South Purcell-Yaak and south Selkirk ecosystem grizzly bear mortality summary

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Abstract

Canadian and US trans-border grizzly bears in the south Selkirk and Purcell-Yaak ecosystems live in small fragmented threatened populations. Reducing human-caused mortality where feasible is an important strategy for "recovery" of these populations. We examined patterns of human-caused mortality spatially and temporally in these ecosystems by reviewing 29 years of mortality records from the US Fish and Wildlife Service, Idaho Fish and Game, and the British Columbia Ministry of Water, Lands, and Air Protection. This report crystallizes three important points:

1) human-caused mortality rates in these ecosystems are likely contributing to declines in the Purcell-Yaak area and may be limiting growth in the Selkirk Mountains
2) the vast majority of Canadian grizzly bears are being killed after being attracted to residences and small farms on the periphery of these ecosystems
3) actions focused on reducing bear attractants in settled areas may improve several bear management issues:
    - reducing human-bear conflicts,
    - reducing bear mortality and thus improving survival rates in and around these threatened populations, and
    - reducing attractants, allowing inter-population linkage without increasing human-bear conflicts in linkage zones.

We found human-caused mortalities to be increasing in both ecosystems, culminating in a known mortality rate averaged over the past 6 years of an estimated 4.0% of the Purcell-Yaak population and 3.0% of the south Selkirk population. Males were killed more often than females, sub-adults (1-5 yrs. old) more often than adults, and deaths were more likely to occur in the fall than the spring and summer combined. We make recommendations for strategies to reduce these mortalities within Canada, as the US has on-going organized efforts aimed at minimizing grizzly bear mortalities. In the recent decade, we found that 75% of Canadian non-hunting mortalities occurred as a result of attractants at residences and small farms from fruit trees, livestock and feed, and garbage (including 3 self-defense kills at residences and several unspecified causes at attractant sites) on the periphery of these ecosystems. The other category was backcountry mortalities in the eastern portion of the Purcell-Yaak area which included mistaken identification, illegal kills, self-defense, black bear hound hunters, and several of unknown cause resulting in 11% of known mortalities. We recommend using the existing well organized BC Bear Aware program modified to encompass the rural scattered nature of on-site attractant-based grizzly bear mortalities occurring on the periphery of these ecosystems. We also recommend a committee of relevant interested community and government individuals be formed to guide these efforts. We further recommend that a member of this research team and a local conservation officer approach the local hunting community using the east Purcell-Yaak area for discussions on the solutions to the backcountry mortality occurring in that region. And finally, we recommend that hunting be eliminated south of Highway 3 in the Purcell Mountains (South Purcell Grizzly Bear Population Unit) and a no hunting buffer around these threatened populations be considered to facilitate population interchange.

Introduction/ Background

Grizzly bear (*Ursus arctos*) populations spanning the U.S.–Canada border in the south Selkirk and Purcell-Yaak ecosystems are small, vulnerable, and at the front lines of any further range contraction in North America. These populations have been fragmented into habitat peninsulas corresponding to the north/south oriented Rocky, Purcell, and Selkirk Mountain ranges that span the international border (Proctor 2003). The southern tip of the occupied habitat peninsula in the Purcell–Yaak area appears to have limited female connectivity with adjacent areas across Highway 3, potentially creating a small female island population (Fig. 1; Proctor et al. 2005a). There is evidence of male movement across Highway 3 in this same area which appears to maintain gene flow and genetic diversity. The trans-border Purcell-Yaak population likely consists of less than 50 individuals and is declining (Wakkinen and Kasworm 2004). In the south Selkirk Mountains, movement of both sexes appears restricted across a narrow valley containing British Columbia (BC) Highway 3A, a thin but continuous strip of human development, and a narrow river and lake waterway. The genetic differences detected across this valley were striking considering the small geographic distance (1–5 km). The high genetic distance and the relatively low average expected heterozygosity (15–20% less than in adjacent populations) suggest that genetic interchange with adjacent populations has been limited for at least several generations (Proctor et al. 2005a). The trans-border south Selkirk population is estimated to have less than 100 individuals with a slightly increasing growth rate (Wakkinen and Kasworm 2004).

Considering the small and fragmented status of these populations, and their location at the southern edge of the contracted North American distribution, both populations are considered "Threatened" by the US Endangered Species Act and British Columbia (Hamilton and Austin 2002). As these populations are shared between the US and Canada, British Columbia and the US Fish and Wildlife Service (USFWS) have entered into a cooperative working relationship to apply enhanced research and management to facilitate the recovery and long-term persistence of these trans-border populations. The USFWS, Montana Fish, Wildlife, and Parks, and Idaho Fish and Game, and the US Forest Service jointly research and manage these ecosystems to minimize mortality within the US border. One of the goals of the effort is to integrate an enhanced Canadian effort within BC. The vision of this effort is to use science-based research to guide a comprehensive management plan that addresses the causes and solutions for recovery of these populations and apply them to the Canadian jurisdiction of these ecosystems. Briefly, we plan to enhance and re-establish inter-population connectivity with adjacent geographic areas, reduce any excessive human-caused mortality, improve habitat security where appropriate, and carry out educational activities for the public, local landowners, industry, and relevant government agencies (Proctor et al. 2004).

Human-caused mortality is a ubiquitous factor in regulating bear populations in the region (McLellan et al.1999). However in small populations, even with the absence of legal hunting, human-caused mortality is a dominant concern (Schwartz et al. 2004). Minimizing human-caused mortality is fundamental to achieving population increases (Gunther 1994, Swenson et al. 1998, Mattson and Merrill 2002). Causes of mortality are diverse (McLellan et al. 1999, Wakkinen and Kasworm 2004) and require interagency cooperation and country-specific strategies to reduce. There is cause for optimism in the example of the Yellowstone Ecosystem where enhanced mortality management has reduced known human-caused mortality to within the targets established in recovery plans (Gunther 1994, USFWS 1993) and has stimulated geographic expansion (Schwartz et al. 2002, Pyare et al. 2004). Management efforts to reduce mortality have also resulted in increased bear densities and geographic expansion in Sweden (Swenson et al. 1995, 1998) resulting in increased hunting opportunities.

More specific to the south Selkirk and Purcell-Yaak ecosystems, simulation work exploring various management options suggests that reducing human-caused mortality will be most significant factor in improving long-term population viability for small grizzly bear populations (Proctor et al. 2004). Our objective here is to use patterns in human-caused grizzly bear mortality to guide the design and implementation of management plans to enhance recovery of these populations. This report summarizes the human-caused grizzly bear mortality in the south Selkirk and Purcell-Yaak ecosystems, reveals their spatial and temporal patterns, and recommends strategies for their reduction.

Methods

Grizzly bear mortality records were gathered from British Columbia Ministry of Water, Lands, and Air Protection, US Fish and Wildlife Service, and the Idaho Fish and Game files. BC records date back to 1976, and US records to 1982. We summarized mortality patterns for an area including the south Selkirk Mountain and the south Purcell / Yaak River ecosystems. The south Selkirk area is located south and west of BC Highway 3A spanning the U.S.-Canada border into northeastern Washington and northwest Idaho; the Purcell–Yaak area is located south of Canada Highway 3 to U.S. Highway 2 extending to the northwest corner of Montana (Fig. 1). Because our long-term goals include enhancement of inter-population exchange of bears (linkage) with adjacent areas we included a 15km wide periphery of land in our mortality summary. Consideration of mortality patterns (causes, locations and timing) and potential reductions in our focal ecosystems and their periphery will enhance the growth potential from increased survival (and future reproduction) and immigration.

Results

Human-caused mortalities are increasing in both ecosystems (Fig. 2a & b). The long-term average mortality rate is 1.8 bears/yr. in the Purcell-Yaak and 1.7 bears/yr. in the south Selkirk Mountains (Table 1). In the last 6 years (1999 - 2004), the annual mortality rate is 4.3 bears/yr. and 3.0 bears/yr. in Purcell-Yaak and the south Selkirk Mountain systems respectively. Estimating the Purcell-Yaak population at 50 animals (Wakkinen and Kasworm 2004; Proctor et al. 2004), we found the annual known mortality rate to be 4.3% of the population averaged over the past 6 years, Estimating the south Selkirk population at 100 animals (Weilgus et al, 1994; Wakkinen and Kasworm 2004; Proctor et al. 2004), the 6-year average known mortlaity rate was 3.0% of the population (Table 1).

Overall, males were killed by humans more than females (not sig, $X^2 = 3.3$, df = 1, p slightly >0.05), sub-adults were killed more than adults (adjusted for cohort size, $X^2 = 6.9$, df = 1, $p<0.005$), and mortalities were more likely to occur in the fall than the spring and summer combined ($X^2 = 14.6$, df = 1, $p<0.001$; Table 1). Further, Canadian mortalities on private land far outnumbered the US (white dots, Fig. 3). Canadian mortalities cluster around major valleys with roads and human settlements. Almost 80% of all human-caused non-hunting mortalities occurred within 500m of an open road; not surprising as these mortalities occur where human and bears come into conflict, typically in roaded environments (rural residences, etc).

Specific causes of mortality are diverse (Table 1). Mistaken identity occurred more in the US than Canada. Poaching and illegal kills were equal between the countries (7 US : 5 Can). Management on-site-related mortalities (protection of property, fruit tree and livestock related bear/human conflicts) were more prevalent in Canada than the US (1 US : 15 Can). This difference may be a consequence of reporting patterns. From a reporting perspective, there were 19 cases where the specific cause of mortality (or attractant) was unknown (fruit tree, livestock, garbage, etc was not recorded) in Canada, however the majority of these were the result of bears being attracted to a private residence or farm and the specific attractant was not recorded.

When looking at the causes of mortality in the most recent decade (Table 2) it is apparent that small farm related conflicts in the form of fruit trees, livestock, and property damage account for 37% of mortalities within Canada. Several additional self-defense kills occurred after a bear had been attracted in for unspecified reasons. While 22% or 12 mortalities have an unknown specific cause, 10 of those were a result of a bear being attracted to a residence or farm in Canada. In other words, in the recent decade, Canada had 32 (82%) of 39 non-hunting mortalities that were a result of attraction to a residence or farm on the periphery of the Selkirk and Purcell-Yaak ecosystems. These types of mortalities can be visualized in Figure 3 where yellow dots representing recent-decade mortalities follow major highway and settlement corridors across the Selkirk and Purcell Mountains. Mistaken identity accounts for another 7% and occur in both the US and Canada with no spatial pattern apparent.

The other pattern within Canada in the recent decade is a loose cluster of 6 backcountry mortalities in the eastern portion of the Purcell-Yaak area. These were mainly recorded as self defense and mistaken identity and appear to be associated with hunting (see discussion below).

Hunting

Hunting grizzly bears is not legal in most of the Purcell-Yaak and all of the south Selkirk ecosystems as both populations are considered "threatened" in the US and Canada. Hunting is allowed in a portion of the Purcell-Yaak ecosystem within Canada south of BC Highway 3 in the southern portion of the South Purcell grizzly bear population unit (GBPU; Hamilton and Austin 2002; BC hunting & Trapping Regulations). Hunting is also legal in the Canadian populations that are immediately adjacent to both areas. There were 48 hunter kills (24 north and 24 east) in the 15km immediately peripheral to the north and east across BC Hwy 3 into the Purcell Mountains and Rocky Mountains (red dots; Fig. 3). Due to the relationship between human-caused mortality (including hunting) and fragmentation (Proctor 2003), the reduction of hunting mortality in the southern portion of the south Purcell GPBU and areas directly adjacent to these threatened populations should be considered. Reductions in mortality adjacent to human transportation and settlement corridors (BC Hwy 3) may be important to facilitate inter-population movement. It will be important to integrate intensive public outreach in these areas to minimize and secure bear attractants to reduce potential human/bear conflicts.

Discussion

The mortality rates we have estimated for the Purcell-Yaak (4.3% of the population for the past 6 years) are consistent with estimates of population decline as estimated by Wakkinen and Kasworm (2004) who found the Purcell-Yaak population may be decreasing at 3.7% per year. When unknown (or undetected) human-caused mortalities are considered, the Purcell-Yaak may have a mortality rate in the range of 6-8%, a rate considered unsustainable for grizzly bears in this region (Miller 1990; Bunnell and Tait 1991; Hovey and McLellan 1996; Austin et al. 2004) and certainly not consistent with population increases necessary for “recovery”. Mortality rate alone is not a complete indicator of population growth rate. Reproductive rate is the other important component of growth rate that must be considered. Wakkinen and Kasworm 2004 report a reproductive rate for the Cabinet-Yaak ecosystem that is low relative to other interior populations suggesting that the Yaak population may not be able to sustain mortality rates near the high end of what otherwise is the acceptable range for grizzly bears in the region. The mortality rate we have documented for the south Selkirks (3.0% of the population for the last 6 years) rises to 4.5-6% when unknown mortalities are considered. Unknown mortalities have been estimated to range from 50% (USFWS 1993) to 100% (McLellan et al. 1999) of reported human-caused mortalities. Wakkinen and Kasworm (2004) report a slightly increasing growth rate for the south Selkirk Mountains, which may be adversely affected by the recent rise in this ecosystem’s mortalities. Also, population estimates at this time are estimates only, as no thorough population survey has been carried out since Weilgus et al. (1994).

Target mortality rates for recovery

We recognize that human-caused mortality will always occur where bears and humans coexist. Our goal is to minimize it, to allow population recovery in these threatened populations. Reducing human-caused mortality requires a concerted international multi-agency effort. In the Yellowstone ecosystem, proactive multi-agency cooperative mortality management has reduced known human-caused mortality to within the targets established in recovery plans (Gunther 1994, USFWS 1993) and has facilitated geographic expansion (Schwartz et al. 2002, Pyare et al. 2004). The USFWS has set mortality targets for the US portion of the Purcell-Yaak and south Selkirk ecosystems of zero-human – caused mortalities (USFWS 1993). Total human-caused mortality rates for interior grizzly bear populations should not exceed 3-5% for population stability, depending on habitat quality, according to current BC provincial guidelines (Miller 1990; Hovey and McLellan 1996; Peek et al. 2003; Austin et al. 2004). This rate includes known, and estimates of unknown mortalities. Known human-caused mortality targets for ‘recovery” of the Purcell-Yaak population and its periphery should be no more than 2% of the population/yr. or approximately 1 bear/yr. on average. The target for the south Selkirk Mountains and periphery should 2 bears/yr. or less. Females should comprise less than 30% of this rate.

Current mortality management

Current grizzly bear mortality management in British Columbia falls into 2 main areas. The BC Conservation Service has the responsibility to handle problem wildlife situations arising from encounters between bears and humans and their property. Conservation officers respond to "complaints" about bears that have been attracted to human environments. Solutions range from educating people about controlling their bear attractants (fruit trees, bee hives, pet food, garbage etc), to relocating or killing appropriate bears. Conservation officers also have many other responsibilities beyond bears that divide their time so bear problems must be solved reasonably efficiently. The second area is in preventative education of the public, farmers, and industry. The BC Ministry of Water, Lands, and Air Protection and the Conservation Service publishes and distributes several pamphlets and brochures on how to avoid bear conflicts aimed at city, suburban, village, and rural residents as well as agriculture and industrial sectors (timber harvest, tree planters, mining etc). They also maintain an informative website. The British Columbia Conservation Foundation administers a "Bear Aware" program designed to help reduce human/bear conflicts and mortality in and around communities. This program is well considered and organized and is applied to communities who raise money and request it. The BC MWLAP also has recently initiated a "Bear Smart Community" program where interested communities can get provincial funding to improve their bear conflict problems. Further, BC has a full compliment of bear-proof garbage containers along public highways and several small town landfills have been secured by electric fencing or transformed into secure transfer stations and as a result several chronic problems have been eliminated. In a few instances a community organizes a "Bear Management Committee" and hires a person to facilitate the management of bear attractants. The above suite of solutions has been applied in and around Revelstoke BC and their bear problem has diminished significantly (Proctor and Neumeier 1996; Ciarniello 1997).

The BC MWLAP and the BC Wildlife Federation administers a first-time hunter certification testing program that has a detailed section on distinguishing black bears from grizzly bears. The BC MWLAP also publishes and distributes a pamphlet on telling the bears apart in the field.

Recently, Conservation Officers, regional government biologists, and managers from the US and Canada who are charged with south Selkirk and Purcell-Yaak grizzly bear management attend an annual workshop to discuss problems and solutions furthering inter-agency and international cooperation.

Management options

There are two main patterns to the Canadian human-caused mortalities in the past decade: on site attractants (fruit trees, livestock and feed of small hobby farms, and garbage) in settled valleys on the periphery of the south Selkirk and Purcell-Yaak ecosystems that account for the majority of Canadian deaths, and backcountry kills in the eastern portion of the Purcell-Yaak area.

Residence and farm attractant mortality

British Columbia (the government and public) is motivated to apply solutions to bear conflicts and we feel that given accurate data and strategic efforts, solutions to reduce bear mortalities are attainable. Given this atmosphere, we recommend that the established bear-educational community (Bear Aware and Bear Smart Community programs) be integrated into a regional strategy for grizzly bear mortality reduction. This report has documented that rural settlements are experiencing an increase in bear-related conflicts on the periphery of the south Selkirk and Purcell-Yaak ecosystems, from the attractive qualities of fruit trees, livestock, feed, and garbage. In the past decade, fruit trees, livestock, feed, and property damage have been responsible for up to 75% of all non-hunting human-caused mortality in the Canadian portion of these ecosystems. These results clearly suggest that efforts to reduce mortality should be focused on residential and rural small farm attractants to bears. Reducing and managing attractants to bears at many personal residences and farms is not an easy task and the realization of meaningful improvements will require a thoughtful organized effort.

Actions focused on reducing bear attractants in settled areas may improve several bear management issues: reducing human-bear conflicts, reducing bear mortalities, improving survival rates in and around threatened populations, and allowing inter-population linkage without increasing human-bear conflicts in linkage zones. One concern often mentioned when mortality reductions are considered, is that increased bear numbers will lead to more human-bear conflicts for residents living in settled valleys. But consider, if we increase bear numbers by ***reducing conflicts*** this will also work towards alleviating future problems with increased bear numbers, as attractants will be better managed. If bears are not being attracted to rural residences and getting killed, inter-population exchange may also benefit as bears occasionally move through settlements in valleys separating more remote mountainous areas.

Avenues for reaching semi-rural and rural communities within Canada include raising the awareness of landowners to helping develop workable on-site solutions to local bylaws concerning control of bear attractants. The current model for BC Bear Aware programs is aimed at discrete communities and focuses on education and attractant control. From a grizzly bear management perspective, our results suggest that a south Selkirk-Purcell regional "Bear Aware" effort may be more appropriate as mortality sites are scattered along human-settled valleys on the periphery of these ecosystems. We recommend that a "grizzly bear mortality committee" be formed to organize and guide specific solutions throughout the region. This committee would include the regional bear aware organizer, a BC Conservation Officer, a representative of the regional district, a farmer/rancher association member, an interested rural landowner from the Nelson and Creston areas, an employee of the BC MWLAP, an interested member of the conservation community, and a bear biologist. The goal of this group would be to guide the implementation of practical workable solutions for the reduction of bear conflict and mortalities in the region. Much of this work would be in the form of general public education and specific education aimed at localized "trouble" spots that require fine scale attention. The mechanism for action should be funding of a seasonal "bear aware educator/specialist" for the region. Methods and materials already developed for the Bear Aware program would be suitable in most cases, but require they be applied in rural and semi-rural areas on the periphery of these ecosystems. Funding would have to be secured by this committee through the public and private granting community. Opportunities exist to join forces with the Bear Aware administration for tailoring and financing this program.

We also suggest that NGOs be integrated into solving specific bear-attractant problems by providing expertise and funding for solutions such as electric fencing of highly attractive, lethal sites. For instance, Defenders of Wildlife has a growing Canadian program for solving specific wildlife-related problems in an equitable and lasting manner. An example is a need for electric fencing of dead cow compost dumps in the Creston area.

Backcountry mortality

In the last decade, the human-caused mortalities that occurred in the Canadian backcountry were in the eastern portion of the Purcell-Yaak area (Figure 3). There were 7 human-caused mortalities; 4 recorded as human management with no specific cause, 1 mistaken identity, 1 illegal kill, and 1 black bear hound hunter. This is an area for local hunters and we recommend a more detailed assessment of the very exact causes of these kills and with that information, strategies be undertaken to improve the situation. This may take the form of improved backcountry skills in bear awareness, or improved attitudes towards grizzly bears. Contacting local hunting organizations and giving presentations about potential conflicts with grizzly bears while working or recreating in the backcountry and having discussions about the recent mortalities may lead to some workable solutions. Individuals from this project would be willing to accompany Conservation Officers or another appropriate government official to approach hunting groups for these discussions.

Hunting mortality

We recommend that hunting be temporarily eliminated in the portion of the BC South Purcell GBPU south of Highway 3 because this area is biologically a part of the Purcell-Yaak threatened population and immediately adjacent to the US border. This is a small, threatened international population under stress from fragmentation and reliant on north to south movement of bears (Proctor et al 2005a), human-caused mortality is one of the dominant factors contributing to this fragmentation (Proctor 2003), and the population is in decline (Wakkinen and Kasworm 2004). For the above reasons and to facilitate inter-population connectivity, we also think consideration should be given to creating a buffer of no hunting around these threatened international populations (the Purcell-Yaak and south Selkirk populations). One option for buffer width might be the extent male bears that are known to cross Highway 3 actually range north of the Highway. These males currently provide genetic connectivity between areas north and south of Highway 3. Our research team is working to understand linkage ecology in the area and has found one male bear to travel approximately 35km north of Hwy 3 and south into the US (Proctor et al. 2005b – Purcell progress report). This option would only be feasible with a complementary integrated effort to reduce bear attractants in the linkage zones as recommended in this report.

Conclusions

In conclusion, this report was undertaken to facilitate the understanding of grizzly bear mortality patterns in the threatened south Selkirk and Purcell-Yaak populations and develop a strategy to reduce those caused by humans within Canada to levels that are conducive to population growth and recovery. Because the majority of Canadian mortalities are a result of bears being attracted to residences and farms on the periphery of these ecosystems, the direction of management efforts is clear, reduce attractants in these areas. However easily said, this is a challenging task, and requires the thoughtful and organized efforts of experienced people. We therefore recommend the formation of a committee of appropriately qualified personnel to oversee a BC “Bear Aware” style program modified to fit the spatially scattered rural nature of the situation. The mechanism for action should take the form of a seasonally funded experienced person to carry out activities related to reducing grizzly bear mortality in human settled areas through attractant reduction. Detailed tracking of mortality patterns should continue to monitor the effectiveness of any such program.

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Table 1. Summary of human-caused grizzly bear mortalities in the south Selkirk and south Purcell / Yaak ecosystems from 1976 through 2004. Mortalities span both the US and Canada and include a 15 km perimeter.

CATEGORY			Purcell/Yaak	S Selkirks	Both % ot total	Total
Total human-caused mortalities			110	84		194
Human-caused morts, no hunting			52	47		99
		male	28	25	0.54	**53**
		female	21	14	0.35	**35**
		unknown	3	8	0.08	11
	Hunting	**US**	0	0		
		Canada	51	30	0.45	81
	Age	**<1**	4	6	0.15	10
		1-5	18	16	**0.52**	**34**
		>5	11	11	0.33	**22**
	Season	**Spring**	11	9	0.20	20
		Summer	3	7	0.10	10
		Fall	38	31	0.70	69
	Private land	**US**	5	1	0.06	6
		Canada	25	21	0.46	46
	Public land	**US**	11	13	0.24	24
		Canada	11	12	0.23	23
Within 500m of road						
	US	**yes**	13	7	0.20	20
		no	3	5	0.08	8
		unk	0	2	0.02	2
	Canada	**yes**	29	27	0.57	56
		no	7	3	0.10	10
		unk	0	3	0.03	3
GENERAL CAUSES						
		Mistaken ID	7	3	0.10	10
		Poaching/ Illegal	2	7	0.09	9
		Unknown	0	2	0.02	2
		Under Investigation	6	3	0.09	9
		Self-defense	13	4	0.17	17
		Train	2	0	0.02	2
		Research	1	0	0.01	1
MANAGEMENT MORTALITIES						
		Fruit trees	0	7	0.07	7
		Livestock	7	5	0.12	12
		Garbage	3	1	0.04	4
		Property	1	1	0.02	2
		Unknown	9	17	0.26	26
TOTAL			**51**	**50**		**101**
Known deaths / year*			1.76	1.72		
Known deaths / yr last 6 years*			3.5	2.8		
Known deaths / yr last 6 years**			2.2	3.0		
Percent of population**			4.3%	3.0%		

*** includes bears in ecosystem & periphery**
**** includes only bears within ecosystem**

Table 2. Summary of human-caused mortality (non-hunting) in the south Purcell-Yaak and south Selkirk ecosystems in the most recent decade fron 1995-2004. The Can : US column refers to the number of mortalities in each category that occurred in Canada or the US.

Recent Decade 1995-2004	Purcell/Yaak	S Selkirk	Total	Can : US	Proportion of total
Human, unknown*	7	5	12	10 : 2	0.22
Under investigation	6	3	9	0 : 9	0.16
Livestock	4	4	8	7 : 1	0.15
Self defense**	6	2	8	7 : 1	0.15
Fruit trees	0	7	7	7 : 0	0.13
Mistaken ID	2	2	4	2 : 2	0.07
Garbage	2	1	3	3 : 0	0.05
Property damage	1	1	2	1 : 1	0.04
Train	2	0	2	2: 0	0.04
TOTAL			55		

*All 10 of the Canadian unknown mortalities resulted from being attracted to a residence or farm
**Includes some BB hound hunters

Figure 1. a. Current North American grizzly bear distribution; b. Regional trans-border grizzly bear distribution. In both maps, blue is the current distribution of grizzy bears.

a. **b.**

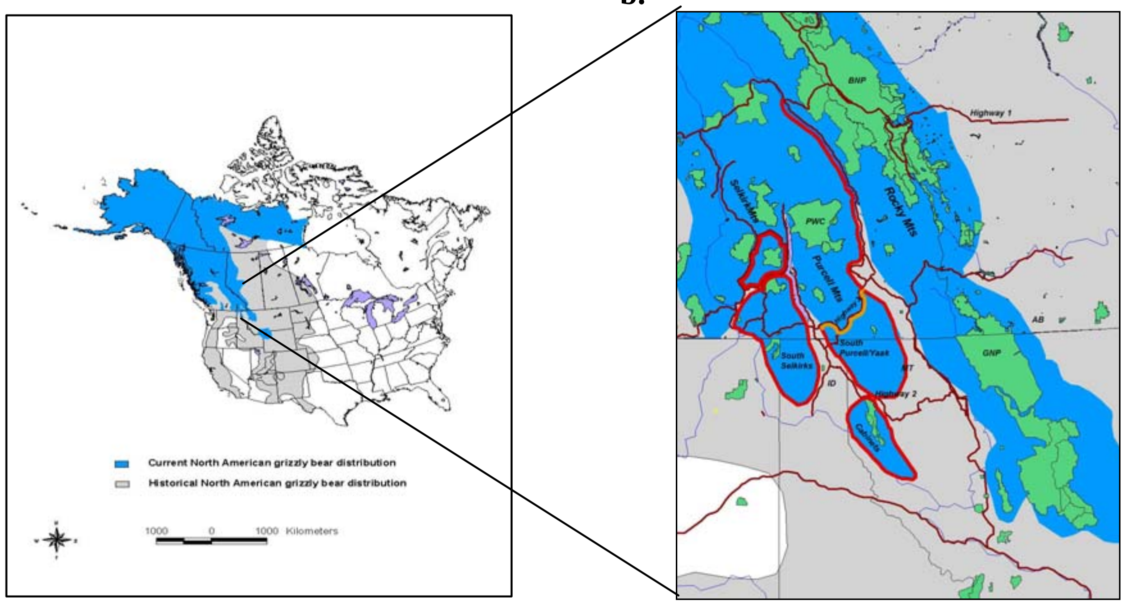
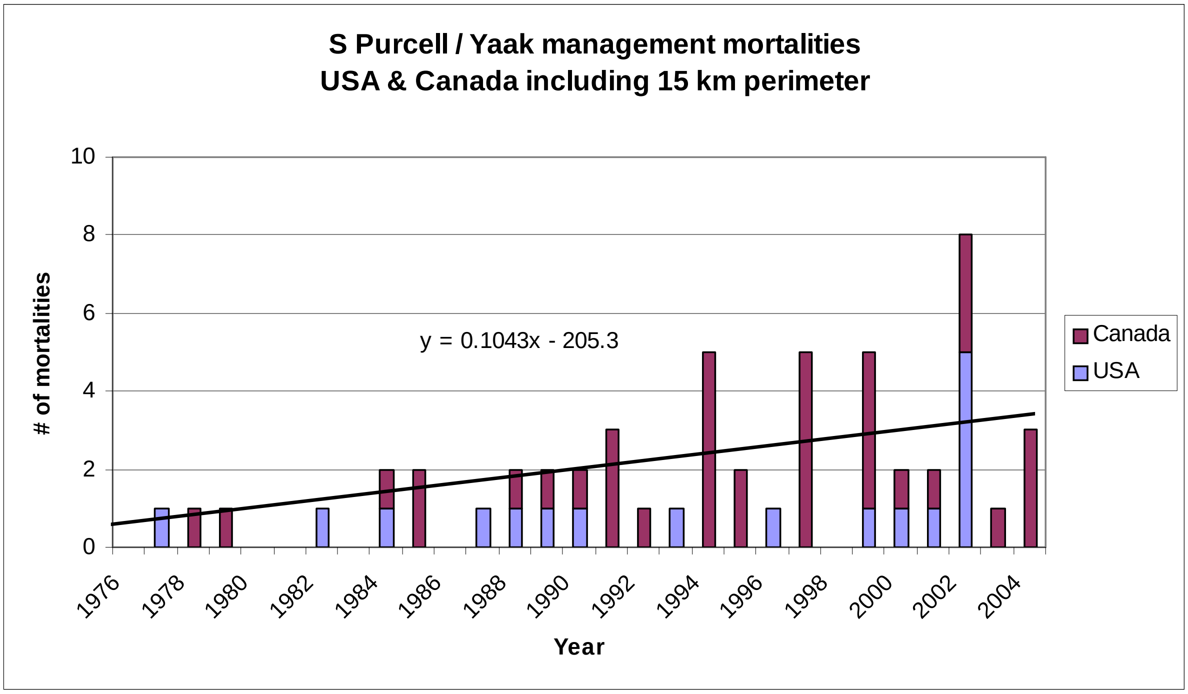


Figure 2. Human-caused grizzly bear mortalities in the a.) south Selkirk and b.) south Purcell / Yaak ecosystems from 1976 through 2004. Mortalities span both the US and Canada and include a 15 km perimeter. Hunting and natural mortalities are not included.

a,



b.

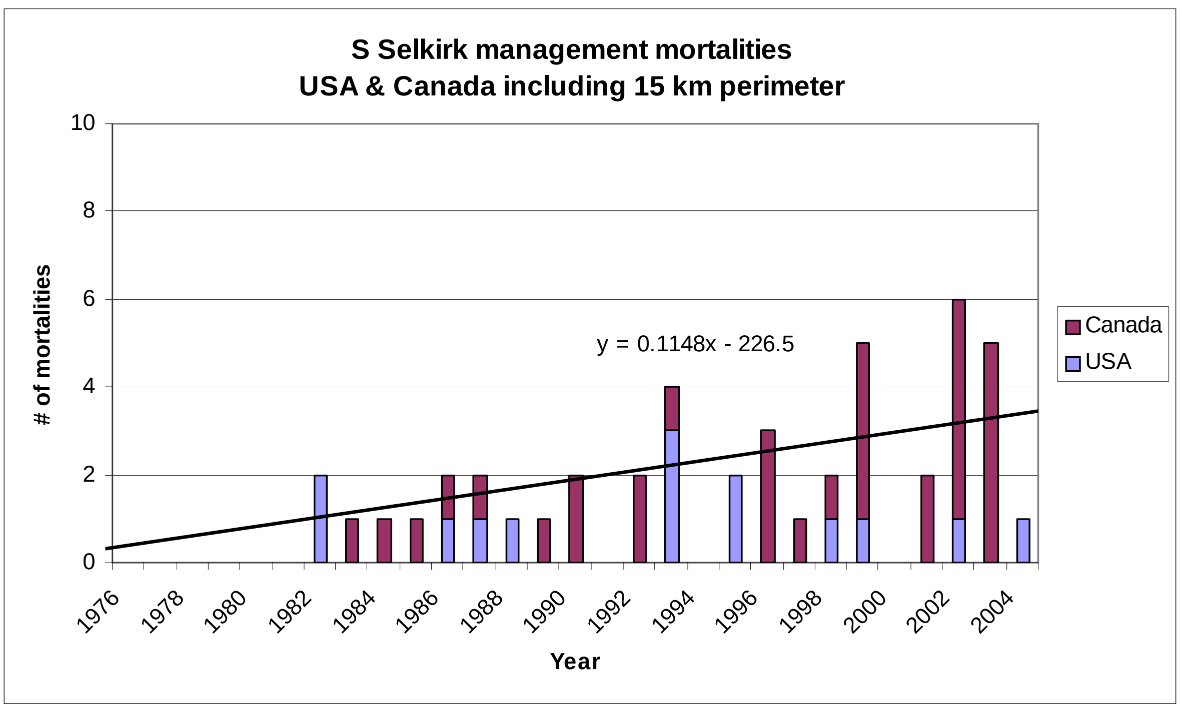


Figure 3. Map of human-caused grizzly bear mortalities in the south Selkirk (orange polygon) and south Purcell / Yaak (yellow polygon) ecosystems from 1976 through 2004. Mortalities span both the US and Canada and include a 15 km perimeter (white line). Included are: hunting mortalities (red dots), management and other human-caused (white dots), natural (blue dots) and unknown caused mortalities (brown dots). PWC is the Purcell Wilderness Conservancy, GRPP, KGPP, VPP, and WAPP are Goat Range, Kokanee Glacier, Valhalla, and West Arm Provincial Park respectively

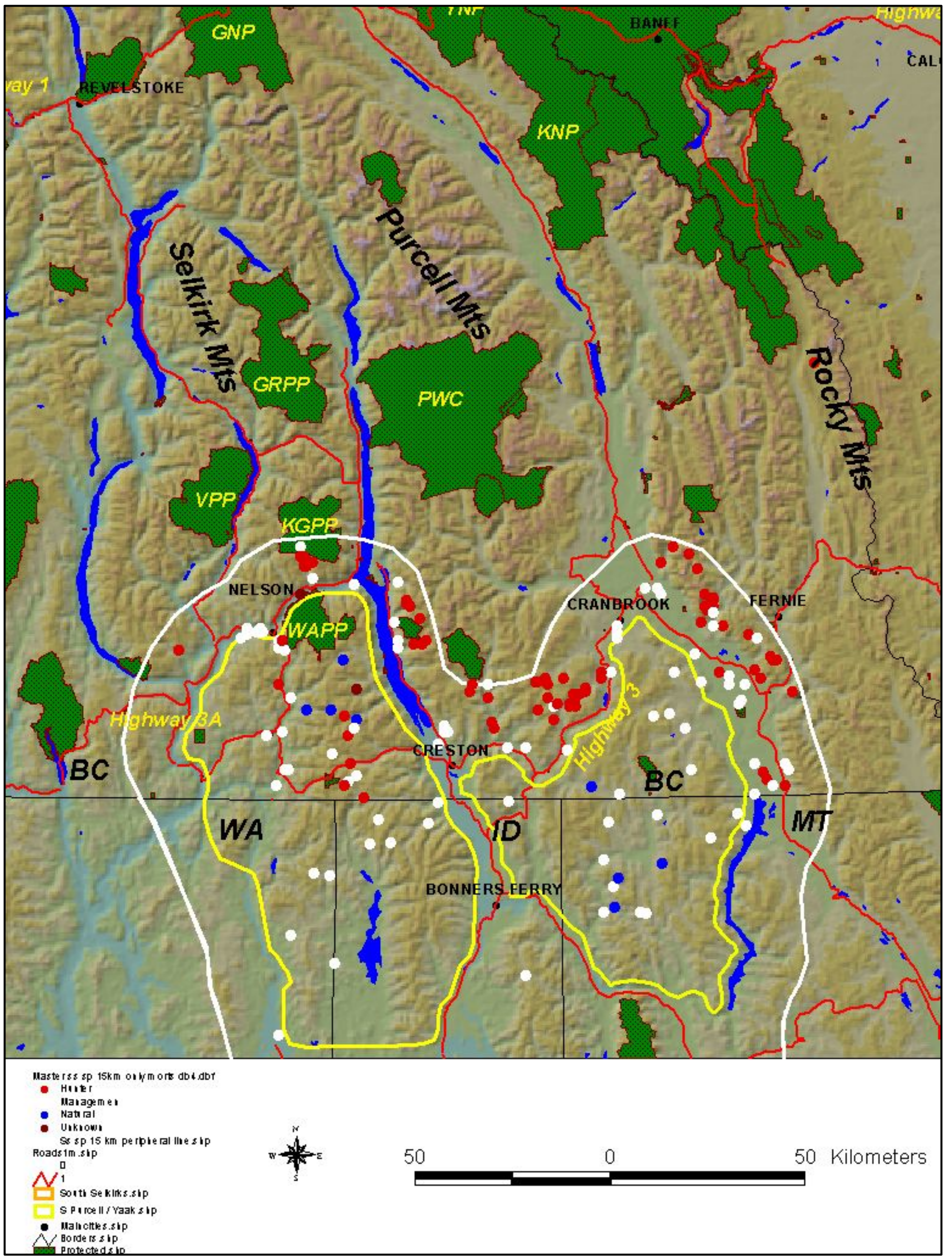


Figure 4. Map of human-caused grizzly bear mortalities in the south Selkirk (orange polygon) and south Purcell / Yaak (yellow polygon) ecosystems from by decade. Mortalities span both the US and Canada and include a 15 km perimeter (white line). Included are: human-caused mortality between 1976-1984 (red dots), 1985-1994 (pink dots), 1995-2004 (yellow dots). Green shaded areas are protected; PWC is the Purcell Wilderness Conservancy, GRPP, KGPP, VPP, and WAPP are Goat Range, Kokanee Glacier, Valhalla, and West Arm Provincial Park respectively.