Roads, Rails and Grizzly Bears in the Bow River Valley, Alberta

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Abstract

The Bow River Valley is one of the most developed landscapes in the world where grizzly bears persist. Since 1994, we have recorded over 5,000 radio locations for 51 radio-marked grizzly bears in the Central Canadian Rocky Mountains. We present preliminary findings on some aspects of how roads and a railway influenced these bears' movements and behavior. Our results suggest that the Trans Canada Highway in Alberta, with its high traffic volume, both inside and outside of Banff National Park, is a barrier to female grizzly bear movement, and a significant filter to male movement. This has occurred despite the construction of 12 underpasses in previously fenced sections and another 10 underpasses and two overpasses along the recently fenced section of the highway in the Park. In contrast, eight females have crossed two-lane, secondary highways in other portions of our study area. Three of these females regularly crossed secondary roads. These secondary highways, in contrast with the Trans Canada Highway, have low traffic volumes during evenings, night and mornings. All three females that crossed the secondary roads were habituated. This raises another problem. Over 80 percent of 118 recorded grizzly bear mortalities in Banff National Park Between 1971-95, were within 500m of a road. We show why certain grizzlies are attracted to near road environments. Most grizzlies, especially long-term survivors, avoid them. Clearly near road environments cause grizzly bears to make difficult choices with little opportunity to learn successful behaviors if they die in the process. This has obvious implications for successful use of highway crossing structures built to mitigate the adverse affects of recent upgrading along sections of the Trans Canada Highway. We conclude there is a dynamic tension between road avoidance and attraction.

Introduction

Within the Canadian Rocky Mountains, the status of many large carnivores is becoming increasingly threatened by many types of human development, including transportation routes (Paquet et al. 1994, Banff-Bow Valley Study 1996). The Central Canadian Rockies is one of the most highly developed landscapes in the world where grizzly bears still survive. Our area of focus is within this highly developed landscape, between 70-180 km west of Calgary, Alberta, where the Bow river Valley is confined by mountainous terrain (Figure 1). 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 the Trans Canada Highway Canadian Pacific Railway, two major transcontinental transportation routes, paralleling the Bow River through the Central Canadian Rocky Mountains.

Roads and railways are long and thin in shape and cut across landscapes potentially fragmenting large areas for species like grizzly bears. Vegetative hiding cover is always removed from the transportation corridor surface and along some portion of the right-of-way, thus making the corridor unfriendly or dangerous to grizzly bears. Jalkotzy et al. (1997), adopted a typology developed by McLellan (1990) for impact assessment, and identified and did a literature review of six major potential categories of effects of disturbance corridors (such as roads and railways) on wildlife species such as grizzly bears: direct and indirect mortality, population effects, habitat avoidance, habitat disruption or enhancement, individual disruption, and social disruption. Jakotzy et al.'s (1997) review documents effects on grizzly bears from each of the six categories.

The most significant effects of any activity on wildlife are mortality related. If total population mortality exceeds natality then population decline occurs. Ironically, in Banff National Park, which is a protected area, total man-caused mortality during at least portions of the period 1971-1995, appeared to have exceeded recruitment (Gibeau et al. 1996). Further analysis of Banff National Park mortality data has documented 188 mortalities during 1971-1995 of which only 11 were not man-caused (Benn pers. comm.). Over 80 percent of the man-caused mortalities occurred within 500m of a road, an area of only 5.7 percent of the Parks. Only 14 percent of these mortalities were due to highway or railway collisions. Most were management actions toward "problem" grizzly bears. Ruediger (1996) linked extirpation of certain carnivore species in the United States to the broad effects of highways.

Puchlerz and Servheen (1994) summarized studies regarding the influence of roads on grizzly bear habitat use, documenting a range of distances between 100-914 meters wherein bears apear to show avoidance. Given this range in the zones of less than expected use they recommended .3 miles (500 meters) as a standard buffer for grizzly bear/motorized access management.

Grizzly bear use of the landscape in proximity to roads is undoubtably influenced by the density of the road network. Forman (1996) suggests a road density of approximately .6 km/km^2 (1.0 mi/mi^2) appears to be a maximum or threshold for a naturally functioning landscape containing sustained populations of some large carnivores.

Gibeau (In press) applied the Grizzly Bear Cumulative Effects Model (Weaver et al. 1987, USDAFS 1990) to Banff, Yoho and Kootenay National Parks. This analysis suggested that disturbance corridors have been the major source for loss of habitat effectiveness for grizzly bears in these parks. This loss was projected to have focused in the better quality habitat of the Parks.

The many documented effects of disturbance corridors on grizzly bears are summarized by the dictum that grizzly bears do best in places where people and our developments are infrequent (Herrero 1995). Because disturbance corridors typically provide access for vehicles and people they have a variety of negative influences in grizzly bears. Typically theses are proportionate to the degree of human and vehicular use of the corridor (Puchlerz and Servheen 1994, Mace et al. 1996).

While most of the literature concentrates on the deleterious effects or roads on grizzly bears, little of it depicts the dynamic tension that exists between grizzly bears and roads. This tension includes both attraction to roads and alienation from roads depending upon context. Some of the more subtle effects of roads on grizzly bears are much harder to quantify than the direct effect of highway and railway mortality (Gibeau and Heuer 1996).

Attraction to roads can take a number of different forms. In heavily forested regions like the Canadian Rockies, the process of right-of-way clearing allows light to penetrate into areas that would not have received direct sunlight under a forest canopy. This simple act of allowing sunlight to reach the forest floor can have dramatic changes in plant community composition (Angold 1997). Snow melt occurs sooner in open areas than under a forest canopy drawing bears to early emerging vegetation. Because of their early green-up, grasses planted to revegetate disturbed right-of-ways appear to be preferred early in the season by some bears. Hamer (1996) found forest canopy cover accounted for 70 percent of the variation in fruit production of buffaloberry (*Shepherdia canadensis*), a staple for grizzly bears in the Canadian Rockies. Buffaloberry production is highly variable year to year, forcing grizzly bears to search widely during poor berry years. In places like the Bow River Valley where fire

suppression has created a predominately closed canopy forest, the edges of road and rail right of ways have become some of the better berry producing areas during poor years. These areas of high berry production are attraction sources for both black and grizzly bears.

Methods and Preliminary Findings

Since 1994, we have radio-marked and monitored approximately 25 grizzly bears per year in the Central Canadian Rocky Mountains (Gibeau and Herrero 1997). All radio-marked animals were normally searched for at least once per week from the air and opportunistically from the ground on a daily basis. In addition to systematic radio tracking, infrequent 24-hour monitoring of individual animals was conducted at hourly intervals to obtain daily movement patterns. Radio locations were supplemented by occasional direct observation or reports from the public. To date, our sample of over 5,000 radio locations from 51 different individuals is assisting in our understanding of how developments and human-induced mortality impact grizzly bears. In this paper, we present preliminary results from some aspects of this broader research project.

In addition to the proliferation of natural food items along transportation right of ways, our findings show a number of anthropogenic foods also attract bears to roads and rail lines. Grain spills along the Canadian Pacific rail line have become a major source of attraction in recent years. While grain has been hauled through the Canadian Rockies for decades, a major spill in 1994 that was not cleaned up for several months became a focal point for bears in Banff National Park. Upon closer examination, Park Wardens began to document a litany of smaller spills from leaky hopper doors as rail cars sit along sidings waiting to be moved west (Laurenson 1996). Hopper doors on some rail cars leak constantly resulting in a small amount of grain spread along the rail line from one side of the Rockies to the other. Six of the seven radio-marked grizzly bears that have come into contact with the rail line in the Bow River Valley have at one time or another fed on spilled grain.

As the economics of ground transportation change, more and more grain is now being moved by truck to west coast ports. The same scenario can be seen along the Trans Canada Highway, where grain leaks from faulty hopper doors when trucks are parked at roadside pull offs. The sheer size of the piles of gain leads to speculation that truckers may be off loading as they move across the Rockies before they arrive at weigh scales in British Columbia.

The synergism of both national and anthropogenic attractants continues to bring bears and people into contact along roadsides. While the number of people attempting to feed bears has dropped dramatically in the last decade with better education programs, viewing opportunities still exist. For example, in 1997 about 80 bear jams (traffic snarls caused by people slowing or stopping to look at bears) were reported along highways in Banff National Park (Pilklington 1997). Unfortunately, some of these viewing opportunities become human-bear conflicts as people attempt to approach bears on foot for better viewing and photographic opportunities. This exposure to people, and occasionally our food, sets the stage for the well documented process of habituation, food conditioning and vehicular collision death, or removal of the bear from the ecosystem.

At the other end of the spectrum from the problem of attracting bears to roadsides, our data demonstrates many grizzly bears are rebuffed by roads. To some extent, this degree of alienation depends upon the size of the road, traffic volume and temporal use of the road; and the sex, age class, and degree of human habituation of the bear attempting to cross.

Our sample of more than 5,000 radio relocations of 51 bears over the last four years show clear differences between male and female grizzly bear use of the highly developed portions of the Bow River Valley. To date, no radio collared females have crossed the Trans Canada Highway, which has an average daily summer traffic volume of 20,000 vehicles (Figure 2). Five male bears have crossed the Trans Canada Highway at one time or another, but only one does so with any amount of regularity.

In contrast to the Trans Canada Highway, eight female bears have crossed secondary highways on a regular basis. However, each of these three individuals displays behaviour that could be categorized as more human habituated than the other five females. Six male bears have also regularly crossed these secondary highways.

An indepth analysis of the relationship between traffic volume, traffic temporal patterns and grizzly bear highway crossing rates will be conducted in 1998. We also plan to explore the relationship between grizzly bear habitat use and distance to roads upon completion of data collection in 1998.

Road density calculations completed for a linkage zone analysis of the Bow River Valley (Gibeau et al. 1996) ranged up to 3.0 mi/mi^2 along the highly developed valley bottom. This significantly exceeds Forman's (1996) threshold of 1.0 mi/mi^2 (.6 km/km^2) for sustaining large carnivore populations. This is not surprising given the Tarns Canada Highway, the transcontinental railway and a secondary highway are all located in a relatively narrow mountain valley. In addition to road density, the linkage model used the density and nature of developed human sites, presence or lack of hiding cover, and occurrence of riparian areas to predict potential grizzly bear crossing sites between habitats separated by human activities. Our analysis demonstrates the combination of multiple human developments and fencing of the Trans Canada Highway through portions of Banff National Park has had a significant effect on the ability of grizzly bears to move across the Bow River Valley (Gibeau et al. 1996).

Discussion

The literature to date suggests that most grizzly bears under utilize habitats in proximity to high use roadways. While this may be the general case, it is far too simplistic to characterize the interactions of bears and roads. Several issues need to be teased apart to understand these interactions. First, several factors affect a bear's willingness to be in the proximity of roads, which is of course a precursor to being able to cross roads. Secondly, several factors influence an individual bear's ability to cross a road.

High human presence underlies the unwillingness of most grizzly bears to utilize habitats near busy transportation corridors. High road density values along the Bow River Valley contribute significantly toward habitat alienation for grizzly bears along valley bottom habitats. This avoidance behaviour is strongest in the adult segment of the population where we believe males select for high quality habitats and an absence of humans. Adult females select areas with a high degree of security for raising cubs, which in some cases means avoiding adult males. With the safest and most habitats taken upon by adult males and resident females, subordinate bears and other adult females are forced to utilize sub-optimal habitats including those with high human density. In this way roadside vegetation and other anthropogenic foods become important resources in sub-optimal habitats. Unable to successfully compete elsewhere, some bears are relegated to utilizing habitats close to people and our developments. While in the proximity of humans a bear may become habituated to people. While these habituated bears appear to successfully use habitats near busy transportation corridors, they are also most likely to die at the hands of humans (Mattson et al. 1992, Benn pers. comm.).

This is particularly problematic in National Parks like Banff where on one hand people expect to be able to view bears on the roadside. On the other hand, managers are reluctant to allow habituated bears to remain in areas frequented by humans due to human safety issues. Recent management techniques such as hazing and aversive conditioning, using tools ranging from rubber bullets to Karelian Bear Dogs, (Gillin et al. 1992, Heuer 1993, Hunt pers. comm.) have been employed to teach bears to use roadside habitats only in the absence of people. The results has been that bears either avoid the area all together or use it nocturnally.

In addition to attraction to repulsion from roads, there are significant differences in an individual grizzly bear's motivation to cross busy transportation corridors. In most interior habitats grizzly bears have large home ranges. For example, after four years of study in the Bow River Watershed, Gibeau and Herrero (1997) found that home ranges for males averaged 1560 km^2. These large home range sizes mean significant potential for habitat and population fragmentation if transportation routes are barriers or significant filters to grizzly bear movement. Our results suggest that the Trans Canada Highway in Albert, with its high traffic volume, both inside and outside of Banff National Park, is a barrier to female grizzly bear movement, and a significant filter to male movement. This has occurred despite the construction of 12 underpasses in previously fenced sections and another 10 underpasses and two overpasses along the recently fenced section of the highway in the Park. The effectiveness of the overpasses is yet to be determined.

Avoidance of high use roads and areas nearby them may be somewhat cohort specific, at least in the coast of national parks where grizzly bears are not hunted. Mattson et al. (1987) suggested that adult female grizzly bears use

roadside habitat in order to avoid close contact with adult male grizzly bears which pose a mortality risk, especially to the cubs. However, the potential safety from males was counterbalanced because between 1975-1990, habituated, radio-marked grizzly bears were killed 3.1 times more often than wary radio-marked bears in the Greater Yellowstone Ecosystem (Mattson et al. 1992). Clearly near road environments cause grizzly bears to make difficult choices with little opportunity to learn successful behaviors if they die in the process.

Management agencies in the Bow River Valley now find themselves in a particularly difficult position with respect to maintaining a contiguous grizzly bear population in the Central Canadian Rockies. A number of competing interests have created a dilemma that may become untenable if not managed in a comprehensive and coordinated way. Crossing structures were provided for wildlife passage in an attempt to mitigate the adverse effects of recent upgrading along sections of the Trans Canada Highway (Leeson 1996). The two, 50m overpasses in the most recent construction phase were built to specifically address the needs of sensitive species like the grizzly bear. While a significant amount of time, energy and money has gone into the design, placement and construction of these overpasses and underpasses, the question remains as to how species like grizzly bears will get to the mouth of these structures in order that they may cross the highway.

For bears to use these crossing structures they must first be in proximity of the road. The provision of well placed, effective crossing structures is only part of maintaining a contiguous grizzly bear population in the Central Canadian Rockies. Currently, the Bow River Valley as a whole has low habitat effectiveness for the grizzly bear population, thus making the valley bottom unattractive to many grizzly bears unless they are habituated. As discussed previously, habituation creates another whole set of problems. Habitat effectiveness must therefore be significantly improved near points where grizzly bears might cross.

Within Banff National Park innovative methods are now being considered for managing grizzly bears. This is an obvious necessary first step, however, emphasis now needs to be directed toward managing overall human use in the valley. While little more can be done to ameliorate the adverse effects of the Trans Canada Highway, creative and resourceful solutions must be found to allow grizzly bears better access to habitats in the valley. Without a comprehensive and coordinated approach, we risk finding that all the efforts directed toward providing crossing structures across the Trans Canada Highway were, in the final analysis, "ineffective".

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IKGA WILSON MOSLEY MAPS

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

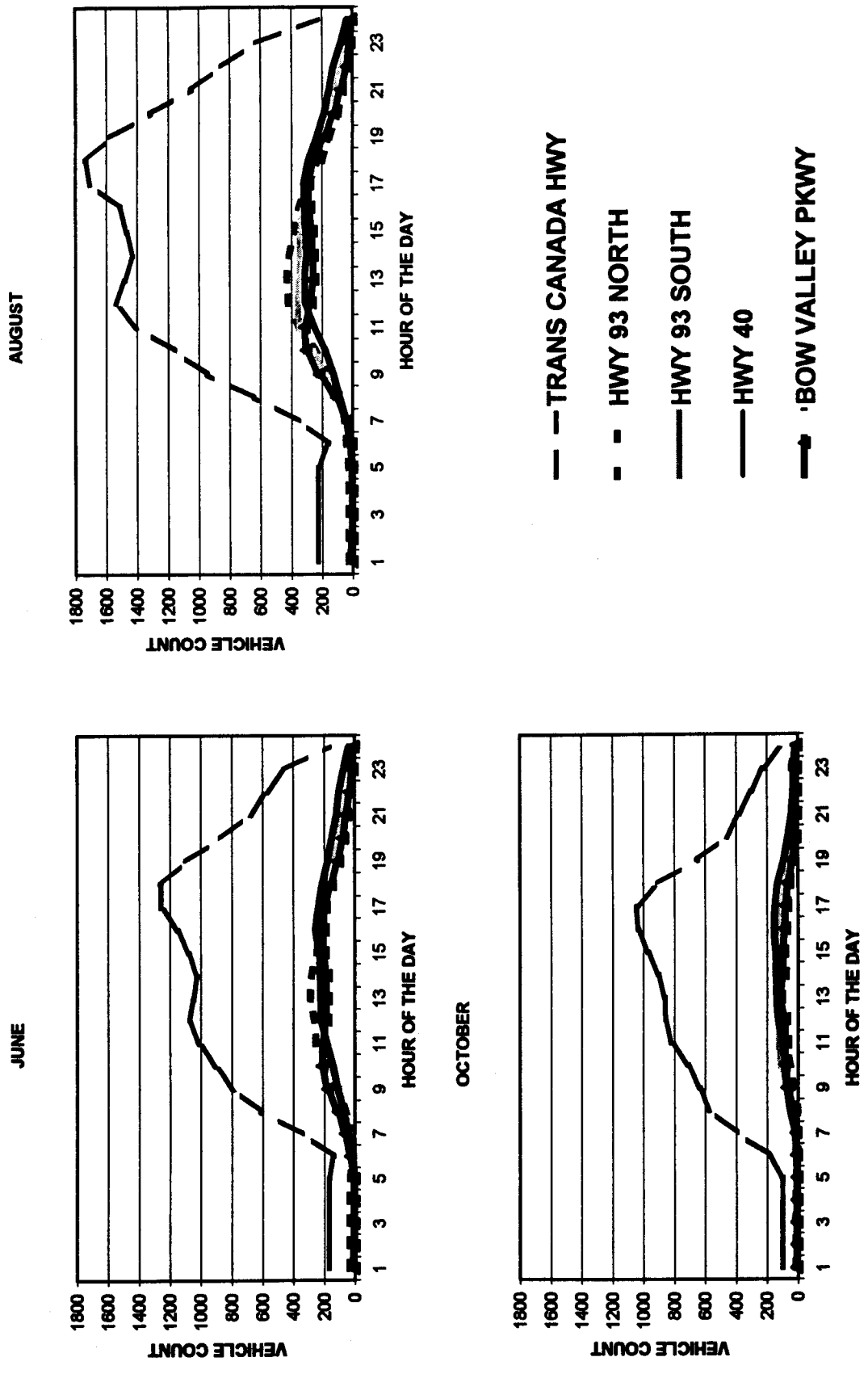

Figure 2.
Mean 1996 traffic volumes for highways in the Bow Valley Watershed, Alberta.