West Slopes
Bear Research Project
Second Progress Report
1997

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Glacier - Donald - Yoho Area
Kootenay Region, British Columbia, Canada

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ABSTRACT

From May 1994 to December 1996, the West Slopes Bear Research study team handled bears on 210 occasions (71 grizzly bears, 139 black bears). One elk and 3 wolverine were incidentally captured and released. The bear sample included 145 individual bears (46 grizzly bears, 99 black bears). Radio-collars were placed on 95 bears including 46 grizzly bears (23 male, 23 female) and 49 black bears (25 male, 24 female). All collars were fitted with cotton breakaway spacers to prevent neck damage. Breakaway failure, physical damage to the collar, and animal deaths reduced this sample to 49 bears by December 31, 1996 including 28 grizzly bears (14 males, 14 females) and 21 black bears (8 males, 13 females). The research sample included 6 female grizzly bears and 4 black bears (3 male, 1 female) which had been translocated from their original capture site for public safety reasons.

To September 1997, there were 5 deaths of radio-collared grizzly bears: 1 subadult male (0106) and 1 adult female (0290) were legally killed during the 1996 and 1997 limited entry hunting seasons, 1 translocated adult female (0095) was killed by another grizzly bear during the spring of 1996, 1 adult female (0292) was killed in an avalanche, and 1 adult female's death is still under investigation (0031). The observed mean of adult female grizzly survival was 0.8889 (S.E. 0.0748202). For subadult males, the survival was 0.6667 (S.E. 0.3056313). There were no deaths within other sex and age classes.

To September 1997, there were 8 deaths of radio-collared black bears including: killed by grizzly bear (1); died of natural, unknown causes (2); killed by trains (2); shot by legal hunters (1); shot by landowner (1); and poached (1). There have been 3 capture related black bear deaths.

To December 1996, mappable locations of radio-collared bears were obtained on 1,921 occasions (925 grizzly bear, 996 black bear). Aggregate multi-annual ranges were calculated for 4 classes of bears (excluding translocated bears): female grizzly (89 km^2, N=14); male grizzly (318 km^2, N=23); female black bear (42 km^2, N=24) and male black bear (124 km^2, N=24). Six translocated grizzly females had an average home range size of 651 km^2.

Radio-tracked translocated female grizzly bears (N=6) did not return to their points of origin and had average aggregate home ranges 730% larger than non-translocated female grizzly bears. These bears had erratic long distance movements of up to 123 km between radio checks. One translocated grizzly bear became in conflict with humans and was translocated for a second time.

An extensive DNA fingerprint database has been obtained from study area bears (41+ grizzly bear and 116+ black bear genotypes). Allele frequency distributions have been calculated at up to 9 microsatellite loci. Genetic variability is greater in black bears (mean number of alleles 10.0) than in grizzly bears (mean number of alleles 6.56). A method of obtaining DNA fingerprints from free-ranging black and grizzly bears was developed and tested in the field and laboratory.

Four bear mark-recapture census experiments have been completed: 1 using remote cameras and 3 using DNA samples from free ranging bears. In 1996, a large scale census of the 4096 km^2 central core of the study area revealed a non-uniform distribution of grizzly bears with most bears in the north-east and south-west quadrants of the census area and few bears in the central Rocky Mountain Trench. Nuclear DNA (nDNA) fingerprinting hair samples from the census area identified 54 individual grizzly bears (24 female, 30 male).

Preliminary analysis using the program CAPTURE and assuming a closed population was 104 grizzly bears (CI 86-133, $p < 0.05$) using the study grid during the census session (June/July 1996). However, radio-telemetry demonstrated that the population was not closed: radio-collared grizzly bears spent 26.8% of the time during the census period out of the study grid. The statistical analysis of these data is still under development.

The radio-collaring of new study bears will need to be reviewed before the 1998 field season. Current plans are to track bears intensively until November 1998 and then monitor them on a less intensive basis until their collars drop off or the bear dies. A refined DNA based census is proposed for the eastern side of the study area in 1997 and the western side in 1998. Detailed analyses of bear interactions with highways and railways began in 1995 with thesis completion expected in 1998 (Robin Munro, UBC, M.Sc. candidate). Detailed habitat analyses of avalanche tracks began in 1996 and field work will be completed in 1997 (Roger Ramcharita, UBC, M.Sc. candidate). Faecal collections for food habit studies and DNA fingerprinting commenced in 1997. A final report on the project is scheduled for the winter of 1999.

1. INTRODUCTION

A. Working Plan

The West Slopes Bear Research Project is a 5-year inter-agency applied research programme which commenced in May 1994. The project uses a combination of radio-telemetry, remote camera, and DNA-fingerprinting techniques to assess population characteristics, habitat use, and movements of grizzly and black bears.

The core study area is a 70 x 70 km block located in the west slopes of the Rockies and east slopes of the Columbia Mountains in the vicinity of Golden, British Columbia (Figure 1).

The major questions addressed by this research are:

1. What is the density of bears in the study area?
   a. How can bear densities be accurately and economically measured?
   b. How do study area bear densities compare to estimates generated by the Fuhr-Demarchi method (Fuhr and Demarchi 1990)?

2. What are bear survival rates in the study area (by age/sex classes)?
   a. How do these rates compare to the Raine and Riddell (1991) estimates for the Yoho-Kootenay area and to other study areas?
   b. What are the causes of bear mortalities?
   c. Are survival rates of translocated problem bears different from non-translocated bears?

3. What are bear recruitment rates in the study area?
   a. What is the age of first reproduction and the interval between litters?
   b. How do recruitment rates of translocated problem bears compare with non-translocated bears?

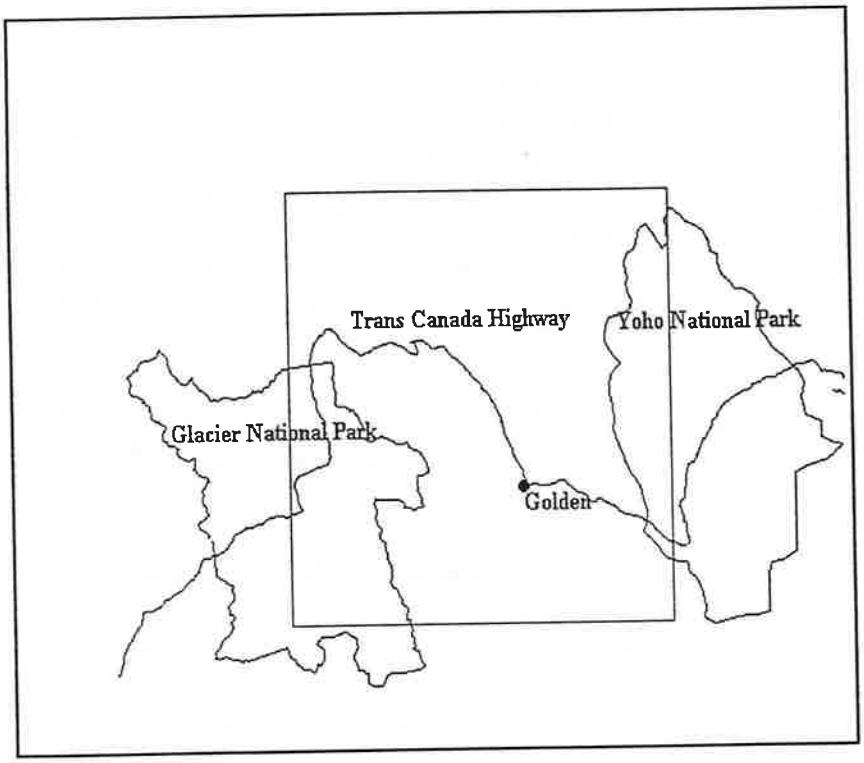
4. What are the bear movement patterns within the study area?
   a. Is the Columbia River valley a barrier to movement between the Rocky and Columbia mountains (east-west movements)?
   b. Is the Trans-Canada Highway / railway corridor a barrier to movement (north-south movements)?
   c. Are protected areas within and adjacent to the study area serving as population sinks or sources?
   d. How do movements of translocated problem bears compare with non-translocated bears?
   e. Do translocated bears adopt new home ranges?

5. How do bears use habitat within the study area?
   a. Which habitats do bears select during each season?
   b. What do bears eat during each season?

6. What impact are human activities having on bears within the study area?
   a. What are the current and projected human land-uses in the study area?
   b. How are these changes likely to affect bears?
   c. What management strategies might mitigate present and future impacts?

Readers should refer to the project working plan (Woods *et al.* 1994) and the first progress report (Woods and McLellan 1996) for additional background.

Figure 1. West Slopes Study Area. The inner square shows the boundaries of the 1996 DNA census grid (64 x 64 km^2)



B. Acknowledgements

This project is guided by a multi-agency steering committee representing the Columbia Basin Fish and Wildlife Program (J. Krebs), the Ministry of Environment, Lands and Parks (A. Fontana, T. Hamilton), the Ministry of Forests (B. McLellan), and Parks Canada (A. Dibbs and J. Woods).

M. Super (principal radio-telemetry technician) and D. Mair (principal fixed-wing pilot, Silvertip Aviation, Revelstoke) provided expert aerial locations of radio-collared bears under varying weather conditions in mountainous terrain. D. McTighe (principal helicopter pilot, Canadian Helicopters, Golden) assisted in many facets of the project including handling bears and DNA trap-site checks on the ground. R. Munro and K. Stalker provided valuable help in trapping, den site checks, and ground tracking.

D. Paetkau, C. Strobeck, M. Watt, L. Waits provided DNA analysis and tutoring in molecular biology. D. Lewis and M. Matsushita ran the camera stations in 1995. M. Proctor conducted the DNA hair census trial in the Beaver Valley in 1995. E. Dafoe, J.P. Kors, M. Proctor, and K. Stalker ran the DNA hair census project in 1996. Connie Davis typed all hair and tissue samples collected during 1996 (hair census and captured bears). B. Hughson provided financial support and tactical encouragement for the DNA analyses from their inception.

Numerous individuals assisted with animal capture including; R. Beardmore, B. Browne, W. Cibulka, E. Dafoe, J. Flaa (ground and aerial team leader), A. Fontana, F. Hovey (east side team leader in 1994), B. Klassen, J.P. Kors, J. Krebs, L. Ledoux, D. Lewis, B. McLellan, D. McTighe (Canadian Helicopters), J. Niddrie, M. Morris, H. Morrison (ground and aerial trapping on the east side), M. Peterson, M. Proctor, R. Ramcharita, H. Schwantje (veterinarian), R. Smith (veterinarian), C. Wilson (Bighorn Helicopters) and J. Woods. W. Cibulka and B. Klassen provided valuable linkages with the Conservation Officer Service. M. Gibeau (Eastern Slopes Grizzly Project) was very helpful in discussing techniques and providing drugs and equipment.

In addition, we would like to thank G. Matson and his staff (Matson's Laboratory, Milltown, Montana) for determining bear ages from tooth cementum analyses. I. Parfit prepared the home range figure used in this report and a set of wall maps plotting all bear home ranges.

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2. METHODS AND RESULTS

A. Radio-telemetry

I. Animal capture

Most bears were captured during spring and autumn trapping sessions in 1994, 1995 and 1996. Low elevation sites serviced from the ground were mostly unsuccessful in capturing grizzly bears. Starting in June 1994, helicopter supported, multi-elevation trapping became the primary capture method. Darting free-ranging bears from helicopters supplemented trapping during most capture sessions.

Although grizzlies were the primary target, many black bears were captured (Tables 1, 2) and trap sites often were disturbed by black bears. This reduced trapping effectiveness for grizzly bears.

All bear collars were fitted with breakaway spacers which allowed the collar to drop off the bear after a period of time. The standard spacer material was Wajax Blue Chain Spec2400 forestry hose (300 pound test unlined linen hose). Premature failure of collar breakaway spacers became evident during the spring and summer of 1995. To counteract this, the breakaway protocol was modified in the autumn of 1995. The revised protocol was a double thickness canvas breakaway on all adult bears (5 years old or older). Breakaways on male bears usually were nicked 0.5-1.0 cm on either side (breakaways for very old adults caught in the autumn usually were not nicked). Subadult bears were fitted with single canvas breakaway spacers of varying widths and extra strapping. This protocol improved collar retention while continuing to protect bears from over-tight collars.

A number of problem bears translocated from or to the study area and were handled by the research study team (Table 2). In most cases these bears were trapped in culverts by the Conservation Officer Service, John Flaa, or Bruce McLellan.

Table 1. Animal Captures, including recaptures, all sources, May 1, 1994 - December 31, 1996

Species	Captures	Individuals	Radio-collared bears
Grizzly Bear	71	46	46
Black Bear	139	99	49
Elk	1	1	n.a.
Wolverine	3	2	n.a.
Total	214	148	95

Table 2. Radio-collared bears, May 1, 1994 - December 31, 1996

Species/Sex (active)[1]	**Female**	**Male**	**Total**
Grizzly	23[2] (14)	23 (14)	46 (28)
Black	25[3] (13)	24[4](10)	49 (23)
Total	48 (27)	47 (24)	95 (50)

[1] as of December 31, 1996
[2] includes 6 translocated bears and 1 with a previous translocation history
[3] includes 1 translocated bear
[4] includes 3 translocated bears

ii. Radio-tracking

We attempted to radio-track grizzlies weekly and black bears biweekly during May - October. Den sites were located during additional winter flights. Supplementary funding from Parks Canada and the Ministry of Forests, and graduate student assistance, allowed additional black bear locations within the Beaver River valley during 1995 and 1996.

Ground tracking was very difficult due to the rugged nature of the study area and the rapid vertical movements of the bears. Most locations were obtained from the air using Cessna 336 and 337 aircraft based out of Revelstoke (Table 3). Although bears were occasionally lost for 1-2 weeks, most of these animals were eventually found. There have been no known collar failures and only 1 collared bear is not accounted for (a subadult male black bear: 0265). During the

spring and autumn of 1995 and 1996, a special effort was made to see all adult female bears to determine if they had cubs. All collars on mortality mode (dropped collars and dead bears) were investigated on the ground.

Table 3. Aerial and ground locations[1] for radio-collared bears, May 1994 - December 1996.

Period	Grizzly Bear	Black Bear	Total
April 1994-March 1995	230	335	565
April 1995-March 1996	331	366	697
April 1996- Dec 1996	364	295	659
Total	925	996	1921

[1]suitable for mapping, general locations and pulse-checks excluded

In flight, each animal location was marked on an aerial photograph, assigned an accuracy category, and the habitat type at the animal's position was visually assessed. These points were then plotted on standard forest cover maps and a U.T.M. grid position determined along with elevation, aspect, slope, and standard stand attribute data. Distances to human activity (e.g. roads) were measured directly off either forest cover maps or topographic maps. For ground locations, multiple bearings were used to estimate bear location and the locations were directly plotted on standard topographic maps and error assessed using triangulation programs. The ground locations were then treated in the same matter as aerial locations.

iii. Habitat analyses During 1995 and 1996, Robin Munro (M.Sc. candidate, UBC) conducted intensive radio-tracking and habitat analyses in the Beaver River valley as they relate to bear ecology adjacent to railways and highways. This thesis is scheduled for completion in 1997/98 (Appendix 1). Starting in the spring of 1996, Roger Ramcharita (M.Sc. candidate, UBC) began a detailed habitat analysis of grizzly bear use of avalanche paths (Appendix 2). During 1997, volunteer researcher Verena Wittenberg (M. Sc. candidate, TU Braunschweig, Germany), studied patch selection by grizzly bears feeding on glacier lily bulbs within avalanche paths. Also in 1997, volunteer researcher Ludger Wenzelides (M. Sc. candidate, TU Braunschweig, Germany) studied black and grizzly bear bedding site selection in and adjacent to avalanche paths. Avalanche path related habitat work is scheduled to conclude at the end of the 1997 field season. Ramcharita (1997) has prepared a preliminary assessment of grizzly bear and black bear denning habitat which is available from the author on request.

iv. Home ranges and movements

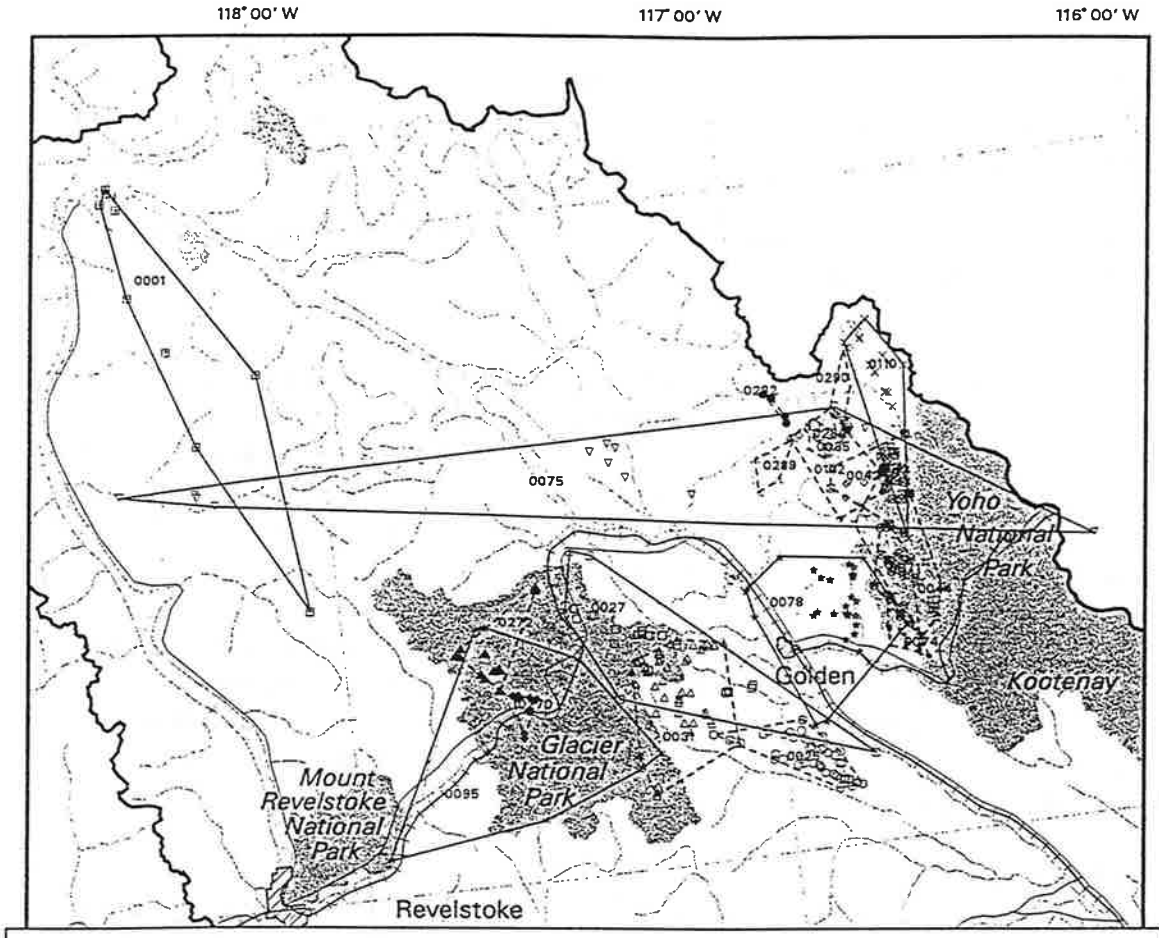
Minimum convex polygons (100% MCP) were calculated for each bear on a multi-year aggregate basis for all seasons and on a multi-year aggregate basis for the June/July census period (Table 4, Figure 2). These were plotted as part of a data edit routine and a first approximation of area use. Home ranges and movements have not been analyzed in detail and will likely involve alternative methods in the final report (e.g. adaptive kernel).

Table 4. Multi-year bear home ranges (100% MCP)

Species/Sex Status	Average Area (km^2) All Year (n)	Average Area (km^2) June-July only (n)
Grizzly - male	318 (23)	111 (18)
Grizzly - female	89 (14)	50 (10)
Translocated Grizzly-female	651 (6)	153 (4)
Black bear - male	124 (24)	not calculated
Black bear - female	42 (24)	not calculated

Detailed notes on movements and home range sizes of translocated bears are presented in Section 2 D. Movements of non-translocated bears have not been reviewed in detail.

Figure 2. Aggregate home ranges of female grizzly bears, 1994-96.



Aggregate Home Ranges of Female Grizzly Bears, 1994-1996

Bear ID	Age at Collaring	100% MCP Home Range (km2)
0001	2	630
0025	8	123
0027	16	578
0031	11	331
0035	15	38
0042	14	122
0044	3	220
0071	4	78
0074	16	19
0075	8	1164
0078	2	455
0095	6	910
0110	2	166
0132	cub	148
0270	adult	14
0272	adult	83
0282	adult	11
0284	adult	3
0289	adult	28
0290	adult	26

NOTE: Bears 0037, 0294, and 0295 have been deleted (only one point each).

Bear Type
— Translocated Bears
--- Research Bears

0 10 20 30 40 50 km

Scale 1:1,000,000
Map Projection UTM Zone 11 - Datum NAD 83
Map Production Date – August 06, 1997

v. Mortalities

Deaths

There have been 5 mortalities of radio-collared grizzly bears to September 1997. One subadult male (0106) and 1 adult female (0290) were legally shot during the 1996 and 1997 limited entry hunting seasons, 1 translocated adult female (0095) was killed by another grizzly bear during the spring of 1996, 1 adult female (0292) was killed in an avalanche, and 1 adult female's death is still under investigation (0031). The observed mean of adult female grizzly survival was 0.8889 (S.E. 0.0748202). For subadult males, the survival was 0.6667 (S.E. 0.3056313). There were no deaths within other sex and age classes.

There have been 8 deaths of radio-collared black bears including: killed by grizzly bear (1: 0083); natural - unknown cause (2: 0016 and 0085); rail kill (2: 0092 and 0269); hunt (1: 0070); shot by landowner (1: 0033); and poached (1: 0142). Several marked (but not actively collared) bears are known to have died during this period including: hunt (3: 0005, 0065 and 0096) and rail kill (1: 0067). In addition, a rural land owner shot the collar off a black bear male (0040) and later shot at the bear when it returned (the status of this bear is unknown).

There have been 3 research related black bear deaths. One cub was bitten by its mother during a den investigation (0121); 1 adult male (0134) was killed in a snare by a grizzly bear; and 1 adult male (0262) died in a snare after becoming wedged between 2 trees. In all research related cases of bear death the handling team discussed the circumstances and adjusted protocol where possible to promote animal safety.

Radio-tracking Days

Bears have been tracked for an aggregate of 37,212 collar-days (Table 5). Survival rates will be calculated in future years using the methods of Heisey and Fuller (1985) and Pollock *et al.* (1989). We will then compare them to the previous estimates presented by Raine and Riddell (1991).

Table 5. Active Tracking Days for Radio-collared Bears 01-May-94 to 31-Dec-96 .

Species	Total Days Active
Grizzly Bear	16683
Black Bear	20529

vi. Den site investigations

Eighteen black bear den sites were visited on the ground (Table 6). At 2 sites, bears walked away before they could be handled. Many black bear dens are in inaccessible sites and are difficult to safely visit. Den site characteristics based on aerial telemetry locations and ground visits are summarized in Appendix 3

Table 6. Ground Visits to Black Bear Dens

Bear ID	Sex	Age	Date	Number of Cubs (Sex)	Notes
0006	F	20	03-Mar-97	2 (1M1F)	under roots of large overthrown tree
0043	F	10	12-Mar-96	1 (M)	shallow excavation under roots and brush
0060	F	16	14-Mar-95	3 (3M)	under roots, excavation
0059	F	4	15-Mar-95	0	under brush pile
0037	F	12	4-Apr-95	2 (2M)	under roots, large excavation
0061	F	15	13-Mar-95	heard in den	inside cottonwood tree
0062	F	7	13-Mar-95	2 (1M1F)	under roots, slight excavation
0063	F	11	14-Mar-95	2 (1M1F)	under roots, excavation
0082	F	21	20-Sep-95	not determined	collar slipped off inside den; den excavated in ground at base of mature hemlock
0097	F	6	12-Mar-96	0	under horizontal fallen log; no obvious excavation
0097	F	7	25-Mar-97	1 (F)	shallow excavation under wood debris
0279	F	12	31-Mar-97	0 heard in den, 3 later seen	in ground at base of large spruce snag; no cub sounds,
0022	M	7	9-Mar-95	not applicable	under roots, excavation
0040	M	4	9-Mar-95	not applicable	under roots, slight excavation
0053	M	13	14-Mar-95	not applicable	under roots, large excavation
0069	M	11	13-Mar-96	not applicable	in ground at base of large cedar
0070	M	4	13-Mar-96	not applicable	9 m up inside large cedar

vii. Animal Care

All bear capture teams were lead by personnel who had completed the provincially certified drug immobilization course and utilized the animal handling protocols as developed by B. McLellan in previous bear studies. In addition, veterinarians H. Schwantje and R. Smith provided the field team with advice in animal handling procedures.

In 214 captures of bears, there were 3 research related bear deaths (see section iv. Mortalities). An additional black bear (0133) was caught in a snare and escaped after sustaining serious foot injuries. It is not known if this bear was attacked by a free-ranging bear. Amongst the remaining snared bears, there were no broken bones or other major injuries caused by trapping. There have been a number of instances of minor abrasions caused by the snares. Several captured bears had major wounds presumably inflicted at earlier times by other bears (ripped ears, punctures). One black bear (0003) had apparently been shot through the leg and chest a year or more earlier and another (0271) had lost a front foot.

Most research bears were caught in snares. Most problem bears were trapped in culvert traps. Among the culvert-trapped bears, there were a number of cases of broken claws and teeth. Great care is necessary in culvert design, maintenance, and use to minimize injuries to bears.

Several free-ranging grizzlies were darted from helicopters. Many of the technical difficulties in free-range captures appear to have been overcome (charges, darts, needles, pilot experience, shooter experience). Aerial net-gunning of grizzlies was tried but was largely unsuccessful.

All collars were fitted with breakaway canvas spacers to allow them to drop off at varying lengths of time depending on the age and sex of the bear. These spacers worked well in preventing neck injuries but in a number of cases they prematurely failed (resulting in dropped collars). To counteract this, the breakaway spacer standard has been adjusted to provide longer retention (also see section 2.Ai). Inspection of necks during recaptures indicated that the collars are not causing significant chaffing. In 1 instance (0023, adult grizzly male), the neck appeared to be injured by the collar but closer inspection showed that the bear had deep puncture wounds through the collar and into his flesh (probably inflicted by fighting with other bears).

The hog ear-tags used in the study appear to be working well when used alone. However, when used in conjunction with ear flagging, they are almost always ripped out (Woods and McLellan 1996). Use of ear-flags was discontinued in 1995.

B. DNA Research

I. Cooperation with the University of Alberta - Background

Since 1994, the West Slopes Bear Research Project has worked closely with Curtis Strobeck and David Paetkau of the University of Alberta molecular genetics laboratory. Initial cooperation involved the provision of tissue samples (blood, ear plugs) for microsatellite analysis. Subsequently, hair was developed as a primary nDNA collection tissue and methods of combining molecular genetics with field ecology were developed (Woods and McLellan 1996, Woods *et al.* 1996). Current areas of cooperation include the use of nDNA fingerprinting from hair samples to estimate bear populations and the development of methods to use scat as a mtDNA and nDNA source.

All genetic material from West Slope research bears is stored in the permanent genetic repository at the University of Alberta (see Strobeck 1994, 1995). L. Waits, J. Ward, and their colleagues at the University of Utah have analyzed mtDNA from West Slopes project grizzly and black bears obtained through the University of Alberta repository (Waits et. al 1995, Wooding and Ward 1995).

In a related pilot project, Conservation Officers throughout the Kootenay Region took DNA samples from compulsory inspections of hunter killed grizzly bears and bears handled in management actions during 1996 and 1997. These samples will form the basis of a DNA catalogue for the Kootenay Region.

ii. Allele Frequency Distributions

Up to 9 microsatellite loci (short, identifiable segments of nDNA) have been examined for each West Slopes research bear. These loci are designated G10H, G10B, G10C, G10L, G10M, G10P, G10X, G1A and G1D and were useful because they have several alleles (measured as different lengths) at each loci. This variability makes them useful in genetic studies at both the individual and population levels.

Because different populations of bears can have different frequencies of particular alleles at each microsatellite position, it is possible to characterize populations on the basis of the frequency distribution of these alleles. For example, a particular allele may be rare in 1 population and common in another. Allele numbers and sample sizes for West Slopes research bears are presented in Table 7 and the allele frequency distribution for an example microsatellite (G10C) is given in Table 8. These data illustrate greater genetic diversity in black bears compared to grizzly bears (mean number of alleles 10.0 and 6.56 respectively) and how the differences in allele frequency distributions at 1 microsatellite position can vary between populations.

Table 7. Microsatellite alleles and sample sizes[1] for West Slopes black and grizzly bears.

Microsatellite Designation	Number of Alleles in Black Bears	Sample Size (2N)[2]	Number of Alleles in Grizzly Bears	Sample Size (2N)
G10H	14	186	8	34
G10B	6	232	8	82
G10C	8	232	5	82
G10L	13	232	6	82
G10M	10	232	4	82
G10P	9	232	5	82
G10X	13	232	8	82
G1A	7	232	7	82
G1D	10	232	8	82

[1] samples analyzed to 1-Oct-96

[2]2 copies of each locus from each nDNA bear sample; sample sizes are not equal because not all microsatellites were analyzed for each sample

Table 8. Frequency distribution of alleles at the G10B microsatellite in 4 bear populations.[1]

Allele Length[2]	West Slope Black Bears	Newfoundland Black Bears	West Slope Grizzly Bears	Kodiak Island Grizzly Bears
148	0	0	0.097561	0
152	0	0.075758	0.121651	0
154	0	0.636364	0.085366	0.985294
156	0.146552	0	0.073171	0
158	0.189655	0	0.207317	0.014706
160	0.262931	0	0.02439	0
162	0.215517	0	0.378049	0
164	0.181034	0.287879	0.012196	0
166	0.004310	0	0	0

[1] Paetkau *et al.* 1997
[2] expressed in units of base pairs

iii. DNA Fingerprinting

The high degree of genetic variability exhibited by West Slope bears enables genetic samples to be assigned to individual bears with a high degree of certainty. For example, based on these data, the probability that 2 random, unrelated individuals will be identical at all loci is 1 in 153 billion for West Slope black bears and 1 in 81 million for West Slope grizzly bears. However, within a research project such as ours, samples are not drawn at random because related bears may use the same home ranges (obviously the case when cubs are still accompanying their mothers). The worst case scenario (in terms of saying that 2 samples are from the same bear when they are really from different bears) occurs when samples being compared come from siblings. Therefore, in analyzing DNA fingerprints within the West Slopes, we use statistics which recognize this sib-sib possibility and assign a probability of error to each sample with $p < 0.05$ as our criterion for a match. In practice, this means we must look at about 4-6 loci to achieve this degree of precision.

iv. Sex Determination

All samples from bears of unknown sex (e.g. hair only) are identified using a Y (male) chromosome test. Although this test has been accurate in all blind trials, an improved test is under development by Curtis Strobeck and his colleagues.

v. Parentage

In a blind trial, hairs from 8 newborn black bear cubs were randomly mixed and submitted to the DNA laboratory for analysis. Without any knowledge of the parents of these cubs other than that the mothers were research animals, nDNA analysis correctly identified litter mates, mothers, and in 2 of 3 cases, the fathers. The third father was not a research animal. A full parentage analysis of West Slope bears has not yet been conducted.

vi. Species Identification

Black and grizzly bears are readily separated by mtDNA analysis. mtDNA is abundant in most genetic samples and this test is used to distinguish black from grizzly bears in all hair samples.

vii. Hair Versus Faeces as a DNA Source Tissue

This study has established hair with attached follicles as a reliable source of nDNA and mtDNA for genetic studies. Bear epithelial cells contained in bear faeces are an additional potential nDNA source which may be very useful in field ecology studies. Although there have been promising developments in this area (Wasser *et al.* 1997), the use of DNA derived from bear faeces is not yet a routine field procedure. In the West Slopes project in 1997, we will be gathering faecal samples for use in this development and for food habit studies.

C. Population Estimates

I. Photograph Based Mark-Recapture

The study area was divided into a 70 x 70 km grid containing 49 10 x 10 km cells. We positioned cameras triggered by motion sensors near the centre of 40 cells. Using suspended rotten meat as a lure, we ran the camera stations for approximately 4 weeks (1148 camera nights) in late June and July, 1995. Inspection of the resulting photographs showed numerous pictures of marked and unmarked bears including approximately 21 grizzly photographs (9 with obvious research marks) and 254 black bear photographs (23 with obvious research marks).

Analyses of these data was hampered by technical problems causing the cameras to not record the time and date on many photographs and by the difficulty of recognizing individual bears, including marked bears, with certainty. Concurrent development of an accurate DNA mark-recapture technique (see below) overcame this individual recognition problem and the photograph based approach was abandoned after 1995.

ii. DNA Based Mark-Recapture

Two experiments were conducted in 1995 to assess the feasibility of using DNA fingerprinting of bear hair as a mark-recapture technique. In 1996, a large scale DNA mark-recapture census was conducted across the entire 70 x 70 km census grid.

a. Beaver Valley Experiment - 1995

In the first experiment, 20 DNA collection stations were established in a linear arrangement at approximate 1 km intervals in the Beaver River valley, Glacier National Park. Ten stations were located north of the Beaver River highway bridge in an area including the Trans-Canada Highway and the Canadian Pacific Railway. An additional 10 stations were located south of the bridge in wilderness area lacking roads and railways. Alaska Fish Fertilizer was used as a scent lure.

Four hair collection methods were tried using a variety of wire brushes and barbed wire configurations. The sites were visited weekly during mid-June to mid-July. During each visit, all hair was removed from the brushes and wire and the scent lure was refreshed. At the end of the trial, the wire and brushes were removed.

The most successful hair collection technique was a perimeter strand of barbed wire positioned about 5 m from a central scent tree and about 30-55 cm above the ground. Bears left hairs where they walked over or under the wire.

The 4 week trial produced 291 bear hair samples. These were visually examined and 171 hair samples with visible roots were retained. Of these samples, 141 were selected for DNA analysis. This analysis revealed the genotypes of 25 different black bears including 5 bears of known genotypes from earlier trapping collections.

This trial confirmed that hair collection now provides a reliable field method to identify the species, sex, and individual genotype of bears. There was little mixing of individuals within hair samples, and when this occurred, nDNA analysis was able to separate the individual bears. Proctor (1995) fully reported on this trial.

b. DNA Collections at Camera Sites - 1995

During weeks 3 and 4 of the photograph mark-recapture session, perimeter barbed wire was added to most of the camera sites. This produced numerous hair collections (from both grizzly and black bears). This trial study confirmed the suitability of the technique for both grizzly and black bears (Proctor 1995, Woods *et al.* 1996).

c. DNA Census Using Hair-Traps - 1996

In June and July 1996, bear hair traps were placed in a 64 x 64 km grid with 1 trap in each 8 x 8 km cell (NW corner: U.T.M. Zone 11U: 463000-5727000). Four 10-day sessions were run and the hair trap was moved within the cell at each session. During 2653 trap nights, 1550 hair samples with roots were collected. mtDNA species testing identified 384 grizzly samples, 303 of which produced useable nDNA fingerprints. nDNA analysis at 4 microsatellites identified 54 different grizzly bears using the study grid (24 females, 30 males). mtDNA analysis identified 1126 black bear samples, none of which have yet been analyzed for nDNA fingerprints.

The distribution of grizzly bears across the grid was highly non-uniform (Figure 3) with most bears in the north-east and south-west cells. The main valley of the Columbia River running roughly south-east to north-west was largely devoid of grizzly bears.

A naive bear population estimate based on the program CAPTURE and assuming a closed population was 104 bears (CI 86-133, $p < 0.05$). However, radio-collared bears demonstrated that the study area was clearly not closed and grizzlies using the census grid at some time during June and July 1996, spent 26.8% of their time outside the grid. Therefore, we adjusted the analysis to account for these movements and obtained a revised population estimate of 76 bears (CI 63 - 97, $p < 0.05$). However, even with this adjustment for movements, analysis problems remain including: was our cell size too large to detect female grizzly bears?; are the movements of radio-collared bears unbiased?; is there a segment of the population which will not approach a hair trap?; how does a June - July census compare with an average annual density estimate for the study area?.

Our current analysis of these data and questions includes simulation modelling in cooperation with John Boulanger and a June - July 1997 census trial on the eastern side of the study area using 5 x 5 km grid cells and 5 sessions without trap movement between sessions. These questions as well as a comparison with modified Fuhr-Demarchi method of population estimation (Fuhr and Demarchi 1990) will be examined in the final report.

Table 9. Summary of capture and re-captures by DNA fingerprints of grizzly bears in the study grid during June and July 1996.

Session/Category	Session A	Session B	Session C	Session D	Total
Bear captures	16	15	22	20	73
New bears	16	11	18	9	54
Recaptured bears	0	4	6[1]	15[2]	25
Cumulative new bears	16	27	45	54	

[1]includes 2 bears from session A and 4 from session B

[2]includes 6 bears from session A, 4 from session B and 5 from session C

Figure 3. Distribution of Individual Grizzly Bears based on DNA Fingerprints during the 1996 Census, West Slopes Bear Study, British Columbia

1	2 A 0299F B 0299F, 0325F	3 A0288M, 0337M	4 D 0294F*, 0331F	5 A 287M, 0335M, 0338F B0294F, 0306M 295F* C0326F,0327F D0294F, 0306M 0295F,0286M	6 A 0287M, 0288M,0322M B0322M, 0351F	7 C0316F	8
9 D 0330F,0332M	10	11	12 C 0331 F D 0333M	13	14 A 0287M B 0350M C 0345M	15	16 C0 312M
17 B 0334M	18	19	20	21 C0302M,0308F, 0311F D0302M,0308F, 0311F	22 A0308F, 0311F	23 A0298M	24 B 0298M C0317M,0318 M 0346M,0132F
25	26	27 C 0321F	28	29	30	31 A 0078F C 0298M D 0298M,0309M	32 C0310F,0320M, 0071F D 0300F,0301M 0314M
33	34 B 0073M	35	36	37	38	39 B 0078F	40 C 0298M **D 0044F**
41 **B0091M** C0344F	42	43	44	45	46	47	48 A 0298M, **0044F**
49 B 0289F* C 0289F*	50	51	52 C 0315M, 0347M	53	54	55 B 0319M	56 D 0354F
57 A 0303M,0304F 0 328M, 0077M D 0303M,0304F	58	59	60	61	62	63	64

LEGEND: 1st number is cell number 1 - 64; each cell is 8 x 8 km; total sample area 4096 km^2; other numbers are permanent grizzly bear ID numbers (e.g. 332); prefix = session date: A = June 10-20, 1996; B = June 20-30, 1996; C = June 30- July 10, 96; D= July 10 - July 20, 1996; hair trap moved between sessions; normal type = new grizzly bear id from DNA hair trap only (e.g. 332);- bold type = collared grizzly bear recaptured by DNA (e.g. **044**); underscored = previously collared (collar no longer on bear) grizzly recaptured by DNA (e.g. 078)

D. Other Samples

I. Blood Serum Analyses

In cooperation with the Eastern Slopes Grizzly Bear Project and veterinarian Todd Sherry, all blood serum samples from West Slopes research bears have been analyzed at the Western Veterinarian College and surplus serum added to their repository. These analyses were funded by Helen Schwantje, Ministry of Environment, Lands, and Parks, Victoria. An agreement is in place detailing the use of these data and samples.

ii. Hair Isotope Analyses

In cooperation with Keith Hobson of the Canadian Wildlife Service, hair samples were analyzed for stable isotope ratios to look for trophic level feeding differences within 4 classes of West Slope research bears: grizzly male, grizzly female, black bear male, and black bear female. These analyses are complete and were funded by research grants to Keith Hobson. An agreement is in preparation detailing the use of these data and samples.

iii. Hair Protein Analyses

West Slopes bear hair samples have been sent to Charlie Robbins for use by his graduate students in stable isotope analyses to identify trophic level food consumption of grizzly bears on a continental basis..

E. Translocated Bears

During the period 1986-95, 12 grizzlies were translocated into the main West Slopes study area (Proctor and Neumeier 1996). This included radio-collared bears 0027, 0075, 0078, 0095, and 0110. Bear 0001 was moved out of the study area. An additional 14 grizzly bears were translocated immediately north and 13 immediately south of the study area. In 1996, grizzly bear 0292 was moved into the study area and few if any bears were moved into adjacent areas. There have been very few black bear translocations into the study area. Most translocated grizzly bears originated in Revelstoke (Proctor and Neumeier 1996).

I. Translocated Grizzly Bear Case Histories

Female grizzly bears had a mean post-translocation home range of 651 km^2 (multi-year, 100% MCP, N=6, Figure 2) compared to a mean non-translocated female grizzly bear home range of 89 km^2 (multi-year, 100% MCP, N=14). No adult female returned to her site of origin and the only grizzly killed by another grizzly was a translocated female. No male translocated grizzlies were radio-collared.

0001. This 2 year-old female grizzly was translocated from Golden to the Sorcerer/Downie Creek area in the spring of 1994. She moved north into the vicinity of Mica Dam (several km east of the dam near Redrock Harbour) and denned there. She dropped her collar in the spring of 1995 near Mica Townsite and has not been seen again. 0001's DNA fingerprint was not identified within

the main West Slopes study area in June/July 1996. Her multi-year home range was 630 km^2 (100%, MCP), the third largest home range of 20 grizzly bear females tracked to date.

0027. This 15 year-old female grizzly was translocated from Revelstoke to the upper Spillimacheen River valley in 1993, the year before the West Slopes study began. In 1994, she was trapped as a research animal within the Grizzly Creek valley of Glacier National Park. She stayed in the vicinity of her trapping location until the autumn of 1995 when she moved to the Columbia River across from McMurdo and dropped her collar. She did not have cubs in either 1994 or 1995. 0027's DNA fingerprint was not identified within the main West Slopes study area in June/July 1996. Her multi-year home range was 578 km^2 (100%, MCP), the 4th largest home range of 20 grizzly bear females tracked to date.

0075. This 8 year-old female grizzly with 2 cubs was translocated from Revelstoke to the upper Blaeberry River valley in July 1994. She spent the summer of 1994 in the Blaeberry area and then moved west with her cubs to the Goldstream River valley in the autumn (123 km in 20 days). She was reported on the front lawn of the Adamant Lodge and later seen feeding on available garbage at the Goldstream Mine. She denned near the mine and then returned to the Blaeberry area with her cubs in the spring of 1995 (78 km in 15 days). She spent the spring and summer of 1995 in the Blaeberry area and then disappeared in mid-September. In late September 1995 she was trapped along with 1 yearling cub at the Chateau Lake Louise in Banff National Park where she was apparently attracted to garbage. Banff Park wardens translocated her to the lower Chatter Creek area along the north shore of Bush Arm. She was radio tracked to Kinbasket Creek where she dropped her collar in October 1995. Subsequent investigation of a human mauling incident in Lake Louise identified 0075's DNA fingerprint at the scene. 0075's DNA fingerprint was not identified within the main West Slopes study area in June/July 1996. Her multi-year home range was 1164 km^2 (100%, MCP), the largest home range of 20 grizzly bear females tracked to date.

0078. This 2 year-old female grizzly was relocated from Revelstoke to Glenogle Creek in the summer of 1994. She remained in the general translocation site during the summer and autumn and denned there. In the spring, she briefly moved west across the Columbia River and then returned to Glenogle Creek. She recently dropped her collar within sight of the spot where she was released the previous year. 0078's DNA fingerprints were identified at several locations within the main West Slopes study area in June/July 1996. Her multi-year home range was 455 km^2 (100%, MCP), the fifth largest home range of 20 grizzly bear females tracked to date.

0095. This 6 year-old female grizzly with 2 yearling cubs was translocated from Revelstoke to the upper Spillimacheen River valley in September 1995. Immediately after its release, 0095 may have chased forest workers in the release site area (unconfirmed) and then moved into Glacier National Park. She travelled as far west as Mount Revelstoke National Park and then moved into the Mountain Creek area of Glacier where she denned with her young. In May, 1996 she was located in Mountain Creek with her cubs and then found dead in Mountain Creek in late May,

apparently killed by another grizzly. In the brief interval she was tracked (September 1995 to May 1996), her multi-year home range was 910 km^2 (100%, MCP), the second largest home range of 20 grizzly bear females tracked to date.

0110. This 2 year-old female grizzly was translocated from Mica to the Blaeberry in September 1995. She continues to live in the Blaeberry - Wildcat/Collie Creek area. Her multi-year home range was 166 km^2 (100%, MCP), the 8th largest home range of 20 grizzly bear females tracked to date.

0292. This 8 year-old (estimated age) female grizzly with 1 cub was translocated from the Fernie area to the headwaters of the Duncan/Beaver on 13-Sept-96. She was not found during the remainder of 1996 and returned to the general vicinity of her release site in the Spillamacheen River in the spring of 1997.

b. Translocated Black Bear Case Histories

0009. This 5 year-old male black bear was translocated from the summit of Rogers Pass to the Beaver River valley in 18-October-95. It has spent time in the Sue Burn as far north as Help Lake/Blackwater Ridge and also in Carrot Creek.

0018. This female black bear was translocated from Mountain Creek Campground where she was implicated in raiding garbage containers and picnic tables, to the Incomappleaux River in July 1986. In June, 1994 she was retrapped as 13 year-old research bear in Mountain Creek Campground. She remained in the general vicinity of the campground and Ursus Creek until June, 1995 when she slipped her collar.

0024. In September 1995 this 3 year-old male black bear was translocated from the summit of Rogers Pass where he was raiding garbage, to the Gold River area. He was radio-tracked until April 1996 when he dropped his collar in the Beaver Valley/ Mountain Creek area..

0040. This 3 year-old male black bear was translocated from Parsons to the Bluewater River in September 1994. He remained in that general area until May 1995 when his collar was shot off by a rural land-owner. The bear later returned and was shot at again. The fate of this bear is unknown.

0081. This 4 year-old male black bear was translocated from the Golden Golf Course to Susan Lake in August 1994. By late autumn, he had made his way back to the general vicinity of his capture site (the bench between Nicholson and Canyon Creek) where he denned. He dropped his collar in August 1995 along the west side of the Columbia River.

0094. This 10 year-old male black bear was radio tracked from June to August 1995 within Glacier National Park and adjacent areas west of the park. In late August, 1995 he slipped his

collar and in September 1995 was trapped at the Glacier Park Lodge hotel in Rogers Pass where he may have been feeding on garbage. He was translocated to the Beaverfoot River area (no radio-collar) and has not reappeared in the West Slopes study area.

0142. This 4 year-old male black bear was translocated from the Golden Golf Course to an area south of Gold Arm in August 1995. Within a few days he made his way back to the Golf Course area. In September 1995, his collar was found buried at the bottom of a deep canyon just outside of Golden. It had been cut off the animal's neck, the apparent result of a poaching incident.

G. Database Management

All research capture bears were given a unique 4 digit identifier code (e.g. 0261) irrespective of species. These permanent numbers may or may not refer to ear tags and other marks and are necessary because 1 bear may have several ear tags and radio-collars over time and because some bears are known to us first as DNA bears (bears first identified from DNA samples and later physically trapped, e.g. 0099). This system will be extended to other bear studies in eastern British Columbia and Alberta to avoid confusion between studies. Confusion is particularly likely when DNA samples from several studies are analyzed in a single laboratory and when individual bears may be encountered in more than one stu dy.

These permanent identification numbers are used as the primary key in an ACCESS relational database (BEARWEST.MDB) containing all capture, morphological, reproductive, DNA, habitat, and movement data collected by the project. Property tables within the database give specific definitions of the variables used.

3. COMMUNICATIONS

A. Public communications

In the autumn of 1993, open houses on the project were held for the public in Golden and Revelstoke. During the period 1994-96 there have been public lectures reporting on the project in Revelstoke, Golden, Invermere, Cranbrook, and Nakusp. In addition, there have been several newspaper articles (Vancouver, Revelstoke, Calgary); magazine articles (Canadian Geographic, B.C. Report); special publications (Parks Canada's Research Links (Paetkau and Strobeck 1996), Parks Canada's 'Selkirk Summit', Columbia Basin Fish and Wildlife Compensation Program updates); radio interviews (CBC, Big R); and a television documentary (Discovery Channel) featuring aspects of the West Slopes project. In October 1996, a display on the genetic component of the West Slopes project formed part of the Parks Canada display at the World Conservation Congress in Montreal. The project has an extensive public mailing list of persons who receive copies of all reports and papers. In addition, information on the project is available through the Columbia Mountains Institute of Applied Ecology website (www.cmiae.org).

B. Technical, management and scientific communications

I. Conferences and meetings

Preliminary research results have been used in discussions with several professional groups including: the U.S. Federal Highways Wildlife Corridor Group Meeting (Missoula, May 1995), the Kootenay Regional Grizzly Bear Management Planning Workshop (Creston, May 1995), the Inter-agency Grizzly Bear Committee (Fairmont, August 1995), the Scientific Committee responsible for reporting to the B.C. Grizzly Bear Conservation Strategy, the Western Black Bear Workshop (Washington, April 1997) and the Use of DNA in Field Ecology workshop (Revelstoke, January 1997).

Data on translocated bears has been used by M.O.E.L.P. and Parks Canada staff responsible for bear translocations within their jurisdictions. A poster on the project was presented at the International Bear Research and Management meeting in Sweden (September 1995).

ii. Scientific Publications

The project is currently entering the period when significant results can be reported in the scientific literature. A paper on the use of DNA as a bear census tool is currently in preparation and will be submitted to a peer reviewed journal by the end of 1997. This method has been incorporated into the draft British Columbia standard inventory methods for black and grizzly bears (M.O.E.L.P. 1997). The project also plans to present original material at the International Bear Association conference in April 1998. West Slopes DNA data were used in a paper on the genetic diversity of grizzly bears in North America by Paetkau *et al.* (1997).

Robin Munro is scheduled to have her thesis on the interaction of bears with the highway and railway completed by the end of 1997. Roger Ramcharita should have his thesis on grizzly bear use of avalanche path habitat completed sometime in 1998/99.

A variety of other reports and non-peer reviewed publications stemming from the project are listed in the Literature Cited section of this progress report.

4. MANAGEMENT IMPLICATIONS AND FUTURE WORK

The study questions posed by the West Slopes Project address some of the primary issues facing bear managers within and outside of protected areas in British Columbia. Resolution of the primary issues (e.g. how many bears are there? how do bears die? what is the female mortality rate?) will require at least 5 years of data and may require pooling with previous and adjacent projects including the Yoho-Kootenay study (Raine and Riddell 1991, the Revelstoke grizzly bear study (Simpson 1983), and the Eastern Slopes Grizzly Bear Project (Gibeau and Herrero 1997).

The West Slopes work has made major advances in developing nDNA fingerprinting as a bear census and monitoring tool. This method has already been used in several other areas in western North America (M.O.E.L.P. 1997). Preliminary project information has also been used in assessing the success of grizzly bear translocations in the Kootenays and is available to assist in site specific land use questions (e.g. the Cougar Valley grizzly closure, ski hill redevelopments, expansion of the Trans-Canada Highway).

Much of the data gathered by the project has yet to be analyzed. This is particularly true for habitat information. The two graduate student projects reported on in the appendices make intensive use of these data and their theses will be available in 1998/99. Faecal DNA and faecal fragment analyses for food habits will be featured new activities in 1997-98. Considerable analyses of existing DNA material remains to be done including parentage analysis of all samples and fingerprinting the black bear hair samples.

In the final 2 major years of the project (1997-98) data will continue to be intensively collected on radio-collared bears. There will be a continuing effort past 1998 to less intensively monitor bear collars and causes of death until all the collars are either non-functioning or have dropped off the bears.

The final report on the project will be presented in 1999.

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APPENDICES

Appendix 1: Progress in assessing the impact of the Trans-Canada highway and Canadian Pacific Railway on bear movement and habitat use pattern in the Beaver Valley

by Robin Munro, M.Sc. Candidate, Department of Animal Science, UBC, robmunro@hotmail.com

Objective

This project is a comparative study designed to examine the cummulative effects of human activity on grizzly and black bear habitat use patterns in the West Slopes. Logistic regression, in combination with GIS, will be used to model habitat suitability at the landscape level using selection probablility functions which will be based on the following variables: habitat (slide chutes, riparian, burns, timber, alpine and clear cuts), highways, railways, human point disturbances (towns, rural settlements, etc..), elevation, slope and aspect. I will compare the characteristics of telemetry coordinates to random coordinates within each bears home range (100% MCP).

Current status

The completion of my analysis is largely dependent upon the GIS mapping of the area. Map layers for the variables involved are currently being created for the West Slopes study area. TRIM files produced by the Ministry of Forest contain all the necessary data to create map layers for human point disturbances, highways, railway, elevation, slope and aspect. LANDSAT thematic mapper images and forest cover maps will be used to classify the the study area into broad habitat types. Map layers have already been created for some variables in the Glacier Park portions of the study area. I am working closely inconjunction with a GIS contractor, Clayton Apps, to complete the map layers for the remaining study area. The entire study site will be mapped for all variables by December/January. Once mapping is completed truthing will be carried out using aerial photos. The telemetry data are ready to be used in the analysis, i.e. errors have been corrected, 100% MCP's (Calhome) have been calculated, and recorded habitats have been recategorized into the larger categories. In addition, I have begun writing the introduction, study area, and methods sections of my thesis. By the time the mapping is complete it should be fairly straight foreward to run the data through the logistic regression and complete the analysis. If all goes according to plan, I should have a draft copy of the thesis completed by March 1998.

Appendix 2: Grizzly Bear Use of Avalanche Chutes in the Columbia Mountains, British Columbia - Year Two, 1997

by Roger Ramcharita, M.Sc. Candidate, Dept. of Forestry, Univ. British Columbia, kramchar@unixg.ubc.ca

Introduction

Many studies have shown that avalanche chutes are important spring habitat for grizzly bears (Mace *et al.* 1997, McLellan 1989, Simpson 1986, Zager 1980). Forest managers in the Columbia Mountains are seeking information needed to facilitate timber extraction without adversely affecting avalanche chute habitat. The Kootenay / Boundary Land Use Plan (Kootenay Inter-Agency Management Committee 1996) currently recommends establishing 50 m or 100 m wide buffers around all avalanche chutes, in which only partial cutting would be allowed. This guideline does not recognize the variation in the value of different avalanche chutes to grizzlies. Because of differences in parent material, slope, aspect and moisture, the plant communities that are found in avalanche chutes, and therefore the value of different avalanche chutes, is highly variable. Information on what features of avalanche chutes influence grizzly bear use is required to develop refined guidelines that will protect avalanche chute habitat while avoiding undue impact on timber supply.

Objectives

1) Develop a classification of plant communities that occur in avalanche chutes in our study area
2) Document grizzly bear use of each plant community and the timber adjacent to avalanche chutes
3) Determine which factors influence where grizzlies feed and bed in avalanche chutes and adjacent timber

Progress

A classification of the avalanche chute plant communities occurring in our study area is currently being developed by the Columbia Basin Fish and Wildlife Compensation Program (Jamieson *et al.* 1996), with completion expected by the spring of 1998. Five years of radio-telemetry relocation data (1994-1998) from the West Slopes Bear Research Project will then be used to determine grizzly bear use of these communities and other features such as slope and aspect.

In 1996 and 1997, 53 telemetry relocations were visited to determine characteristics of grizzly bear feeding and bedding sites in avalanche chutes. Estimates of food abundance and visual cover were recorded at each of these sites. Fifty-two randomly situated sites in avalanche chutes were also visited to compare with use sites. Additional field work will be conducted in the spring of 1998. Analysis of these data are ongoing, with completion expected by the winter of 1998/99.

Preliminary results from 1996 indicated that two topics required more intensive effort to increase our understanding of grizzly bear/avalanche chute ecology - 1) what factors influence grizzly bear use of glacier lilies within avalanche chutes ; 2) what factors influence where grizzlies bed, particularly within the adjacent timber. Our research was expanded in 1997 to include these topics, and results from these studies are expected by the spring of 1998.

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