

# TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nevada Department of Transportation

## INSTRUCTIONS:

Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i> TPF-5(358)	<b>Transportation Pooled Fund Program - Report Period:</b> <input checked="" type="checkbox"/> Quarter 1 (January 1 – March 31) 2021 <input type="checkbox"/> Quarter 2 (April 1 – June 3) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 1 – December 31)	
<b>Project Title:</b> <i>The Wildlife Vehicle Collision (WVC) Reduction and Habitat Connectivity Transportation Pooled-Fund Project Strategic Integration of Wildlife Mitigation into Transportation Procedures</i>		
<b>Name of Project Manager(s):</b> Nova Simpson for Nevada DOT Patricia Cramer, PI	<b>Phone Number:</b> Nova Simpson: 775-888-7035 Patricia Cramer: 435-764-1995	<b>E-Mail</b> <a href="mailto:nsimpson@dot.nv.gov">nsimpson@dot.nv.gov</a> <a href="mailto:cramerwildlife@gmail.com">cramerwildlife@gmail.com</a>
<b>Lead Agency Project ID:</b> Nevada Dept. of Transportation	<b>Other Project ID (i.e., contract #):</b> Agreement #: P700-18-803	<b>Project Start Date:</b> 12/13/2018
<b>Original Project End Date:</b> 12/31/2021	<b>Current Project End Date:</b> 12/31/2021	<b>Number of Extensions:</b> 0

Project schedule status:

☒ On schedule
 ☐ On revised schedule
 ☐ Ahead of schedule
 ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$146,000.00	\$85,823.23	58 %

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
2.50%	2.4%	67 %

**Project Description:**

The *Wildlife Vehicle Collision (WVC) Reduction and Habitat Connectivity* pooled fund study is a collaborative research project through the Transportation Pooled Fund Program. Partners from both the United States and Canada have come together with a common interest in reducing WVC's for the safety of humans and wildlife, as well as restoring habitat connectivity in landscapes fragmented by roadways. Contributing partners currently include Alaska DOT, Arizona DOT, California DOT, Iowa DOT, Minnesota DOT, Nevada DOT, Ontario Ministry of Transportation, Oregon DOT, and Washington DOT.

This pooled fund study (PFS) will seek to identify solutions that integrate highway safety and mobility with wildlife conservation and habitat connectivity. The Project: Strategic Integration of Wildlife Mitigation into Transportation Procedures is conducted under Principal Investigator Patricia Cramer and is reported on in this progress report.

Within U.S. states and Canadian provinces, there are few standardized planning processes for considering wildlife in transportation planning, or Best Management Practices (BMP) manuals to instruct personnel at every level how to consider, plan, design, construct, and maintain transportation infrastructure that permits connectivity for wild and domestic animals that could become involved in WVC. This study investigates and makes recommendations on successful procedures that consider and create mitigation solutions to reduce WVC and provide connectivity for wildlife to assist transportation agencies in developing standards at every level.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

The Task 1 Final report chapters were revised and finalized with Advisory Panel edits, comments, and communication added.

The PI on the project reached out to various entities to begin planning the communication plan for the written material and future webinars.

**Anticipated work next quarter:**

The team will complete Task 1 by bringing together all the chapters of Task 1 into a final report that will be posted on a future website. The national census on crash costs will be completed and a formal paper will be prepared. The Task 2 manual will begin to be developed. The communication plan will be more formalized with FHWA and TRB committees for presentations on webinars, and posting to websites.

**Significant Results:**

The Task 1 final report was revised; the national census of all U.S. state DOT's crashes with animals and wildlife was completed, and crash costs were 99% completed.

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

The budget is very constrained for the tasks in this work. The team will strive to complete all deliverables within the budget and time frame set forth in the contract. The Covid-19 pandemic will continue to affect this project. All activities that entailed meeting with people in 2020 are curtailed, including the annual meeting for this pooled fund study. It may be prudent to extend the project for an additional year to accommodate opportunities to present at conferences that will be

canceled or pushed back, such as the Transportation Research Board meeting in Washington DC, the Northeastern Wildlife Conference, and possibly ICOET.

**Potential Implementation:**

The information generated from this work will be available for U.S. DOT's and Canadian MoT's for assistance in incorporating wildlife concerns into transportation processes.  
It may also be used in the development of the forthcoming U.S. Transportation Act.

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Lead Agency (FHWA or State DOT): Nevada Department of Transportation

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<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>  <b>P200-20-803</b>	<b>Transportation Pooled Fund Program - Report Period:</b> <input checked="" type="checkbox"/> Quarter 1 (January 1 – March 31) <input type="checkbox"/> Quarter 2 (April 1 – June 30) 2021 <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 1 – December 31)	
<b>Project Title:</b> <b>Permeability of large underpasses to wildlife: Effects of ledges and addition of structure for facilitating movement of small mammals and herpetofauna.</b>		
<b>Name of Project Manager(s):</b> Cheryl Brehme, Jeff Tracey, Robert Fisher <b>Budget:</b> Curtis Hettich	<b>Phone Number:</b> 858-761-8883, add, 619-206-5686	<b>E-Mail</b> <a href="mailto:cbrehme@usgs.gov">cbrehme@usgs.gov</a> , <a href="mailto:jtracey@usgs.gov">jtracey@usgs.gov</a> , <a href="mailto:rfisher@usgs.gov">rfisher@usgs.gov</a> <a href="mailto:chettich@usgs.gov">chettich@usgs.gov</a>
<b>Lead Agency Project ID:</b> GR21ZC00TPMFA00	<b>Other Project ID (i.e., contract #):</b>	<b>Project Start Date:</b> 18 May 2020
<b>Original Project End Date:</b> 31 May 2022	<b>Current Project End Date:</b> 31 May 2022	<b>Number of Extensions:</b>

Project schedule status:

☒ On schedule
 ☐ On revised schedule
 ☐ Ahead of schedule
 ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$83,127.56	\$53,875.02	Approximately 65%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
\$12,118.17 – Approx. 15%	\$12,118.17	Approximately 65%

**Project Description:**

The Department of Transportation (DOT) currently recommends that structure be added to large underpasses to increase wildlife use and movement, but there are a lack of scientific studies to show the efficacy of this mitigation for small mammals and herpetofauna or potential effects on use by larger species. The USGS has completed two years of Before-After Control-Impact field studies on 8 large upland wildlife underpasses in San Diego County. The objectives of this study are to determine; 1) if small vertebrate species are using these underpasses, 2) if ledges and the addition of structure (rock piles 5m apart along one side of structure) within underpasses facilitate small animal movement and 3) if the addition of structure (rock piles) affect the use rates of medium and large mammals. Using highly sensitive cameras over two years resulted in over 3 million images of which ~200,000 have been reviewed (less than 10% of total). Preliminary analysis indicates that responses to structure and ledges are specific to animal species and groups. This provides substantial training and test data sets to create a machine learning algorithm to classify images by the presence or absence of animals, and a possible second stage of classification to the species level. In order to process all photos, USGS will program a convolutional deep network (DN) to perform supervised species/group classification. Existing classified photos will be used to train the network to predict classes for the remaining ~2.8 million photos. Explanatory models will then be run to compare the relative permeability of underpasses to animal movement and effects of structure on animal activity. The results will inform the design of large underpasses for use by wildlife communities and target species.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

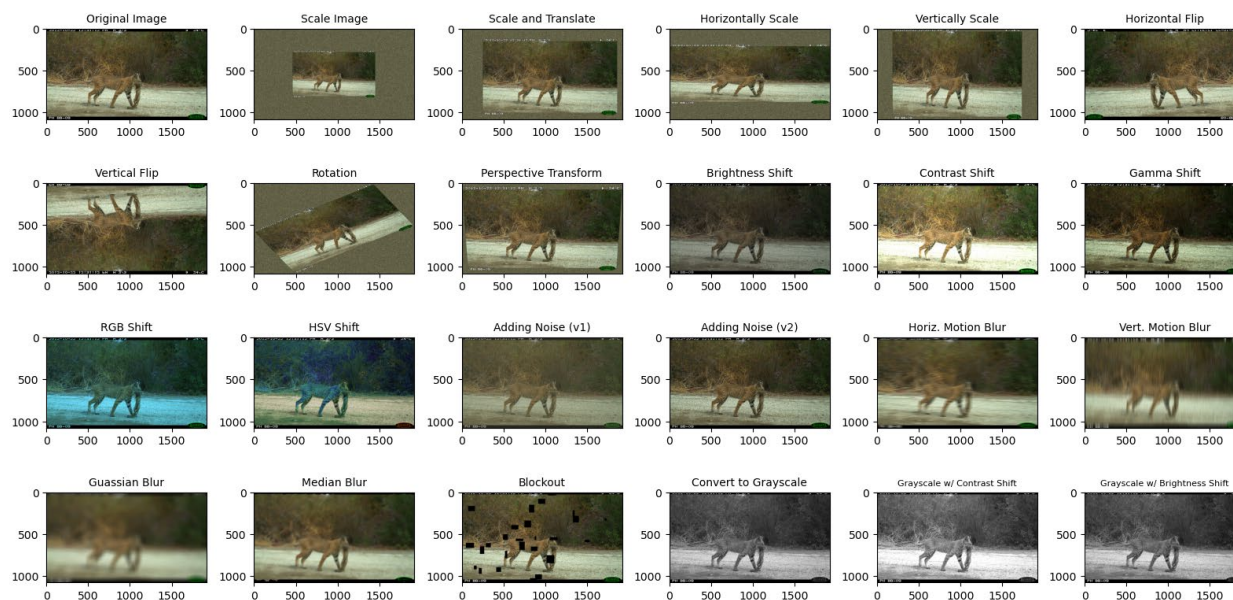
- Using the Python TensorFlow API, we constructed an image data pipeline for efficient storage and loading of the image data from disk, functions for preprocessing the image data, and a convolutional neural network (CNN; specifically, a ResNet-50 architecture) model for supervised image classification.
- We continued development and testing the current model.
- We developed python code for offline data image augmentation and other regularization techniques to improve model training and generalization (see example photos in Significant Results Section).
- We identified a source for additional images for snakes, an under-represented taxonomic group.

### Anticipated work next quarter:

- Incorporate image augmentation functions into the main program. Write functions to balance the class representation in the dataset used for training.
- Conduct final testing and optimization of the python code that implements the model training workflow.
- We will acquire 500 additional images from snakes and assign metadata for supplementary training data for this class.
- Progressively scale up the number of classes and images for training and evaluate the accuracy of the trained models on a hold out validation dataset.
- Train a supplementary model to perform a binary classification to identify images with no animals versus those with animals of any species.

### Significant Results:

These images show examples of each data augmentation technique developed to include changing image geometric transformations, color transformations, and image degradation to improve model training and generalization.



**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

Note that total percentages of time and budget completed does not directly compare to project expenses due to use of matching funds for portions of this project.

**Matching Funds:**

Note: 120 hours charged for deep learning algorithm programming

280 hours USGS matched this Quarter from USGS Advanced Research Computing

Note: Jeff Tracey has moved to USGS Advanced Research Computing and continues to work on this project

**Potential Implementation:**

TBD

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<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>  <b>P342-20-803</b>	<b>Transportation Pooled Fund Program - Report Period:</b> <input checked="" type="checkbox"/> Quarter 1 (January 1 – March 31) <input type="checkbox"/> Quarter 2 (April 1 – June 30) 2021 <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 1 – December 31)	
<b>Project Title:</b> Research to inform passage spacing for migratory amphibians and to evaluate the effectiveness of an elevated road segment to reduce road mortality and maintain connectivity between wetlands and uplands: Case study with the Yosemite toad.		
<b>Name of Project Manager(s):</b> Cheryl Brehme, Robert Fisher Budget: Curtis Hettich	<b>Phone Number:</b> 619-225-6427 619-225-6422 916-278-9479	<b>E-Mail (preferred contact method)</b> <a href="mailto:cbrehme@usgs.gov">cbrehme@usgs.gov</a> , <a href="mailto:rfisher@usgs.gov">rfisher@usgs.gov</a> <a href="mailto:chettich@usgs.gov">chettich@usgs.gov</a>
<b>Lead Agency Project ID:</b> Not yet assigned	<b>Other Project ID (i.e., contract #):</b>	<b>Project Start Date:</b> 10 Sept 2020
<b>Original Project End Date:</b> 30 June 2022	<b>Current Project End Date:</b> 30 June 2022	<b>Number of Extensions:</b>

Project schedule status:

☒ On schedule
 ☐ On revised schedule
 ☐ Ahead of schedule
 ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$120,630.42	\$33,544.23	Approximately 28%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
\$32,865.72 – Approximately 27%	\$32,865.72	Approximately 27%



**Project Description:**

Many small animals, especially amphibian populations that must migrate between aquatic and terrestrial habitats, are susceptible to negative impacts from roads within their habitat. Narrow tunnels (<1m) under roads connected with barrier fencing are a standard mitigation solution. However, there is recent evidence that tunnel mitigation systems can act to filter migratory movements of species that disperse over large areas and unintentionally cause population decline. This project supports continued field study to determine; 1) the distances that Yosemite toads will move along barrier fencing before they “give up” and move back into the habitat and 2) the efficacy of a novel road crossing prototype for toads and other small wildlife species. The prototype is an 8” high elevated road segment on a US Forest Service road that provides a safe crossing nearly 100’ wide while allowing both light and rain to pass through. Although the prototype is 100’, it can be made to any length. The project includes an assessment by transportation engineers in collaboration with Caltrans to provide insight, guidance, and concept designs for similar crossing solutions that could be implemented on improved roads and highways. The results of this study will inform the minimum distances required between passages to provide permeability for migratory toads to make population level movements across roads. It will also provide a permeability analysis and concept plans for a new passage design that may provide greater connectivity and offer an alternative to below grade tunnels for sensitive amphibians, reptiles, and small mammals.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

- Completed contract (\$15,000.00) for transportation engineering evaluation (Dokken Engineering).
- Met with transportation engineering firm and Caltrans representatives to go over goals for ERS on highways and specifics of engineering aspects of this project.
- Complete contracting (\$5,835.48) for rental of HALT-2 cameras for fenceline.
- Prepared contract with USFS to check cameras weekly during field season

**Anticipated work next quarter:**

- Prepare for field study set up and fence maintenance
  - Prepare cameras (for under ERS and turnarounds)
  - Prepare field equipment for maintenance of fencing, jumpouts, and ERS
  - Purchase equipment
- Set up field study in Sierras and do fence maintenance/replacement as needed
  - (May 10-14- as soon as most of snow melted)

**Significant Results:**

NA

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

NA

**Potential Implementation:**

NA

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<b>Transportation Pooled Fund Program Project #</b>  <i>Wildlife Vehicle Collision (WVC) Reduction and Habitat Connectivity</i> Task 1 – Cost Effective Solutions Transportation Pooled-Fund Project TPF-5(358)	<b>Transportation Pooled Fund Program - Report Period:</b> <input checked="" type="checkbox"/> Quarter 1 (January 1 – March 31) <input type="checkbox"/> Quarter 2 (April 1 – June 30) <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 1 – December 31) <div style="text-align: right; margin-top: -20px;">2021</div>	
<b>Project Title:</b> <div style="border: 1px solid black; padding: 2px; margin-top: 5px;">WVC Reduction &amp; Habitat Connectivity NVDOT</div>		
<b>Name of Project Manager(s):</b> Dr. Marcel Huijser	<b>Phone Number:</b> 406-543-2377	<b>E-Mail</b> mhuijser@montana.edu
<b>Lead Agency Project ID:</b> 4W7576	<b>Other Project ID (i.e., contract #):</b> 4W7576	<b>Project Start Date:</b> 18 Dec 2018
<b>Original Project End Date:</b> 30 Sep 2022	<b>Current Project End Date:</b> 30 Sep 2022	<b>Number of Extensions:</b> 0

Project schedule status:

☒ On schedule
 ☐ On revised schedule
 ☐ Ahead of schedule
 ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$354,001.00	\$144,488.04 (thru Feb)	43%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
\$9433.98 2.67% thru Feb)	\$9433.98 thru Feb)	38%

**Project Description:**

All research modules have been submitted, have been processed, and are active.

Topic	Title	Proposed Budget		PI	Submitted?	Approved by NV?	Active account?
C	Design of Fiber-Reinforced Polymer (FRP) Wildlife Overpass Structures	\$70,000		Rob Ament and Matt Bell	yes	yes	yes
F	Identification of the patterns and processes that result in highway accidents involving elk: Informing the design of effective mitigation strategies in areas where elk is a dominant species	\$20,000		Tony Clevenger	yes	yes	yes
G	Wildlife community and species factors affecting crossing structure use: A continental meta-analysis and a 16-year perspective	\$65,000		Tony Clevenger, Marcel Huijser	yes	yes	yes
H	Jump-out design and measures at fence ends and at access roads	\$115,000		Marcel Huijser	yes	yes	yes
I	Efficacy and cost-savings of fencing and wildlife crossings to reduce wildlife-vehicle collisions in the Bow River Valley, Alberta	\$30,000		Tony Clevenger	yes	yes	yes
X	Economic value select species based on biological conservation	\$90,181.20		Chris Neher and John Duffield (as subcontractors from Bioeconomics)	yes	yes	Yes Subcontract (WTI-Bioeconomics) is also active

The literature review section on livestock and feral horses and mules was completed.  
The literature review section on small animal species is not completed yet

**Anticipated work next quarter:**

General:

1. Finish literature review.
2. Finish the update for the costs and benefits of mitigation measures

**Significant Results:**

None yet

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

Positive:

MDT funded a project for 2 electrified barriers along Hwy 93N, contract is signed. Contracted Services Agreement with the NGO People & Carnivores is not finalized yet.

Negative:

- Covid-19 increased expenses related to transportation.

**Potential Implementation:**

None

## C TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT):     Nevada DOT    

### INSTRUCTIONS:

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<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>  TPF-5(358) Transportation Pooled Fund Study	<b>Transportation Pooled Fund Program - Report Period:</b> <input checked="" type="checkbox"/> Quarter 1 (January 1 – March 31) <input type="checkbox"/> Quarter 2 (April 1 – June 30) 2021 <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 1 – December 31)	
<b>Project Title:</b> Innovative Fiber-Reinforced Polymer Structures for Wildlife Crossings (Adaptable for Bicyclists/Pedestrians)		
<b>Name of Project Manager(s):</b> Damon Fick Rob Ament	<b>Phone Number:</b> 406-994-6123 406-600-6348	<b>E-Mail</b> damon.fick@montana.edu rament@montana.edu
<b>Lead Agency Project ID:</b>	<b>Other Project ID (i.e., contract #):</b> 4W8317	<b>Project Start Date:</b> April 27, 2020
<b>Original Project End Date:</b> October 31, 2021	<b>Current Project End Date:</b> N/A	<b>Number of Extensions:</b> N/A

Project schedule status:

☒ On schedule
 ☐ On revised schedule
 ☐ Ahead of schedule
 ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$70,001	\$43,638.56	45%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
2%	\$2,844.52	30%

**Project Description:**

There are no known FRP wildlife overpasses in North America at this time. The overall objectives of this research project are to identify cost sensitive and environmentally friendly FRP materials and use them in the design of the continent's first FRP wildlife crossing. This structure can then be adapted for use in other locations across North America and will lead to innovation for bicycle and pedestrian crossings over roads. The development and deployment of a structural prototype by this project will help provide technical information that is sorely lacking for such a promising technology.

The project is organized into four tasks: 1) identify and select FRP manufacturers and materials that will contribute to efficient and cost-effective bridge structures; 2) investigate and perform a preliminary design of up to three different wildlife overpass structures using different FRP applications and assure they can meet Caltrans' structural specifications and address wildlife's needs; 3) evaluate the implementation of the selected FRP wildlife overpass structure via cost-benefit, construction and life-cycle metrics; and, 4) disseminate the results, recommendations and conclusions of the investigation.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

Task 7. Due to the COVID pandemic, the in-person design workshop with ARC has been cancelled. Instead, ARC is developing its first virtual design co-laboratory. Originally envisioned as a 2-day in-person workshop format, the co-lab will now take 5 months via online meetings. ARC Solutions has assigned a team of experts to help Caltrans and the WTI Team develop site-specific context-sensitive design elements so that the FRP superstructure has appropriate fencing, jump-outs, and sound barriers. The co-lab will develop a FRP guidebook for wildlife crossing structures that consists of two sections. One section will cover all wildlife crossing elements and those that can be made from FRP materials, and the second will consist of design features specific to the US-97 site location. ARC and WTI hosted the first kickoff meeting to introduce all the Technical Advisory Team (TAT) to the project and goals. Our working team has started to compile the TAT opinions and develop a strategy to have smaller working groups

The WTI Team have conducted the first of three co-labs. The engineering session was conducted and potential use of FRP for structural and non-structural elements was investigated. Many ideas were identified and put into different categories. These categories are mainly divided into two groups: FRP elements that Caltrans may be willing to add to the structure to increase FRP use, and FRP elements that may be possible but require more research. These results are going to be analyzed in a cost-benefit analysis conducted by the WTI Team. That analysis will guide Caltrans' decision on if an FRP wildlife crossing is feasible and the best solution for them.

Task 8. The WTI Team is working with Caltrans and Advanced Infrastructure Technologies to align bridge designs and ensure FRP technology can be applied on California roads.

**Anticipated work next quarter:**

Task 7. Finish ARC co-labs and develop guidebook.

Task 8. Continue to develop an FRP designs using AIT designs.

Task 9. Start cost-benefit analysis.

**Significant Results:**

This quarter we have launched the virtual design laboratories for Task 7.

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

No conflicts.

**Potential Implementation:**

Yes! Caltrans is committed to building the FRP wildlife overpass and has secured funding to support the design and planning elements of this research project. The result will be an efficient continuation of the final design, resulting in Caltrans putting the US97 FRP overpass crossing out for competitive bid for its eventual construction.

# I TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nevada Department of Transportation

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<b>Transportation Pooled Fund Program Project #</b>  TPF-5(538)	<b>Transportation Pooled Fund Program - Report Period:</b>  Quarter 1 (Jan-Mar 2021)  <div style="text-align: right;">2021</div>	
<b>Project Title:</b> Efficacy and cost-savings of fencing and wildlife crossings to reduce wildlife-vehicle collisions in the Bow River Valley, Alberta		
<b>Name of Project Manager(s):</b> AP Clevenger	<b>Phone Number:</b> 4036881138	<b>E-Mail</b> apclevenger@gmail.com
<b>Lead Agency Project ID:</b>	<b>Other Project ID (i.e., contract #):</b>	<b>Project Start Date:</b> Jan 2020
<b>Original Project End Date:</b> Mar 2021	<b>Current Project End Date:</b> 30 June 2022	<b>Number of Extensions:</b> 1

## Project schedule status:

Behind schedule

## Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$30,000	\$0	25%

## Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
\$0	\$0	10%



**Project Description:**

Currently there is an array of mitigation measures to meet reduce impacts of roads on wildlife. Of paramount importance is that measures need to be effective at meeting their intended objective or management role in the project. While there is general agreement that wildlife fencing in combination with wildlife crossing structures benefits human safety as well as nature conservation goals, there is the opinion that these mitigation measures may be too costly or have little cost-benefits. To obtain a better understanding of the actual costs and benefits of road mitigation measures cost-benefit analyses recently identified threshold dollar values above which individual mitigation measures start generating benefits in excess of costs. The Bow River Valley is one of the most critical habitats for wildlife in the Canadian Rockies. Wildlife research in the area highlights the complexity and limitations of wildlife movement through the Bow Valley due to human activity and natural barriers. We use WVC data previously collected on two mitigated sections of the Trans-Canada Highway (TCH) in the province of Alberta: 1) a 5-km section in Dead Man's Flats, Alberta and 2) an 18-km section in Banff National Park. This work will determine whether highway mitigation effectively reduced the occurrence of WVC and quantify the cost-benefits of the measures in place. Our objective is to evaluate changes in the number of WVCs after each mitigation phase was completed. We will assess cost-effectiveness of the mitigation measures by using the Huijser economic model, comparing the annual cost of the mitigation infrastructure against the cost of WVCs occurring prior to and after mitigation treatment. We believe the results from our mitigation evaluation and cost-benefit model can be a valuable decision support tool for determining mitigation measures to reduce WVCs and demonstrate the utility and cost-effectiveness of highway mitigation in protected and non-protected landscapes.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

- Little progress on this project given the effort in finishing the elk-vehicle collision project.
- We requested an extension to this project. Now end date is 30 June 2022.

**Anticipated work next quarter:**

- Continue with data analysis.
- Continue review and edits of drafted text for report.

**Significant Results:**

None to date

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

This project is in line after the elk-vehicle collision project, so once that is completed we will have more time to work on this project.

**Potential Implementation:**

None to date

## F TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nevada Department of Transportation

### INSTRUCTIONS:

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b>  TPF-5(538)	<b>Transportation Pooled Fund Program - Report Period:</b>  Quarter 1 (January 1 to March 31) 2021 <div style="text-align: right;">2021</div>	
<b>Project Title:</b> Identification of the Patterns and Processes that Result in Highway Accidents Involving Elk: Informing the Design of Effective Mitigation Strategies in Areas Where Elk is a Dominant Species		
<b>Name of Project Manager(s):</b> AP Clevenger	<b>Phone Number:</b> 4036881138	<b>E-Mail</b> apclevenger@gmail.com
<b>Lead Agency Project ID:</b>	<b>Other Project ID (i.e., contract #):</b>	<b>Project Start Date:</b> Jan 2020
<b>Original Project End Date:</b> Dec 2020	<b>Current Project End Date:</b> 30 June 2021	<b>Number of Extensions:</b> 1

### Project schedule status:

In process of final review and edits of report

### Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$20,000	\$18,200.70 (Thru Feb)	95%

### Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
\$0	\$0	95%

**Project Description:**

Road networks are extensive in many western North American landscapes and vehicle use has sharply increased with population growth and development in rural and suburban areas. Roads alter important habitat components, such as forage, water, and cover for large herbivores, and often intersect migration and daily movements. In addition, landscapes inundated with roads may cause shifts in ungulate distribution and reduce carrying capacity. By far, the greatest and most direct effect of roads on ungulate populations comes from collisions with motor vehicles. Currently ungulate-vehicle collisions are a significant problem worldwide particularly in rural or suburban areas where they are a major safety problem for motorists. This project will describe the patterns and processes that result in highway accidents involving elk in order to provide transportation planners with the design of effective mitigation strategies in areas where elk is a dominant species. We use selected primary and secondary road segments within Banff, Yoho and Kootenay National Parks and within the adjacent Alberta provincial lands. Records of elk vehicle collisions (EVCs) were collected year-round by Parks Canada in the three national parks and Alberta Environment and Parks from 1986-2000. We tested for independence of the following: 1) sex and age (adult, subadult) classes in EVCs; 2) Demography and condition of elk killed on highways, railways and by predators; 3) differences in sex, age and condition of elk killed on highways, railways and by predators; 4) possible seasonal effects on EVC frequencies; 5) determine the relative risk of EVC occurrence on each highway we calculated the EVC rate per km per year; and 6) how traffic volumes and elk abundance influence EVC rates. We propose to identify and describe the patterns and processes that result in highway accidents involving elk in order to provide transportation planners with the design of effective mitigation strategies in areas where elk is a dominant species.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

- The project End Date was extended to 30 June 2021.
- We have completed a draft and are near final report completed.

**Anticipated work next quarter:**

- Project ends this 2<sup>nd</sup> quarter (30 June 2021), final editing and report formatting will take place in this quarter.

**Significant Results:**

- We found that more females are involved in collisions, but when compared to the age and sex classes of the elk population, males and subadults are more prone to elk-vehicle collisions and this occurs more commonly in the fall season.
- The condition of elk as measured from percent fat marrow content was greater for road- and rail-killed elk than predator killed elk indicating that all elk are susceptible to vehicle collisions.
- The magnitude of elk collisions was strongly correlated to traffic volumes, however elk abundance was the primary driver influencing occurrence of collisions over time.
- Our information is informative to design mitigation measures targeting the most vulnerable demographics of a population, i.e. subadults and male elk in the fall.
- Declining wildlife-vehicle collision rates with increasing traffic volumes is a good indicator that a population is declining, especially when 'road avoidance' of the species is known and can support implementation of wildlife mitigation measures before a population crash occurs.
- These results should be meaningful to road and natural resource managers because in many cases, traffic volumes and road-kill data sets are logistically easier to collect and compile as compared with abundance measures.
- Analyses such as ours can help inform the design of strategies by designing strategies for the most vulnerable members of a population, as well as informing placement of measures for recovery efforts.

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

Project has not had significant delays this quarter.

**Potential Implementation:**

We are in process of developing the management implications and implementation components of project. These will be included in the finalized report in June 2021.

# X TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nevada Department of Transportation

## INSTRUCTIONS:

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

<b>Transportation Pooled Fund Program Project #</b> <i>(i.e., SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX))</i>		<b>Transportation Pooled Fund Program - Report Period:</b> <input checked="" type="checkbox"/> Quarter 1 (January 1 – March 31) <input type="checkbox"/> Quarter 2 (April 1 – June 30) 2021 <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 1 – December 31)	
<b>Project Title:</b> <b>Pilot Study: Incorporating Large Ungulate and Small Reptile Total Value in Collision Mitigation Benefit-Cost Calculations</b>			
<b>Name of Project Manager(s):</b> John Duffield	<b>Phone Number:</b> 406-721-2265	<b>E-Mail</b> bioecon@montana.com	
<b>Lead Agency Project ID:</b> P701-18-803 TASK 05	<b>Other Project ID (i.e., contract #):</b> G105-21-W8409	<b>Project Start Date:</b> 06/01/2020	
<b>Original Project End Date:</b> 12/31/2020	<b>Current Project End Date:</b> 12/31/2021	<b>Number of Extensions:</b> 1	

Project schedule status:

☐ On schedule     
 ☒ On revised schedule     
 ☐ Ahead of schedule     
 ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
69,974.00	\$9,891 invoiced through 1/31/21	33%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
\$9,891 invoiced through 1/31/21 (14%)	\$9,891 invoiced through 1/31/21	33%



**Project Description:**

Funding decisions on specific wildlife collision mitigation measures are based largely on cost-benefit analysis and answering the question; do the benefits to humans and wildlife outweigh the direct fiscal costs of the mitigation measures? To date, one potentially significant component of the benefits of wildlife mortality and injury avoidance has been largely ignored in these calculations--passive use values to humans associated with species protection. This project will develop total value estimates for deer and turtles in Minnesota in a collision mitigation context. Total values include not only direct use such as hunting and viewing but also passive use values (biological conservation values).

The study will utilize an industry-standard repeat contact random household mail survey of Minnesota households to elicit preferences and valuations for avoiding deer and turtle collisions through use of collision mitigation structures incorporated into road design.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

In the current quarter, work has pushed ahead, within the constraints of Covid restrictions. Several rounds of key informant review of the draft survey instrument were undertaken. The input from these reviewers were combined with information from cognitive interviews to finalize the draft mail survey instrument.

A sample of mail addresses for 2500 residents of Minnesota was purchased, and the mailings for a pre-test of the survey using 200 of those contacts is currently underway. This pretest will provide information on the appropriate structure of the valuation questions in the survey, as well as identify other possible issues.

**Anticipated work next quarter:**

Following review of the returned surveys from the pretest, the survey will be finalized and the full mailing of the remaining 2,300 surveys will commence.

**Significant Results:**

ongoing

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

While Covid restrictions continue to constrain some aspects of the research, the researchers have in large part Worked with these restrictions, and the project is now at a point less dependent on activities under covid constraintys.

**Potential Implementation:**

Ongoing

## H TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nevada Department of Transportation \_\_\_\_\_

### INSTRUCTIONS:

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<b>Transportation Pooled Fund Program Project #</b>  <i>Wildlife Vehicle Collision (WVC) Reduction and Habitat Connectivity</i> Task 1 – Cost Effective Solutions Transportation Pooled-Fund Project TPF-5(358)	<b>Transportation Pooled Fund Program - Report Period:</b> <input checked="" type="checkbox"/> Quarter 1 (January 1 – March 31) <input type="checkbox"/> Quarter 2 (April 1 – June 30) 2021 <input type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 1 – December 31)	
<b>Project Title:</b> Jump-out design and measures at fence ends and at access roads		
<b>Name of Project Manager(s):</b> Dr. Marcel Huijser	<b>Phone Number:</b> 406-543-2377	<b>E-Mail</b> mhuijser@montana.edu
<b>Lead Agency Project ID:</b>	<b>Other Project ID (i.e., contract #):</b>	<b>Project Start Date:</b>
<b>Original Project End Date:</b> 30 Nov 2022	<b>Current Project End Date:</b> 30 Nov 2022	<b>Number of Extensions:</b> 0

Project schedule status:

☒ On schedule
 ☐ On revised schedule
 ☐ Ahead of schedule
 ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
115,000	58,228.36 (thru Feb)	33%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
\$6,959.34 (6.05%) (thru Feb)	\$6,959.34	43%

**Project Description:**

- A. Investigate measures aimed at reducing intrusions of large wild mammals, especially carnivores, at gaps in wildlife fences through a literature review and field experiments.
- B. Investigate measures aimed at increasing the use of wildlife jump-outs by deer species (white-tailed deer and mule deer) through a literature review and field experiments.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

A1 Literature review  
Not Started yet

B1 Literature review  
Not Started yet

**Field experiments**

A2a. Electrified cattle guards at access roads, Parks Canada.

Sunshine and Compound road:

1. The WTI cameras have been installed at Sunshine and Compound road (12 Aug 2020).
2. The cameras were not installed in front of guards, but behind, looking to the area in front.
3. Animals entering the zone 2 m before the electrified area will trigger the cameras.
4. From 2 Sep onwards the cameras have restricted hours because traffic volume was too high to allow 24/7 operation, so now it is 17:00-8:00 (daylight saving time) for both locations.
5. Camera settings 5 images per trigger, no quiet time (rapidfire), high sensitivity
6. 8 Oct 2020: steel plates were installed in front of electrified barriers (completes installation).
7. The 2 ft grounding plate for Compound Road was damaged and was removed on or before 20 Oct. Re-installation will likely be in spring. The Sunshine grounding plate will also be deferred. They both need metal strips installed to protect them from snow plows. These strips have not yet arrived, and so the grounding plates were unprotected when there was the 1<sup>st</sup> major snow fall (October 14) when it got damaged. So, even though, the wildlife guards are turned on they will not work as well without the grounding plate, nor were they intended to be nearly as effective during the winter (i.e. snow covered). Ground plates and strips will be installed in the spring.
8. Guards filled up with snow in February, not functional, as expected. From Dan Rafla: the accumulation of snow, salt, gravel, etc. between the negative and positive charge cause it to short, or the guard can be completely covered. There has also been connection break, but it has since been repaired.



Lake O'Hara

Images reviewed 1-6 Oct : No animals

Lake Louise

Camera post not installed yet, will be spring 2021

A2b. Electrified mats at fence ends, Thompson Falls.

Camera at west fence end was installed 30 Sep 2020

Coyote approached, did not cross



Camera at east fence end required a new post in the clear zone.

Camera at east fence end required a new post in the clear zone.

A right-of-way encroachment permit was obtained from MDT on 8 Oct 2020.

Post and camera were installed on 27 Oct 2020.

2 wt-deer left the fenced road section, walking/running over guard.

1 of them appeared to have been shocked, the other not.

Multiple elk and w-t deer walked in and out of the fenced road corridor early February, apparently without being shocked. MDT and the manufacturer were alerted again.

The manufacturer is now sending Marcel a voltage meter to check voltage (should arrive mid-April).

However, it seems that MDT may have put the guards at 50% power since installation, against the recommendation of the manufacturer (recommendation is 100%).



A2d. Different types of gates at gaps in electric wildlife fence, Dixon Melon Farm.

The images have been interpreted and the data have been entered in a database (through Nov 2020).  
Summary statistics and graphs have been made.

B2. Modifications to 10 Jump-outs, US93N Montana.



- Candidate jump-outs have been identified along US93N. 4 are known to receive relatively high use by mule deer, 6 are known to receive relatively high use by white-tailed deer.

The current height of the ten jump-outs selected for this project. EV=Evaro, HH= Ravalli Hill.

Area	#	Height	
		ft	cm
EV	14	6' 8.5"	204
EV	17	6' 0"	183
EV	19	6' 8"	203
EV	20	6' 0"	183
EV	21	6' 1.5"	187
EV	23	5' 6"	168
RH	26	5' 11"	180
RH	27	6' 0"	183
RH	28	5' 9"	175
RH	29	5' 11"	180

- Permission has been obtained for the modifications (from MDT) and research (from CSKT).
- MDT will assist with equipment in lowering (after agreement between MDT and WTI-MSU) is signed.
- MDT – WTI agreement was signed in Dec 2020.
- MDT – CSKT agreement was signed early January 2021.
- Permission was obtained from MDT to lower the jump-outs to 5 ft with 18 inch bar on 31 Mar 2021.
- Locate for buried lines was completed on Sat 10 Apr.

#### Anticipated work next quarter:

General:

3. Install camera Lake Louise
4. Modify / repair guards Compound and Sunshine.
5. Modify jump-outs (scheduled for 19 and 21 Apr)
6. Install cameras at Jump-outs
7. Further analyze data Dixon Melon Farm

#### Significant Results:

The low-cost electrified barriers at the Dixon melon farm seem promising as (after modifications) they seem to be a very substantial barrier to black bears.

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

**Positive:**

Funding from MDT for 2 electrified barriers and permission to lower selected jump-outs along Hwy 93N has been obtained. This will supplement the effort of the pooled fund study related to electrified barriers and jump-outs.

**Negative:**

- Covid-19 increased expenses related to transportation.
- The electrified guards in Canada need protection from snow plows. The protective equipment was not available early enough before winter started. Hopefully the protective equipment will be installed in spring.
- The passage of deer and elk at east side of Thompson Falls is very concerning. I am hoping that it is because the voltage was set too low (lower than manufacturer recommended).

**Potential Implementation:**

The low-cost electrified barriers at the Dixon melon farm seem promising as (after modifications) they seem to be a very substantial barrier to black bears. Two sites along a real highway are now considered for implementation of these types of barriers (see above).

It is important to follow the recommendations of the manufacturer (and not deviate by setting lower voltage, as seems to be the case at Thompson Falls).

## G TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nevada Department of Transportation

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<b>Transportation Pooled Fund Program Project #</b>  TPF-5(538)	<b>Transportation Pooled Fund Program - Report Period:</b>  Quarter 1 (Jan-Mar) 2021  <div style="text-align: right;">2021</div>	
<b>Project Title:</b> Long-term Responses of an Ecological Community to Highway Mitigation Measures		
<b>Name of Project Manager(s):</b> AP Clevenger	<b>Phone Number:</b> 4036881138	<b>E-Mail</b> apclevenger@gmail.com
<b>Lead Agency Project ID:</b>	<b>Other Project ID (i.e., contract #):</b>	<b>Project Start Date:</b> July 2020
<b>Original Project End Date:</b> Mar 2021	<b>Current Project End Date:</b> 30 June 2022	<b>Number of Extensions:</b> 1

### Project schedule status:

Behind schedule

### Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
\$65,000	\$0	10%

### Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
\$0	\$0	10%

**Project Description:**

Crossing structures (CS) in Banff National Park and along US Hwy 93 North in Montana, have been monitored for many years, starting as early as 1996, forming the richest database on CS monitoring in the world. These data provide a unique opportunity to assess long-term changes in CS use by a large mammal community. Such a long-term and data-rich perspective is important to understand how slow-reproducing species interact with CS over time. These datasets come from areas with an intact community of large mammals ranging from rare carnivores like wolverine to more common ungulates like white-tailed deer. It is also characterized by mixed landscapes with agriculture and dispersed houses and roads with high traffic volumes. This combination of a relatively intact wildlife community in an area with substantive variation in human disturbance (Banff relatively low human presence and disturbance; Montana relatively high human presence and disturbance) creates a unique 'reference' condition to understand how highways and large mammals interact. Developing a statistical model to describe the relationship between population size and passage rates at CS has a number of important benefits to management. First, structural attributes of CS that contribute to a greater-than-expected passage rate by wildlife enable planners to more rigorously design species-specific mitigation measures. Second, if a strong association between population size and passage rate at particular sites can be found, then management can use monitoring of these limited areas to infer population trends in the broader study area. Third, detection rates of animals using CS are relatively high given the constricted nature of the passage, so monitoring CS use may be a more economical means of population monitoring than other index-type measures. Thus, the various crossing structures along the TCH can serve as a multi-species "super-transect" if appropriate population size and passage rate associations can be demonstrated. Specifically we are interested in understanding the following questions and will use data sets shown in bold to address each one: 1) What is the effect of different covariates on species use over time? Banff & Montana; 2) What are the effects of design and function of CS on community level metrics? Banff & Montana; 3) Can CS monitoring (counts) be used as an indicator of population abundance? Banff.

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

- We requested an extension for this project. End date is now 30 June 2022.
- No work done this quarter as this is the 3<sup>rd</sup> project in our series of 3 PFS projects.
- We will focus on this sporadically and once BACI (2<sup>nd</sup> project) is completed we will give full attn. to this work.

**Anticipated work next quarter:**

- Continue with some data analysis and report writing.

**Significant Results:**

None to date.

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that**

might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

None.

**Potential Implementation:**

None to date