Lava Butte Wildlife Crossing Monitoring Project

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Background

This monitoring project evaluated the efficacy of the wildlife passage mitigation measures along the US-97: Lava Butte to South Century Drive, south of Bend, Oregon. The highway improvement project that widened the existing highway from milepost [MP] 149 to MP 153 to two lanes in each direction separated by a median also provided the opportunity to install structures that could increase the ability of wildlife to more safely cross from one side to the other. Due to the high risk of serious injuries from deer-vehicle collisions along this stretch and to the barrier to animal passage created by the busy highway, a variety of wildlife features were incorporated into the improvement project. Among those features were two sets of wildlife under-crossing structures.

One set of the crossing structures, the Crawford Road Bridges are located near the Lava Lands Visitor Center, at MP 149.55, and the other set of crossing structures the South Lava Butte Bridges are at MP 152.0 (Figure 1). Additional measures installed to encourage wildlife use of the structures and deter them from accessing the busy highway include rocks, logs, and native plantings under the crossings to encourage small animal use; four miles of wildlife exclusionary fencing (8 feet high) on both sides of the highway; four wildlife escape ramps; and six ElectroBraid TM mats to prevent wildlife from entering the road right of way at intersections. The main goal of this monitoring project was to evaluate the effectiveness of these structures and other measures for wildlife.

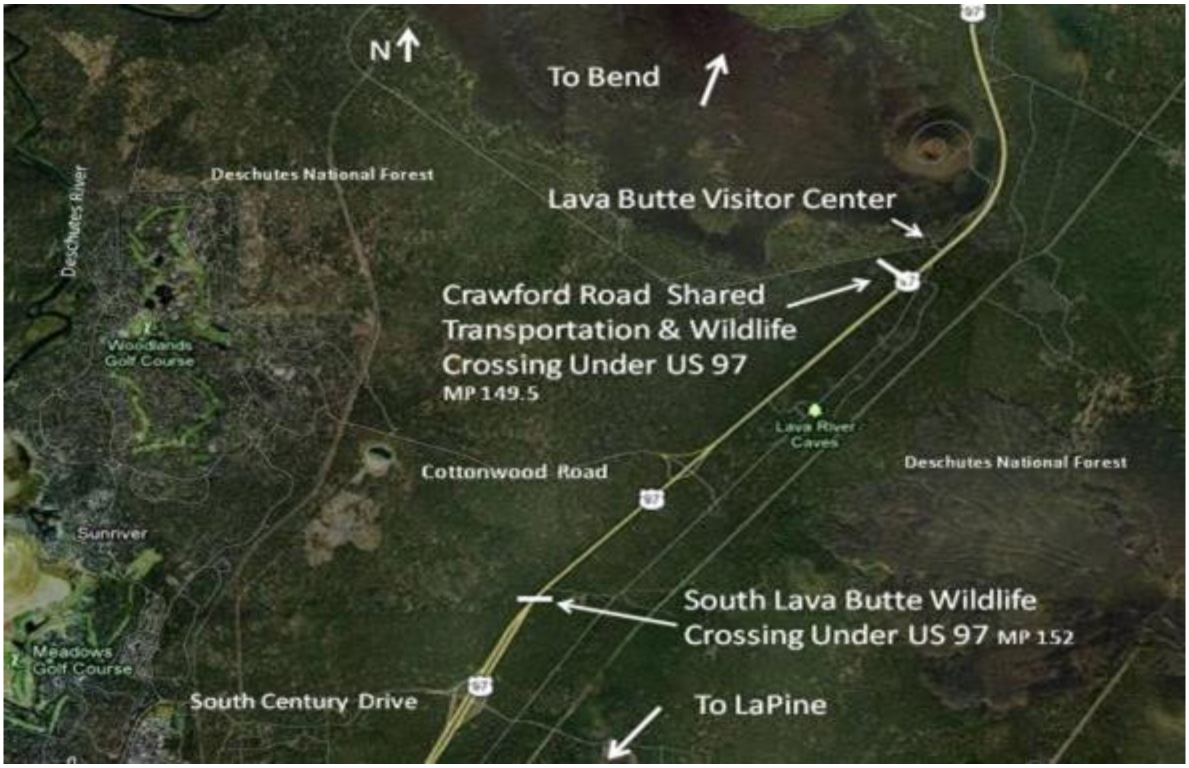


Figure 1. The Lava Butte Wildlife Crossings study area, south of Bend, Oregon.

The wildlife crossing measures were initiated because of the high incidents of mule deer-vehicle collisions, the significant effect of heavy traffic volume on mule deer migratory paths, and concerns of the effects of the highway on all wildlife in the area. Oregon Department of Fish and Wildlife (ODFW) and U.S. Forest Service (USFS) biologists were aware that historically mule deer moved across US-97 in an east-west direction as they migrated between summer habitat in the Cascade Mountains west of the highway and winter habitat on the Deschutes National Forest low elevation lands to the east. This latitudinal migration occurs in a sheet flow pattern from Lava Butte (near MP 149) southward for almost 100 miles. In 1969, ODFW (Bright and Ingram 1969) estimated there were over 7,000 mule deer on the winter range located southeast of the study site, near Fort Rock, Oregon. The population plummeted to approximately 2,000 in 1992 (Thames 1992). In 2010, ODFW estimated the herd size was 5,300 deer (Jackson et al. 2011).

Over time the traffic volume in this area increased to a current average daily traffic (ADT) of over 20,000 vehicles in the project area (ODOT Lava Butte Automatic Traffic Recorder). Mule deer herds changed their migratory pathway to avoid this high volume of traffic. Based on ODFW's GPS tracking as reported in the publication *Identifying migration corridors of mule deer threatened by highway development* (Coe et al 2014) published in The Wildlife Society Bulletin, individuals were found to migrate 30 miles south of their historic routes down toward LaPine to cross where traffic volumes were lower. The US-97: Lava Butte to South Century Drive highway project was intended to accommodate these and higher traffic volumes, which are expected to exceed 30,000 ADT in the next 20 years. The existing and anticipated high traffic volume increases the risk of serious human injury due to animal-vehicle collisions. Furthermore, ODFW and USFS wildlife biologists predict that the high traffic volume will become a near complete barrier to mule deer migration, separating herds and resulting in over utilization of habitat.

In the fall of 2005, ODFW initiated a study of the mule deer populations that they speculated were most affected by highway traffic in south-central Oregon, including the Upper Deschutes, Paulina, Fort Rock, Silver Lake and Sprague management units (Coe et al 2014). These herds migrate yearly and seasonally between winter and summer ranges across US-97 and OR-31 roughly between Bend and Chemult, Oregon. The mule-deer migration study was partially funded by ODOT's Research Unit to address issues associated with how and where to place mule deer crossing structures under the highway, thus helping to reduce the very serious safety risk of deer-vehicle collisions in the study area. The Oregon mule deer migration study provided a better understanding of mule deer movements across 100 miles of Highway 97, from Bend, approximately MP 144, to Spring Hill, approximately MP 220, to the south. Over 1,300 mule deer-vehicle collision carcasses were recorded by ODFW along this stretch from October 2005 through December 2010 and reported in the *Highway Mortality of Mule Deer in Central Oregon Wildlife Technical Report 001-2011* by Jackson et al. 2011, currently in draft. Although high records of carcasses were found all the way from MP 150-220, the highest incidents were near MP 176 (a few miles south of the OR-31 interchange) and MP 208 (near Chemult) (Figure 2). During that time period in the Lava Butte Wildlife Crossings project area, ODFW recorded mule deer carcasses between MP 149 and MP 153 and documented a total of 34 carcasses over the four mile study area, over 5 years. This averaged 6.8 carcasses in the four mile stretch per year.

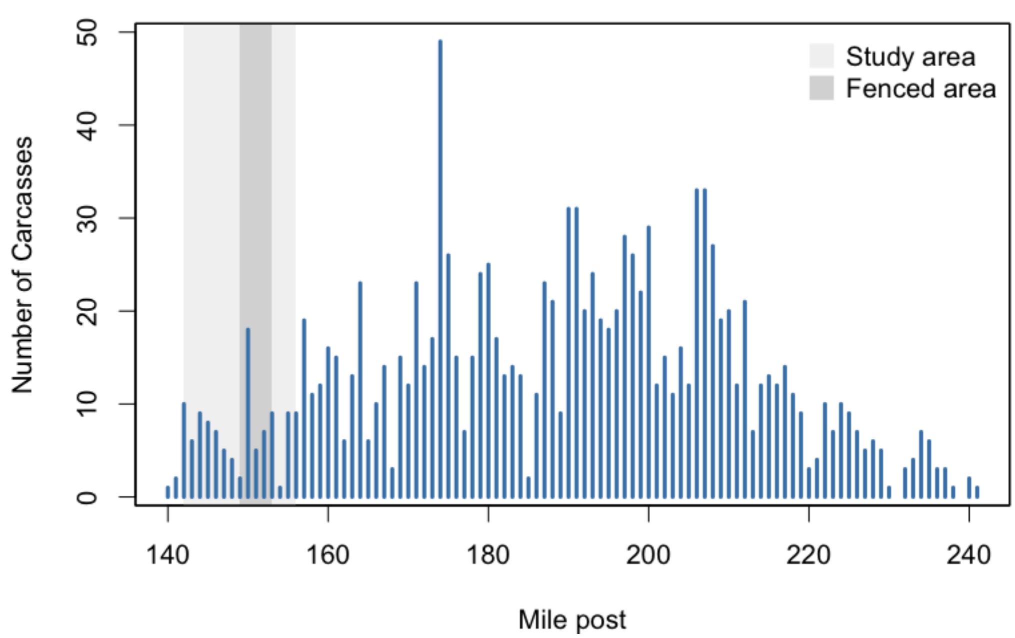


Figure 2. Distribution of vehicle-killed deer carcasses along US-97 from October 2005 to December 2010. The fenced Lava Butte project area occurs from MP 149 to 153. Post construction monitoring extending beyond the fenced area and is shown by the shaded “Study area”.

The Lava Butte Wildlife Crossings Project consists of bridged under-crossings and other measures designed to limit wildlife access onto the highway in the project limits. The paired Crawford Road bridges each consist of 95-foot span bridges that create this multi-use structure, with a low volume road for access to the Lava Butte Visitor Center, as well as a separated wildlife path. The South Lava Butte Bridges are located two miles to the south consist of approximately 40-foot span bridges and were designed as a dedicated wildlife crossing. Four miles of wildlife exclusion fencing (8-foot tall) were placed on both sides of the highway and in the median, from MP 149.22 to MP 153.03. The fencing is intended to keep wildlife off the road and guide them to the crossing structures. Four escape ramps were also placed near the northern and southern ends of the fence, to allow animals trapped on the road the opportunity to jump over the top of the fence into open forest habitat. With this investment, it is important for ODOT to learn if mule deer and other wildlife are using the ramps to escape rather than access the highway, if the number and placement of ramps is sufficient for this many miles of fencing and if mule deer and other wildlife access the road at the ends of the fencing.

The ElectroBraid TM electric mats were at the time a relatively new method to keep wildlife off the road right-of-way at ingress and egress points. If these mats prove effective and not a hindrance for the public or highway maintenance personnel, they could be a viable alternative to the more standard double cattle guards.

Movement of other wildlife species is also an objective of this research. US-97 was identified in the Oregon Wildlife Movement Strategy as a significant barrier and could be causing population issues such as lack of genetic connectivity for many wide ranging species, including fisher and wolverine. The fence was designed with a smaller weave mesh near the bottom to restrict movement of smaller animals onto to traffic lanes and guide them two the two sets of under-crossings. At the Crawford Road Bridges, habitat structure was strategically placed under the bridge to support a variety of wildlife species. Boulders, stumps, and logs were placed on the top of slope along the length of the crossing for smaller species such as rabbits, squirrels, and mice. Although the Crawford Road Bridges are multi use, allowing vehicle traffic and pedestrian use, the utilization of the bridges by humans was expected to be low during fall through spring when the Lava Lands Visitor Center is closed. In the event that the human activity is still a barrier for some animals, they may instead utilize the South Lava Butte Bridges, which do not provide for vehicular or pedestrian use. The objective of these crossing structures is to provide passage for all wildlife species in the area. Monitoring the areas under both these bridged crossings will provide important data to compare the different designs and help to improve future wildlife crossing designs.

The goals of the wildlife crossing mitigation measures were not only to decrease the number of mule deer killed on US-97, but to allow them to re-establish historic migratory patterns in the Lava Butte area, and to promote connectivity for all species of animals near the highway. This report provides a short-term (2 yr) first assessment of the efficacy of the range of measures taken to reduce wildlife-vehicle collisions. A more complete assessment will be possible after an additional three year monitoring period is conducted.

Task 1 - Deer - Vehicle Collisions

The purpose of this task was to compare the mule deer vehicle collision carcass data pre and post construction in the US-97: Lava Butte to South Century Drive highway project area to evaluate if collisions decreased as predicted as a result of the wildlife crossing measures. Methodology used was consistent with previous carcass surveys conducted by ODFW from 2005-2010 (Jackson et al draft report). The monitoring period of this report covers two years, whereas the Jackson et al. report covers a five year monitoring period. Because of this discrepancy it is important to note that the variability in carcass data is not well captured in comparisons between the two monitoring periods. This variability will be better captured at the completion of the full five years of post construction monitoring and the following data should be taken with this caveat in mind.

1.1 Changes in deer/vehicle collisions methods

Carcass surveys were conducted three times per week by car during mule deer spring and fall migration periods and covered south and northbound lanes of US HWY 97 from mile marker 142 to 156. Methodology used was consistent with previous carcass surveys conducted by ODFW from 2005-2010 (Jackson et al draft report). Data collected during the monitoring period were spatially compared in two ways. First we compared collision carcasses occurring within the fenced project area (MP 149 to 153) and second we compared across the entire post-monitoring area, which includes 7 additional miles before and 3 miles after the fenced project area. This buffer area of monitoring on either side of the fenced project area allows for examination of potential collision risk at the project fence ends. For example, this examination can help determine whether collision risk increased compared to previous data at the fence end locations, stayed the same, or decreased.

1.2 Effectiveness of crossing structures and fencing at reducing collisions

The goal of this objective is to determine if these wildlife crossing designs and concurrent mitigation are effective methods to decrease deer-vehicle collisions and promote wildlife movement under the road.

Collisions within project area (MP 149-153)

Carcass data were collected from June 2013 to January 2015 and were compared to previous data collected by ODFW from 2005-2010 (Jackson et al draft report). The ODFW study documented 34 mule deer strikes within the four mile project area over five years. Over that time the calculated annual average number of collisions was 6.8 strikes within the project area.

We documented a single deer-vehicle collision carcass early in the monitoring of the first year, and zero collisions in the second year (Figure 3). In the first year of monitoring post construction we were able to demonstrate an 85% reduction in deer-vehicle collisions and in the second year 100% reduction within the fenced project area. If this trend holds then the collision rate for the four-mile Lava Butte project area will have greatly reduced.

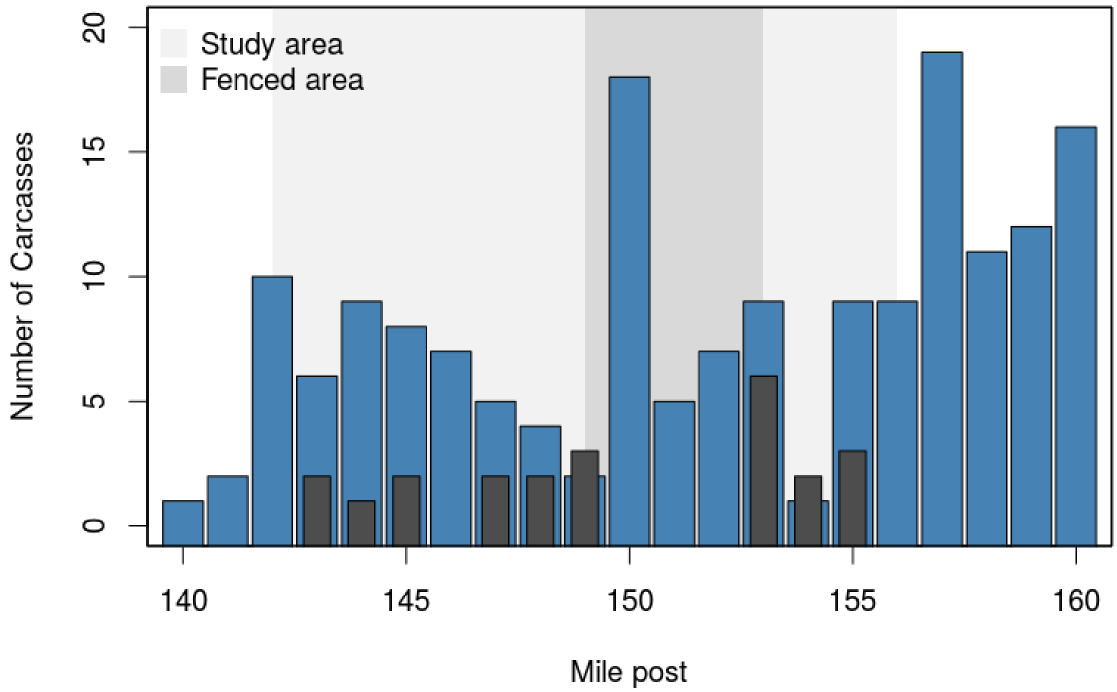


Figure 3: Distribution of carcasses along study area by milepost. Blue bars show the 2006-2010 carcass data, gray show the 2013-2015 monitoring data.

1.3 Changes in deer-vehicle collision rate of the full monitoring area

In other wildlife crossing project studies that include fencing it has been suggested that collision rates will increase at fence ends. Collision monitoring extended beyond the four-mile fenced project area and therefore allows us to compare these additional areas to previously collected data (Jackson et al. draft report).

Collisions across full monitoring area (MP 142-156)

We compared collision data from the 2013-2015 monitoring period to previous data collected by ODFW in 2006-2010 (Jackson et al draft report). These data were compared over several spatial scales. Comparisons were made within the four-mile fenced project area (as described above in Task 1.2), eleven miles north of the fenced project area, four miles south of the fenced project area and across the full 19 miles where carcass surveys were conducted during the 2013-2015 monitoring period (Table 1, Figure 4, Figure 5).

	Before crossing structures		After crossing structures		Avg % Reduction
	5 year Total	Annual Avg +/- SE	2 year Total	Annual Avg +/- SE	
Fenced area	34	6.8 +/- 2.4	1	0.5 +/- 0.7	- 93%
Northern end	50	10 +/- 2.6	11	5.5 +/- 2.1	- 45%
Southern end	19	3.8 +/- 0.9	11	5.5 +/- 3.5	+ 45%
Total	103	20.6 +/- 5.6	23	11.5 +/- 6.4	- 44%

Table 1 Mule deer collisions before and after the crossing structures were installed. Positions for the 2006-2010 data (before) are estimated based on the provided carcass location and the current location of the fence ends. Estimates of the standard error are provided to illustrate variability of the estimates. Before estimates are derived from five years worth of monitoring while after estimates are from only two.

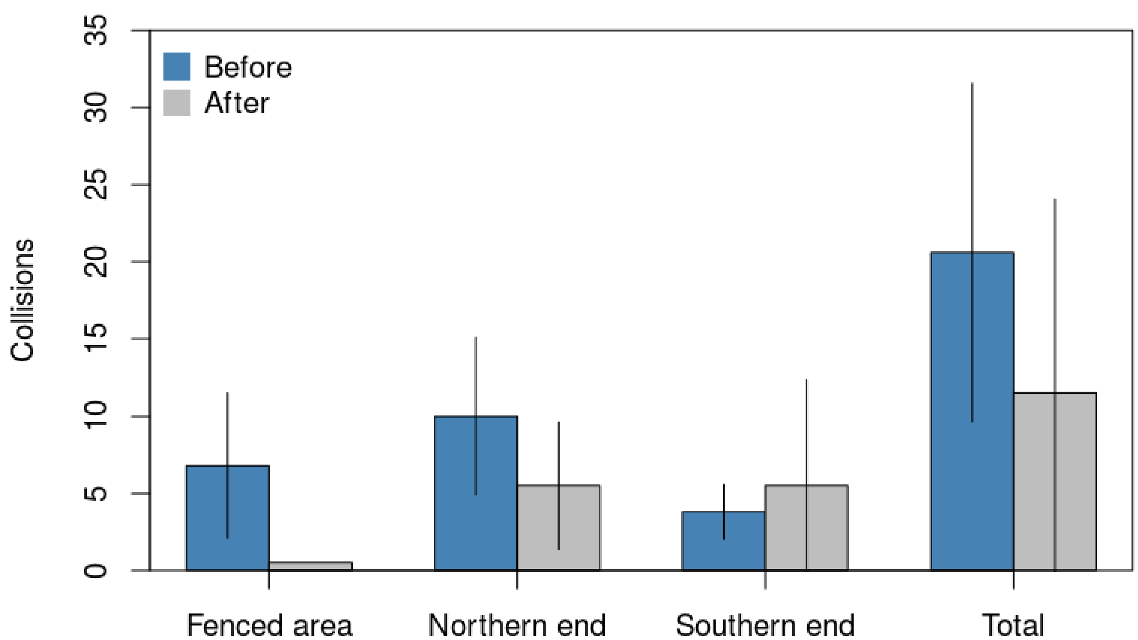


Figure 4. Average annual Mule deer collisions before construction (2005-2010 monitoring) and after (2013-2015 monitoring) the crossing structures were installed. Error bars show 95% confidence intervals.

The ODFW study documented 103 mule deer strikes from MP 142 to MP 156 over the 5 year period. Over that time the calculated annual average number of collisions was 20.6 strikes within the fourteen mile area. The 2013-2015 monitoring period documented 23 total carcasses, an annual average of 11.5 strikes (Figure 5). These data indicate a 44% reduction overall in collisions.

North of the fenced project area (MP142-148), 2006-2010 monitoring results documented a total of 50 carcasses for an annual average of 10. The 2013-2015 monitoring period documented 11 carcasses in this same area for an average of 5.5 strikes, which is a 45% reduction.

South of the fenced project area (MP153-155), 2006-2010 monitoring results documented a total of 19 carcasses, for an annual average of 3.8 strikes over the monitoring period. The 2013-2015 monitoring period documented 11 carcasses for an average of 5.5 strikes, which is a 45% increase.

It should be noted again that these estimates are based on only two years of data whereas the ODFW estimates are a result of 5 years. Given the amount of variability in the carcass data we recommend waiting for the full 5 years of monitoring data before drawing conclusions from these data.

Discussion and Recommendations Regarding Deer-Vehicle Collisions

Our data clearly show that a majority of the unsuccessful crossings (crossings that resulted in collisions) in the monitored area occurred at the fence ends. Therefore we recommend that future projects pay special attention to the siting of fence ends. Knowing that animals will be moving across the road surface where fences end, the fence ends can be strategically located in areas where the line-of-sight for drivers is greatest. In addition vegetation could be managed in these areas to increase visibility and deter deer from crossing in these locations.

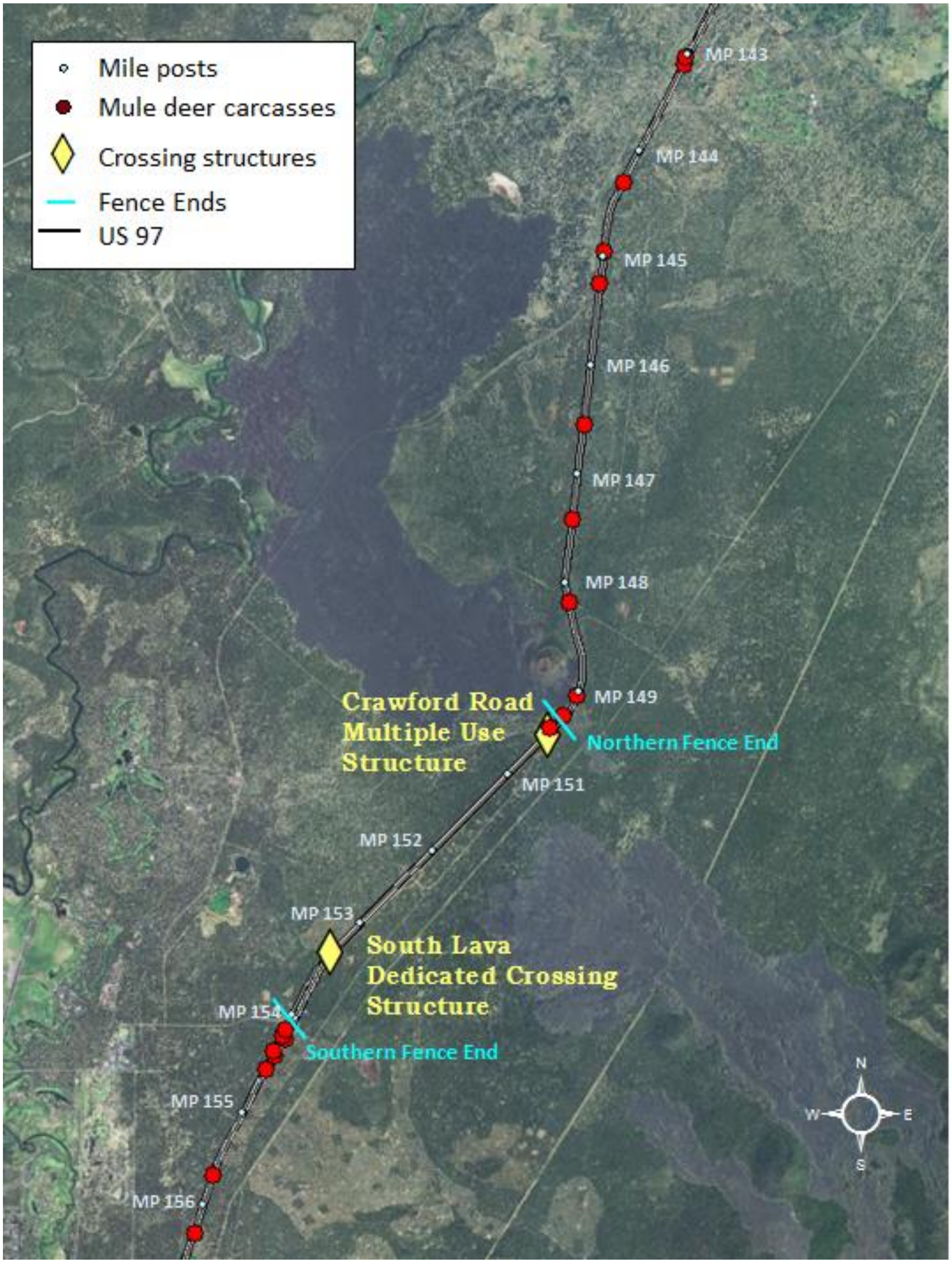


Figure 5: Spatial distribution of mule deer carcasses documented in the 2013-2015 monitoring period.

Task 2 - Wildlife Crossing Structures

The purpose of this task is to document wildlife use of the Crawford Rd and South Lava Butte Bridges crossing structures and determine the effectiveness of these structures at maintaining and enhancing habitat connectivity for the entire wildlife community. Special focus is given to ungulates and large carnivores as they pose the greatest safety concern to motorists when present on the road surface and are of conservation concern.

Methods

Reconyx brand Hyperfire 800 cameras were installed at the entrances of both wildlife crossing structures (see Appendix A for exact locations). Installation of cameras took place on 21 June 2012. The cameras were mounted in steel utility boxes, and pointed toward the areas underneath the bridges to record wildlife approaches and use of the structures. Cameras were positioned so they also recorded some approximation of lack of use by animals that approached the bridges within 30 feet of the entrance, allowing quantification of potential repel behaviors from the structures. At both locations several cameras were also positioned closer to the ground to observe small mammal movements along the logs and stumps placed to facilitate their use of the structures.

The cameras were checked every two weeks at which time memory cards were exchanged and batteries were changed as needed by ODOT personnel. Data from the memory cards were brought into the office, organized into folders, copied onto backup locations and shared with project PI's. Data were analyzed and input into a database. Each event when an animal was detected was recorded and if the same species was detected at the same location within a 15 minute interval, with no evidence to the contrary, it was assumed to be the same individual and was not considered a separate event. All animals photographed were classified to species, and if it could be determined, to their gender and general age class. If the animal approached the structure and was recorded coming through, it was counted as a success. If the animal approached the structure and turned away, it was counted as a repel. Camera photographic data were analyzed from January 2013 through January 2015.

Task 2.1 - Successful passage use

Passage use is documented with the goal of evaluating passage use through the structures by multiple species, particularly mule deer in the short term.

Crossing structure use

Remote camera monitoring at the Crawford Rd and South Lava Butte Bridges Crossing structures yielded 6,141 individual wildlife sightings composed of 31 different species over the two-year monitoring period (Figure 6). The most frequently detected species were the golden mantled ground squirrel (32%), followed by mule deer (21%) and yellow pine chipmunk (19%).

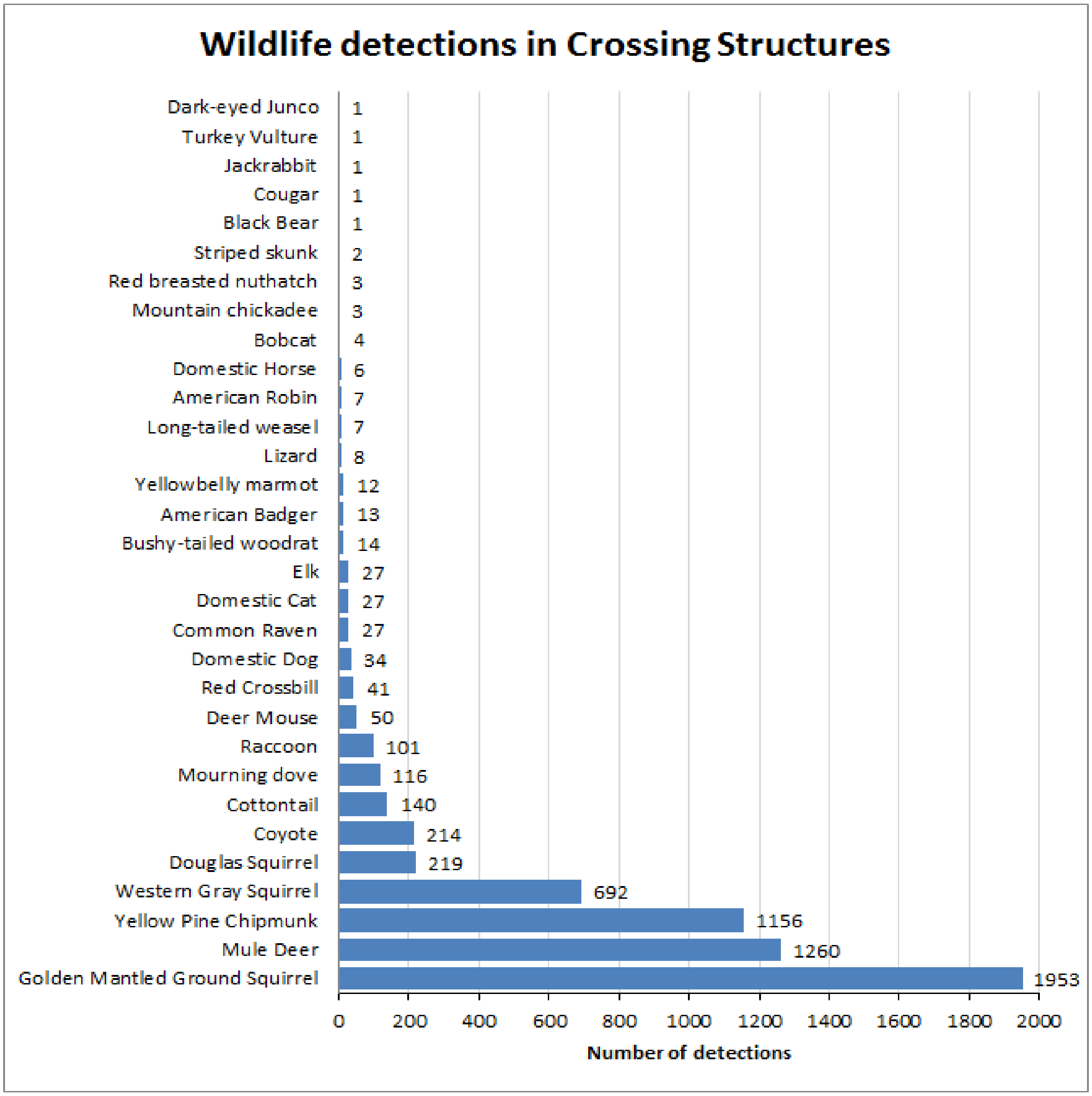


Figure 6: Total number of wildlife detections found at crossing structures by species.

Task 2.2 - Carnivores use of crossing structures

Mammalian carnivore sightings account for less than 6% of the total wildlife detections in the crossing structures. Of that 6%, Coyotes make up the vast majority of the carnivore sightings in the crossing structures (63%) followed by raccoons (30%). Large carnivores of greatest conservation concern have only been documented twice, a single cougar sighting and a single black bear sighting. Large carnivores are known to take several years to become habituated to regular use of crossing structures and so only through continued monitoring can we establish a more accurate picture of crossing structure use by these species.

Species	Crawford Rd Crossing	South Lava Crossing	Total Sightings
American Badger	1	12	13
Black Bear	1	0	1
Bobcat	4	0	4
Cougar	1	0	1
Coyote	12	202	214
Long-tailed weasel	7	0	7
Raccoon	55	46	101
Total	81	260	341

Table 2: Mammalian carnivores detected using crossing structures

Task 2.3 - Crossing structure comparison

Wildlife detections of the Crawford Rd crossing and South Lava crossing varied by species in frequency and timing of use, with some species only being detected in one crossing and not the other (Table 3).

Crawford Road Crossing Structure

Despite the fact that the Crawford structure is designed for use by vehicles and pedestrians, seasonally, as well as animals, we detected fourteen species in the Crawford Rd structure that were not also detected at the South Lava Butte Bridges structure. Observations on seven of these species, six birds and one reptile that could be considered opportunistic and are likely under-representative of the true signal. The motion detect cameras, especially given the specific orientations used, were not targeted to avian species and the cameras in their current configuration do not reliably trigger on poikilothermic species. The remaining seven species include species of conservation interest such as large carnivores (black bear and cougar) as well as mesocarnivores (long-tailed weasel and bobcat) and native rodents (yellow-belly marmot and bushy-tailed woodrat) and a native lagomorph (jackrabbit). Currently we have documented very few of these unique mammal detections (14 detections or less in two years). Continued monitoring will no doubt result in changes to these detections and provide more reliable estimations of established wildlife use of these structures as notoriously “shy” species such as black bear and cougar become acclimated to the crossings.

More habitat elements and greater structure size likely contribute to the greater number of species using only the Crawford Road structure compared to the South Lava Butte Bridges structure. Crawford Road contains larger and more frequent placement of habitat structure elements designed to promote small animal use. An increase in small mammal presence could translate to a corresponding increase in mesocarnivore presence and activity and provide one explanation for the higher level of diversity currently detected at Crawford Rd. This hypothesis could be tested more rigorously through an experimental approach where additional structural habitat features (e.g. logs, large rock) are added or removed from a crossing structure and monitored for abundance before and after the change for a change in the abundance and diversity of small mammal use. Overall, the larger size of the Crawford Rd structure may also contribute to the higher number of unique species detections than the South Lava Butte Bridge crossing, as the Crawford Road structure more closely mimics surrounding habitat conditions such as natural light penetration.

Collisions on Crawford Road

Two deer-vehicle collisions were documented within the Crawford Rd crossing structure, one in November 2013 and another in July 2014. Currently vehicle speeds are not specially limited in this area nor is there any signage on site to identify the area as a wildlife crossing. Since project completion traffic has steadily increased in the Crawford Rd crossing as people have become accustomed to using it as a route in their daily commutes, not to mention the high volume of tourist traffic during summer and winter breaks. While two collisions may not be impressive in comparison to the 588 detections of mule deer using the structure, nonetheless the objective is to provide safe passage without risk of collisions. With minor adjustments it is likely we can reduce these collisions altogether by limiting speeds through the crossing structure to 20mph with the use of large speed bumps, and increasing driver awareness by including signage on site that this is a wildlife crossing area.

South Lava Butte Bridges Crossing Structure

Only three species were detected in the South Lava Butte Bridges structure that were not also detected at Crawford Rd. One of these detections was an opportunistic bird sighting (red-breasted nuthatch) another of a mesocarnivore (striped skunk) and lastly a large ungulate (elk). Elk are of particular concern for motorist safety and are also a species that has been notoriously wary of undercrossing structures. On one occasion a bull elk was documented to have approached the Crawford Rd structure, but that animal turned back and did not successfully cross. In contrast small herds of elk were twice detected at the South Lava Butte Bridges structure, cautiously investigating, then eventually successfully using the structure. Previous crossing structure monitoring, such as that conducted by the Arizona Department of Transportation has shown that elk are more likely to use large, wide open crossing structures over smaller structures. Conversely, the results from this monitoring study show elk had an apparent preference for the smaller Lava Butte structure. Clearly there are additional factors to consider than simply the size of the structure given that the Crawford Rd structure, while much larger in height and span, includes greater human activity by way of the access road. Potentially it is this level of disturbance in Crawford Rd that has resulted in elk utilizing the smaller structure. An additional contributing factor to this somewhat unusual finding could simply be the spatial orientation of the crossings. South Lava Butte Bridges is the more southerly crossing and is situated closer to known elk habitat on the landscape; therefore, the elk may simply be reaching the South Lava Butte Bridges crossing first and so have a greater chance of utilizing that structure.

Currently there are very few detections of any of these species (27 elk, 2 skunk in two years). Again, continued monitoring will likely result in changes to the patterns of these detections.

Species only detected in the Crawford Road Crossing		Species only detected in the South Lava Crossing	
American Robin	7	Elk	27
Black Bear	1	Red breasted nuthatch	3
Bobcat	4	Striped skunk	2
Bushy-tailed woodrat	14		
Common Raven	27		
Cougar	1		
Dark-eyed Junco	1		
Jackrabbit	1		
Lizard	8		
Long-tailed weasel	7		
Mourning dove	116		
Red Crossbill	41		
Turkey Vulture	1		
Yellowbelly marmot	12		

Table 3: Species and number of detections for taxa that were found in only one crossing structure.

Comparison of Mule deer detections between structures

Mule deer use patterns of the Crawford Road structures differed from the observations at the South Lava structures (Figure 7). The pattern of use at the Crawford Road structures is much more variable than the detections at South Lava with very low values early in the project, a spike in fall of 2013, followed by relatively low use throughout the rest of the monitoring period. Mule deer use of the South Lava structures appears more consistent over time but also peaks at alternating times with Crawford Road activity.

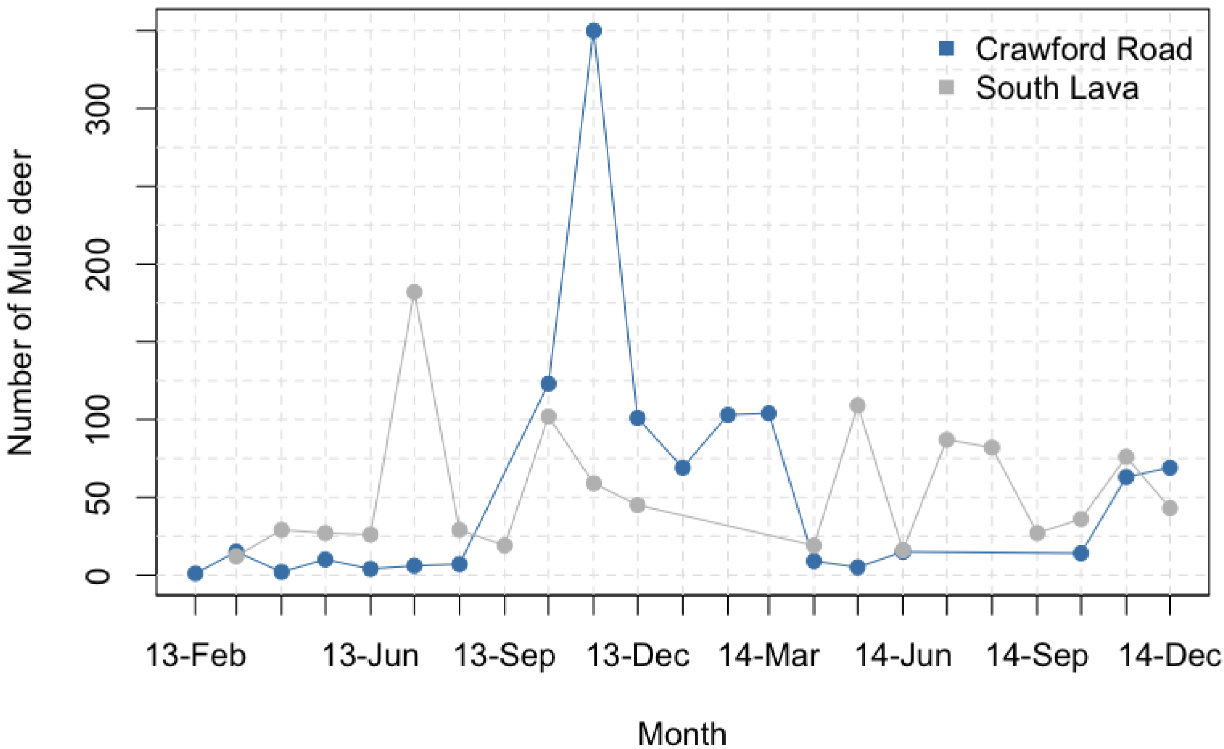


Figure 7: Monthly Mule deer counts at each of the crossing structures.

Task 2.4 - Vehicle and Deer use of the Crawford Road Structure

The Crawford Rd structure is unique in that it includes a local access road as well as wildlife passage. Because of these dual and potentially conflicting uses it is important to evaluate if vehicle use at the Crawford road structure is influence the timing and/or frequency of deer use. Vehicle activity was recorded using motion detect camera records and then compared to mule deer activity for the year from Jan 1, 2014 to Jan 1 2015.

Average daily patterns of use by deer are displayed against average daily patterns of vehicles (Figure 8). Overall there were very few occurrences of daytime detections of deer (when vehicles were highest) in comparison to nocturnal and crepuscular detections.

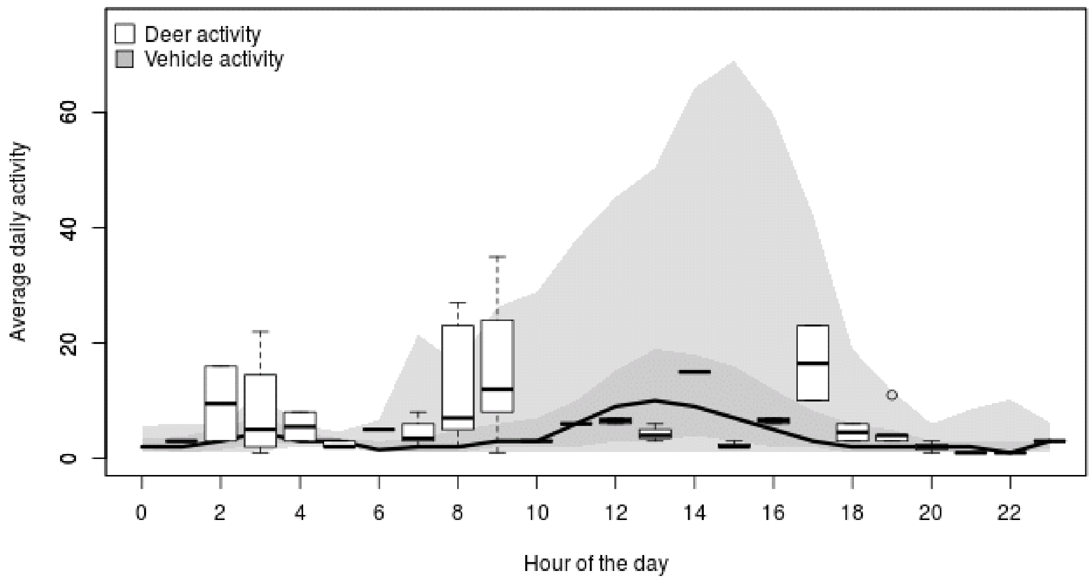


Figure 8: Shaded area shows the distribution of vehicles with the lighter gray showing the 90% confidence interval, darker gray 50% confidence interval and black line giving the median number of vehicles passing through the Crawford road structure on a daily basis throughout 2014. Deer activity is shown using box plots with the "whiskers" giving 90% confidence intervals, boxes showing 50% and black lines giving the median number of daily deer activity records during 2014. Data is shown `time-beginning' which means that the value given at 10 is the count for 10 to 11.

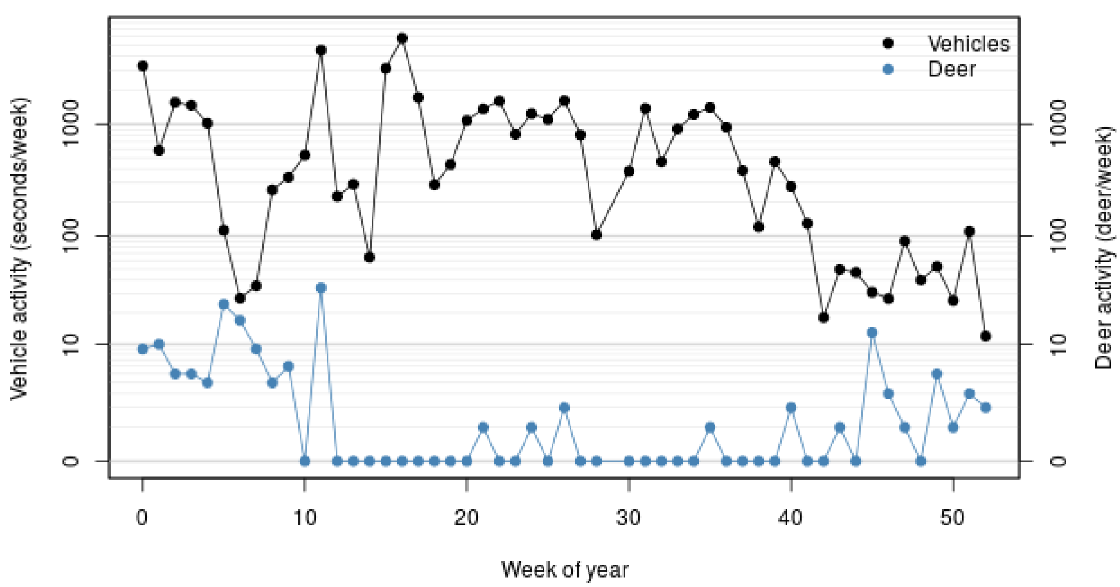


Figure 9: Vehicle and deer activity by week in the Crawford Road crossing structure from Jan 1 2014 to Jan 1 2015. Data is displayed in log scale.

Reviewing these data aggregated by week over the course of the year (Figure 9) we can examine seasonal trends for 2014 where deer activity peaks during spring and fall migration and patterns of vehicle activity when visitors are frequenting the area for recreation opportunities.

A single year cannot capture the wide range in variability, particularly in mule deer activity and so as additional monitoring continues patterns will emerge and these data can more accurately be examined by season. This, in addition to comparing deer activity patterns in the South Lava crossing structure can aid in addressing the question of if vehicle presence in the Crawford Rd structure is influencing wildlife activity.

Task 3 - Escape Ramps

Four escape ramps were constructed within the Lava Butte project area. These structures were designed to allow wildlife, particularly large ungulates, to safely return to the habitat side if they somehow become trapped within the fenced area along the highway. The four miles of the project area are completely fenced between crossing structures and access roads in order to funnel wildlife to the crossing structures. The escape ramp structures as well as the ends of project fencing were monitored for wildlife activity in order to assess the efficacy of the fencing at funneling mule deer and other wildlife toward the wildlife crossing structures rather than allowing them to move around the ends of the fence to access the highway. The monitoring also evaluated if mule deer and other wildlife that approach the escape ramps used them to escape from the right of way.

Methods

Each escape ramp structure (four total) were monitored with two motion detection cameras installed in June 2012 (see Appendix D for diagram of those placements). One camera was positioned to capture approach of the escape ramp from the highway side of the project and the second camera was positioned on the habitat side to capture any wildlife activity at the top of the escape ramp and successful use of the structure. On August 1, 2013 all of the escape ramp cameras previously positioned along the highway side of the project were removed and repositioned in nearby trees to provide a wider and more reliable view of activity in the escape ramp area. Additionally, on August 1, 2013 four motion detection cameras and security housings borrowed from Portland State University were installed at each of the fence ends of the project.

Task 3.1 - Successful use of Escape Ramps

The goal of this task is to determine if mule deer and other wildlife are using the escape ramp features successfully. Escape ramps were monitored using remote trail cameras. The target for success of escape ramps was set as at least 90% of all deer photographed on the road corridor used the ramp to exit the highway and return to habitat.

Detections were separated into three categories for interpretation successful use, investigation or attempt, and no attempt. When an animal was observed at the top of the structure and successfully jumping down into the habitat side of the project area it was categorized as a ‘success’. When an animal was observed at the top of the escape ramp, peering over the edge and otherwise indicating an interest in using the structure, but then ultimately not completing the action, then that was categorized as ‘attempted or investigated’. If an animal were detected moving and/or browsing along the road verge and displaying no signs of intent to flee this area nor using the escape ramp, then it was categorized as a ‘no attempt’ detection.

Mule deer observations documented 3% ‘successful’ uses of the escape ramp, 16% ‘attempted or investigated’ and 81% ‘no attempt’ detections (Figure 10, Table 4).. Elk observations documented three occurrences of an animal on the roadside of the project area, and two successes (60% and 40% respectively). Elk detections showed a much higher proportion of successes and no failed attempts (attempted or investigated category); however, with only 5 observations it is difficult to make any assertions about this pattern continuing with future use. Additional species documented at the crossing structures (both road and habitat sides) include golden mantled ground squirrel, yellow pine chipmunk, Douglas’ squirrel, western grey squirrel, long tailed weasel, cottontail rabbit, coyote, wild turkey, raccoon, common raven, mourning dove, mountain chickadee, striped skunk, deer mouse, domestic dog, domestic cat and domestic horse (with rider).

Discussion and Recommendations for Escape Ramps

Of the mule deer observations only 3% were successful. Another 16% may have been successful but some aspect of the escape ramp caused hesitation and lack of follow through. Even if the attempted or investigated detections had been successful overall use of the escape ramps would fall short of the performance measure of 90% success set at the inception of this monitoring project. From our observations we can provide insight into some potential causes for the lack of use and look to other examples of escape ramp design.

The height of the structures and a lack of stability at the top edge could explain the unsuccessful use we categorized as ‘attempted or investigated’. Because these structures used a gabion design covered with landscape fabric and soil, the edge of the escape ramp had flex and give and in general felt unstable. Moreover, wire mesh was exposed at the top creating the potential for a situation where a hoof or other appendage could become entangled. The edge of the escape ramp is an important location as that is where the animal is gaining purchase before making the jump down to the habitat side. With the identification of this issue ODOT took steps to stabilize the edge and cover the exposed wire mesh that posed a potential hazard in an animal getting a leg stuck while trying to use the structure. Unfortunately due to making this correction, the height of the structure was increased another 6-12 inches for a total of approximately seven feet. Even perfect escape ramp design would not have likely made a difference in the 81% of the 'no attempt' detections as those mule deer did not even approach the structure or indicate likelihood of using it.

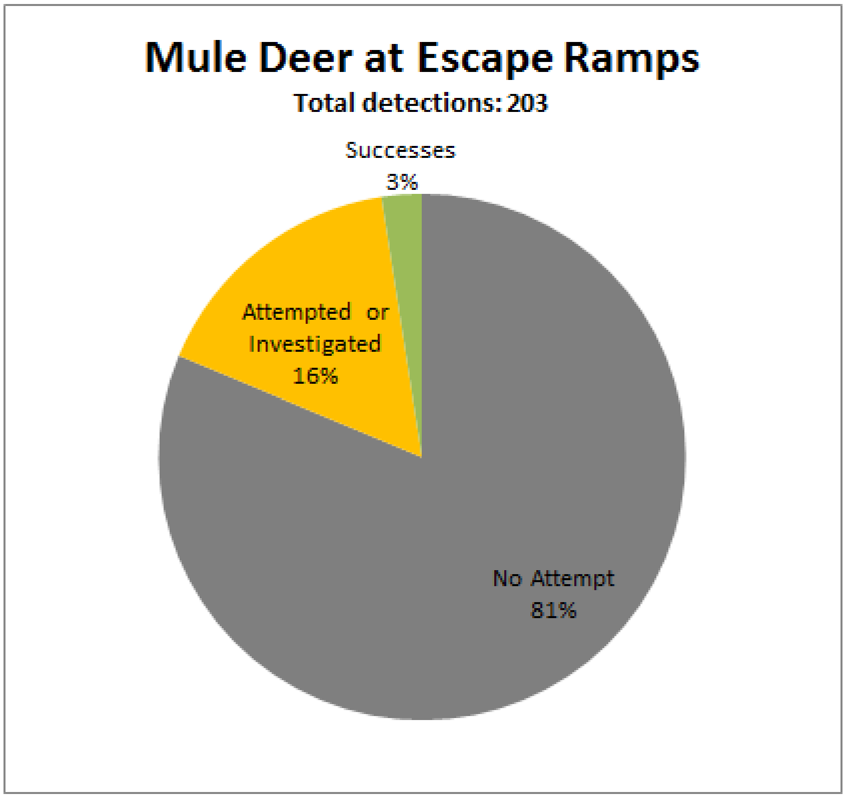


Figure: 10: Percent mule deer detections by category at escape ramps.

MULE DEER	2013	2014	Total	Percent Total
No Attempt	63	102	165	81%
Attempted or Investigated	15	18	33	16%
Successes	4	1	5	3%
Total	82	121	203	

Table 4: Observations of mule deer use of escape ramp features

Task 3.2 - Improper/reverse use of escape ramps

Through the use of remote trail cameras at the ramps, the goal of this task is to determine if their design prevents wildlife from jumping up and entering the road right of way or if the animals are coming up from the wild area up onto the ramps;

One Elk was detected on the habitat side of the jump out and appeared to be investigating the ledge, but did not make any obvious attempt to use the jump out in reverse. Other than that single occurrence there were no documented instances of any large wildlife species attempting or successfully moving from the habitat to the road-side of the project area through the jump out structures.

Task 3.3 - Evaluation of additional structures, escape ramps and fences

Through the use of remote trail cameras at the ends of the fencing the goal of this task is to evaluate if wildlife are moving toward the road and entering the road right of way at the end of the fences within the range of the cameras. Not all “end runs” were documented by the cameras due to their distance limitations. Fence end cameras were installed in August 2013 and monitored until Jan 1 2015. Detections were broken into four categories for interpretation. If an animal was seen moving through the area but staying on course and not actually moving perpendicular to the fence end it was recorded as either habitat or road, depending on the side of the fence it was seen on. If an animal was seen moving from one side of the fencing to the other it was categorized by the direction it started and finished at so either habitat to road, or road to habitat. Of these categories, the locations of mule deer and elk in the project with the lowest collision risk would be either a habitat detection, or a road to habitat detection (light and dark green segments of Figure 11).

During this period 248 mule deer and 7 elk detections were recorded at the fence ends of the project area. During the monitoring period 69% of the mule deer detections were in the lower collision risk categories of habitat and road to habitat (Figure 10, Table 5). The remaining 31% were documented on the road-side, or moving from the habitat to the road-side of the project area, putting those individuals at greater risk for potential collisions with drivers.

Elk observations documented five occurrences on the habitat side and two moving from habitat to the road. Of these, 71% of the total detections were in the low risk categories; however, with only 7 observations it is difficult to make any assertions about this pattern.

Discussion and recommendations for additional structures

It is not feasible to fence the entire highway system and so with the knowledge that wildlife will be moving around project fence ends vegetation management and spatial consideration for siting where fences end on the landscape can help to decrease collision risk in these areas. By strategically locating fence ends in areas where the line-of-sight for drivers is greatest and utilizing specific vegetation management in these areas ODOT can also increase visibility for drivers and hopefully deter deer from crossing in these locations.

Additional species documented at the fence end locations include coyote, yellow pine chipmunk, western grey squirrel, golden mantled ground squirrel, jack rabbit, domestic dog, domestic cat.

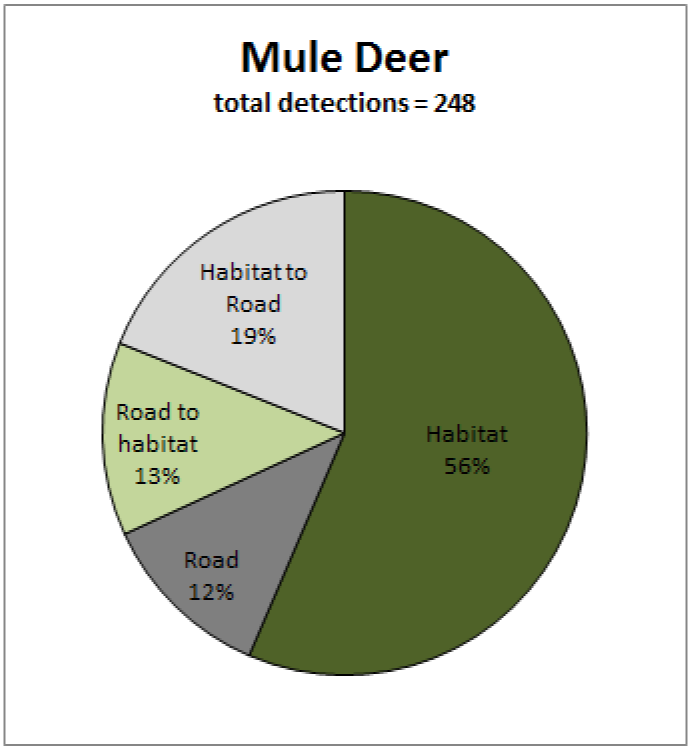


Figure 11: Percent total mule deer detections by category at fence ends.

MULE DEER		NW Fence end	NE Fence end	SW Fence end	SE Fence end	Total	Percent Total
Pass through	Habitat	3	12	33	92	140	56%
	Road	8	14	1	6	29	12%
Around fence	Road to habitat	6	20	6	0	32	13%
	Habitat to Road	13	14	12	8	47	19%
	Total	30	60	52	106	248	

Table 5: Detections of mule deer at project fence ends.

Fence ends, escape ramp and collision data comparison

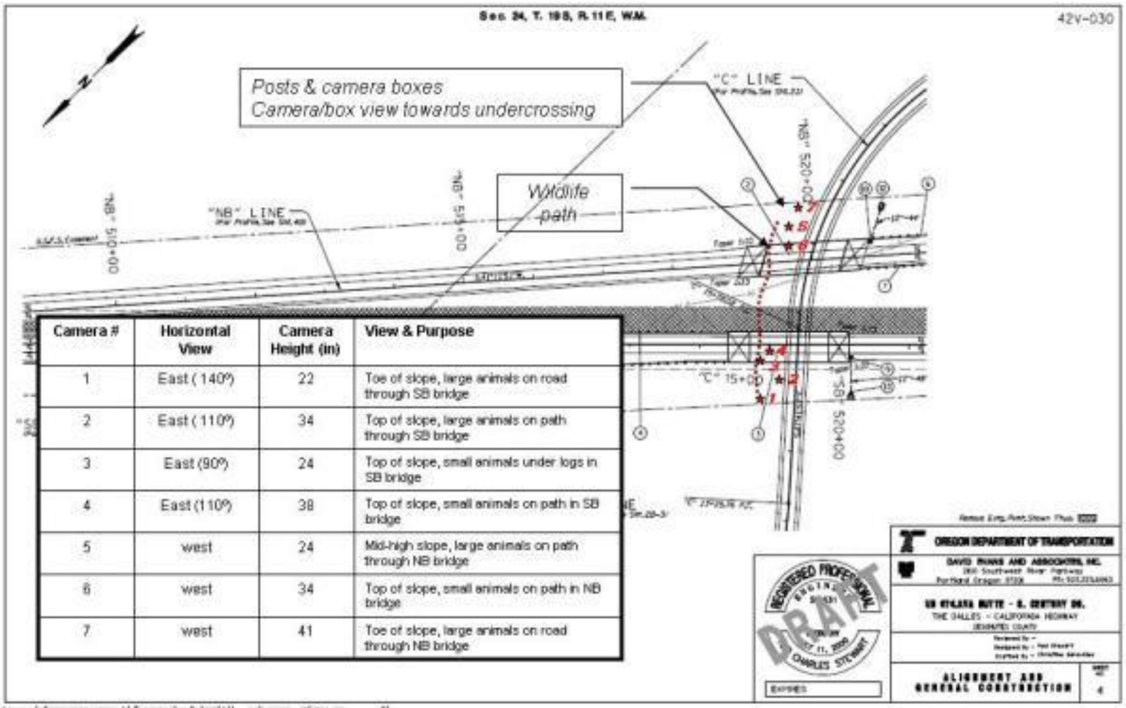
When we compared the number of detections at the escape ramp structures with fence end detections we found similar values, 248 mule deer detections at fence ends and 203 at escape ramps and 7 elk at fence ends and 5 at escape ramps. indicating that animals that skirt the fence ends mostly walk toward the main project area. The escape ramps are located near the fence ends so the similar values make sense spatially. However as we saw in the escape ramp monitoring results 97% of the mule deer did that were using the road corridor by the escape ramps did not successfully use the escape ramp. Despite the continued presence on the road right-of-way the documented collision rates were much lower than the numbers of animals detected, particularly within the fenced project area. One hypothesis is that the animals are finding an alternative way, other than escape ramps, to get back to the habitat side of the project area. Electromat pads were used at highway on and off ramps to deter wildlife from moving freely between the road and habitat side of the project area. However, the Electromats did not consistently function and the specific placement of fencing abutting the Electromats allowed for gaps that wildlife could easily exploit. Electromat locations were not monitored during this period. Because of the heavy investment in maintenance required to keep them functioning as well as factors such as snowfall and build up of gravel from road sanding that reduce functionality it is not recommended that Electromats are used in this area in the future. An alternative technique that has been successful in other projects has been to use double cattle guards, these structures would likely be more effective for the central Oregon climate and site conditions.

Conclusions

It appears that the Lava Butte Wildlife Crossing structures have shown success at reducing deer-vehicle collisions and promoting habitat connectivity for the local wildlife community. However, the high variability inherent in wildlife monitoring data limits our ability to make quantitative conclusions. The complete post monitoring period proposed of five years will allow for a more informed estimation of the effectiveness of these structures as long as data quality is maintained and additional information such as herd population size is included and detailed vehicle counts in the Crawford Rd structure continue to be recorded.

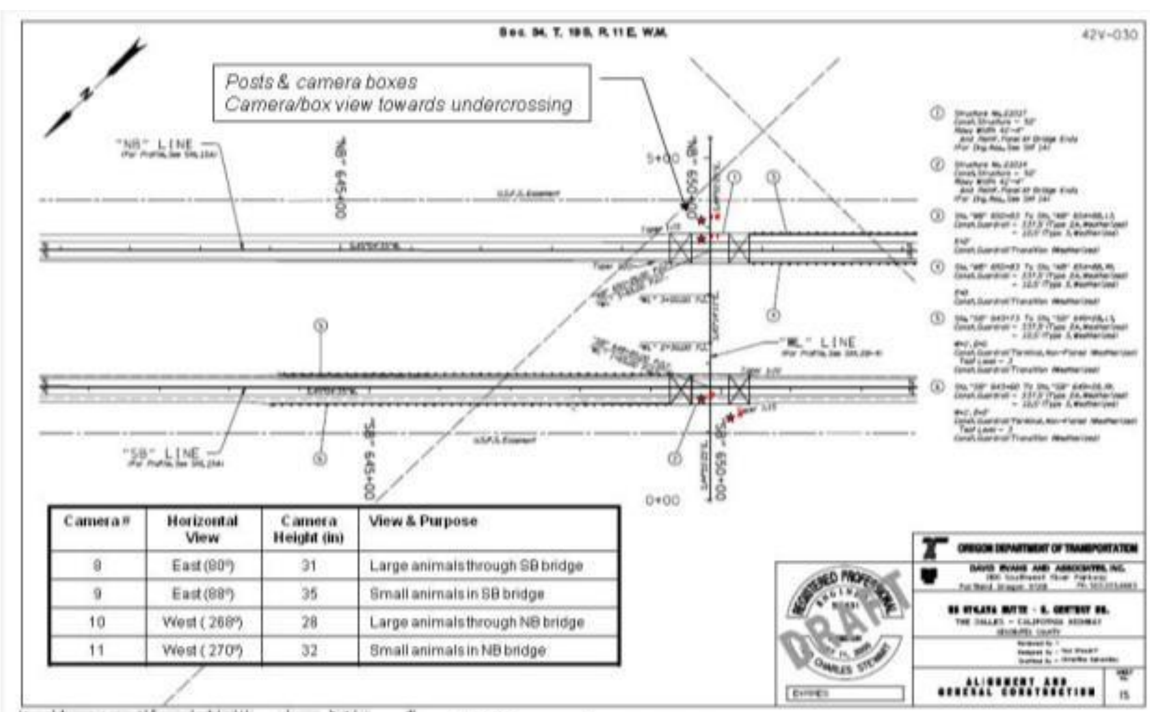
Appendix A.

Locations of wildlife cameras placed at Crawford Road Bridges and South Lava Butte Bridges.



Camera #	Horizontal View	Camera Height (in)	View & Purpose
1	East (140º)	22	Toe of slope, large animals on road through SB bridge
2	East (110º)	34	Top of slope, large animals on path through SB bridge
3	East (90º)	24	Top of slope, small animals under logs in SB bridge
4	East (110º)	38	Top of slope, small animals on path in SB bridge
5	west	24	Mid-high slope, large animals on path through NB bridge
6	west	34	Top of slope, small animals on path in NB bridge
7	west	41	Toe of slope, large animals on road through NB bridge

Crawford Road Bridge 7 camera locations.



Camera #	Horizontal View	Camera Height (in)	View & Purpose
8	East (80º)	31	Large animals through SB bridge
9	East (88º)	35	Small animals in SB bridge
10	West (268º)	28	Large animals through NB bridge
11	West (270º)	32	Small animals in NB bridge

Wildlife crossing cameras
(updated 6/25/2012)

South Lava Bridge 4 camera locations.