox, bobcat, western striped skunk, rabbits and hares, mountain lion, grizzly bear, American badger, elk, river otter, yellow-bellied marmot, and weasel species were observed less frequently using the structures. It is noteworthy that in 2011 there were 15 crossings by grizzly bears (only three in 2010), and 6 by elk (none in 2010).

For the road sections with a concentration of mitigation measures (Evaro, Ravalli Curves and Ravalli Hill) the average number of deer (white-tailed deer and mule deer combined) that were estimated to cross the road before road reconstruction was estimated at 1,732 per year (2003 through 2005) while this number was 109 for black bears. It appears that far more deer (n=8,555) and black bear (n=239) crossings occurred through the structures in these areas in 2011 than the pre-mitigation reference values, with no indication of a considerable increase in the deer population in 2011 compared to 2004 and 2005. While wildlife use of the structures can be considered substantial, the term “success” is specifically defined based on consensus between Montana Department of Transportation (MDT), Confederated Salish and Kootenai Tribes (CSKT) and Federal Highway Administration (FHWA). Thus whether the wildlife crossing structures are considered “successful” or not can only be concluded after more data have been collected and after they have been analyzed in the context of the measures of effectiveness agreed upon by the stakeholders listed above.

1. INTRODUCTION

1.1. Background

The US Highway 93 North (US 93 North) reconstruction project on the Flathead Indian Reservation in northwest Montana represents one of the most extensive wildlife-sensitive highway design efforts in North America. The reconstruction of the 56 mile (90 km) long road section includes the installation of 41 fish and wildlife crossing structures, 2 underpasses for live-stock, 1 bicycle/pedestrian underpass, and approximately 8.3 miles (13.4 km) of road with wildlife exclusion fencing on both sides (excluding future mitigation measures in the Ninepipe wetland area) (Figures 1, 2, and 3). The mitigation measures are aimed at improving safety for the traveling public through reducing wildlife-vehicle collisions and allowing wildlife to continue to move across the landscape and the road. Other examples of relatively long road sections in North America with a high concentration of wildlife crossing structures and wildlife fencing are I-75 (Alligator Alley) in south Florida (24 crossing structures over 40 mi; Foster & Humphrey 1995), the Trans-Canada Highway in Banff National Park in Alberta, Canada (24 crossing structures over 28 miles (phase 1, 2 and 3A); Clevenger *et al.* 2002), State Route 260 in Arizona (17 crossing structures over 19 miles; Dodd *et al.* (2006)), and I-90 at Snoqualmie Pass East in Washington State (about 30 crossing structures planned over 15 miles; WSDOT 2007). Both the road length and number of wildlife crossing structures of US 93 North on the Flathead Indian Reservation makes it the most extensive mitigation project of its kind in North America to date. If the section of US 93 South (south of Missoula, Bitterroot valley) is included, the mitigation measures along US 93 in Montana are even more substantial.

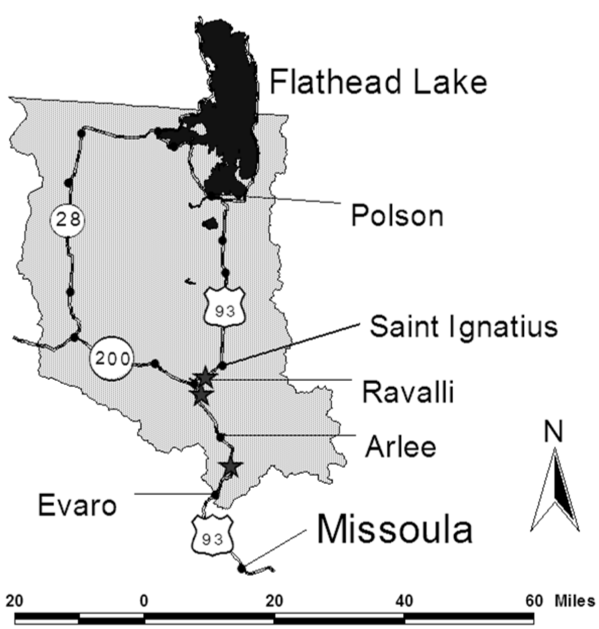

Figure 1: The Flathead Indian Reservation in northwestern Montana including major highway routes. The US 93 North reconstruction effort and evaluation study area traverses 56 miles (90 km) from Evaro to Polson. Stars represent the Evaro, Ravalli Curves, and Ravalli Hill study areas from south to north, respectively, where more intensive pre-construction sampling efforts were focused.

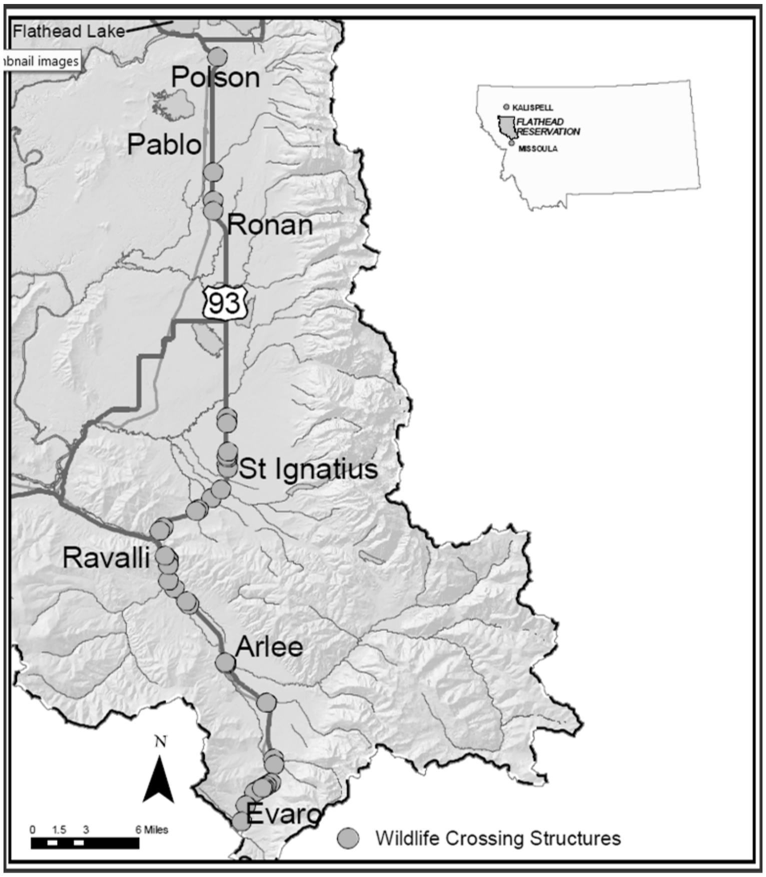

Figure 2: The location of the 41 fish and wildlife crossing structures along US 93 North on the Flathead Indian Reservation in northwestern Montana.

The magnitude of the US 93 North reconstruction project and associated mitigation measures provide an unprecedented opportunity to evaluate to what extent these mitigation measures help improve safety through a reduction in wildlife-vehicle collisions, maintain habitat connectivity for wildlife (especially deer (*Odocoileus* spp.) and black bear (*Ursus americanus*)), and what the monetary costs and benefits are for the mitigation measures. In addition, the landscape along US 93 North is heavily influenced by human use, resulting in relatively short sections of wildlife fencing and gates or wildlife guards at access roads. This is in contrast to the more natural vegetation along most of the other road sections that have large scale wildlife mitigation including continuous wildlife fencing in North America. As the roads with most wildlife-vehicle collisions are in rural areas, the results from the US 93 North project are expected to be of great interest to agencies throughout North America (Huijser *et al.* 2008).

In 2002, prior to US 93 North's reconstruction, the Western Transportation Institute at Montana State University-Bozeman (WTI-MSU) was funded by the Federal Highway Administration (FHWA) and the Montana Department of Transportation (MDT) to initiate a before-after field study to assess the effectiveness of the wildlife mitigation measures and to document events and decisions that shaped the process of planning and designing the mitigation measures.

Preconstruction field data collection efforts were completed in the fall of 2005 and a final report on the preconstruction monitoring findings was published in January 2007 (Hardy *et al.* 2007).

While the preconstruction monitoring and research efforts (Hardy *et al.* 2007) are valuable on their own, their main purpose is to provide a reference for a before-after comparison with the post-construction data.

In 2010 MDT contracted with WTI-MSU to conduct the post-construction research with regard to the effectiveness of the mitigation measures. For this project, the Confederated Salish and Kootenai Tribes (CSKT) act as a subcontractor to WTI-MSU.

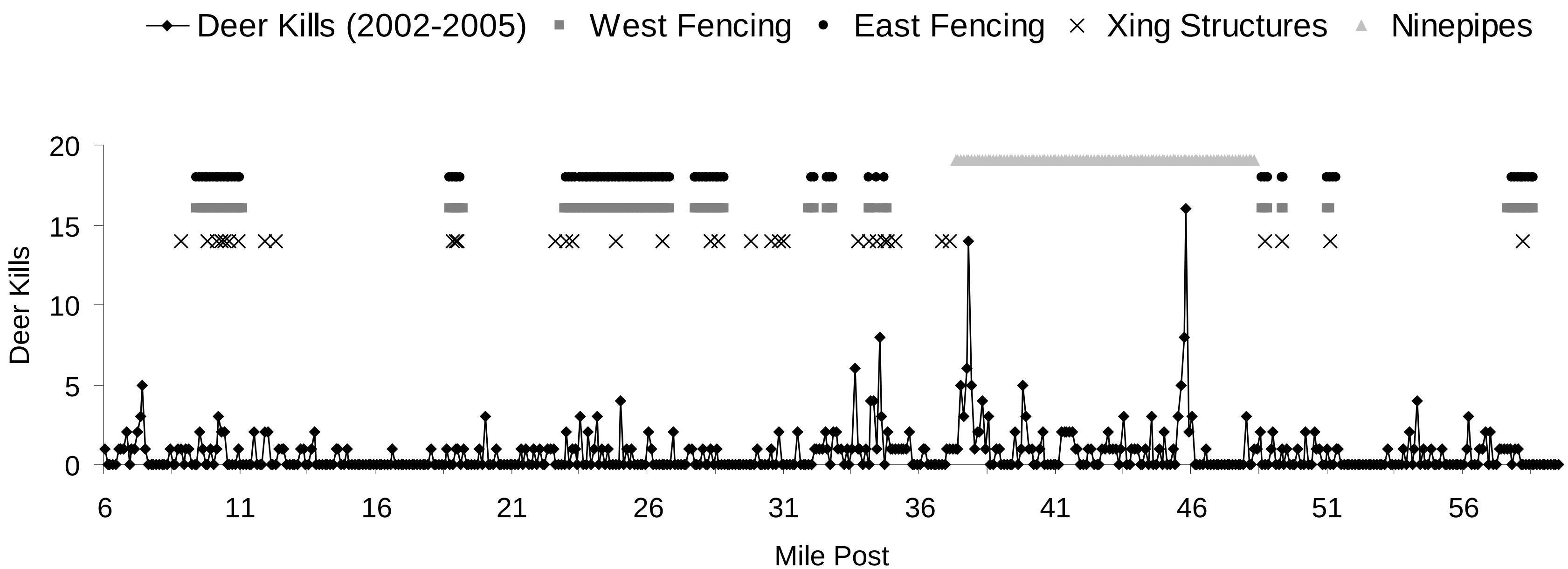

Figure 3: Total reported deer-vehicle collisions for each 0.1 mile between 2002-2005 along the US 93 North study area, including mitigation measures. Location of the following areas with continuous fencing and mitigation measures: Evaro (mile reference post 9.4-11.1), Ravalli Curves (22.9-26.8), and Ravalli Hill (27.7-28.8). The future mitigation measures for the Ninepipe section (mileposts 37-48) are not shown in this figure (from Hardy *et al.* 2007).

1.2. Objectives

Consistent with the direction provided by MDT, the project has the following objectives:

- Investigate the effect of the mitigation measures on human safety through an anticipated reduction in wildlife-vehicle collisions;
- Investigate the effect of the mitigation measures on the ability to maintaining habitat connectivity for wildlife (especially for deer (white-tailed deer [*Odocoileus virginianus*] and mule deer [*Odocoileus hemionus*] combined) and black bear (*Ursus americanus*) through the use of the wildlife crossing structures; and
- Conduct cost-benefit analyses for the mitigation measures.

This document is the third in a series of annual reports detailing the progress on these tasks.

1.3. Post-Construction Research Activities Prior to 2011

CSKT and WTI-MSU conducted post-construction research prior to being contracted by MDT in 2010. A substantial part of the WTI-MSU efforts was made possible through a fellowship for Tiffany Allen, allowing her to pursue her M.Sc. degree at MSU. The previous two annual reports summarized the activities and results of these activities through December 2010 (Huijser et al., 2010; 2011). The current annual report summarizes the main results of data collected in 2011.

2. MITIGATION MEASURES AND HUMAN SAFETY

2.1. Introduction

Wildlife-vehicle collisions affect human safety, property and wildlife. The total number of large mammal-vehicle collisions has been estimated at one to two million in the United States and at 45,000 in Canada annually (Conover *et al.* 1995, Tardif & Associates Inc. 2003, Huijser *et al.* 2008). These numbers have increased even further over the last decade (Tardif & Associates Inc. 2003, Huijser *et al.* 2008). In the United States, these collisions were estimated to cause between 135 and 211 human fatalities, between 26,647 and 29,000 human injuries and over one billion US dollars in property damage annually (Conover *et al.* 1995; Khattak 2003; Centers for Disease Control and Prevention 2004). In most cases the animals die immediately or shortly after the collision (Allen and McCullough 1976). In some cases it is not just the individual animals that suffer. Road mortality may also affect some species on the population level (e.g. van der Zee *et al.* 1992, Huijser and Bergers 2000), and some species may even be faced with a serious reduction in population survival probability as a result of road mortality, habitat fragmentation and other negative effects associated with roads and traffic (Proctor 2003, Huijser *et al.* 2008). In addition, some species also represent a monetary value that is lost once an individual animal dies (Romin and Bissonette 1996, Conover 1997).

While this chapter focuses on the reduction of collisions with large ungulates, this group is not necessarily the most abundant or the most important species group hit by vehicles. Large mammals (e.g. deer size and larger) receive most attention because of the following reasons:

- A collision with a large mammal can result in substantial vehicle damage and poses a threat to human safety;
- Large mammal carcasses on or adjacent to the road pose a safety hazard on their own as they can cause drivers to undertake evasive maneuvers, be a general distraction to drivers, and become an attractant to potential scavengers; and
- Some large mammal species are threatened, endangered or considered charismatic.

The preconstruction research along US 93 North found that deer (white-tailed deer [*Odocoileus virginianus*] and mule deer [*Odocoileus hemionus*] combined) were by far the most frequently recorded species group (Hardy *et al.* 2007). However, rare, threatened or endangered species may be removed before agency personnel was able to record them, and small and medium sized species such as coyote and smaller are rarely reported. It is notable though that the western painted turtle (*Chrysemys picta bellii*) is frequently hit by vehicles in the Ninepipe area (Griffin 2007).

This chapter focuses on the potential reduction in wildlife-vehicle collisions along US 93 North as a result of the implementation of the mitigation measures described in Chapter 1. The results, discussion, and conclusion should all be considered preliminary as the final results will not be available until 2015. Previous research has shown that wildlife fencing in combination with wildlife under- and overpasses can reduce collisions with large wild ungulates with 79-97% (Reed *et al.* 1982, Ward 1982, Woods 1990, Clevenger *et al.* 2001, Dodd *et al.* 2007). However, specific measures of effectiveness (parameters and thresholds) were determined based on consensus by MDT, CSKT, and FHWA (Huijser *et al.* 2009).

2.2. Methods

2.2.1. Crash and Carcass Data

Crash report data and carcass removal data were obtained from MDT. The two data sets ranged from 1 January 1998 through 31 December 2011. If more than one animal was recorded for one incident (either a crash or a carcass removal effort) each individual animal was counted and resulted in a separate record in one of the two databases. The crash data selected for this analysis involve all crashes where the first or most harmful event involves animals. Note that neither the crash data nor the carcass removal data are believed to include all crashes that occur or carcasses that are present (Huijser *et al.* 2007). There are thresholds for crash data (e.g. at least $1,000 in vehicle repair costs) and carcasses of small or medium sized species (e.g. coyote [*Canis latrans*] and smaller) may not be removed from the roadside, and carcasses of larger species that are not on the actual road surface and that are not highly visible to drivers in the right-of-way are also not removed and remain unrecorded. However, both data sets can be very useful for the US 93 North monitoring and research project as long as their search and reporting efforts are consistent. For example, it is not necessary to record all animal-vehicle collisions to detect potential changes in the number of collisions, as long as the search and reporting effort remains consistent.

For the purpose of this report the researchers did not combine the crash data and the carcass removal data. Instead, the researchers used the two separate data sets to investigate potential patterns in the individual data sets. Currently these efforts are mostly targeted at evaluating the data collection processes rather than conducting final analyses with regard to a potential reduction in wildlife-vehicle collisions. However, we do provide a preliminary summary of the number of wildlife-vehicle collisions, before and after completion of the mitigation measures in selected areas, and a comparison of the mitigated and unmitigated areas. For this purpose, the begin and end dates for construction in selected road sections with a concentration of mitigation measures are provided in Table 1. The researchers distinguished three different time periods: before reconstruction, during reconstruction, and after reconstruction. The preliminary analyses for this report combined data for the three areas listed in Table 1, but, as a consequence only one year of post construction data was available (Evaro only had post reconstruction data available for 2011). Additional analyses for this report distinguished between Evaro and the other two areas (Ravalli Curves and Ravalli Hill) which allowed for the inclusion of the three additional years with post reconstruction data from Ravalli Curves and Ravalli Hill (2008 through 2011).

Table 1: Begin and end dates of the reconstruction of selected road sections with a concentration of mitigation measures.

Road Section (mile reference posts)	Begin Construction	End Construction
Evaro (9.4-11.1)	2009	May 2010
Ravalli Curves (22.9-26.8)	January 2006	November 2007
Ravalli Hill (27.7-28.8)	January 2006	Spring 2007

2.2.1. Deer Pellet Group Surveys

If there are more deer in a certain year than in a previous year, more deer-vehicle collisions can be expected. Similarly, reduced deer population size may be expected to result in fewer deer-vehicle collisions. Therefore it is important to have a measure for potential changes in the deer population size

Because there are no deer population estimates or hunting statistics available for the Flathead Indian Reservation, pellet group surveys were conducted in the Evaro and in the Ravalli Curves and Ravalli Hill areas to provide a relative measure for potential changes in deer population size. There were 24 transects perpendicular to the road; 11 in the Evaro area and 13 in the Ravalli Curves and Ravalli Hill areas. Each transect originated from the road and was 1640 ft (500 m) long and 3.3 ft (1 m) wide. The surveys were conducted in 2004 and 2005, and 2008 through 2011. However, the 2008 through 2010 surveys were only conducted in the Ravalli Curves and Ravalli Hill areas as construction was not completed yet in the Evaro area. If a deer pellet group was encountered it was classified as fresh black, old black, or brown. For the purpose of the current analyses only the fresh and old black pellet groups were included as brown pellets may be from a previous season.

2.3. Results

2.3.1. Crash and Carcass Data

The crash data do not specify the species, but the carcass removal data do contain species identification. The species involved with animal-vehicle collisions along US 93 North between 1 January 1998 and 31 December 2011, based on carcass removal data, consist mostly of large mammals and are heavily dominated by white-tailed deer (Figure 4). The category “domestic” (n=9) was excluded from further analyses as domesticated species, in this case dogs, livestock and a mule, are controlled by people and livestock fences rather than mitigation measures aimed at wildlife. Relatively small wild species (n=13) were also excluded from further analyses as the species involved bobcat [*Lynx rufus*] (n=1), red fox [*Vulpes vulpes*] (n=1), raccoon [*Procyon lotor*] (n=7), turkey [*Meleagris gallopavo*] (n=2), and coyote [*Canis latrans*] (n=2) were too small to pose a substantial safety risk to humans.

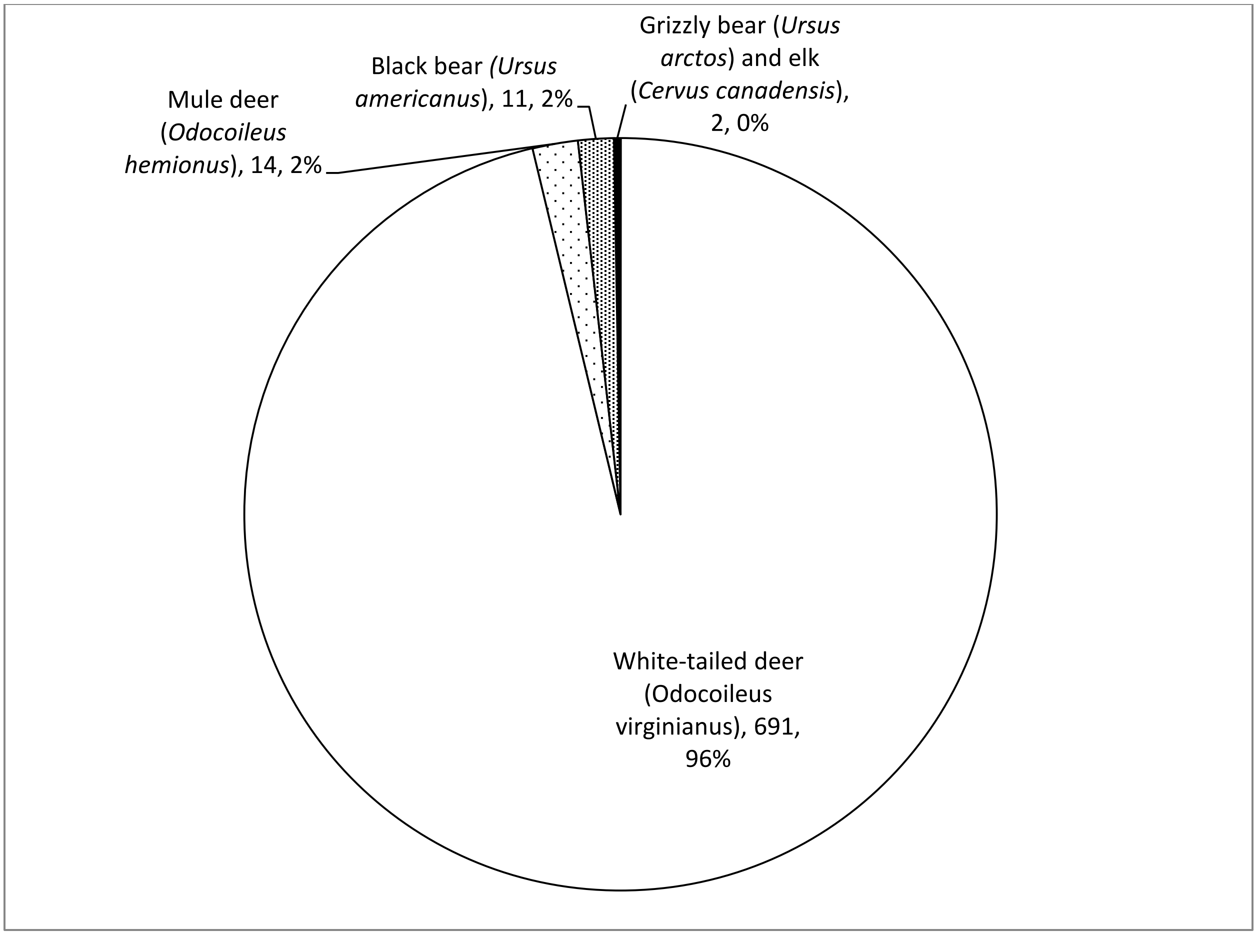

Figure 4: Species involved with animal-vehicle collisions based on carcass removal data (1998 through 2011) along US 93 North between Evaro and Polson (N=718).

The search and reporting effort was relatively low until 2002 (Hardy *et al.* 2007). MDT maintenance personnel were instructed to have better and more consistent reporting from 2002 onwards (Hardy *et al.* 2007). Therefore the researchers only included carcass data from 2002 onwards for the evaluation of the effectiveness of the mitigation measures in reducing the number of animal-vehicle collisions. The average number of large mammal carcasses in the Evaro, Jocko River, and Ravalli Curves and Ravalli Hill areas is shown in Figures 5-7. The research concentrates on three road sections with a concentration of mitigation measures: Evaro, Ravalli Hills and Ravalli Curves.

The number of reported large wild mammal carcasses was lower during reconstruction and after the implementation of the mitigation measures than before reconstruction. For Evaro, Ravalli Curves and Ravalli Hill combined (only one year of post mitigation data), there was a decrease of 100% in the average number of reported large mammal carcasses per year (Figure 5).

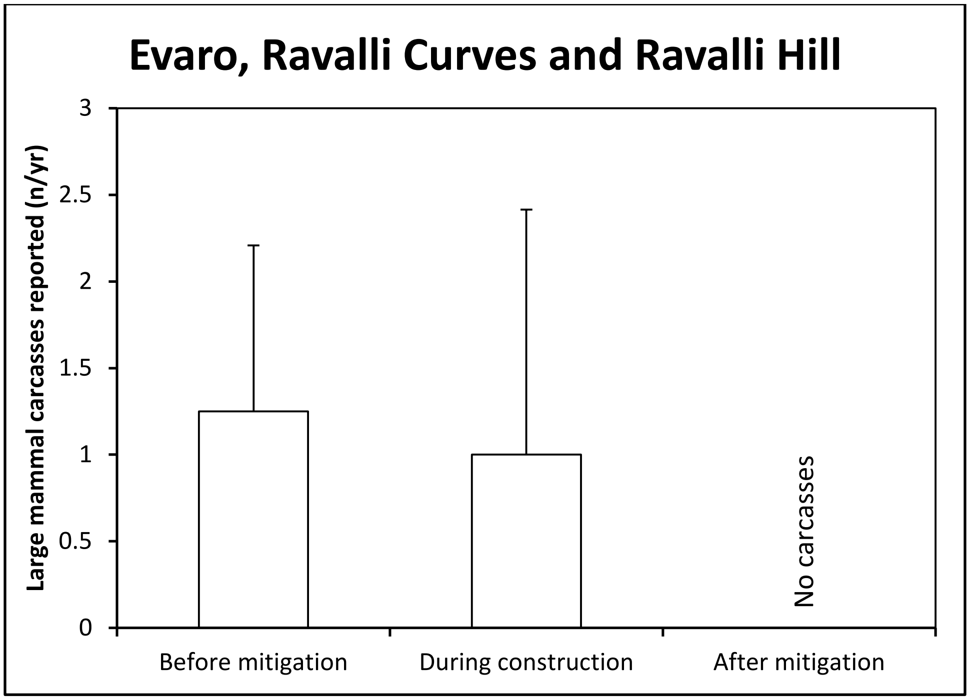

Figure 5: The number of wild large mammal carcasses and associated standard deviation that were reported during the four years before reconstruction (without wildlife fencing or wildlife crossing structures), the two years during reconstruction, and one year after reconstruction (with wildlife fencing and wildlife crossing structures) in the Evaro, Ravalli Curves, and Ravalli Hill areas combined.
The data are based on carcass removal data only. Note that the reconstruction for the areas took place in different years (see Table 1) and that there was only one year with post construction data available for the Evaro area (2011).

The Evaro area, with only one year of post-reconstruction data, showed a decrease of 100% in the average number of reported large mammal carcasses per year (Figure 6) whereas Ravalli Curves and Ravalli Hill, with four years of post-reconstruction data combined showed a decrease of 16.7% (Figure 7).

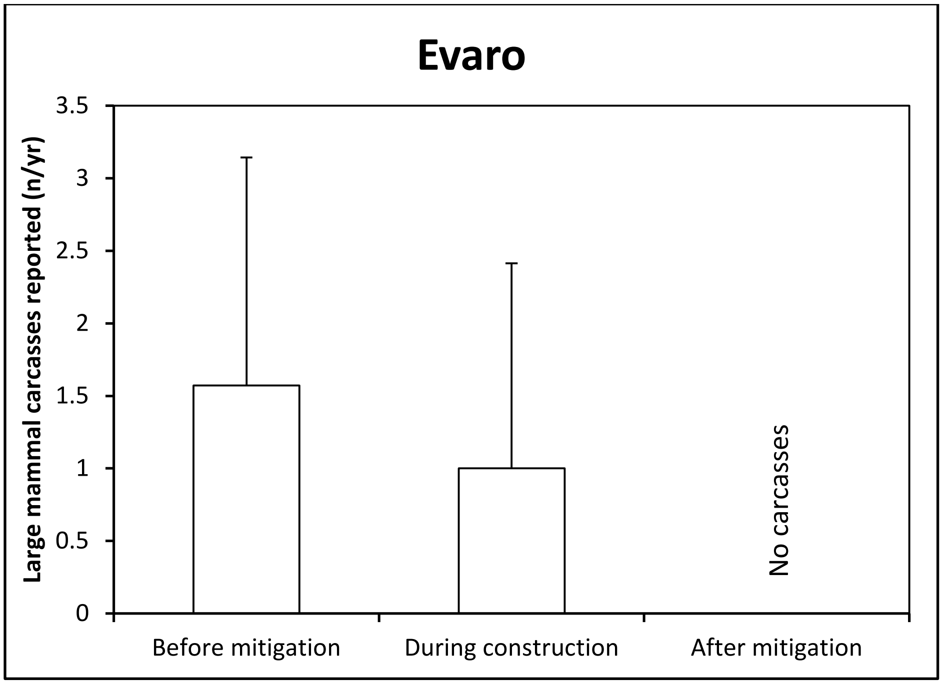

Figure 6: The number of wild large mammal carcasses and associated standard deviation that were reported before (without wildlife fencing or wildlife crossing structures), during, and after reconstruction (with wildlife fencing and wildlife crossing structures) in the Evaro area.
The data are based on carcass removal data only. Before reconstruction = 2002 through 2008, during reconstruction is 2009 and 2010, after reconstruction = 2011.

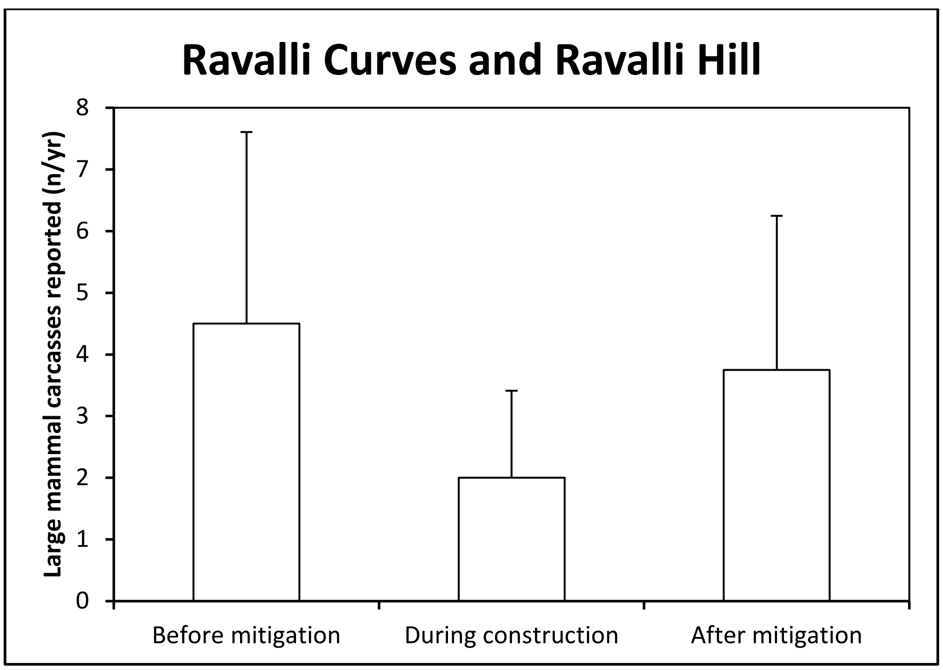

Figure 7: The number of wild large mammal carcasses and associated standard deviation that were reported before (without wildlife fencing or wildlife crossing structures), during, and after reconstruction (with wildlife fencing and wildlife crossing structures) in the Ravalli Curves and Ravalli Hill area combined.
The data are based on carcass removal data only. Before reconstruction = 2002 through 2005, during reconstruction is 2006 and 2007, after reconstruction = 2008 through 2011.

The number of reported crashes with large wild mammals was lower during reconstruction and after the implementation of the mitigation measures than before reconstruction. For Evaro, Ravalli Curves and Ravalli Hill combined (only one year of post mitigation data), there was a decrease of 100% in the average number of reported large mammal carcasses per year (Figure 8).

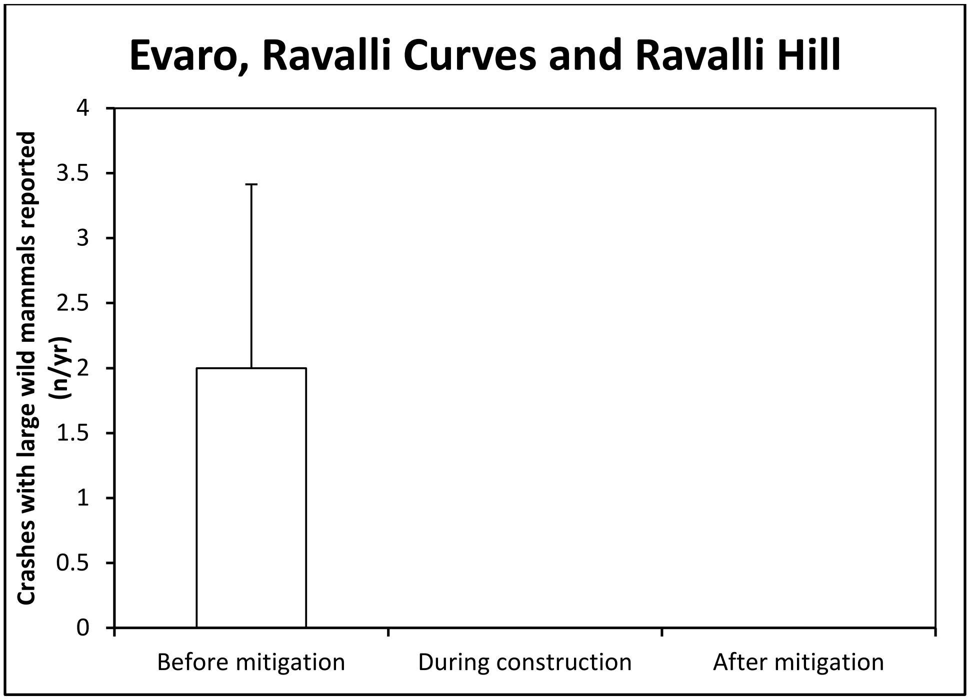

Figure 8: The number of crashes with large wild mammals and associated standard deviation that were reported during the four years before reconstruction (without wildlife fencing or wildlife crossing structures), the two years during reconstruction, and one year after reconstruction (with wildlife fencing and wildlife crossing structures) in the Evaro, Ravalli Curves, and Ravalli Hill areas combined.
The data are based on crash data only. Note that the reconstruction for the areas took place in different years (see Table 1) and that there was only one year with post construction data available for the Evaro area (2011).

The Evaro area, with only one year of post-reconstruction data, showed a decrease of 100% in the average number of reported crashes with large wild mammals per year (Figure 9) whereas Ravalli Curves and Ravalli Hill, with four years of post-reconstruction data combined showed a decrease of 41.7% (Figure 10).

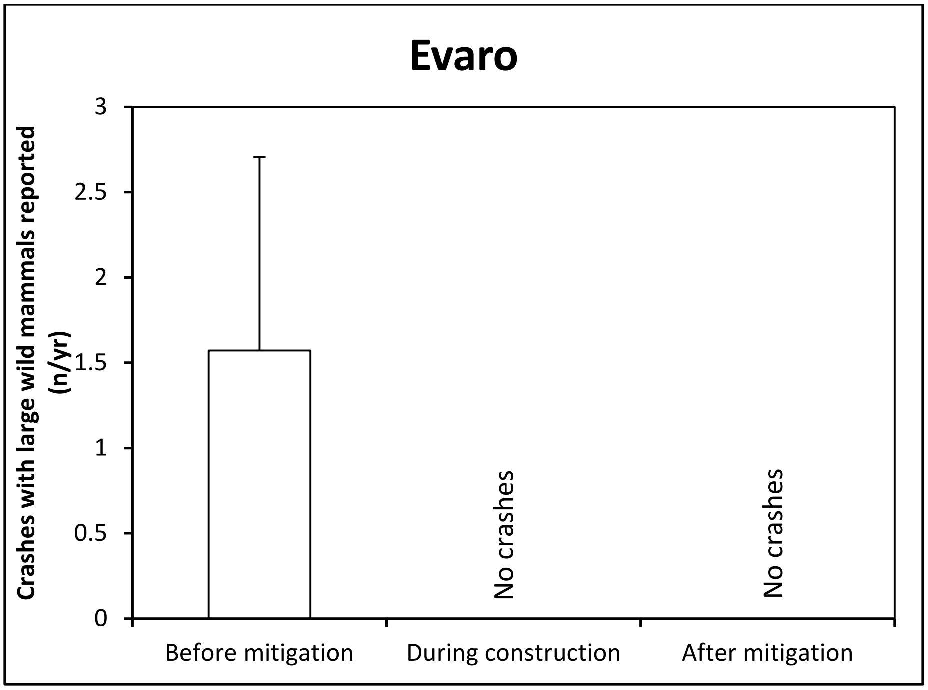

Figure 9: The number of crashes with large wild mammals and associated standard deviation that were reported before (without wildlife fencing or wildlife crossing structures), during, and after construction (with wildlife fencing and wildlife crossing structures) in the Evaro area.
The data are based on crash data only. Before construction = 2002 through 2008, during construction is 2009 and 2010, after construction = 2011.

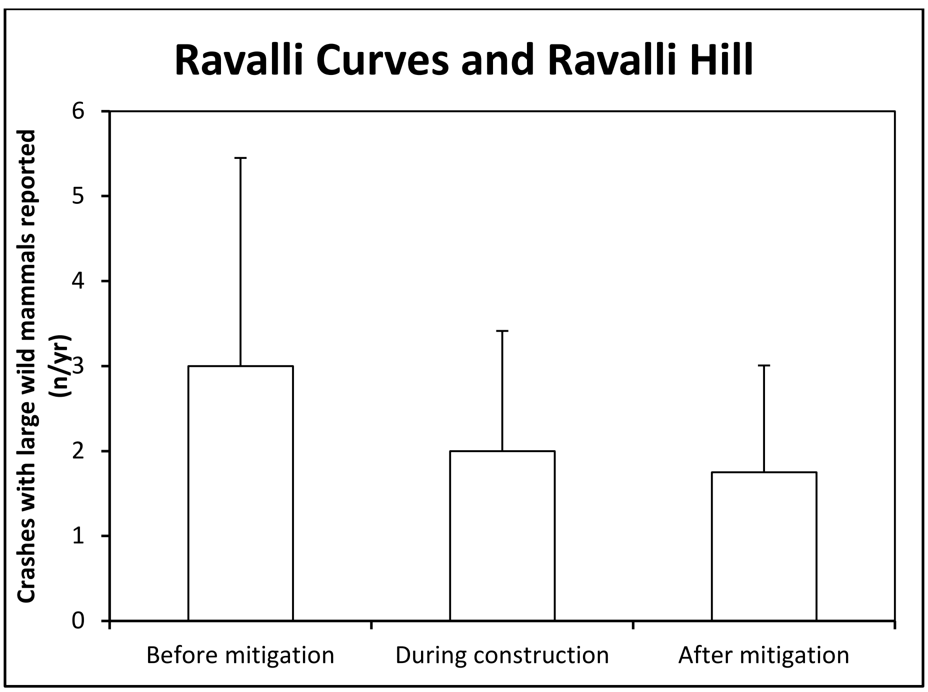

Figure 10: The number of crashes with large wild mammals and associated standard deviation that were reported before (without wildlife fencing or wildlife crossing structures), during, and after construction (with wildlife fencing and wildlife crossing structures) in the Ravalli Curves and Ravalli Hill area combined.
The data are based on crash data only. Before construction = 2002 through 2005, during construction is 2006 and 2007, after construction = 2008 through 2011.

The overall number of reported large mammal carcasses between Evaro and Polson dropped substantially in 2008 and 2009 with increasing numbers in 2010 and 2011 (Figure 11). However, a similar reduction occurred in the unmitigated road sections (Figure 11). Interestingly, the crash data do not show a drop in animal-vehicle crashes in 2008 and 2009; if anything there may be a slight increase between 2007-2010, both for the entire road section between Evaro and Polson and the unmitigated road sections (Figure 12).

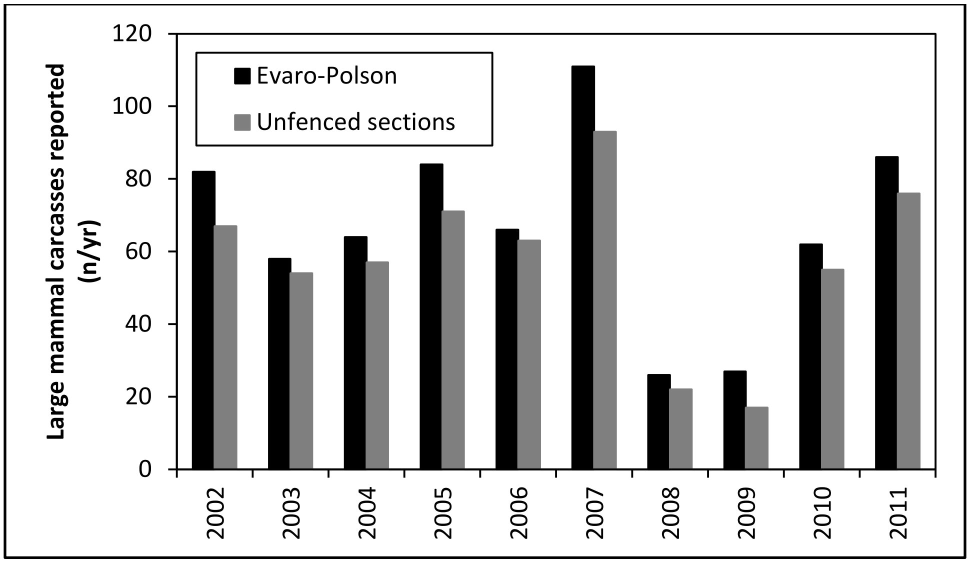

Figure 11: The number of wild large mammal carcasses that were reported between 2002 and 2011 for the entire 56 mile (90 km) between Evaro and Polson, and the road sections within this stretch that do not have wildlife fencing or wildlife crossing structures.

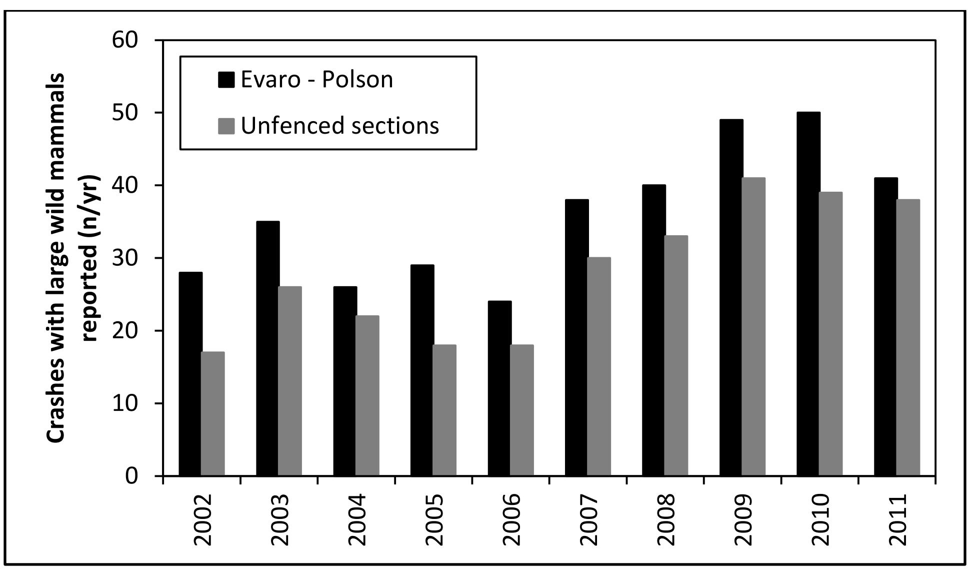

Figure 12: The number of animal-vehicle crashes that were reported between 2002 and 2011 for the entire 56 mile (90 km) between Evaro and Polson, and the road sections that do not have wildlife fencing or wildlife crossing structures.

2.3.1. Deer Pellet Group Surveys

The number of fresh and old black pellet groups in the Ravalli Curves and Ravalli Hill areas was variable with relatively large standard deviations (Figure 13). The number of fresh and old black pellet groups in the Evaro area was 2.72 (SD = 4.54) in 2011 (based on 11 transects).

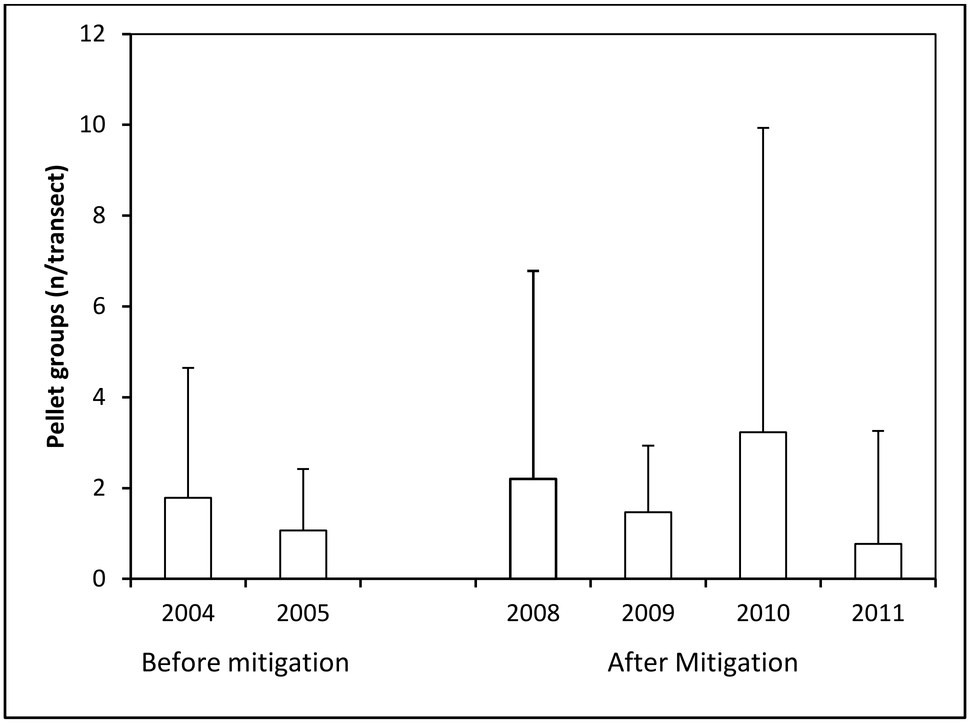

Figure 13: The average number of deer pellet groups (fresh and old black) per transect and associated standard deviations per year in the Ravalli Curves and Ravalli Hill areas combined (based on 13 transects).

2.4. Discussion and Conclusion

At first glance the carcass removal and crash data for the Evaro, Ravalli Curves and Ravalli Hill areas combined suggest a 100% decline in the number of large mammal carcasses and the number of animal-vehicle crashes in the first year after the mitigation measures were implemented. However, this analyses only includes one year of data with mitigation measures present. A separate analysis for only the Evaro area showed a reduction of 100% for the carcass removal data and also for the crash data. The Ravalli Curves and Hill areas combined showed a reduction of 16.7% based on carcass removal data and 41.7% based on crash data. The absolute number of crashes was relatively low; both before and after the mitigation measures were implemented. This means that only one crash more or one crash less can have a substantial effect on the percentage reduction. Collecting data for longer and combining the data with those for other mitigated road sections will provide a more precise and robust estimate in the future.

Most of the post reconstruction carcasses in the Ravalli Curves and Ravalli Hill areas were located in the Ravalli Curves area (15 out of 18 carcasses). There appears to be a concentration of carcasses between mile reference posts 24.1-24.3 (Figure 14). The mitigation measures in this area include wildlife fencing, a large mammal underpass (RC496), wildlife guards, gates, and wildlife jump-outs (Figure 15). The researchers inspected this road section for potential design or maintenance issues but could not identify obvious gaps that would allow deer to gain easy access into the fenced road corridor. Interestingly the underpass at mile marker 14.2 (RC496) is one of the most heavily used underpasses, particularly by white-tailed deer.

As discussed previously (see Huijser et al., 2011), the carcass removal data collection effort may have been lower in 2008 and 2009 than in previous and later years.

The number of fresh and old black pellet groups was variable through the years with high standard deviations. The data indicate that deer continue to be present in more or less similar numbers in the Evaro, Ravalli Curves and Ravalli Hill areas. However, the pellet group counts cannot detect subtle changes in population size as the standard deviations are high.

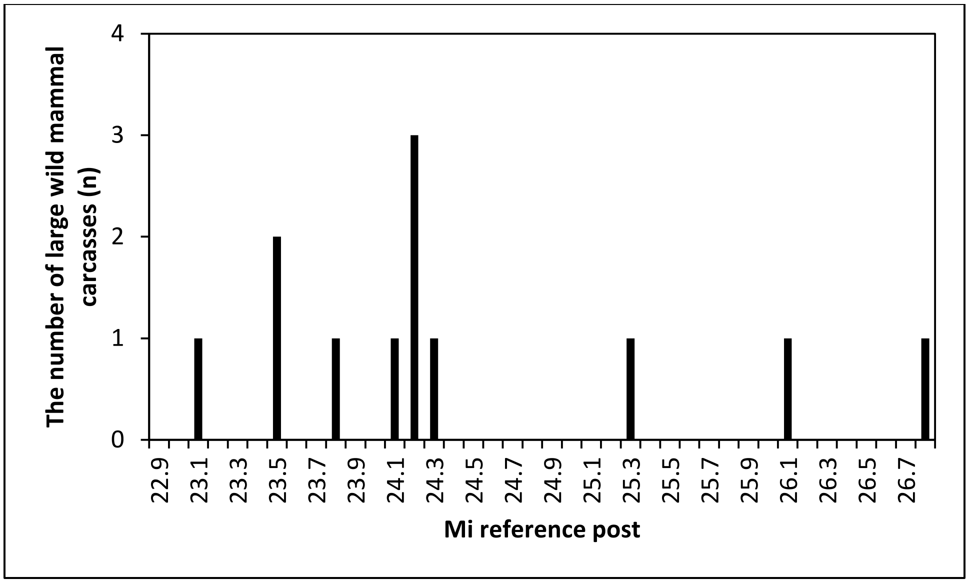

Figure 14: The number of wild large mammal carcasses that were reported after the wildlife fencing and wildlife crossing structures were installed in the Ravalli Curves area (2008 through 2011).

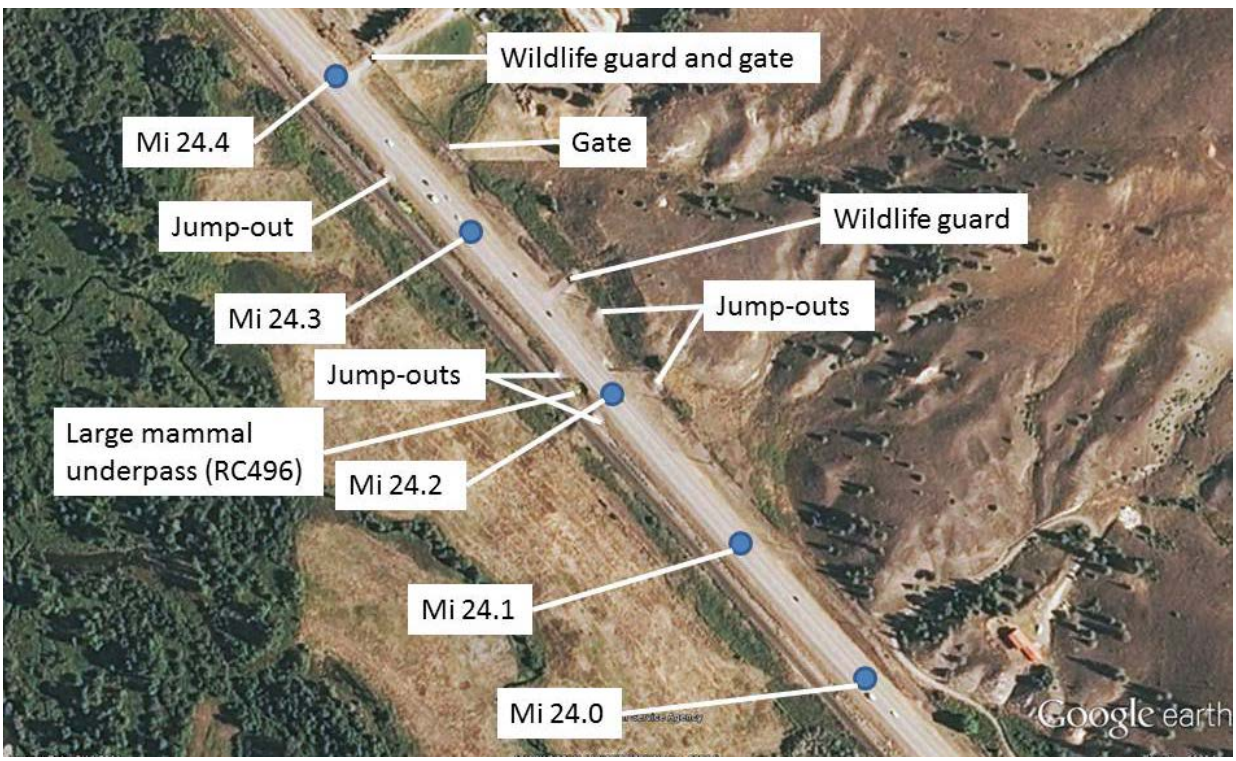

Figure 15: The mile markers, large mammal underpass, wildlife guards, gates and jump-outs between mi marker 24.0-24.4 at the potential concentration of large mammal-vehicle collisions in the Ravalli Curves area. Note that there is a wildlife fence in this area on both sides of the road that ties together the large mammal underpass, the jump-outs, and the wildlife guards and gates.

3. MITIGATION MEASURES AND HABITAT CONNECTIVITY FOR WILDLIFE

3.1. Introduction

The preconstruction research measured the number of animals, especially deer and black bear, crossing the road before the road was widened and before the mitigation measures were put in place (Hardy *et al.* 2007). For this purpose 38 tracking beds (100 m long, 2 m wide) were installed along three road sections that would later have continuous wildlife fencing and wildlife crossing structures (Evaro, Ravalli Curves, and Ravalli Hill). The tracking beds covered about 30% of the road sections that would later be mitigated. Now that the road has been widened and the fences and crossing structures are in place in these three areas, the animals can only cross the road by using the underpasses (although some animals may cross wildlife guards or climb fences).

This chapter reports on the preliminary data for the use of the wildlife crossing structures in the Evaro, Ravalli Curves and Ravalli Hill areas in 2011. In addition this chapter reports on the use of more isolated crossing structures with no or only limited wildlife fencing (e.g. up to a few hundred yards (meters)). Furthermore this report reports on research activities related to the barrier effect of wildlife guards (similar to cattle guards) at access roads, and the functioning of wildlife jump-outs or escape ramps that are designed to allow wildlife to escape from the fenced road corridor.

While continuous fencing over relatively long road sections combined with wildlife crossing structures can result in a substantial (>80%) reduction in collisions with large mammals and substantial use by wildlife of the structures, such mitigation measures are not always possible or desirable. Much of the landscape in North America is heavily used by people (agriculture, houses, access roads etc.), resulting in a push towards more isolated crossing structures with no or limited wildlife fencing. However, the effectiveness of more isolated crossing structures is not known very well; not in terms of potential collision reduction and not in terms of wildlife use of the structures. Therefore this project also aims to measure wildlife use at a minimum of 10 more or less isolated wildlife crossing structures and analyze their use in relation to collisions in the immediate vicinity of the structure and potential short section of wildlife fence. For the purpose of this annual report the wildlife use data of the isolated crossing structures are summarized, but not analyzed in the context of the research question described above.

3.2. Methods

3.2.1. Crossing Structures

In 2011 the wildlife use of the crossing structures was measured through wildlife cameras (1 January 2011 through 31 December 2011). For the purpose of this report the researchers only included records that related to actual crossings (excluding animals that rejected the structure after approaching it, excluding animals walking by a structure, and excluding animals that were in a group with a “mixed response”), and species that the researchers were able to identify with certainty (species identification “definitely”; excluding “probably” and “possibly”. However, if species identity was not certain, but the individual did cross the structure, the observation was included in the category “other”. Potential human use of the structures was excluded for the purpose of this report.

The researchers distinguished between the structures in the 1. Evaro area and 2. Ravalli Curves and Ravalli Hill areas (Table 2) as the structures in these areas were completed in different years. The structures in the Ravalli Curves and Ravalli Hill areas were completed in 2007 whereas the structures in Evaro were completed in 2010. This means that wildlife has had more time to learn about the location of the structures and that it is safe to use them in the Ravalli Curves and Ravalli Hill areas than in the Evaro area and that a separate analyses is appropriate for these areas for the 2011 data. The wildlife use of the “isolated” structures (Table 3) was summarized separately.

Table 2: The 17 wildlife crossing structures in road sections with continuous fencing in the Evaro, Ravalli Curves and Ravalli Hill areas that were monitored for wildlife use in 2011, including the period and the methods of monitoring since 1 January 2010.

Area	Name structure	Method	Period monitored
Evaro	EV 163 Montana Rail Link underpass (partial coverage with 2 cameras 8 September 2010) full coverage from 18 September 2010 onwards.	Camera	a. 18 September 2010 – 31 December 2011
	EV 169 Finley creek 1 EV 172 Finley creek 2 EV 176 Finley creek 3 EV 181 Finley creek 4 Cameras installed 3 September 2010 with full coverage from 8 September 2010 onwards	Camera	a. 8 September 2010 - 31 December 2011
	EV 173 Wildlife Overpass: Incidental cameras on overpass in June and early July, partial coverage wildlife overpass (partial coverage with 4 cameras; 6-29 July 2010) (full coverage 1 approach with 7 cameras; 29 July- 18 August 2010, full coverage both approaches 8 August 2010-present).	Camera	a. June 2010 – 31 December 2011
Ravalli Curves	RC 377 (Schall Flats #1)	Camera	a. 1 January 2010 – 31 December 2011
	RC 381 (Spring Creek) RC 396 (Ravalli Curves #1) RC 406 (Ravalli Curves #2) RC 422 (Jocko Side Channel) RC 426 (Ravalli Curves #3) RC427(Ravalli Curves #4) RC 431(Ravalli Curves #5) RC 432 (Copper Creek)	a. Tracking bed b. Cameras	a. 1 January 2010 – 26 February 2010 b. 26 February 2010 - 31 December 2011
Ravalli Hill	RH 459 (Ravalli Hill #1) RH 463 (Ravalli Hill #2)	a. Tracking bed b. Cameras	a. 1 January 2010 – 26 February 2010 b. 26 February 2010 - 31 December 2011

Table 3: The 12 isolated wildlife crossing structures that were monitored for wildlife use in 2011, including the period and the methods of monitoring since 1 January 2010.

Name structure	**Method**	**Date or period monitored**
148 (North Evaro)	Camera	6 July 2010 – 31 December 2011
198 (Schley Creek)	Camera	29 June 2010 - 31 December 2011
204 (East Fork Finley Creek)	Camera	4 October 2010 – 31 December 2011
499 (Pistol creek #1)	Camera	1 January 2010 – 31 December 2011
502 (Pistol creek #2)	Camera	1 January 2010 – 31 December 2011
529 (Mission Creek)	a. Camera (south side) b. Camera (north side)	a. 1 January 2010 – 31 December 2011 b. 13 October 2010 -31 December 2011
551 (Post Creek #1)	Camera	29 June 2010 – 31 December 2011
555 (Post Creek #2)	Camera	1 January 2010 – 31 December 2011
560 (Post Creek #3)	Camera	1 January 2010 – 31 December 2011
774 (Spring Creek #1)	Camera	1 January 2010 – 31 December 2011
784 (Spring Creek #2)	Camera	11 March 2010 - 31 December 2011
917 (Polson Hill)	Camera	11 October 2010 - 31 December 2011

Because sand tracking beds inside structures (sheltered) have a different detection probability for wildlife than sand tracking beds alongside the road (exposed to wind, precipitation etc.) a relationship between preconstruction road crossings on sand tracking beds alongside the road, and post construction sand tracking beds inside underpasses must be established. The same is true for detecting wildlife crossings with cameras compared to using tracking beds. Therefore four crossing structures had a tracking bed placed outside the structures (exposed to the elements, similar to pre-construction methods). These four tracking beds were installed on 20/21 July 2010 and monitored, twice a week between 9 August 2010 and 2 November 2010, and between 27 May 2011 and 25 October 2011. These four crossing structures have a relatively high use by deer and black bear, which should result in a high enough sample size to establish this relationship. The four tracking beds are located at RC 396 (Ravalli Curves #1), RC 427 (Ravalli Curves #3), RC432 (Copper Creek), and RH 459 (Ravalli Hill #1).

3.2.2. Wildlife Guards

In the areas with longer sections of fencing wildlife guards were installed at most of the access roads. Wildlife guards consist of modified bridge grating material (Peterson *et al.* 2003) and are designed to be a barrier for ungulates such as deer (*Odocoileus* spp.). The wildlife guards are not expected to be a barrier for bears (*Ursus* spp.). For the purpose of this annual report the behavior of the various wildlife species that approached the road was summarized. Currently, data are collected at four guards (Table 4). The wildlife guards are to keep animals from entering the roadway. While the wildlife guards represent the same physical barrier for animals that are caught in the fenced road corridor, it would be quite acceptable if those animals would cross the wildlife guard to reach the "safe side" of the fence. In addition, animals that were present on the "road side" of the fence may have been more motivated to cross the wildlife guard compared to animals present at the "safe side" of the fence. For these reasons the researchers distinguish between the direction of travel of the animals. Data through mid-2010 have been analyzed and have been reported by Allen (2011).

Table 4: The wildlife guards that were monitored for wildlife approaches and crossing from 2008 onwards, methods of monitoring, and the time periods these methods were in effect.

Wildlife guards	
Maintenance of the two camera traps at two wildlife guards in Ravalli Curves section took place on a biweekly basis from July 2008 until 26 February 2010.	July 2008 – 26 February 2010
Maintenance of the two camera traps at two wildlife guards in Ravalli Curves section continued on a monthly basis from 26 February 2010 onwards.	26 February 2010 - present
Camera traps at two additional wildlife guards were installed on 20 October 2010 (guard just north of RC 396) and 31 October 2010 (guard north of RC 381 on east side). One camera has a technical problem (removed 1 May 2011). The repaired camera was used at another location that had higher priority. The other camera was removed 21 October 2011 to a location with a higher priority. Cameras reinstalled 20 March 2012.	20 October 2010- 1 May 2011 / 21 October 2011 20 March 2012 - present

3.2.3. Wildlife Jump-outs

Wildlife jump-outs (also referred to as "escape ramps") were installed near wildlife crossing structures as well as in between wildlife crossing structures in areas with continuous fencing. The purpose of the wildlife jump-outs is to allow animals that are caught in between the fences of the fenced road corridor to escape to the safe side of the fence. The ramps allow the wildlife to walk up to the top of the wildlife jump-out at or below the height of the fence (between 1.7 and 2.7 m high). The animals can then jump-down towards the safe side of the fence. Wildlife jump-outs should be low enough so that animals will readily jump down to safety and high enough to discourage them from jumping up into the fenced road corridor. The appropriate height of jump-outs is unknown for most species. All 29 jump-outs in the Ravalli Curves and Ravalli Hill areas were monitored for wildlife presence and behavior at the top and bottom of the jump-outs. Sand tracking beds were installed at the top and bottom of each of the jump-outs. Each tracking bed was about 16 ft (5 m) long and 6.5 ft (2 m) wide. The tracking beds were checked about once a week between 8 June 2008 – 24 July 2008, 10 June 2009 - 17 August 2009, 13 June 2010 – 2 November 2010, and 27 May 2011 – 25 October 2011. One of the jump-outs had a wildlife camera installed to obtain images of the wildlife at the jump-out allowing for more insight in their behavior than based on tracking data only. There were an additional 23 jump-outs monitored in the Evaro area. These were monitored 4 August 2010 - 2 November 2010 and 27 May 2011 – 25 October 2011. The jump-out data are projected to be analyzed in the next annual report.

3.3. Results

In 2011 a minimum of 22,466 movements by animals (at least 23 species) passed through the 29 structures listed in Table 2 and 3 (Figure 16, Table 5). The animal crossings through the structures that were monitored were dominated by white-tailed deer, domestic dogs, mule deer, and domestic cats (Figure 16). The estimate is reported as a minimum because not all structures were monitored for the entire year and it excluded groups of animals with a mixed response to the structure.

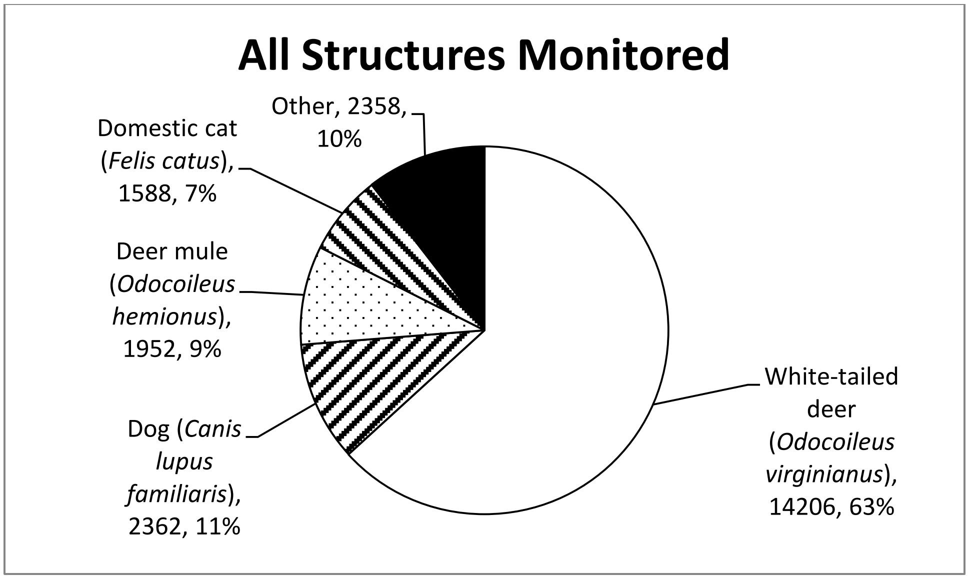

Figure 16: Wildlife use of all the 29 wildlife crossing structures monitored in 2011 (1 January 2011 through 31 December 2011). Preliminary data (N=22,466).

Table 5: The number and percentage of the crossings that related to the species that were grouped in the "other" category in Figure 16.

Species	N	%
Birds (Aves)	553	2.46
Raccoon (*Procyon lotor*)	439	1.95
Black bear (*Ursus americanus*)	289	1.29
Coyote (*Canis latrans*)	263	1.17
Red fox (*Vulpes vulpes*)	250	1.11
Bobcat (*Lynx rufus*)	202	0.90
Western striped skunk (*Mephitis mephitis*)	124	0.55
Deer spp. (*Odocoileus* spp.)	63	0.28
Rabbits and hares (Lagomorpha)	55	0.24
Mountain lion (*Felis concolor*)	51	0.23
Other	18	0.08
Grizzly bear (*Ursus arctos*)	15	0.07
Unknown	12	0.05
American badger (*Taxidea taxus*)	9	0.04
Elk (*Cervus canadensis*)	6	0.03
Bear spp. (*Ursus* spp.)	3	0.01
River otter (*Lutra canadensis*)	3	0.01
Yellow-bellied marmot (*Marmota flaviventris*)	2	0.01
Weasel spp. (*Mustela* spp.)	1	0.00

In 2011 a minimum of 5,186 movements by animals passed through the six structures in the Evaro area (Figure 17, Table 6). The animal crossings through the structures that were monitored were dominated by white-tailed deer, domestic cats, and birds (Figure 167. There were a minimum of 3,846 crossings by deer and 80 crossings by black bear in this area. Interestingly there were 6 crossings by elk across the overpass (n=3) and Finley Creek 4 (n=3).

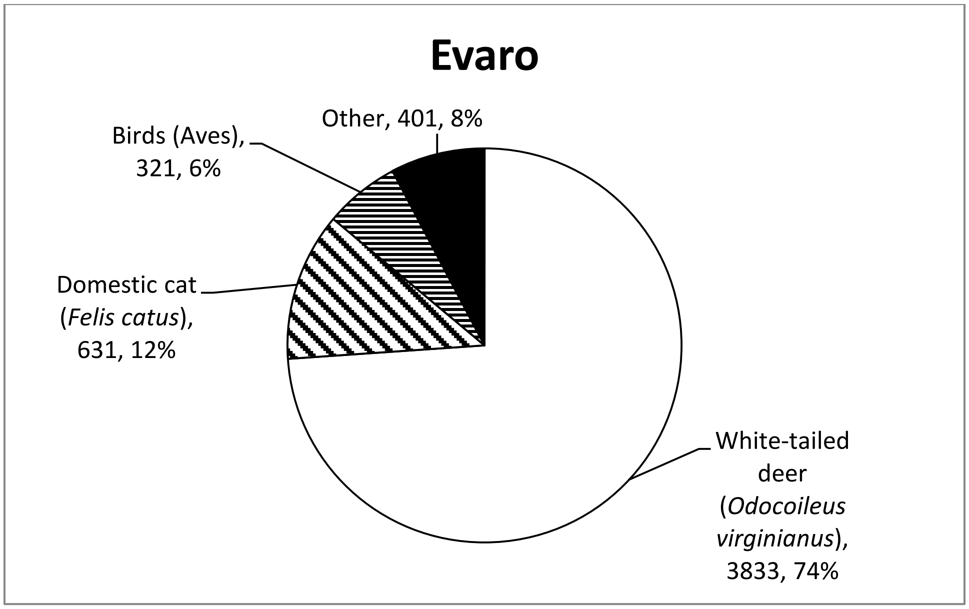

Figure 17: Wildlife use of the 6 wildlife crossing structures monitored in the Evaro area in 2011 (1 January 2011 through 31 December 2011). Preliminary data (N=5,186).

Table 6: The number and percentage of the crossings that related to the species that were grouped in the "other" category in Figure 17.

Species	**N**	**%**
Coyote (*Canis latrans*)	91	1.75
Dog (*Canis lupus familiaris*)	88	1.70
Black bear (*Ursus americanus*)	80	1.54
Raccoon (*Procyon lotor*)	68	1.31
Bobcat (*Lynx rufus*)	46	0.89
Deer spp. (*Odocoileus* spp.)	13	0.25
Elk (*Cervus canadensis*)	6	0.12
Unknown	4	0.08
Mountain lion (*Felis concolor*)	3	0.06
Rabbits and hares (Lagomorpha)	1	0.02
Other	1	0.02

In 2011 a minimum of 5,562 movements by animals passed through the eleven structures in the Ravalli Curves and Ravalli Hill areas (Figure 18, Table 7). The animal crossings through the structures that were monitored were dominated by white-tailed deer and mule deer (Figure 18). There were a minimum of 4,709 crossings by deer and 159 crossings by black bear in this area.

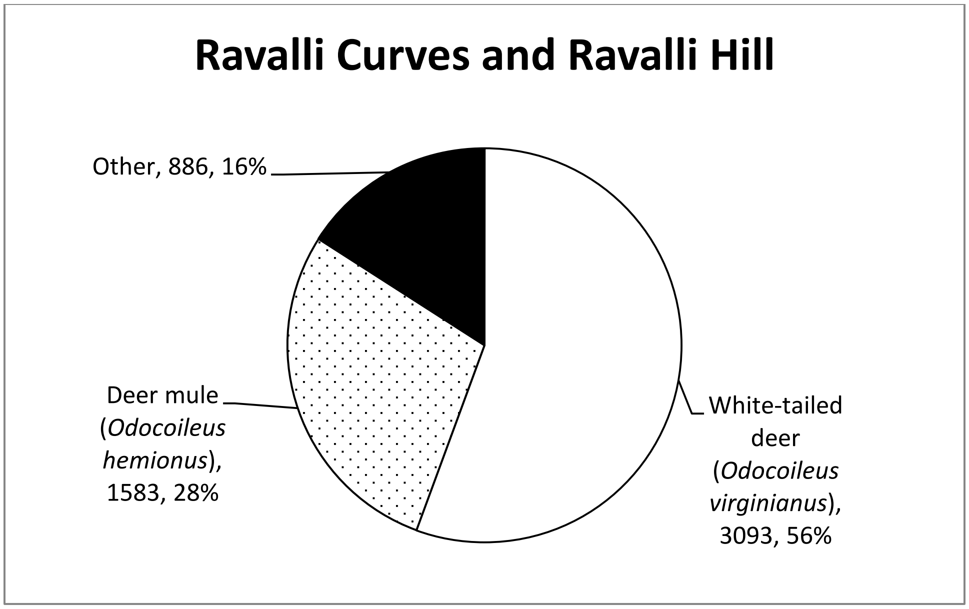

Figure 18: Wildlife use of the 11 wildlife crossing structures monitored in the Ravalli Curves and Ravalli Hill areas in 2011 (1 January 2011 through 31 December 2011). Preliminary data (N=5,562).

Table 7: The number and percentage of the crossings that related to the species that were grouped in the "other" category in Figure 18.

Species	**N**	**%**
Raccoon (*Procyon lotor*)	173	3.11
Black bear (*Ursus americanus*)	159	2.86
Bobcat (*Lynx rufus*)	155	2.79
Coyote (*Canis latrans*)	146	2.62
Domestic cat (*Felis catus*)	64	1.15
Rabbits and hares (Lagomorpha)	54	0.97
Mountain lion (*Felis concolor*)	42	0.76
Deer spp. (*Odocoileus* spp.)	33	0.59
Birds (Aves)	26	0.47
Other	15	0.27
American badger (*Taxidea taxus*)	8	0.14
Dog (*Canis lupus familiaris*)	4	0.07
Western striped skunk (*Mephitis mephitis*)	3	0.05
Bear spp. (*Ursus* spp.)	2	0.04
Yellow-bellied marmot (*Marmota flaviventris*)	1	0.02
Weasel spp. (*Mustela* spp.)	1	0.02

In 2011 a minimum of 11,718 movements by animals passed through the twelve isolated structures, scattered between Evaro and Polson (Figure 19, Table 8). The animal crossings through the structures that were monitored were dominated by white-tailed deer, domestic dog and domestic cat (Figure 19). There were a minimum of 7,666 crossings by deer and 49 crossings by black bear through these structures. Interestingly there were 15 crossings by grizzly bear through Pistol Creek 1 (n=12) and Post Creek 3 (n=3).

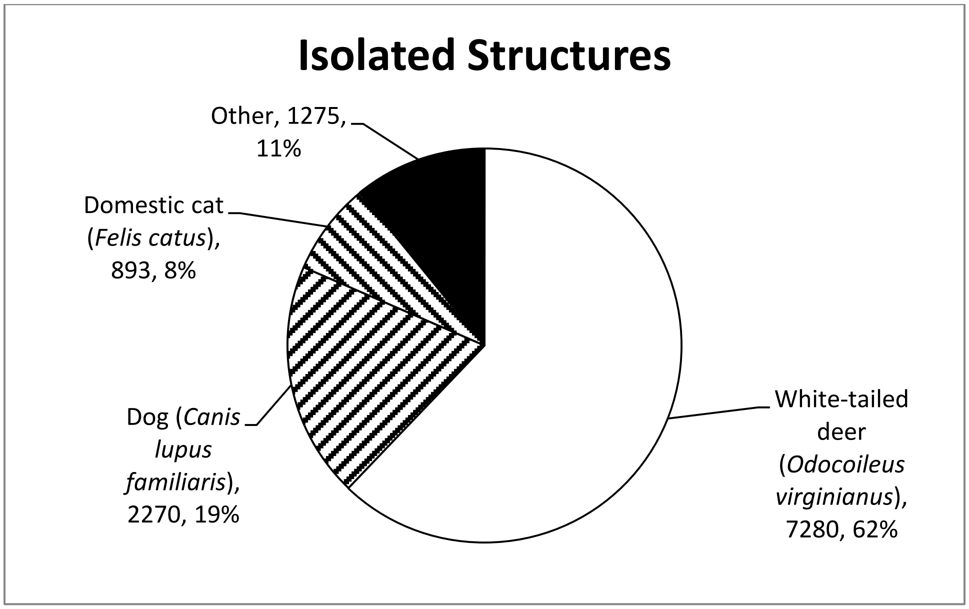

Figure 19: Wildlife use of the 12 isolated wildlife crossing structures monitored in 2011 (1 January 2011 through 31 December 2011). Preliminary data (N=11,718).

Table 8: The number and percentage of the crossings that related to the species that were grouped in the "other" category in Figure 19.

Species	N	%
Deer mule (*Odocoileus hemionus*)	369	3.15
Red fox (*Vulpes vulpes*)	250	2.13
Birds (Aves)	206	1.76
Raccoon (*Procyon lotor*)	198	1.69
Western striped skunk (*Mephitis mephitis*)	121	1.03
Black bear (*Ursus americanus*)	50	0.43
Coyote (*Canis latrans*)	26	0.22
Deer spp. (*Odocoileus* spp.)	17	0.15
Grizzly bear (*Ursus arctos*)	15	0.13
Unknown	8	0.07
Mountain lion (*Felis concolor*)	6	0.05
River otter (*Lutra canadensis*)	3	0.03
Other	2	0.02
American badger (*Taxidea taxus*)	1	0.01
Bear spp. (*Ursus* spp.)	1	0.01
Bobcat (*Lynx rufus*)	1	0.01
Yellow-bellied marmot (*Marmota flaviventris*)	1	0.01

3.4. Discussion and Conclusion

The wildlife crossing structures in the road sections with continuous fencing in Evaro, Ravalli Curves and Ravalli Hill, as well as the selected isolated structures appear to receive substantial use by a wide variety of wildlife species (at least 23 species), especially white-tailed deer and mule deer, domestic dogs and cats, and birds.

Raccoon, black bear, Coyote, red fox, bobcat, western striped skunk, rabbits and hares, mountain lion, grizzly bear, American badger, elk, river otter, yellow-bellied marmot, and weasel spp. were observed less frequently using the structures. It is noteworthy that there were 15 crossings by grizzly bears (only three in 2010), and 6 by elk (none in 2010).

For the road sections with a concentration of mitigation measures (Evaro, Ravalli Curves and Ravalli Hill) the average number of deer (white-tailed deer and mule deer combined) that were estimated to cross the road before road reconstruction was estimated at 1732 per year (2003 through 2005) while this number was 109 for black bears (Hardy *et al.* 2007). It appears that far more deer (n=8,555) and black bear (n=239) crossings occurred through the structures in these areas in 2011 than the pre-mitigation reference values, with no indication of a considerable increase in the deer population in 2011 compared to 2004 and 2005 (see pellet group counts in Chapter 2). While wildlife use of the structures can be considered substantial, the term "success" is specifically defined based on consensus between MDT, CSKT and FHWA. Thus whether the wildlife crossing structures are considered "successful" or not can only be concluded after more data have been collected and after they have been analyzed in the context of the measures of effectiveness agreed upon by MDT, CSKT, and FHWA.

4. COST-BENEFIT ANALYSIS

Cost data were collected for the wildlife mitigation measures along US Highway 93 North throughout 2011. The cost-benefit data are projected to be analyzed in the next annual report.

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