Proposal for Monitoring Wildlife Crossings on US 93 South

RFP Number HWY 30844-RP

Submitted by

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Problem Statement

Wildlife-vehicle collisions are an ecological problem for wildlife populations and a safety issue for the motorists of Montana, as well as the remainder of North America. Montana is a leader in North America in the design and placement of wildlife crossing structures, mainly because of the mitigation work accomplished and planned along US 93 (Cramer and Bissonette 2006). To date the road has 50 wildlife crossings installed and approximately two dozen more planned. The Montana Department of Transportation (MDT) and the US Federal Highways Administration, along with the input of others, have invested millions of dollars in time and construction of wildlife crossings. It is critical to evaluate their efficacy at reducing wildlife-vehicle collisions, protecting wildlife from these collisions, and keeping animals moving across the landscape in order to justify the cost of the project and to plan for future mitigation, in Montana and other places. Since the establishment of these 50 US 93 crossings, the official monitoring plan has not yet been initiated to judge if they are functioning at a specific level in reducing wildlife-vehicle collisions, specifically those with white-tailed deer. There is an immediate need to: 1) monitor existing wildlife crossings to determine if wildlife are using them; 2) to determine if these crossings and concurrent fences have helped reduced wildlife-vehicle collisions along the stretches of road they've been established; 3) to evaluate future crossing areas, pre-construction for wildlife movements and wildlife-vehicle collisions as a base line and 4) to prepare for and later conduct research to compare to this pre-construction data in determining the efficacy of these future crossings.

Background Summary

Montana is poised to embrace an important opportunity to evaluate the efficacy of their wildlife mitigation efforts and to help demonstrate to North America the most effective methods to go about making a road more permeable for wildlife. Through its wildlife crossing mitigation along US 93 and the pre-construction and post-construction monitoring efforts, Montana will not only be evaluating how well their crossing are working at passing wildlife and reducing wildlife-vehicle collisions, they will be helping to determine many factors in the importance of designing crossings and evaluating data.

Across North America animal-vehicle collisions have been mitigated for with wildlife underpasses that are effective. There are a minimum of 600 underpasses in North America and 190 of them designed specifically with deer as the target species, the majority of these for white-tailed (Cramer and Bissonette 2006). In a review of 27 research projects that evaluated the efficacy of wildlife crossings for many species, 76 underpasses and overpasses were monitored; all passages passed wildlife, and 74 passed the target species (Cramer and Bissonette 2007b). There are approximately 1.5 million wildlife-vehicle collisions in the United States each year, the majority of which are with white-tailed deer. Since this species occurs in virtually every state, is abundant in most states (with populations as high as the 100's of thousands), and is the number one animal involved in wildlife-vehicle collisions, the majority of all wildlife and roads mitigation is dedicated to this species. Consequently, there is more information about white-tailed deer responses to mitigation strategies than any other species' research. We know wildlife underpasses for deer work.

If we ask the question, "Do the wildlife crossing structures along US 93 South function as passages for white-tailed deer?" it is almost certain that within approximately two years the answer will be yes. It is when we ask more specific questions as to the level of efficacy of the crossings, such as how well do they work at reducing deer-vehicle collisions, and at allowing for deer movement along both sides of the highway, that we begin to define a need for a monitoring program. MDT has spent millions of dollars installing wildlife crossings along US 93 and would like to learn more about its investment. Montana is also among the top three states in the U. S in terms of the number of wildlife crossings placed (Cramer and Bissonette 2006). As a leader, Montana is poised to help teach the nation and the rest of the world how to design and maintain effective wildlife crossings, particularly for larger mammals. The next step in this process of evaluating actions and leading the nation in wildlife mitigation is to evaluate just how effective mitigation efforts will become. The opportunities for monitoring for wildlife along US 93 both North and South will present an important time for Montana to lead the nation as it evaluates and justifies the wildlife passages along the most mitigated for wildlife road in North America.

The principal investigator (PI) submitting this proposal is familiar with the crossings to be evaluated in this study. Dr. Cramer has been in regular contact with the MDT biologist largely responsible for installing these crossings, Pat Basting. We have discussed the creation and management of wildlife crossings, visited existing ones during the creation of the Bass Creek Crossings in 2004, and P. Cramer has visited the US 93 South and North crossings in July 2007 to review them and their potential use by wildlife. Dr. Cramer is aware of the initial wildlife use of these structures happening already.

Objectives

The objective of this proposed project is to determine the effectiveness of animal crossing structures and associated wildlife fencing along US 93 South of Missoula, Montana, in providing improved public safety and permeable roadways for wildlife. Through investigating animal-vehicle collisions and animal crossing structure usage before and after construction, the level of efficacy of these measures will be evaluated. White-tailed deer will be the species of focus for this investigation, while it is understood that data on other species will also incidentally be collected and may be useful.

Benefits

The results of this proposed research can be used by Montana Department of Transportation Biologists, planners, engineers, and others in the future designs and maintenance of wildlife crossings, fencing, planning, construction, and later evaluation of the mitigation's ability to perform as expected. The results of this research are expected to have far reaching effects on wildlife crossing designs, and the evaluation of animal-vehicle collisions for all of North America. If we can determine what types of wildlife crossings are working best for white-tailed deer and tangentially other wildlife, we should be able to minimize designs in a cost-effective manner, such as making them perhaps smaller than we had expected, or with materials they may prove to be more cost-effective. We may also be able to detect how much fencing is needed on both sides of a crossing in order to encourage wildlife use of the crossing rather than the road. These improved and cost-effective designs in turn can help make the motoring public more safe from wildlife-vehicle collisions. It is also intended that thorough analyses of the efficacy of wildlife crossings and animal-vehicle collisions (a-v-c) will help to develop standard, statistically valid methods that accurately portray the wildlife-vehicle collision and wildlife movement situation. An added benefit of this study is that MDT and others will be able to provide a more permeable landscape for wildlife movement from lessons learned from this study. MDT will almost certainly learn more about how to improve wildlife mitigation creation and maintenance procedures.

Research Plan

The proposed research is designed with two objectives in mind: evaluate if wildlife crossings are working in passing wildlife, and if they are working at reducing predicted animal-vehicle collisions to a specific level. The target species will be white-tailed deer. The research has two parts, both in research focus and in its temporal span. First, the research is focused on what wildlife are doing near the road, both near the road Right-of-Way, and underneath at the wildlife crossings and the areas where future crossings will be installed. Second, research will evaluate the current a-v-c data and predict what the future a-v-c numbers would be given the amount of deer activity near the road, traffic volume, and if wildlife did not use wildlife underpasses. The a-v-c numbers after wildlife crossings are installed will then be compared to see if there is a significant enough reduction of a-v-c compared to predicted numbers, to say that the crossings were effective in helping to reduce collisions. The two temporal parts of the research are based on pre-construction and post-construction data. While there are currently 12 wildlife crossings along US 93 South that are part of the scope of this project and will be monitored for their effectiveness at passing wildlife, the major focus of the seven years of this proposed project will be the approximately six new wildlife crossings that are yet to be built. The first three years of research will focus on wildlife movements near the road and a-v-c in the area prior to wildlife crossing construction. The second half of the project, years four through six will focus on wildlife use and a-v-c after the six crossings are built. The final year will be a time for analyses and writing up of the final report.

The evaluation criteria for making a final judgment on the effectiveness of the wildlife crossings at passing wildlife and at helping to reduce a-v-c will be made after the start of this project, with the help of MDT biologists and engineers, along with others involved in the creation of US 93 South passages, and the monitoring of US 93 North (of Missoula).

The monitoring of wildlife passages will be done predominantly with infra-red, motion sensed computerized cameras that store pictures in memory cards. As described below, some of the passages will contain single cameras to record wildlife usage, and others will have two cameras to help ascertain what animals may have approached the crossings but were repelled for some reason. The monitoring of wildlife use of the area near the road will be carried out with additional cameras, and the use of pellet count transects. Sand tracking beds will not be used. Some of the information that may have been garnered from sand tracking beds will be learned from local citizens in annual meetings to be held in the study area with local stakeholders. Further details are provided below.

Animal-vehicle collisions data will be analyzed spatially and temporally. Temporally, the a-v-c situation will be assessed for the current numbers and collision rates. Then statistical analyses using Empirical Bayesian methods and Safety Performance Functions will be used to predict important roadway variables, and what the future a-v-c numbers would be if there were no wildlife mitigation measures (a hypothetical “control”). Deer numbers in the area will also be predicted and incorporated into the models to give a deer “exposure” variable to the models. After the six new wildlife passages are placed, a-v-c will be analyzed to determine if numbers were reduced from the predicted amount. A-v-c will be analyzed spatially in a Geographic Information System (GIS) platform. Typical land cover, human density, and road layers will be mapped along with a-v-c hotspots for all stages of the research, and two additional analyses will be conducted over these phases as well. These include the Ripley’s K-statistic and the Kernel density estimator functions. They will help to graph and map a-v-c’s over time and space to show patterns and changes. Further details are provided below.

Section 3

3.0 Purpose: The purpose of this project is to determine the effectiveness of animal crossing structures and associated wildlife fencing in providing improved public safety and permeable roadways by investigating animal-vehicle collisions and animal crossing structure usage before and after construction. White-tailed deer is the species of focus for this investigation: however, it is likely that data on other species will also incidentally be collected and may be useful.

3.1 Tasks

3.1.1 All works shall be conducted in a rigorous statistical manner.

Four methods will be applied to the deer-vehicle collision data in order to find the best goodness of fit of data, and the answers to several types of questions. These include the Empirical Bayesian method for analysis of past and predictions of future animal-vehicle collisions. We will explore the use of Safety Performance Functions to see what roadway variables play a role in predicting areas of high wildlife-vehicle collisions. The Kernel density estimator will be applied to measure spatial dimensions of animal-vehicle collisions, and the Ripley’s K function to determine the scale and degree of clustering of collisions along the road study area. Additional statistical methods will be explored and applied if deemed appropriate. These methods are further described in Section 3.1.4.

Statistical analyses will be used to ascertain wildlife use of different crossing types in relation to crossing dimension, fencing, landscape features, and any other factors deemed relevant. These methods are further described in sections 3.1.6 and 3.1.7.

3.1.2 All work shall be consistent with US 93 North research, particularly in the post-construction phase of US 93 North. There will be three deviations from the US 93 North pre-construction study. These include track beds and pellet group transects. Track beds will not be used due to their high cost and maintenance and their lack of efficiency. In the US 93 North pre-construction study, it was recommended track beds should cover 33% of the total length of each area in the study in order to accumulate a large enough statistical sample to determine changes of white-tailed deer use of the road Right-of Way. This would entail approximately 8 miles of track beds for 6 years. Due to the inability to fully determine white-tailed deer tracks, many logistical problems (such as freezing of track beds in winter), and high costs for this older methodology (such as high use of personnel time), and the limited success of this method in the US 93 North Pre-Construction study, the track beds will not be used. Animal use of area near the road (in and near the road Right-of-Way) will be determined through the use of infra-red, motion sensed cameras, as will be used in the wildlife crossing efficacy portion of study. Determination of specific areas to be monitored will be executed in conjunction with pellet group transects, described next.

Pellet group transects will be included in the study. As in the US 93 North Pre-Construction Study, transects will be 500 meters and broken up into 10 plots that are 1 meter wide and 50 meters long. These transects, like the US 93 North Pre-construction study (from here on this study will be referred to as the original study), shall be perpendicular to the road, starting at the edge of the road. Pellet groups will be considered in accordance with the original study, with one exception. All counted pellet groups shall be dispensed, to avoid re-counting them at a later date. These pellet counts will be done each year, with the possibility of two counts per year. Additionally, transects will be established running parallel to the road. These transects will be 100 to 500 meters long and will be located in the road Right-of-way, 250 meters from the road, and 500 meters from the road (if landowner permission is granted). This method will be compared in the same areas the perpendicular transect method. Comparisons will be made after two years of twice-yearly data collection, and a final, suitable method will be chosen and continued for the remainder of the study. Statistical analyses for the pellet group transects will include negative binomial distribution, and any other noteworthy methods.

The placement of near the road cameras that replace track beds to determine white-tailed deer use of the road area will be determined in part from the pellet group transects. Areas with the highest concentrations of pellet groups will receive high priority, along with areas identified by local residents and biologists as places wildlife are seen near and in the road, and areas determined to have high deer-vehicle collisions. Further details provided below in sub-sections of section 3.

Cameras for this study will reflect an updated technology since the original study on US 93 North. Cameras will be from the companies Cutteback and Reconyx. Their cameras are infra-red, motion senses digital computer cameras. The cameras run on batteries and have memory cards that can be placed and removed monthly with all pictures on them. The use of specific cameras will be coordinated with the US 93 North Post-construction study researchers in order to maintain cameras sensitivity and efficiency that is similar in both studies. We will work directly with the US 93 North post-construction researchers to ensure methodologies are coordinated for future evaluations.

3.1.3 Data loss. Cameras will be checked during a one week period per month for every month of the entire course of the pre and post construction study. In order to prevent theft of cameras, they will be placed in 8”x 8”x 36” utility boxes. These boxes will be locked, the cameras locked to them. The utility boxes will be bolted to metal stakes which will be driven into the ground for 2 to 3 feet. This method has worked successfully in Utah, with 2.5 years of no vandalism to three cameras. In a recent act of vandalism, the box and its stake were pulled from ground, but were not stolen or destroyed. The utility box protection method has resulted in no camera loss. In order to better prevent data loss, there will be two extra cameras in service with the researchers. These will be brought to the field sites as backup to malfunctioning or lost cameras. This will allow immediate replacement once problems are discovered. All data from the cameras are stored on memory cards. This information will be downloaded to computer hard drives and stored on CD’s as backup. Traffic counters will be checked monthly to assure they area operating correctly.

3.1.4 Determining changes in the anima-vehicle collisions pre and post construction for 25 miles of US 93 South. Spatial and temporal analyses will be conducted on animal-vehicle collisions along the study area. These analyses include mapping and analyzing data in a Geographic Information System (GIS) and, applying Baysian statistics and Safety Performance Functions (SPF’s), as well as exploring other statistical tests for their goodness of fit and applicability. The Spatial analyses will include mapping existing animal-vehicle collisions and carcass data. Analyses will be conducted to ascertain landscape, temporal, and data collection variables related to animal-vehicle hotspot sections. We will use the kernel density estimator to measure the scale and magnitude of collisions along designated segments of the highway. We will then use the Ripley’s K function to statistically determine the scale and degree of clustering of collisions along the entire highway (Figure 1). This analysis will help managers focus in on the scale, i.e. length of road segment for mitigation, for a particular transportation mitigation project. Temporal analyses will also be conducted to assess when the collisions have occurred through time. We will then determine the statistically significant seasonal and daily clustering of wildlife mortality. A combined space and time analysis will determine if where hotspots occur is also dependent on when they occur (Figure 2). We will also measure the excess risk of collision associated with space and time interactions. This will assist in determining if mortality hotspots are changing in time due to several factors such as changing traffic volumes, dynamic animal movement and behavior patterns, etc. Space and time graphs will be produced which will display the results from our analyses (Figures 1 and 2).

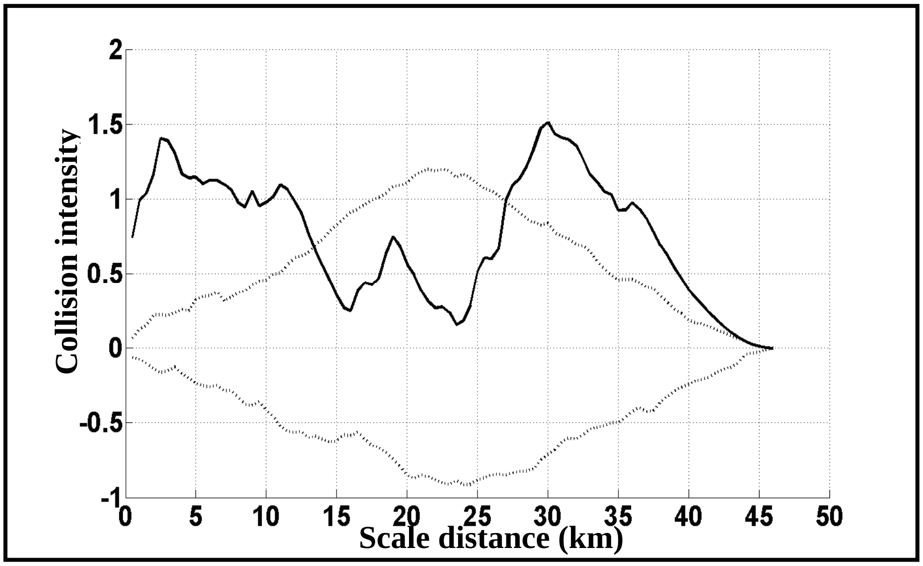

Figure 1. This graph depicts the significant scale at which moose-vehicle collisions occur on a 50 km road in Vermont. For this particular road, peak collisions occurred at a scale of 3 km.

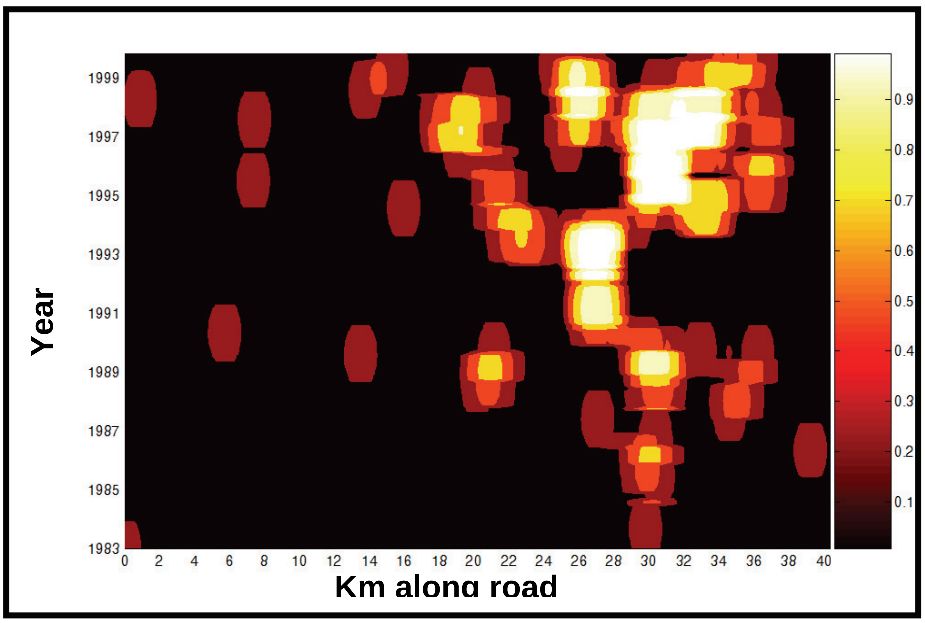

Figure 2. This picture depicts the space and time output from the kernel intensity analysis using moose-vehicle collisions in Vermont. The hotpots in collisions occur from km 26 to km 35 in three distinct time periods (1985-1990, 1991-1995 and 1995-1999) which suggest a change in moose crossing behavior along roads.

Space and time analyses will help us begin to understand the processes and patterns of wildlife-vehicle collision on Highway 93S. We will then take this one step further by understanding the factors associated with collisions by applying the available remote sensory imagery in a GIS to statistically determine the landscape factors associated the above patterns in wildlife-vehicle collisions. Available traffic volume and abundance datasets will further assist in determining other factors associated with collision hotspots. GIS maps will be produced that will identify hotspots in space and time for all wildlife species killed on highway 93S for data collected. These analyses will help produce better management decisions for manipulating the landscape and or motorist behavior to alleviate road associated wildlife mortality.

With the combined knowledge of P. Cramer and K. Gunson and cutting edge methodology for collecting and analyzing wildlife-vehicle collision data, recommendations will be made for future data collection. Local experts, e.g. wildlife ecologists will also be contacted to learn about their perceptions concerning wildlife on and near the road and we will document their ideas on potential solutions related to carcass-collision data collection. We will then outline an effective protocol to meet the needs for long-term accurate wildlife mortality data collection.

Empirical Bayesian statistics will be applied to current a-v-c data in an effort to predict what the pre-construction a-v-c numbers might be. In our just finished work in the safety analysis of multiple states' deer-vehicle collisions as part of the NCHRP 25-27 project '*Evaluation of the use and effectiveness of wildlife crossings*', Safety Performance Functions were also used to examine highway factors associated with collisions. In the current proposed project Bayesian statistics would be used to help minimize the yearly variability in a-v-c data. We would use three years of current data to develop the Bayesian statistics and the Safety Performance models. The three year time frame is the standard data set for analyzing causes related to motor vehicle crashes. A recent study (2007) supported by the Utah DOT and the Transportation Research Board analyzed drowsy driver crashes. Researchers found that once data is analyzed beyond three years, confounding variables such as changes in traffic, human demographics, and landscape habitats become too numerous and may be more responsible for changes in crash rates than the factors examined. Utah Dot consistently uses only a 3-year time frame for looking at specific types of crashes. For this study the current three years of data concerning a-v-c's and traffic volume will be analyzed and included in a model to predict projected crash rates with deer. This would be done in two models: one with only an increase in traffic volume and no changes in the populations of deer or humans, and one accounting for changes in deer population numbers near the road. This will be done with Bayesian statistics. The pre-construction a-v-c data will then be used to test the model. The model will be validated and then adapted according to new data sources. The model will be developed to measure deer population numbers near the road, or exposure. These numbers will be estimated from bi-annual pellet counts, cameras mounted along roads to measure deer approaches to the highway area, and white-tailed deer population estimates from Montana Fish, Wildlife, and Parks' population research, harvest and hunt numbers. Predictions will be made for deer-vehicle collisions in the stretches of highway analyzed if there were no wildlife crossing mitigation measures. These predictions will be used to ascertain if the post-construction a-v-c's in the areas of mitigation are lowered significantly from predictions. A measure of mitigation efficacy will be chosen, such as a desired reduction of 35% of predicted a-v-c post mitigation.

3.15 Determining relationship between a-v-c numbers and wildlife crossings over time and space. A-v-c's will be mapped in a GIS. Current data available will be mapped for the 12 mile stretch from mile posts 53-66, to determine existing a-v-c hotspots. This data will be used as part of the decision process as to where monitoring cameras will be placed for determining deer exposure along the road right-of way. During pre-construction a-v-c and carcass data will be accessed and mapped to determine the pre-construction hotspots, as described in part in 3.1.4. These hotspots will be compared with post construction a-v-c and carcass data. Our NCHRP 25-27 work on the evaluation of use and effectiveness of wildlife crossings found carcass and a-v-c data are often collected differently, and when mapped, can identify different hotspot areas. In regards to this discrepancy, both data sets, a-v-c and carcass, will be used to the extent they are available.

A-v-c data indicate general hotspots where animals are NOT crossing the road safely. There may be places along the study area of US 93 South where deer and other wildlife are successfully crossing the road. This may be due to roadway characteristics such as in open, straight stretches that allow motorists and animals full visibility of each other, or the lack of guardrails or jersey barriers, and other factors. Although the objectives of this study are to determine a-v-c hotspots and crossing efficacy, it is prudent for scientists and managers to be aware of the situation from other perspective as well. Data are not the only inputs to a decision of mitigation efficacy and a course of future actions. Local area citizens are witness to wildlife on the road, the swerves and near accidents, and areas deer prefer to graze, bed, and move in relation to the road. This proposal also includes yearly meetings with citizens and stakeholders in the valley area of this study . These meetings could be potentially held in September of each year to raise awareness of deer movements during the rut and migrations, but more importantly, to bring the study to local citizens, informing them of preliminary results, and asking them for their input in identifying where deer and other wildlife are seen alive along the roadway. The objective of this part of the study is to learn about where deer are successfully crossing, potential a-v-c areas not found through data analyses, how these may change over the course of the study. The meetings would also serve to raise community awareness and support for the study.

3.1.6 Usage rates of structures by type and across types. Our understanding is there are 12 existing wildlife crossings large enough for deer in the full 25 mile study area, and approximately 6 new crossings to be built. As Greenwood suggests in the RFP, it would be prudent to sample/monitor all 12 existing structures to obtain a sample large enough to evaluate crossing characteristics that would be rigorous enough for statistical analyses of wildlife crossing data and rates. There are confounding variables related to crossing locations, but a multi-variant analysis with these 12 structures and the new structures could contribute to an understanding of the variables important to deer and other wildlife use. In order to determine deer crossing rates in the wildlife crossings, we propose a minimum of one infra-red, motion sensitive, computerized camera in all 18 structures existing and proposed for US 93 South in this study area. We also would include a second camera mounted at one of the entrances of one-half of these structures (9) to ascertain if animals are approaching the crossings but are being repelled. N. Dodd, J. Gagnon et al. have established a similar monitoring methods to determine elk preferences along Arizona's SR 260. This study design has helped the Arizona DOT evaluate the type of structures with lower repel rates and the structural attributes that make a crossing more "elk-friendly."

In a study we are establishing in Utah, there will be six to ten crossings that will have a secondary camera on the outside in this same design to determine repel rates, which can also be viewed as rates of passage as related to approaches. The Utah study will run concurrently with the first three years of this US 93 study and a comparison of data could be conducted. There also exists a potential to compare usage and repel rates with US 93 North.

3.1.7 Relationships with crossings and landscape variables and crossing rates. Data concerning landscape variables such as land cover type, canopy cover, distance to cover, plant species present, if a stream runs through a crossing, if there is human use through the crossing etc., as well as the structural attributes of the structures, will be correlated with the wildlife crossings rates through a multi-variate analysis. A multi-variate analysis would also be conducted to compare usage rates in relation to deer presence, as determined by pellet counts and roadside cameras and standardized across sites, and deer repel rates on the secondary cameras. The objective of the analyses would be to determine if there were significant relationships between usage rates and landscape and wildlife crossing structure features, such as crossing length and height, and materials of the structure, and the place in the landscape, such as riparian corridors. Further statistical testing will be evaluated to determine if the data could be analyzed in different platforms.

3.1.8 Data Collection Three Years Pre – Three Years Post. The data collection for this proposed study would entail immediate monitoring of the 12 existing crossings identified by Greenwood in the RFP, and the six areas where future crossings are proposed, as identified in Addendum #1. Three to six areas along the 12 mile stretch of the new crossings from mile post 54 to 65 will also have cameras installed near the road Right-of-Way to evaluate wildlife movement near the roadway. These areas will be identified by analyses of a-v-c/road kill carcass data, local community input on wildlife movement near the roadway, and pellet counts. Monitoring these areas with cameras is a method to replace the sand track beds used in the original study. In an adaptive management approach, the camera monitoring will be evaluated on a yearly basis (if not sooner) and adapted according to results and conditions, as well as the concurrent research and results along US 93 North wildlife crossings.

Cameras are predicted to be ones made by the companies Cuddeback and Reconyx. Each camera will be checked once per month throughout the study. Backup equipment such as extra cameras, batteries, memory cards, and utility boxes will be carried by the field researchers at all times. Data will be downloaded to computers, analyzed, and reported through quarterly and interim reports. Formats of those reports will be similar to those submitted to the Utah DOT and Utah Division of Wildlife Resources for a preliminary concurrent project. See Appendix A, page 23.

After three years of monitoring, data will be analyzed at the 12 existing crossings to evaluate how animal use changed over time. This information will be used in the decisions concerning post-construction monitoring of the newer crossings. The proposal time frame is for seven years; the state of Montana limit for contracts. After the first three years of monitoring, the results, the construction progress, and overall situation will be evaluated to deploy the second half of the study; the post-construction stage. This re-evaluation may mean a re-negotiation for an extension of the contract in order to accurately monitor the new crossings, some of which may not have been built in the projected time frame which are projected to be let to contract later in the study, or if data indicated little use of crossings in the first year post construction.

A final connectivity analysis will be evaluated and reported in the seventh year of the project.

3.1.9 Data Inputs. We will use the available traffic, a-v-c, road kill carcass and deer population data. Further deer studies are not part of this proposal. If we were to win the award for this study, we would write grant proposals and work with Montana Fish, Wildlife, and Parks to obtain outside funding for more detailed studies on the white-tailed deer in the area. In our concurrent Utah wildlife crossings study we are working with Utah Division of Wildlife Resources to obtain funding for a study that would use Global Positioning System (GPS) collars to study mule deer and elk movements near two highways where we will have monitoring cameras and which are scheduled for wildlife crossings in the coming years. We would make similar efforts with Montana Fish, Wildlife, and Parks.

3.2 Meetings and Deliverables

3.2.1 Patricia Cramer understands and will comply

3.2.2 Interim meetings are anticipated. They will be added to the schedule as appropriate based on the research approach and complexity of the project. If these meetings do not take place, cost budgeted for those meetings will not be billed to Montana DOT.

3.2.3 Patricia Cramer understands and will comply

3.2.4 Patricia Cramer understands and will comply

3.2.5 Interim Reports will be provided every six months of the project length.

3.2.6 A Final Report will be submitted as described in the RFP, Appendix B, section 3.3.

3.2.7 Patricia Cramer understands and will comply

3.2.8 Patricia Cramer understands and will comply

3.2.9 Patricia Cramer understands and will comply

Products

Products to be delivered during the course of this proposed research include:

- Quarterly and interim reports with pictures of wildlife use of crossings, a-v-c hotspots, and maps of a-v-c hotspots.
- Several statistical and GIS methodologies of analyzing wildlife-vehicle collision data that are most pertinent to the wildlife crossings and a-v-c along US 93.
- Recommendations for future wildlife crossing placement, configurations and materials, maintenance, fencing, escape structures, and continued connectivity of the natural landscape for wildlife.
- Final Report
- Project Summary Report

Implementation

- The findings will be reported in a connectivity analysis most pertinent to biological/ecological professionals, AND in a statistical report format that evaluates the four statistical-GIS methodologies used to evaluate a-v-c. Recommendations will be made as to the types of wildlife crossings that appear most readily accepted by white-tailed deer, and where they appear to work best on the landscape. Recommendations will also be made for maintenance schedules, fencing, and wildlife roadway escape structures.
- Research results would best be applied by MDT engineers, planners, and biologists looking to design and place wildlife crossings, fencing, and escape structures, and also those data managers who analyze wildlife-vehicle collisions data. Federal Highways would also be in a position to best apply the principles developed in this research. AASHTO officials could take this information back to their states, and potentially make it available on their websites and documents.
- It would be a goal for the results of this study to help AASHTO make recommendations in its Green Book and other documents as to what specific structural and landscape attributes worked for passing white-tailed deer in Montana. We would only suggest these be recommendations, since they would be proven only in Montana in the specific situation. MDT could certainly take the recommendations from the Final Report and apply them to their future wildlife mitigation efforts and a-v-c data analyses.
- Implementation Plan. If the performance measures agreed upon by personnel involved with this project, such as a Technical Advisory committee, are met, such as a specific reduction in the number of a-v-c post-construction, then specific recommendations could be made pertaining to how the US 93 South mitigation projects were carried out. For instance, if there was a 35% reduction in a-v-c from predicted a-v-c given specific traffic volumes and amounts of deer near the road, then the placement, configuration, and other factors of the crossings could be recommended for further use. If the 35% reduction in a-v-c was not met, a cautionary recommendation could be made, for future designs and further study.

Time Schedule

Task	Months of Year 1 (not calendar year)									
	1	2	3	4	5	6	7	8	9	10	12
Kick off meeting											
Task 1 Purchase equipment											
Task 2 Install equipment											
Task 3 Monitor wildlife movement											
Task 4 Obtain & analyze current a-v-c											
Task 5 Hold public meeting											
Task 6 Create a-v-c prediction models											

Task	Months of Year 2										
	1	2	3	4	5	6	7	8	9	10	12
Task 6 Create a-v-c prediction models											
Task 7 Monitor wildlife movement											
Task 8 Create Interim Report											
Task 9 Hold public meeting											

Task	Months of Year 3										
	1	2	3	4	5	6	7	8	9	10	12
Task 10 Monitor wildlife movement											
Task 11 Create Interim Report											
Task 12 Analyze pre-construction data											
Task 13 Hold public meeting											

Task	Months of Year 4										
	1	2	3	4	5	6	7	8	9	10	12
Task 14 Monitor wildlife movement											
Task 15 Create Interim Report											
Task 16 Analyze pre-construction data & compare to predicted											
Task 17 Hold public meeting											

Task	Months of Year 5

	1	2	3	4	5	6	7	8	9	10	12
Task 18 Monitor wildlife movement											
Task 19Create Interim Report											
Task 20 Hold public meeting											

Task	Months of Year 6										
	1	2	3	4	5	6	7	8	9	10	12
Task 21 Monitor wildlife movement											
Task 22 Create Interim Report											
Task 23 Hold public meeting											

Task	Months of Year 7										
	1	2	3	4	5	6	7	8	9	10	12
Task 24 Monitor wildlife movement											
Task 25 Create Interim Report											
Task 26 Analyze avc data and compare results with expected											
Task 27 Hold public meeting											
Task 28 Create draft final report											
Task 29 Meet with MDT officials											
Task 30 Submit final report											

Staffing

Name	Role in the Study	Tasks= hours	Total Hours
Patricia Cramer	Principal Investigator	1=75, 2=50, 3=30, 5=40, 6=40, 7=30, 8=40, 9=30, 10=30, 11=40, 12=120, 13=30, 14=30, 15=40, 16=120, 17=30, 18=50, 19=40, 20=30, 21=50, 22=40, 23=30, 24=30, 25=50, 26=40, 27=40, 28=160, 29=40, 30=320	1,725
Kari Gunson	A-v-c Spatial Analysis	4,6,12,16,26	960

Field Researcher	Camera installation and monthly checking & analyses	2=80, 3=960, 5=30, 7=960, 9=30, 10=1000, 13=30, 14=1000, 17=30, 18=1000, 20=30, 21=1000, 23=30, 24= 600, 27=40, 28=220, 29=40, 30=240	7,320

Dr. Cramer will be working on this project part time, from a low of 90 hours per year in year 5 of the project, to a high of 720 hours in the final year. Currently Dr. Cramer is wrapping up an NCHRP project that will end May 31, 2008. She will have begun the Utah DOT wildlife crossing monitoring project by the first of 2008, but she intends to hire a researcher to conduct field work and analyze wildlife monitoring data. All the cameras and set up for that project will have been obtained and finished by Spring 2008 when the Montana US 93 South Monitoring project would be scheduled to begin. She foresees oversight, analysis, and writing responsibilities for this project, with the assistance of a field researcher and Kari Gunnson as an a-v-c analysis specialist. Kari Gunson has recently (August 2007) finished her second master's degree and will be working on contracts periodically in the coming years. She does not foresee full time employment, and believes she can devote 960 hours over 7 years.

The level of commitment by researchers and staff will not be changed without written consent of MDT.

Facilities

Research will be conducted in the field and the individual researchers' offices. Equipment for this research will be purchased, see budget. The equipment will consist of electronics such as the cameras and a computer, and other hardware such as utility boxes, stakes, batteries and memory cards. A field vehicle will be provided for this project.

MDT Involvement

Montana DOT will be involved for the following tasks:

- Written permission for conducting research along MDT rights of way
- Traffic counter with daily, monthly, and yearly estimates of traffic volume, for every year of the study
- Access to a-v-c data from the past, present and the future
- Maintenance of wildlife crossings, fencing, escape ramps
- Participation in annual public meetings for this project
- Assistance with complications with installation of cameras, land owner access permissions, and other aspects of field research

Budget
FARS Cost Sheet

Bid # HWY-308445-RP						Date: November 2, 2007		
Estimate Prepared By: Patricia Cramer								
COST SUMMARY								
Project: Proposal for Monitoring Wildlife Crossings on US 93 South								
Labor overhead								
Team members			Hours		Rate			Extension
<u>Principal</u>								$
Patricia Cramer			1,725		$62/hr	$41.33/hour + benefit rate of 0.5		106,950
<u>Researchers</u>								
Kari Gunson			960		$37/hr	$24.67/hour + benefit rate of 0.5		35,520
Field Researcher			7,320		$30/hr	$20/hour + benefit rate of 0.5		219,600
							Labor total	362,070
Direct Non-Labor								
35 Infra-red motion sensed cameras, utility boxes, memory cards, batteries, field computer, etc.								45,000
Travel costs for field work and public meetings								58,075
Travel costs for three interim meetings								2,650
							Total Direct Non-labor	105,725
							Total Estimated Cost	**$467,795**

Budget by Task

Task	**Description**	**Federal Year**	**State Year**	**Cost**
1	Task 1 Purchase equipment	**Oct 1 07**	**FY July 07-June 08**	**$49,650**
2	Task 2 Install equipment		**FY July 07-June 08**	**6,300**
3	Task 3 Monitor wildlife movement		**FY July 07-June 08**	**18,105**
4	Task 4 Obtain & analyze current a-v-c		**FY July 07-June 08**	**8,520**
5	Task 5 Hold public meeting	**- Sept 30 08**	**FY July**	**3,380**

			08-June 09	
6	Task 6 Create a-v-c prediction models	Oct 1 08	FY July 08-June 09	9,880
7	Task 7 Monitor wildlife movement		FY July 08-June 09	39,360
8	Task 8 Create Interim Report		FY July 08-June 09	3,720
9	Task 9 Hold public meeting	-Sept 30 09	FY July 09-June 10	2,760
10	Task 10 Monitor wildlife movement	Oct 1 09	FY July 09-June 10	40,560
11	Task 11 Create Interim Report		FY July 09-June 10	3,720
12	Task 12 Analyze pre-construction data		FY July 09-June 10	13,360
13	Task 13 Hold public meeting	-Sept 30 2010	FY July 10-June 11	2,760
14	Task 14 Monitor wildlife movement	Oct 1 2010	FY July 10-June 11	40,560
15	Task 15 Create Interim Report		FY July 10-June 11	3,720
16	Task 16 Analyze pre-construction data & compare to predicted		FY July 10-June 11	14,800
17	Task 17 Hold public meeting	Sept 30 2011	FY July 11-June 12	2,760
18	Task 18 Monitor wildlife movement	Oct 1 2011	FY July 11-June 12	40,560
19	Task 19 Create Interim Report		FY July 11-June 12	3,720
20	Task 20 Hold public meeting	Sep 30 2012	FY July 12-June 13	2,760
21	Task 21 Monitor wildlife movement		FY July 12-June 13	40,560
22	Task 22 Create Interim Report		FY July 12-June 13	2,080
23	Task 23 Hold public meeting	Sept 30 2013	FY July 13-June 14	2,760
24	Task 24 Monitor wildlife movement	Oct 1 2013	FY July 13-June 14	40,560
25	Task 25 Create Interim Report			2,080
26	Task 26 Analyze avc data and compare results with expected			18,800
27	Task 27 Hold public meeting	Sept 30 2014	FY July 14-June 15	2,760
28	Task 28 Create draft final report	Oct 1 2013		16,520
29	Task 29 Meet with MDT officials			3,680
30	Task 30 Submit final report	Sept 30 2015	June 30 2015	27,040

Point by Point Review of Sections and Subsection of the RFP

Proposal for Monitoring Wildlife Crossings on US 93 South

<u>Section 1</u>

1.1 Contract term shall be seven years. This involves an initial step up of monitoring period, three years of pre-construction monitoring, three years of post monitoring, a final year of data analysis and preparation time for a draft and final report.

1.2 Patricia Cramer understands and will comply

1.3 Patricia Cramer understands and will comply

1.4 Review of RFP

- 1.4.1 Review of RFP has taken place, instructions have been understood, and questions concerning the RFP were submitted to Richelle Parkhurst by the 10/22/07 deadline.
- 1.4.2 Questions were submitted to point of contact by 10/11/07.
- 1.4.3 State's answers, in the form of addendum # 1 were received and Addendum #1 is signed and included in this packet.

1.5 General Requirement

- 1.5.1 I have read appendices A & B and accept standard terms and conditions set out in these sections of the RFP.
- 1.5.2 Resulting Contract. I understand this RFP, Addendum 1, our RFP response, and a best and final offer shall be included in a resulting contract. I understand the contract and its attachment will govern in the same order of procedure, as listed in the contract, in the case of a dispute.
- 1.5.3 I understand the description of and necessary compliance with this RFP description.
- 1.5.4 Patricia Cramer understands and will comply.
- 1.5.5 Patricia Cramer understands and will comply.

1.6 Submitting the Proposal

- 1.6.1 The proposal is organized in sections, following the RFP instructions, with tabs separating each section. This proposal has a point by point response to all numbered sections, subsections, and appendices of the RFP.
- 1.6.2 Patricia Cramer understands and will comply.
- 1.6.3 Patricia Cramer understands and will comply.
- 1.6.4 Patricia Cramer understands and will comply.
- 1.6.5 Patricia Cramer understands and will comply.
- 1.6.6 Patricia Cramer understands and will comply.

1.7 Cost of Preparing Proposal

- 1.7.1 Patricia Cramer understands and will comply.
- 1.7.2 I understand all submitted materials become property of the State of Montana.

<u>Section 2</u>

2.0 Authority: Patricia Cramer understands and will comply

2.1 Competition: Patricia Cramer understands and will comply.

2.2 Receipt of Proposals and Public Inspection

2.1.1 I understand that all submitted materials are deemed public information.

2.2.2. Patricia Cramer understands and will comply.

2.3. Classification and Evaluation of Proposals: Patricia Cramer understands and will comply.

2.4 States Rights Reserved: Patricia Cramer understands and will comply.

Section 3

All Section 3 tasks are addressed in the Research Plan section above. Patricia Cramer fully understands and will comply.

Section 4

4.1 Qualifications

4.1.1 References are provided in Appendix B, page 28.

4.1.2. Resumes are provided in Appendix C, page 30. Company Profile. Patricia Cramer is submitting this proposal as a sole proprietor consultant. Dr. Cramer has been working on wildlife and roads issues since she helped convince Florida DOT to install wildlife passages and a herpitile wall along US 440 along Payne's Prairie Reserve. This multi-team project began in 1997. She has been working with monitoring wildlife passages and helping to determine passage dimensions and research since 2004. Dr. Cramer and Ms. Gunson's credentials are provided in their resumes in Appendix C.

4.1.3. Work plan. The work plan is provided above under Research Plan.

Section 5

5.0 Cost Submittal

Cost proposals have been submitted under the Budget section, in accordance with the requirements of section 5.0. Benefits for employees have been included in the hourly rates of each researcher. This research is submitted without an overhead (indirect costs) rate. An overhead rate IS NOT PLANNED to be added to the project in the event the award is given to the contractee. The FARS sheet has been reproduced and is presented in the Budget section, page 18. Section 5.4.2 is presented below. The proposal has been written without an indirect costs rate. In the event a rate needs to be chosen for this section, a fixed rate has been chosen in 5.4.2, below. It is understood that the award amount will not be changed if an indirect costs amount is added.

5.1 Cost Schedules have been provided under the Budget Section

5.2 Project Budget has been provided in the Budget Section.

5.3 Cost Revisions. Patricia Cramer understands and will comply.

5.4 Federal Acquisition Regulation (FAR) Payment For Services.

5.4.1 Patricia Cramer understands and will comply

5.4.2 Indirect Cost Rate

__X__ Contractor chooses that its indirect cost rate will remain fixed to the date stated in Section 2.0 of the contract. In the event of an extension beyond the date stated in Section 2.0 of the contract, the Contractor will provide a new FAR-audited rate as of the original completion date.

5.4.3 Annual Audit. Patricia Cramer understands and will comply.

Section 6
Evaluation Criteria. Patricia Cramer understands and will comply.

Appendix A. Standard Terms and Conditions
Patricia Cramer understands and will comply.

Appendix B. Standard Contract
Patricia Cramer understands and will comply.

Literature Cited

Cramer, P. C. and J. A. Bissonette. 2007a. Priorities in research and practice. Pages 33-46 *in*: J. A. Bissonette, editor. Evaluation of the use and effectiveness of wildlife crossings. Final Report prepared for the National Academy of Science (Transportation Research Board – National Cooperative Highway Research Program). URL: http://www.wildlifeandroads.org/publications/.

Cramer, P.C., J. A. Bissonette. 2007b. Integrating wildlife crossings into transportation plans and projects in North America. *In*: Proceedings of the 2007 International Conference on Ecology and Transportation, Little Rock Arkansas. Center for Transportation and the Environment, North Carolina State University, NC.

Cramer, P. C., and J. A. Bissonette. 2006. Wildlife crossings in North America: The state of the science and practice. Pp. 442-447; *In*: Proceedings of the International Conference on Ecology and Transportation, San Diego, California. Center for Transportation and the Environment, North Carolina State University, NC. http://www.icoet.net/ICOET_2005/proceedings/06IPCh9-442-460.pdf

Appendix A. Scipio Report

Scipio Wildlife Passages Monitoring Program Quarterly Update July – October 2007

Patricia Cramer; patricia.cramer@usu.edu; 435.797.1289
USGS Utah Coop Unit and Utah Transportation Center, Utah State University

July 20th Through October 17 Summary

During this three month period only the North and South Underpasses were monitored, due to a malfunction of the overpass camera that has not been corrected yet. The cameras were photographing a total of 89 days. The Scipio North underpass had a total of 441 deer passages (mean=4.95 passes per day) and the Scipio South underpass had 32 deer passes (mean = 0.34 passes per day) over that period of time. (That's 473 times deer did not come up on I-15). Vehicles, all terrain vehicles, equestrians, and people also passed through the passages. The North passage had a total of 18 vehicle passages over this time, and 16 pedestrian and equestrian passages, with 3 atv passes. The Scipio South passage has a Forest Service Road running through it. Scipio South had 1029 vehicle passes over these 89 days (mean=11.6 vehicles per day). These vehicles run from 6 am through midnight most days, with occasional early morning hours also having vehicle passes. There were 57 atv and equestrian passages. Over time, I will evaluate if these vehicles are possibly negatively affecting wildlife in the area, since there is so little time in the day where a vehicle is not passing through. This area at this high level of vehicle activity is functioning much more as a Forest Service road than a wildlife passage.

Deer use of these passages is beginning to show predictable patterns. Scipio North is a major wildlife passage, part of both home ranges of local deer, and migrants. In the past 3 months there is steady daily use of the passage, usually in the early morning hours between 5 to 7:30 am, and again from 5 to 8 pm. There is a definable herd of 8 does and 3 fawns that can be viewed in photos going back and forth almost daily. Bucks occur in only 5 sets of pictures over this time. The deer are at home in the median area, often grazing. The older does are leading the movement through this passage, and in August and September photos, there appears to be a matriarchal march, as I call it, where the new does are learning the way by following the leaders. These "new kids on the block" are often seen looking up and around with their ears forward. (See pictures below). By late September and October, the herd is more at home in these movements. (See pictures). The Scipio South deer are rare visitors to the passage area. I am not even sure they are using the passage because their movements are parallel to the road, and rarely do photos show animals going under the passage. The pictures are mainly activity in front of the north-bound bridge. (See pictures below). There has been an adjustment to this. The camera was moved to within the median area, to ascertain if deer actually come through the whole area.

Vandals attacked the Scipio South camera on October 13. They pulled the camera box up from its anchor, placed it along the fence nearby, and stuffed garbage in its front. I am thankful they didn't just take the whole box and camera. The camera is no longer working at this time; it will need some repair assistance after its "violent" experience. Their pictures are shown below, in case any of you may recognize the individual. This instance teaches me that we need to put some stickers on the boxes, and inform the local Utah Highway Patrol and Sheriff's offices of the study, in the event they are aware of any illegal activity in the area that may ultimately involve or threaten the cameras. Challenges for the next month are to get the two damaged cameras up and working again, especially since animals may be migrating through the area at this time.

Scipio North Matriarchal march. These 2 does and 3 fawns use this area almost everyday. I am convinced that one doe has twins. They are part of a herd of about 10 deer.	

Scipio North’s local herd. Seven of the deer are visible here. You can actually watch the fawns grow over time with the photo series.

Scipio South had some herd activity in August. There are 2 bucks that were regularly photographed here in August, sometimes together, and as here, sometimes in the presence of does.

Here are the two Scipio bucks. They have left the area and have not been photographed since this day in August.	
Hunters have not overlooked passages. I believe this guy is looking for wildlife tracks here.	

Yes, there is other wildlife. Here a cottontail rabbit triggers the camera.	
Here is the vandal that took the camera and box off its base and disabled it. My question, "What were they doing at 3:30 in the morning?"	

Appendix B. References for Researchers

For Patricia Cramer

Dr. John Bissonette, Leader of USGS Utah Cooperative Research Unit, and Professor, Utah State University. Email: john.bissonette@cnr.usu.edu. Phone: 435.797.2511. Current supervisor for past 3.5 years on NCHRP project: Evaluation of the use and effectiveness of wildlife crossings. Also Technical Advisory Team advisor to Utah DOT project, "Determining Wildlife Use of Wildlife Crossings in Utah." Co-Primary Investigator on an implementation grant from NCHRP for NCHRP 25-7 extension. Services provided in Logan, Utah. 2004-2010.

Bruce Bonebrake, Southern Regional Habitat Program Manager, Utah Division of Wildlife. Email: bruceabonebrake@utah.gov. Phone: (435) 865-6111. Colleague in wildlife and roads research in Utah. Also Technical Advisory Team advisor to Utah DOT project, "Determining Wildlife Use of Wildlife Crossings in Utah." Services provided across Utah, with concentration on I-15, Scipio region. Colleague in planning cameras monitoring locations throughout Utah. 2004-2010.

Paul West, Wildlife Program Manager, Wildlife/Wetlands Biologist, Utah Department of Transportation. Email: paulwest@utah.gov. Phone: (801) 965-4672. Colleague in wildlife and roads research in Utah. Also Technical Advisory Team advisor to Utah DOT project, "Determining Wildlife Use of Wildlife Crossings in Utah." A contractor-contractee relationship. Services provided across Utah, with concentration on I-15, I-70, US 6, and I-80. Colleague in planning cameras monitoring locations throughout Utah. 2004-2010.

Randall Taylor, Engineer, Utah Department of Transportation. Email: randalltaylor@utah.gov. Phone: (435) 893-4714. Colleague in wildlife and roads research in Utah. Also Technical Advisory Team advisor to Utah DOT project, "Determining Wildlife Use of Wildlife Crossings in Utah." A contractor-contractee relationship. Services provided across Utah, with concentration on I-15, I-70, US 6, and I-80. Colleague in planning cameras monitoring locations throughout Utah. 2004-2010.

Jason Alcott, Natural Resource Specialist-Ecologist, Minnesota Department of Transportation. Email: jason.alcott@dot.state.mn.us. Phone: (651) 366-3605. Advisor to NCHRP project 25-27, "Evaluation of the use and effectiveness of wildlife crossings."

Shane Marshall, Environmental Program Manager, Utah Department of Transportation. Email: SMARSHALL@utah.gov. Phone: (801) 965-4784. Colleague in wildlife and roads research in Utah. Also Technical Advisory Team advisor to Utah DOT project, "Determining Wildlife Use of Wildlife Crossings in Utah." A contractor-contractee relationship. Services provided across Utah, with concentration on I-15, I-70, US 6, and I-80. Colleague in planning cameras monitoring locations throughout Utah. 2004-2010.

Christopher Hedges, Senior Program Officer, Transportation Research Board, The National Academies Cooperative Research Programs. (202) 334-1472. chedges@nas.edu.

Contractor-contractee relationship with execution of the NCRHP project 25-27, "Evaluation of the use and effectiveness of wildlife crossings," and current grant to implement the decision guide and recommendations created from NCHRP 25-27, of which Dr. Cramer is a co-Primary Investigator with Dr. Bissonette. 2004-present.

References from Kari Gunnson road ecology research:

Dr. Tony Clevenger, Western Transportation Institute, Montana State University, PO Box 174250, Bozeman, MT 59717, USA. Email: tony.clevenger@pc.gc.ca, Phone: (403) 760-1371. Supervisor on research, see publications part of resume for list of wildlife and roads research project completed.

Alan Dibb, Parks Canada-district west, Kootenay National Park. Email: alan.dibb@pc.gc.ca, Phone: (250) 347-6158. Colleague for analyzing wildlife-vehicle collision data for Parks Canada.

Tom Hurd, Parks Canada-district east, Banff National Park. Email: tom.hurd@pc.gc.ca, Phone: (250) 490-2261. Colleague in researching efficacy of wildlife crossings in Banff National Park, Alberta.

Dr. Giorgos Mountrakis-State University of New York-Environmental Sciences and Forestry, Syracuse, New York. Email:gmountrakis@esf.edu, Phone: (315) 470-4824. Supervisor for master's research, analyzing and creating analyses to evaluate wildlife-vehicle collision data in Vermont.

Jon Jorgenson-Alberta Fish and Wildlife Division, Canmore Alberta. Email:jon.jorgenson@gov.ab.ca, Phone: (403) 678-5508. Colleague in researching efficacy of wildlife crossings in Banff National Park, Alberta.

Appendix C. Resumes

PATRICIA CRAMER

USGS Utah Cooperative Fish and Wildlife Research Unit
College of Natural Resources, Utah State University
Logan, UT 84322-5290
Work phone: 435.797-1289 Cell phone: 435.764.1995
Patricia.Cramer@usu.edu

EDUCATION

Doctor of Philosophy
Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL
Modeling Florida Panther Movements to Predict Conservation Strategies in North Florida

Master of Science
Ecology Department, Montana State University, Bozeman, MT
Small Mammal Diversity and Abundance in Two Old Growth Douglas Fir Forests

Bachelor of Science
Wildlife Biology, State University of New York,
College of Environmental Science and Forestry, Syracuse, NY

CAREER INTERESTS

Landscape connectivity and land conservation planning through the use of wide-ranging wildlife to promote conservation. Transportation Ecology at the national and regional level. Policy development at the national level. Ecological modeling, human dimensions of ecology, including land use planning, environmental education, and private landowners.

PROFESSIONAL EXPERIENCE

Research Associate
USGS Utah Cooperative Fish and Wildlife Research Unit, and Utah Transportation Center, College of Natural Resources, Utah State University, Logan.
Co-Primary Investigator on a National Academies, Transportation Research Board research project to evaluate the use and effectiveness of wildlife crossings, created and ranked national priorities for moving wildlife across roads safely, developed a decision guide for transportation professionals to help make roads more permeable for wildlife across the

United States. Developed and maintain the website: www.wildlifeandroads.org. Finishing up research with an implementation phase of taking research results and decision guide to state Departments of Transportation across the U.S. 2004 to 2008.

Primary Investigator on a Utah Department of Transportation UTRAC research project to monitor wildlife use of areas near roadways and existing wildlife passages across Utah. Will be installing 25 – 30 cameras at existing wildlife underpasses and potential sites for new passages along Interstates 15, 70 and 80, and highway US 6 in Utah. Installation will take place winter 2007-08. Currently monitoring wildlife movement under I-15 with 3 cameras in the Scipio region. 2007-2011.

Expert Witness
Consultant for Attorney General of the State of Arizona in a court case involving wildlife-vehicle collision. April 2007 to present.

Scientific Consultant
Scientific guide for: Big Sky Institute, Montana State University, and the Sierra Club. 2002-2003
Editor of annual report for: Yellowstone Ecological Research Center, 2003.
Researcher, Western Transportation Institute, Montana State University, 2002-2003.

Full Time Parent
Skills mastered include patience, time management, and negotiating. August 2001 - 2004

Visiting Assistant Professor
Ecology Department, Montana State University. Taught graduate level Landscape Ecology and Management, and undergraduate course (with 200 students), Principles of Ecology, 2001-2002.

Visiting Assistant Professor
Department of Wildlife Ecology and Conservation, University of Florida. Taught Biodiversity Conservation, an undergraduate course of 200 students, and graduate and undergraduate levels of Landscape Ecology and Management, 1999-2001. Won Departmental Faculty Member of the Year award 1999-2000.

Graduate Researcher
Created an individual-based spatially explicit model of potential reintroduced Florida panther movements in North Florida. Created model from C++ code and GIS layers, using ArcInfo and ArcView. 1994-1999.

Program Coordinator – Environmental Education Program
Department of Wildlife Ecology and Conservation, University of Florida. Conceived, secured funding, and completed the Northeast Florida Panther Education Program, a public environmental education program, jointly funded by the Florida Advisory Council on Environmental Education and Occidental Chemical Corporation. Conducted telephone surveys, public programs. 1994-1995.

Restoration Advisor
Department of Wildlife Ecology and Conservation, University of Florida. Consulting scientist for mining restoration in the Upper Suwannee River basin, FL. 1992-1995.

Wildlife Technician
U.S. Forest Service, Gallatin National Forest, Bozeman, MT. Conducted wildlife and ecological surveys and inventories. Created district Goshawk Monitoring Plan. 1992.

Graduate Researcher
Ecology Department, Montana State University, Bozeman, MT. Live-trapped small mammals in old growth forests, conducted vegetation surveys, and statistical analyses. 1990-1992.

Instructor for College Course Laboratory and Discussion Sections
Ecology Department, Montana State University, Bozeman, MT. Courses: Environmental Issues, Vertebrate Anatomy, Physiology, Animal Form and Function. 1989-1991.

Coordinator of Old Growth Mapping Project
Coordinated volunteers and Forest Service personnel in mapping and field evaluating old growth stands on the Gallatin National Forest, Bozeman Montana. 1990-1992.

Assistant Supervisor of Children's Zoo
New York Zoological Society (Bronx Zoo), Bronx, NY. 1985-1987.

ADDITIONAL SKILLS

Excellent public speaking skills and consensus building experience. Experience programming in C++ computer language, and use of Geographic Information Systems (GIS), including ArcGIS 9.0 training certification. Successful proposal and grant writing. Experience as a public environmental educator. Work well with federal and state agency personnel, private company personnel, landowners, and environmental organizations.

PUBLICATIONS

In Preparation or Submitted

Cramer, P.C., J. A. Bissonette. North American priorities for safely accommodating wildlife movements within transportation systems. *In preparation.*

Cramer, P.C., J. A. Bissonette, N. Newhouse, T. Kinley, K. Knapp, B. Persaud, C. Lyon, I. Brakop, A. Clevenger, and S. Jacobson. 2007. A wildlife crossing decision tool to mitigate transportation corridors for wildlife. *In preparation*.

Cramer, P. C. and J. A. Bissonette. Evaluating the effectiveness of wildlife crossings in North America. *In preparation.*

Cramer, P. C., J. A. Bissonette, J. Anderson, and P. Jones. 2006. Wildlife and Roads: A resource to help mitigate roads for wildlife. Website for NCHRP 25-27, Evaluation of the use and effectiveness of wildlife crossings. url:http://www.wildlifeandroads.org/

Scientific Peer-Reviewed Published Papers

Cramer, P.C., J. A. Bissonette.2007. Integrating wildlife crossings into transportation plans and projects in North America. *In*: Proceedings of the 2007 International Conference on Ecology and Transportation, Little Rock Arkansas. Center for Transportation and the Environment, North Carolina State University, NC.

Cramer, P. C., and J. A. Bissonette. 2006. Wildlife crossings in North America: The state of the science and practice. Pp. 442-447; *In*: Proceedings of the International Conference on Ecology and Transportation, San Diego, California. Center for Transportation and the Environment, North Carolina State University, NC. http://www.icoet.net/ICOET_2005/proceedings/06IPCh9-442-460.pdf

Cramer, P.C, and K.M. Portier. 2001. Modeling Florida panther movements in response to human attributes of the landscape and ecological settings. Ecological Modelling,140:51-80.

Technical Papers

Cramer, P. C. and J. A. Bissonette. 2007. Priorities in research and practice. Pages 33-46 *in*: J. A. Bissonette, editor. Evaluation of the use and effectiveness of wildlife crossings. Final Report prepared for the National Academy of Science (Transportation Research Board – National Cooperative Highway Research Program). URL: http://www.wildlifeandroads.org/publications/.

Bissonette, J. A., **P. C. Cramer**, A. P. Clevenger, K. K. Knapp, B. Persaud, N. Newhouse, T. Kinley, C. Lyon, S. Rosa, E. Shaw Schowalter-Hay, A. Hardy, K. Gunson, J. Anderson, C. O'Brien, K. G. Wolfe, B. Jennings, S. Jacobson, I. Brakop. 2006. Evaluation of the use and effectiveness of wildlife crossings. Two Year Interim Report prepared for the National Cooperative Highway Research Program, Transportation Research Board, National Research Council, National Academy of Science. USGS Utah Cooperative Fish and Wildlife Research Unit, Utah State University, Logan, Utah. url: http://www4.trb.org/trb/crp.nsf/All+Projects/NCHRP+25-27

Cramer, P., S. Rosa, and J. A. Bissonette. 2006. Condition of Highway 91 Wildlife Underpasses, Escape Ramps, and Fencing in Sardine Canyon, Wellsville Mountains, Utah, Winter 2006. Project Report No. 1. USGS Utah Cooperative Fish and Wildlife Research Unit, Utah State University, Logan Utah. 2006(1):1-20.

Bissonette, J. A., and P. C. Cramer. 2004. Evaluation of the use and effectiveness of wildlife crossings. Interim Report prepared for the National Academy of Science (Transportation Research Board – National Cooperative Highway Research Program).

Thesis and Dissertation

Cramer, P.C. 1999. Modeling Florida panther movements to predict conservation strategies in North Florida. Ph.D. Dissertation. University of Florida. Gainesville. http://uf.aleph.fcla.edu/F/EQYVEVG99TGARDGPJE554VHCQSJERGGNK2FY2H9T3XUV8MKRI4-03095?func=full-set-set&set_number=008164&set_entry=000001&format=999

Cramer, P. 1992. Small mammal diversity and abundance in two old growth Douglas fir forests. M.S. thesis. Montana State University, Bozeman, MT.

Articles, Book Chapters, and Reports

Cramer, P. 1996. Using the Florida Panther to promote conservation. Women in Natural Resources 17(4):10.

Cramer, P. 1995. The Northeast Florida Panther Education Program. Final Report to the Florida Advisory Council on Environmental Education. University of Florida, Department of Wildlife Ecology and Conservation. Gainesville FL.

Harris, L. D., and P. Cramer. 1994. Parks and biodiversity preserves as islands; lessons from historical biogeography and limited trend analysis. *In*, Conservation Corridors in the Central American Region (ed.) A. Vega. Tropical Research and Development, Inc. Gainesville, FL.

Cramer, P., and K. Whitney. 1993. A Compilation of Papers on Conservation Biology: Current Research and Management Issues. Prepared for the Paseo Pantera Central American Wildlife Corridor Conference. Paseo Pantera Project, University of Florida and Tropical Research and Development, Inc. Gainesville, Florida.

GRANTS AND AWARDS

Co-Primary Investigator with John Bissonette. Grant "Implementing the Best Practices for Wildlife Crossings Across North America," from National Academies of Science, National Cooperative Highway Research Program. $75,000. July 2007-June 2008.

Primary Investigator. Awaiting contract: 'Determining Wildlife Use of Wildlife Crossing Structures under Different Scenarios.' Utah Department of Transportation. $220,000; 2007-2011.

Faculty Member of the Year, 1999-2000, Department of Wildlife Ecology and Conservation, University of Florida. Voted by the students for teaching excellence.

Travel Awards to present papers at the Annual Meetings of the Ecological Society of America, August 1999, and the Society for Conservation Biology, June 1999. University of Florida, Graduate Student Council. Grants totaling $ 300. Department of Wildlife Ecology and Conservation, University of Florida Grant of $ 200.

The Florida Advisory Council on Environmental Education with Occidental Chemical Corporation. Grant for the Northeast Florida Panther Education Program, Gainesville, Florida.
Grant: $23,000. 1994-1995.

Occidental Chemical Corporation. Grant for Phosphate Mining Reclamation Landscape Conservation Vision, and Graduate Research Assistantship, Gainesville, Florida. Grants: 1992, $20,000; 1993, $23,000.

The Cinnabar Foundation. Student Research Grant, Bozeman Montana, for Master's Research.
Grant: $1,000. 1990-1991.

The Center for High Elevation Studies. Grant for Master's research, Bozeman, Montana. Grant: $1,500, plus $6,000 research assistantship. 1990-1992.

Regents Scholarship (Undergraduate). State University of New York. Grant of $1,000. 1979-1983.

PAPERS AND POSTERS PRESENTED

Cramer, P. C. 2007. How to keep wildlife off the road and moving. Invited Keynote Speaker at the Deer-Vehicle Crash Symposium, Schenectady, New York, October, 2007.

Cramer, P. C. and J. A. Bissonette. 2007. How do we make the roaded landscape more permeable for wildlife? Presented at The Wildlife Society Annual Meeting, Tucson, Arizona, September, 2007.

Cramer, P. C. and J.A. Bissonette. 2007. Wildlife and transportation planning: The new paradigm. Invited Keynote Speaker for Idaho Transportation Department Streamside Chat Workshop, Rigby Idaho, June 2007.

Cramer, P. C., and J. A. Bissonette. 2007. Integrating wildlife crossings into transportation plans and projects in North America. Paper presented at International Conference on Ecology and Transportation, Little Rock, Arkansas. May 2007. Center for Transportation and the Environment, North Carolina State University, NC.

Cramer, P. C., and J. A. Bissonette. 2007. North American decision guidelines for mitigating roads for wildlife. Paper presented at International Conference on Ecology and Transportation, Little Rock, Arkansas. May 2007. Center for Transportation and the Environment, North Carolina State University, NC.

Cramer, P. C. 2007. Transportation ecology: current and future directions of the science of wildlife and roads. Invited Seminar, Road Ecology Center, University of California, Davis. May 2007. http://roadecology.ucdavis.edu/vistingscholarmay8.html

Cramer, P. C., and J. A. Bissonette. 2007. NCHRP 25-27 update: Evaluation of the use and effectiveness of wildlife crossings in North America. Presented to American Association of State Highway Transportation Professionals (AASHTO) Standing Committee on Highways. Spring Meeting, Phoenix, Arizona, May 2007.
http://highways.transportation.org/?siteid=54&pageid=2247

Cramer, P. C., and J. A. Bissonette. 2007. Wildlife crossings and transportation planning in the U.S. Invited keynote speaker. Toronto Zoo Roads and Ecopassages Forum, Toronto, Ontario, Canada. March 2007.

Cramer, P. C., and J. A. Bissonette. 2007. The state of the practice of wildlife crossings. Invited keynote speaker. Toronto Zoo Roads and Ecopassages Forum, Toronto, Ontario, Canada. March 2007.

Cramer, P. C., and J. A. Bissonette. 2007. The state of the science and practice for mitigating roads for wildlife in North America. Keynote speaker at Caltrans Road Ecology Meeting, University of California, Davis. February 2007.

Cramer, P. C., and J. A. Bissonette. 2007. Wildlife crossings: Current and future directions. Invited speaker at Caltrans Road Ecology Meeting, University of California, Davis. February 2007.

Cramer, P. C., and J. A. Bissonette. 2007. Wildlife crossings and transportation planning in the United States. Invited seminar speaker to Utah State University Department of Landscape Architecture. February, 2007.

Cramer, P. C., J. A. Bissonette, N. Newhouse, T. Kinley, S. Jacobson, K. Knapp, B. Persaud, C, Lyon and A. Clevenger. 2007. A wildlife crossing decision tool to mitigate transportation corridors for wildlife. Presentation to the Transportation Research Board Annual Meeting, Washington, D.C. January, 2007.

Cramer, P. C., and J. A. Bissonette. 2007. Overview of NCHRP Project 25-27: Evaluation of the use and effectiveness of wildlife crossings. Invited presentation to the Transportation Research Board Annual Meeting, Washington, D.C. January, 2007.

Cramer, P. C., and J. A. Bissonette. 2007. Priorities for safely accommodating wildlife movement within transportation systems. Invited presentation to the Transportation Research Board Annual Meeting, Washington, D.C. January, 2007.

Cramer, P. C. and J. A. Bissonette. 2006. Carnivore crossings and roads in North America: How are we doing? Paper presented at Defenders of Wildlife Carnivores 2006 Conference, St. Petersburg, FL, November 2006.

Cramer, P. C. 2006. Transportation Ecology: Current and Future Directions of the Science of Wildlife and Roads. Invited Seminar, College of Natural Resources, Utah State University, Nov. 2006.

Cramer, P. C. and J. A. Bissonette. 2006. Wildlife crossings and transportation planning in the United States. Invited presentation to 2006 The Transportation Conference Hosted by the U.S. Fish and Wildlife Service, Shepherdstown, West Virginia, August 2006.

Cramer, P. C. and J. A. Bissonette. 2006. Wildlife and roads: The state of the science and practice. Invited presentation to the 2006 MNDOT Environmental Stewardship and Streamlining Workshop. Minneapolis, MN, March 2006.

Cramer P. C. and J. A. Bissonette. 2006. Wildlife passages: How does Utah compare to the rest of North America? Paper presented at Utah Chapter of the Wildlife Society Annual Meeting, Moab, UT. March 2006.

Cramer, P. C. and J. A. Bissonette. 2006. The use and effectiveness of wildlife crossings. Invited presentation to the Natural Resources Law Forum at the Wallace Stegner Center for Land, Resources and the Environment, S. J. Quinney College of Law, University of Utah, Salt Lake City, UT. February 2006.

Cramer, P. C. and J. A. Bissonette. 2006. Wildlife crossings in North America. Invited presentation to the Transportation Research Board Wildlife and Highways Workshop. Washington, D.C. January, 2006. url: http://refugedata.fws.gov/trb/2006Workshop/index.html.

Cramer, P. C. and J. A. Bissonette. 2006. Priorities for research and practice related to wildlife and roads. Invited presentation to the Transportation Research Board Wildlife and Highways Workshop. Washington, D.C. January, 2006.

Cramer, P. C. and J. A. Bissonette. 2006. NCHRP 25-27 Update: Evaluation of the use and effectiveness of wildlife crossings in North America. Invited presentation to the Transportation Research Board Wildlife and Highways Workshop. Washington, D.C. January, 2006.

Cramer, P.C., and J. A. Bissonette. 2005. NCHRP 25-27 update: Wildlife crossings in North America. Invited presentation to Deer-Vehicle Crash Reductions: Setting a

Strategic Agenda Workshop. University of Wisconsin, Madison, Wisconsin October, 2005.

Cramer, P.C., and J. A. Bissonette. 2005. Wildlife Crossings in North America: The State of the Science and Practice. Paper presented at International Conference on Ecology and Transportation, San Diego, California, August-September 2005. Center for Transportation and the Environment, North Carolina State University, NC. url: http://www.icoet.net/ICOET_2005/proceedings/06IPCh9-442-460.pdf

Bissonette, J. A., P. C. Cramer, N. Newhouse, T. Kinley, K. Knapp, B. Persaud, C. Lyon, A. Clevenger, S. Jacobson. 2005 A Decision Tool for Mitigating Roads for Wildlife: The NCHRP 25-27 Project (Poster). International Conference on Ecology and Transportation, San Diego, California, August-September 2005. Center for Transportation and the Environment, North Carolina State University, NC.

Cramer, P. C, and J. A. Bissonette. 2005. Wildlife and Roads: The State of the Science and Practice. Cramer, P. C. and J. A. Bissonette. 2006. Priorities for research and practice related to wildlife and roads. Invited Co-Keynote Address, Rockies Wildlife Crossing Field Course, Payson Arizona. Southern Rockies Ecosystem Project, Arizona Game and Fish, Arizona Department of Transportation, and Center for Transportation and the Environment, NC State. April, 2005.
To view slide show see: http://itre.ncsu.edu/CTE/gateway/rockies_classroom.asp#Cramer

Cramer, P.C., and J. A. Bissonette. 2005. Restoring permeability in the roaded landscape: Priorities for research. Paper presented at International Association of Landscape Ecology Annual Symposium. March 2005. Syracuse, NY.

Cramer P. 2000. A spatially explicit model to assist in Florida panther reintroduction and conservation priorities. Paper presented at Defenders of Wildlife, Carnivores 2000 Conference, November, 2000, Denver, CO.

Cramer, P., and R. Hamlin. 2000. Using the Florida panther and a spatially explicit model to predict conservation strategies. Paper presented at International Society of Landscape Ecology, North American Annual Symposium. April, 2000. Fort Lauderdale, FL.

Cramer P. 1999. A model to predict Florida panther movements and conservation strategies. Paper presented at Ecological Society of America, Annual Meeting, August 1999. Spokane, WA.

Cramer, P. and K. Portier. 1999. A spatially explicit model to predict Florida panther movements and regional conservation strategies. Paper presented at Society for Conservation Biology, Annual Meeting. June 1999. Baltimore, MD.

Cramer, P. and K. Portier. 1999. A spatially explicit model to predict movements of potential reintroduced Florida panthers in north Florida. Paper presented at Florida Chapter of the Wildlife Society Annual Meeting. March 1999. Orlando FL.

Cramer, P. 1991. Small mammal diversity and abundance in old growth forests. Paper presented at The Montana Wildlife Society Annual Meeting. March 1991. Bozeman, MT.

Cramer, P. and E. S. Dierenfeld. 1987. Reviewing the diets of an Education Department collection. Paper presented at AAZPA Regional Conference Meeting. May 1987. Syracuse, NY.

REFEREE FOR PEER-REVIEWED PAPERS

Reviewed papers at the request of editors for:
Human-Wildlife Conflicts (2007), Landscape and Urban Planning (2007), Prairie Naturalist (2006), Transportation Research: Transport and Environment (2005), Conservation Biology (1998), Springer Publishing Company book proposal review (2007)

INVITED PARTICIPANT IN FLORIDA PANTHER CONSERVATION

Member of MERIT Panther Sub-Team, a U.S. Fish and Wildlife Service scientific panel consulted for the implementation of the South Florida Multi-species Recovery Program. 1999- 2000.
Florida Panther Population and Habitat Viability Analysis Workshop 1999
Florida Panther Conflict Resolution Consortium 1998
Private Habitats: Havens for Threatened and Endangered Species 1998
Florida Panther Recovery Plan Revision Process 1997

HONORARY AND PROFESSIONAL SOCIETIES AND ORGANIZATIONS

Appointed Member of the Transportation Research Board's Committee on Ecology and Transportation (2007-2010)
International Conference on Ecology and Transportation, Research and Program Committees
Society for Conservation Biology
International Association of Landscape Ecology
Ecological Society of America
The Nature Conservancy
Gamma Sigma Delta Agricultural Honor Society

Kari Gunson

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EDUCATION:

- State University of New York, Environmental Science and Forestry, M.Sc. in geospatial technologies, May 2005-August-2007.

- University of Cape Town: M.Sc. in Conservation Biology, January 1998- February 1999.

- University of Calgary: B.Sc. in Zoology and Ecology, 1989-1994.

COMPUTER LITERACY:

- Applied use of Geographic Information Systems (G.I.S.), Arcview 3.3, and ArcGIS 9.1, and their various extensions (Spatial and 3D Analyst).
- Matlab 7.1 computer programming (Applied mathematical manipulation of raster images arranged in matrices).
- GPS software (Pathfinder, Oziexplorer), and its applications to G.I.S.
- Various applications of Statistical Analysis Software, including SPSS 11.0, Minitab, Statistica, and SAS.
- Front Page web page design software.
- Graphic Software, Coreldraw 8 and Adobe Photoshop.

WORK HISTORY:

Parks Canada, Trans-Canada Highway Project, Banff, Alberta: September 1999-May 2006, Contract Wildlife Biologist.

- Responsibilities include leadership and management of field data collection, database organisation, and analysis of biological field data
- Accomplishments:
  - Co-authored many progress reports, manuscripts, and peer-reviewed biological journal articles
  - Presented in Discovery Channel-Animal Tracks & National Geographic Yellowstone to Yukon documentaries on international television
  - Contracted by Discovery Channel to obtain video footage of animal crossings on overpass in BNP, used in one hour documentary
  - Collected and monitored 6 years of laser triggered digital and slide images on two overpasses which led to the publication ‘Banff Wildlife Crossings’ poster and exhibit at the Whyte Museum to help promote Ecological Integrity in Canada’s National Parks

- Supervised and involved in the daily collection of wildlife-vehicle collision and wildlife crossing data
- Collaborated with other wildlife projects, graduate students, and park wardens to assimilate monitoring data to determine ecological integrity of BNP's wildlife community
- Analysed and interpreted data in statistical software to be used for manuscripts and peer reviewed journal articles
- Presented project description and results of research to many international and local audiences, and developed the Trans-Canada Highway Research web page on Parks Canada website
- Used differentially correctable Trimble and Garmin Geographic Position System (GPS) units to map roadways, roadkills and road features into a G.I.S.
- Modelled and spatially analysed animal mortalities on highways to identify spatial and temporal patterns of mortality
- Compiled 30 years of mortality data stored in various computer formats and database templates into one common Microsoft Access database

OTHER PROJECTS WITH PARKS CANADA:

- Currently contracted by Dr. Tony Clevenger, to write various reports and scientific papers on wildlife vehicle collision research in the Rocky Mountains
- Project leader for amphibian monitoring project in the Banff-Bow Valley designed to determine the relative population trends in the mountain parks
- Project leader to Managed for an amphibian habitat assessment of wetlands adjacent to a major transportation corridor
- Downloaded GPS grizzly bear collar data using Televilt software and compiled 10 years of grizzly telemetry data into a single Microsoft Access database

Petro-Canada, Calgary, Canada: July 1997-Jan.1998, April 1996-Dec. 1996, & May 1994-April 1995, Benefits Administrator.

- Responsibilities entailed administering the employees their benefits, within the human resources department
- Accomplishments:
  - Implemented computer coding system for new savings plan scheme
  - Reconciled two years of savings plan statements and financial summaries
  - Formalised letters to employees for new savings plan package
  - Trained new employees on numerous human resource skills

VOLUNTEER WORK:

University of Calgary, Calgary, Alberta, April 1998-August 1998, Field technician.

- Involvement with Masters student in assessing the effects of pipelines on the local stream ecology.
- Entailed taking stream water measurements, such as temperature and water velocity, and invertebrate and substrate samples to be later analysed in the laboratory.

Mondi Forestry, White River, South Africa, May 1997-July 1997, Sub-contracted Vegetation Analyst.

- Responsibilities included mapping vegetation within forestry plantations, taking note of any poor plantation planning.
- A report was formulated advising Mondi on better conservation management within the plantations, e.g. recommendations to protect the surrounding indigenous flora from alien invasion

RESEARCH COMPLETED

Thesis

1) Gunson, K.E., Multi-scale, spatiotemporal, and statistical analyses of moose-vehicle collisions in Vermont. Submitted in partial fulfillment of MSc requirements to the State University of New York, Environmental Science and Forestry, August 2007.

2) Gunson, K.E., The economic value and sustainability of use of wetland plant resources in the eastern Caprivi wetlands, Namibia. Submitted in partial fulfillment of MSc requirements to the University of Cape Town, February 1999.

Publications-peer reviewed

1) **Gunson, K.E**., Mountrakis, G. (in review) A review of spatial predictive models for wildlife-vehicle collisions. Biological Conservation, in review.

2) **Gunson, K.E**., Clevenger, A.P., Bissonette, J.A., and Hardy, A. (accepted with major revisions) Limited applications of wildlife-vehicle collision analyses for mitigation planning due to spatial inaccuracy. Conservation Biology.

3) Chruszcz, B.J., Clevenger, A.P., **Gunson, K**., and Gibeau, M. 2003. Relationships among grizzly bears, roads and habitat in the Banff-Bow Valley, Alberta, Canada. Canadian Journal of Zoology. 81:1378-1391.

4) Clevenger, A.P., B. Chruszcz, and **K. Gunson** 2003. Spatial patterns and factors influencing small vertebrate fauna road-kill aggregations. Biological Conservation 109:15-26.

5) Clevenger, A.P., Wierzchowski, J., Chruszcz, B., and **Gunson, K**. 2002. GIS-generated expert based models for identifying wildlife habitat linkages and mitigation passage planning. Conservation Biology 16:503-514.

6) Clevenger, A.P., Chruszcz, and **Gunson, K**. 2001. Drainage culverts as habitat linkages and factors affecting passage by mammals. Journal of Applied Ecology 38 :1340-1349.

7) Clevenger, A.P., McIvor, M., McIvor, D., Chruszcz, B. and **Gunson, K**. 2001. Tiger salamander, *Ambystoma tigrinum*, movements and mortality on the Trans-Canada highway in southwestern, Alberta. Canadian Field-Naturalist 115 :199-204.

8) Clevenger, A.P., Chruszcz, B. and **Gunson, K**. 2001. Effectiveness of highway mitigation fencing at reducing wildlife-vehicle collisions. Wildlife Society Bulletin 29:646-653.

Technical reports

1) Clevenger, A.P., A. Hardy, and **K.E. Gunson.** 2006**.** Analyses of wildlife-vehicle collision hotspots and their application to transportation planning. In National Highway Cooperative Research Program Final Report, Utah State University.

2) Clevenger, A.P., A. Hardy, and **K.E. Gunson.** 2006**.** Analyses of wildlife-vehicle collision data: applications for guiding decision-making for wildlife crossing mitigation and motorist safety. In National Highway Cooperative Research Program Final Report, Utah State University.

3) Huijser, M.P., **K.E. Gunson**, and C. Abrams. 2006. Animal-Vehicle Collisions and Habitat Connectivity along US Highway 83 in the Seeley-Swan Valley, Montana: a Reconnaissance. Final Report to Montana Department of Transportation. Helena, Montana.

4) **Gunson, K**. **E.** 2004. Field summary for the 2004 Banff-Bow Valley amphibian survey, and relative abundance trends. Final report to Parks Canada. Banff National Park, Canada.

5) **Gunson, K. E.** 2003. Field summary for the 2003 Banff-bow valley amphibian survey, and recommendations for long-term monitoring. Final report to Parks Canada. Banff National Park, Canada.

6) **Gunson, K**. **E.,** and Clevenger, A.P. 2002. An amphibian habitat assessment of the phase IIIB portion of the Trans-Canada highway. Final report to Parks Canada. Radium Hot Springs, B.C., Canada.

7) Clevenger, A.P., B. Chruszcz, B., **K.E. Gunson** and J. Wierzchowski. 2002. Roads and wildlife in the Canadian Rocky Mountain Parks - movements, mortality and mitigation. Final report to Parks Canada. Banff, Alberta, Canada.

8) Clevenger, A.P., B. Chruszcz, and **K. E. Gunson** and M. Brumfit. 2002. Highway mitigation monitoring, Three Sisters Parkway Interchange. Final report. Alberta Environment, Canmore, Alberta.

Conference and workshop proceedings

K.E. Gunson, and A.P. Clevenger. Limited applications of wildlife-vehicle collision analyses for transportation planning and mitigation efforts due to spatial inaccuracy. International Conference on Ecology and Transportation. Little Rock, Arkansas. May 2007.

K.E. Gunson. Paving the road towards the future: Developing valid spatial models to predict wildlife-vehicle collision locations. Toronto Zoo Ecopassages Forum (keynote speaker). Toronto, Ontario. 2007.

K.E. Gunson, *A. P. Clevenger, B.J. Chruszcz. What features of the landscape and highway influence ungulate vehicle collisions in the watersheds of the Central Canadian Rocky*

Mountains: a fine-scale perspective? International Conference on Ecology and Transportation. San Diego, California. September 2005.

K.E. Gunson, A. P. Clevenger, B.J. Chruszcz. Large animal-vehicle collisions in the Central Canadian Rocky Mountains: patterns and characteristics. International Conference on Ecology and Transportation. Lake Placid, New York. September 2003.

Clevenger, A.P., B.J. Chruszcz**, K.E. Gunson.** Mitigation for impacts of roads on wildlife – Road ecology session. International Conference on Ecology and Transportation 2001. Keystone, Colorado, USA. September 2001.

Clevenger, A.P., N. Waltho, **K.E. Gunson,** and B.J. Chruszcz**.** Factors affecting the permeability of wildlife passages in Banff, Alberta, Canada. 85th Meeting of the Ecological Society of America, Snowbird, Utah. August 2000.

Clevenger, A.P., B.J. Chruszcz**,** and **K.E. Gunson.** A GIS approach for identifying wildlife crossing structure placement using landscape linkage modeling. 15th Annual Symposium, U.S. Regional Association of the International Association for Landscape Ecology, Fort Lauderdale, Florida. April 2000.

Chruszcz**,** B.J. and **K. Gunson.** Multiple species mortality and the assessment of mitigation effectiveness in Banff National Park. Transportation and Wildlife Workshop, Banff National Park. February 2000.