

## 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 type="checkbox"/> Quarter 1 (January 1 – March 31) 2021 <input type="checkbox"/> Quarter 2 (April 1 – June 30) <input checked="" 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	\$94,543.23	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
\$1,920 = 1.3%	\$1,920.00	91 %

### 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 was completed and posted to the Pooled Fund Website:  
<https://pooledfund.org/Details/Study/610>

A paper summarizing the results of Task 1 was written and submitted to the Transportation Research Board (TRB) for presentation at the 2022 TRB Annual Meeting. It was accepted. Daniel Smith, co-chair of the TRB Committee AEP70, Environmental Analysis and Ecology, accepted the presentation as one of the talks the committee will sponsor.

**Anticipated work next quarter:**

The national census on crash costs will be completed and a formal paper will be prepared.

The PI will meet with the Pooled Fund Partners in November.

The Task 2 manual will be developed with team members. The communication plan will include proposals to TRB for webinars in 2022.

**Significant Results:**

The Task 1 final report 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 PI on the project, Dr. Cramer had to take family leave for 6 weeks this quarter. 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.



**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.):**

## Meetings (Internal USGS):

- Meetings to discuss project, strategies and results (July 29, Aug 18, Sept. 2, Sept. 23, 2021)

## Programming and Testing:

- Developed code for evaluating the performance of the DNNs and predicting classes on unclassified images. We have further refined the code for managing directories and files to support data flow between various steps in the workflow.
- Incorporated additional snake images previously gathered into the training image dataset.
- Began training and evaluating the CNNs according to the strategy we developed. This includes training CNNs on various combinations of taxonomic groups and evaluating their performance, including a model that predicted 20 taxonomic groups.

**Anticipated work next quarter:**

- Add additional training images from other camera trap studies for under-represented taxa.
- Continue to refine the workflows for image labeling, preprocessing, augmentation, conversion to TFRecord files, model training, and model evaluation.
- Develop a system for hyperparameter optimization (which may rely on tools such as Keras Tuner, Cray HPO, etc.) and begin to apply it to improving the performance of CNNs.
- Conceptual development of “collaborative intelligence” approach.

**Significant Results:**

Following initial model runs we have attained an accuracy of 88.46% on the validation dataset. While this is promising, we want higher accuracy of class predictions before using the predictions in further statistical analyses of the camera trap dataset.

**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).**

Challenges We Encountered:

1. Developing workflow is a significant challenge that we did not anticipate. This is a result of having a multi-step, interconnected workflows and very large datasets.
2. The first tests of the convolutional neural nets (CNNs) produced good results on the validation dataset, but less than desirable results on the testing dataset. In both case, predictions need to improved prior to using them in a statistical analysis.
3. There are some cases for which CNN algorithms will always make poor predictions. For example, animals in poor lighting, images with only small parts of animals, very underrepresented taxa, etc.

Steps to Address Challenges We Encountered:

1. Addressing this challenge basically requires iterating through the workflow many times, identifying and addressing new problems encountered, and refactoring code.
2. Addressing the challenge of improving performance of the CNNs depends, first, on addressing the workflow issues and second, on repeated experimentation to optimize CNN hyperparameters and numbers of augmented images that need to be added to the training dataset. We may also have to gather and label additional images for other underrepresented classes (i.e. taxonomic groups).
3. Explore a “collaborative intelligence” approach that leverages the efficiency of the CNNs for predicting species in images, but a subsystem that flags images for which the CNN predictions are likely to be poor so a human observer can verify the labels. Whether or not this step is necessary depends on how well we are able to address the challenge of improving predictive performance of the CNNs.

We request a 3-6 no-cost extension of the project timeline to address these challenges. (Original request rescinded- plan for meeting deadline)

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

**Matching Funds:**

- 140 hours USGS matched this Quarter from USGS Advanced Research Computing for deep learning algorithm programming and running of machine learning algorithms.
- Note: Jeff Tracey has moved to USGS Advanced Research Computing and continues to work on this project

**Potential Implementation:**



**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.):**

- Transportation engineering evaluation (Dokken Engineering).
  - Met with Dokken engineering on 2 occasions for continued discussions of project and design criteria for elevated road.
  - Meeting with Caltrans, Dokken, and USGS on design concept ideas (April 14 not reported on last update)
- Continued camera monitoring
  - US Forest Service field crew checking cameras and uploading data weekly
  - Monthly transfer of data to USGS database

**Anticipated work next quarter:**

- Continue checking of cameras on weekly basis (USFS contract: through Sept/Oct)
- Transferring photos in project database
- Continued meetings with Dokken on concept designs for primary roads and highways

**Significant Results:**

Low activity reported of herpetofauna in general at site. Most photos have not yet been analyzed, will have results to report on toads, frogs, and other herpetofauna after field portion of study is complete.

**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).**

Summer rainfall is important for toad movement for this project so drought will affect numbers of Yosemite toads. However, we will accumulate data for a wide number of species.

**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 type="checkbox"/> Quarter 1 (January 1 – March 31) 2021 <input type="checkbox"/> Quarter 2 (April 1 – June 30) <input checked="" type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 1 – December 31)	
<b>Project Title:</b> WVC Reduction & Habitat Connectivity NVDOT		
<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 701-18-803 TO 1	<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	\$165,647.65 (thru Sep)	46%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
\$16330.82 4.61 (% thru Sep)	\$16330.82 (thru Sep)	42%

**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

**Literature review**

A new version of the literature review was completed and submitted for review on 1 Oct 2021. Comments are due 31 Oct 2021.

**Anticipated work next quarter:**

General:

1. Implement comments on literature review after they come in.
2. Finish the update for the costs and benefits of mitigation measures

**Significant Results:**

None

**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 2 installers are active.

Negative:

Covid-19 increased expenses related to transportation.

**Potential Implementation:**

None



## **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 6. The WTI Team presented the progress on implementing the first wildlife overpass in North America at the International Conference of Ecology and Transportation (ICOET) 2021 in September. This included the process of selecting the design site in Siskiyou County, California, from all the proposed sites, visiting US-97, selecting the specific location, and the experience and challenges of working with Caltrans on this project so far.

Task 7. The WTI Team in collaboration with ARC Solutions has wrapped up the virtual design co-laboratory sessions. The results will be summarized in this project's second task report (Task 9). The task report is scheduled for completion in the first week of November. ARC Solutions and the WTI Team will also complete a guidebook based on the co-laboratory, with recommendations on design features for FRP crossing structures, in general, and some that will be specific to the US 97 site. The guidebook will be completed by the end of October. The co-laboratory sessions identified which FRP applications are applicable to current infrastructure and which ones will require more design and safety research. The results and process of the design lab were presented by ARC Solutions at the virtual ICOET conference in September 2021.

Task 8. The WTI Team has been working with Caltrans and Advanced Infrastructure Technologies (AIT), the FRP manufacturer selected by Caltrans for US97, to align bridge designs and ensure FRP technology can be applied at this project's site as well as on other California roads. We are currently finalizing the loads (dead and live) so the geometric dimensions of the FRP girders can be estimated for Caltrans. Furthermore, the Caltrans engineers are exploring writing specific requirements for the construction and use of the US97 wildlife crossing. This means that by using new techniques, like FRP decks rather than concrete, we can reduce the size of the girders and increase the spacing between them. This will make the overpass more efficient to construct and reduce the amount and size of the FRP materials required to manufacture for the crossing. Combined, these improvements will reduce the costs of construction due to lighter materials and streamlined construction methods. WTI will be reporting three different structural designs of the FRP superstructure based on the different load limits.

Task 10. The results from Task 7 are being used to inform the cost/benefit analysis. Originally, we were trying to complete the analysis ahead of schedule for a Caltrans decision-making meeting, but it was no longer needed because they are not deciding about the materials selected (FRP) for the crossing until later. Therefore, the expected completion date for the cost/benefit analysis is back on schedule and should be completed by December.

## **Anticipated work next quarter:**

Task 9. Submit report for Tasks 6-8.

Task 10. Finish the cost/benefit analysis for the US-97 site location and submit to Caltrans to help with their decision-making process

Task 11. Begin drafting final report.

## **Significant Results:**

- Collaboration with Caltrans and AIT is leading to FRP bridge designs to ensure the process and materials used will be accepted by Caltrans decision-makers. This will assure that the construction of the FRP overpass, as designed by this research project, can be pursued by Caltrans upon completion of the project.
- Presentation at International Conference on Ecology and Transportation 2021

**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. Thus, instead of a theoretical design, the WTI Team is working more closely with Caltrans staff and the manufacturer of the FRP structure to assure the FRP design will meet state standards and other requirements. The result will be an efficient continuation of the final design, resulting in Caltrans putting the US97 FRP overpass crossing out for a competitive bid for its eventual construction.

# I 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> TPF-5(538)	<b>Transportation Pooled Fund Program - Report Period:</b> Quarter 3 (Jul-Sep 2021)	
<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> 701-18-803 TO 3	<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	30%

**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	15%

**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.):**

- We have completed the analysis.
- Report is in preparation: completed Intro, Methods, Results.

**Anticipated work next quarter:**

- Report is in preparation: completed Intro, Methods, Results.
- Finish drafting the Results and Discussion.

**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).**

No issues affecting his project at the moment.

**Potential Implementation:**

None to date

## F TRANSPORTATION POOLED FUND PROGRAM QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nevada DOT

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<b>Transportation Pooled Fund Program Project #</b> TPF-5(538)		<b>Transportation Pooled Fund Program - Report Period:</b> Quarter 3 (Jul 1 to Sep 30) 2021	
<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> 701-18-803 TO 4	<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	\$19,933.35 (Thru Sep)	100%

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	100%

**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 our final report and the report has been reviewed and accepted by Pooled Fund committee.

**Anticipated work next quarter:**

- None. Project Completed.

**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:**

The management implications and implementation components of project are included in the finalized report.

## 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 type="checkbox"/> Quarter 1 (January 1 – March 31) <input type="checkbox"/> Quarter 2 (April 1 – June 30) <span style="float: right;">2021</span> <input checked="" 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	\$64,282.70 invoiced through 9/30/21	91%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
\$23,781 invoiced through 9/30/21 (34%)	\$23,781 invoiced through 9/30/21	90%

**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 this 3<sup>rd</sup> quarter, the survey data that was collected in the 2<sup>nd</sup> quarter was analyzed. Also, the draft analysis report was produced, and was reviewed by cooperators. The comments of cooperators were incorporated in the report and a final report was submitted.

**Anticipated work next quarter:**

It is anticipated that Q4 will involve project wrap-up including press release (requested by MN), preparation and delivery of a Powerpoint presentation on the project and its findings and archiving all work products.

**Significant Results:**

**A final report outlining the study results has been submitted.**

**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:**

N/A

## H 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>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 type="checkbox"/> Quarter 1 (January 1 – March 31) <input type="checkbox"/> Quarter 2 (April 1 – June 30) <input checked="" type="checkbox"/> Quarter 3 (July 1 – September 30) <input type="checkbox"/> Quarter 4 (October 1 – December 31) <span style="float: right;">2021</span>	
<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> 701-18-803 TO 6	<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	\$91,601.73 (thru Sep)	79.65%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
\$24,101.97 (thru Sep) 20.96%	\$24,101.97	80%

**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.
9. 14 Jul 21: Grounding plates have still not been installed because of lack of funding (Pers. com. Dan Rafla).
10. 14 Jul 21: During the winter, the wiring was not able to withstand the vibrations from vehicles and gravel/salt that fell between the pipes. Wires have since been repaired with the wiring redone to more robust standard (Pers. com. Dan Rafla).
11. 14 Jul 21: Hours of operation for cameras, which were from 5pm to 8am, have been extended from 4pm to 10am. In addition, a 2<sup>nd</sup> camera was added at Sunshine, facing 90 degrees to the road, and two meters away from the wildlife guard (Pers. com. Dan Rafla).
12. 14 Jul 21: No known intrusions except for a black bear from last fall (Pers. com. Dan Rafla).
13. End Sep 2021: Grounding plates were installed on both locations (Pers. com. Dan Rafla). This completes the



#### Lake O'Hara

Images reviewed 1-6 Oct : No animals

Guard turned on again on April 17, 2021

15 July 21: guard is operational.

#### Lake Louise

Camera post not installed yet, will be spring 2021

15 July 21: Parks Canada is still working on getting the Lake Louise camera installed, hopefully soon (Pers. com. Jón Stuart-Smith).

15 July 21: guard is operational.

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%).

In June 2021 it was confirmed that the voltage is set too low on the electric mats (between 4.2-4.8kV). This was reported to MDT, and MDT has stated that they intend to increase the power to the settings recommended by the manufacturer.

WTI observed on 28 Aug 2021 that the voltage was increased to 9.6-10kV (this is what it should have been all along). So far, MDT has not been able to report what date the voltage was increased.



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.
- An abstract was submitted to the 2021 ICOET conference, and it was accepted for a podium presentation (virtual conference).
- A presentation was given at the 2021 ICOET conference
- Crosstek installed a drive-over electrified barrier 4-6 Aug 2021. This replaced the “drive-over wires” barrier. So far 3 bears approached, none crossed.



- So far, far fewer bears have been observed at the gates and at the fence in 2021 than in 2020. It seems that the barriers have been so effective (since end season 2020) that the bears no longer show up... I think the bears think it is a waste of time.
- Farmer reports no or negligible melon loss due to bears in 2021.

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 for the 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.
- All 10 jump-outs have been lowered to exactly 5 ft (4 in Ravalli on 21 Apr 2021; 6 in Evaro on 4 May 2021). Soil was scraped from the top and deposited at the bottom to achieve a height of 5 ft. The landing area was made level, about 6 ft from the face of the jump-outs. MDT assisted with personnel, a bobcat and a backhoe.



- All 10 jump-outs were equipped with an 18-inch barrier above the ground (rebar) on 18 May 2021.



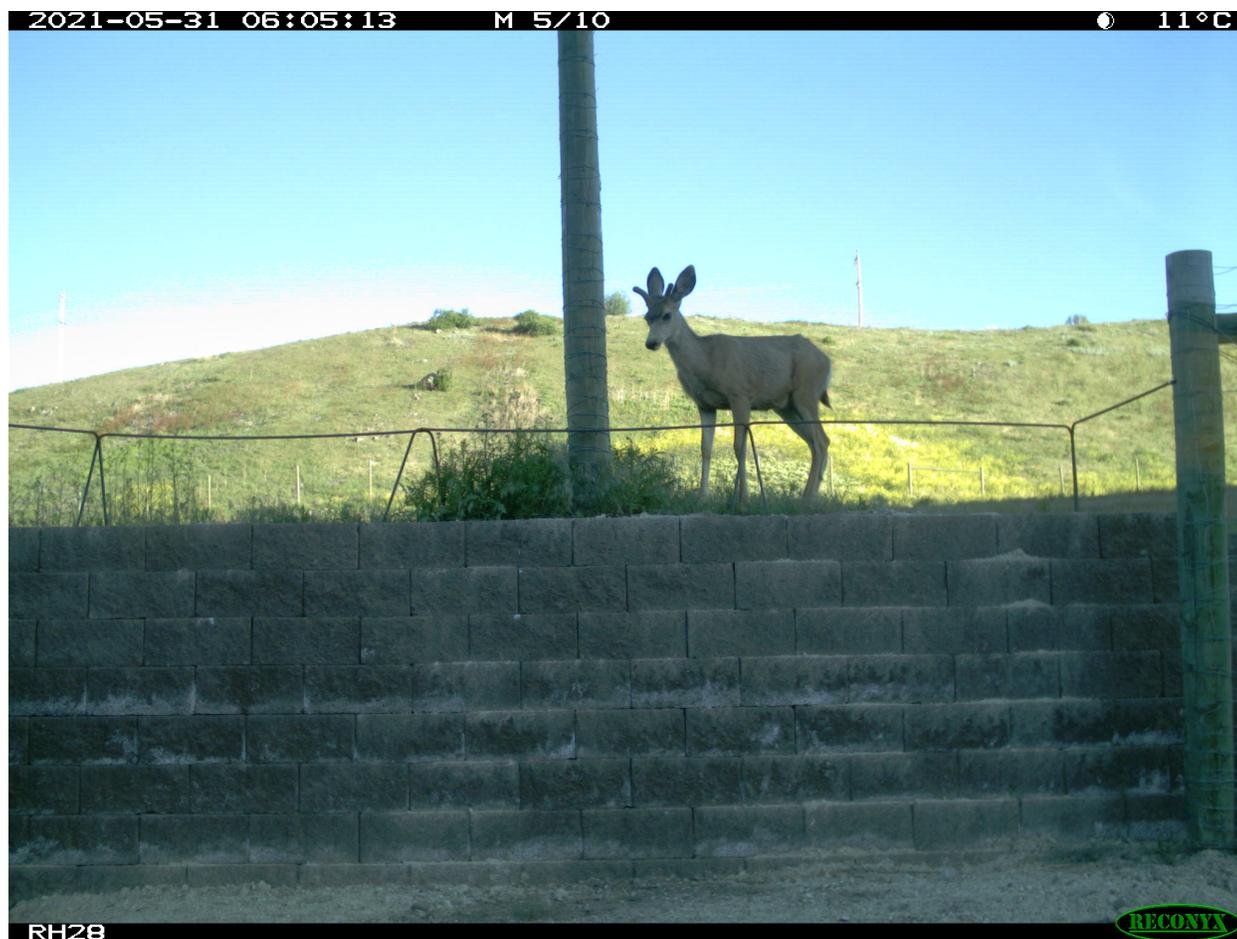
- All 10 jump-outs had cameras installed on 28 May 2021.



Preliminary data (through 8 June) showed that

- a. No deer jumped down (about n=3 groups), This is not good.
- b. No deer jumped up (about n=10 groups). This is good.
- c. 1 black bear climbed down
- d. 1 coyote jumped down

While since June 8 some mule deer and a white-tailed deer did jump down, the results were disappointing. The majority of the animals that jumped down first stepped over the bar with their front feet. Therefore, at half the jump-outs, the rebar was lowered 3 inches. At the other half, the rebar was set back from 12 to 15 inches and with the original height of 18 inches. Evaluation is ongoing.



**Anticipated work next quarter:**

**General:**

3. Install camera Lake Louise
4. Collect data from Canadian locations
5. Enter and analyze data from barriers at Thompson Falls, Melon farm
6. Data entry jump-outs and data analyses.

**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. Equipment was only installed end Sep 2021.
- 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). Evaluation is ongoing.

**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 case at Thompson Falls).

## G 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> TPF-5(538)	<b>Transportation Pooled Fund Program - Report Period:</b> Quarter 3 (1 Jul – 30 Sep) 2021	
<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> 701-18-803 TO 7	<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
\$64,941.84	\$203.75	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
\$203.75 (0.003%)	\$203.75	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 project 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