No Ordinary Highway: A Thirty-Year Retrospective, Trans Canada Highway, Banff National Park of Canada

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The setting

In the fall of 1883, three Canadian Pacific Railway construction workers stumbled across a cave containing hot springs, on the eastern slopes of Alberta's Rocky Mountains. From that humble beginning came Banff National Park, Canada's first national park, and the world's third. Spanning 6,641 sq km (2,564 sq mi) of valleys, mountains, glaciers, forests, meadows, and rivers, Banff National Park is one of the world's premier destination spots. Almost half of its area is alpine ecoregion, comprising rock and ice, and is inhospitable for wildlife, leaving only the valley floors between mountain ranges for their survival.

The Trans Canada Highway (TCH) is Canada's major pan-Canadian corridor, spanning from sea to sea. First conceived in the mid-1930s, it was initially a hodgepodge of roads of different standards. In the mid fifties, the Canadian government undertook a major redevelopment program to bring the highway to a modern and consistent standard across the country, culminating in its completion on September 3, 1962. It was at this time that the opportunity to relocate the highway outside of Banff National Park existed. Given the times, little attention was paid to wildlife, their habitat needs, and how the highway might alter ecosystem function. The route selected followed the historic route forged by early motorists, paralleling the railroad within the Bow River's low flat valley, cutting through the heart of Banff National Park. This same valley is home to much of the park's wildlife. The die was cast and the impact of this decision on park wildlife would be felt for decades.

The situation

Banff National Park is administered by Parks Canada Agency, with a mandate to present and protect the park for present and future generation. As a length of the Trans Canada Highway is located within and on lands designated as national park, the responsibility for administration and management of this section of highway also falls to Parks Canada.

Banff National Park is also home to the richest diversity of large mammals remaining in North America. However, because its landscape is comprised to a large extent of rock and ice, the quality of habitat to support some species, such as grizzly bears and wolverines is extremely poor, resulting in large home ranges to seek out food. Animals like grizzlies are always hungry and on

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the move in search of their next meal or mate with the highway representing an obstacle that must be crossed. This environment also has a direct correlation to births. Grizzlies in Banff National Park have extremely low reproduction rates, and to maintain the population, the simple relationship exists that birth rate must equal the death rate. Highway-caused mortality represents a disruption to this delicate balance.

It is this need to maintain a reproduction/mortality ratio of one, and Parks Canada's mandate, that best explains the effort and costs that have been invested to reduce wildlife deaths caused by wildlife-vehicle collisions, and to create safe habitat connectivity and permeability across the Trans Canada Highway.

The early years of twinning (liability)

In the late 1970s, traffic volumes and lengthy delays on the Trans Canada Highway between the park's east gate and Town of Banff, combined with increasing number of personal injury and property damage claims arising from wildlife-vehicle collisions, led to the demand by motorists for the twinning (converting a two lane highway into a divided four-lane highway, two lanes going in each direction) of the highway through Banff National Park. While human deaths were rare occurrences in these collisions, the increasing number of wildlife deaths, especially to elk, was disturbing to many, given the national park context. In response, the federal government put forward a proposal to twin the section of highway known as Phase I, which runs from Banff National Park east gate to the Town of Banff.

Countering this demand was a small, vocal group of local and national environmental organizations that argued that a major highway corridor had no place within a national park, and should be diverted to an alternate alignment outside of the park. Apart from wildlife deaths, concern was voiced with respect to the significant habitat loss from the expanded footprint caused by twinning the road. In addition, the possibility of habitat fragmentation and, as a consequence, potential habitat isolation leading to loss of genetic diversity within the species population, was also cited.

The divergence of opinion about the project led to the conclusion by the government in May 1978, that an Environmental Impact Statement be prepared, a formal review panel under the then Canadian environmental law should be convened to review the environmental impacts of the project, and public hearings should be conducted for this proposed first phase. Interveners in favour and opposed presented their perspectives, suggesting potential mitigation measures, and short and long term alternatives, as well as challenging the very need for the project. The debate was emotionally charged, but in the end, the panel concluded that the proposed project need was clearly demonstrated; no viable alternatives existed; that the environmental disturbances/impacts could be mitigated through the installation of fencing to eliminate ungulate mortality, along with construction of underpasses to permit safe wildlife movement across the highway; and that the overall environmental impact would not be significantly detrimental.

No sooner had this ruling been made and design commenced, than additional funding was received to pursue expanding an additional 14 km (Phase II) section of the highway, west of the Town of Banff. Given the lack of satisfaction and results of the first environmental assessment, interveners opposed to the project were able to successfully lobby that another formal review panel be convened to again review need and environmental impacts. Many of the same issues and concerns were raised, and in the end, the panel again concluded that the project could proceed, providing similar mitigations of underpasses and fencing to address elk, sheep, and moose mortality be adopted, and that their effectiveness be evaluated.

As a result of these conclusions and rulings, the Trans Canada Highway in Banff National Park embarked on becoming a world leader in mitigating the environmental impact of highways on flora and fauna, both at a local, and larger temporal level. Seven exclusive 16.5 m wide by 4 m

high wildlife underpass structures were constructed in Phases I and II. Fifty four and a half km of 2.5 m high page-wire fence was erected, with one way gates to permit ungulates that inadvertently found themselves inside the fenced right-of-way to escape. Nine Texas gates (cattle guards) were installed on access roads, to permit vehicles unimpeded ingress and egress through fences

The cost of these environmental mitigations amounted to approximately 13% of total construction costs. The success of these mitigations was immediately evident, with the number of ungulate mortalities as a result of wildlife-vehicle collisions reduced by 95%. Use of the crossing structures by elk and other ungulates was monitored for a year, and indicated that they were being used. No further monitoring took place.

The changing tide (transition)

Twinning of the Trans Canada Highway has proceeded in phases, as traffic volumes and accidents increased. It was not until the mid-1990s that the next phase (IIIa) of twinning was justified and funded; Phase IIIa ran between the end of Phase II and Castle Mountain Interchange, a distance of 18 km. Environmental concerns about the level of development in Banff, and the park's carrying capacity to accommodate more visitors without impairing it for future generations, were at the forefront of public concern. Opposing camps argued that parks were not intended to be nature preserves, but rather places for people to experience the park.

Trust in Parks Canada's management and administration, on the part of many external stakeholders, was at an all-time low. The successfulness of mitigations in earlier phases of twinning were questioned and challenged. Sheep that once used cliffs as escape terrain were prevented from using them by fences, with result that the population was decimated by predators. Wolves had re-colonized the park, and along with other carnivores, such as grizzlies, were now being killed within the highway right-of-way because the fence had been designed to prevent only large ungulates from accessing it. Monitoring the crossing structures had not continued beyond the first year after highway completion for any of the earlier project phases. Thus, no data existed to refute claims that no wildlife other than deer and elk had ever used them, which subsequently led to concerns about fragmentation and gene pool isolation.

With this as a background, the next phase of twinning environmental assessment took place and, building on past assessments and mitigation strategies, concluded that impacts could be mitigated through fencing and underpass structures. Public comment and concern centered on the lack of evidence that the previously constructed 16.5 m crossing structures and fencing actually worked for carnivores. With no data to refute these concerns, Parks Canada committed to building two 30 m wide underpass structures at known wildlife crossing locations, along with constructing seven smaller crossing structures at more frequent intervals than had been used during the previous phases (one every two km). A buried apron, in association with the fence, was proposed to prevent carnivores from gaining access by crawling or tunnelling beneath the fence.

Despite these commitments, there still remained critics of the underpasses that argued for overpass structures. During the detailed highway design process, the option of overpasses was more closely examined, and a simple arch overpass design was conceived that would be about two thirds the estimated cost of an underpass. Parks Canada, as project proponent, and in line with its mandate, chose to reinvest this difference by erring on the side of caution by building the overpasses 50 m wide, rather than the initial proposed 30 m width.

The cost of these mitigations amounted to approximately 25% of total construction costs. The success of these mitigations, other than reduced wildlife mortalities as a result of wildlife-vehicle collisions, was not immediately evident.

Having failed to follow up on monitoring mitigation effectiveness in past phases, Parks Canada embarked on a twelve year monitoring program to gauge the use of crossing structures by various species and genders. This long term monitoring provided evidence that there was an adap-

tion period and learning curve associated with wildlife crossing structures, with ungulates using structures sooner than carnivores. It was observed that grizzly bears, moose, wolves, and other ungulates tended to prefer the larger overpass with good visibility, while cougars and, to some extent, black bears gravitated toward more confined, smaller underpasses that provided greater cover. Over this period, researchers recorded more than 185,000 wildlife passages through the 24 crossing structures between Banff East Gate and Castle Interchange.

Metamorphosis (adaptive management)

Another decade passed before traffic volume and accidents justified funding the westward twinning of the Trans Canada Highway through the remainder of Banff National Park (Phase IIIb), a distance of 35 km. Based on the results from long term monitoring, the overall success of fencing and crossing structures as mitigation measures was no longer being challenged by external stakeholders. However, scepticism remained within environmental groups that Parks Canada would continue, or even improve, the level of investment in mitigation necessary to protect wildlife.

The environmental assessment for this phase of twinning was undertaken in 2004, and again concluded that any impacts from the project could be mitigated through fencing and wildlife crossing structures. The environmental assessment noted that this particular area of the park was home to grizzly bear and wolverine populations that were in a precarious balance between birth and death rates. Erring on the side of caution, and in keeping with its mandate, Parks Canada proposed to mitigate potential impacts by again fencing, plus improving permeability, by increasing the frequency of crossing opportunities to one every 1.5 km; increasing width of overpass structures from 50 m to 60 m; extending bridge structures well past the riparian zone at streams and rivers, so as to avoid fishery impacts and permit wildlife movement; and installing small 400 mm to 750 mm diameter culverts every 400 m to accommodate small mammal and amphibian movements across the highway.

The net result was a commitment to construct a total of four large 60 m overpass structures, one 60 m underpass structure, two 25 m underpass structures, two extra long bridge structures incorporating a 30 m or wider wildlife crossing opportunity, and nine 7 m wide underpass structures. In addition, where fish passage had been interrupted during original highway construction in the 1960s, Parks Canada committed to restoring this connectivity by installing culverts at the right grade and size to restore fish movement across the highway.

The cost of these mitigations amounted to approximately 36% of the total forecasted Canadian $315 million in construction costs.

A remarkable transformation occurred, as both opponents and proponents of the project came together to support the project, proceeding with agreement that the goal of improving highway safety and maintaining wildlife connectivity where not necessarily exclusive of each other, and should be given equal weight. Thus, when it came to funding and investment decisions, one goal could not be traded at the expense of the other, and that each kilometer of road twinned also had to have all mitigations built at the same time.

Conclusion

Over the past 30 years, Parks Canada has focused its efforts on mitigating the effect of the TCH on wildlife mortality and habitat fragmentation in Banff National Park. A range of engineering mitigation measures, including fencing, underpasses, and overpasses have been incorporated and adapted, with each successive phase of TCH twinning. This has resulted in the first large-scale complex of highway mitigation measures of its kind in the world, and a natural laboratory for understanding the value of highway mitigation measures in conserving and protecting wildlife. Banff National Park's stature as a world-renowned national park has helped to further elevate the awareness of the value of these efforts, and their effectiveness.

Because of Parks Canada's pioneering of these wildlife-related mitigation measures, augmented by more than a dozen years of continuous monitoring, the use of wildlife fences and wildlife crossing structures has become increasingly common elsewhere in North America. This research and monitoring has resulted in the most complete body of scientifically sound information in the world on how wildlife respond to crossing mitigation. Parks Canada is now viewed as an international leader in highway mitigation performance and evaluation, design and connectivity studies.

Once referred to by some environmental groups as the "meat grinder" or the "Berlin Wall for wildlife," the Trans Canada Highway within Banff National Park has undergone a 30 year metamorphosis from environmental liability, to environmental leader in sustainable highway development.