Highway Wilding

Wildlife Monitoring and Research Collaborative in the Canadian Rocky Mountains

# Backgrounder: Research on highway effects on wildlife populations

**March 2012**

Banff National Park and its environs represent one of the best testing sites of innovative roadway mitigation – wildlife passages in the world. Long-term research has been conducted since 1996 assessing the impacts of highways and performance of their mitigation measures designed to reduce fragmentation of wildlife habitat.

**Transportation Environment**

The Trans-Canada Highway (TCH) has long been recognized as a lethal barrier to wildlife and a potential fracture zone for population connectivity at local and landscape scales. Mitigation in the form of wildlife underpasses and overpasses has essentially restored habitat connectivity across large sections of this major transportation corridor. Currently there are 44 "safe passage" structures for wildlife, large and small, along the 83 km of the TCH in Banff National Park.

**Natural Environment**

Canada's Rocky Mountain front harbors the richest diversity of large mammals remaining in North America. This landscape is among the continent's last remaining undisturbed natural areas, and provides a critical transboundary linkage with the United States. Maintaining landscape connectivity throughout the ecoregion is critical for animal movement and dispersal as well as ecosystem health. At the ecoregion-scale this has occurred through integrating public and private land management that, combined, provide regional scale connectivity. However, securing local-scale connections will be equally important for making landscapes permeable for wildlife movement at a continental-scale.

**Our Geographic Location**

Our research is situated in the heart of the Canadian Rocky Mountains, straddling the Continental Divide, and amongst the largest protected area complex in North America (approximately 5 million acres, or over 2 million hectares): Banff, Jasper, Yoho, & Kootenay National Parks). This vast area is one of eight Priority Areas identified by the Yellowstone to Yukon Conservation Initiative (Y2Y). This is the southernmost Priority

Area, recognized as being critical for harboring important source populations that can potentially disperse to and populate more fragmented and human-disturbed ecosystems to the south, east and west.

**Research History**

In 1996, Parks Canada contracted Dr. Tony Clevenger, at the time an independent wildlife biologist, to assess the performance of Banff's TCH mitigation measures. The research project responded with a rigorous, peer-reviewable, five-year study (Clevenger et al. 2002). Once this initial phase of monitoring was complete, Parks Canada scaled back funding for Clevenger's research to maintain only basic monitoring of the crossing structures.

In 2002, Dr. Clevenger became affiliated with the Western Transportation Institute (WTI) at Montana State University, while maintaining the monitoring program in Banff and searching for broader support to re-initiate long-term research. In 2004, funding from the Woodcock and Wilburforce Foundations supported a pilot research project devising a non-invasive method of sampling DNA from bears using the Banff crossing structures (Clevenger and Sawaya 2010). In 2005, the Woodcock, Wilburforce and Henry P. Kendall Foundations and WTI formalized a 3-year partnership agreement with Parks Canada to support a continuation of Dr. Clevenger's research and population genetics study.

**Research Impact**

To date, the Banff research is recognized by transportation, wildlife and land management agencies as a leading source of information for the field of road ecology, providing science-based guidance for resolving highway-wildlife conflicts throughout North America and abroad. In addition, it continues to garner attention of the news media and educational publishing houses worldwide. More than 30 scientific papers have been published in peer-reviewed journals since his research began 15 years ago. Dr. Clevenger communicates science to local communities, decision makers, conservation advocates and other stakeholders. He maintains solid working relationships with diverse stakeholders such as Alberta Transportation, Canadian Pacific Railway, Bow Valley Naturalists, Canadian Parks and Wilderness Society, the Alpine Club of Canada and Y2Y as well as many others.

**Partnerships**

The *Wildlife Monitoring and Research Collaborative in the Canadian Rocky Mountains* (later branded *Highway Wilding*) was formed in 2009 to provide solutions that help reduce conflicts between transportation corridors, wildlife conservation, and large-scale landscape connectivity. Collaborative partners include the Miistakis Institute, WTI at Montana State University, Parks Canada and the Woodcock Foundation. Our goal is to gather the essential scientific information and to develop the appropriate tools to address current and future ecosystem management priorities as they relate to

maintaining landscape-scale connectivity across transportation corridors and changing climates.

**Roll the Numbers…**

Research has shown the 11 species of large mammals in Banff National Park have been detected using the wildlife crossing structures more than 200,000 times. Unique or unexpected use by red fox, striped skunk, hoary marmot, boreal toad, garter snakes, wolverine, lynx and beavers also has been recorded.

- The number of recorded grizzly bear crossings has soared 35-fold, from five crossings in 1996 to over 180 crossings in 2008. As a proportion of all wildlife traffic on the crossing structures, grizzly bear use went from once every 2000 crossings to a little more than one in every 100 crossings by wildlife.
- Use by other large mammal species fluctuates annually. Yearly proportional usage of the crossings for elk declined by 45 per cent, while deer use of the crossing structures increased dramatically from 45 per cent to over 70 per cent in a 10-year period.
- The presence or absence of an alpha female wolf makes a significant difference in how wolves use the crossing structures. The number of recorded through passages by wolves decreased 13 per cent in the month after the mortality of an alpha female wolf and the number of crossing events where wolves hesitated to cross increased threefold following her death.

**Road-related Wildlife Mortality**

The highway fencing along the Trans-Canada Highway (TCH) combined with crossing structures reduced rates of wildlife–vehicle collisions for most species and improved motorist safety.

- Ungulate (deer, elk, and moose) mortality was two to four times lower on the mitigated section of the TCH than sections without fencing and crossing structures.
- The overall trend in road mortality rates for elk is approaching zero along the mitigated section of TCH. Before mitigation, there were over 100 elk-vehicle collisions per year on the same section of TCH.
- Road mortality rates were 50–100 per cent lower for large carnivores along the mitigated section of the TCH than on other unmitigated stretches of the highway.

**Overpass or Underpass?**

Grizzly bears, moose, wolves, elk and deer have a greater tendency to use large crossing structures including wildlife overpasses, while cougars use the opposite – smaller more constricted underpass structures. Black bears and coyotes used both large and small crossing structures equally.

**Crossing Structures as "Prey Traps"?**

Do predators sit and wait at the entrances to pounce on prey? This question always comes up and we've done a thorough analysis of the data to determine whether the Banff wildlife crossings are prey traps. Looking over three independent data sets we

found that the Banff crossings were not prey traps. The proximity of ungulate kill-sites to the TCH was roughly the same prior to and after the construction of fencing and crossing structures. Only 5 kill-sites were found near crossing structures after more than 32,000 monitoring visits over the span of 13 years. We used remote, motion-triggered cameras and found no evidence of predators pursuing prey. These results suggest that large mammal predator-prey interactions at wildlife crossing structures in Banff National Park are not explained by the prey trap hypothesis.

**Interspecific Avoidance?**

Inter-species interactions may be a more important factor in determining species use of wildlife crossings than previously thought. It was found that there was a low probability of wolves, cougars and coyotes being detected at the same wildlife crossing structure during the same time interval (~3 days). When they were detected during the same monitoring interval, coyotes were nearly twice as likely to be detected with wolves as with cougars. Cougars and wolves rarely co-occurred at the same crossing structures.

**Are There Design Type Differences?**

The proportional use of the wildlife crossing design types (box culverts, metal culverts, open-span bridge underpasses, wildlife overpasses) has been consistent year to year for some species but not for others.

- Use of the four crossing design types by deer, elk, moose, grizzly bears, and wolves varied little during a 12-year period.
- However, for cougars, black bears and coyotes, use of crossing design types were not consistent and varied from year to year. Interpretation of the data suggests preference for crossing structures by these species is less a function of selection and more influenced by the presence of larger predators in the study area.

**A Learning Curve?**

What do we know about adaptation periods and learning curves for animals using wildlife crossing structures? We examined time-series data from eight species of large mammals (three ungulates and five carnivores) using the Phase IIIA wildlife crossings over a 12-year period (1997-2008). In a generalized graph, the amount of use at the crossing should increase over time, but at some point use would begin to level out and then fluctuate slightly each year. We determined the number of monitoring years required to reach a discernable leveling off point. The estimated initial adaptation periods ranged from three years (cougar, black bear) to six years (grizzly bear, wolf). The average estimated adaptation period for the eight species was 5.9 years.

**Tunnels of Love and Bridges of Gene Flow: A population genetics study**

*Question:* Let a virile adult male black bear (M1) run back and forth across the TCH using wildlife underpasses and overpasses during breeding season – and how many females might he breed with? *Answer:* Five.

*Question:* And how many offspring might this male be able to father, thanks to these safe passages? *Answer:* Eleven!

These are just some of the revelatory results of an intensive 3-year PhD study by Mike Sawaya using an innovative noninvasive technique (hair capturing at the wildlife crossings and the adjacent population) to determine the number of individuals using the Banff crossings, their gender and relatedness. There were few male grizzly bears as prolific as M1, however, one male mated with two females and had five offspring. The study provides the first empirical evidence of gene flow occurring at wildlife crossing structures anywhere – whereby male and females were documented using the crossings and successfully dispersing, accessing mates, breeding and moving genes across a major transportation corridor.

*What does it take?*
Over 6,000 DNA samples were collected between 2006-2008 from bears (black and grizzly) in Banff NP from the population within our study area (hair traps and rub trees) and bears using the wildlife crossings.

*What did we find?*

- In 2006, 11 black bears (five females, six males) and 11 grizzly bears (four females, seven males) were identified using the wildlife crossings. In 2007, eight black bears (four females, four males) and 12 grizzly bears (six females, six males) were sampled using the wildlife crossings.
- The greatest number of passages occurred in peak summer months when bears have the greatest need to move around the landscape to find food and mates.
- The yearly average number of crossings per individual identified through DNA analysis was 5.4 for black bears and 6.1 for grizzly bears.
- It was found that bear rub trees can be an especially powerful population monitoring tool for grizzly bears in the Central Canadian Rockies and can even outperform the conventional bear population estimation method for the region, hair traps.
- We also found that bear rub trees do not detect many black bears in Banff NP, but hair traps work well.
- All of our results taken together show the power of non-invasive genetic sampling methods to study bear populations and confirm earlier results based on track pad and remote camera data suggesting that both male and female bears mixed freely across the TCH using the wildlife crossing structures and the Banff crossings are functional from a genetic and demographic standpoint.

For more information, please visit http://www.highwaywilding.org