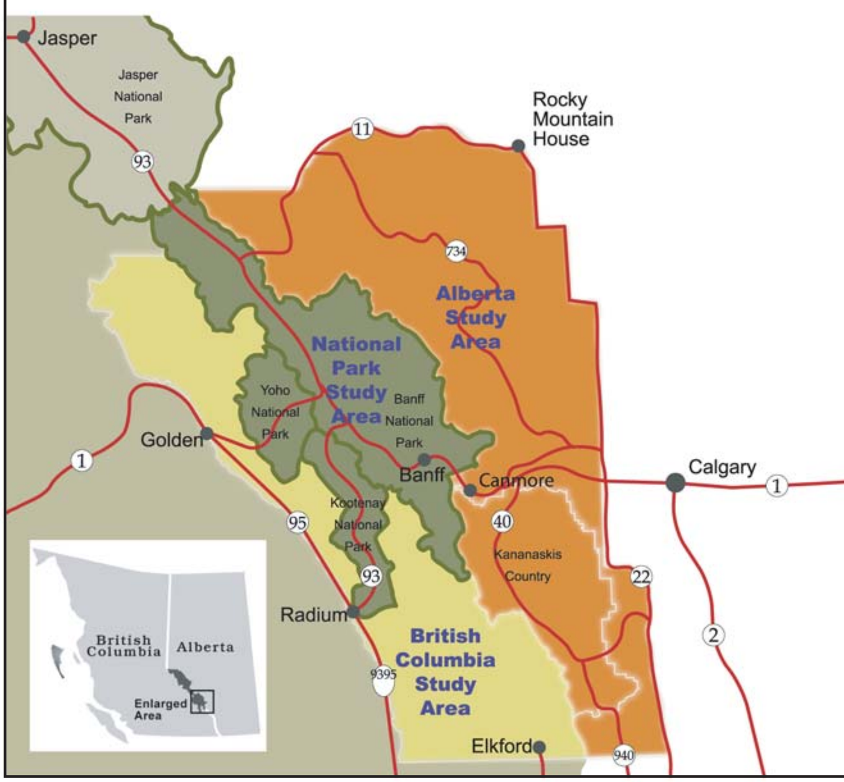
CHAPTER 6

ADDITIONAL GRIZZLY BEAR MORTALITY ANALYSES



ESGBP

6.1 GRIZZLY BEAR MORTALITY IN THE CENTRAL ROCKIES ECOSYSTEM: INTRODUCTION

Stephen Herrero

Population dynamics of grizzly bears are a function of reproduction and mortality. Reproduction is difficult for managers to influence (Garshelis et al. 2005). It is driven by energy available to bears as food. Changes in foods available to bears naturally fluctuate between years and may influence reproductive output (Rogers 1976, Blanchard 1987, Stringham 1990). In the Central Rockies Ecosystem (CRE) during some years, berries, a primary energy source for grizzly bears, are abundant. During other years relatively little berry production occurs and grizzly bears forage more on less calorically dense roots (Hamer and Herrero 1983, Hamer 1985, Hamer and Herrero 1987). Other major changes in energy available to grizzly bears as food take place over longer time periods and are influenced by succession in vegetation communities. Dynamic changes occur in the decades after a fire or avalanche. While fluctuations in reproduction occur between years, population growth is much less sensitive to changes in reproduction than to changes in survival.

High female survival is fundamental to sustaining grizzly bear populations (Knight and Eberhardt 1985, Eberhardt 1990, Mace and Waller 1998, Schwartz et al. In press). Consistent with this broadly applicable finding, we found that the population trajectory for grizzly bears in the Bow River Watershed was most sensitive to changes in the survival rate for adult females (Garshelis et al. 2005). In the Bow River Watershed it would require a 15% improvement in reproductive output to be able to reduce the target survival rate by just 1% (Garshelis et al. 2005). This disproportionate contribution of survival to population growth or decline is highly likely to also be true for grizzly bears in the rest of the CRE.

Throughout our broader study area, the CRE, 75% and upwards of adult female and male grizzly bear deaths were caused by people (Benn 1998, Benn and Herrero 2002, Garshelis et al. 2005, Chapter 6.4 this report). This was true in the CRE in areas closed or open to grizzly bear hunting. Because of the diversity of situations that led to grizzly bear mortality in both hunted and unhunted areas, grizzly bear mortality is difficult to manage (Benn and Herrero 2002, Chapter 6.4, this report).

However, grizzly bear mortality in the Bow River Watershed was successfully managed 1994–2002. During this period there was >90% chance of grizzly bear population increase in the Bow River watershed (Garshelis et al. 2005). This occurred because wildlife managers were successful in keeping adult female mortality very low, with survival from year to year being 95–96%. However, had survival of adult females been less than 91%, which could have been caused by one more additional adult female mortality per year, the population's trajectory would have been decreasing (Garshelis et al. 2005). Maintaining 1994–2002 grizzly bear survival rates in the Bow River Watershed will become more difficult because of the increasing human population and development (Chapter 13, this report). During 2003 and 2004 the estimated female (all ages pooled) survival rates were 88% (95%CI 72–100%), and 71% (95%CI 45–96%) respectively (Chapter 5.1, this report). While we have less confidence in these data, due to the ESGBP field research having ended in 2002 and subsequent samples being smaller and potentially biased, they are cause for concern because they were below the minimum rate of survival (91%) necessary to sustain the sampled population (maintain $\lambda \geq 1$) given previous reproductive output (Chapter 5.1, this report).

Human-caused grizzly bear mortalities are a function of the number of contacts with humans and the potential lethality of each encounter (Mattson et al. 1996). In theory both of these variables are amenable to management. In practice, management of mortality becomes increasingly more difficult with higher levels of human activities (Mattson et al. 1996). The non-protected portions of the CRE have extensive non-paved and paved road development as well as extensive off-road areas. The protected portions of the CRE in Banff National Park and Kananaskis Country have lower road densities but more high-speed, high-use volume highways. Access and road development are well known to be positively correlated with grizzly bear mortality probability (Mattson et al. 1987, Nagy et al. 1989, Mace et al. 1996).

When viewed in a North American context grizzly bears in the CRE are part of the southern and eastern fringe of the species' distribution (McLellan 1998). Here too they coexist with a large and growing human population and because of this it is challenging to keep human-caused mortality at sustainable levels. Grizzly bears in the eastern portion of the CRE in Alberta have very little secure habitat, areas where they can avoid contact with humans and meet their daily needs (Gibeau et al. 2001).

The Bow River Watershed, where we found a high probability of grizzly bear population growth 1994–2002, is only 11,400 km^2 of the approximately 40,000 km^2 Central Rockies Ecosystem. Almost no grizzly bear hunting occurs in the Bow River watershed. However, a significant portion of the northeastern part of the CRE (of which the Bow River watershed forms a part) is encompassed by Bear Management Unit 4C of Alberta. Grizzly bear hunting occurs in this BMU (Chapter 6.4, this report). Here recent research by an Alberta Government appointed group of population biologists showed a trend of declining age structure for female grizzly bear mortalities over time. The authors recommended, "In a conservative management approach it would be prudent to take steps to reduce overall man-caused mortality…until better population inventory data is available" (Stenhouse et al. 2003). Grizzly bear hunting also occurs in extensive, non-protected portions of the British Columbia portion of the CRE area (Chapter 6.4, this report). Population effects have not been subject to specific research (However, see Benn 1998, and Chapter 6.4 this report). Ungulate hunting, which has lead to self-defense killing of grizzly bears at carcass sites is also practiced throughout a large portion of the CRE (Chapter 6.6, this report).

Access by grizzly bears to human-related foods and garbage remains a fundamental cause of bears getting in trouble throughout the CRE . Such "food-conditioned bears" are more likely to be killed by humans or removed from the ecosystem (Herrero 1985, Benn 1988, Benn and Herrero 2002, Chapter 6.4 this report).

Demographic research in the Greater Yellowstone ecosystem suggests a source-sink dynamic with $\lambda \geq 1$ inside Yellowstone National Park and the Grizzly Bear Recovery Zone but $\lambda \leq 1$ outside the Recovery Zone (Doak 1995, Schwartz et al. In press). A source/sink structure may also exist within the CRE with protected areas like Banff National Park and Kananaskis Country being a modest source grizzly bear population and other areas like BMU 4C in Alberta possibly being a mortality sink. Portions of Banff National Park such as Lake Louise and the Trans Canada Highway have relatively high female grizzly bear mortality density, as do portions of Kananaskis Country (Chapter 6.5 and 6.6, this report). Rigorous scientific data is needed to determine if a source/sink population structure exists in the CRE. This is likely because grizzly bears found in the CRE, but outside of areas protected from grizzly bear hunting, have more potential sources of mortality and greater chance of encountering human activities and developments. Also relevant is that dispersal by sub-adult female grizzly bears from maternal home ranges occurs slowly and conservatively (McLellan and Hovey 2001). Thus population sink areas are only slowly re-occupied, and this only occurs if factors causing excessive mortality have improved.

In the CRE human-caused grizzly bear mortality limits grizzly bear population abundance (Garshelis et al. 2005). Therefore, an objective of the ESGBP was to document and analyze mortality and to identify management options regarding grizzly bear mortality in the CRE. In this chapter we present detailed numerical, spatial, temporal, and causal analyses of grizzly bear mortalities. Such analyses, when combined with demographic analyses such as we did (Garshelis et al. 2005), may be used to support a logical development of management priorities and actions with the aim of minimizing mortality of adult female grizzly bears, thereby supporting population goals. This approach is being successfully taken in the Greater Yellowstone Area (Gunther et al. 2004, Servheen et al. 2004). High survival of independent female grizzly bears is what has led to recovery and expansion of the Greater Yellowstone Area population (Knight and Eberhardt 1985, Pyare et al. 2004, Schwartz et al. In press). Ultimately, the appropriate mortality-rate target for independent female bears will depend on the risk that managers and the public are willing to incur relative to a population decline (i.e., $\lambda < 1$) (Schwartz et al. In press).

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6.2 MORTALITY OF GRIZZLY BEARS IN THE BOW RIVER WATERSHED

Michael Gibeau

Persistence of grizzly bear populations is directly linked to the amount and type of human activity upon the landscape (Mattson et al. 1996). This pattern occurs not because grizzly bears are incompatible with human activities, but rather because humans conducting these activities are intolerant of grizzly bears (McLellan 1998, Woodroffe 2001). Consequently, human-caused mortality is the greatest threat to grizzly bear persistence today.

Garshelis et al. (2005) examined age and sex class survival rates among the research sample of grizzly bears in the Bow River Watershed (BRW). This is not the complete picture of mortality patterns within the study area as only the radio collared sample was considered. A more comprehensive overview of mortality has been systematically documented through annual reporting (Gibeau and Stevens 2003) of all known mortalities within the BRW since 1993 (Table 1). Known mortalities were compiled annually from Banff National Park and Provincial records, as well as follow up investigations by Conservation Officers of reports from the public. These are only the known mortalities. McLellan et al. (1999) estimated that as many as 50% of all mortalities may go undetected in areas where humans and grizzly bears share habitat.

Table 1. Age-sex class for known grizzly bear mortalities in the Bow River Watershed, Alberta, 1993–2002.

	Age-Sex class								
Cause of Death	Adult Female	Adult Male	Subadult Female	Subadult Male	Adult sex unknown	Subadult sex unknown	Male age class unknown	Female age class unknown	Total
Natural	2	1				1			4
Human Caused									
Legal Harvest		1							1
Government Action									
Safety	2		1	1					4
Agriculture		1		1					2
Garbage				1					1
Citizen Action									
Self-Defense	1	1	1	1					4
Agriculture		1						1	2
Garbage									
Misidentification				1					1
Accidental									
Railway	2								2
Highway	1		1	1					3
Other				1					1
Illegal				2					2
Treaty Indian		2	3	2			1		8
Research		1	1	1					3
Unknown						1			1
Total: human-caused	6	7	7	12	0	0	1	1	34
Total: all deaths	8	8	7	12	0	2	1	1	39

Several trends in the data were evident with detailed categorization of the cause of death. Natural mortality accounted for 10% of all recorded deaths. All of these were within Banff National Park. There were no known cases of a natural mortality on Provincial lands in the 10 years of record keeping. Treaty Indians, who have the legal right to kill grizzly bears at any time anywhere outside the national parks, stood out as the single largest factor with 23% of known human-caused mortalities. Public safety action by government officials and self-defense actions by citizens were the second largest factors, each accounting for 12% of the known human-caused mortality. All mortalities associated with self-defense actions by citizens were by hunters during the legal hunting season for ungulates.

Combining the data into broader categories again identified Treaty Indians as the single largest grizzly bear mortality factor (n=8) followed by government action (n=7), citizen action (n=6) and accidental (n=6). Sex specific data revealed that 41% of human-caused mortalities were female bears (n=14). It is generally accepted among management agencies that the maximum allowable human-caused mortality for female bears should not exceed 30% (Harris 1986). This statistic is further compounded by an additional 3 adult female bears translocated out of the ecosystem (essentially lost) over the 10 year period. This large proportion of female mortality in the sample is a serious management concern that was not identified in the analysis of the radio collared sample (Garshelis et al. 2004) but was previously identified within Banff National Park (Benn and Herrero 2002).

The wide range of causal factors in the mortality data set (table 1) demonstrates the complexity of management. Legal harvest, the single largest contributor in the Provincial mortality database, is a minor factor in the BRW. There is currently no effective dialogue with First Nations, the single major mortality source. Multiple sources of female mortality including public safety action by government officials, self defense, highway and railway collisions, Treaty Indians, and translocations out of the ecosystem are collectively jeopardizing this population's status with what is probably unsustainable female mortality.

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6.3 GRIZZLY BEAR MORTALITY AND HUMAN ACCESS IN BANFF AND YOHO NATIONAL PARKS, 1971–98

Bryon Benn and Stephen Herrero

This is a summary, in which the methods section has been shortened, of a paper published in the journal Ursus (Benn and Herrero 2002).

ABSTRACT

We conducted spatial and temporal analyses to examine the relationship between access, changing grizzly bear management strategies, and grizzly bear (Ursus arctos) mortality from 1971–98 in Banff and Yoho National Parks, Canada. Grizzly bears are not legally hunted in these parks. We summarized mortality by cause of death, sex, age, and cohort. The annual number of grizzly bear deaths declined significantly between the periods 1971–84 and 1985–98. However, the female portion of this mortality increased from 50% to 80% between the same time periods. Human-related causes were the primary sources of recorded grizzly bear mortality in the study area (119 of 131 known mortalities). Control of problem bears accounted for 71% of 119 known human-caused mortalities, followed by highway and railway mortalities (19%), unknown cause of death (9%), and research (<1%). All 95 human-caused mortalities with known accurate locations were within 500m of roads or 200m of trails. Eighty percent of these mortalities occurred below 2000m. Kills were concentrated at Banff townsite, Lake Louise, and along the Trans Canada Highway. Minimizing the human-caused mortality of adult female grizzly bears is crucial to maintain grizzly bear populations in Banff and Yoho National Parks. Management of development, trail access, and human food and garbage are critical for managing grizzly bear mortality in the national parks. We present specific recommendations.

Ursus 13: 213–221 (2002)

INTRODUCTION

Grizzly bears in Banff and Yoho National Parks are part of a regional ecosystem in Canada called the Central Rockies Ecosystem (Fig. 1). The Central Rockies Ecosystem is experiencing intensive exploration and development of coal, oil, gas, and timber reserves. Cattle production, housing and highway development, and outdoor recreation are also increasing. As a result, the grizzly bear is suffering from continuing habitat degradation and potentially unsustainable mortality rates in some regions of the Central Rockies Ecosystem (Herrero et al. 2000).

The national park portions of the Central Rockies Ecosystem continue to experience increases in human use, commercial development, and major transportation expansion with the doubling of the number of lanes of the Trans Canada Highway through Banff National Park (Banff-Bow Valley Study 1996). Grizzly bear hunting occurs on most provincial lands surrounding the parks. Interagency planning for effective land use at the regional scale (Herrero 1994), whereby grizzly bears can meet their energetic requirements, and encounters between humans and bears can be reduced, may be the best option for reducing grizzly bear mortality (Mattson and Knight 1991).

Natural survival rates for adult grizzly bears in unhunted populations are high and consistent (Knight and Eberhardt 1985, McLellan 1990), whereas young bears die more frequently of natural causes such as intraspecific aggression (Stringham 1983), accidents (Nagy et al. 1983), and nutrition related causes (Nagy et al. 1983, Knight et al. 1988). However, tracking natural mortality is very difficult because habitat is often remote and heavily forested, and carcasses are soon scavenged. Nonetheless, natural mortality is probably a minor cause of adult mortality (McLellan et al. 1999). Mortality data from North America show that human-caused mortality far outnumbers natural mortality (Craighead et al. 1988, McLellan 1990, Dood and Pac 1993, Gunson 1995). Historical (Storer and Tevis 1955, Noble 1972, McCrory and Herrero 1982) and recent works (McLellan and Shackleton 1988*a*, Mattson et al. 1996) consistently link the type and degree of human land use with grizzly bear mortality.

Roads are frequently implicated in contributing to increased grizzly bear mortality. They facilitate access for a host of human activities, increase the frequency of energetically costly flight responses, and increase vehicle related mortalities (Mattson et al. 1987, Nagy et al. 1989, Gibeau et al. 1996). As well, roadside vegetation may attract bears to roads, compounding the risk. At some undetermined level of human use, grizzlies, in particular established adult females, cease crossing major transportation corridors (Gibeau and Herrero 1998, Proctor 2003).

We analyzed grizzly bear mortality for Banff and Yoho National Parks from 1971–98. Results are discussed before and after changes in grizzly bear management strategies and relative to access.

STUDY AREA AND METHODS

The study area was Banff (6,836 km²) and Yoho National Parks (1,313 km²) (Fig. 1). We conducted spatial and temporal analyses to examine the relationship between access, changing grizzly bear management strategies, and grizzly bear (*Ursus arctos*) mortality from 1971–98 in these unhunted, protected areas. We summarized mortality data by cause, sex, age, cohort, and location related to development and elevation (Benn 1998). Access and mortality data were entered into a geographic information system, MapInfo 4.0 (MapInfo Corporation, Troy, New York, USA). Zones of influence (ZOI) of 500m and 200m were set around roads and trails. We stratified mortality data into 2 time periods to relate changes in mortality characteristics with changing patterns of human use and evolving management concerns and actions. We chose 1984–85 as the break as cumulative changes in management made human food and garbage much less available to grizzly bears. Additional details can be found in Benn (1998) and Benn and Herrero (2002).

Figure 1. The National Parks of the Central Rockies Ecosystem

RESULTS

We collected 108 and 11 records of human-caused mortality from Banff and Yoho National Parks, respectively. The average annual mortality was 4.3 grizzly bears/year, with peaks of 15 recorded deaths in 1972 and 13 in 1980 (Fig. 2). All human-caused grizzly bears mortalities in Yoho National Park occurred prior to 1981.

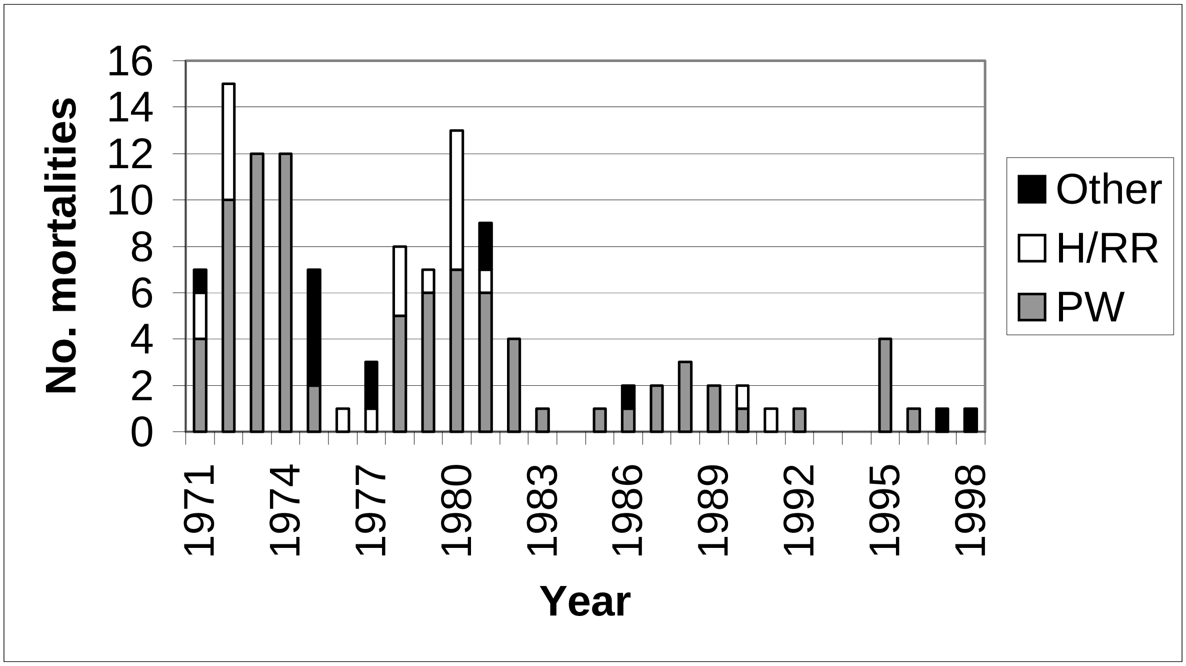

Figure 2. Annual human-caused grizzly bear mortality by type for Banff and Yoho National Parks, 1971–98, (*n* = 119). PW = problem wildlife, H/RR = highway/railway, Other = research or unknown.

Management actions and vehicle and train collisions accounted for 71% and 19%, respectively, of the 119 human-caused grizzly bear deaths. We knew the sex and age of 83 dead grizzly bears (Table 1). Adult females and dependent young (cubs-of-the-year and yearlings) accounted for 65% of this total. Females accounted for 51% of all mortalities of known sex since 1971 (Table 1), and even after closure of the Banff landfill in 1981, 18 of 22 bear mortalities with sex known were female (Fig. 3). An additional 11 mortalities were unclassified as to sex during this time.

Of 15 vehicle and train collisions where the cohort was known, adult males accounted for 47%, dependent bears 33%, and adult and subadult females 20%.

Table 1. Percent grizzly bear mortality (number) by sex, age, and cohort for Banff and Yoho National Parks, 1971–98 (*n* = 119).

Sex		Age		Cohort	
male	33.9	adult	34.7	dependent	29.4 (35)
female	35.3	dependent	29.7	adult female	16.0 (19)
unknown	31.1	subadult	12.7	adult male	15.1 (18)
		unknown	22.9	subadult female	7.6 (9)
				subadult male	1.7 (2)
				unknown	30.3 (36)

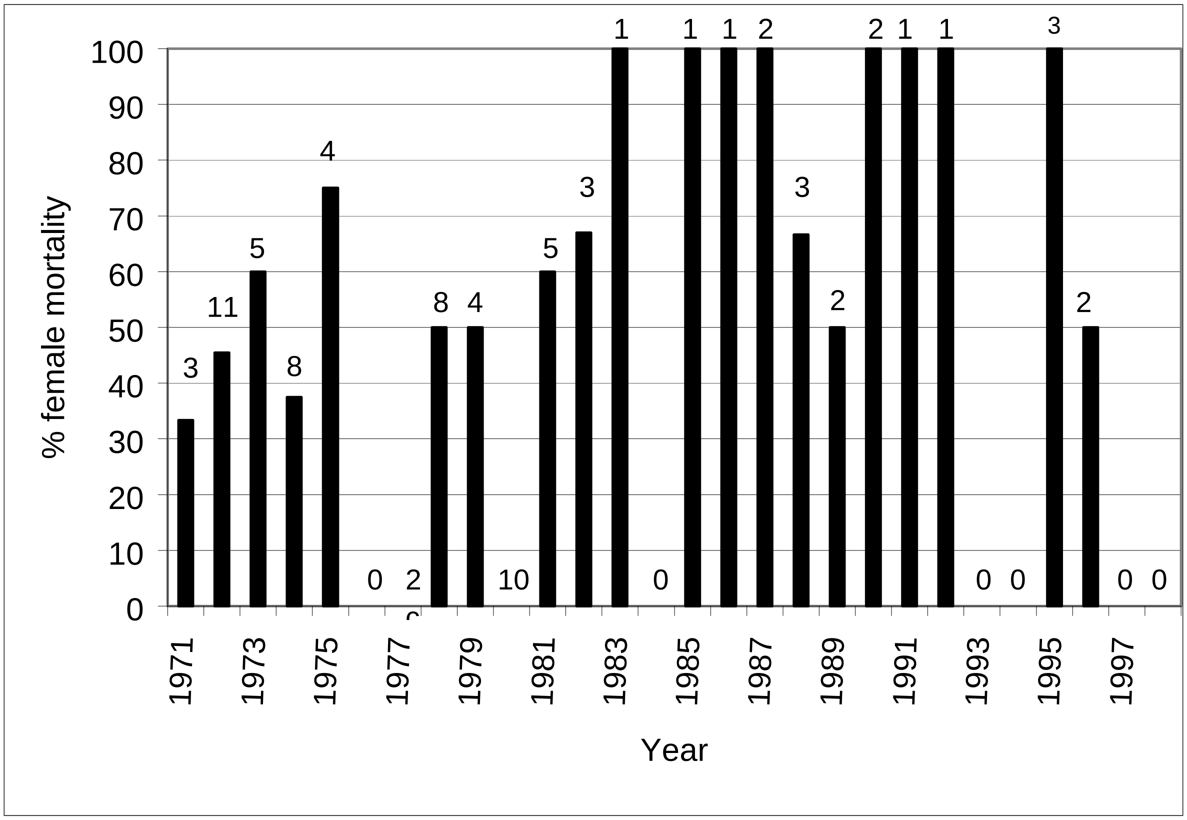

Figure 3. Percent females in annual grizzly bear mortality. Numbers above the bars are the total mortalities with sex known for that year.

Spatial Analyses

All 95 human-caused grizzly bear mortalities, classified as having accurate or reasonable locations, occurred within zones of influence along roads and trails or around human settlements (Fig. 4). Mortality concentrations occurred at Banff and Lake Louise townsites and along the Trans Canada Highway (Table 2). A minimum of 59 mortalities throughout the analysis period was associated with the presence of human food and garbage.

Table 2. Types of developments and land uses where human-caused grizzly bear mortalities occurred in Banff and Yoho National Parks, 1971–98 (n=95).*

Location of Kill	No.	Detail of Location
highway/railway	22	Trans Canada (16), Banff-Jasper (2), other (1), railway (3)
townsite	27	Lake Louise (15), Chateau Lake Louise (7), Banff (2), Field (3)
garbage dump/landfill	19	Banff (15), Lake Louise (4)
campground	16	
ski resort	8	Lake Louise (3), Norquay (3), Sunshine (2)
commercial lodge	11	
warden cabin	3	

* Total number listed is >95, as Highway mortalities at some townsites are tallied twice.

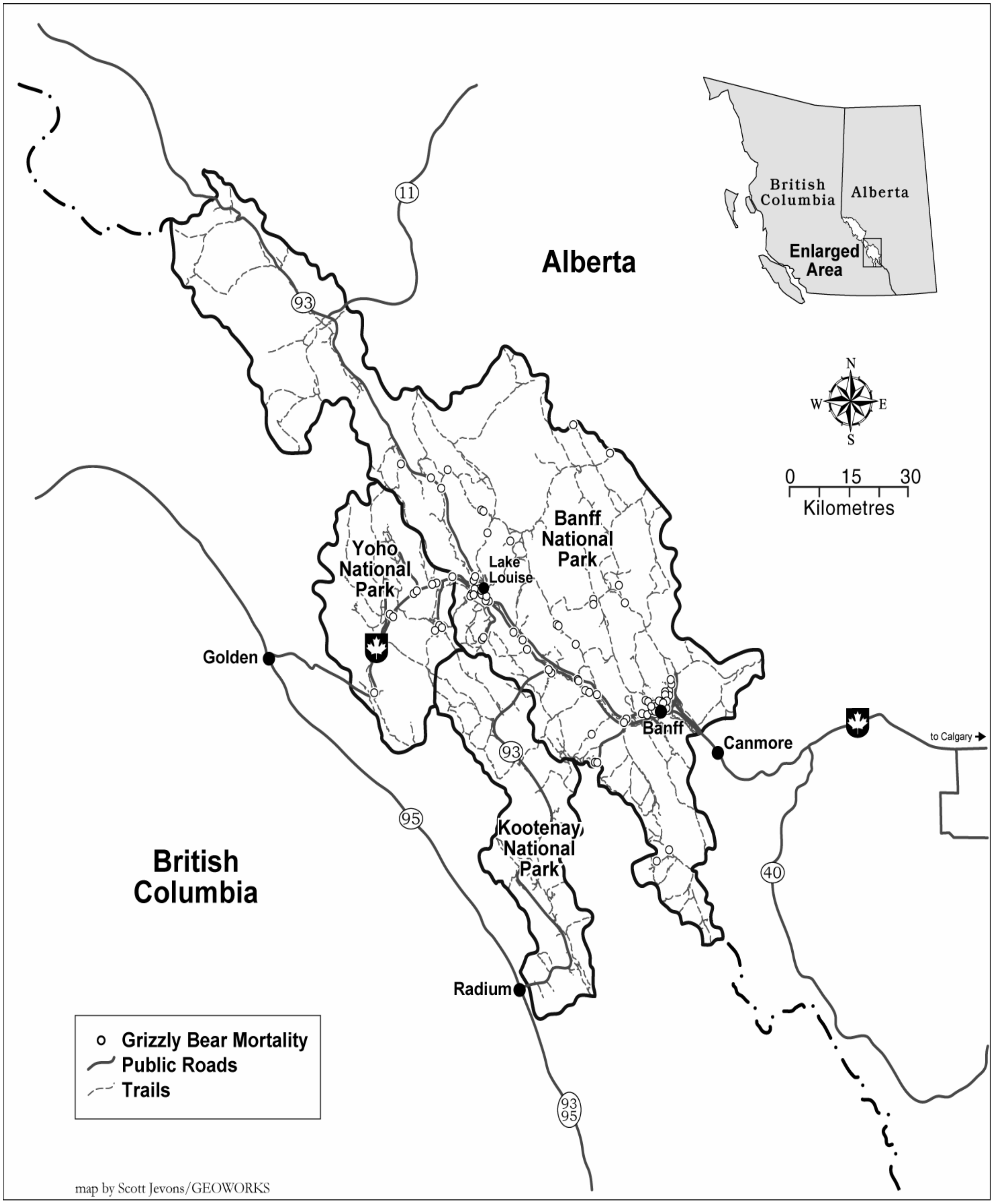

Figure 4. Grizzly bear mortality locations in relation to roads and trails in Banff and Yoho National Parks, 1971–98.

Eighty percent of all known mortality locations were below 1800m. The remaining 20% occurred between 1800m and 2100 m (Fig. 5).

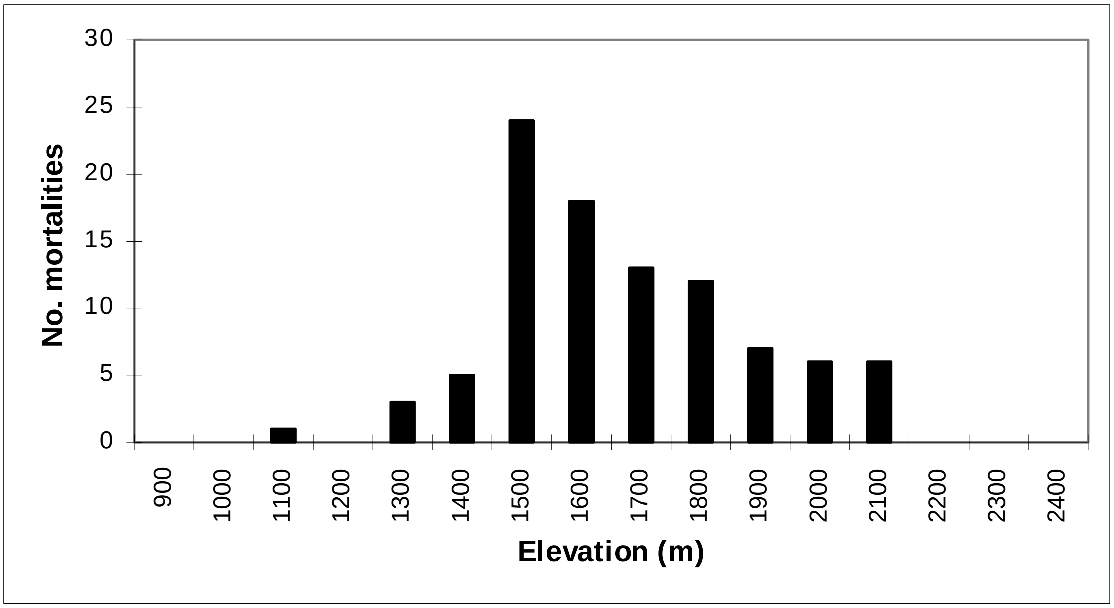

Figure 5. Grizzly bear mortality locations by elevation in Banff and Yoho National Parks, 1971–98 (*n* = 95). Elevations of high human use areas in the parks: Banff, 1375m; Castle Junction, 1430m; Lake Louise, 1540m; Chateau Lake Louise, 1740m; Skoki Lodge, 2135m; Moraine Lake Lodge, 1900m; Lake O'Hara, 2000m; Field, BC, 1250m.

Temporal Analyses

The mean annual number of mortalities declined significantly from 1971–1984 ($\bar{x}$ = 7.07) to 1985–98 ($\bar{x}$ = 1.43; *U* = 164.5, *P* = 0.0010). The mean annual number of problem wildlife mortalities also declined significantly from 1971–84 ($\bar{x}$ = 4.93) to 1985–98 ($\bar{x}$ = 1.14; *U* = 151.0, *P* = 0.0066).

Most mortalities in both periods were problem bears (67% during 1971–84; 80% during 1985–98). Although the number of problem bear deaths declined during 1985–98, the percentage of females increased from 50% to 80%. Adult females and dependent bears (cubs-of-the-year and yearlings) increased from 66% of the total mortality in the early period to 79% during period 2. Only 2 of 22 highway and railway mortalities occurred in the latter period.

We knew the date of death in 72 instances. More deaths (57%) occurred during the berry season (mid-Jul–late Sep) than during the pre-berry (35%), and post-berry (8%) seasons. Seventy-five percent and 58% of 48 dated mortalities of problem bears occurred during the peak tourist season (late Jun–early Sep) and during the berry season, respectively.

DISCUSSION

The 119 recorded human-caused grizzly bear deaths in Banff and Yoho National Parks were considered to be the minimum number from 1971–98. This large number of deaths caused by humans contrasts strongly with the adjacent and larger Jasper National Park, where in 1975–98 there were only 39 known grizzly bear mortalities (W. Bradford, Wildlife Warden, Jasper National Park, Alberta, Canada, personal communication, 1999).

Problem bear mortality was the most significant cause of death for this study. Management interventions helped reduce the total number of deaths (male and female) in 1985–98. However, the percent of female mortalities during this period increased from 50% to 80%, and the average annual female mortality was still higher than the total human-caused mortality target set based on the park's population estimate. This human-caused female mortality is the highest percent of total human-caused mortality reported for a

10 year period for any grizzly bear population. The higher male mortality in the early period was probably the result of more male bears feeding closer to people (in landfills and unsanitary campgrounds, Noble 1972). With the landfill closures and improved camper attitudes and garbage management, adult males may have selected habitats remote from human activity zones. Adult females with young and subadult grizzlies may have been more likely to use habitats near people, presumably to avoid adult males (Mattson et al. 1992, Gibeau et al. 1996). Thus, they may have been prone to habituation to humans and attraction to human food and garbage, increasing their mortality risk relative to males (Fig. 3) and their potential to be destroyed or translocated as problem animals (Mattson et al. 1987). This dynamic was previously described for the Yellowstone Ecosystem (Craighead et al. 1995).

Road mortality declined during 1985–98 even though traffic volumes increased. We have no definitive data to explain this; however, one likely cause is that the highway was fenced in stages to keep wildlife off the highway. Also, traffic became distributed over a 24-hour period and may have become so continuous as to act as a barrier to bears attempting to cross unfenced portions of the corridor.

We found that grizzly bears died at low elevations and near human settlements and access. Roads, trails, and developments are almost always placed in valley bottoms, often fragmenting riparian habitats. Similarly, concentrations of kills at settlements and along roads and trails occurred throughout the Central Rockies Ecosystem (Benn 1998) and in other grizzly bear populations (Mattson et al. 1987, Nagy et al. 1989, Mace et al. 1996). Gibeau et al. (2001) showed that human use and developments reduced the amount of secure habitat for grizzly bears. Roads and trails improve access, and when placed in important seasonal habitats, increase the potential for negative bear–human encounters (McLellan and Shackleton 1988*b*). Increased access to the backcountry has been shown to alter bear behavior (McCullough 1982, Jope 1985), increase bear–human conflicts (Dalle-Molle and Van Horn 1989), increase the number of grizzly bear removals (Martinka 1982, Leonard et al. 1990), and displace certain cohorts, such as females with young (Mattson et al. 1987, Gilbert 1989).

The abrupt decline in grizzly bear mortality into the mid-1980s was correlated with closing the Banff landfill, improving garbage management, increasing public education regarding living and recreating in bear country, improving tolerance of grizzly bears, fencing of the Trans Canada Highway, and increasing use of aversive conditioning techniques over removals. However, the high mortality rate of the early period may have depressed the park's grizzly bear population. This effect could have continued through the 1985–98 period due to a lag effect and mortality concentrated in the female cohort. Closures of Yellowstone National Park landfills were followed by sharp declines in reproductive and survival rates (Craighead et al. 1974).

Finally, we found that a high proportion of mortalities occurred during the berry season. In Mid-July to early October, grizzlies in the Central Rockies Ecosystem feed primarily on buffaloberry (*Shepherdia canadensis*) at lower elevation, often along roads and near people.

Human intolerance, inadequate management of access and food attractants, and a high rate of commercial development continue to be important contributing factors to grizzly bear mortality in Banff National Park. However, specific steps have been taken to reduce human-caused grizzly bear mortality. Recommendations by the Eastern Slopes Grizzly Bear Project to the Banff-Bow Valley Task Force (Gibeau et al. 1996) led to the implementation of an annual human-caused mortality target of <1% of the estimated grizzly bear population. Also, habitat effectiveness targets aimed at supporting grizzly bear habitat use have been set for most carnivore management units. By implementing measures aimed at reducing potential conflicts between humans and grizzlies, human-caused grizzly bear mortality and the potential for human injury can be reduced.

There is an urgent need for these measures to be successful in the national parks and the rest of the Central Rockies Ecosystem. As precise measurements of population demographic rates are only now becoming available (Garshelis et al. 2005), management of mortality must be conservative and management plans must consider adjacent jurisdictions in Alberta and British Columbia (Herrero et al. 1998). A recent population and habitat viability assessment workshop predicted both population and habitat declines for grizzly bears in the Central Rockies Ecosystem (Herrero et al. 2000). Because Banff and Yoho National Parks are assumed to serve as core refugia for sensitive species such as grizzly bears, and because grizzly bear hunting exists on most of the land surrounding these national parks, human-caused mortality inside the parks, especially in the adult female cohort, must be minimal. Ecological integrity is the stated priority of the national parks (Banff National Park 1997), and the grizzly bear serves as the premier indicator of the health of the terrestrial ecosystem (Banff-Bow Valley Study 1996). Managing grizzly bear mortality at a level that prevents population decline (Garshelis et al. 2004) is fundamental.

MANAGEMENT IMPLICATIONS

The following recommendations are based on the stated goal of Parks Canada to maintain a naturally regulated population and distribution of grizzly bears in the mountain national parks (Banff National Park 1997). These recommendations are offered as ways to prevent future increases in mortality, to reduce the unnecessary killing of grizzly bears, and to assist in the inter-jurisdictional management of grizzly bear mortality.

During the analysis period, a considerable number of grizzly bear deaths went unrecorded in official park databases, and the records were often incomplete. This has improved in recent years and must continue to improve.

There is some variation in the way mortality data are classified between jurisdictions in the Central Rockies Ecosystem. Park wildlife managers should work with managers from other jurisdictions to develop the same coding conventions and to clearly define the different causes of death.

Acquiring accurate mortality locations is necessary for understanding and managing mortality with respect to access, development, and use of the landscape. Mortality needs to be monitored in the future to understand the effectiveness of management decisions. Additional information needs to be collected such as the distance a bear died from an access route or facility, the type of access route, the condition of the access route at the time of the mortality, the mode of travel of the person(s) responsible for the removal of the bear, presence of food attractants including natural foods, and what, if any, human behaviors played a role in the mortality.

Management of garbage and human and pet food continues to be a problem around Banff, Lake Louise and in some campgrounds. Effective legislation and enforcement should be employed with respect to food and garbage handling. All backcountry users should be required to store food, garbage, and horse feed in bear-proof metal or seamless PVC containers, or effectively elevate attractants between trees or isolate camp within an effective portable electric fence.

To understand the effects that new management strategies and increases in human use of grizzly bear habitat have on grizzly bear mortality and population status, analyses should be repeated and reassessed in the future with more accurate population estimates.

The use of aversive conditioning programs on roadside- and campground-habituated bears, especially females, should be increased. On-site releases and aversive conditioning of many problem bears would reduce the costs and risks associated with translocating grizzlies.

Efforts should continue to inform the public about bear activity in high human use areas and to educate the public with respect to how to behave in bear country.

All of these recommendations will require adequate funding and administrative support.

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