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**TPF-5(358)
THE STRATEGIC INTEGRATION OF WILDLIFE
MITIGATION INTO TRANSPORTATION
PROCEDURES: 2019 ANNUAL REPORT**

March 2020

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2019 Annual Report of the Nevada Department of Transportation and
Federal Highway Administration Pooled Fund Study:
The Wildlife Vehicle Collision (WVC) Reduction and Habitat Connectivity
Transportation Pooled Fund Project TPF 5(358)

**Research and Report on Strategic Integration of Wildlife Mitigation into
Transportation Procedures**

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Mule deer use wildlife overpass over State Road 77 in Pima County, Arizona.

March 2020

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**Research and Report on Strategic Integration of Wildlife Mitigation into
Transportation Procedures**

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Key Terms and Abbreviations

Acronym	Definition
AASHTO	American Association of State Highway Transportation Officials
AVC	Animal-vehicle collisions. Crashes with wild and domestic animals or because of animals. They may or may not be reported crashes. The term is more of a phenomenon than a specific type of crash or carcass. Evolving to the term animal-vehicle conflict, which explains the effects of transportation on wildlife and animals, and not just collisions.
DOT	Department of Transportation, for individual states in the U.S.
DTD	Division of Transportation Development – a division described here in the Colorado DOT
FHWA	The U.S. Federal Highway Administration
HSIP	Highway Safety Improvement Program – a source of funding from the U.S. federal government for highway safety projects
ICOET	International Conference on Ecology and Transportation
ITRD	International Transport Research Documentation (https://www.itf-oecd.org/international-transport-research-documentation-public)
KABCO	Crash types: Fatality of human involved (K), Type A injury – suspected serious injury, Type B Injury – suspected minor injury, Type C injury – possible injury, and Property Damage Only (O).
L RTP	Long Range Transportation Plan
MoT	Ministry of Transportation for each province in Canada
MPO	Metropolitan Planning Organization – a U.S. federally designated organization representing localities in all urbanized areas with human populations of 50,000 or more. The board is to carry out the metropolitan transportation planning process. See: URL: https://www.transit.dot.gov/regulations-and-guidance/transportation-planning/metropolitan-planning-organization-mpo
MTP	Metropolitan Transportation Plans – developed by MPOs
PAS	Passage Assessment System, created by Kintsch and Cramer (2011) for Washington DOT to assess existing infrastructure for wildlife permeability of various types of species
PDO	Property Damage Only accidents
PFS	Pooled Fund Study

Acronym	Definition
ROW	Road right of way, area owned by the transportation agency, stretching from the ROW fence to the ROW fence on each side of a road
STIP	U.S. State Transportation Improvement Plan. A 5 year planning document created by every U.S. DOT that include upcoming projects across the state.
TAC	Technical Advisory Committee – the members of the supporting organizations that advise the project. See Acknowledgement section for key members.
TIP	Transportation improvement programs – short range plans for upcoming transportation projects.
TRB	Transportation Research Board of the U.S National Academies (https://www.nationalacademies.org/trb/transportation-research-board)
TRID	An integrated database that combines the records from TRB’s Transportation Research Information Services, (TRIS) and the Joint Transport Research Centre’s International Research Documentation (ITRD) Database. URL: https://trid.trb.org/ .
TRIS	Transportation Information Services (http://www.trb.org/InformationServices/InformationServices.aspx)
USDOT	U.S. Department of Transportation, the federal level DOT
VZS	Vision Zero Suite – a benefit-cost approach to looking at crashes
WSWPS	Colorado’s Western Slope Wildlife Prioritization Study
WVC	Wildlife-vehicle collisions. The phenomenon of wildlife involved in crashes on the highway, whether reported or un-reported. It is evolving to represent wildlife-vehicle conflict, which includes crashes and the effects of transportation on wildlife such as reduced connectivity

Executive Summary

This study is part of the Wildlife Vehicle Collision (WVC) Reduction and Habitat Connectivity Pooled Fund Study of 2018-2022. This pooled fund study (PFS) seeks to identify cost-effective solutions that integrate highway safety and mobility with wildlife conservation and habitat connectivity. This is a collaborative project through the U.S. Federal Highway Administration Transportation Pooled Fund Program. Contributing partners include the Departments of Transportation (DOTs) of Alaska, Arizona, California, Iowa, Minnesota, New Mexico, Oregon, Washington, and Nevada. The Nevada DOT administers this project. Canadian partners include the Ontario Ministry of Transportation (MoT), and Parks Canada. The non-profit, ARC Solutions, Incorporated is also a partner. Representatives from these organizations serve on the Technical Advisory Committee (TAC) for this study. The goal of this greater project is to reduce wildlife-vehicle collisions (WVC) for the safety of motorists and wildlife, and to promote and restore wildlife connectivity.

This report summarizes the 2019 research on the second task of the larger PFS, “The Strategic Integration of Wildlife Mitigation into Transportation Procedures.” The team for this PFS second task is completely independent of the team working on the first task. There are three sub-tasks to the reported research under this PFS Task 2: 1) Investigate transportation procedures; 2) Develop a manual to integrate wildlife mitigation in transportation planning; and 3) Develop a communication plan. The researchers also meet annually with the TAC.

During 2019 the research team worked on sub-task 1 of this research. The technical objective of sub-task 1 is to identify and describe how transportation agencies integrate wildlife mitigation into transportation procedures such as planning, project development, infrastructure design, construction, monitoring, and related processes. In 2019, the researchers worked on the subtasks described below in chapters two through four.

Chapter 2 Literature Review and Comparisons

Literature Review

The researchers used multiple public and academic databases to search for articles and publications related to wildlife and transportation. Eight search terms were used to search various academic, transportation, and personal databases. The 265 references were organized into eight sub-headings:

- Guidance resources for planning for wildlife in transportation
- Mapping wildlife-vehicle conflicts
- Applications and websites for reporting wildlife carcasses
- Identifying and prioritizing wildlife-vehicle conflict areas
- Benefit-cost assessments in transportation
- Animal detection systems, driver warning systems, and other techniques

- Wildlife and habitat connectivity.

This sub-task revealed that the field of and publications on transportation ecology have grown dramatically in recent years. However, there is still a disparity in how such information is shared. There is a need to establish protocols and strategic and economic planning tools that are more broadly transmitted among governmental transportation agencies (federal, state, provincial, and Metropolitan Planning Organizations - MPOs), engineers, and biologists.

The U.S. & Canadian Survey on the Inclusion of Wildlife Consideration in Transportation Processes Survey Results

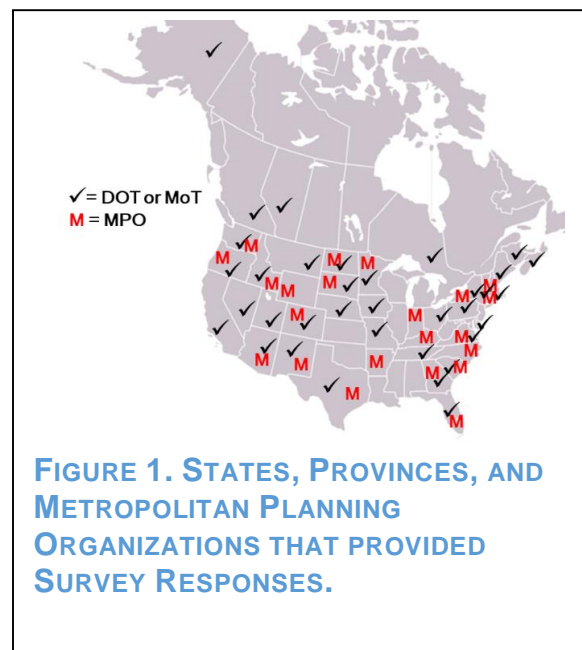
The research team conducted an on-line survey of U.S. and Canadian transportation agency (DOTs and MoTs, respectively) personnel and U.S. MPO personnel to assess how states and provinces address the reduction of wildlife-vehicle conflict and the need for wildlife connectivity. The survey also included questions to gauge practitioners' opinions on best directions to pursue to improve transportation practices.

There were 57 respondents to the DOT/MoT survey from 31 U.S. state DOTs, and six Canadian MoTs. For the MPO survey, there were 39 respondents from 27 MPOs, in 21 states, Figure 1.

Survey participants relayed that the most important factors to the implementation of wildlife mitigation measures were demonstrated safety hazard, and that the mitigation action was recommended by a wildlife agency.

Respondents consistently identified the information sources most important for integrating wildlife needs into transportation planning were: 1) wildlife-vehicle collision crash data; and 2) hotspot analyses of the crash data. Survey participants indicated the most important part of planning processes were: 1) collaboration with wildlife agencies; and 2) inclusion of wildlife mitigation plans in the long range transportation plans.

Respondents indicated the top barriers external to the agency for the incorporation of wildlife mitigation into plans, project and everyday operations were lack of legislative



mandate to mitigate, and general lack of political support. The top two intra-agency barriers were lack of funding and agency culture.

This need to adapt the agency culture was also mentioned consistently in the respondents more than 100 comments concerning potential changes in the way transportation agencies conduct business with respect to wildlife connectivity needs. The two themes that emerged were: 1) the need for the incorporation of wildlife awareness into the agency/corporate culture from the top down at the headquarters and local levels; and 2) instilling a sense of environmental stewardship among personnel within transportation agencies.

An interesting trend that did not appear in a similar survey concerning wildlife crossing structures conducted in 2004-2007 (Bisonette and Cramer 2017) is that three states (MN, ND, and MA) mentioned that they did not have a specific target species for the mitigation, but rather, in the words of Peter Leete of Minnesota “Our structures have not specifically targeted any species. The intent is to maintain (or reconnect) ecological connectivity along our streams and rivers.”

The maintenance and restoration of ecological connectivity is the overall goal of ecologists and natural resources professionals for the intersection of transportation corridors and natural ecosystems. As transportation engineers and other professionals incorporate wildlife concerns into their goals of motorist safety, the maintenance of ecological integrity can slowly be achieved through collaborative work and understanding of the various viewpoints.

Chapter 3 Partnerships

The research conducted in Task 1, and the research team’s experience guided the researchers in identification and presentation of several successful methods transportation and MPO agencies have embraced to help increase the consideration of wildlife in transportation. Seven case studies are presented in Chapter 3 that touch on some of the most important factors to developing practices that include wildlife concerns. These include:

- A method for benefit-cost analysis of wildlife-vehicle collision crash data
- Recommendations for changes to DOT manuals
- Potential changes to the laws that govern how MPOs plan for environmental concerns
- A wildlife and ecological education program in a department of transportation
- A state’s legislative actions to plan for and mitigate for wildlife movement
- Partnerships to advance wildlife-highway mitigation
- A federal agency civil engineer perspective.

Additional case studies will be explored during years two and three of this study. The goal of the presentation of case studies is to demonstrate methods and best practices of collaboration that lead to the inclusion wildlife connectivity and mitigation considerations in transportation.

Chapter 4 Data Requirements

Data are key to identifying a challenge and the potential solutions. There are two types of data needs for transportation agencies to consider wildlife movement concerns and the reduction of wildlife-vehicle conflict: transportation data, and ecological data. A major data requirement is animal and wildlife crash data. The crash data analyses can help convince transportation personnel and legislators as to the magnitude of wildlife-vehicle conflict, which in turn can help bring about changes to practices, funding, and legislative support for wildlife crossing structures. The societal costs of the wildlife crashes were computed using a standardized value for the crash types; the Harmon et al. (2018) white paper commissioned by the Federal Highway Administration (FHWA), Table 1.

TABLE 1. U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA) CRASH COSTS TO SOCIETY ESTIMATES FOR 2018. BASED ON HARMON ET AL. 2018.

Crash Type	Cost to Society
Property Damage Only (PDO)	\$ 11,900
Possible Injury (C)	\$ 125,600
Suspected Minor Injury (B)	\$ 198,500
Suspected Serious Injury (A)	\$ 655,000
Fatality	\$ 11,295,400

Fifteen western states, Iowa's and Ontario's crash data were compiled in early 2019. There are on average, over 65,000 reported crashes with wildlife each year in these 16 states and one province. The total estimated average annual cost to society for wildlife-related crashes for these states and province were over 2.1 billion U.S. dollars (Table 2).

In 2020 the researchers will continue to compile up to date crash data on all crashes, animal crashes, and wildlife only crashes for all U.S. states and Canadian provinces. The numbers and values will be reported as soon as possible.

TABLE 2. THE AVERAGE ANNUAL NUMBER OF TOTAL CRASHES, WILDLIFE-VEHICLE CRASHES, PERCENTAGE OF TOTAL THAT ARE WILDLIFE-RELATED, AND COST OF WILDLIFE-VEHICLE COLLISION CRASHES IN 15 WESTERN STATES, IOWA, AND ONTARIO BASED ON 2013 - 2017 CRASH DATA AND FEDERAL HIGHWAY ADMINISTRATION 2018 CRASH COST ESTIMATES.

State	Annual Average Number of Total Crashes	Annual Average Number of Wildlife-Vehicle Crashes	Percentage of Crashes that are Wildlife-Related	Annual Average Cost of Wildlife-Related Crashes Based on FHWA Costs
Alaska	11,458	696	6.1	\$52,341,680
Arizona	117,909	1,984	1.7	\$80,779,840
California	171,663	1,190	0.7	\$72,923,760
Colorado	116,616	3,782	3.2	\$151,028,660
Idaho	24,105	1,270	5.3	\$51,828,800
Montana	22,241	2,762	12.4	\$115,797,700
Nevada	47,406	464	1	\$23,054,920
New Mexico	42,352	1,431	3.4	\$35,024,220
North Dakota	16,229	3,339	18.9	\$57,139,140
Oregon	23,321	789	3.4	\$60,747,200
South Dakota	17,549	4,495	25.6	\$86,089,280
Texas	561,031	7,469	1.6	\$477,230,500
Utah	58,222	3,338	5.7	\$115,667,560
Washington	51,446	1,568	3.0	\$51,725,040
Wyoming	14,165	2,672	18.9	\$63,103,920
Western States Sub-Total	1,252,484	44,879	3.58	\$1,691,974,936
Iowa	56,127	7,630	13.6	\$80,443,380
Ontario	201,848	12,616	6.3	\$275,273,720
Total	1,510,459	65,125	4.3	\$ 2,147,692,036

Future Work

Research will continue on Task 1 through 2020 and the team will begin on Task 2- Develop a Manual to Integrate Wildlife Mitigation into Transportation Planning.

Chapter 1 Introduction, Background, and Approach

1.1 Introduction

This study is part of the Wildlife Vehicle Collision (WVC) Reduction and Habitat Connectivity Pooled Fund Study of 2018-2022. This pooled fund study (PFS) seeks to identify cost-effective solutions that integrate highway safety and mobility with wildlife conservation and habitat connectivity. This is a collaborative project through the U.S. Federal Highway Administration Transportation Pooled Fund Program. The goal of this greater project is to reduce wildlife-vehicle collisions (WVC) for the safety of motorists and wildlife, and to promote and restore wildlife connectivity. Contributing partners include the Departments of Transportation (DOTs) of Alaska, Arizona, California, Iowa, Minnesota, New Mexico, Oregon, Washington, and Nevada. The Nevada DOT administers this project. Canadian partners include the Ontario Ministry of Transportation (MoT), and Parks Canada. The non-profit, ARC Solutions, Incorporated is also a partner. Representatives from these organizations serve on the Technical Advisory Committee (TAC) for this study.

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1.2 Background

State, provincial, and smaller transportation agencies need standardized proven methods to integrate wildlife concerns into transportation processes. The science and practice of transportation ecology have grown exponentially in the past 20 years. It is time national level proven standards and guidance are created to assist these and other agencies. Bissonette and Cramer (2008) found that the states and provinces with the largest number of wildlife crossing structures (dozens) had just three to five people within the transportation agency who promoted wildlife connectivity. Today there may be more individuals involved in wildlife mitigation, but administrators, engineers and planners struggle to understand what types of structures and fences work, and how they can incorporate concerns for wildlife in regular transportation practice. The experiences of states and other entities who have created standards and wildlife mitigation can be used as examples and templates for a two-nation manual to help guide professionals in the consideration of wildlife in the course of transportation processes. The several examples below are indicative of the rich body of work taking place, which have yet to be brought together in one place to help practitioners. These studies will be part of the base of this research project.

Progress in the field of transportation ecology began to in earnest in the mid to late 2000's. Since then several guidance documents and manuals have been published, Bissonette and Cramer (2008), Huijser et al. (2008), and Shilling et al. (2011). Additionally, Washington DOT (WSDOT) created a Passage Assessment System (PAS) to evaluate retrofit potentials (Kintsch and Cramer 2011). WSDOT developed a method for integrating wildlife concerns over time (K. McAllister, personal communication), and Arizona created a draft document to begin such measures (N. Dodd personal communication). Texas DOT (TxDOT) included wildlife concerns into TxDOT manuals as an approach to incorporate wildlife concerns into everyday activities as well as planning (Loftus-Otway et al. 2019).

Idaho was the first state to create a standardized process for prioritizing road segments for wildlife mitigation (Cramer et al. 2014). This was followed by Nevada's prioritization process for addressing wildlife-vehicle conflicts (Cramer and McGinty 2018), and Colorado's Western Slope Wildlife Prioritization Study (Kintsch et al. 2019). Utah recently completed a standardization study for incorporating wildlife crash hotspots into transportation planning (Cramer et al. 2020). In 2019-2020 New Mexico was developing its Wildlife Corridors Action Plan to address top priority areas for wildlife-connectivity mitigation (P. Cramer, J. Hirsch New Mexico DOT, personal communication). These efforts are also growing across regions. Now is a critical time to synthesize the results of these and other studies. This research reviews progress made across the U.S. and Canada, and will provide guidance to the U.S. and Canadian transportation agencies for approaches to including wildlife concerns in transportation procedures.

1.3 Research Approach

This research project has two main tasks: Task 1 – Investigate Transportation Procedures, and Task 2 – Develop a Manual to Integrate Wildlife Mitigation into Transportation Planning. During 2019 the research team worked on Task 1. The technical objective of Task 1 is to identify and describe how transportation agencies integrate wildlife mitigation into transportation procedures such as planning, project development, infrastructure design, construction, monitoring, and related processes. The research in Task 1 is organized into three subtasks which in turn are presented in individual chapters: 1) Literature Review and Comparisons; 2) Partnerships; and 3) Data Requirements. In turn, these sub-tasks are organized into several additional sub-tasks. There will be several more sub-tasks the research team will accomplish in future work, and will be included in later reports.

Sub-Task 1. Literature Review and Comparisons – Chapter 2

This sub-task addresses the problem of the lack of knowledge of what has worked and what has not for the integration of wildlife needs into transportation by conducting a literature review, and on-line survey.

2.1. Literature Search

Our team searched the Transportation Research Board's (TRB) Transportation Research Information Services (TRID) database, the International Conference on Ecology and Transportation (ICOET) proceedings, scientific literature, engineering reports and ecological reports of how states, provinces and other countries have included wildlife needs in transportation to complete this sub-task. The literature review results are presented in Appendix A.

2.2 U.S. and Canadian Electronic Survey of Transportation Professionals

Our team conducted an on-line electronic survey of U.S. and Canada personnel in departments and ministries of transportation. We also surveyed personnel from several MPOs across the U.S.; MPOs are responsible for developing long-range transportation plans in more populated areas of the U.S. and have a role in regional transportation decision-making. Two separate surveys were developed for the transportation agencies and MPOs. The survey results are presented in Chapter 2, with additional information in Appendix B.

Sub-Task 2. Partnerships – Chapter 3

Our team has begun to identify and describe some of the partnerships that have made transportation agencies successful in incorporating wildlife mitigation into their transportation procedures. These results are presented in Chapter 3. Our team presents five case studies that represent states transportation and MPOs perspectives on including wildlife in transportation processes. Each case study represents a specific concept that the research team and survey respondents indicated they thought was important to changing the way transportation agencies have traditionally conducted business. Following the case studies, two perspectives are presented in examples of successful partnerships.

Sub-Task 3. Data Requirements Chapter 4

Our team has begun to identify and describe the data and map requirements needed for the successful integration of wildlife passage mitigation into transportation procedures, including project prioritization, planning, and implementation. In Chapter 4 we present the initial analysis of the costs of reported wildlife-vehicle collision crashes in predominantly western states. The study will continue to secure and update the data.

Guiding Flow Diagram

As the information is sought and obtained in this project, it is important to organize it according to transportation processes that result in wildlife mitigation projects. This research project will present information related to every box in the flow diagram (Figure 2). It will be referred to as the project develops.

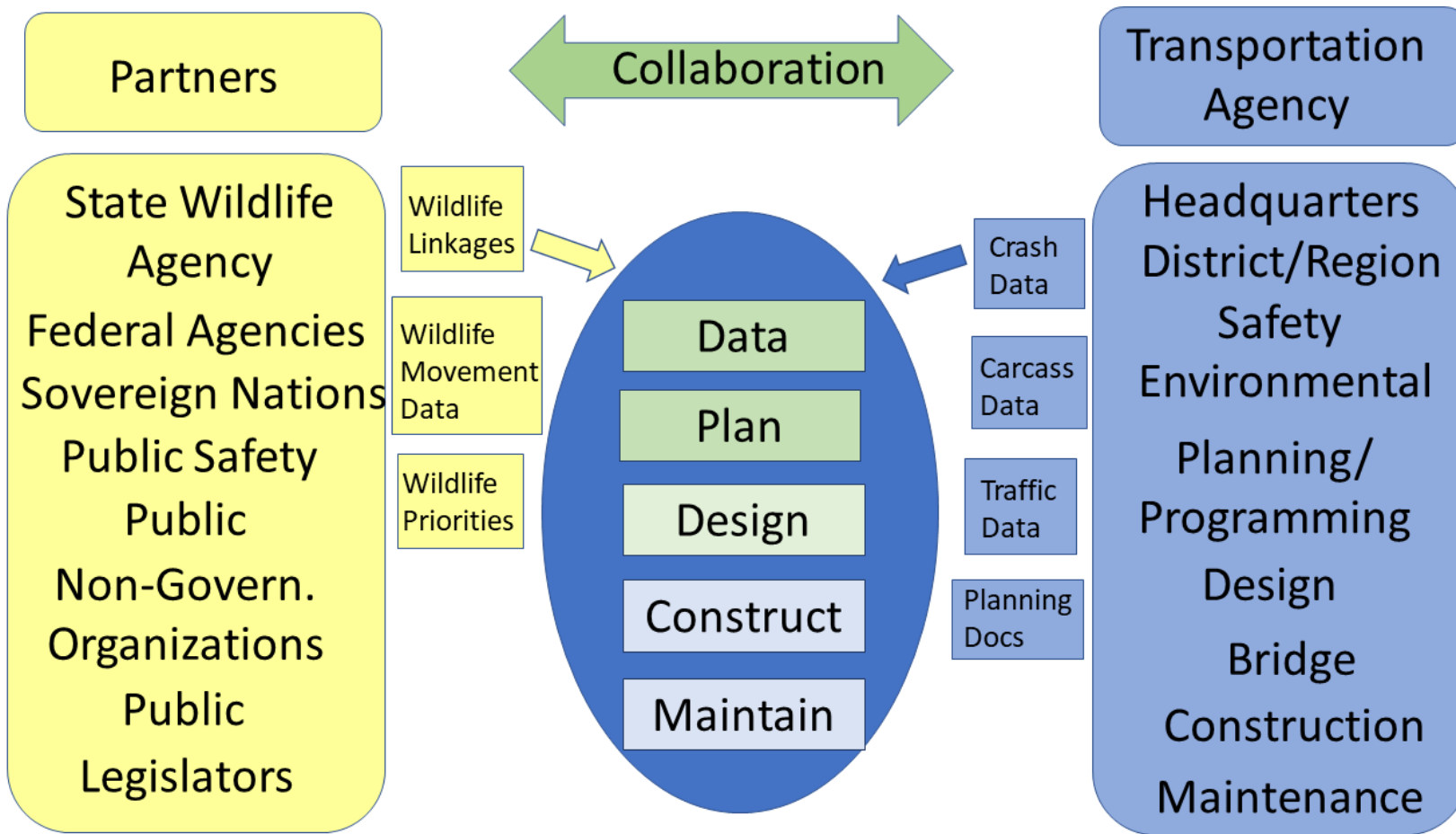


FIGURE 2. THE TRANSPORTATION PROCESS, DATA NEEDED, TRANSPORTATION AGENCY DIVISIONS, AND OUTSIDE PARTNERS IMPORTANT TO THE CREATION OF WILDLIFE MITIGATION.

Chapter 2. Literature Review and Comparisons

Task 1 had two subtasks, the literature review and the U.S.-Canadian survey of transportation professionals. These sub-tasks are completed, but the information in this chapter will be treated like a living document and be updated over the course of the study.

2.1 Literature Review

Kimberly Andrews and Patricia Cramer

2.1.1 Summary

The researchers used multiple public and academic databases to search for articles and publications related to wildlife and transportation. Eight search terms were used to search various academic, transportation, and personal databases. The 265 references were organized into eight sub-headings.

2.1.2 Methods

References included in this literature review were compiled through existing databases and through online literature searches. Specifically, citations were gathered using public sources (Google Scholar) and libraries at the University of Georgia (Web of Science; Wildlife and Ecology Studies Worldwide). Notably, searches conducted via Google Search also accessed databases for the ICOET and TRB's TRID, and Transportation Information Services ([TRIS](#)) and the International Transport Research Documentation ([ITRD](#)). Where free access is available, the URL links to the articles are included (all checked as of 16 August 2019). Our primary focus was to search for articles that featured work in North America; yet, we included reference to international materials that have application to the topics of focus. Within the search terms listed below, we queried both biology and engineering publication platforms. Specifically, our goal was to query resources that focused on *planning* tools or research findings that directly contribute to planning, rather than to enumerate articles focused on specific mitigation designs and their efficacy. However, articles featuring key species of interests for this project were included.

Reference to unpublished literature, active research projects, and informational websites is not included in this literature review. Upon request, we can provide further information from these unpublished and current sources. The literature review will be an ongoing process and updated throughout the project.

Specific search terms (and variations thereof) that were used for each of the database inquiries:

- Wildlife planning transportation
- Wildlife planning road

- Wildlife transportation engineering
- Wildlife road engineering
- Wildlife transportation crossing design
- Wildlife road crossing design
- Wildlife mitigation.

2.1.3 Results

The 265 references presented are organized according to the following headings:

- Guidance resources for planning for wildlife in transportation
- Mapping wildlife-vehicle conflicts
- Applications and websites for reporting wildlife carcasses
- Identifying and prioritizing wildlife-vehicle conflict areas
- Benefit-cost assessments in transportation
- Animal detection systems, driver warning systems, and other wildlife-vehicle collision reduction techniques
- Wildlife and habitat connectivity.

This sub-task revealed that the field of transportation ecology and publications on how transportation-related infrastructure impacts wildlife has grown dramatically in recent years. However, there is still a disparity in how such information is shared, including how research findings are implemented, and the degree of exchange among states and provinces. In summary, there is a need to establish protocols and strategic and economic planning tools that are more broadly transmitted among governmental transportation agencies (federal, state, provincial, and MPOs), engineers, and biologists.

The Literature Search results are presented in [Appendix A](#).

2.2 The U.S. & Canadian Survey on the Inclusion of Wildlife Consideration in Transportation Processes Survey Results

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2.2.1 Summary

The research team conducted an online survey sent to 237 professionals in all U.S. state DOTs and Canadian MoTs. Simultaneously, a similar online survey was sent to 230 MPO personnel. The objectives of the surveys were to learn of activities and opinions concerning agency inclusion of wildlife consideration in transportation processes. The completed surveys represented 57 respondents in 31 U.S. state DOTs, and six Canadian MoTs, 39 respondents in 27 MPOs in 21 states, and eight anonymous responses.

Respondents consistently identified the information sources most important for integrating wildlife needs into transportation planning were: 1) wildlife-vehicle collision crash data; and 2) hotspot analyses of the crash data. Survey participants indicated the most important part of planning processes were: 1) collaboration with wildlife agencies; and 2) inclusion of wildlife mitigation plans in the long range transportation plans. The top four most common themes among the 47 written responses were:

- A need for dedicated funding;
- Legislation support to incentivize or compel transportation agencies to consider wildlife movement needs into transportation processes;
- Collaboration with wildlife agencies was considered important to respondents in both surveys;
- A need to instill environmental stewardship and awareness of wildlife into the agency/corporate culture from the top down.

This theme of instilling environmental stewardship was a consistent theme in the survey results. It led to specific ideas that there is a need for a change in agency culture to improve consideration of wildlife connectivity into transportation processes. The respondents' ranked legislative action, and direction from the headquarters and local offices of the agencies were the two most important means to accomplish this. Respondents from three states, Washington, Minnesota, and Massachusetts mentioned that their state transportation agency can no longer keep track of specific dedicated wildlife crossing structures because incorporating wildlife concerns have become standard operating procedures. Respondents from these three states mentioned that they did not have specific target species for the wildlife mitigation, but rather, in the

words of Peter Leete of Minnesota “Our structures have not specifically targeted any species. The intent is to maintain (or reconnect) ecological connectivity along our streams and rivers.” This was a sign that some states are succeeding at incorporation of wildlife concerns into every day and long range planning activities.

Another sign of the progress that has been made in agencies across the two countries, is that respondents from 28 states and provinces indicated their agency had upsized replacement structures and made enhancements on structures to promote wildlife passage. These increasingly more common activities demonstrate that the consideration of wildlife movement has become more common than when a similar survey was conducted in 2004-2006 (Bissonette and Cramer 2008), or if one only considers the number of wildlife crossing structures in a jurisdiction as the sole measure of progress.

2.2.2 Introduction

For this research project to best provide recommendations to transportation agencies to better consider wildlife movement needs in transportation processes, two tasks needed to be accomplished during this sub-task of the research:

- 1) It is necessary to assess where various agencies are on the continuum of incorporating wildlife crossing structures into their programs;
- 2) It is necessary to understand how the prevailing attitudes in those agencies can support or hinder a shift in traditional processes toward accommodating wildlife.

Our approach to this survey was to reach out to the American Association of State Highway Officials (AASHTO) Committee on Environment and Sustainability member representatives for each state, and equivalent members in Canadian Provincial MoTs to ask for their knowledge and opinions on the topic. It was assumed that the environmental staff within these agencies would have the best understanding of how their agency considers wildlife movement needs and wildlife-vehicle collisions (WVC). It was also assumed these individuals would be best positioned to identify what potential changes that may be needed to better address wildlife connectivity within their transportation planning processes.

We also reached out to representative U.S. MPO’s. All U.S. state DOTs include transportation plans from city, county, and regional level MPOs in the overall state transportation improvement program (STIP), a four to five-year list of planned transportation projects. These federally mandated MPOs are planning agencies for cities and regions with 50,000 or more residents. MPOs have rarely considered wildlife movement needs or the reduction of wildlife-vehicle collisions as a priority in their regional transportation plans. A key part of our team’s survey was to examine MPO participants’ understanding of opportunities for increasing their agency’s planning for wildlife connectivity and potential collisions with vehicles.

The objectives of the surveys were to learn of 1) current efforts to include wildlife consideration in transportation planning and processes, and 2) what efforts the

respondents thought would best enhance those efforts, and 3) what were the most important barriers to those efforts. This survey was part of Task 1.A.i of the Pooled Fund Project: to identify and describe how transportation agencies integrate wildlife mitigation into transportation procedures such as planning, project development, infrastructure design, construction, monitoring, and related processes.

2.2.3 Methods

Survey Development

The questions used in the on-line survey were developed from May through August of 2019 by the project researchers in conjunction with the TAC. Two separate surveys were created, one targeting state and provincial transportation agencies, and the second directed to MPOs that represent counties and cities. Surveys were administered using the Qualtrics platform, which allows subscribers to create single-question web pages with various opportunities to install check off boxes, and typed answers. Once the survey is closed, the results are summarized with spreadsheets.

Survey Question-Answer Format

The research team employed four different formats to present survey questions:

- 1) Questions with multiple choice answers with the opportunity to select more than one answer;
- 2) Questions with multiple choice answers with only one selectable answer;
- 3) Questions using the Likert scale, with five distinct rating choices: Not at all important; Slightly important; Moderately important; Very important; and Not applicable;
- 4) Open ended questions to which participants could opt to provide a written response.

Overview of Survey Question Topics

The DOT/MoT survey presented 10 questions on the following seven topics:

- 1) Wildlife mitigation implemented by the DODT/MoT since 2014;
- 2) Primary factors supporting the agency's integration of wildlife accommodations;
- 3) Greatest internal and external to the agency barriers to incorporating wildlife mitigation into transportation processes;
- 4) Rating the importance of six information sources for wildlife considerations;
- 5) Rating the importance of five planning tools and processes needed to support the inclusion of wildlife considerations;
- 6) Rating the importance of entities inside and outside of the agency; and
- 7) Provide written recommendations on how transportation agencies can improve their practices to include considerations for wildlife connectivity and wildlife-vehicle conflict in long-term planning and everyday practices.

The MPO survey presented seven questions on the following six topics:

- 1) How important addressing wildlife-vehicle conflict is to the agency;

- 2) Wildlife mitigation implemented by the MPO since 2014;
- 3) Information sources needed to incorporate wildlife considerations;
- 4) Rating the importance of collaboration with various outside entities;
- 5) The internal and external barriers to the inclusion of wildlife accommodations into plans, projects and everyday operations; and
- 6) The primary elements that could assist the MPO in improving their ability to consider wildlife connectivity and WVC in transportation planning.

Invitation to Participate to Departments and Ministries of Transportation

The invitation to partake in the on-line survey was sent via email to 237 professionals in U.S. state DOTs and Canadian MoTs. The U.S. state DOT professionals' contact information was obtained from members of the AASHTO Committee on Environment and Sustainability, the Environmental Process Sub-committee and the Natural Resources Sub-committee. In states not represented on those committees, internet searches of the state DOTs and the phrases "environmental branch" and "environment division" were the only phrases used and revealed the potential points of contact to disseminate the survey.

The Canadian transportation professionals' contact information were obtained for each Canadian provincial or territorial ministry of transportation with internet searches of each agency combined with the phrases used in the U.S. survey. Through these methods, personnel from the environmental departments or divisions were contacted in every U.S. state, and Canadian province and territory. Survey recipients were asked to share the survey with up to three colleagues whom were the most knowledgeable about wildlife crossings and transportation in their jurisdiction.

Invitation to Participate to Metropolitan Planning Organizations

The Federal Highway Administration (FHWA) master list of 404 MPOs was subsampled for representative MPOs. The large number of contacts on the list, the small size of some MPOs, and out of date contact information for some personnel necessitated a sampling from the list to create the contact list of potential survey participants. This sampling provided geographic representation throughout the U.S, and MPOs of various size populations of small, medium and large, based on the 2010 US Census data.

The sampling of the MPOs for potential participants also included other criteria. MPOs bordering Canada or Mexico were also targeted where relevant. In addition, specific MPOs that were known to have integrated wildlife accommodations in their master plans were also selected. Finally, the research team also selected MPOs that were close to forest areas/preserves/national or state parks and mountains where wildlife would be expected to be present in large numbers, or would migrate through or around the MPOs jurisdiction. It should be noted, that in some states MPOs were not

geographically distributed across the state: the research team sought to gain spatial coverage, without nullifying selection methodology.

The research team reviewed MPO website contact pages to gather current names and emails for staff who (1) held management positions or (2) were principal/lead staff in a position of managing the development of federally mandated long-and short-range plans and programming of transportation projects. In some of the larger MPOs, staff that had titles indicating they conducted environmental analysis were points of contact. Emails to participate in the survey were sent to 230 personnel in MPOs throughout the U.S.

Survey Invitations, Posting, and Reminder Emails

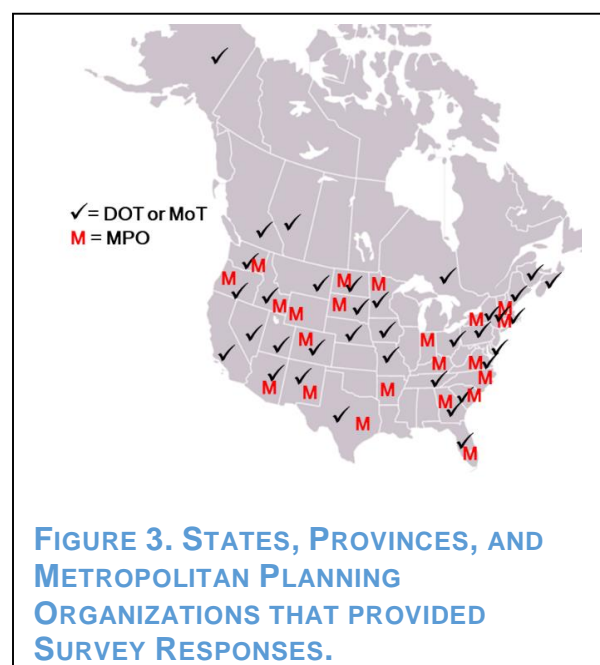
The two surveys were administered using the Qualtrics online survey platform. This platform allowed for separate pages for each question, response buttons, and other features for both ease of use and of analysis of responses. Two days prior to the survey, a pre-survey email was sent to inform recipients of the upcoming invitation to partake in the survey. Email invitations to participate in the survey included the subject line “Survey on the Inclusion of Wildlife Considerations in Transportation Processes” were sent out on to state and provincial transportation agencies on August 26, 2019. The survey to MPOs was sent on August 29, 2019.

The survey was open through September 30. On September 21, the researchers sent reminder emails to all contacts in agencies who had not yet submitted a survey response. Several respondents requested the survey be extended an additional week, so the survey was officially closed on October 4, 2019.

2.2.4 Results

There were 57 respondents to the DOT/MoT survey from 31 U.S. state DOTs, and six Canadian MoTs. The Ontario Ministry of Transportation sent in responses electronically via email after the survey had closed. Missouri was included in the results of Question 4, the only question the respondent from that state answered. There were three anonymous respondents.

For the MPO survey, there were 39 respondents from 27 MPOs, representing 21 states (see Figure 3). Like the DOT/MoT survey, there were respondents who chose to remain anonymous (n=5).



Each of the survey questions and the available answer choices for both surveys are presented below. For certain survey questions, a discussion of the results is presented to provide context for interpretation.

Transportation Agency Survey Questions and Responses

Wildlife Mitigation Since 2014

1. Since 2014, has your agency implemented any of the following mitigation measures for large or small wildlife? Check all that apply.

- New dedicated wildlife crossing structures **with** wildlife exclusion fencing. Please note how many have been constructed since 2014: _____
- New dedicated wildlife crossing structures **without** wildlife exclusion fencing. Please note how many have been constructed since 2014: _____
- Wildlife exclusion fencing **without** crossing structures
- Replaced existing culverts or bridges with upsized structures to promote wildlife passage
- Enhanced or improved existing culverts or bridges to promote wildlife passage (e.g., add fence, add cover elements, remove sediment, create pathways, etc.)
- Animal detection systems or crosswalks

Please include a written response if you would like to describe your answer in greater detail [Optional]

Wildlife Crossing Structures

Respondents from all 31 states and provinces and two anonymous respondents indicated their agency had implemented at least one of the above mitigation measures. Twenty-four states and provinces reported building wildlife crossing structures with or without fences since 2014. The number of wildlife crossing structures built in a given state or province ranged from one per state or province, to a high of 26 structures in Ontario. In total, the respondents reported over 188 new wildlife crossing structures built since 2014 (Table 3). These results can be considered estimates. In general, states and provinces may have different definitions of what constitutes a wildlife crossing structure (e.g., only purpose-built wildlife crossings versus bridges or culverts that may provide some wildlife passage function). In addition, some respondents noted a lack of formal counts of the number of wildlife crossing structures, and when structures were created for smaller animals such as reptiles, the exact number created was generally not known.

There was a geographic range of states and provinces with dedicated wildlife crossing structures, including 13 states and provinces from the western parts of the U.S. and Canada; three mid-western states; nine eastern states and one eastern Canadian province.

TABLE 3. THE NUMBER OF WILDLIFE CROSSING STRUCTURES REPORTED BY EACH STATE OR PROVINCE CREATED SINCE 2014*.

State/ Province	Number of Wildlife Crossing Structures with Fence	Number of Wildlife Crossing Structures without Fence	State/ Province	Number of Wildlife Crossing Structures with Fence	Number of Wildlife Crossing Structures without Fence
Arizona	4	0	Nevada	11+	0
California	15	20	New York	3	10
Colorado	15	0	North Dakota	1	0
Delaware	1	0	Ohio	5+	1
Florida	~3	0	Ontario	26	1
Idaho	1	0	Oregon	1	0
Georgia	0	1	Texas	8	0
Iowa	3	1	Virginia	2	0
Maine	1	5	Washington	10	0
Maryland	1	0	Anonymous1	18	0
Massachusetts	2	1	Anonymous2	12	0
Montana	5	1	Total reported	147+	41
States/ Provinces that did not report numbers					
Utah					
Wyoming					
British Columbia					
Alberta					
			Overall Total		188+

* Utah, Wyoming, British Columbia, and Alberta participants responded ‘yes’ to this question, but did not report specific numbers.

Wildlife Exclusion Fence, Enhanced and Retrofit Structures, and Animal Detection Systems

Survey participants’ responses on agencies’ use of these three types of mitigation are listed in Table 4, below. Upsizing existing structures and the enhancement of existing structures were combined for reporting purposes. These were the most commonly implemented mitigation measures for most agencies since 2014.

TABLE 4. U.S. STATE AND CANADIAN PROVINCES REPORTING ON USE OF THE THREE TYPES OF MITIGATION FOR WILDLIFE: FENCES ALONE, THE ENHANCEMENT OR RETROFIT OF STRUCTURES, AND ANIMAL DETECTION SYSTEMS AND/OR CROSSWALKS SINCE 2014.

State / Province	Wildlife Exclusion Fence	Enhanced and Retrofit Structures	Animal Detection Systems and / or Crosswalks
Alberta	✓	✓	
Alaska	✓	✓	
Arizona	✓	✓	✓
British Columbia	✓	✓	✓
California		✓	
Colorado	✓	✓	✓
Delaware	✓	✓	
Florida	✓	✓	
Georgia	✓	✓	
Idaho		✓	
Iowa	✓		✓
Maine	✓	✓	
Maryland	✓	✓	
Massachusetts	✓	✓	
Minnesota	✓	✓	✓
Montana		✓	
Nevada	✓	✓	
New Brunswick	✓	✓	
New Mexico	✓	✓	✓
New York	✓	✓	
North Dakota	✓	✓	
Ohio		✓	
Ontario			
Oregon	✓	✓	✓
Pennsylvania		✓	
Tennessee			✓
Texas	✓	✓	
Utah		✓	✓
Virginia	✓	✓	✓
Washington			
Wyoming			

Discussion on Wildlife Mitigation Questions and Responses

The respondents’ optional written responses were informative for providing details beyond the limits of the survey’s multiple choice answers. These responses spanned a range of ideas including wildlife crossing structures that were in the planning stages, fish passage, the placement of wildlife crossing structures in conjunction with water flow, and animal detection systems. Several respondents described practices that have

supported the inclusion of wildlife considerations in transportation projects. In Washington, Minnesota, and Massachusetts, it has become common practice to include wildlife accommodations as part of bridge or culvert replacement projects or in new larger projects wherever it is relevant. In these cases, it can be difficult to specify that these structures were upsized or retrofit specifically for wildlife. The creation of terrestrial pathways beneath bridges within the field of rock rip rap (which is very difficult for any wildlife to negotiate) is also becoming more common. In Minnesota, there is a new bridge and rip rap design aimed at assisting wildlife. The riprap does not have a bench pathway, but rather the entire slope is backfilled to fill the voids among the rocks, and make the surface walkable for a range of wildlife. Another common practice mentioned in several states was the installation of wildlife exclusion fence to existing bridges and culverts.

Overall the survey revealed the now common practices for upsizing replacement structures and retrofitting existing structures for wildlife. These practices may have been overlooked in previous studies. The important findings of this survey demonstrate that states and provinces across the two countries: install fence parallel to roadways to direct wildlife to existing structures to guide wildlife toward culverts and bridges for use; upsize new culverts and bridges to better accommodate wildlife passage; and retrofit structures, rip rap, pathways, and remove debris in structures to improve wildlife passage. These actions may be most affordable and most feasible mitigation strategies across all states and provinces. Complete written responses are presented in [Appendix B](#).

Question 1 was meant to also determine each respondent's agency's recent (previous five years) experience constructing wildlife crossing structures. The researchers could then correlate responses on specific opinion questions with the respondent's agency's recent past actions. If respondents did not report wildlife crossing structures or wildlife mitigation had been implemented by their agency in the previous five years, it was assumed the respondents may not have had recent experience in negotiating the process of implementing wildlife crossing structures. The goal of determining a difference among respondents was to see if the opinions of those working in an agency that was actively creating wildlife crossing structures were different than those whose agency had not created such structures in the past five years.

Target Species

1b. If your agency has constructed dedicated wildlife crossing structures since 2014, for which target species were these structures constructed? Check all that apply.

- Federally protected species - please specify taxonomic group(s):
- State or provincially protected species - please specify taxonomic group(s):
- Large ungulates (such as deer, elk, moose, bighorn sheep, pronghorn)
- Large carnivores (such as bear, mountain lion)
- Medium to small sized mammals (such as bobcat, fox, raccoon, rabbit, mouse)

- Reptiles
- Amphibians
- Invertebrates

Other: please specify _____

There were several trends in the responses for question 1b, results are presented in Table 5. Key findings from the answers include the following:

Eighteen out of 33 (55 percent) of the states/provinces reported creating structures for large ungulates such as deer.

Thirteen states (39 percent, including three states that were associated with anonymous respondents) reported having created structures for federally or state/provincial protected species. The species listed were (in order of how often the species was mentioned): turtles, desert tortoise, lynx, grizzly bear, indigo snake, ocelot, and a number of species Washington included as targets species of their projects: wolverine, Cascades red fox, fisher, hoary marmot, American pika, Cascades golden-mantled ground squirrel, yellow pine chipmunk, and Douglas squirrel.

Thirteen of the states reported building structures for small to medium sized animals that were not listed as federal or state/provincial protected species.

Eleven states (33 percent) reported building structures for reptiles, the majority reported were turtles and tortoises, many of which are listed as federal or state/provincial threatened or endangered species, and were the target specie for improving passage on those transportation projects.

Ten states reported amphibians were the target species for building wildlife passage structures.

Large carnivores were the lowest represented taxa in the list, with seven states and provinces (21 percent) indicating there were structures built for them.

There were two written answers. Delaware replied they built structures for fish. Washington respondents indicated that target species for transportation projects in the Central Cascade mountains included: "All invertebrates that occur in the central Cascades," lichens and fungus.

Minnesota and North Dakota mentioned that "restoring ecological function" was the target species.

Geographic locations of respondents spanned the U.S. and Canada. There were 12 states/provinces from the western half of the continent, nine states from the eastern region, and three states from the Midwest. There were also three anonymous respondents whose locations were not known.

TABLE 5. RESPONDENTS' IDENTIFICATION OF TYPES OF TARGET SPECIES WILDLIFE CROSSING STRUCTURES WERE CONSTRUCTED TO ACCOMMODATE SINCE 2014.

State/ Province	Target Species						
	Federally protected species	State or provincial protected species	Large ungulates	Large carnivores	Medium to small sized mammals	Reptiles	Amphibians
AB			✓	✓			✓
AZ	✓	✓	✓			✓	
			Bighorn sheep		✓	Desert tortoise	
CA	✓	✓			✓	✓	✓
CO			✓	✓	✓		
DE			✓				
DE						Fish	
FL	✓	✓		✓	✓		
GA	✓						
	Eastern Indigo snake, Gopher tortoise					✓	
MA	✓	✓				✓	
		Reptiles Amphibians	✓		✓	Turtles	✓
IA		✓				✓	
ID			✓				
ME	✓				✓	✓	
	Lynx	✓			Lynx	Turtles	
MD			✓				

State/ Province	Target Species						
	Federally protected species	State or provincial protected species	Large ungulates	Large carnivores	Medium to small sized mammals	Reptiles	Amphibians
MT	✓						
	Grizzly bear		✓	✓	✓		
ND	✓		✓		✓		✓
NM			✓	✓			
NV	✓						
	Desert tortoise		✓			✓	
NY					✓	✓	✓
OH			✓		✓	✓	✓
OR			✓		✓		
PA			✓	✓			
TX	✓				✓		
	Ocelot				Ocelot		✓
UT			✓				
VA			✓				✓
WA	✓	✓					✓
	Wolf, Grizzly bear, Canada lynx	Wolverine, Cascades red fox, Fisher, Hoary marmot, American pika, Cascades golden-mantled Ground squirrel, Yellow pine chipmunk, Douglas squirrel, etc.	✓	✓	✓	✓	All invertebrates that occur in the central Cascades AND lichens and fungus

State/ Province	Target Species						
	Federally protected species	State or provincial protected species	Large ungulates	Large carnivores	Medium to small sized mammals	Reptiles	Amphibians
Anonymous	✓						
	Mammals Amphibians				✓		✓
Anonymous	✓						
	Amphibians		✓			✓	
Anonymous	✓						
	Mohave desert tortoise						

Discussion of Target Species

The results of this survey are very similar to a survey conducted between 2004 and 2006 (Bissonette and Cramer 2008). Both surveys found the primary reasons transportation agencies build wildlife crossing structures are for large ungulates, and for federally and state/provincially protected species. There are many exceptions, but the trend continues to be that the construction of wildlife crossing structures is based mainly on safety factors (the ungulates' threat to motorists), and from regulatory input from wildlife agencies, such as the U.S. Fish and Wildlife Service. These two factors align with the following question concerning the primary factors for integrating wildlife accommodations into transportation projects.

An interesting trend that did not appear in the 2004-2007 survey is that three states (MN, ND, and MA) mentioned that they did not have a specific target species for creating the mitigation, but rather, in the words of Peter Leete of Minnesota "Our structures have not specifically targeted any species. The intent is to maintain (or reconnect) ecological connectivity along our streams and rivers." This is an important point along the evolution of transportation ecology; progression in wildlife mitigation trends from a focus on species that pose a danger to motorists or that are protected by legislation, to preserving or restoring ecological connectivity across the landscape. This more holistic approach may be considered ecologically sound and easier to strive for than following specific data or regulatory requirements.

Several comments are reported in [Appendix B](#).

Primary Factors for Integrating Wildlife Mitigation

Respondents were then asked to identify various factors that have compelled their agency to integrate wildlife accommodations into projects. Ten respondents from agencies that had not created mitigation for wildlife since 2014 also answered this question. Thirty-eight respondents from states and provinces that created wildlife crossing structures since 2014 answered this question. Respondents could select multiple responses. This question did not limit responses from respondents whose agencies constructed mitigation since 2014.

2. If your agency has implemented wildlife mitigation, what were the primary factors that compelled your agency to integrate wildlife accommodations/mitigation into projects? Check all that apply.

- Demonstrated safety hazard
- Legislative requirement (e.g., federal or state/provincial listed species mandates mitigation, or other legislative mandate)
- Action recommended by wildlife agency
- Research demonstrating an area is critical for wildlife movement
- Private entities such as citizens and non-profits are promoting mitigation

- Wildlife mitigation identified at the district or regional level of the transportation agency
- Wildlife mitigation identified at the headquarters level of the transportation agency
- Political support outside of the agency (e.g., state/provincial representatives or governor)

Please include a written response if you would like to describe your answer in greater detail [Optional]

Responses were divided between those from agency personnel who indicated their agency had created wildlife crossing structures since 2014, and those that did not. The goal was to determine if the personnel whose agencies had recent (in the past five years) experience implementing wildlife crossing structures provided different answers and thus perspectives than those whose agencies had not recently created wildlife crossing structures. In Figure 4 below, the deep orange bars represent responses from personnel in agencies with experience creating wildlife crossing structures since 2014 (state/provinces with crossings), while the light mustard-yellow bars represent agency personnel responses from agencies that did not have recent (since 2014) experience creating wildlife crossing structures (state/province no recent crossings). Respondents could select all answers that applied.

The most commonly identified factors identified by respondents from agencies with recent crossing structures were, presented as percent of the 38 respondents who answered the question:

- 1) A demonstrated safety hazard (77 percent);
- 2) Mitigation action recommended by wildlife agency (71 percent); and
- 3) Research demonstrating that an area is critical for wildlife movement (53 percent).

For 10 agency personnel from agencies with no recent crossings, who responded, the top factors identified are presented as percentages of those respondents who chose the factor:

- 1) Demonstrated safety hazard (70 percent);
- 2) Mitigation action recommended by wildlife agency (40 percent); and
- 3) Mitigation identified at district/regional level of the transportation agency (40 percent).

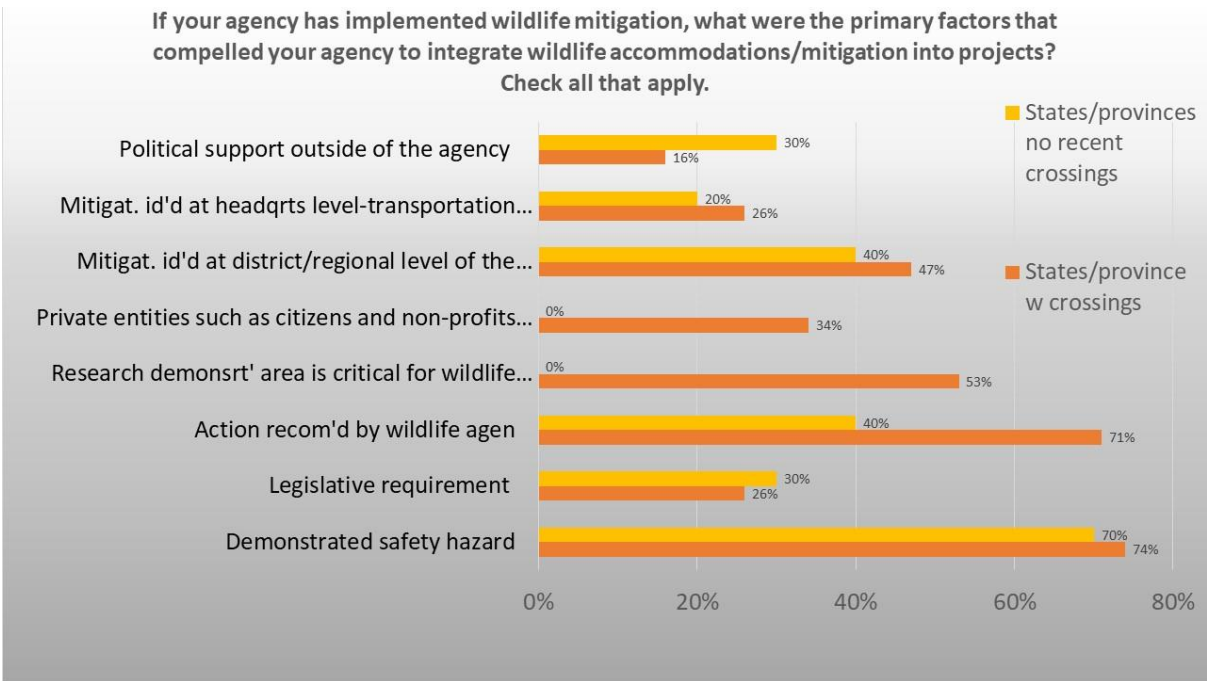


FIGURE 4. RESPONSES FROM SURVEY PARTICIPANTS IN STATES AND PROVINCES THAT CREATED WILDLIFE CROSSINGS STRUCTURES SINCE 2014 (DARK ORANGE BARS), AND RESPONDENTS WHOSE AGENCIES HAVE NOT CREATED CROSSING STRUCTURES SINCE 2014 (YELLOW BARS). RESULTS REPORTED IN PERCENTAGE OF THOSE IN EACH CLASS OF AGENCY THAT SELECTED EACH FACTOR.

Discussion of Important Factors

There was no clear distinction between the two groups of agency personnel who answered Question 2: those in agencies with experience in implementing crossing structures in the past five years, and those who had not. Both groups ranked a need for a project to have a demonstrated safety hazard as the top factor, and recommendation by wildlife agency to create mitigation as a second factor as the main drivers for constructing wildlife crossing structures. Agencies that had not recently created wildlife crossing structures also identified the importance of mitigation identified at district/regional level of the transportation agency as another second place factor. Overall, these results help inform this research as to what all agency personnel view top factors that compel agencies to develop projects with wildlife crossing structures.

[Appendix B](#) presents the participants' comments.

Barriers to Incorporation of Wildlife Mitigation

Question 3 asked participants about external barriers to agency incorporation of wildlife mitigation, while Question 4 asked about barriers internal to their agency. The answers are displayed in Figures 5 and 6.

3. Of the following items, which presents the greatest barrier to your agency incorporating wildlife mitigation into plans, projects, and everyday operations? Select one.

- No need to incorporate wildlife mitigation into transportation planning
- Lack of wildlife movement data
- No legislative mandate to construct wildlife crossings or mitigation
- Political climate, i.e., lack of high-level political support outside of the agency.

Please include a written response if you would like to describe your answers in greater detail [Optional]

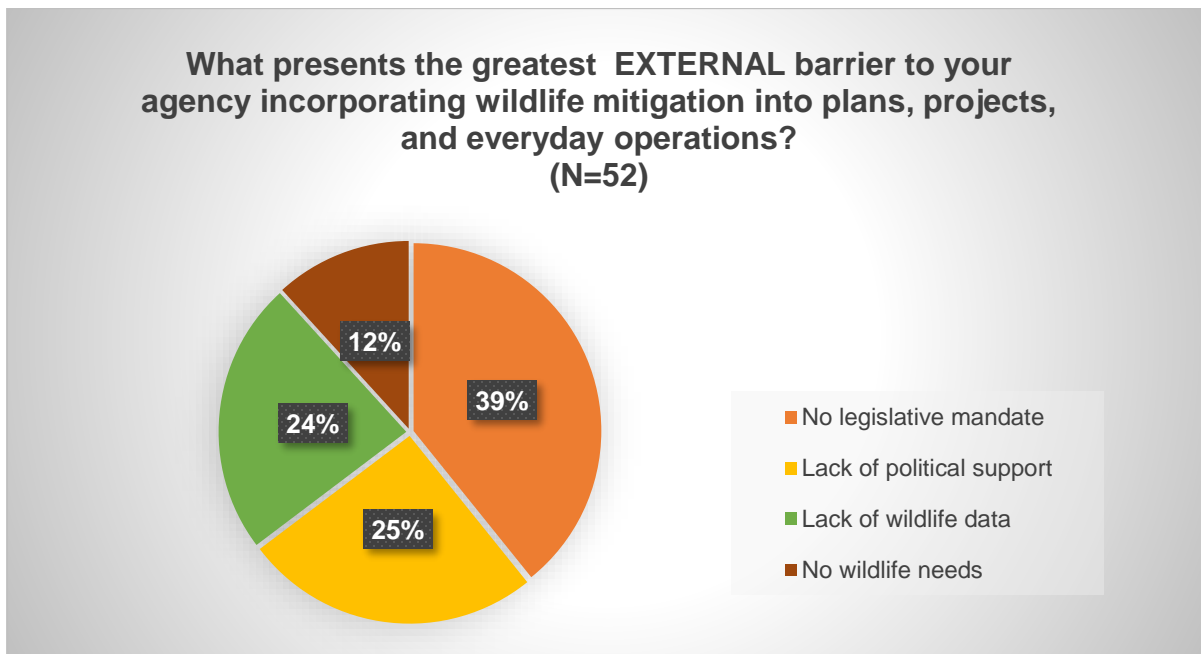


FIGURE 5. IMPORTANCE OF DIFFERENT BARRIERS EXTERNAL TO THE AGENCY, AS SELECTED BY RESPONDENTS. PERCENTAGES REPRESENT THE PERCENTAGE OF RESPONDENTS THAT SELECTED THE BARRIER.

4. Of the following items, which presents the greatest barrier to your agency incorporating wildlife mitigation into plans, projects, and everyday operations? Select one.

- Lack of knowledge about wildlife mitigation strategies
- Lack of in-house guidance or expertise
- Limited staff availability
- Lack of funding for mitigation
- Concerns about setting a precedent for future commitments
- Agency culture, i.e., lack of internal support for wildlife mitigation

Please include a written response if you would like to describe your answers in greater detail [Optional]

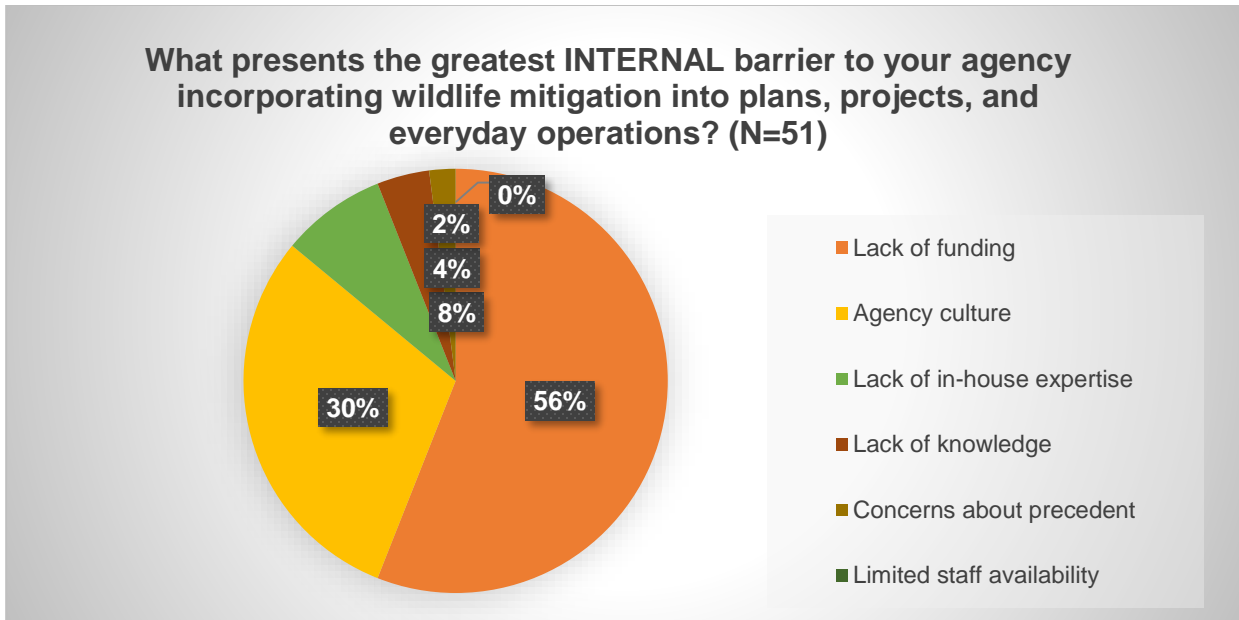


FIGURE 6. IMPORTANCE OF DIFFERENT BARRIERS INTERNAL TO THE AGENCY, AS SELECTED BY RESPONDENTS. PERCENTAGES REPRESENT THE PERCENTAGE OF RESPONDENTS THAT SELECTED THE BARRIER.

Discussion of Barriers

The responses most frequently mentioned were no legislative mandate for barriers outside the agency, and lack of funding to do so as the barrier within the agency. The second most important set of barriers were lack of political support external to the agency, and agency culture.

The 20 comments from respondents were instructive in specific pros and cons of various agency practices. See [Appendix B](#).

Importance of Information Sources

Respondents were asked to use a Likert scale to rate how important various information sources were to incorporating considerations of wildlife connectivity and wildlife-vehicle conflict into transportation planning, projects and everyday operations.

5. In your opinion, how important are each of the following *information sources* for including consideration of wildlife connectivity and wildlife-vehicle conflict during transportation planning and project development?

- State/provincial wildlife action plan
- Wildlife maps and data
- Wildlife-vehicle collision crash data
- Carcass reports
- Hotspot analysis of wildlife-vehicle collision data
- Research results of mitigation monitoring

The following percentage of respondents rating each of these information sources as ‘Very Important’ or ‘Moderately Important’ was:

- 1) Wildlife-vehicle collision data (96%);
- 2) Research results from mitigation monitoring (93%);
- 3) Carcass data (93%);
- 4) Hotspot analyses of wildlife-vehicle collision data (91%);
- 5) Wildlife maps and data (90%);
- 6) State/provincial wildlife action plans (68%).

The full range of responses for each question are presented below (Figure 7).

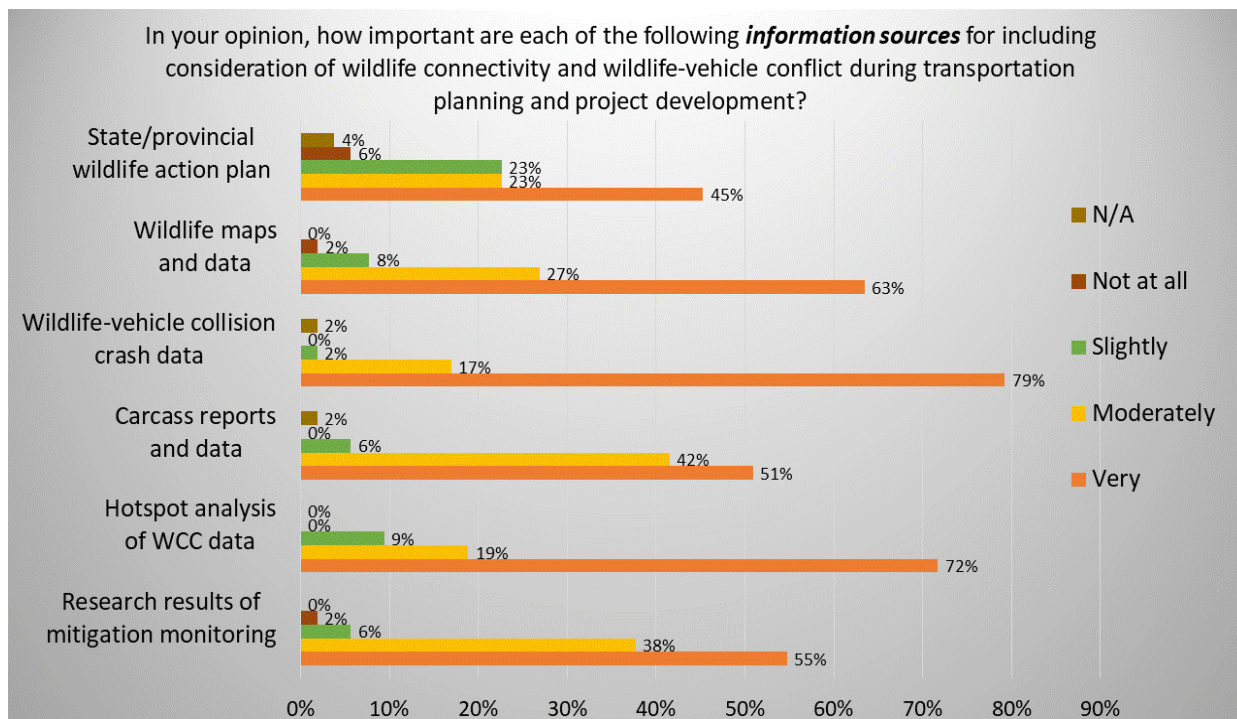


FIGURE 7. RATINGS OF IMPORTANCE OF VARIOUS INFORMATION SOURCES.

Importance of Planning Tools

Participants were asked to rate on a Likert scale, how important five planning tools and processes were for integrating wildlife connectivity and collision concerns into transportation planning and project development. The results are presented with the five different tools and processes ranked in Figure 8.

6. In your opinion, how important is each of the following *planning tools or processes* to integrating wildlife accommodations into transportation planning and project development?

The percentage of respondents rating each of these planning tools and processes as ‘Very Important’ or ‘Moderately Important’ was:

- 1) Collaboration with wildlife agencies (98%);

- 2) Inclusion of wildlife mitigation plans in the long range transportation plans (94%);
- 3) Long range transportation plans (LRTP) informed by environmental staff (87%);
- 4) Input from maintenance personnel (85%); and
- 5) State/Provincial regulations (81%).

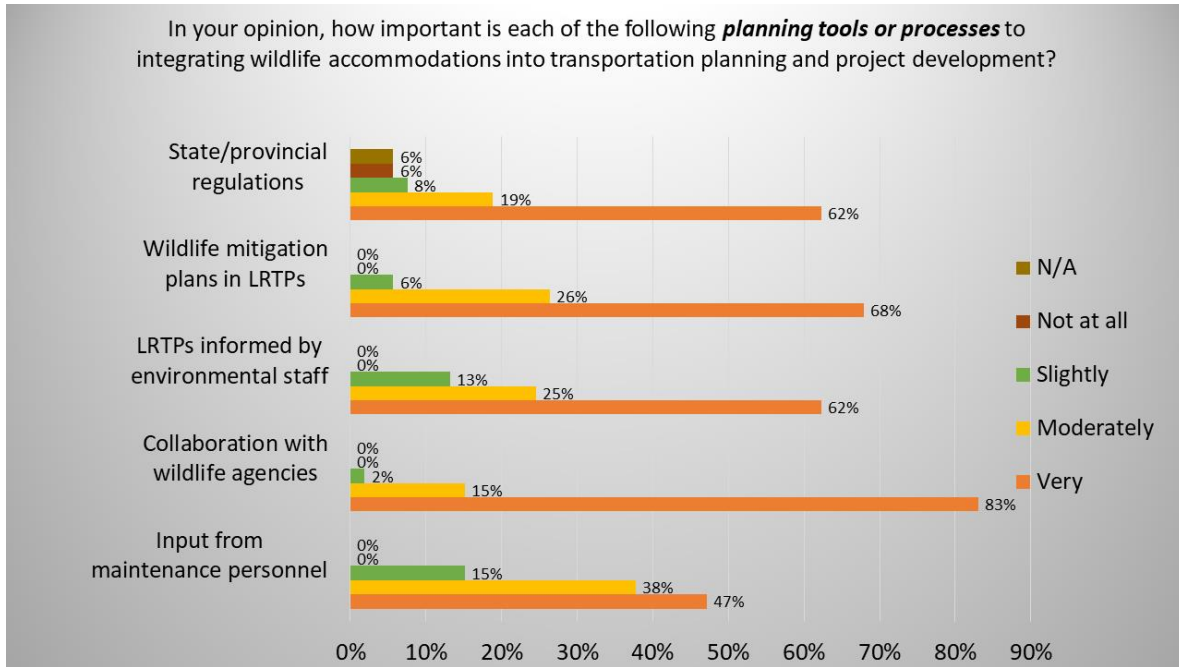


FIGURE 8. RATINGS OF IMPORTANCE OF PLANNING TOOLS OR PROCESSES.

Importance of Support from Different Entities

Question 7 of the survey asked respondents about their opinions on the importance of support from various entities within and outside the agency to integrating wildlife accommodations into transportation planning and project development.

7. In your opinion, how important is support from each of the following entities to integrating wildlife accommodation into transportation planning and project development?

The percentage of respondents rating support from each of these entities as 'Very Important' or 'Moderately Important' was:

- 1) Agency headquarters (98%);
- 2) Local communities (91%);
- 3) Outside political support (85%);
- 4) Environmental organizations (79%);
- 5) Indigenous communities (70%);
- 6) Law enforcement (66%), and
- 7) Media (66%).

The full ratings of the importance of each entity are presented below, Figure 9.

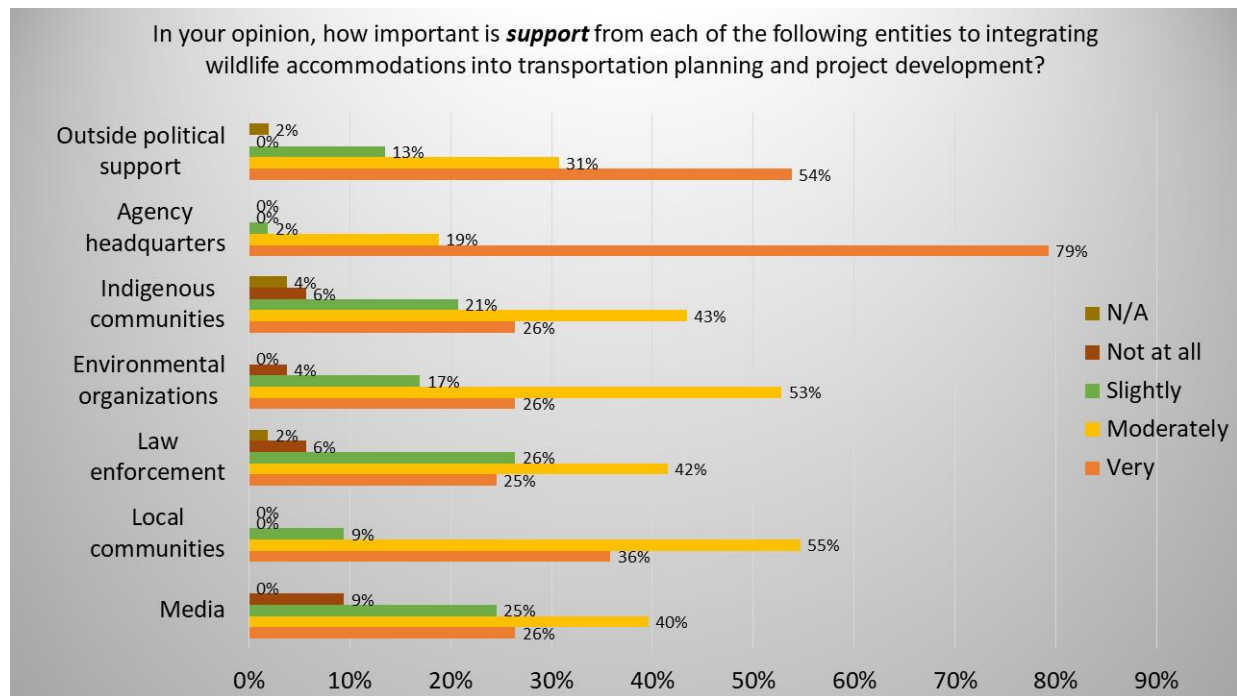


FIGURE 9. RATINGS OF THE IMPORTANCE OF DIFFERENT ENTITIES IN INTEGRATING WILDLIFE INTO TRANSPORTATION PLANNING AND DEVELOPMENT.

Respondents' Recommendations

The final question asked participants to give recommendations.

8. Please provide your recommendation(s) for how transportation agencies can improve their practices to include considerations for wildlife connectivity and wildlife-vehicle conflict in long-term planning and everyday practices.

Common themes among the 47 written responses included:

- 1) A need for dedicated funding;
- 2) Legislation to incorporate wildlife-vehicle collision hotspot analyses into Action Plans;
- 3) Incorporation of wildlife awareness into the agency/corporate culture from the top down, from headquarters to local levels;
- 4) A need to instill environmental stewardship within transportation agencies;
- 5) Agencies should make data available, such as statewide wildlife corridors and action plans;
- 6) States and provinces need additional wildlife movement studies;
- 7) There is a need for federal designation of critical wildlife habitat;
- 8) Agencies should map wildlife-vehicle collision hotspots;
- 9) Maintain provincial/state interagency databases; and
- 10) Establish working groups between transportation and wildlife agencies which in turn can promote important early coordination.

All comments are presented in [Appendix B](#).

Metropolitan Planning Organizations Survey Responses

The types of questions and response choices for MPOs were similar to those described for the transportation agencies survey but tailored toward MPOs.

Importance of Addressing Wildlife-Vehicle Conflict in the Agency

1. Please describe the relative importance of addressing wildlife-vehicle conflict to your agency.

Thirty-eight respondents characterized the value of addressing wildlife-vehicle conflict in their jurisdiction as follows:

- 1) Very important (5);
- 2) Moderately important (9);
- 3) Slightly important (15); and
- 4) Not at all (9).

Responses are presented in Figure 10.

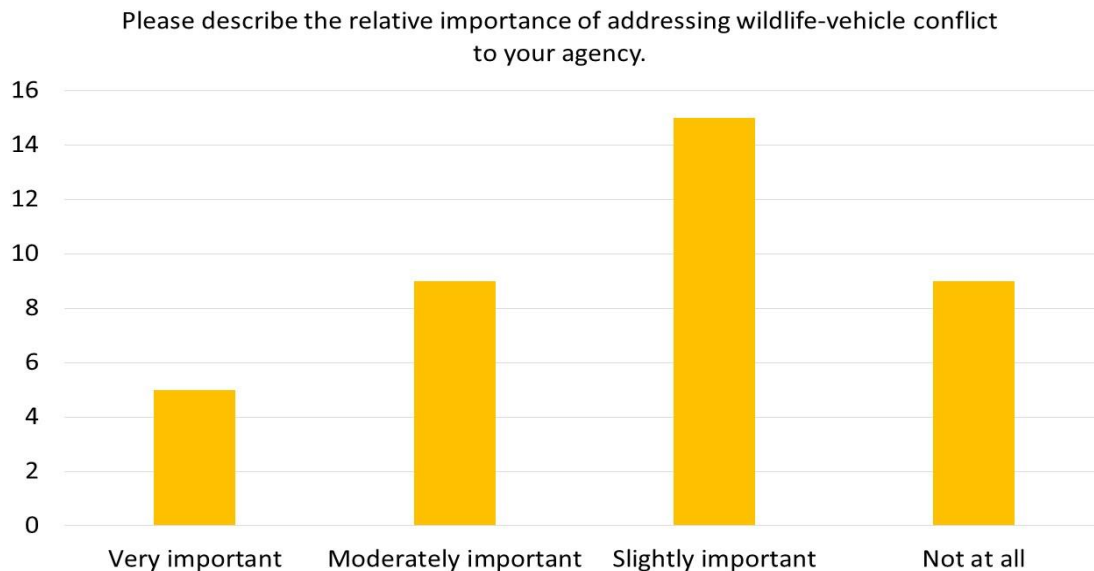


FIGURE 10. IMPORTANCE TO AGENCY OF ADDRESSING WVC.

2. Since 2014, has your agency been involved in planning or constructing mitigation to reduce wildlife-vehicle collisions and/or improve wildlife connectivity?

- Yes
- No

Seven respondents (18%) replied yes.

The five comments received all focused on planning efforts for wildlife. An Arizona MPO used the wildlife agency wildlife linkage data to identify areas of potential wildlife-vehicle conflict, prioritized those areas, and set project costs. Another MPO was developing a master plan that included wildlife crossing structures. A third agency was working with various agencies to promote safety and security for wildlife.

Importance of Various Factors to Include Consideration of Wildlife

3. In your opinion, how important are each of the following factors for including considerations for wildlife connectivity and wildlife-vehicle conflict during MPO transportation planning and project development?

The percentage of respondents rating each of the following factors as ‘Very Important’ or ‘Moderately Important’ was:

- 1) Areas of high conservation value/concern (81%);
- 2) Wildlife maps and data (68%);
- 3) Wildlife-vehicle collision hotspot analysis (64%);
- 4) Guidance for how to document and analyze wildlife-vehicle conflict (60%); and
- 5) Include wildlife mitigation priorities identified in the long range transportation plan (51%).

Ratings of the factors are presented in greater detail below (Figure 11).

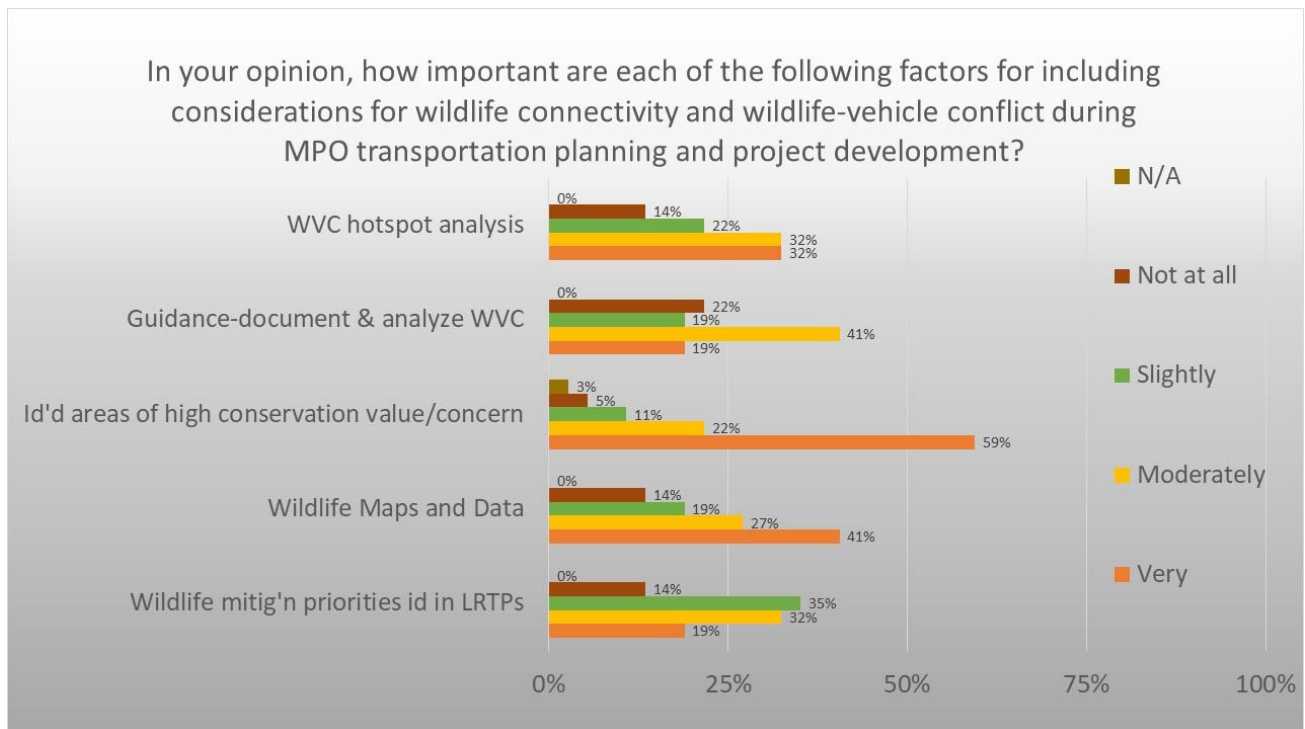


FIGURE 11. IMPORTANCE OF FACTORS TO INCLUDING CONSIDERATION OF WILDLIFE DURING MPO TRANSPORTATION PLANNING AND PROJECT DEVELOPMENT.

The major themes that emerged from the 13 detailed responses were:

- 1) Lack of resources and guidance (policy/data) offered for long range plan development at the federal and state level;
- 2) Opportunity challenges – MPO’s do not consider this an urban area issue because:
(a) limited wildlife in their jurisdictions or species are considered highly adaptable;
(b) long range plans are high-level and not specific to particular corridor or mitigation options; and (c) corridor studies require specific data/hot spot analysis that are not available for the jurisdiction;
- 3) Priority focus – wildlife-vehicle collisions are not a political priority and other policy/project considerations such as bike/pedestrian projects take a stronger prioritization focus in plan development in urbanized areas.

Importance of Collaboration with Various Entities

MPO survey participants were asked to rate the importance of collaboration with eight different entities, using a Likert scale.

4. In your opinion, how important is collaboration with each of the following entities to including consideration of wildlife connectivity and wildlife-vehicle conflict during transportation planning and project development?

The percentage of respondents rating each of the following entities as ‘Very Important’ or ‘Moderately Important’ collaborators:

- 1) State/Provincial DOTs/MoTs (89%);
- 2) State/Provincial Wildlife Agencies (86%);
- 3) Citizens/Community Groups (69%);
- 4) Non-Governmental Organizations (67%);
- 5) Law Enforcement (64%);
- 6) US DOTs (55%);
- 7) Colleges/Universities (53%); and
- 8) Tribes/First Nations (50%).

The results are presented in greater detail below (Figure 12).

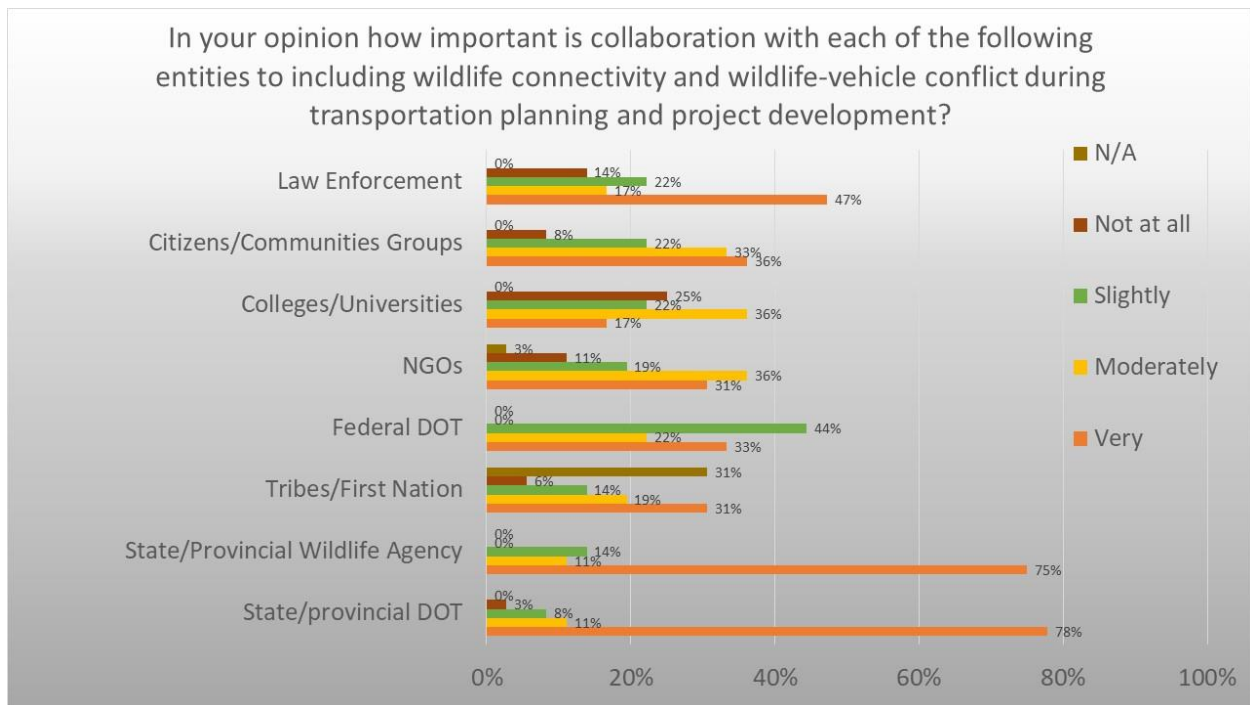


FIGURE 12. RATING OF COLLABORATION WITH DIFFERENT ENTITIES TO INCLUDE CONSIDERATION OF WILDLIFE.

Barriers External and Internal to the Agency

The survey presented a list of four barriers external to the agency for the incorporation of wildlife mitigation into transportation planning within the MPO’s. Respondents could only choose one of the options.

5. Of the following items, which presents the greatest barrier to your agency incorporating wildlife mitigation into plans, projects, and everyday operations? Select one.

- No need to incorporate wildlife mitigation into transportation planning
- Lack of wildlife movement data
- No legislative mandate to construct wildlife crossings or mitigation
- Political climate, i.e., lack of high-level political support outside of the agency

Results are presented collectively below (Figure 13).

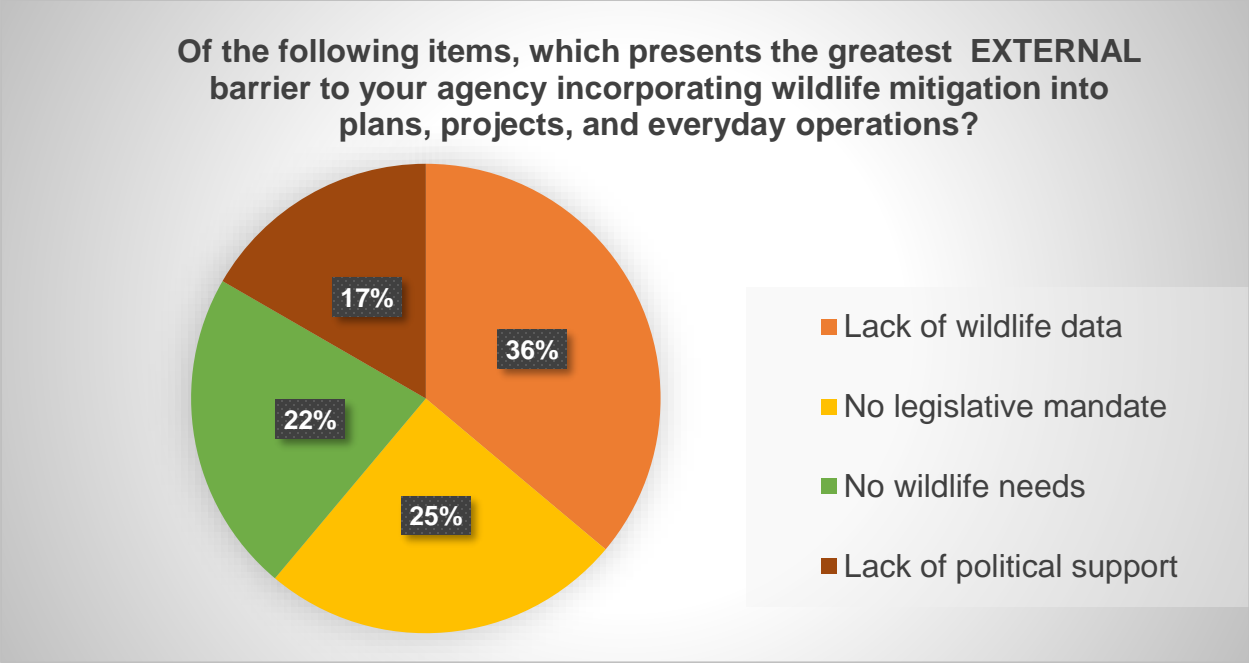


FIGURE 13. RATINGS OF BARRIERS EXTERNAL TO THE AGENCY TO INCORPORATING WILDLIFE CONCERNS.

Participants of the survey were asked about barriers within their agency that limited wildlife mitigation actions.

6. Of the following items which presents the greatest barrier to your agency incorporating wildlife mitigation into plans, projects, and everyday operations? Select one.

The barriers from inside the agency were ranked by respondents’ choices:

- 1) Lack of funding (31%);
- 2) Limited staff availability (23%); and
- 3) Lack of knowledge (20%)
- 4) Lack of in house expertise (14%)
- 5) Agency culture (9%)
- 6) Concerns about precedent (3%).

The overall results are presented below, (Figure 14).

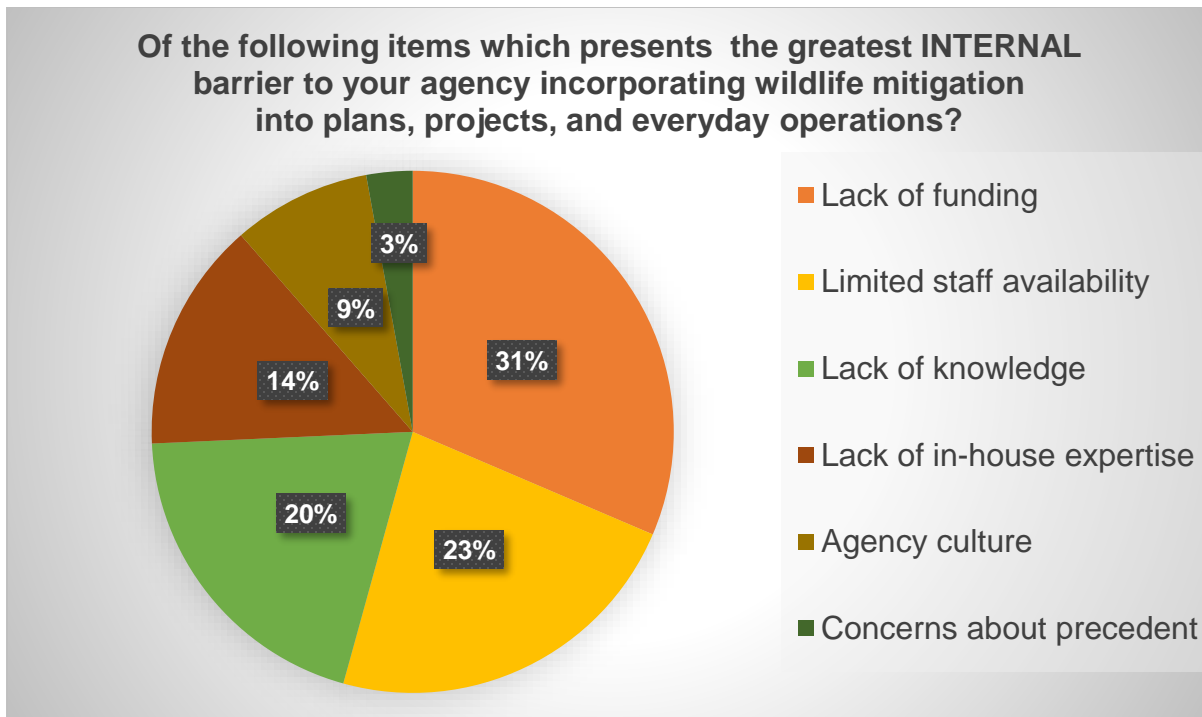


FIGURE 14. BARRIERS WITHIN AGENCY FOR INCORPORATING WILDLIFE CONCERNS.

Participants were asked:

Please include a written response if you would like to describe your answer in greater detail [Optional]

In addition to the above identified barriers, respondents cited a lack of ability to influence the state DOT that actually implements projects and complexity in integrating projects into State DOT plans and local jurisdiction plans. All comments are presented in [Appendix B](#).

Recommendations from MPO Respondents

7. What are the top 3 elements that could assist Metropolitan Planning Organizations in improving their ability to include considerations for wildlife connectivity and wildlife-vehicle conflict in transportation planning?

Responses are presented in Table 6 in the same order they were written by respondents. Data and funding were the top first and second elements suggested. Training and education and a will within an agency were a third theme.

TABLE 6. RESPONSES TO THE QUESTION OF THE TOP THREE ELEMENTS TO ASSISTING MPO'S IN THEIR ABILITY TO CONSIDER WILDLIFE.

Recommendation 1	Recommendation 2	Recommendation 3
Identification of high crash locations	Concepts to address these issues (how do we reduce conflict?)	Identification of migratory corridors and crossing locations
Funding	Mandate legislatively	data
More support from state DOT	Better data	Better education about the topic
Funding	Data	Low-Cost Mitigation Strategies
Education	Data	funding
Guidance documents	Templates	Webinar (that would also be recorded) discussing how to incorporate into documents
Better mapping and data, include larger geo context	Funding for mitigation in projects	Range of solutions for range of species
Committed funding to improvements (fiscal constraint)	Wildlife tracking data	Wildlife conflict/crash data
Data; coordination for data	Cost effective recommendations or implementation techniques	Impacts or outreach from agencies heading up this effort (our MPO has never heard much)
Resources to analyze issues	Understanding of motivations in this discussion	Predictable funding source for large projects
Amount of wildlife vehicle collisions that take place	Shared Data	Internal want
Shared Guidance/Expertise	Ability to identify cost/benefit of projects	Additional Staff
Grant funding from DCR or DEQ to hire a consultant to undertake this analysis for our region	Direction from above ie legislature	Encourage collaboration with FDOT design and engineering prior to construction contract.
Data driven mapping of wildlife movements, include multiple species	Funding	Identified funding for design and construction of facilities
Data	Require coordination with FDEP and water management	Additional funding for staff with this sort of expertise at the regional level

Recommendation 1	Recommendation 2	Recommendation 3
Availability of Data	Best practices for mitigation for specific species	Data Supporting Need for Planning and Investment
Land use review authority	State DOT Requirements and guidance	State DOT policy on wildlife roadway management
GIS shapefiles and or maps	Design of Replacement Infrastructure or Adaptations	Data is by MPO planning area, county, municipality, or Census Tract
Identification of endangered species in the planning area	Adequate knowledge of wildlife movement / tendencies	Increased funding for mitigation.
FHWY requirements and guidance	Data is in GIS format	Information/Resources
Funding for Physical Improvement	Political support outside of the agency.	Requirement for funding
Get the information communicated to MPO.	Training	Greater political support
Wildlife incident data by location	State agencies working together (DNR + DOT)	Wildlife movement data
Regularly collected wildlife data	greater influence over project implementation	Training on wildlife mitigation techniques
Incorporating these considerations into permit requirements.	Mitigation techniques	
Funding	Coordination with regulators and data scientists	
Guidance	More information on wildlife movements	
Wildlife data		
Funding availability		
Regulatory mandate		
A sense among the jurisdictional staff and policy-makers that it was important		

2.2.5 Discussion

Both surveys revealed:

- Regardless of a respondent’s agency’s level of experience with wildlife mitigation, the results were similar in terms of identified needs and barriers to incorporating wildlife accommodations.

- Respondents from both surveys found that the greatest barriers to incorporating wildlife considerations were lack of funding and a lack of legislative mandates to consider wildlife.
- Collaboration with wildlife agencies was considered important to respondents in both surveys.
- A consistent theme was a need to enact change in the agency culture to consider wildlife concerns. The respondents' comments mentioned this could be achieved through legislative action, or a changes at the headquarters and local level offices of the agencies.

It is important to note that states are incorporating wildlife concerns into standard operating procedure, and because of this, they can no longer keep track of specific dedicated wildlife crossing structures. Washington, Minnesota, and Massachusetts' respondents mentioned this. Thus our efforts to track the numbers and types of mitigation placed or upgraded and retrofit structures is eventually diminishing as incorporate of wildlife concerns become standard operating procedure.

Another interesting result was the 28 states and provinces out of 31 that responded to the transportation agency survey question 1 indicated that replacement structures were upsized for wildlife and enhancements were made on structures and infrastructure to promote wildlife passage. This finding indicates that consideration of wildlife movement needs has become more common than may have been determined from solely looking at the number of wildlife crossing structures a state or province has created, and since a similar survey was given in 2004-2006 (Bissonette and Cramer 2008). These actions may be most affordable and most feasible mitigation strategies across all states and provinces. The use of these methods may indicate the approach to inclusion of wildlife needs in transportation has begun in most states and provinces and may start with these smaller actions in some jurisdictions, rather than larger wildlife mitigation projects. These actions, along with the very informative comments received from the respondents indicate the US and Canada are progressing as nations and as collections of state and provincial departments and ministries of transportation toward including wildlife concerns as a matter of everyday business practices.

The respondents of the MPO survey revealed very little progress has been made within these agencies. It appears a lack of data, training, understanding, funding, and legislative mandate all work to keep the status quo of the way these agencies conduct business with respect to wildlife. Fortunately, survey respondents of the MPO survey indicated the same needs for change as transportation agency participants: the need for dedicated funding for wildlife, data to inform, training and education, and fundamental changes in the agency attitude and approach to including wildlife concerns in transportation processes. The information from these surveys helped to form the remainder of the research presented in this report, and will continue to guide the research in completing the remainder of the tasks in this study.

Chapter 3 Partnerships

Introduction

The research conducted and the research team's experience allowed the researchers to identify and present several successful methods transportation and MPO agencies have embraced to help increase the consideration of wildlife in transportation. In this chapter the researchers present seven case studies of DOT, MPO, and Federal Agency approaches that promote ways agencies can include the reduction of WVC and wildlife connectivity needs in transportation process. The case studies focus on:

- A method for benefit-cost analysis of wildlife-vehicle collision crash data
- Recommendations for changes to DOT manuals
- Potential legal changes to the laws that govern how MPOs plan for environmental concerns
- A wildlife and ecological education program in a department of transportation
- A state's legislative actions to plan for and mitigate for wildlife movement
- Partnerships to advance wildlife-highway mitigation
- A federal agency perspective of a civil engineer.

All case studies that detail actions within a state DOT were approved by a representative of that agency.

There will be forthcoming case studies on other states, provinces, MPO and agency actions.

Colorado's Western Slope Wildlife Prioritization Study Benefit Cost Analysis

Pat Basting

The Colorado Department of Transportation (CDOT) and Colorado Parks and Wildlife (CPW) sought a more comprehensive approach to assist in evaluating potential wildlife-highway mitigation projects. Currently in Colorado, CDOT does not include wildlife and residual values in a benefit-cost analysis for wildlife mitigation projects. The research team on the Colorado Western Slope Wildlife Prioritization Study (WSWPS), led by Jacobs Engineering, developed a hybrid benefit-cost technique, drawing from both CDOT Traffic and Safety Engineering and CDOT's Division of Transportation Development (DTD) methodologies to allow potential wildlife-highway mitigation projects across the Western Slope to be compared (Kintsch et al. 2019). This hybrid approach, summarized below, is designed to provide a more comprehensive evaluation than is currently possible with the formula used by CDOT Traffic and Safety Engineering.

There are two benefit-cost approaches used by CDOT; the Traffic and Safety Engineering Branch uses the Vision Zero Suite (VZS), and the Division of Transportation Development uses the U.S. Department of Transportation (USDOT) method. The VZS analyses are used to identify crash locations above expected norms for a facility, then uses an expense-based approach to calculate benefit-cost derived from the AASHTO Highway Safety Manual. CDOT Traffic and Safety Engineering slightly modifies AASHTO values to be more specific to Colorado and avoid over-valuing fatalities. The USDOT method is used when applying for federal funding grants or using federal bond funding (USDOT 2018). This method uses the accepted economic theory of willingness to pay, whereby values for fatalities, injuries, and property damage only (PDO) accidents are not based upon actual costs, but societies willingness to pay to avoid such accidents in the first place.

The research team identified a need to include the residual value of wildlife mitigation beyond the typical benefit-cost analysis service life because wildlife crossing structures typically have a design life (75 years or more) that exceeds the analysis period used in benefit-cost equations (20 to 30 years). The USDOT recommends assessing the residual value of the remaining asset life when project assets have useful lifetimes that continue beyond the end of the analysis period (USDOT, 2018).

Current methods for integrating wildlife values into benefit-cost analysis include using statutory values assigned by a state legislature for wildlife that are unlawfully taken (Cramer et al., 2016; Wakeling et al., 2015) or using the hunting value of the animal expressed as the probability that an animal will be successfully harvested by a hunter

(Huijser et al., 2009). However, study panel members believed that both approaches underestimate the economic value of mule deer and elk in relation to their benefits to Colorado's economy. The research team worked with CPW and CDOT to develop an alternative approach based on an accepted economic theory of contingent valuation, which is used to assign dollar values to nonmarket resources, such as wildlife or other environmental values (USFWS, 2011). The contingent valuation method uses statistically valid public surveys to calculate net willingness to pay, or consumer surplus. Accordingly, this technique was used to identify the maximum amount that a hunter would pay for the opportunity to hunt mule deer or elk, beyond hunting fees or trip expenses. While still conservative, the following values were calculated for mule deer and elk in Colorado in 2018 dollars:

Mule Deer Value = \$2,061

Elk Value = \$2,392

These values were then integrated into the benefit-cost equation. The research team synthesized actual costs of wildlife-highway mitigation from recent projects (2016 through 2018) across Colorado and developed costs for the various components of a mitigation project, such as wildlife underpasses and overpasses of varying dimensions, deer guards, fencing, and escape ramps. These cost estimates were then reviewed by CDOT contracting cost estimators. After reviewing maintenance costs on existing mitigation projects, the research team determined to use a maintenance cost of 1 percent over the life of the structure in the WSWPS benefit-cost formula.

In addition, the team reviewed the literature to determine how best to estimate the effectiveness of various wildlife mitigation measures. For road-based improvements, estimating the change in the number of fatalities, injuries, and amount of PDO can be calculated using crash modification factors, which relate different types of safety improvements to crash outcomes (USDOT, 2018). The team calculated crash modification factors for different mitigation measures, which were included in the benefit-cost analysis.

The newly created hybrid benefit-cost analyses developed during this study was developed by the research team with CDOT Traffic and Safety Engineering and DTD to allow potential wildlife-highway mitigation projects across the Western Slope to be compared. This hybrid approach, shown below, is designed to provide a more comprehensive evaluation than is currently possible with the formula used by CDOT Traffic and Safety Engineering; however, this approach is not as comprehensive as the DTD/USDOT approach, which can also consider several variables not considered here, such as value of time savings and emission reductions. Such a detailed benefit-cost analysis is only relevant in the context of a larger roadway improvement project and is not needed to evaluate where wildlife-highway mitigation will have the greatest benefit for the investment.

Most wildlife-highway mitigation projects are more likely to be funded by state grants than by highly competitive national grants. Therefore, the team applied the Traffic and Safety Engineering crash costs and discount rate in its hybrid approach. Complete benefit cost inputs and calculations can be viewed in the Benefit-cost worksheet at <https://www.codot.gov/programs/research/pdfs/2019/WSWPS> . Below (Table 7) is a comparison of how benefit cost elements are evaluated.

TABLE 7. COLORADO’S WESTERN SLOPE WILDLIFE PRIORITIZATION STUDY BENEFIT-COST EQUATION VARIABLES AND VARIOUS BENEFIT-COST EVALUATIONS.

Benefit Cost Equation Element	Evaluation Approach		
	Traffic and Safety Engineering Evaluation	Division of Transportation Development (DTD)	WSWPS Hybrid Approach
Crash Costs	Derive from AASHTO	Derive from USDOT	Use traffic and safety costs
WVC Timeframe	10-year average	10-year average	10-year average
Discount Rate	5 percent	7 percent	5 percent
Infrastructure Life Span	20 years	30 years	30 years
Residual Value	Not considered	CDOT DTD/USDOT methodology	CDOT DTD/USDOT methodology
Wildlife Value	Not considered	Non-monetized benefit	Deer value = \$2,061 Elk value = \$2,392

Using inputs discussed above, a sophisticated and practical automated Excel tool for calculating benefit-cost was created by Anthony Vu (CDOT Traffic & Safety Engineering) with significant input from the research team and Dr. Oana Ford (CDOT DTD). The hybrid approach discussed above allows decision makers to evaluate wildlife mitigation benefits and costs for purposes of comparing wildlife mitigation projects and potential use of other CDOT Regional discretionary funds to be used in helping pay for wildlife mitigation. In addition, this Excel worksheet tool, also calculates benefit-costs using the CDOT Traffic and Safety Engineering and DTD methods so that it may be used by CDOT staff for planning purposes and aiding in determining potential funding sources for mitigation projects. Specifically, the CDOT Traffic and Safety Engineering benefit-cost formula and valuations would be used for state Traffic and Safety Engineering grant applications. DTD would use the USDOT benefit-cost methods and valuations for federal grant applications.

Texas Department of Transportation Manuals

Patricia Cramer and Lisa Loftus-Otway

One of the ways to enact change across a state or provincial department/ministry of transportation is to provide instructions for that change in the manuals of the dozens of divisions and professions within the agency. In 2017 Texas Department of Transportation (TxDOT) with the University of Texas, Center for Transportation Research led a research project to update TxDOT division manuals with recommendations based on the state of the science and practice on wildlife crossing structures and mitigation across the U.S.

The research team investigated current TxDOT and multiple state DOT manuals from across the U.S. to determine how planning, design, and maintenance for wildlife concerns would be added to each manual. The project researchers also provided guidance for animal-vehicle conflict data collection, and mitigation options. The final report summarized national and state-level efforts to reduce animal-vehicle conflict, analyzed Texas's animal-vehicle collision (AVC) data, explained how to identify AVC hot spots, and provided benefit-cost ratios for various AVC mitigation efforts across the TxDOT highway system. Additionally, guidance was provided on the reduction of wildlife-vehicle conflict and the promotion of wildlife connectivity.

The project recommended specific language modifications to 18 TxDOT manuals to help ensure that consideration of wildlife-vehicle conflict and wildlife connectivity became standard business procedure, Table 8. Recommended changes included: definitions of terms, such as wildlife corridors; how to include wildlife crossing structures in the planning process; the reporting of carcasses by maintenance staff; maintenance and repair of structures and fences for wildlife; consideration of wildlife when establishing speed zones; the review of animal-vehicle conflict in project planning; and the examination of wildlife-vehicle crash hotspots for transportation programming, along with dozens of other recommendations.

The project findings demonstrated that data-driven, carefully planned, and well-designed wildlife crossing structures can enhance traffic safety significantly, and are cost-effective within much of the TxDOT infrastructure. The recommended changes for the 18 manuals were under review by TxDOT divisions at the time of this writing.

Click here for [the website for the project and publications](#):

TABLE 8. TEXAS DEPARTMENT OF TRANSPORTATION MANUALS SELECTED FOR REVISIONS FOR CONSIDERATION OF WILDLIFE-VEHICLE CONFLICT AND HABITAT CONNECTIVITY.

Access Management	Manual on Uniform Traffic Control Devices
Bridge Design	Plans, Specifications and Estimate Development
Bridge Project Development	Procedure for Establishing Speed Zones
Construction Contract Administration	Project Development Process
Design and Construction Information Systems	Roadside Vegetation Management
Highway Safety Improvement Program	Roadway Design
Landscape and Aesthetics Design	Traffic Safety Program
Maintenance Management	Transportation Planning
Maintenance Operations	Transportation Programming and Scheduling



The TxDOT Pharr District, based in the southern tip of Texas, encompasses the Laguna Atascosa National Wildlife Refuge, home to ocelot. The presence of this endangered species predicated a partnership between the U.S. Fish and Wildlife Service and TxDOT to build wildlife crossing structures that could accommodate ocelot and other wildlife. The lessons learned in this district helped to inform the recommendations for the TxDOT manuals. Photo credits: left photo, P. Cramer, right, ocelot TxDOT and US Fish and Wildlife Service.

The MPO Connection: The Potential for Integrating Wildlife Crossing Consideration as a Standardized Process into Transportation Plans and Programs

Lisa Loftus-Otway

Metropolitan Planning Organizations (MPOs) are designated entities in urbanized and suburbanized areas throughout the U.S. which sit at a critical cusp to become the drivers and generators of planning for wildlife crossings within their jurisdictions. MPOs are tasked by federal law to represent urbanized areas with more than 50,000 people (23 United States Code (U.S.C.) 134, 23 U.S.C. 150, and 49 U.S.C. 5303, as amended) and to develop long range metropolitan transportation plans (MTP) that in turn become on-the-ground projects through the short range transportation improvement programs (TIP). These MTP and TIP are the fundamental drivers of transportation plans and project development within U.S. urban-suburban areas, and offer the 400 plus MPOs opportunities to include wildlife concerns in transportation. In turn, the state DOTs must include approved MPOs' MTP and TIP's in the overall state Long Range and STIP plans. The MPO transportation planning process is thus a critical but often overlooked piece of state transportation planning that could be improved to include wildlife concerns. The MPO transportation planning process is described in some detail below along with recommendations on how the process can be adapted to assure wildlife concerns are considered.

MPOs represent populations from 50,000 to over 18 million people, thus not all have the same capacities in terms of staffing and technical expertise to conduct AVC analyses or to develop wildlife crossing structures. For example, during this study's survey development, the researchers found that: (i) many small MPOs have just three employees; (ii) many MPOs are in small urban areas, and have staff that may be housed within the county/city departments of transportation and/or planning, and so host joint duties; and, (iii) the MPOs are political creatures, whose oversight boards are comprised of elected officials, public agency officials, and sometimes state officials, and require consensus to develop plans/projects (23. Code of Federal Regulations (C.F.R.) (d) (1) (1)-(iii)). However, wildlife crossing structures represent key safety components of transportation planning, and help ensure the MPOs populations can have access to wildlife as a resource, for tourism activities, and ensure the MPOs meet federal and state protection for endangered species. Most MPOs include areas that are wildlife habitats, or are adjacent to suburban and rural areas with wildlife, or are close to national/state parks and wildlife areas. Thus the number of MPO staff or residents within the jurisdiction are not the best indicators of the need for and ability to plan for wildlife crossing structures.

Requirements Under the Law

MPOs are required under federal law to develop a long range metropolitan transportation plan (MTP) of no less than 20 years (23 C.F.R. §450.324) and a short term TIP covering no less than 4 years (23 C.F.R. 450.326). Both of these plans are required to access federal transportation funding, and in many instances state transportation funding. The MTP process requires adherence to 11 planning factors, one of which is assessment of environmental mitigation activities and potential areas to carry these out (23. C.F.R 450.324 (f) (10)). Within the TIP processes the TIP *shall* also include for each phase (e.g. preliminary engineering; NEPA/environment; right of way, design, construction) sufficient descriptive material. So for example, type of work could include wildlife crossing structures at known hotspots (23 C.F.R 450. 326 (g) (1)). So in both of these planning documents there are places in which the MPOs can begin to carve out plans and project scopes for wildlife crossing structures and other mitigation.

In addition, within the TIP, each project or project phase included *shall* be consistent with the approved MTP (23 C.F.R §450.326 (i)), so if a wildlife crossing issue is noted in the environmental assessment area of the MTP, the TIP can then develop out a project to redress this issue. Once the TIP is approved by the MPO and the Governor, it *shall be* included within the DOT produced State Transportation Improvement Program (STIP) without change and directly by reference (23 C.F.R. 450.328 (b)). So the DOT's cannot amend or change in any way, the individual TIPs.

The MPOs can also undertake a multimodal, systems-level corridor or subarea planning study as part of the MTP process (23 C.F.R 450.318). These studies can result in development of multiple elements including purpose and need statements, preliminary screening, basic description of the environmental setting and/or preliminary identification of environmental impacts, and mitigation (23 C.F.R. 450.318 (a) (1), (3), (4) and (5)). The MPOs can also utilize an optional framework for development of programmatic mitigation plans within the MTP process to address potential environmental impacts of future projects (23 CFR 450.320). The MPOs here – according to statutory language - *will* determine scope and contents in consultation with the Federal Highway Administration / Federal Transit Administration and other agencies who have jurisdiction and special expertise over the resources being addressed in the plan. Scope can include a plan that is within a defined geographic area, or on a resource such as aquatic, wildlife habitat (which are listed within the examples in the statute). Content can include assessment of a corridor, identification/inventory of resources within a geographic area, assessments of opportunity for improvement of overall quality of identified resources, adoption of standard measures or operating procedures for types of impacts, and adaptive management procedures (23 C.F.R. 450.320).

Within this setting, there are opportunities for wildlife and transportation professionals to provide assistance and guidance to MPOs to undertake hot spot analysis for AVC, identification of critical habitat areas, cost estimates for mitigation and design descriptions from wildlife vehicle crossings that have been developed around the U.S. and globally. Some MPOs have already developed wildlife crossing structures and they can also provide critical input and training to other MPOs to help get them started in developing wildlife crossings mitigation.

The Easy Inclusion Route for Change

Current federal law already affords opportunities within statute and regulation for MPOs to be the ‘drivers’ of developing wildlife crossing structure discussion and development: This is what we call the easy inclusion route, not necessitating federal statutory amendment. The MTP and multimodal, systems-level corridor or subarea planning study offers ample opportunities using current language and specific requirements to plan for wildlife crossing structures, and to identify mitigation options for impacts as well as a choice of potential future mitigation options. Most notably, because within the TIP *each project or project phase included shall be consistent with the approved MTP*, the MTP should be the first phase of identification, analysis and discussion of wildlife crossing structures because of the need for consistency. The TIPs also have another weapon in their arsenal to assist in integrating wildlife crossings: once the TIP is approved by the MPO and the Governor, *it shall be included within the State Transportation Improvement Program (STIP) without change and directly by reference (22 C.F.R. 450.328 (b))*. So, there is latitude here, to begin discussion and identification of AVC issues within the MTP process and to develop actual mitigation activities within the TIP, that the DOTs then amalgamate into the STIP without a change. This also provides a revenue stream identification and flow from MTP through to TIP.

The Hard Inclusion Route for Change

This route would require changes within 23 United States Code (U.S.C.) 134, 23 U.S.C. 150, and 49 U.S.C. 5303, as amended and Code of Federal Regulations Title 23: Highways Part 450—Planning Assistance And Standards Subpart C—Metropolitan Transportation Planning and Programming to require MPOs to not only begin preliminary identification of environmental impacts and environmental mitigation, but to require hot spot analysis for AVC, rather than the mere ‘assessment’ of the existing condition of the natural and human environmental resources required in 23 C.F.R. 450.320 (a) (2)(i).

Future research

Future areas that should be researched to help identify how wildlife movement and AVC can be included in MPO transportation planning include:

- Review MPO plans to determine the level and quality of mitigation plans and activities
- Review MPO in-house processes and procedures to develop guidance for the smaller versus larger MPOs.

Further Reading

Link to Electronic Code of Federal Regulation

URL: https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title23/23tab_02.tpl

Link to Electronic Code of Federal Regulation – Planning and Research

URL:

<https://www.ecfr.gov/cgi-bin/text-idx?SID=c896c7551ca61d30f7d9559ed495f3d6&mc=true&tpl=/ecfrbrowse/Title23/23C1subchapE.tpl>

Highways & Habitats Training for Vermont Transportation Agency Staff: Intangible Magic

Patricia Cramer, taken from an interview with Chris Slesar of VTrans

Vermont Transportation Agency (VTrans) created a slow wave of change concerning wildlife within the agency by inspiring change from within its people. The Highways & Habitats for VTrans personnel has been a successful program that brings transportation professionals from all disciplines into the road ecology conversation.

VTrans identified habitat connectivity as an important consideration in the development of transportation projects. With financial support from FHWA, VTrans regularly offers a three-tiered series of trainings and seminars to help VTrans staff better understand the relationship between transportation and wildlife connectivity and habitat needs. In turn, personnel from every division within VTrans have learned of the needs of wild animals of all sizes to move to critical habitat and their vulnerability to traffic and roads. As course graduates move into higher positions within VTrans, they become more empowered to implement

programmatic changes and project improvements that affect wildlife connectivity and habitat. The cultural changes from these trainings have occurred over decades, and from the highest levels of VTrans to the local maintenance personnel, in effect, creating an intangible magic within the agency.



Participants in the Highways and Habitats course learn about wildlife tracks. Photo credit: VTrans.

Chris Slesar, a co-creator of the program, relayed two stories of how the course may have helped influence actions at the agency, from the local level to executive decisions. Personnel in one of the VTrans districts identified an area where snapping turtles were getting hit on the road. In the Highways & Habitats training, ecologists showed the class participants in that district how the turtles in a nearby wetland were attracted to the berms on the road right of way (ROW) to lay and incubate eggs, thus placing the females in danger of being killed as they moved near and across the road. The district graduates of the course took old and discarded W-beam guard rail and repurposed it as a retaining wall, north and south of a culvert near a pond where turtles were getting killed on the road. The district then back filled the new retaining wall with stone that wasn't conducive to laying eggs. The intent was to both guide the turtles to the culvert and make the road berm less attractive to nesting females. In

essence, they used ingenuity from their areas of interest to help turtles in their everyday actions.

Recently, the VTrans Chief Engineer was presented with evidence from staff of the need to upgrade a culvert replacement on Route 9 near Searsburg to a full bridge to allow for wildlife connectivity not only near the highway, but regionally. A key VTrans wildlife expert conducted a benefit-cost analysis of the bridge upgrade and completed an exhaustive review of the benefits of re-establishing wildlife connectivity in the area. The Chief Engineer was supportive and called the decision to upgrade the project from a \$300,000 culvert to a \$3 million bridge a common sense decision about public investments. This engineer is not a graduate of the Highways and Habitat course, but is surrounded by course participants in his office. In essence the engineer understands regional connectivity is important to wildlife, while also stating that this is action does not open the door for every culvert replacement to become a bridge.

Institutionalized Awareness

Since 2002 the Highways & Habitats Program has trained agency personnel on the ecology and practice of wildlife movement with respect to roads. The education and discussions from these sessions come back to the personal question for participants, “What can you do in your job for wildlife?” This is asked of personnel from the management to plow drivers. In earlier years the course required a commitment of one full day a month for six months for participants. They would meet in the field and learn of wildlife ecology from vernal ponds and how breeding salamanders need to cross roads on cold rainy spring nights, to working with fisheries biologists to shock water ways and work with fish. The course has since evolved into three tiers of participation.



Participants discuss mitigation options under a VTans bridge. Photo credit: VTrans.

Tier One of the program is to inspire. It has been developed into an on-line 90-minute training tutorial for individuals to become acquainted with transportation ecology and become inspired as to actions they can do in their positions to help wildlife, in small and large ways. It will be available to not only VTrans but also personnel in municipalities.

Tier Two is designed to empower participants to have a voice and role. It is three days of field course training over six months. It is offered every year. There is a palatable “magic” for participants of seeing wildlife and their signs in the wild, holding a snake, seeing turtles up close, handling fish, etc., that make this Tier the most important part of the training. Participants brain storm solutions at locations such as bridge sites. The field component is also beneficial for project managers, for them to be able to say, “We’d love to do these things for wildlife, but we can’t afford it. How do we maximize funds and do the right thing?” These visits result in dynamic conversations that are never exactly the same from class to class.



A VTrans participant handles a snake for the first time. Photo credit: VTrans.

Tier Three is structured to empower engineers to have the tools to make technical improvements. It will be a classroom course, offered every other year. This is a still developing part of the educational program, but the initial organization of Tier Three is for people with experience with tools to design infrastructure for wildlife to present their experiences and work with the engineers. The goal is to have experienced engineers speaking with other engineers. The wildlife mitigation solutions that may be considered big and bold in western states and Canadian provinces are probably not indicative of what the VTrans engineers will be working with in their careers. They need instructions on small infrastructure retrofits and designs that can facilitate wildlife and fish movement at smaller scales, in the mountainous roads of Vermont.

Culture Change

Chris Slesar is by training an anthropologist, and he gave words of wisdom as to how the success of this program can be repeated in other places. It is based on change. Most people think culture is static, and change occurs when something big happens. The anthropologists understand culture is in a constant state of flux. Changes at the micro level can happen and change culture. The small changes at VTrans, some presented here as examples, are these the agents of change. The leaders that have under gone that change can make things happen at a greater level, and those little changes add up.

New Mexico's Legislators Integrate Wildlife Concerns Into Agency Actions

Patricia Cramer

New Mexico state legislators understand the importance of reducing wildlife-vehicle collisions (WVC) and promoting wildlife connectivity. Since 2003 the state has enacted four memorials/laws/acts that direct New Mexico Department of Transportation (NMDOT) and New Mexico Department of Game and Fish (NMDGF) to cooperatively address WVC issues and pursue funding to mitigate top priority areas. In 2019 New Mexico became the first state to enact a Wildlife Corridors Act, with the New Mexico Wildlife Corridors Act (See Appendix X). With this Act, it is now law for the transportation and wildlife agency to work together in identifying and addressing top priority areas for wildlife connectivity across New Mexico roads. This Act and the resulting Wildlife Corridors Action Plan may become a model for other states to codify how states bring wildlife movement concerns into transportation plans and projects, and how stakeholders participate in this effort.

New Mexico's legislative mandates began with House Joint Memorial 3, passed in 2003. It resulted in a critical mass workshop that brought together approximately 100 participants who identified 30 priority WVC road segments. The participants recommended these areas be further evaluated for WVC mitigation measures. The resulting map and report led to the development of the Tijeras Canyon Safe Passages Project which was completed in 2008.

In 2011, New Mexico legislators passed House Joint Memorial 10. As a result, NMDOT, NMDGF, the University of New Mexico Division of Government Research (DGR), and New Mexico State Police participated in a workshop that again identified areas of highest risk for WVC. DGR identified 54 highway segments that had at least 10 crashes in five years involving large animals. Additional analysis was performed on these segments that identified areas that had at least five human injury crashes. This resulted in funding of the US 64/84 Pilot Project located between Tierra Amarilla and Chama. This project involved roadway vegetation control to increase sight-distances and the installation of illuminated warning signs.

In 2013 New Mexico legislators passed House Memorial 1 and Senate Memorial 11. The legislation was drafted by Wild Friends, a youth education program organized by the University of New Mexico Institute of Public Law. It again resulted in a workshop that identified and prioritized 32 road segments with high incidences of WVC. It further directed NMDOT and NMDGF to seek Highway Safety Improvement Program (HSIP) dollars to fund at least one WVC mitigation project. Two game fence projects were successfully funded, which exceeded legislative goals. Game fence projects were

constructed along I-25 at Raton and US 550 south of Cuba. These projects excluded large mammals from the roadway and directed them to safely cross through existing concrete box culverts and bridges. The effectiveness of these projects are currently being evaluated through FHWA research dollars.

In 2019 state legislators worked with the National Wildlife Federation, Defenders of Wildlife, Wildlands Network, tribal entities, and other stakeholders to develop and pass the New Mexico Wildlife Corridors Act ([Appendix C](#)). It directs NMDOT and NMDGF to develop a comprehensive Wildlife Corridors Action Plan that would identify and prioritize important areas for wildlife movement and key barriers, such as roads, to those movements. The Act directed that approaches to address wildlife-vehicle conflict areas would not only enhance safety to the traveling public but also consider critical wildlife movement areas. The Act marks an advanced approach to mitigating WVC by: (1) identifying areas important for large mammal movements across the state first, (2) then identify where those movement corridors intersect with roads and highway, and (3) then prioritize mitigation projects through publication of a projects list. It also is unique in that there is state-wide stakeholder participation in prioritizing mitigation projects once the scientists identify the important movement corridors and areas where wildlife come into conflict with vehicles. The specifications in the Act dictate how the NMDOT and NMDGF will consistently analyze data, prioritize potential projects, and construct necessary mitigation.



Participants in the 2013 Workshop. Photo credit: M. Watson.



Elk photographed using the area beneath the U.S. 550 Rio Puerco Bridge. Photo credit: J. Gagnon, AZGFD, & NMDOT.

The Act did not change institutional practices at NMDOT or NMDGF, but rather provided

direction and the opportunity to identify critical wildlife-vehicle conflict areas through more robust GIS analysis that incorporates both ecological and WVC data. Past efforts directed by past legislation utilized less robust analysis using primarily WVC data. The Act further directed both NMDOT and NMDGF to consider input from stakeholders, tribes and the general public.

The WVC mitigation projects developed up through 2020 have resulted in three (3) wildlife crossing structures in one project, and nine major mitigation projects that exclude large mammals from the roadway and provide safe wildlife passage through existing bridges and other drainage structures. In essence, New Mexico started its wildlife mitigation program modestly, in small steps rather than with a large project with multiple wildlife crossing structures. As the New Mexico Wildlife Corridor Action Plan is developed, it will be of interest if the results lead to one or more projects where a wildlife crossing structure is built in a priority location for wildlife. These types of projects, while much more expensive than wildlife exclusion fence projects, are a standard of change that indicate an agency is truly beginning to include wildlife connectivity and the reduction of WVC in their standard operating procedures.

The Wildlife Corridors Act of 2019 can be found at the website below, or [Appendix C](https://wildlandsnetwork.org/wp-content/uploads/2019/04/New-Mexico-Wildlife-Corridors-Act-2019.pdf).
<https://wildlandsnetwork.org/wp-content/uploads/2019/04/New-Mexico-Wildlife-Corridors-Act-2019.pdf>

Building Partnerships to Advance Wildlife-Highway Mitigation in Colorado

Julia Kintsch

As with many state departments of transportation and state wildlife agencies across the nation, the Colorado Department Transportation (CDOT) and Colorado Parks and Wildlife (CPW) remained largely isolated from one another through much of their histories. While relationships varied from one office to the next, to a large extent, the two agencies lacked a mutual understanding of the common threads of their missions, including maintaining wildlife habitat connectivity in Colorado during transportation planning and development. The agencies conducted project-specific consultations as required, but information exchanges and discussions were generally limited to site-specific projects. Neither agency fully appreciated the constraints of the other, and as a result, opportunities to jointly pursue large-scale planning and design new projects with common benefits were missed.

While multiple factors have prompted increased interagency collaboration in recent years, the cumulative successes of simple, but effective and well-publicized small-scale wildlife-highway mitigation projects such as the construction of wildlife fencing escape ramps along highway US 550 near Ridgway State Park have gone a long way towards promoting greater communication and collaboration. The increased trust and confidence resulting from these small-scale efforts combined with a multi-agency seasonal driver awareness campaign increased the engagement of both agencies over time and allowed greater collaboration to tackle larger projects such as the one on State Highway 9 (SH 9) in Grand County.



The SH 9 project was initially spurred by funding from a conservation ranch adjacent to the highway corridor. A broad array of public and private entities came together to raise additional funds, ultimately prompting CDOT to advance the project under a one-time grant opportunity. This safety improvement project included the construction of two wildlife overpasses, five large underpasses, and ten miles of wildlife exclusion fencing and associated mitigation features designed in close collaboration with CPW. In just the first few years following construction, these structures boasted tens of thousands of

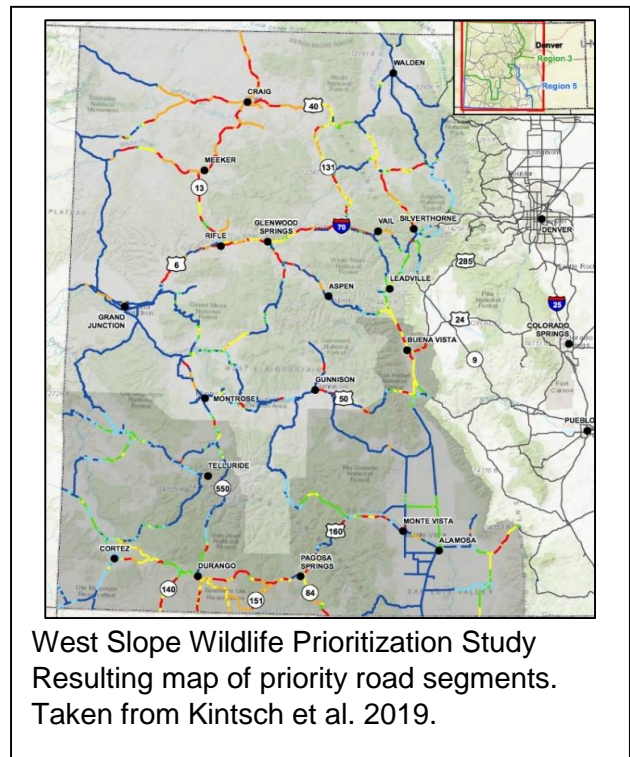
successful mule deer crossings and many other wildlife, and the mitigation has resulted in an 89% decrease in wildlife-vehicle collisions.

Building on these and other local successes, in 2017, CDOT, CPW and FHWA joined forces to host a two-day interdisciplinary Wildlife and Transportation Summit. The Summit invited agencies and organizations representing an array of interests to share ideas and expertise around improving highway safety and protecting wildlife populations and movement corridors. Participants included representatives from multiple state and federal agencies, local and state policymakers, non-profit organizations, foundations, academia, wildlife experts, and public and private stakeholders. The Summit established new partnerships around common goals and developed broad recommendations and identify funding to improve highway safety and protect wildlife populations.



Participants in the 2017 Summit visit the SR 9 wildlife mitigation to discuss lessons learned. Photo credit: P. Cramer.

A direct result of this gathering was the formation of the Colorado Wildlife and Transportation Alliance to carry forward the momentum generated by the Summit. The Alliance is led by an inter-organizational Steering Committee composed of representatives from CDOT, CPW, FHWA, the USDA Forest Service, the Bureau of Land Management, the Southern Ute Tribe, Rocky Mountain Elk Foundation, and the Mule Deer Foundation. The initial tasks of the Committee were to define a mission and vision, and to develop an action plan. The action plan identifies specific goals, actions and timelines, and led to the formation of technical teams to broaden the capacity of the Alliance. The primary goals and associated technical teams are focused in four arenas: 1) education and outreach, 2) partnerships and funding, 3) policy, and 4) data coordination and planning. In addition, the Summit and subsequent formation of the Alliance coincided with the Western Slope Wildlife Prioritization Study, a CDOT and CPW-funded research study to



West Slope Wildlife Prioritization Study Resulting map of priority road segments. Taken from Kintsch et al. 2019.

prioritize highway segments for mitigation across Colorado's Western Slope (Kintsch et al. 2019). In 2020, this regional study is being expanded to the Eastern slope and Plains so that transportation planners and resource managers will be equipped with a complete statewide prioritization to guide future mitigations projects and funding.

Combined, these concurrent efforts are generating broader support and leaving Colorado better positioned to address wildlife-highway conflict. In 2019, Colorado Governor Jared Polis signed an Executive Order on Big Game Winter Range and Migration Corridors and Wildlife Crossings, which explicitly reinforces the ongoing work of the Alliance, including revising an interagency Memorandum of Understanding to streamline collaboration between CDOT and CPW; and identifying policy, regulatory or legislative opportunities that will ensure the ongoing conservation of seasonal habitat and migration corridors.

Diverse public and private partnerships have proved essential from the beginning of Colorado's journey to address wildlife-highway conflict. Partnerships at multiple scales from local to statewide have proven essential for increasing education and awareness; leveraging funding; and achieving on-the-ground results benefitting people and wildlife. Given the multiple complexities involved, coordinated actions across jurisdictions and interests will continue to be required.

Link to the CPW-CDOT MOU

<https://www.codot.gov/programs/environmental/wildlife/cdot-and-cpw-mou-signed>

SR 9 promotional videos

<https://cpw.state.co.us/hwy9>

Annual Reports posted on CDOT:

<https://www.codot.gov/programs/research/pdfs/2019/SH9Yr3/view>

2017 Summit Video

<https://www.codot.gov/programs/environmental/wildlife/wildlife-transportation-summit>

The Colorado Wildlife and Transportation Alliance

<https://coloradowildlifeandtransportationalliance.com/>

The link for the West Slope Study docs

<https://www.codot.gov/programs/research/pdfs/2019/WSWPS/view>

Link to Governor Polis' executive order

<https://www.codot.gov/programs/environmental/wildlife/governor-signs-wildlife-exec-order>

A Personal Federal Agency Perspective

Terry Brennan

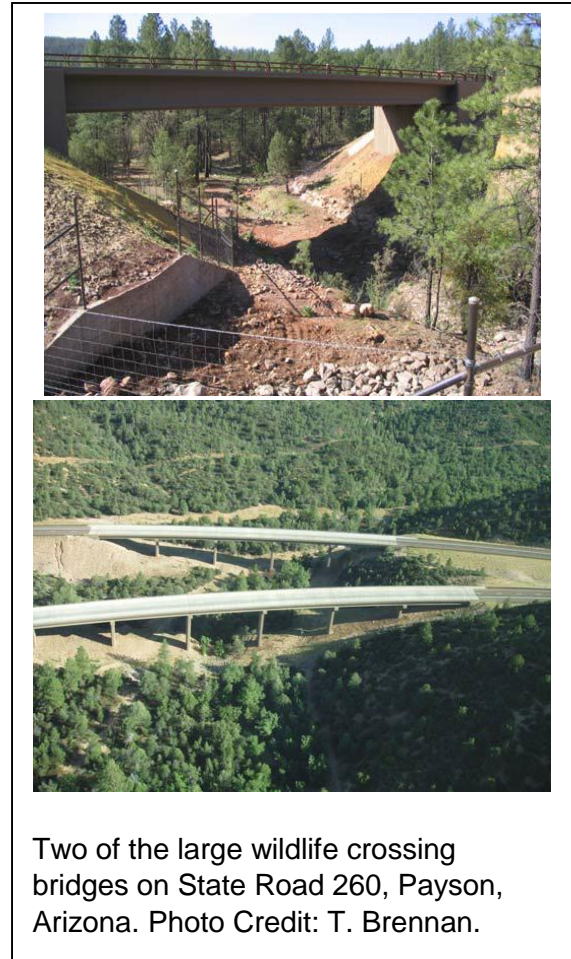
Opportunities such as this only come along once in a while. This was the situation for my endeavors on the Tonto National Forest (TNF) as the Arizona Department of Transportation (ADOT) spent over \$500 million dollars expanding much of their highway system across the TNF over a ten- year period. Implementation of the highway program afforded me a chance to help both the land management agency and the highway department complete multiple projects that included dozens of wildlife crossing structures. These included numerous bridges and large culverts that incorporated many facets of adaptive management and lessons learned. With each project design and construction, we incorporated the best ideas from each structure to make the next project even better. The common theme throughout my advice would be to get involved as early in the process as feasible.

Obtaining Wildlife Data To Provide Wildlife Crossing Infrastructure

As most DOT employees are aware, changes to designs that are requested later than at a 30 percent design stage, are very difficult to implement. This may be due to numerous issues, but more often than not, it is a scheduling delay that often causes a pushback on any requested modifications. With the advent of these possible delays, it is imperative to obtain the wildlife input from various sources as early as possible in the design process and be able to implement wildlife connectivity solutions. This information can come from a number of sources as other detailed descriptions from other case studies in this report attest to.

Important Information Sources

From the survey respondents in this study's on-line survey for transportation agency personnel, two of the most important sources for wildlife information were wildlife collision crash data and hotspot analysis of the crash data reported. This is very important information to a design engineer, but they must be cautious as to how to



Two of the large wildlife crossing bridges on State Road 260, Payson, Arizona. Photo Credit: T. Brennan.

interpret the data results. All engineers want to eliminate safety hazards and WVC that are a safety hazard. But the solution might not be exactly where the collisions are taking place. Other factors may cause the animals to be forced to a different area to cross the highway. For this reason, wildlife expertise should be consulted before project implementation.

Obtaining Critical Approval At Key Critical Path Times.

My position within the USDA Forest Service, at the Tonto National Forest, was financed by the ADOT as a reimbursable expense from Federal Highways. This position allowed ADOT to go to one individual to obtain answers to the process for approval or clearances from the land management agency (The USDA Forest Service). Often times the DOT does not understand the organizational structure or approval process in the federal agency. It was my responsibility to help ADOT obtain these approvals. This helped provide both cost effective solutions and on time product delivery.

Continuity For Projects From Planning To Construction To Maintenance

DOT's often have specific groups that have a small piece of the total project. During the project implementation there is a planning group, a design group, a construction contractor and finally the maintenance section. Being able to pass on the historical decisions helps the implementation by the construction contractor. This can be accomplished by having the design groups that completed the construction plans included as a part of the monthly meetings with the contractor during the construction process. By doing this, the designers are able to make timely changes for the project's benefit or explain future project impacts that might not be readily apparent to the construction team at the current time and provide for continuity through the project completion.

Another predesign project impact to be dealt with is the geotechnical investigation necessary for a new or reconstructed bridge. Being able to think of a contractors' access for the larger construction activity during this part of the project can help in minimizing the disturbance in critical habitats utilizing one access for multiple entries.

Identifying Project Impacts Outside The Identified Right Of Way

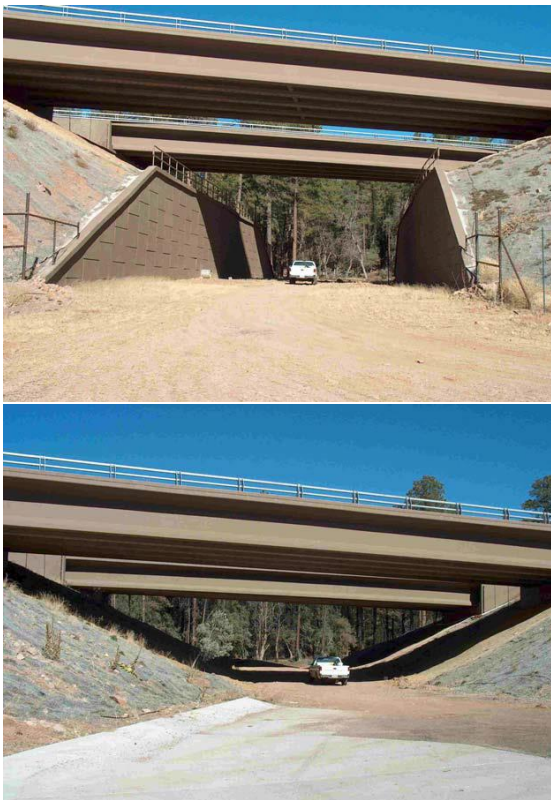
All construction projects require additional land disturbance outside of the



Contractor staging area inside the Arizona State Road 188 ROW. Photo Credit: R. Brennan.

existing ROW and NEPA cleared areas. By identifying these impacts early in the design process, clearances could be obtained in an orderly manner and project design plans incorporated into the construction contract. These plans included the areas of disturbance and the remediation of the contractors' activities. This created a win-win for all parties. The contractor had a known staging area, detour or waste site, the land management agency got a new trailhead or past dumping area closed and remediated and the DOT met its timeline objective by having clearances obtained before contract award.

Adaptive Management for Wildlife Crossings



The scheduling of numerous projects during my tenure allowed for lessons learned during the project development. One lesson learned was the threat to animals from large retaining walls from predators as they proceed through the space under the bridge. This was alleviated in some cases by the use of a full depth bridge abutment. This solution removed the retaining walls as well as provided a better natural environment under the bridge to ease the animals' anxiety. The need for fencing to funnel the animals to the structure and reduce the animals getting onto the highway has been a part of the construction implementation. To reduce the amount of wildlife fencing, natural barriers or landforms were often used when appropriate to act as a fencing replacement.

Arizona State Route 260 Wildlife crossing bridges with and without retaining walls.
Photo credit: T. Brennan.

is to place large rock rip rap in these locations. Alternate design solutions will allow better accessibility for wildlife movement.

Water outlet velocities under bridges and culvert ends often require energy dissipaters. A typical engineered solution

Modifying Existing Infrastructure

As the need for replacement of an aging infrastructure continues and increases across the country, we can help solve wildlife connectivity issues as projects are compiled and

scheduled on the STIP. As discussed above, obtaining WVC data can help identify key locations for wildlife crossing structures as projects are designed.

Key Points For Better Project Implementation

- Get involved early with accurate and current data to provide the best wildlife crossing solutions.
 - Speaking to the engineer, it is often identified that the biologists may not have all the studies or data they would wish, in order to provide their input. The biologist must give their input with their best judgement at the time rather than delay the project in order to obtain more data or a better analysis. The DOT has a schedule and a timeline for completion and will continue their design process in order to meet their target completion date.
 - As land managers we need to review the State Transportation Improvement Plan to know what construction and reconstruction projects are planned
- Don't take the first response from the project manager as the final decision. A DOT project engineer will not wish to spend limited resources on something that is not required. Use safety of the traveler and eliminating WVC's as a basis to convince the project manager of the importance of the request.
- If the project is crossing Federal, Tribal or Provincial lands, identify who in the agency has the ultimate decision making authority. As a project manager from a land management agency, keeping that individual updated in the design process will help alleviate unknown impacts from the project implementation.
- Usually, allowing a larger construction disturbance on the short term, provides a better solution in the long term. An example of this from my perspective, I was trying to limit the disturbance or footprint of a new 4-lane highway, but the ultimate concrete barrier median divider had far more negative impact on wildlife movement. Try thinking of the long term reclamation needs and not the immediate ground disturbance. This is also important because maintenance funds usually are provided by the state and not the federal government. Do it right the first time and heal the areas of impact.
- Don't forget to identify sources of water for construction activities as water is one of the largest resource impact items necessary for a contractor's activities.
- Don't be apprehensive to ask for advice. There are numerous sources available that have valuable information. A few that might be useful include www.icoet.net, Wildlife Crossing Handbook: Design and Evaluation in North America (Clevenger and Huijser 2011), and www.arc-solutions.org.
- Identify funding sources that can complement wildlife crossing implementation. Often bringing even a small amount of additional funding can swing a decision that favors a wildlife crossing. Sources can be from non-profits or from trust fund sources that are not in the large Surface Transportation program items, such as transportation enhancements, safety or even Recreation trails funds.

Chapter 4 Data Requirements

4.1 Introduction

Data are key to identifying a challenge and the potential solutions. There are two types of data needs for transportation agencies to consider wildlife movement concerns and the reduction of wildlife-vehicle conflict: transportation data, and ecological data. A major data requirement is animal and wildlife crash data. In 2019 crash data were secured and analyzed from 15 western states, Iowa, and Ontario, Canada. This initial analysis will be expanded upon in 2020. The information can help convince transportation personnel and legislators as to the magnitude of wildlife-vehicle conflict, which in turn can help bring about changes to practices, funding, and legislative support for wildlife crossing structures.

4.2 Crash Data Analyses Methods

Fifteen western states, Iowa's and Ontario's crash data were compiled in early 2019. The project's TAC members and known engineers and environmental staff of other agencies were contacted for the data for five years, ranging from 2013 to the most updated year of data, typically 2017. Specifics were asked for the number of total crashes for each year; the total number of wildlife-related crashes for each of those years; the number of wildlife-related crashes for each of the five different crash types (Property Damage Only (PDO) through to Fatal, or KABCO as used by engineers), and the cost each transportation agency places on those five types of crashes in traffic safety analyses. The societal costs of the wildlife crashes were computed using a standardized value for the crash types; the Harmon et al. (2018) white paper commissioned by FHWA. The FHWA 2018 costs for each crash type (Harmon et al. 2018) are presented in Table 9.

TABLE 9. U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA) CRASH COSTS TO SOCIETY ESTIMATES FOR 2018. BASED ON HARMON ET AL. 2018.

Crash Type	Cost to Society
Property Damage Only (PDO)	\$ 11,900
Possible Injury (C)	\$ 125,600
Suspected Minor Injury (B)	\$ 198,500
Suspected Serious Injury (A)	\$ 655,000
Fatality	\$ 11,295,400

4.3 Results

The total crashes, total wildlife crashes, percentage of crashes that were wildlife-related, and FHWA costs to society for those crashes for each state and province are presented

in Table 10. The annual average number of reported wildlife-vehicle crashes each year in these 16 states and one province is over 65,000. The total estimated average annual cost to society for wildlife-related crashes for these states and province were over 2.1 billion U.S. dollars.

TABLE 10. THE AVERAGE ANNUAL NUMBER OF TOTAL CRASHES, WILDLIFE-VEHICLE CRASHES, PERCENTAGE OF TOTAL THAT ARE WILDLIFE-RELATED, AND COST OF WILDLIFE-VEHICLE COLLISION CRASHES IN 15 WESTERN STATES, IOWA, AND ONTARIO BASED ON 2013 - 2017 CRASH DATA AND FEDERAL HIGHWAY ADMINISTRATION 2018 CRASH COST ESTIMATES.

State	Annual Average Number of Total Crashes	Annual Average Number of Wildlife-Vehicle Crashes	Percentage Crashes that are Wildlife-Related	Annual Average Cost of Wildlife-Related Crashes Based on FHWA Costs
Alaska	11,458	696	6.1	\$52,341,680
Arizona	117,909	1,984	1.7	\$80,779,840
California	171,663	1,190	0.7	\$72,923,760
Colorado	116,616	3,782	3.2	\$151,028,660
Idaho	24,105	1,270	5.3	\$51,828,800
Montana	22,241	2,762	12.4	\$115,797,700
Nevada	47,406	464	1	\$23,054,920
New Mexico	42,352	1,431	3.4	\$35,024,220
North Dakota	16,229	3,339	18.9	\$57,139,140
Oregon	23,321	789	3.4	\$60,747,200
South Dakota	17,549	4,495	25.6	\$86,089,280
Texas	561,031	7,469	1.6	\$477,230,500
Utah	58,222	3,338	5.7	\$115,667,560
Washington	51,446	1,568	3.0	\$51,725,040
Wyoming	14,165	2,672	18.9	\$63,103,920
Western States Sub-Total	1,252,484	44,879	3.58	\$1,691,974,936
Iowa	56,127	7,630	13.6	\$80,443,380
Ontario	201,848	12,616	6.3	\$275,273,720
Total	1,510,459	65,125	4.3	\$ 2,147,692,036

4.4 Future Work

This effort was a preliminary endeavor that helped the researchers learn of how different entities parse crash data to define crashes as with animals or wildlife. In 2020 the effort will encompass a more formalized standardized methodology.

Future iterations of the chapter will include; the data transportation agencies need to identify wildlife-vehicle conflict problems; and their locations; the extent of the problem and priority areas; the inclusion of ecological data; how states use data to identify wildlife corridors; and other factors.

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Appendix A – Literature Review

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Appendix B. Results of Survey: Transportation Agency and Metropolitan Planning Organizations Written Responses

Transportation Agencies' Written Responses

Question 1 -Wildlife Mitigation Efforts Since 2014

Question 1 of the survey, asking respondents what types of wildlife mitigation has their agency created since 2014 had several written responses presented below.

[Link to return to Question 1 results.](#)

Since 2014, has your agency implemented any of the following mitigation measures for large or small wildlife? Check all that apply.

- New dedicated wildlife crossing structures **with** wildlife exclusion fencing. Please note how many have been constructed since 2014: _____
- New dedicated wildlife crossing structures **without** wildlife exclusion fencing. Please note how many have been constructed since 2014: _____
- Wildlife exclusion fencing **without** crossing structures
- Replaced existing culverts or bridges with upsized structures to promote wildlife passage
- Enhanced or improved existing culverts or bridges to promote wildlife passage (e.g., add fence, add cover elements, remove sediment, create pathways, etc.)
- Animal detection systems or crosswalks

Please include a written response if you would like to describe your answer in greater detail

State/Province	Comments
Oregon	Oregon DOT has two wildlife under crossings in design/construction to be completed in the next three years. In all Oregon DOT existence, I do know we've spent about 5.25 million on wildlife features over 4 projects.
New Foundland	2 animal detection systems were installed in 2011 and one 17 km stretch of fencing in 2012. The animal detection systems (break beam) were removed because they were deemed ineffective and prone to outages. Fencing has been maintained and has require on minimal maintenance since 2012.
Massachusetts	Much of our wildlife accommodation efforts are through building larger culverts and bridges over waterways, as it is the most cost effective strategy for our agency. By small (relatively) increases in project cost across many culvert and bridge projects, we're able to improve wildlife passage at a much larger scale, than if we were focusing those dollars on just a couple dedicated wildlife tunnels each year.
North Dakota	One dedicated wildlife crossing with fencing has been completed with fencing/jumpouts, completed in 2017. A high flow structure (3 cell box culvert) was also constructed as part of this project which

State/Province	Comments
	<p>functions as a wildlife crossing during drier parts of the year. Many many years ago, high chain link fence was installed along Missouri river in Mandan, ND to keep deer from crossing the interstate (there was a big WVC problem). No crossing was included with the exclusion fencing. We also buried some rip rap under a bridge on the interstate, creating a „Ábench,“À. No fencing was included, but the bench has made movement underneath the bridge possible with documented photos of deer, moose, waterfowl, turkeys, etc. We also bury riprap at culvert ends and sink box culverts.</p>
Washington	<p>The Snoqualmie Pass East project on I-90 is the only project constructing wildlife crossings in this recent time period. It's fairly difficult to distinguish between "dedicated" wildlife crossing structures and "upsized structures to promote wildlife passage." Many of the structures replace small corrugated steel culverts yet they are huge bridges, much larger than would ever be considered necessary to provide natural stream dynamics. There are also many small culvert crossings that have no hydrologic function and are strictly for wildlife passage. I don't know how many of these have been installed and more are being installed right now as the project continues to proceed toward completion. Also, a wildlife exclusion fencing project starts construction next month (September) and it is not associated with a "dedicated" wildlife crossing structure. It is associated with an existing bridge that provides exceptionally good conditions for providing safe passage.</p>
Virginia	<p>The "replaced existing culverts..." applies to 2 fish passage projects. We also have a pilot project of a buried cable animal detection system that was recently completed (but I didn't check the box for that because it's not formally implemented). VDOT is considering the installation of an animal detection system for elk on a new alignment roadway. However, construction of the new road has not been completed and the detection system is still in the discussion phase. Virginia Tech Sustainability Center installed animal detection systems as part of their SMART Highway/Road research center. The fencing project I believe tied into existing crossing structures but itself did not include the install of a new structure.</p>
Arizona	<p>New Box Culverts have been installed with skylights, reduced bends or turns to allow 'see-through' to other side of culvert. Wildlife-friendly right-of-way fence has been installed to promote crossing by elk, deer and antelope while keeping livestock in. Culverts also have installed rip-rap spillways with paved pathways in the rip-rap to accommodate wildlife passage.</p>
Tennessee	<p>The Tennessee Department of Transportation, Wildlands Networks, and National Parks Conservation Association is investigating an eco-logical approach to reducing the number of wildlife-vehicle</p>

State/Province	Comments
	<p>crashes, especially large mammals such as whitetail deer, black bear, and even elk. From 2014 to 2017, there were 248 wildlife-vehicle related crashes in Tennessee with the I-40 Pigeon River Gorge being one of the areas with the highest number of wildlife-vehicle crashes. This area is known to draw tourist from around the world for hiking, camping, and spotting and photographing black bear. From 2014 to 2018 in the I-40 Pigeon River Gorge, there has been a total of 19 bear crashes recorded with all of these being property damage crashes occurring at night between 7:30 PM and 4:00 AM. We attended a Wildlife Crossing Workshop and Peer Exchange in Maggie Valley, NC to learn about potential countermeasures for TDOT to implement to prevent vehicle to animal collisions along the interstate. The workshop and peer exchange mainly focused on elk and bear crashes along I-40 from the Newport exit to the TN/NC state also known as the Pigeon River Gorge in the Cherokee National Forest and located adjacent to the Great Smoky Mountains National Park. Lessons Learned include, but not limited to, wildlife crossing structures, fencing, and tracking wildlife. Tennessee does not currently have adequate wildlife crossing structures or fencing to prevent vehicle to animal collisions.</p>
Maine	<p>We are using Stream simulation design for crossings which can include a bank along the stream inside the culvert</p>
Nevada	<p>The above number is for large over-and under-passes along US 93, I-80, I-11, SR 160, and USA Parkway. We have also added in numerous culvert for desert tortoise not reflected in the above number.</p>
Minnesota	<p>It is a standard design feature to include a minimum 3ft passage bench on all MnDOT bridges. I've lost count how many. Though this feature has been around since 2004. It is uncommon to have fencing. A new design is now being included where bridge riprap does not have a bench, but the entire slope is backfilled to fill the voids and make the surface walkable. Three are going in this year. "Offset culverts" are considered for both flood flows and animal passage. With the dry culvert being animal passage during normal flow conditions. The only fencing we are working on is small animal fencing (primarily turtles). Tests on design are ongoing</p>

Responses from Transportation Agency Question 1b- Target Species of Mitigation

[Link back to target species results.](#)

State/Province	Comments on Target Species
New Mexico	Haven't built actual crossing structure but have built game fence for large ungulates.
Minnesota	Most bridges constructed over waterways include paths ("passage benches") to facilitate wildlife movement. It is uncommon to have fencing. Our structures have not specifically targeted any species. The intent is to maintain (or reconnect) ecological connectivity along our streams and rivers.
Alberta	Retrofits and accommodation for wildlife underpasses new bridges have occurred
Minnesota	Our structures have not specifically targeted any species. The intent is to maintain (or reconnect) ecological connectivity along our streams and rivers.
Oregon	Oregon DOT has two wildlife under crossings in design/construction to be completed in the next three years.
Delaware	Fish
Washington	Lichens and Fungus

Responses to Transportation Agency Question 2 – Primary Compelling Factors for Wildlife Mitigation Efforts

[Link back to Question 2 results.](#)

Respondents' home state or province was withheld from comments to protect the identify of respondents if their opinions were not those of their agency. If a respondent indicated a state or province in their response, the information remained intact. The land on both sides was protected by the government and the entity that owned the road were all on board.

Each project had various components, but human safety and ESA requirements have been the primary concern in supporting mitigation.

We assume this entire survey considers efforts 2014 or later. We assume legislative action does not include ESA or other existing federal laws and regulations. Bighorn sheep and elk were being hit on the State's Highways and crossing signs were installed to warn the traveling public.

NYSDOT is very de-centralized and consideration is a function of staff knowledge, training statewide has been given to look at riparian corridors to widen culverts and include upland areas under structures (Culverts and Bridges). The VDOT Bristol District implements wildlife mitigation for many transportation projects. However, to date, this has not included wildlife crossings. These answers relate to 2 different projects. Safety hazard response is for research projects/implementation studying the effects of adding fencing to existing underpasses. "Private entities..." checkmark applies to an amphibian tunnel project currently in construction.

In the case of the I-90 East project, a variety of factors were influential in making the project happen, including several that were checked. However, the factor that wasn't offered was the special use permit the WSDOT had to obtain from the U.S. Forest Service and the fact that the Forest Service has its own planning document, the Northwest Forest Plan, that dictated the ways in which a permittee would need to comply with their plan to be permitted for something like a highway widening.

Primary factors leading to wildlife mitigation comes from our State Game and Fish Dept. Examples include USFS-required mitigation because of easement requirements; part of proposed federal action as described in project's biological assessment (section 7 ESA); one or two projects including wildlife undercrossings for mule deer as part of a curve correction project and safety factors.

There was no apparent option for this but our installations were due to NEPA requirements from say, USFS.

One undercrossing will be built due to NEPA requirement on USFS property.

DNR does have permit rules that require measures to maintain, enhance, or restore ecological connectivity.

MnDOT designs were developed to be utilized as on-site measures to do so. NO studies for placement are done, though they have been implemented as regular part of project design.

The Alberta Wildlife Watch Program is an Animal-Vehicle Collision Safety Program designed to improve driver safety while reducing the impacts that highways have on wildlife populations. This is done through the analysis of accurate animal carcass data for large bodied species at a district, region and provincial level to identify, validate and design for Animal-Vehicle Collision Prone Locations.

OTHER; research identified area of wildlife mortality. worked to reduce this mortality. The wildlife detection systems were implemented as a result of a Minister's directive

Responses to Transportation Agency Questions 3 and 4 - Barriers to Mitigating for Wildlife

[Return to Questions 3 and 4 results.](#)

Respondents' home state or province was withheld from comments to protect the identity of respondents if their opinions were not those of their agency. If a respondent indicated a state or province in their response, the information remained intact. There were 20 Comments from respondents to the external and internal to the agency barriers.

1. Wildlife mitigation is considered for all projects when wildlife needs are identified.
2. Agency is siloed by region and by division with little interaction between those that design crossings and those interested in seeing them used.
3. The greatest barrier is that there is no perceived need to implement specific wildlife crossings.
4. The AWW program integrates AVC analysis and mitigation from planning through to operations of the provincial highways. There are limited barriers in integrating AVC mitigation.
5. Lack of dedicated funding for connectivity mitigation and our culture.
6. I think we are doing pretty good overall. Though large stand-alone structures are not in the mix. Designs in our DOT typically also have secondary benefits (large culverts that also carry flood flows, ease of bridge inspections). Though fencing is a struggle to get into plans.
7. Oregon now has HB2834 requiring ODOT to consider wildlife passage in high collision areas but there is no funding attached to the legislation.
8. Lack of legislative mandate and funding are both factors. Ex: fish passage barrier remediation is a mandate in CA but with no dedicated funding and we are not meeting statewide goals for remediating these barriers.
9. Since spending money on wildlife mitigation wasn't common practice for many decades, it still isn't present in the agency culture to realize the necessity or value. There is also a long-standing culture of setting a precedence for future projects.
10. We've got some serious internal opposition, from maintenance, to wildlife barrier fencing. However, it's safe to say that our dire budget situation is a bigger impediment at this time.
11. While the answer to this question for individual projects is about lack of funding, I responded to the "everyday operations" portion of the question. The DOT environmental division sees wildlife crossings as a safety issue and therefore not

under their purview, but the safety staff are not fully aware of the problem and the fact that there are viable solutions.

12. For both of these questions, multiple answers could apply.
13. As noted earlier, decentralized Agency and many chefs and limited understanding. Lacking any regulatory requirements (typically) this is not perceived as a real need in many cases vs. an opportunity.
14. Bids for our current construction projects are coming in higher than budgeted for.
15. If it is not driven by human safety or ESA requirements, it is hard to get support from management to include 'ecological' needs when there are so many other immediate transportation needs.
16. It is the people at the highest levels of our state DOT that are resistant to funding or encouraging wildlife crossings. New Jersey is unique too in that the large ungulates we have are also a pest species (white-tailed deer) and bears are the only other concern for property damage. There are concerns about drivers swerving not to hit smaller animals and the emotional trauma resulting from that, but that hasn't been in the narrative as much.
17. Funding stand-alone wildlife crossing projects is challenging in the current political climate. Retrofitting existing infrastructure is also very challenging (numerous entrances, drainage issues, challenging tie-ins to existing culverts, etc).
18. None of the reasons listed in questions 4 and 5 have much bearing on the incorporation of wildlife mitigation into NWR projects. Two factors in NWR limit the use of the preferred mitigation measures presented in this survey (i.e., exclusion fencing, wildlife crossing structures and detection systems) those being practicality and effectiveness. 1 Practicality: In NWR wildlife occurrences are mostly random due to most of the region being Crown land in a natural state (i.e., there are few manageable corridors where animals "prefer" to cross where exclusion fencing, for example, could be implemented). In areas of higher human population densities there are increased collisions rates, but this is a function of increased traffic not necessarily concentrated wildlife crossings. That said, measures could be implemented here such as exclusion fencing; however, practical tie-ins for fencing are not easily identified and there is risk that wildlife crossing the roadway will be concentrated at fence ends. Furthermore, because most intersections are at-grade crossings in NWR, application of exclusion fencing could funnel animals into heavy traffic at or between intersections. 2 Effectiveness: There is a lack of supporting evidence that the preferred mitigation measures listed in this survey will be effective in NWR and perhaps other regions within the province, particularly the use of animal detection systems/cross walks. Mitigation measures would be better supported in NWR where proven empirical results show effectiveness and cost /benefits of these measures and they could be practically implemented.

19. The larger more encompassing barrier is that our infrastructure is improved on a conditions or needs basis-which means that wildlife mitigation implementation has to wait until an infrastructure need is identified.
20. While some stand-alone projects have been implemented to address hotspots for large wildlife-vehicle collisions (i.e. detection systems), it is not the typical model for implementation. Mitigation, in the form of modifications to existing infrastructure or new mitigation measures, is typically implemented in associated with a planned infrastructure rehabilitation project where a hotspot has been identified or legislatively mandated to implement. While there is provincial legislation for species at risk protection and recovery, there is no legislative requirement to implement mitigation measures for large wildlife movement so this is driven primarily by WVC data. Where Ontario Endangered Species Act authorizations are required for maintenance, rehabilitation and new construction of transportation infrastructure, authorization conditions may require MTO to implement site-specific mitigation measures such as crossing structures, fencing, replacement habitat for species at risk (i.e. typically small wildlife such as reptiles, birds, bats).

Transportation Agency Respondents' Recommendations

[Link to return to Respondents' Recommendation Results.](#)

Forty-seven comments were received from survey participants that provided recommendations for including wildlife mitigation in transportation.

1. Transportation agencies need dedicated funding in order to install structures and fencing for projects that are not safety related.
2. Legislation and wildlife-vehicle conflict hotspot analysis incorporated into an Action Plan.
3. Incorporate wildlife awareness in the corporate culture. Ensure new hires understand the implications of wildlife mitigation for wildlife protection and public (motorist) safety.
4. Data must be available supporting placement/replacement of structures.
5. Improvements will be dependent upon the species of concern in each state. There may be a wide variety of techniques and methods that may be applicable. Research results will be critical to DOTs in determining what might be viable solutions.
6. Considerations for wildlife crossings/mitigation needs to be integrated as early as possible in project planning.
7. Statewide wildlife corridors action plan or a Statewide wildlife-vehicle conflict plan that identifies and prioritize areas needing wildlife-vehicle collision mitigation. Support from Agency headquarters is also very important.
8. Dedicated funding for crossings incorporated into long-range plans and monitoring of structures when finished.
9. The easiest is to evaluate each bridge replacement not only for hydraulics but wildlife passage as well.
10. A collaborative approach with the government agencies that have the wildlife management/conservation mandate and the transportation ministry. Once that collaboration is established formally then both can work to identify how to collect the important and accurate data to develop a data driven decision making process.
11. Highlight Road safety. Most animals are not specifically protected but hitting a raccoon on a bridge approach is not good on many levels.
12. In Idaho, until it is mandated by the federal or state government, it will continue to be a low priority for the transportation department.
13. I'd suggest more focus be placed on instilling an environmental stewardship mindset - doing right by the environment. We can write all the policies and procedures we want but if there is no appetite for it, we stay status quo. We have to work on the culture from all angles, not just the policy angle.
14. Dedicated funding

15. Staff with the required expertise must be in place and they must be given the authority to have input into the development of long-term plans and work activities.
16. Data is needed to make sensible decisions. Likewise, unintended consequences need to be thoroughly examined before making decision. The movement or channelization of wildlife could result in introducing wildlife to areas they are either not welcomed or which may not be able to provide suitable habitat. Use of structures (culverts and fencing, for example) have to be backed up financially with maintenance funding.
17. To start with, our state needs to have the conversation to at least give the perception that we are concerned about the issue. Then we need to collect some data to determine if anything can be done.
18. First, we need the data. The need will have to rise to the top of a very long list of needs. I think we are getting very close. We then have to be crazy successful on our first attempt.
19. Complete research and implementation
20. Minimizing and mitigating impacts to wildlife should be assessed for every project, similarly to how wetlands are. Stream and wetland crossing structures should always be evaluated for their potential to be replaced with larger structures to accommodate the full suite of species expected to reside or move through the project area.
21. For a start, transportation agencies should recognize that wildlife connectivity should be a consideration in long-term planning.
22. Inclusion of mapped migration corridors, federally designated critical habitat, WVC hotspots into RTPs completed by MPOs, corridor plans done by DOTs, asset management and system planning documentation, and more. Include remediation goals into State Highway System Mgmt Plan, identify wildlife crossings as a transportation need/safety index similar to how calculations for cross-center line accidents are generated. Mandate inclusion of wildlife connectivity into project nomination forms, so project scoping teams at least have to address it. Development of standard plans for wildlife crossing project features. Bring in Maintenance, Environmental, and Highway Patrol into planning process (100% of the time). Develop wildlife crossing mitigation crediting scheme to incentivize construction.
23. Have agency buy-in (upper management) buy in that wildlife connectivity is an important consideration. Not only for wildlife, but for safety of the traveling public.
24. I cannot say that we've found the key to success, other than the perfect storm of environmental context, regulatory necessity, Support from diverse groups and pressure on the legislature which led to the design and construction of the I-90 East project. We've tried to lay the groundwork for additional projects, but few projects have moved forward. Right now, Planning Environmental Linkages is viewed as one way to get these environmental issues established early in the planning process so

they will be adequately deliberated and tested in the affected communities, potentially leading to funding for those that get the most traction. Will it work? I wish I knew.

25. There needs to be an initial top-down approach both at HQ and the Districts (when decentralized). Would also help to have the Governor establish a working group (or at least give his blessing in moving forward) to help set priorities since it really does involve two state agencies working together. Right now, it is a grass roots level action in our state agencies.
26. For our agency, incorporating wildlife crossings and other wildlife-crash mitigation measures is not done primarily because it doesn't have to be done. In addition, no division sees this as their responsibility (environmental sees it as a safety or planning issue, and vice versa). We are at the beginning of creating guidelines for wildlife crossing measures for our DOT, but at the most this will lead to small piecemeal efforts here and there. State bills that require these measures will be the solution to integrating these measures on a large scale and into the planning process.
27. It is important to establish communication and data sharing between the DOT and applicable resource agencies. Providing the DOTs with the appropriate wildlife population information is key. Training DOTs about the available methods and tools would be helpful. Sharing cost benefit analysis data and potential funding would also be helpful. Funding may be the most limiting factor.
28. Guidance that gives general recommendations to consider in transportation projects with training modules. Currently working at NYSDOT to build this into the Bridge and Culvert design manual. Currently doing annual statewide trainings to highlight the low-hanging fruit opportunities such as widening culverts when replacing culverts- typically good for current trend in larger storm events and generally good for connectivity. Consider a FHWA guidance, checklist, or requirement for project development
29. A regulatory mandate followed by funding
30. New funding needs to become available for wildlife crossing planning and projects.
31. Incorporate fully into routine business processes, not an "extra" consideration. Predictable, consistent, and transparent process for considering needs and feasibility of wildlife accommodations in project delivery
32. Early coordination with stakeholders to identify areas for possible wildlife crossing accommodations. Also, considering retrofitting existing structures instead of building new structures where possible.
33. Awareness should be prioritized throughout the transportation agencies of the importance of mitigating threats to wildlife from transportation projects and infrastructure. Funding sources should be identified and rigorously sought out to pay

for needed mitigation activities. Show the transportation agency the positive return on investments in wildlife protection measures, techniques and approaches.

34. Recognizing that wildlife crossings are a business need touching on improving public safety, increasing transportation resiliency, and maintaining habitat connectivity that may prevent the listing (state or federal) of new wildlife species.
35. Establishing Transportation Liaisons
36. Work with NGOs and Wildlife agencies to ensure long term viability
37. Early coordination with key stakeholders. DOTs should engage key division managers, leaders, and decision makers early on, including Maintenance when it comes to long-term maintenance and associated costs. A well-documented cost benefit analysis supports the long-term investment with crossing mitigation with key managers and design engineers at DOTs.
38. Include Indigenous Knowledge into the planning phases
39. Transportation agencies need to have a position dedicated to this topic. I find it hard to juggle all the biological needs of our DOT and know I could make much more progress if I could focus.
40. Environmental regulation requiring design to implement wildlife passage is likely the easiest path towards wildlife sensitive transportation programs. In Georgia, we are working to utilize WVC data to determine crossing hot spots, which may help influence design if there is a safety need.
41. More communication and coordination between wildlife biologists and transportation planners.
42. Development of Crash Reduction Factors (CRFs) that can be applied to animal vehicle collisions. These CRFs could be used to obtain Highway Safety Improvement Program funding for mitigation projects.

Valid points identified in survey:

- Developing a provincial/state prioritization of areas to improve wildlife connectivity/reduce collisions. Obtaining a pre-approval from senior administrators to address these areas during the next round of capital improvement/rehabilitation in the area.
- Liaise with the insurance industry to better capture the overall societal cost of wildlife/vehicle collisions.
- Developing standard drawings and contract language so transportation planners have the tools available at hand.
- Work with the public and private sector to fund future improvements in high profile areas (i.e. provincial/state parks).

Additional considerations from NER perspective:

- a. Conduct post-construction monitoring to ensure effectiveness

- b. Measures most effective when exclusion is incorporated (i.e. fencing)
 - c. Location of crossing is most important factor
 - d. Reducing gaps in fencing also vital
43. Identify what is practical including: regional considerations, infrastructure considerations, etc.
- Maintain provincial interagency databases. NWR Geomatics has compiled OPP collision data with MTO Maintenance road kill data into a comprehensive database and incorporated this information into a mapping tool to identify areas of high collision rates.
 - Identify what works considering: regionally specific considerations, site specific considerations, empirical evidence, cost/benefit, etc.

Consider how the mitigation measures can be easily transferable into contract language. Wherever possible use existing contract standards and provisions to incorporate mitigation measures – see comments on passage benches above for example. The only measures that will be done are those measures that are translated into standard contract language including capital contracts and maintenance contracts.

44. Bring outside agencies (provincial, research institutes, ICs) with wildlife movement data/information on board early in the life of the project. Consider a broader approach (i.e. landscape).

Require structural design reports to include information about how the structure can accommodate wildlife passage/movement. Promote interdisciplinary discussion.

45. Dedicated funding for such initiatives

More long-term planning

Build this into the scope of work for engineering assignments

Planning to allow for time to conduct the research in advance of construction

More knowledge sharing across jurisdictions

Have a clear plan for what happens after construction so when new things are built there is a long term plan for maintenance and monitoring. Who is responsible should be established as well.

Avoid areas that support wildlife habitat when planning new or expansion highway projects

Develop coordinated recording system of roadkill between maintenance contractors and Environmental/ Planning and Design Function. This way, during design, wildlife mortality can be identified ahead of time.

46. It needs to be a recognized priority politically and legislatively to ensure that funding is allocated to it, to make it a common, accepted consideration and practice.
47. A provincial wildlife strategy regarding wildlife movement considerations using a landscape-level approach to prevent/reduce wildlife-vehicle collision conflicts for both large and small wildlife would be beneficial to support a coordinated approach across all sectors in the province. This would require collaboration amongst key players including environment, natural resources, forestry and transportation

ministries, provincial police, and municipalities. Individual, sector-specific guidelines on wildlife mitigation do exist. For example, MTO has an Environmental Guide to Mitigating Road Impacts to Wildlife which outlines species considerations and design recommendations to assist MTO staff with mitigation planning, design and placement of both temporary and permanent mitigation measures along provincial roads. Our natural resources ministry also has multiple guidelines and policies for species at risk mitigation.

To complement road mortality data reporting, it would be beneficial to develop a mechanism to support/promote public reporting of wildlife crossings/sightings on roadways to identify locations with elevated wildlife-vehicle collision risk. These datasets together would be valuable in identifying hotspots with more accuracy.

Metropolitan Planning Organizations' Written Responses

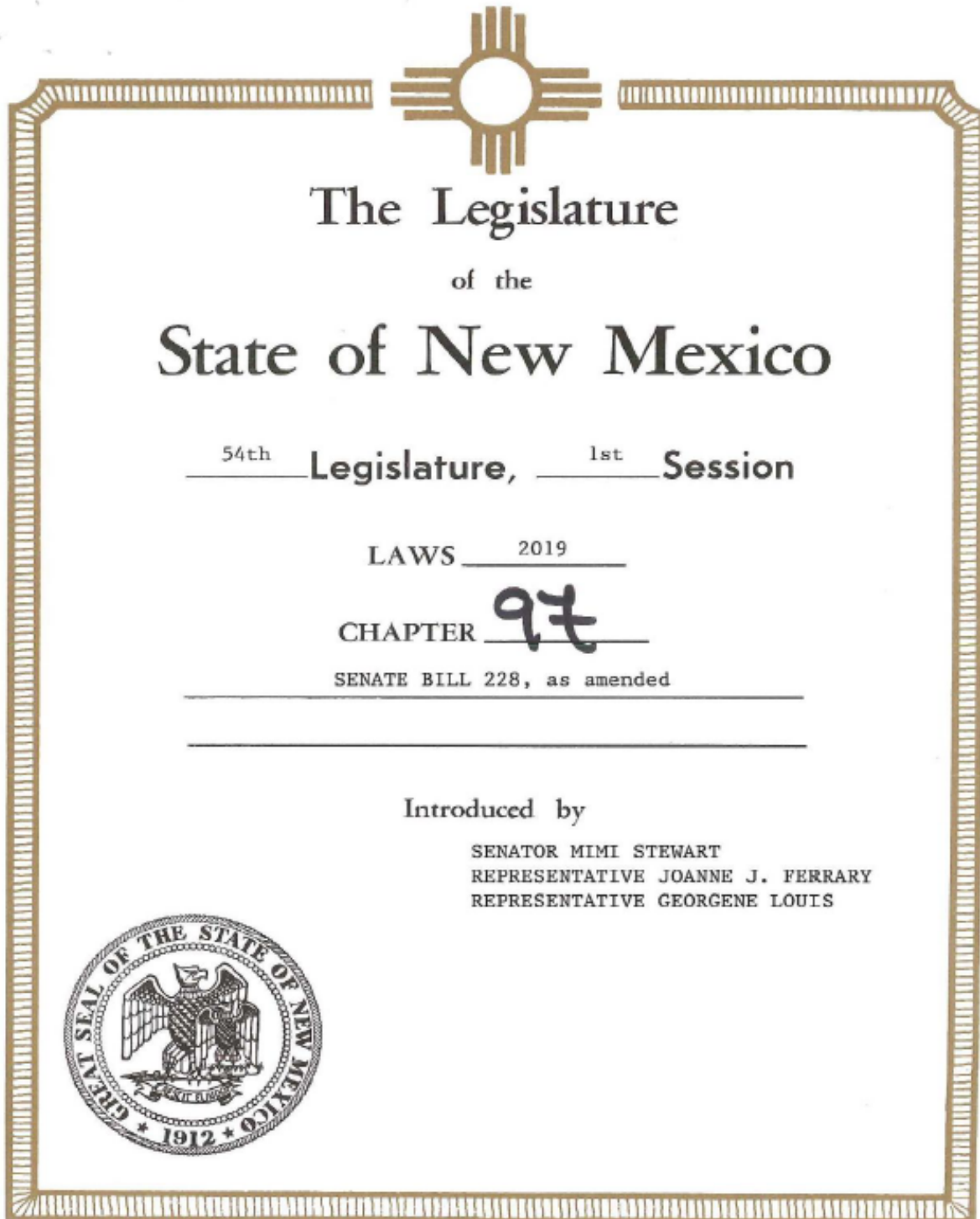
Question 8 Comments on Questions 4 and 5 – Barriers

[Return to Questions 4 and 5 results.](#)

MPO survey respondent's comments concerning barriers.

1. If mitigation is required, or dedicated funding is available, mitigation planning and project development/implementation will take place. Nothing speaks like something being the law or being paid for.
2. Our agency lacks the staff and the political climate places wildlife mitigation as a lower priority.
3. This is not a topic that comes up, in part because this area is not a hot spot for wildlife migration, other than birds. In 20 years, there has been one wildlife crossings project proposed and it did not get built for lack of funding.
4. Lack of need is a driving factor. Not aware of any serious accidents within the MPO involving game in the area.
5. Other hurdles include complexities with integrating projects into DOT plans, land-use planning issues, private landowner/agriculture conflicts, fencing concerns
6. Federal Highway would have to require or at the very least highly recommend incorporation of wildlife corridor studies and mapping into corridor planning to ensure State DOTs would incorporate the need into their planning work for regional planning agencies.
7. This is not something we've ever thought about. We have a lot of mandates to follow and we aren't likely to spontaneously add wildlife considerations to all the other things we have to consider. It isn't applicable to most or any projects on the long-range plan, and it would be up to local govs & state transportation to consider it for those projects (not the MPO level). I'm not sure where this would be relevant in our long-range planning at all.
8. I would say a lack of opportunity (because much of our planning is high-level or 20 years out) and a lack of ability to influence the DOT, which implements projects.

Appendix C. The New Mexico Wildlife Corridors Act



CHAPTER 97

AN ACT

1
2 RELATING TO WILDLIFE; ENACTING THE WILDLIFE CORRIDORS ACT;
3 IDENTIFYING AND PROTECTING WILDLIFE CORRIDORS; REQUIRING A
4 WILDLIFE CORRIDORS ACTION PLAN TO BE CREATED THAT PROVIDES
5 COMPREHENSIVE GUIDANCE TO STATE AGENCIES FOR IDENTIFYING,
6 PRIORITIZING AND MAINTAINING IMPORTANT AREAS FOR WILDLIFE
7 MOVEMENT; PROVIDING POWERS AND DUTIES; DIRECTING THE
8 DEVELOPMENT OF A LIST OF PRIORITY PROJECTS BASED ON THE
9 ACTION PLAN.

10
11 BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF NEW MEXICO:

12 SECTION 1. SHORT TITLE.--This act may be cited as the
13 "Wildlife Corridors Act".

14 SECTION 2. DEFINITIONS.--As used in the Wildlife
15 Corridors Act:

16 A. "human-caused barrier" means a road, culvert,
17 commercial or residential development or other human-made
18 structure that has the potential to affect the natural
19 movement of wildlife across the landscape;

20 B. "large mammal" includes mule deer, elk,
21 pronghorn antelope, bighorn sheep, black bear and mountain
22 lions;

23 C. "species of concern" means a wildlife species
24 identified by the department of game and fish as being
25 adversely affected by habitat fragmentation exacerbated by

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1 human-caused barriers and the high potential of
2 wildlife-vehicle collisions; and

3 D. "wildlife corridors" means those areas used
4 routinely by wildlife to travel through their habitat and
5 includes corridors used by migrating wildlife.

6 SECTION 3. WILDLIFE CORRIDORS ACTION PLAN--CREATION--
7 DEPARTMENT COORDINATION.--

8 A. The department of game and fish, in
9 coordination with the department of transportation, shall
10 create a state "wildlife corridors action plan".

11 B. The wildlife corridors action plan shall
12 contain:

13 (1) identification of existing highway
14 crossings that pose a risk to successful wildlife migration
15 or that pose a risk to the traveling public because large
16 mammals use the crossing;

17 (2) identification of other human-caused
18 barriers, especially road segments that negatively affect
19 wildlife habitat and movement;

20 (3) information about the habitat and
21 movement needs of species of concern with particular
22 attention to large mammals or other species that pose a risk
23 to the traveling public;

24 (4) projections of anticipated effects that
25 drought and other stressors will have on wildlife habitat,

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1 dispersal and movement;

2 (5) information about the habitat quality
3 needed to support and maintain viable populations of
4 wildlife;

5 (6) information about how increased movement
6 of species could benefit overused and highly impacted habitat
7 areas;

8 (7) maps that identify locations of:
9 (a) existing populations of species of
10 greatest concern;
11 (b) existing wildlife crossings; and
12 (c) areas requiring additional
13 monitoring or research;

14 (8) protocols for post-completion monitoring
15 of wildlife corridors projects in order to assess their
16 effectiveness in establishing, maintaining and promoting
17 wildlife movements;

18 (9) economic benefits anticipated from
19 preserving wildlife movement patterns, including the
20 potential impact of reduced wildlife-vehicle collisions;

21 (10) opportunities to collaborate with and
22 enter into joint powers agreements as provided in the Joint
23 Powers Agreements Act as necessary with New Mexico Indian
24 nations, tribes or pueblos; relevant agencies or Indian
25 nations, tribes or pueblos in neighboring states; and

1 relevant federal agencies to protect wildlife corridors that
2 cross state or tribal lines;

3 (11) the wildlife corridors project list;

4 and

5 (12) additional information that the
6 department of game and fish and the department of
7 transportation deem necessary and appropriate to carry out
8 the intent and purposes of the Wildlife Corridors Act.

9 C. The department of game and fish and the
10 department of transportation shall consult with and actively
11 seek the involvement of tribal governments in the development
12 of the wildlife corridors action plan.

13 D. The initial wildlife corridors action plan
14 shall be:

15 (1) open for public comment before being
16 finalized; provided that, once finalized, the department of
17 game and fish and the department of transportation shall
18 publish the initial action plan on their websites and shall
19 submit the action plan to the governor and the legislature on
20 or before January 15, 2020; and

21 (2) updated at least every ten years and may
22 be amended prior to a full update as new research and data
23 become available or changes in conditions affecting wildlife
24 and wildlife-human interactions arise.

25 E. The wildlife corridors action plan or the

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1 provisions of the Wildlife Corridors Act do not apply to
2 private property or private property owners, unless private
3 property owners choose to participate voluntarily.

4 SECTION 4. PRIORITIZED WILDLIFE CORRIDORS PROJECT
5 LIST--PUBLICATION.--

6 A. As part of the wildlife corridors action plan,
7 the department of game and fish and the department of
8 transportation shall publish a prioritized "wildlife
9 corridors project list" of projects to be undertaken.

10 B. The department of game and fish and the
11 department of transportation shall prioritize projects within
12 the wildlife corridors project list by assessing the
13 following criteria, listed in order of importance:

14 (1) the potential to reduce wildlife-vehicle
15 collision and enhance safety to the traveling public;

16 (2) the relative current population size of
17 select large mammal species and species of concern or the
18 value of proposed infrastructure that will improve wildlife
19 corridors;

20 (3) the feasibility and constructability of
21 wildlife corridors infrastructure;

22 (4) the potential costs and economics of
23 wildlife corridors infrastructure, including benefits or
24 other effects on local communities;

25 (5) local community support for proposed

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wildlife corridors infrastructure;

(6) the value of the project to native large mammals and other native species; and

(7) surrounding land-use and ownership, especially tribal lands, and an evaluation of the need for conservation easements or other real estate instrument necessary to maintain the viability of a proposed wildlife corridor.

C. On an annual basis following the issuance of the first wildlife corridors project list, the department of game and fish and the department of transportation shall issue a report to the governor and the legislature stating the progress toward completing the enumerated projects as of the current fiscal year. The report shall represent progress toward completion of a project as a percentage, with a corresponding explanation for the represented number and plans for future progress.



Nevada Department of Transportation

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