EXEMPLARY ECOSYSTEM INTIATIVE AWARD WINNER: LAVA BUTTE US 97 WILDLIFE CROSSINGS IN BEND, OREGON

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ABSTRACT

New management approaches, including inter-agency collaboration, have been emerging to address multifaceted environmental challenges including mitigation of the ecological effects of roads. The Lava Butte US 97 wildlife crossings project in central Oregon is an example of collaborative cross-agency planning efforts and unique applied solutions to habitat connectivity and animal-vehicle collisions. The planning process incorporated several Eco-Logical concepts: early interagency coordination with an emphasis on meeting interagency mission objectives; an interagency mitigation design team that met regularly to plan, discuss and solve project issues; collaborative and creative funding using several sources; and an agreement to monitor effectiveness of the project despite a lack of immediately available funds. Each agency involved committed to furthering its portion of the objectives with specific actions: managing land adjacent to the crossing structures to enhance effectiveness of the structures (USDA Forest Service); monitoring and maintaining fencing (ODFW); and promoting public awareness of the project at Lava Lands Visitor Center (all) with funding for the structures creatively obtained by ODOT.

The Lava Butte project relied on both the Oregon Wildlife Movement Strategy and GPS research on mule deer migration (funded by ODOT and conducted by ODFW) to inform the need for crossing structures in the vicinity. The primary objectives for the crossing structures and other features are to reduce animal-vehicle collisions, restore the mule deer migration pathway, and provide habitat connectivity for all species to cross US Highway 97 successfully. The 4 mile project area includes two large bridge wildlife crossing structures. One is a dedicated wildlife crossing and the other is a combined wildlife and vehicle crossing at Crawford Road, a seasonally closed access road to the Lava Lands Visitor Center. The Crawford Road crossing provides a unique opportunity to assess wildlife use of a structure with temporal separation of people and wildlife. Both crossing structures were enhanced with strategically placed habitat structure and native vegetation to facilitate connectivity of plants and invertebrates as well as small and large animals. Additional project features include exclusionary fencing, four escape ramp structures, bat crevices incorporated into the undercrossing bridge structure, and ElectroBraid™ mats at vehicle access areas. Fencing was designed to deter both large and small animals. Soil was retained and amended within crossing structures to improve passive water retention. Native plants were salvaged pre-construction and stored in the Forest Service nursery then replanted. National Forest System lands on either side of the wildlife crossing structures will be managed for long term enhancement of underpass effectiveness.

Interagency collaboration incorporating the Eco-Logical framework on this project is yielding encouraging results at this early stage. Monitoring began in summer of 2012 and documented mule deer, badger, coyote, and ground squirrel using the two crossing structures. The efforts of multiple agency partners working together and implementing best practices features resulted in the selection of the Lava Butte project as an Exemplary Ecosystem Initiative Projects winner by the Federal Highway Administration for 2012 and highlights Lava Butte as an example project.

INTRODUCTION

The Lava Butte US 97 wildlife crossings project in central Oregon is an example of an inter-agency collaborative approach using applied solutions and best available science in creative ways. These efforts resulted in the project receiving an Exemplary Environmental Initiative award in 2012 from the Federal Highway Administration. Exemplary ecosystem initiatives are identified as those that reduce the fragmentation of habitat and lessen barriers to animal movement as well as stimulate early ecosystem planning and foster ecosystem-based research. The award was given to the Lava Butte project "In recognition of an outstanding commitment of environmental stewardship for coordinating a collaborative effort to develop two wildlife bridge undercrossings along US 97. The project identified appropriate structure locations and developed one bridge undercrossing exclusively for wildlife, including the state's mule deer population, and a second bridge undercrossing for wildlife and vehicles along a low-volume road. The initiative demonstrates a well-developed approach to promote wildlife connectivity and support highway safety for both motorists and animals." This paper will highlight the features that resulted in Lava Butte receiving this award as well as provide lessons learned to help inform future projects.

Site Description

US 97 is a major north-south route through central Oregon. The Lava Butte project area is approximately 15 miles south of Bend, in Deschutes County between Lava Butte at milepost 149 and S. Century Drive at milepost 153 (Figure 1). The project is entirely within the Deschutes National Forest with the north half also within the Newberry National Volcanic Monument. Traffic volume has been steadily increasing in the area and this project was initiated to increase capacity and safe access to recreational destinations including the Lava Lands Visitor Center and Lava River Cave. Project work included adding two lanes in the four-mile project area by constructing a new section parallel to the existing highway resulting in separated north and southbound traffic with a forested median, providing a full diamond interchange at Cottonwood Road, providing additional access points to the Lava Lands Visitor's Center and Lava River Cave as well as building road shoulders to accommodate bicyclists.

Ecological Considerations

Along with improvements for transportation many ecological considerations were included such as wildlife passages and fencing to reduce animal/vehicle collisions and provide safe areas for wildlife migration routes across US 97. The Lava Butte project also included a number of GreenRoads features and qualified for gold certification for efforts in completing a pollution prevention plan, utilizing low impact development practices and educational outreach among others (Scarsella, 2010). Several Eco-Logical concepts were incorporated into the project, including: early interagency coordination: the formation of an Interagency Mitigation Design Team; collaborative, creative funding from several sources; and collaboration among stakeholders on a long term monitoring plan.

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

Eco-Logical Concepts Incorporated

The earliest steps taken in setting the stage for interagency coordination was typical of other highway projects in that the Lava Butte project was included in the State Transportation Improvement Program (STIP) document. The Oregon Department of Transportation (ODOT) contacted the Forest Service (USFS) and a dialogue began. However, several things occurred in a short time frame to make this project unique:

- The presence of an ODOT/Oregon Department of Fish and Wildlife (ODFW) liaison meant that there was a greater awareness among local ODOT and ODFW staff of the importance of the wildlife impacts of US 97.
- The results of the research funded by several agencies were beginning to indicate that the biologists' hypotheses were correct and US 97 was a significant source of mortality and impediment to wildlife movement.
- The Oregon Wildlife Movement Strategy emphasized the need to mitigate the highway's impacts on wildlife, a finding especially weighty due to its agreement among several stakeholder agencies.
- Lastly, the Deschutes National Forest (NF) partnered with the Pacific Southwest Research Station (PSW) to tap into technical expertise on transportation ecology coupled with local knowledge of wildlife to enable the best available science to be used.

This early coordination resulted in the formation of an Interagency Mitigation Design Team initiated by the Deschutes NF/PSW Research Station, which enabled regular monthly meetings of the stakeholders during the project development phase. This group was also able to collaborate and seek creative funding from several sources including state and federal economic

stimulus programs, Federal-Aid Highway Program and the Oregon Transportation Enhancement Program.

IDENTIFYING THE NEED FOR CROSSING STRUCTURES

To inform the need for crossings in the project area the design team utilized information from multiple sources including previous research on carcass collection, mule deer migration pathways and roadkill hotspots on US 97 and the Oregon Wildlife Movement Strategy.

Historical Wildlife Data

Historically ODOT carcass collection records documented mule deer moving across US 97 in an west-east direction as they migrated from their summer habitat in the Cascade Mountains, to their winter habitat on the Deschutes NF and beyond. The movement pattern from Lava Butte southward for several miles occurred in a sheet flow pattern across the highway as detected from wildlife-vehicle collision carcasses that were collected along this stretch (Figure 2). 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. In 1992 ODFW estimated the herd size was 2,200 deer (Thames 1992). Over time the traffic volume in this area has increased to an average daily traffic (ADT) of over 20,000 (Jackson et al 2011, unpublished report). Mule deer herds changed their migratory pathway drastically to avoid this high volume of traffic. Herds were found to migrate 30 miles south of their historic patterns to cross US 97 where traffic volumes were lower (Jackson et al. 2011, unpublished report). With current and projected increases in traffic volume the likelihood that most wildlife highway crossings would result in vehicle collisions is high.

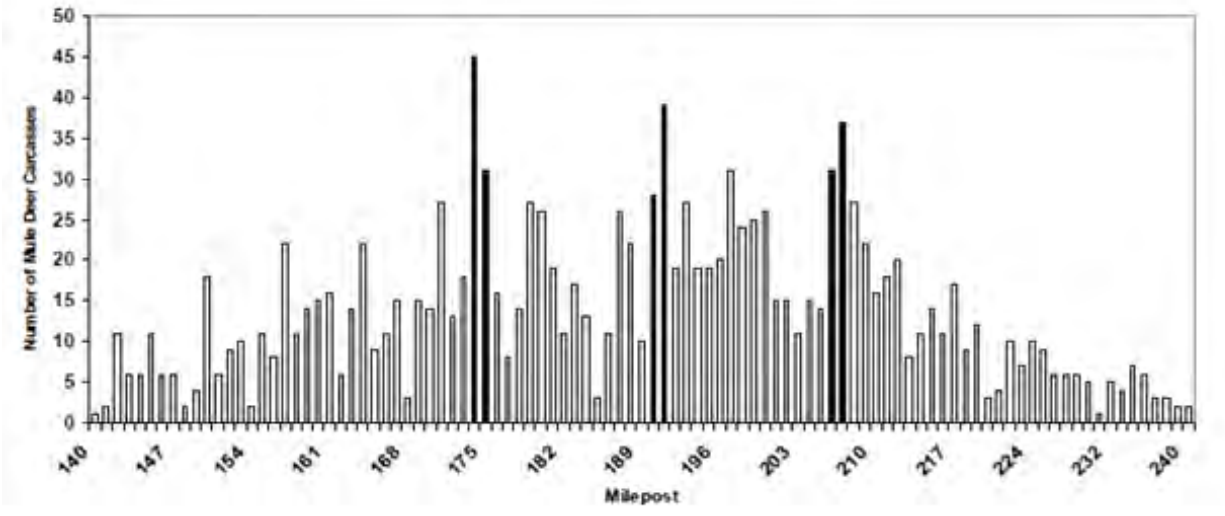

FIGURE 2 Distribution of vehicle-killed deer carcasses along US-97 from October 2005 to December 2010 (Jackson et al. 2011)

Deer Migration Study

ODFW initiated a study of the Lava Butte mule deer population in the fall of 2005. This herd had yearly and seasonal migration between winter and summer ranges across US 97 roughly between Bend and Chemult, Oregon. This study was funded by an ODOT research grant and was initiated in order to address where wildlife crossings should be placed to reduce the serious safety risk of deer-vehicle collisions among other objectives. Collaring of ungulates pre-construction and prior to transportation mitigation is a rare, but important practice. This is another example of the unique accomplishments of the of the Lava Butte project. The migration study provided a better understanding of movements across 100 miles of US 97, from Bend to Spring Hill, and recorded the locations of over 1,300 mule deer carcasses along this stretch.

The Oregon Wildlife Movement Strategy

The Oregon Wildlife Movement Strategy is the product of a partnership initiated in 2006 between ODFW and ODOT with stakeholder agencies USFS, US Fish and Wildlife Service and the US Bureau of Land Management to develop a comprehensive strategy to address habitat permeability and wildlife passages in Oregon (ODFW 2006). In 2009 the stakeholder agencies of the Oregon Wildlife Movement Strategy were also recipients of an Exemplary Ecosystem Initiative award. This statewide initiative identified US 97 for nearly its entire length, highlighting over 100 miles as important for wildlife movement. In particular the Oregon Wildlife Movement Strategy identified US 97 as an important feature interacting with mule deer migration pathways. Knowing this allowed the team to strongly advocate for wildlife crossings and other ecological features opportunistically, which occurred during the planning for the US 97 Lava Butte project.

CROSSING STRUCTURES AND OTHER FEATURES

Although the Lava Butte project area does not have the highest rates of deer-vehicle collisions in the 100-mile mule deer migration study area (Figure 2), interagency stakeholders believe that wildlife mitigation measures were warranted to reduce animal-vehicle collisions, restore the mule deer migration pathway and provide habitat connectivity for all species across this section of US 97. Two bridged wildlife crossing structures were included in the highway widening project that allow wildlife to pass under the highway and access habitat on either side (Figure 3).

FIGURE 3 Wildlife crossing structures. The south Lava Butte crossing (left) note the view of the forested median and paired structure in the background. The Crawford Road combined crossing structure (right) as seen from the median point along the wildlife path.

At the southern end of the project, the south Lava Butte crossing structure is dedicated solely to wildlife, with no vehicular traffic present. The second (northern) structure was designed as a multi-use structure with a low volume and seasonally closed road (Crawford Road) for access to the Lava Butte Visitor Center as well as a separated wildlife path. In considering inclusion of the combined crossing structure the design team was faced with the choice of only including a single wildlife crossing structure within the project or to also combine a wildlife component with the access road in an attempt to accommodate traffic and wildlife, resulting in two crossing structures. This combined passage provides a unique research opportunity to assess passage use and more closely examine possible temporal shifts in use by wildlife both seasonally and daily.

Additional Wildlife Features

Wildlife features implemented in this project to encourage wildlife use of the structures and deter them away from the busy highway include habitat structure and native plantings, wildlife exclusionary fencing, jumpout escape ramps and ElectroBraid™ mats (Figure 4). Crevices were also included in the crossing structure design to provide roosting habitat for local bat species. Wildlife crossing structures were enhanced with materials to increase habitat complexity, promote the growth of native vegetation and to encourage small mammal use. Logs and large rock were added to provide cover and structure for small animal crossing use. Topsoil was retained and amended within crossing to improve water retention. In order to increase native plant colonization and establishment success, native plants were salvaged from the project area pre-construction and stored in the Forest Service nursery then replanted post-construction. The Lava Butte project also installed four miles (6.4 km) of wildlife exclusionary fencing along both sides of the highway. The wire fencing is 8 ft (2.4m) high and was designed for both large and small animals. The wildlife fencing includes increasingly small gaps in the fencing from top to bottom as well as flaring the fencing material at the bottom to deter burrowing animals from digging under the fence. Jumpout escape ramps were installed in four locations within the fenced project area. These structures used a gabion style design, covered with earth to create an elevated area allowing wildlife to jump essentially over the exclusionary fencing and back to the surrounding habitat. ElectroBraid™ mats were installed across six road access points to prevent wildlife from entering the road right of way at intersections.

CONTINUED AGENCY COMMITMENT

An important aspect of this project is the previous and continued agency commitment to furthering objectives with specific actions. ODOT provided funding to construct the crossing structures and the USFS lands on either side of the crossings structures will be managed for long term enhancement of underpass effectiveness. The exclusionary fencing is currently monitored by ODFW with regular inspections and ODOT has initiated effectiveness monitoring.

Public Awareness

All involved agencies have also taken a role in promoting public awareness of the issues of road and wildlife interaction. The Lava Butte project is a unique place for visitors to see crossing structures from the perspective of the wildlife. This project also provides an educational component for both the employees and the public at the Lava Lands Visitor Center. The Forest Service trained the employees of the visitor center on the concepts and issues of road ecology and ODOT funded a permanent display at the center describing the wildlife passage features.

The Lava Lands Visitor Center with approximately three million visitor use days per year is well suited to educate the public far and wide about road-wildlife interactions.

FIGURE 4 Additional wildlife features of the Lava Butte project
a) Habitat structure at the Crawford Road crossing, b) View of a jumpout from the wild-side of the fence, c) ElectroBraid™ mats pictured previous to fence installation, d) Bat Crevices, e) Exclusionary fencing

MONITORING PROJECT EFFECTIVENESS

The effectiveness monitoring project began in the summer of 2012 with the deployment of eighteen Reconyx motion detect cameras. To initiate the project ODOT used the Inter-Governmental Agreement (IGA) process to utilize the services of researchers from Portland State University and Utah State University. As the monitoring plan and scope were developed meetings and discussion continued with a multi-stakeholder advisory panel that included USFS Research and Development, ODFW as well as local project area ODOT staff.

Deer-Vehicle Collision Reduction

One objective of the Lava Butte monitoring project is to evaluate the effectiveness of the mitigation as indicated by the change in mule deer-vehicle collisions before and after highway widening within the Lava Butte South Century Drive project stretch of US 97. This task involves using a similar method of tracking deer-vehicle collision carcasses as was implemented during the pre-construction deer migration study conducted by ODFW (Jackson et al 2011, unpublished report). During spring and fall mule deer migration periods ODOT staff will survey the project area for carcasses. These data in combination with ODOT maintenance crew reports will be compared to pre-project values. Another feature designed to reduce occurrence of deer-vehicle collisions are the jumpout structures. The jumpouts are monitored with motion detect cameras placed on both the road and wild-side of the fencing to assess successful and attempted use of these structures. The primary objective of these structures is to allow wildlife on the road within the fenced project area to return to the habitat area and avoid further potential for collisions.

Restoring the Mule Deer Migration Pathway and Providing Habitat Connectivity

Restoration of the mule deer migration pathway and habitat connectivity for all species is currently being assessed by documenting successful use of the crossing structures. ODOT installed seven Reconyx motion detect cameras at the Crawford Road crossing structures, and four cameras on the South Lava Butte structure. A selection of the cameras within each crossing structure are positioned with the objective of capturing large animal movements to document mule deer activity while the remaining cameras are positioned to better capture smaller animal movement, particularly near habitat structure features within the crossing structure. Multiple research questions may be assessed with this study design, including to: evaluate wildlife use and repels of the structures; determine the diversity of species using the crossings; determining the frequency of each species using the crossing; and observe if mule deer, elk, and other wildlife use increases over time. Passage monitoring will also allow for a comparison of wildlife activity between the multi-use Crawford Road crossing and the wildlife-dedicated south Lava Butte crossing, as well as the potential effects of low volume traffic on wildlife use of a crossing structure. Since installation of the motion detect cameras many successful and attempted crossings have been documented for a variety of species including mule deer, coyote, badger, rabbit and ground squirrel (**Figure 5**).

FIGURE 5 A sample of wildlife documented at the Lava Butte wildlife crossings. Species pictured include elk, coyote, mule deer, ground squirrel and weasel.

LESSONS LEARNED

As with any project, particularly collaborative efforts, there are always ways to improve the process so that future efforts can become increasingly efficient. While the Lava Butte project has far more successes than sticking points, it is nonetheless important to discuss how future collaborative efforts can improve.

From Design through Construction

One important discovery from this project was the need to include the Interagency Mitigation Design Team throughout the process from design through construction, instead of curtailing the Team at the end of the design phase. Without continued and regular feedback from the team, some details were not implemented with the same vision as designed.

Fencing Design

Exclusion fencing design and conceptualization did not match the on-the-ground result. Because the design group did not specify explicitly enough the desired gap size of the fence, the gaps ended up too large to prevent smaller animals from accessing the road surface. The error was detected after all of the customized, vinyl-coated black mesh fence was purchased, and could not be replaced.

Jumpouts

In constructing the jumpout structures a gabion style was used, however this style was not a good fit for the porous soil in this setting. In the design concept, it was believed that soil would cover the wire structure. Unfortunately this was not the case and now there is exposed gabion mesh, creating the possibility of hooves or other wildlife appendages getting stuck in the jumpout structure. Also the specific locations of the jumpout features on the project plans were intended by the design team to be general and then field fit with help from the design team, but without coordination during the construction phase, they were placed exactly as per plans. Without the microsite and topography considerations the jumpouts were not placed in ideal locations within the project area and may have reduced functionality as a result.

Fence Gaps

The design team was unaware of a significant opening left after construction at the north end of the project limits. The design team's intent was that exclusionary fencing would tie into the lava field, which naturally funnels wildlife movement. However, there is an existing access road running along the edge of the lava field and when fencing was installed it ended just before this access road. ODOT will be installing a gate across the access road and tying it into the lava field. Additionally small gaps exist between the ElectroBraid™ mats and fencing, providing enough space to allow wildlife to maneuver around the mats and access US 97 at road crossings. ODOT is currently investigating ways to correct these gaps as well.

Maintenance Agreement

Collaborators feel that a fence maintenance agreement should have been finalized before the Environmental Assessment was completed. ODOT recently discovered that the fence has been built on USFS property and not in the ODOT right of way. State highway funds cannot be used to maintain facilities that are not on ODOT property. Additional steps must now be taken to

provide appropriate fence maintenance. Possible solutions include ODOT receiving an easement for the fence line or USFS maintaining the fence.

Long-term Effectiveness Monitoring
Acquiring funding for effectiveness monitoring is difficult. ODOT is only able to justify monitoring for the duration of time needed to determine if the structures are functioning as intended and achieving goal of minimizing animal/vehicle collisions. Other stakeholders will need to pursue funding for ecosystem-scale and longer-term monitoring objectives.

Stormwater Usage
The project area is in an arid environment and the establishment of native vegetation is primarily limited by available water. Future projects in similar environments could do more to incorporate stormwater runoff inside crossings where appropriate, to encourage the establishment of vegetation. Current monitoring of the mulched, retained native soil may inform how well passive treatments will work in other locations.

Crossing Structure Design
There are currently no official "standards" for designing wildlife crossing features. Each implementation project presents a unique situation. Given that wildlife crossings are a fairly new field of transportation design there is still much to learn, however even mistakes will yield valuable information for future projects. The combination wildlife/vehicle bridge underpass at the north end of the project was a compromise that may show that the reduced extra cost to widen the structure to allow a native-surfaced wildlife lane is well worth the funds, even if the functionality is reduced from a crossing structure exclusively designed for wildlife.

CONCLUSIONS

Importantly, this project was not a re-invention of the wheel, but utilized a variety of lessons learned from many other projects. The aggregation of all these ideas and incremental improvements on those lessons learned are what culminated in the success of the Lava Butte project. This example of interagency collaboration incorporating the Eco-Logical framework is yielding encouraging results at this early stage and the efforts of multiple agency partners working together and implementing best practices are what resulted in the selection of the Lava Butte project as an Exemplary Ecosystem Initiative Projects winner by the Federal Highway Administration for 2012.

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Leslie Bliss-Ketchum is a Ph.D Candidate at Portland State University in Portland Oregon. Her dissertation research focuses on: vertebrate wildlife communities and their interactions with crossing structures of various designs; determining the presence of road avoidance behavior; assessing the functionality of crossing structures; and the effect of the addition of artificial light on wildlife use of crossings. She is currently a lead investigator in monitoring the Lava Butte wildlife crossing structures. Leslie is also serving as president of the Oregon Chapter of The Wildlife Society and completing an internship with the USFWS R1 in Science Applications.

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