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CORRIDORS ON LARGE CARNIVORES IN  
THE BOW RIVER VALLEY, ALBERTA**

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# **EFFECTS OF TRANSPORTATION CORRIDORS ON LARGE CARNIVORES IN THE BOW RIVER VALLEY, ALBERTA**

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## **INTRODUCTION**

The Canadian Rocky Mountains are one of the last places in North America where an assemblage of 7 native large carnivores still exists. Within the Canadian Rockies however, the status of many large carnivores is becoming increasingly threatened by all types of human development, including transportation routes. Our area of focus is between 70-180 km west of Calgary, Alberta, where the Bow River Valley is confined by mountainous terrain.

The Trans Canada Highway and Canadian Pacific Railway are major transcontinental transportation routes paralleling the Bow River through the Central Canadian Rocky Mountains (Figure 1). The Trans Canada Highway is, for the most part, a 4-lane divided highway with an average daily traffic volume approaching 14,000 vehicles. The Canadian Pacific Railway is the main rail link between the west coast and eastern markets and also a high volume route. Within the Bow River Valley there are approximately 212 km of roads in addition to the 2 major transportation routes.

The eastern zone of the Trans Canada Highway has been a 4-lane divided highway since the mid 1960's. No highway fencing exists and animals cross at will. The centre median separating traffic lanes is narrow and does not contain any areas of natural forest. Traffic speed is limited to 110 km/hr from Calgary west through to the east gate of Banff National Park.

Between 1983-87, a 27 km section of the highway was upgraded upon entering Banff National Park, from a 2-lane highway to a 4-lane divided highway. At the same time a 2.4 m high woven-wire fence with 15 cm square 9-gauge mesh was installed on both sides of the highway. In most cases fencing does not follow the highway ditch but is set back into the surrounding forest as far as 40 m to be less visually obtrusive. The centre median separating traffic lanes is sometimes as wide as 50 m and also contains tracts of natural forest to enhance aesthetics. Underpasses provide wildlife opportunities to cross the fenced highway at 10 locations. Traffic speed is limited to 90 km/hr within the divided and fenced section as well as other portions of the highway within Banff Park. At the end of the divided and fenced section, the Trans Canada Highway reverts to 2 lanes although construction began in 1996 to upgrade the next 20 km to a 4-lane divided and fenced configuration. Wildlife mitigations will include two 50 m wide wildlife overpasses and a system of buried culvert-style underpasses.



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Figure 1. A portion of Central Canadian Rocky Mountains highlighting the Bow River Valley.

Our review of the effects of transportation routes on large carnivores in the Bow River Valley is a collection of our experiences and is put forward to provide information for others. Large carnivores for which we provide information on include coyotes, black bear, grizzly bear, cougar, wolverine, and lynx. Wolves will be addressed in a separate report. This report should not be considered definitive as we have not done an exhaustive literature review. We put forward this paper in the hope that others can learn from our experiences.

## **ALL CARNIVORES**

Transportation routes can have an effect on large carnivores throughout North America. Although the literature varies with regard to the amount of displacement and other impacts, there is irrefutable evidence that roads and their associated disturbances reduce habitat effectiveness resulting in reduced fitness and increased risk of mortality (see Diamondback 1990 for overview). Briefly, roads (and railways) fragment carnivore habitat, reducing the capability of habitat to provide security from humans. As a result, animals either avoid or under utilize the fragmented areas or become exposed to an elevated risk of mortality. Direct habitat loss from the physical footprint of transportation routes can also be substantial especially in areas of high quality habitats. Moreover, habitat loss and fragmentation may precipitate population decline and extinction in some species by dividing an existing widespread population into 2 or more subpopulations. Fences may further exacerbate the problem by preventing the natural movement of species over their home range.

In the Bow River Valley, the impacts of direct mortality, habitat loss, and landscape fragmentation are affecting carnivores in several different ways. These impacts are outlined below for all large carnivore species that are considered in detail in this paper.

Banff National Park and Alberta Provincial records have documented the number of carnivores killed in vehicle collisions in the past 10 years (Table 1). This must be considered a minimum number as animals that were hit but never found have not been recorded.

**Table 1: Highway and railway mortality of large carnivores in the Bow River Valley, Alberta, 1985-1995.**

Species	Inside Banff National Park		Outside Banff National Park		Total
	Hwy.	Rail	Hwy.	Rail	
Coyote	117	7	39	1	164
Black bear	12	5	8	2	27
Cougar	1	0	2	0	3
Grizzly bear	1	0	0	0	1
Wolverine	2	0	0	0	2
Lynx	0	0	4	0	4

In mountainous terrain throughout the world, valley bottoms are the preferred habitats for both humans and wildlife. The Bow River Valley is no exception, with loss of the highest quality habitats being a major concern for some carnivore species. Over half of the montane ecoregion in the Bow River Valley has been significantly disturbed by human facilities. This zone is particularly important to a wide variety of wildlife including wolves, black bears, and grizzly bears.

Habitat fragmentation is probably the least understood but potentially the most devastating impact for many large carnivores. High traffic volumes and the physical width of the Trans Canada Highway make it the most obvious threat to habitat connectivity in the Bow Valley. The 27 km fenced section proves to be the greatest movement barrier. A system of 10 wildlife underpasses are meant to mitigate these concerns although Banff National Park data documents limited carnivore use (Table 2). Two 50 meter-wide wildlife overpasses were added to the current upgrading to specifically address fragmentation concerns of large carnivores.

Table 2: Through passages of 10 highway underpasses in Banff National Park.

Species	1983-1988	1994-1996
Black bear	20	17
Cougar	0	23
Coyote	754	450
Grizzly bear	1	1
Lynx	1	5
Wolverine	0	0

Notes: 1) Sampling effort is substantially different between the 2 sampling periods and, as such, numbers are not directly comparable.

2) The single culvert-style underpass was not used by large carnivores in either of the sample periods.

Empirical and anecdotal evidence are given on a species by species basis in the following sections of this paper.

### COYOTE

The coyote is an extremely adaptable species and in some cases actually thrives under human influence. In the Bow River Valley and throughout Banff National Park, the coyote survived an intensive predator control program since the parks inception and through the first half of this century. Coyote abundance and distribution were recorded until the early 1980's. At that time coyotes were common and more abundant in the lower Bow River drainage than anywhere else in the region. The density of coyotes in the Bow River Valley was partially due to the continuous availability of rodents and of road and train-killed carrion. At the time, the most serious man-induced coyote mortality was from collisions with motor vehicles and trains.

Coyote aggression towards humans prompted a study of urban coyotes in the vicinity of the town of Banff between 1991-1993 (Gibeau 1993). The study area was bisected by a divided and fenced portion of the Trans Canada Highway. Radio-telemetry data demonstrated that individuals moved freely across the highway. Highway fencing followed landscape irregularities allowing coyotes to cross almost wherever they chose. Coyotes did use the wildlife underpasses when it was convenient. Analysis of home range data of 11 radio-collared individuals showed that in some cases the highway completely bisected home ranges. In other cases, the highway was used to delineate one side of the home range boundary of a pack.

Gibeau's (1993) study also documented 24 known coyote mortalities between July 1991 and March 1993. All but 3 of these mortalities were highway kills. Analysis indicated a 35% highway mortality rate in the 20 month period for adults, based on the radio-collared sample. Conversion

to a standard time base of 1 calendar year predicted a highway mortality rate of 25% for adult coyotes. That type of mortality rate is typical of hunted or harvested populations and not indicative of a protected population within a national park.

Further research was carried out in 1992-93 as a result of the abnormally high mortality rate along the Trans Canada Highway. Gibeau (unpubl. data 1994) evaluated mice densities using paired plots along the fenced and unfenced sections of the highway. He found that there were almost 3 times as many mice within the fenced highway corridor as outside the fence. Results suggested better mouse habitat was created along the divided and fenced section of the Trans Canada Highway than all other areas. We speculate that coyotes are attracted to the high densities of mice along the fenced section and consequently are exposed to higher probabilities of being hit by a vehicle. Highway mortality statistics seem to support the speculation (Table 1). Despite the high mortality rate and subsequent disrupted social organization, coyotes continue to be common in the Bow River Valley.

Not all aspects of a divided and fenced highway have been negative for coyotes. Within a year of the completion of the highway fence west of the town of Banff, Park Wardens began to notice dead Bighorn Sheep up against the fence and soon realized that escape terrain for sheep along the cliffs of the highway had been removed by the fence. Coyotes were taking advantage of the situation by running sheep into the fence as they attempted to get to escape terrain along the cliffs. In 1988, 14 sheep were found killed along the 8 km length of fence immediately west of the town of Banff. By 1991, Banff National Park records documented a total of 47 sheep killed by coyotes along the highway fence. Today, few sheep use the area due to the disruption of movement patterns and this new mortality source.

## **BLACK BEAR**

Since early settlement of the Bow River Valley the history of black bears has been intertwined with facility development, transportation corridors, and garbage. Little research had been done on black bears until recognition of a dramatic decline in the population in the late 1970's and early 1980's following closure of dumps within Banff National Park. The dearth of black bear sightings may have indicated that the cumulative impact of all types of unnatural mortality had reduced black bear populations to a very low level. A three year research program (Kansas et al. 1989) was initiated in 1986 to determine food habits, habitat use, movements and population levels.

Research results estimated 15-18 black bears in the Banff National Park portion of the Bow River Valley. These bears are all exposed to the network of highways, railway, and the nodes of human development that include towns and outlying tourist resorts. Population density is low compared to other studied populations in North America (Kansas et al. 1989). Possible causes include low habitat capability, interspecific competition with grizzly bears, direct habitat loss, and management removals.

From a local population perspective, the low density of black bears increases the significance of

human caused mortality in the area. Between 1985 and 1995, a total of 17 black bears were killed on highways and the railway in Banff National Park (1.7 bears/yr.) (Table 1). That translates to an average of 9-11% of the Banff National Park black bear population removed by highway and railway mortality each year for the past 10 years. These numbers do not include natural mortality, management removal, and losses outside the park from hunting. Population estimates are not available for lands outside the National Park.

Much of the cause of direct black bear mortality on the highway and railway can be attributed to an attraction reinforced by food reward. Bears seeking both natural and unnatural food sources in and adjacent to the transportation corridors are more susceptible to vehicle collision. Fire suppression has resulted in a proportional loss of early successional plant species favoured by the bears elsewhere in the Park. Highway and railway right-of-ways are rare open habitats that are conducive to the growth of grasses, berries and forbs favoured by bears. Accidental grain spills and inadequate containment of grain cars on railway sidings attract bears, as do the carcasses of over 40 ungulates killed by the train each year (Banff National Park records).

The attraction of food sources along transportation corridors also leads to indirect black bear mortality. Rewarded foraging efforts in road ditches and railway ballasts coupled with frequent human interaction without negative experience lead to rapid habituation. A loss of fear of humans quickly leads to conflict as roadside photographers push for a closer snapshot and bears explore areas of higher human activity in search of food (i.e. campgrounds, resorts and towns). Although the number of black bears destroyed or relocated by park managers has decreased substantially in the past 20 years, berry crop failure periodically pushes the number of handlings back up to alarming levels. For example, in 1992, 16 black bears were involved in human conflicts in the Bow River Valley that led to a total of 21 relocations and 9 bear deaths.

Efforts to address the cause(s) of these problems include law enforcement, public education, railway clean-up, aversive conditioning and highway fencing. The idea of removing all palatable plants from highway right-of-ways has been suggested but is aesthetically unpopular in an area renowned for its scenery. Bear warnings and closures are erected and enforced in areas of known concentrated bear activity. Apart from these restricted areas and regulations prohibiting wildlife harassment, there is little law enforcement to keep bears and people apart. Portable highway signs warning people of bear danger are erected along stretches of road with high bear activity. An agreement to remove ungulate carcasses and to clean up spilled and leaked grain off the railway right-of-way was made this year between National Park managers and the railway company. Efforts to discourage black bear use of highway ditches and townsites have had some short term success (see aversive conditioning in grizzly bear section).

Although targeted at mitigating the loss of ungulates to highway mortality, it was hoped that a fence and wildlife crossing system along divided sections of the Trans Canada Highway would also reduce direct mortality of other large mammals, including black bears. The system of underpasses is used occasionally by black bears (Table 2) even though they are able to climb the fence. Black bears have climbed over the fence into the highway corridor 37 times since fence

installation. Between 1985 and 1995, 4 of the 12 black bears killed on Banff Park roads were killed inside the fenced section of the Trans Canada Highway.

Although the fenced section of the highway appears to be permeable to black bears, the extent to which the fenced and unfenced highway affects movement and black bear distribution in the Bow River Valley is unknown. A research project designed to address this lack of knowledge began this year.

## **COUGAR**

Once ranging from the Atlantic to the Pacific, the historic range of the cougar has been reduced by over 50% (Hummel and Pettigrew 1991). The provinces of British Columbia and Alberta, divided by the Rocky Mountains, harbour virtually the entire population of cougar remaining in Canada. Although no detailed studies have been conducted in the area of concern, Jalkotzy and Ross (1991), estimate 4-7 cougar use the Bow River Valley. The local cougar population in the Bow Valley is contiguous with populations west of the Rocky Mountains, but exists at very low densities due to marginal habitat over the main ranges. Nonetheless, the persistence of individuals is crucial as a "genetic bridge" between geographically isolated populations on either side of the Continental Divide.

Cougar are most common at low elevations in major river valleys where ungulates concentrate and snow accumulation is low. In winter, their movements in the Rocky Mountains are highly restricted to the montane and parts of the lower subalpine ecoregions. As a result, individuals using the Bow River Valley interact with the highway and railway transportation corridors.

Between 1944 and 1985, 9 cougars were killed by vehicle collisions in the Bow River Valley. Since then, 3 cougars have been killed on the Trans Canada Highway (Table 1). In 1996, a yearling female was killed on the railway line. Although seemingly low, direct loss due to highway and railway collision constitutes a significant source of mortality for the small population (mean loss of 3-5% of the local population per year over the last 52 years). Furthermore, because the local population is so small and the home ranges of adult males are so large, an adult male hit on the road may be the loss of the only breeding male in the local population.

Prior to the first stage of highway upgrading and fencing in Banff National Park, two radio-collared cougars dispersed from 70 km away into the Bow Valley (Jalkotzy and Ross 1991). One successfully moved across the highway and dispersed to valleys beyond, whereas the other stopped and retraced her route shortly before encountering the road.

Existing highway wildlife underpasses appear to function for cougar in the Bow River Valley (Table 2). However, a lack of use for the years immediately following construction suggest that local cougars require time to accept and use them. If true, nonresident cougars dispersing from outside the area may not initially accept underpasses. Similar patterns have been seen with a local wolf pack whose newer, less dominant members have failed to follow packmates through

underpasses.

Heuer (1995) documented cougar interaction with the highway fence through snow tracking as part of an ongoing wildlife corridor project in Banff National Park. In one specific area, cougar (and all other wildlife) have 4 options of travel: 1) a 2 km wide, heavily forested, north-facing slope characterized by deep snow; 2) a 4 m wide highway underpass on the valley floor that is well aligned with high quality habitat; 3) a 190 m wide river underpass that contains the Bow River, a 2-lane highway and the railway; and 4) a 1 km wide south facing dry slope of open forest bisected with passable rock outcrops. Of these 4 options, cougar appear to prefer the narrow wildlife underpass (8 passages) and the dry south-facing slopes (5 passages). Cougars were also recorded inside the highway fence on 2 occasions, having gained access underneath the fence as it passed over rugged terrain. The animals paced back and forth inside the highway corridor over a 1 km stretch before exiting through one-way gates. No cougars have been killed within the 27 km long fenced highway corridor since its construction in 1986.

## **GRIZZLY BEAR**

The first large concentrations of grizzlies were reported in the Bow River Valley during the 1960's in the vicinity of dumps, along with the first record of a grizzly being killed by a car on the Trans Canada Highway (National Parks Branch 1962). Feeding on garbage or human food became common which often led to grizzly bears being killed in management actions. After closure of the dumps in the early 1980's, few grizzly bears died in the Bow River Valley as a direct result of vehicle collisions. Between 1985 and 1995, only 1 grizzly has been killed on the Trans Canada Highway (Table 1). There are, however, additional major threats to grizzly bears from transportation corridors other than direct mortality.

There is considerable evidence that grizzly bears avoid human facilities, especially when they are occupied and active (see Mattson 1993 for overview). Cumulative effects assessment has been used to quantify the effects of human activities on grizzly bears. Gibeau (1995a) applied this process to Banff, Yoho, and Kootenay National Parks demonstrating the Bow River Valley to be some of the best potential habitat for grizzlies in the 3 national parks. However, analysis also revealed the Bow River Valley to be one of the most severely impacted areas for grizzly bears. The model predicts that grizzly bears are currently under utilizing some of the best habitat in Banff Park.

Quantitative data demonstrates the extent of habitat fragmentation and alienation in the Bow River Valley. Banff National Park has recorded only 2 unconfirmed uses of the 10 wildlife underpasses in the fenced section since 1987 (Table 2). Since more intensive study of the grizzly bear population was initiated in 1993, there has been 1 confirmed record of a grizzly bear using the largest underpass that also doubles as a highway bridge over the Bow River. Two years of radio-telemetry data reveals not a single female grizzly bear has crossed the Trans Canada Highway anywhere in the Bow River Valley. Several females have, however, crossed other 2 lane highways in the study area (Gibeau and Herrero 1995). The same radio-telemetry data set does

show that 3 male bears have frequently crossed the 2 lane portion of the Trans Canada Highway beyond the end of the fenced section.

Two of the 3 male bears just mentioned have had experience with the highway fence in the last 2 years. Both bears have dug under the fence; 1 in an attempt to flee from tourists after he wandered into the highway corridor through an open gate. The other dug under the fence to access a dead elk that had breached the fence and been killed by a vehicle.

The current research has also raised concerns about the genetics of this population. An initial assessment of mitochondrial (mt) DNA (Gibeau 1995b) along with recent analysis of a larger data set, confirms grizzly bears in the Central Canadian Rocky Mountains have the second lowest mtDNA diversity of all the populations in North America sampled to date. Waits et al. (1995) suggest this may be caused by differences in anthropogenic stress, historic population fluctuations, and the density of physical barriers such as roads.

In a recent evaluation of the status of grizzly bears in Banff National Park, Gibeau et al. (1996) used the linkage zone prediction model (Servheen and Sandstrom 1993) to demonstrate the impacts of the Trans Canada Highway on the grizzly bear population. Results depict a dramatic decrease in potential crossing areas over time. It becomes obvious that fencing of the Trans Canada Highway has had a significant effect on the ability of grizzly bears to move across the Bow River Valley. The implications of highway fencing and associated mitigation could have profound effects on grizzly bear passage across the Bow River Valley and ultimately movement throughout the Central Canadian Rocky Mountains.

As with black bears, cleared highway and railway right-of-ways provide rare open habitats that favour the growth of many bear foods including grasses, berries, and forbs. While most grizzly bears avoid busy highways some are attracted to the quieter roads for high quality habitats. Attraction of bears to these areas provides motorists with exciting viewing opportunities. For example, in 1993 about 105 bear jams (traffic snarls caused by people slowing or stopping to look at bears) were reported along highways in Banff National Park. Unfortunately, many of these viewing opportunities become human-bear conflicts as people often attempt to approach bears on foot for better viewing and photographic opportunities. Bluff charges are rare but warrant special concern for public safety. Public education is the best solution to this problem but not always possible for an international audience of transient visitors.

In 1992, Park managers began to experiment with aversive conditioning techniques that used rubber batons fired from a riot gun to punish bears that persisted on the roadsides. The intent of the program is to 'teach' bears to stay away from roadsides when there is traffic (Heuer 1993). The benefit is that human-bear conflicts are minimized as are the chances of the bear being hit by a vehicle. To date, 3 grizzly bears have been subjected to the program. Two were monitored and conditioned consistently over 2 week periods. Both of these bears exhibited dramatic shifts in habitat use from the roadside to less accessible areas. The third candidate has not received consistent and prolonged exposure to the treatment, and therefore has not displayed any long term

shifts in use of roadside habitats.

## **WOLVERINE**

Wolverine are most common in the subalpine spruce and fir forests of the Bow River Valley. Only the western most section of the Trans Canada Highway and railway line enter the subalpine zone and as a result, little attention has been given to their impact on wolverine habitat. The effects of these transportation routes and other roads in the area on wolverine movement between patches of good quality habitat are also uncertain. Wolverine have been tracked in areas close to highways in the Bow Valley (<1 km), but not adjacent to or across them. Fenced sections of the highway do not occur in good quality wolverine habitat and their use of underpasses has not been recorded (Table 2). However, 2 highway mortalities in the last 10 years in the Bow River Valley (Table 1) suggests that wolverine have been attempting to cross the valley, albeit unsuccessfully.

Wolverine have crossed a ski area access road in the western end of the study area 4 times in the last two winters (Stevens et al. in prep.). On busy days, traffic volume of the road reaches 4,000 vehicles and is concentrated between 0800 and 1700 hours. Three of the 4 wolverine crossing attempts approached and retreated repeatedly, sometimes 100's of metres to rest, before successfully crossing the road. Limited but similar patterns of approach and retreat behaviour have been recorded for wolverine along the Trans Canada Highway west of our study area.

## **LYNX**

Little information exists about the lynx population, their preferred habitats and movement in the Bow River Valley. They use underpasses along the fenced section of the highway infrequently (Table 2). Heuer (1995) has also recorded lynx paralleling the Trans Canada Highway fence. Lynx are susceptible to highway mortality in some areas of the Bow River Valley (Table 1).

Lynx movements were recorded in one area along the divided and fenced section of the Trans Canada Highway. A single 7 m diameter, 50 m long culvert style underpass is meant to mitigate wildlife movement in the area. However, winter tracking over the past 3 years has shown a tendency for lynx to travel around the end of the fence to cross the highway and not to use the culvert underpass. In some cases this entailed a 9 km detour to access habitat immediately adjacent to the highway underpass (Heuer 1995, Stevens et al. In prep.).

Lynx tracking was also conducted in the vicinity of a ski area access road that can see as many as 4,000 vehicles per day (Stevens et al. in prep.). Of 15 recorded crossings, 7 entailed aborted attempts before successfully crossing the road. After an aborted attempt, lynx typically retreated into thick roadside vegetation to bed for a period before reattempting the crossing.

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