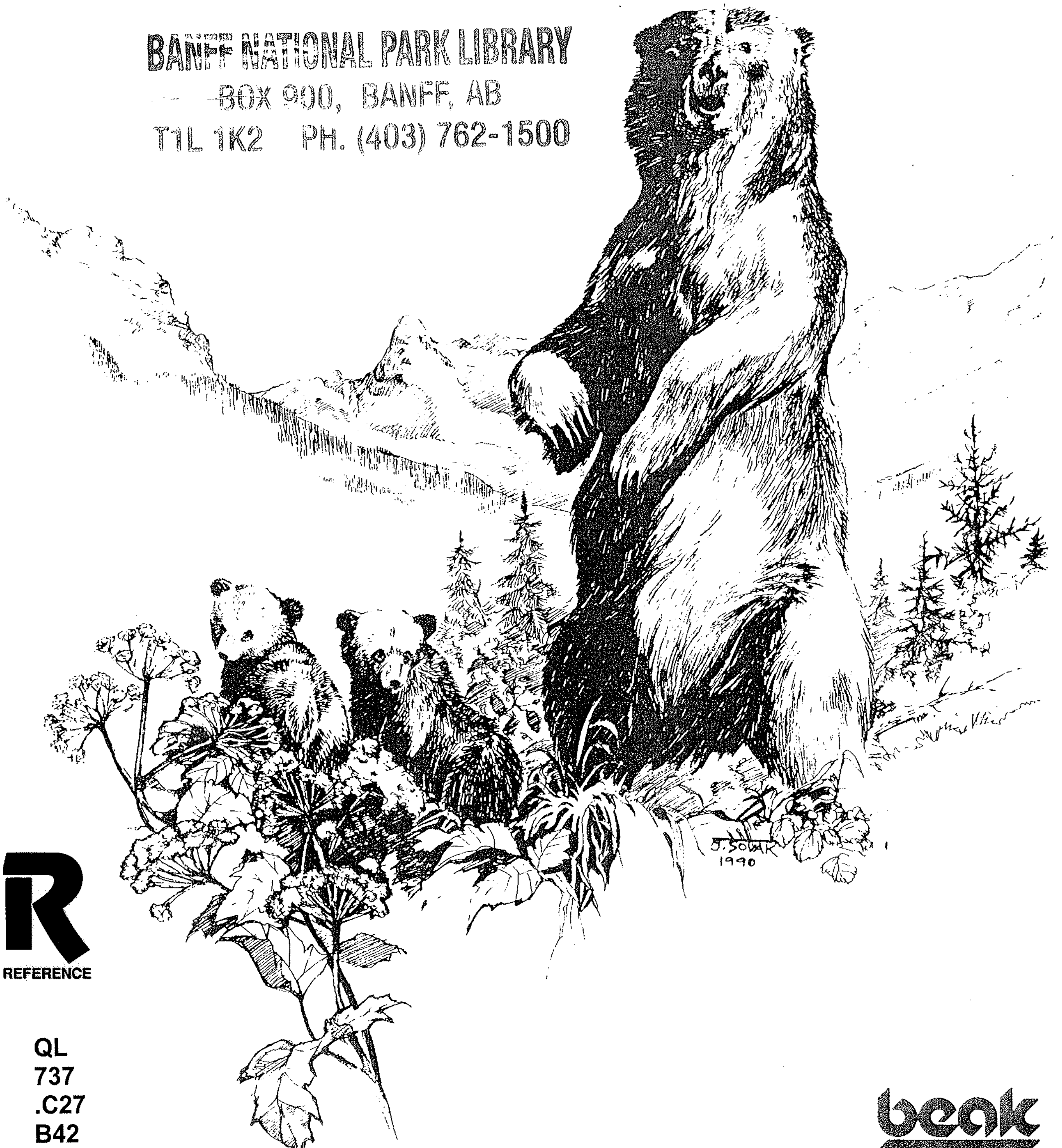
GRIZZLY BEAR RESEARCH

IN

YOHO AND KOOTENAY NATIONAL PARKS



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SENTAR

January 2, 1992

Canadian Parks Service
Western Region
Room 520
220 - 4th Avenue S.E.
Calgary, Alberta
T2P 3H8

Attention: Mr. David Poll, Regional Wildlife Biologist

Dear Dave:

The attached report, "Grizzly Bear Research in Yoho and Kootenay National Parks, 1988 - 1990", is the culmination of three years of intensive field work by the Warden Service in each of these parks and the staff of Sentar Consultants Ltd.

New information on grizzly bear food habits, habitat use, trans-boundary movements, numbers, and mortality rates was collected. This data represents an important new piece in the puzzle of grizzly bear ecology in the main ranges of the Rocky Mountains. The remaining data gaps, and ideas on how to fill them, are discussed in the Recommendations.

The grizzly bear population parameters estimated for the study area are cause for concern. Grizzly bears were estimated to occur in relatively low numbers and have high mortality rates. These facts, in combination with the high rate of trans-boundary movements shown by study animals, makes it imperative that managers from different jurisdictions act together to ensure that a viable population is maintained. Creation of buffer strips around the parks, where the effects of human impacts on bears can be more tightly controlled, is one example of where inter-jurisdictional cooperation can begin.

Thank you for your management and biological skills that you applied to this project.

Sincerely,
SENTAR CONSULTANTS LTD.

Michael Raine

Michael Raine, M.Sc.
Senior Wildlife Biologist

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GRIZZLY BEAR RESEARCH IN YOHO AND KOOTENAY NATIONAL PARKS 1988 - 1990

FINAL REPORT

Prepared for

CANADIAN PARKS SERVICE
WESTERN REGION

Prepared by

R. Michael Raine and Richard N. Riddell

BEAK ASSOCIATES CONSULTING LTD.
CALGARY, ALBERTA

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ABSTRACT

Results of a three year study of grizzly bear ecology in Yoho and Kootenay National Parks are presented. Nine hundred and seventy-one telemetry locations were obtained from 11 grizzly bears radio-collared in the two parks. Of these, 326 sites were investigated on the ground by the study team to determine the vegetation type that the bears were using, to record feeding sign observations and to collect scats.

Four grizzly bear seasons were derived from observations of bear feeding sign: 1) Pre-vegetation (den emergence - mid-May); 2) Vegetation (mid-May - mid-July); 3); Berry (mid-July - early-September); and 4) Post-berry (early September - den entry). Analysis of 449 scats collected indicated that hedysarum (*Hedysarum* spp.) was the most important food during the pre-vegetation season (75% importance value). Once green vegetation began to grow in mid to late May, bears were found to feed mainly upon graminoid vegetation (75%), horsetails (*Equisetum* spp.: 11%), and cow parsnip (*Heracleum lanatum*: 10%). During the berry season, buffaloberries (*Shepherdia canadensis*: 42%), cow parsnip (22%) and blueberries (*Vaccinium* spp. 13%) were found to be the dominant foods in the diets of the collared grizzly bears. In fall, hedysarum was found to again gain prominence (42%) in the diets of grizzly bears. They were also found to eat buffaloberries (34%), blueberries (10%) and crowberries (*Empetrum nigrum*: 4%) during this season.

A subjective assessment of seasonal ecosite importance to grizzly bears was conducted and compared with the results of the Four Mountain Parks Grizzly Bear Habitat Model. A full understanding of grizzly bear habitat in the two parks, however, will not be obtained until avalanche paths, burns, and riparian areas are mapped and analyzed in terms of bear foods.

Only rough population estimates could be derived for the two parks due to the short duration of the project. Yoho and Kootenay National Parks were estimated to be able to support from 11-15 and 9-16 grizzly bears over the age of 2, respectively. It is of importance to note that only 3-5 adult females were estimated to be supported by each park.

Of four sub-adult and seven adult bears radio-collared, three sub-adult and two adult bears had died, and two adult bears were missing, by the fall of 1990. In addition, the one surviving sub-adult bear was trapped and relocated by the Warden Service. The yearly mortality rate for sub-adults was calculated at 61%, excluding the loss of the translocated bear, and 81% if this bear is included in the calculation. Yearly mortality rates for adult bears ranged from 26% (assumes

missing bears alive) to 51% (assumes missing bears dead). Causes of death included hunting mortality outside of the parts (2), highway mortality (1) and unknown causes (2). Adult males and females were found to have home ranges of up to 1478 and 366 square km, respectively, and use as many as four different jurisdictional areas (available jurisdictions included Yoho, Kootenay and Banff National Parks, Mount Assiniboine Provincial Park and British Columbia provincial lands). The high mortality rates and trans-boundary movements of grizzly bears documented makes it imperative that managers from different jurisdictions act cooperatively to preserve bear populations in the study area.

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ACKNOWLEDGEMENTS

This study was conducted under contract to the Canadian Parks Service. It was supervised by Gordon Rutherford, Chief Park Warden of Yoho National Park for all three years of the study; by Peter Whyte, Chief Park Warden of Kootenay National Park in 1988; Brian Sheehan, acting Chief Park Warden of Kootenay in 1989; and Perry Jacobson, Chief Park Warden of Kootenay in 1990. David Poll of the Western Regional Office was also of considerable help in assisting with project supervision. Wardens Harry Abbott, Allan Dibb, Edwin Knox, Kevin McLaughlin, John Niddrie, Ken Schroeder and Mike Westbrook ably assisted with all aspects of the study. Our appreciation also goes to Dave Crerar and his staff at Amiskwi Air Ltd., Golden, B.C., for their excellent support with the aerial telemetry portion of the study.

We would also like to thank Peter Achuff, Paul Burgel, Joanne Cairnes, Mike Gibeau, Dave Gilbride, Reg Hawryluk, Bryon Irons, Allan Knowles, Edwin Knox, Rick Kubian, Rick Kunelius, Brent Lucas, Doreen McGillis, Steve McNaughton, Spencer Pledge, Monica Shafer, Brian Sheehan, Cal Sime, Mark Stevenson, Kevin Van Tighem, Gordon Watkins, Doug Wilkinson, Terry Willis, John Woods, Chris Worobets, members of the Field RCMP detachment, and others for assisting with various aspects of this project.

1.0 INTRODUCTION

1.1 STUDY BACKGROUND

A grizzly bear study was conducted in Yoho and Kootenay National Parks (YNP and KNP, respectively) from 1988-1990. The study was designed to investigate grizzly bear numbers, trans-boundary movements, distribution, food habits and habitat use. These aspects of grizzly bear ecology are poorly understood within the main ranges of the Canadian Rockies where these parks are situated. Although grizzly bear studies have been conducted in Banff and Jasper National Parks in the past (Hamer 1985; Russell *et al.* 1979), these projects were situated in the biophysically dissimilar front ranges of the Rockies. The food habits and habitat use of Yoho and Kootenay grizzly bears were expected to be quite different in the moister main ranges.

1.2 OBJECTIVES

The principal goal of the study was to obtain detailed information on grizzly bear ecology in YNP and KNP to support their future management and protection. More specific objectives are outlined below:

- to determine the status and distribution of grizzly bears in YNP and KNP by estimating their numbers, age/sex structure, population dynamics and home range sizes.

- to determine the food habits of grizzly bears within the study area and to relate these to food availability.

- to determine the seasonal habitat requirements of grizzly bears relative to food, cover and den use, and to describe these requirements in terms of existing Ecological (Biophysical) Land Classification (ELC) for the two parks.

- to integrate and compare grizzly bear habitat use with the results of the Four Mountain Parks Grizzly Bear Habitat Evaluation Project (Kansas *et al.* 1989a).

- to identify important areas to grizzly bears within the two parks such as den sites, migration routes, mating areas, specific prime feeding areas and areas that have a high potential for human/bear conflicts.

- to increase the knowledge and expertise of the Warden Service by training assistants and conducting in-house seminars on the research.

- to develop a practical and effective means of censusing grizzly bears and monitoring the availability of principal food items from year to year.

2.0 STUDY AREA

YNP and KNP are situated primarily in the Main Ranges of the Rocky Mountains in southeastern British Columbia between 50° 34′ and 51° 39′ N and 115 48′ and 116° 47′ W. The Continental Divide forms the eastern border of the two parks where they share a common boundary with Banff National Park (BNP) (Figure 2.1). YNP and KNP are roughly 1300 and 1400 square km in area, respectively.

Field work for the first year of study (Raine *et al.* 1988, Raine 1989) was concentrated in the southern and northern halves of YNP and KNP, respectively. The majority of work was conducted in the following watersheds (watershed codes in brackets are shown in Figure 2.2):

- Emerald (EML)
- Kicking Horse River - Lower (KHL)
- Kicking Horse River - Upper (KHU)
- Ochre Creek (OCR)
- Cataract (CAT)
- Ottertail River - Lower (OTL)
- Ottertail River - Upper (OTU)
- Tokumm Creek (TKM, TOK)
- Vermilion River - Lower (VRL)
- Vermilion River - Upper (VRU)
- Yoho River (YOH)

The second year of study (Raine *et al.* 1990) encompassed a much wider use of watersheds inside and outside of the two parks. Movements of sub-adult bears, in particular, greatly expanded the study area westward to Golden, B.C. and east to Lake Louise in BNP. In addition to the watersheds used heavily in the first year much effort was directed to study animal use of the following watersheds:

- Bow River - Mid (BWM)
- Bow River - Upper (BWU)
- Ice River (ICE)
- Pipestone River (PIP)
- Simpson River (SIM)

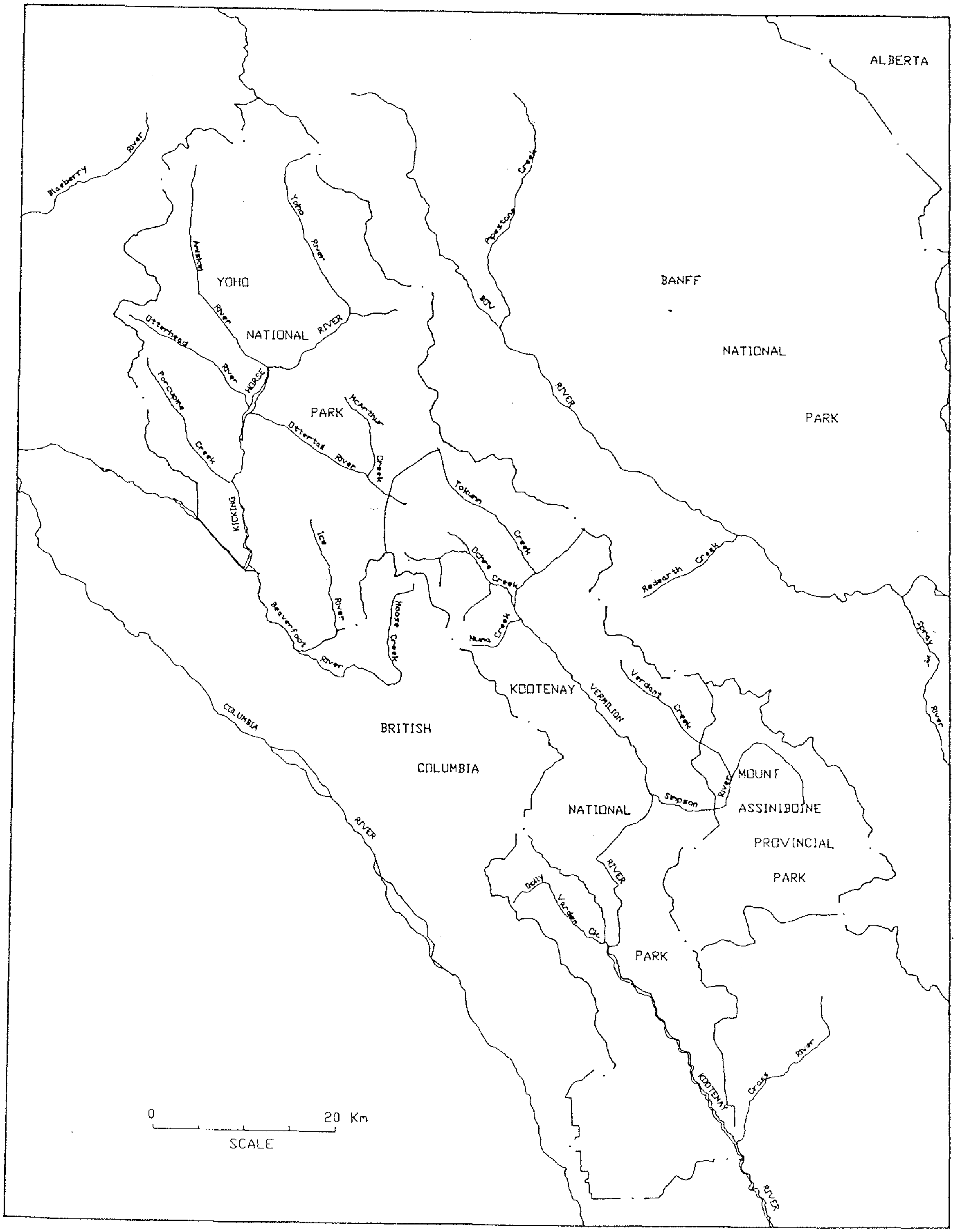

Figure 2.1 Yoho and Kootenay National Parks, British Columbia.

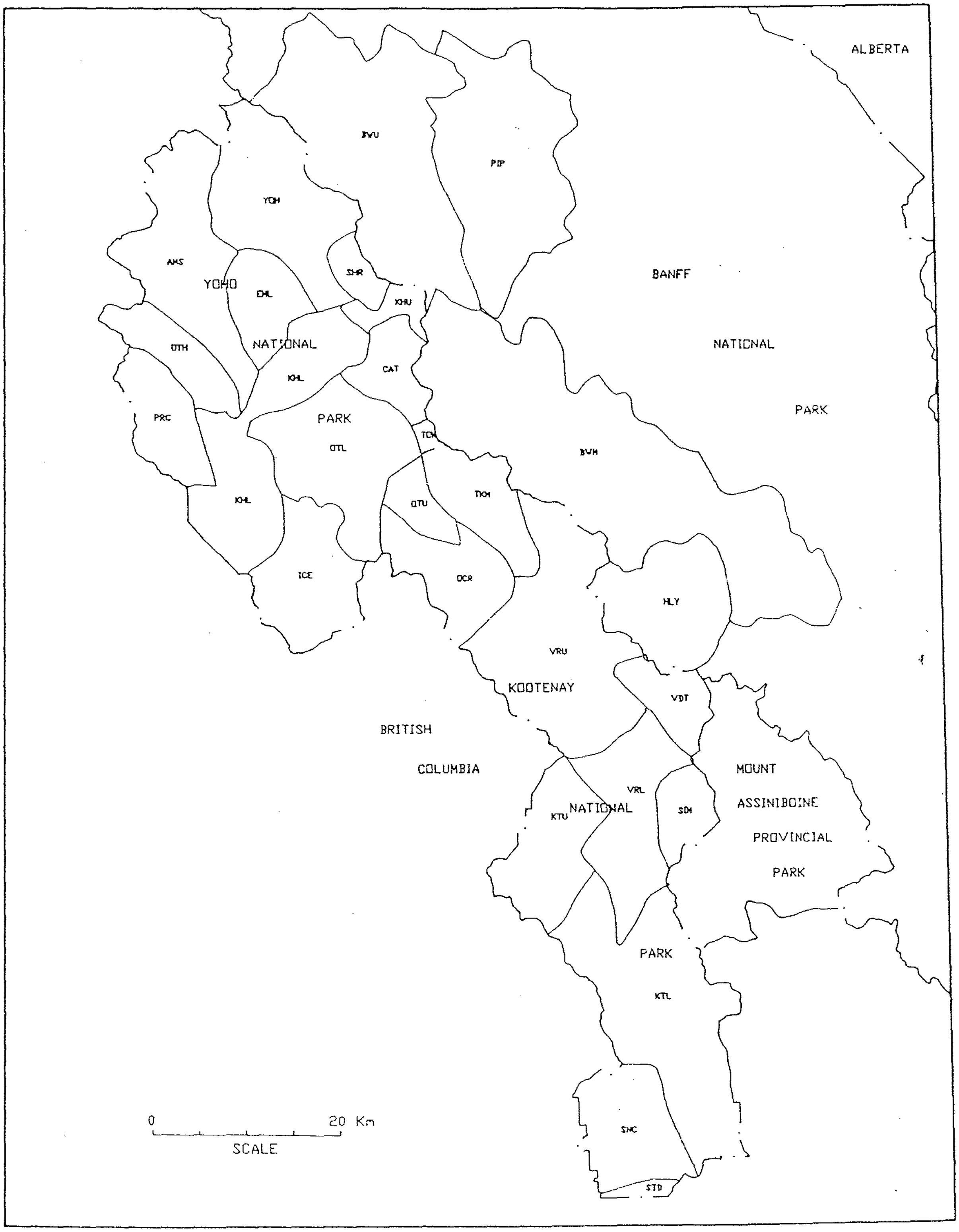

Figure 2.2 Watersheds investigated within the Yoho and Kootenay National Parks study area.

- Verdant Creek (VDT)

In the third year of study, the collaring of two new bears, and relocation of a third, resulted in the study being expanded to include the following drainages:

- Otterhead River (OTH)
- Amiskwi River (AMS)
- Porcupine River (PRC)
- Kootenay River - Upper (KTU)
- Healy Creek (HLY)

The entire study area, which included land in BNP and B.C. provincial lands, was termed the "Yoho and Kootenay National Parks study area". Collared bears were not captured or followed in the southern KNP watersheds of Kootenay River - Lower (KTL), Sinclair (SNC) and Stoddart (STD).

Ecological (Biophysical) Land Classification (ELC) inventories of the parks (Coen and Kuchar 1982; Achuff *et al.* 1984) have divided the landscape into Montane, Subalpine (Lower and Upper) and Alpine Ecoregions based mostly on vegetational features manifested by differences in macroclimate. The elevational boundaries between the different ecoregions vary with latitude and aspect. The boundaries are higher at lower latitudes and on southerly aspects. In KNP, the upper limit of the Montane Ecoregion varies from 1450 - 1800 m, the upper limit of the Lower Subalpine zone is approximately 2000 m and the upper limit of the Upper Subalpine zone is from 2300 - 2400 m. Conceptual differences, however, resulted in the Upper Subalpine - Alpine and Montane - Lower Subalpine boundaries being mapped lower in YNP than in KNP (Kansas *et al.* 1989a).

The mean annual temperature for the Montane Ecoregion in the two parks varies from 1.6° - 4.9° C, while the mean annual precipitation is 457 mm. Thirty to forty-five percent of the precipitation falls as snow. Climate in the Subalpine and Alpine Ecoregions is colder and moister than in the Montane Ecoregion. A stronger maritime influence on climate exists in the two parks than in BNP as they lie west of the Continental Divide (Achuff *et al.* 1984). This results in more precipitation and perhaps milder temperatures than in BNP.

The Montane Ecoregion is dominated by lodgepole pine (*Pinus contorta*), Douglas fir (*Pseudotsuga menziesii*), white spruce (*Picea glauca*) and trembling aspen (*Populus tremuloides*) forests, and grasslands. Soils are classed in the Brunisolic, Regosolic, Luvisolic and Chernozemic orders. The Lower Subalpine is dominated by Engelmann spruce (*Picea engelmannii*) -subalpine fir (*Abies lasiocarpa*) closed forests, while the Upper Subalpine is characterized by coniferous closed and open forests at lower elevations and a mosaic of open forest and heath tundra or herb meadows at higher elevations. Brunisolic soils predominate in the Subalpine Ecoregion. The Alpine Ecoregion is above treeline and dominated by heath, avens and herb tundras.

3.0 METHODS

3.1 BEAR CAPTURE AND HANDLING

Bears were captured in culvert traps and Aldrich foot snares set at baited cubbies (LeCount 1986). Light-weight culvert traps that could be moved by helicopter were also used. Road-killed ungulates were used as bait.

Bears were handled with the assistance of the Warden Service. They were immobilized with Telazol (Zolatil) and blindfolded with a cotton hood. The following information was collected from both grizzly and black bears:

- weight
- body length
- tail length
- chest girth
- neck girth
- foot measurements
- shoulder height
- baculum length
- testes length and width
- physical condition
- sex
- presence of lactation
- presence of vulval swelling
- anal temperature
- respiration rate
- presence of markings and scars
- trap-related injuries
- colouration
- reactions to drugs
- tooth wear and presence

A first premolar tooth was removed from each bear for aging, an ear tag was placed in the left ear and an identification number was tattooed on the lip of most bears handled. Radio-collars (Lotek Engineering Ltd.) were placed on all grizzly bears captured. Sub-adult bears were instrumented with collars designed to break off after a certain time period. These collars were cut and spliced with cotton fire hose. The bears were released on site and monitored until they recovered in order to ensure that accidental contact with the public, scavengers and predators did not occur. Wardens were trained to take the above measurements consistently and accurately.

3.2 TELEMETRY MONITORING

Fixed-wing telemetry flights were flown to determine the collared bears' ecosite use, to delineate their home range sizes, to determine the distances that they moved between locations and to better understand their territorial spacing. Telemetry flights were made every 4 to 7 days depending on weather conditions. Daily ground telemetry fixes were also attempted. A minimum of three bearings were taken for each location, with two of the bearings being as close to 90° as possible to minimize the size of the error polygon. Consecutive bearings were made within a minimum time period of 45 minutes. Locations made with error polygons of greater than 0.25 km were not used for ecosite determination. Locations that fell close to an ecosite boundary were investigated further by the utilization of more bearings or by approaching the study animal more closely before trying to make another fix. Only one location was made each day to preserve the statistical independence of the data collected. Home range calculations were based on the minimum area method (Mohr 1947).

The accuracy of telemetry locations were classified into the following three categories:

1) Site-specific - A visual sighting of the bear was made during the initial location, or fresh sign was observed during follow-up investigations.

2) Remote - A sighting of the bear was not made during the initial location, and a follow-up investigation was not done or no sign was encountered during the investigation. Ecosites were only assigned to remote fixes when the error polygon was less than 0.25 km^2.

3) Home Range Only - Approximate position of the bear determined by telemetry: no ancillary data such as ecosite or elevation recorded.

In addition, incidental visuals made on collared and uncollared bears, and grizzly bear tracks or sign found opportunistically, were recorded in a separate category labelled "Incidental Visual". Observations made by wardens, and reliable sightings by members of the public, were also included in this category. Follow-up investigations of locations made on bears were conducted once the bears had left the area (Kansas *et al*. 1989b). The area was systematically searched on foot for signs of bear activity.

The following information was collected from each location at which bear activity was found:

- ecoregion, ecosite, ELC vegetation type, aspect and slope class
- distance to nearest ecosites

- elevation
- UTM coordinates
- bear activity: feed, bed, travel, mate
- bear foods utilized
- distance to nearest cover, water, trail, campsite and road

When feeding sign was found, the area of most concentrated use was selected, and the following information recorded from an area within a radius of 10 m:

- percent cover of each plant species
- percent cover of deadfall and rocks
- rank of bear foods utilized
- berry production: nil, trace, low, medium, high
- berry phenology: green, coloured, ripe, dropped
- phenology of other foods: emerging leaf, full leaf, flower, cured

Not all of the above data was analyzed for this report.

3.3 DERIVATION OF BEAR SEASONS

Bear seasons were determined from an analysis of bear feeding patterns as determined by feeding site investigations and the results of the food availability transects (as per Kansas *et al.* 1989b).

3.4 SCAT COLLECTION

Scats were collected in conjunction with site-specific fixes, incidental observations and captures (Raine *et al.* 1989). Scats were collected only if a grizzly bear had been located within 200 m of the scat and the estimated age of the scat was within two days of the date of the location.

In addition, incidentally discovered scats were collected if they were found in close association with grizzly bear tracks or diggings.

Portions (0.1 - 0.4 L) of scats were collected and stored in 70% alcohol. Only one scat was collected per bear per location. If several scats of similar age were found at one site, a portion of each scat was combined into one composite sample.

Scats were analyzed using methods similar to those of Russell *et al.* (1979), Aune and Kasworm (1989) and Kansas *et al.* (1989b). They were washed several times in sieves to remove most of the preservative and berry dyes. They were then suspended in approximately 1.0 L of water and vigorously swirled. Two 100 ml subsamples were withdrawn from this solution and placed in enamel pans measuring 22 by 32 cm. The relative percent volume of each item was ocularly estimated for each subsample by superimposing a grid on the enamel pan. Debris (spruce needles, dirt, gravel, wood chips) was noted but not given a volume figure unless it composed a large proportion (> 30%) of the scat. Items found in trace amounts were assigned an arbitrary volume of 1%. The percent volume of each item for the scat as a whole was calculated by averaging the results of the two subsamples. The remainder of the scat was scrutinized in 100 ml portions to determine if all items present were included in the first two subsamples. A list of the components (e.g. leaf, stem, berry, root) of each item was made, and the relative percent volume of each component was estimated.

Items were identified by comparison with a reference collection of plants, berries and hair, and with the aid of reference texts and keys (e.g.: Moss 1983, Adorjan and Kolenosky 1969).

Results were tabulated by percent frequency occurrence, percent volume and percent importance value of each item.

Frequency = Number of scats having the same item

$$\text{Percent Frequency of Occurrence} = \frac{\text{Frequency of item} * 100}{\text{Total number of scats}}$$

$$\text{Percent Volume} = \frac{\text{Total percent volume of item}}{\text{Total number of scats}}$$

$$\text{Importance Value} = \frac{\text{Percent volume} * \text{percent frequency occurrence}}{100}$$

$$\text{Percent Importance Value} = \frac{\text{Importance value of an item} * 100}{\text{Sum of all importance values}}$$

Both frequency of occurrence and volume of food remains in scats should be taken into consideration when analyzing scats. Hatler (1972) and Poelker and Hartwell (1973) found that animal matter in scats was greatly reduced as it passed from a bear's stomach through its digestive system, while green vegetation was not altered much. Thus, volumetric analysis of scats tends to overestimate the amount of green vegetation consumed, and underestimate animal foods. Russell *et al.* (1979) and Aune *et al.* (1986), amongst others, have utilized the above formulae to consider both frequency of occurrence and volume of food remains simultaneously.

3.5 FOOD AVAILABILITY TRANSECTS

The phenology and productivity of key grizzly bear food species were investigated through the use of permanent transects. Buffaloberry (*Shepherdia canadensis*), horsetail (*Equisetum arvense*) and cow parsnip (*Heracleum lanatum*) transects were established in the two parks at varying elevations and degrees of latitude in Year 1 and monitored during all three years of the study.

Buffaloberry. Transects were approximately 100 m in length. At 5 m intervals, the nearest female plant to the transect was selected and flagged. Plants were chosen alternatively on the left and on the right of the line. A total of 20 plants were flagged per transect. All of the stems arising from a single point were considered to be one plant. When plants were too large to be reasonably handled, a cluster of stems was randomly chosen and marked to represent that plant.

Each transect was visited periodically during the summer and plant phenology (flower, green, coloured, ripe) and production (nil, trace, low, medium, high) was recorded. When the majority of the berries on a transect were ripe, the plants with predominantly ripe berries were picked, counted and weighed. The remaining plants were picked as they ripened.

Horsetail. Permanent transects of 10 - 30 m in length were established. The observer measured the height and phenology of the tallest plant within one m of him, at 1 - 3 m intervals. A total of 10 plants were measured on each transect.

Cow Parsnip. Same methodology as for horsetail.

3.6 DETERMINATION OF SEASONAL GRIZZLY BEAR HABITAT USE

The objective for this task was to describe the seasonal habitat use of grizzly bears in the two parks relative to the ELC classifications in each park.

The suitability or importance of a unit of land to wildlife may be assessed using three principal methods:

1) Subjective Assessment.
2) Ecosite Preference/Avoidance Analysis.
3) Modelled Assessment.

The first method, subjective assessment, usually involves a group or committee of species experts who decide, in concensus, the relative importance ratings of various land units. These experts refer to the biophysical descriptions of each map unit and, based on their knowledge of seasonal habitat use of the species of concern, assign relative ratings to land units for each season. Familiarity with local habitat conditions, the type and level of detail of biophysical data available, the levels of existing habitat use research and inventory information available, and the precision required of the particular rating scheme (e.g. 4 versus 10 classes) are key factors that combine to determine the success of subjective assessments.

The second method assumes complete reliance on analyzed field data as a measure of the relative importance of land units. In all but the most rigorous and long-term field studies, analyzed field data is, on its own, inadequate for measuring the relative suitability of land units. This is particularly true at larger mapping scales when a large number of distinct units are to be evaluated. This is certainly the case for this grizzly bear study, where 98 different ELC units occur within the study area (Section 4.6).

Modelled assessments of habitat importance entail assigning numerical values to specific attributes (e.g. food items, vegetation type, landform) of land units for particular life requisites (e.g. food, cover and reproduction) and seasons. The relative importance of these land attributes, life requisites and seasons are assigned subjectively, and then a mathematical equation is established to produce a single numerical value, or importance value, for the land unit of concern. Equations are often simple weighted means, but may be more complex depending on the output required. Computer manipulation is generally required because of the large data bases involved.

These importance values for land units are then listed and subdivided into classes with ranges of values. These classes are then assigned descriptive ratings (e.g. nil, low, medium, high, very high).

Modelled assessments of land unit importance have considerable potential, especially in terms of introducing objectivity and repeatability to the evaluation process. There is, however, a definite need for the validation of modelled assessments as this is a new and evolving field of endeavor. Validation can be done through comparison of the modelled results with the habitat use data collected in the field and/or a rigorous subjective assessment.

Subjective Assessment

The subjective evaluation of ecosite importance was conducted for all ecosites represented in the two parks. The biophysical map units of YNP (Coen and Kuchar 1982) were first converted to ecosites named in the KNP, BNP and Jasper National Park and ELC studies for the sake of consistency (Kansas *et al.* 1989a). Importance ratings of nil, low, medium, high or very high were assigned to each ecosite for each of four grizzly bear seasons (pre-vegetation, vegetation, berry and post-berry).

The two primary authors independently assigned ratings to the ecosites that occurred in the study area(s) in which they each had conducted intensive fieldwork. The followings sources were used to make rating decisions:

1) Vegetation and geomorphology descriptions from Volume 1 of the Kootenay ELC report (Achuff *et al.* 1984) and Volume 2 of the Banff/Jasper ELC report (Holland and Coen 1982).

2) Food habits data from scat analysis.

3) Their knowledge of grizzly bear habitat use based on field study.

The ratings were assigned within the context of YNP and KNP as a whole. For those ecosites that occurred over a wide range of aspects, the rating was chosen for the aspect that produced the optimum food and cover requirements of grizzly bears. A moderate level of berry production was assumed when rating ecosites.

The results of the independent ratings were then compared, and finalized ratings were arrived at by concensus.

Ecosite Preference/Avoidance Testing

Radio-telemetry locations gathered from all three years were insufficient to determine if the observed bear use of ecosites was greater or lesser than the expected use based on the areal extent of each ecosite. The number of ecosites involved (n = 98) was far too large, and the number of locations too low, to use the Chi-square procedure developed by Neu *et al.* (1974) to test the significance of the results. Ecosite preference/avoidance testing was therefore not conducted.

Food Habits Model

The food habits model developed for grizzly bears in the four mountain parks (Kansas *et al.* 1989a) was used to compare with the subjective evaluation of ecosites in YNP and KNP.

The model was comprised of the following sequence of tasks (after Kansas *et al.* 1989a):

1) The seasonal importances of key grizzly bear food items were assigned numerical ratings (critical = 5; very high = 4; high = 3; medium = 2; low = 1; very low = 0.5).

2) A single importance value was then calculated for each ELC vegetation type per season, based on the average percent cover and importance of each key food item of the sampling plots (releves) that were conducted within each vegetation type during the Banff/Jasper Biophysical Inventory. This was done by simply summing the food item importance in each plot and then averaging over all plots in the vegetation type.

3) The percent occurrence of ELC vegetation types within ecosites was then determined through data obtained from habitat evaluation transects.

4) A food related importance value was generated for each ecosite and bear season, by calculating a weighted mean using vegetation type importance and percent occurrence values.

3.7 IDENTIFYING IMPORTANT AREAS FOR GRIZZLY BEARS

Results of the telemetry investigations were used to delineate areas that were deemed critical to the maintenance of a healthy grizzly bear population in the two parks, and areas where the possibility of a high frequency of human/bear interactions exist.

General locations of most bear dens are known from aerial telemetry flights. After a review of budget and manpower constraints in Year I, it was decided that site specific investigation of the dens would not be feasible or necessarily productive for park planning purposes. Therefore, no detailed data on grizzly bear dens is presented.

3.8 ESTIMATING POPULATION SIZE AND MONITORING TRENDS IN NUMBERS

A subjective population estimate for each of the following age and sex classes was developed for both YNP and KNP: adult males, adult females, sub-adults (M. Raine and R. Riddell for each park, Dibbs and J. Niddrie for KNP, H. Abbott and E. Knox for YNP). Estimates were conducted independently by different members of the study team. Adults were considered to be those bears six years of age and over. Sub-adults were considered to be aged three to five.

The following information was made available to each person:

1) Maps of the three year composite home ranges of study bears.

2) A table of home range sizes of study bears.

3) A map of unmarked sow/cub groups observed during the study by the study team, wardens and the public (taken from warden cards). These bear groups were

assigned numbers, and an attempt was made to differentiate between these groups, based on data, location, number of young and age of the young.

4) A map of all other locations of unmarked bears, also taken from warden cards, for the period 1988-1990.

5) Computer printouts of the unmarked bear locations.

6) Information on home range size and overlap found for bears in other studies (e.g. Aune and Kasworm 1989, LeFranc *et al.* 1987).

Bear populations for each park and each sex and age class were estimated to the nearest 0.1 bears. For example, if it was judged that a bear spent 80% of his time in Kootenay, and 5% of his time in Yoho, he would represent 0.8 bears in a Kootenay estimate and 0.1 bears (rounding up) in a Yoho estimate. Conversely, another bear, by being entirely within Yoho, would represent 1.0 bear for that park.

The independent estimates were each arrived at by slightly different methods. Some relied more heavily on counting the minimum number of individual bears present, using Warden Service bear monitoring records, while others relied more on the home range data collected during the study. Those that used the former method were less inclined to assign a percentage to the proportion of the time that the bear in question may have spent in either park. Rather, they included the bear as being entirely within the park. Population estimates conducted in this fashion were most likely overestimates, and are indicated as such in the results. One researcher recalled seeing six different adult grizzly bears on the border of KNP during sheep surveys in the fall of 1989. He assigned a value of 0.5 bears to each of these as he had no way of knowing what proportion of their time they actually spent within the park. Another researcher in KNP assigned a value of 0.5 bears to all unmarked bears that were thought to be different individuals. He assumed that, as KNP is a relatively narrow park, that few bears would have ranges totally encompassed by its borders. Yet another researcher based his estimates on the size of the two parks relative to the size of the ranges of adult male and female bears. Adult male bears that were followed for greater than one year had a mean home range of 1475 square km. Only one adult female (#5) was followed for a sufficient length of time to obtain a reasonable home range estimate, therefore her range of 366 square km was used to represent the average requirements of adult females. The researcher disregarded the internal anatomy of the bear home ranges and the differences in habitat quality over the two parks to arrive at a ballpark estimate of bear populations. He assumed 100% and 50% home range overlap, respectively, for male and female bears. Sub-adult populations were estimated by reviewing the ratio of adult to sub-adult bears found in other areas of the Rocky Mountains (LeFranc *et al.* 1987). A ratio of 1.6 adults to 1.0 sub-adults was used.

3.9 BEAR MORTALITY

Annual mortality rates of study bears were calculated for sub-adult (3-5 years) and adult (greater than 5 years) age classes with the following formula (adapted from Heisey and Fuller 1985):

$$d = 1 - \frac{x - y}{x} * 100$$

In this equation, x represents the total number of bear-years that collared bears were followed, and y represents the number of collared bear deaths recorded during that time frame. Bear-years were calculated by summing the number of days that each bear was followed, and dividing this sum by 365. When the fate of bears whose radio signals were lost was unknown, mortality rates were calculated twice, once assuming that the missing bears were dead, and once assuming that they were still alive.

4.0 RESULTS AND DISCUSSION

4.1 BEAR CAPTURE AND HANDLING

A total of 1,264 culvert trap nights and 740 snare trap nights of effort were used during the three years of study (Table 4.1.1). Most trapping was conducted during the months of May to August, and traps were distributed throughout the parks at elevations ranging from 1100 - 2200 m (3700 - 7300'). Trap locations were skewed toward front-country areas due to accessability and budget considerations. Specific trap locations for Years I and II are described in Raine *et al.* (1988) and Raine *et al.* (1990), respectively. Trap locations for Year III are listed in Appendix I of this report.

Nineteen grizzly bear captures were made in all. Trapping success was one bear per 106 trap nights. More grizzly bears were captured in YNP (13) than KNP (6) despite the fact that less trapping effort was conducted in the former park (754 vs 1,250 trap nights, respectively). It is uncertain whether this difference was due to chance or to differences in habitat between the two parks.

Eleven different grizzly bears were captured during the course of the study (Table 4.1.2). Seven different grizzly bears were captured in 1988, two new bears were trapped in 1989 and an additional two new bears were captured in 1990. Of these, four bears (#'s 2, 5, 6 and 7) were classified as adult females. Adults were considered to be six years of age or over. Although a tooth was not obtained from Bear 5 for aging, she was classified as an adult due to the presence of a cub with her in 1988. Two bears were sub-adult females (#'s 9 and 23), three were adult males (#'s 1, 4 and 11), and two were sub-adult males (#'s 8 and 10). All 11 bears were outfitted with radio-collars.

A third sub-adult female grizzly bear was caught outside of KNP in Fairmount by British Columbia provincial wildlife officers in 1989. This bear was radio-collared and released near Luxor Pass. It returned to the province and was later destroyed in the townsite of Edgewater. Due to its limited nature, data from this bear has been excluded from this report.

Adult and sub-adult females averaged 92 and 45 kg in weight, respectively, while adult and sub-adult males averaged 144 and 74 kg, respectively (Table 4.1.3). Seasonal weight gains and losses were calculated for those bears that were captured and weighed more than

Table 4.1.1. Trap nights and capture success of bear trapping efforts in Yoho and Kootenay National Parks, 1988 - 1990.

Park	Month	Trap Nights Snare	Trap Nights Culvert	Total	Bear Captures[a] Grizzly	Bear Captures[a] Black	Total
Yoho	April		5	5			
	May	4	135	139	3	2	5
	June	16	160	176	6	8	14
	July	1	125	126	2	2	4
	August	7	115	122	1		1
	September	7	86	93	1		1
	October	15	78	93			
Subtotal		**50**	**704**	**754**	**13(58)[b]**	**12(63)[b]**	**25**
Kootenay	May	61	82	143		2[c]	2
	June	55	169	224		3	3
	July	119	150	269	1	2	3
	August	178	62	240		2	2
	September	160	28	188	2		2
	October	117	69	186	3		3
Subtotal		**690**	**560**	**1,250**	**6(208)**	**9(139)**	**15**
STUDY TOTAL		**740**	**1,264**	**2,004**	**19(106)**	**21(95)**	**40**

a Includes recaptures of Bear 9 and 23.
b Trap nights per capture.
c Assiniboine trap in Kootenay National Park was tripped by black bears in addition.

Table 4.1.2. Sex, age and capture information for grizzly bears captured in Yoho and Kootenay National Parks, 1988 - 1990.

Bear I.D.	Sex	Age at First Capture	Date Captured	Location	Method	Collar Frequency	Ear Tag No.
1988							
8	M	3	21 June	NG428804	Culvert	150.189	L7
10	M	3	24 June	NG424856	Snare	150.268	L11
7	F	9	27 June	NG429843	Snare	150.168	L12
1	M	7	30 July	NG596698	Snare	150.009	L105
5	F	-	29 Aug.	NG434786	Snare	150.131	L15
7[a]			2 Sept.	NG331861	Culvert		
10[a]			21 Sept.	NG525664	Culvert		
6	F	6	25 Sept.	NG611639	Snare	150.149	L6
1[a]			13 Oct.	NG599698	Snare		
10[a]			15 Oct.	NG483713	Culvert		
4	M	12	15 Oct.	NG6605984	Culvert	150.109	L8
1989							
09	F	3	18 May	NG354927	Culvert	150.250	L20
23	F	3	6 June	NG354927	Culvert	150.268	L23
23[a]			16 July	NH384003	Culvert		
1990							
09[a]			22 May	NG344915	Culvert		
23[a]			23 May	NG344915	Culvert		
11	M	15	20 June	NG429842	Culvert	150.289	R12
02	F	7	25 June	NG282897	Culvert	150.028	R14
09[a]			16 July	NG358937	Culvert		
23[a]			28 July	NG575955	Culvert	150.341	R187

[a] Recapture

Table 4.1.3. Body measurements (cm) of grizzly bears captured in Yoho and Kootenay National Parks, 1988 - 1990.

Bear ID	Age	Date	Body Length	Tail Length	Chest Girth	Neck Girth	Shoulder Height	EFN[a] (mm)	Weight kg.	Weight lb.
Adult Females										
07	9	27 June 88	155	8	86	48	84	115	77	170
05		29 Aug. 88	173	15	99	64		100	116	255
06	6	25 Sept. 88	161	10	100	64	90		107	235
02	7	25 June 90	147	6	88	48	86	102	69	152
Mean (n=4)			**159**	**10**	**93**	**56**	**87**	**105**	**92**	**203**
Sub-adult Females										
09	3	18 May 89	140	18	61	38	66	140	45	100
23	3	6 June 89	141	14	88	46	69	115	45	100
Mean (n=2)			**140**	**16**	**75**	**42**	**67**	**127**	**45**	**100**
Adult Males										
01	7	30 July 88	192	8	85	58	81	115	100	220
04	12	15 Oct. 88	169	8	127	90	96	140	204	450
11	15	20 June 90	164	21	113	66	82	106	127	280
Mean (n=3)			**175**	**11**	**108**	**71**	**86**	**120**	**144**	**317**
Sub-adult Males										
08	3	21 June 88	140	8	85	47	77	115	73	160
10	3	24 June 88	148	9	78	46	80	105	75	165
Mean (n=2)			**144**	**8**	**82**	**46**	**79**	**110**	**74**	**162**

[a] Ear from notch

once (Table 4.1.4). Bear 1, an adult male, weighed 27 kg less in late July 1988 than he did in mid-August of the previous year, when he was captured by the Banff Black Bear Study team (Kansas *et al.* 1989b). Between 30 July and 13 October 1988, Bear 1 gained a total of 23 kg, or .31 kg/day. Bear 9, a sub-adult female, showed virtually no net weight gain between the ages of three and four following den emergence. In contrast, Bear 23, a sub-adult female, gained 39 kg between the ages of three and four. During the summer of her fourth year, she gained .11 kg/day between 23 May and 28 July, and .72 kg/day between 28 July and 5 September. As these two time periods are roughly aligned with the vegetation and berry seasons (Section 4.3), it can be concluded that this bear gained weight at an appreciably higher rate during the berry season than during the vegetation season.

A total of 21 black bear captures were made, with an average success rate of one bear per 95 trap nights. As with grizzly bears, more black bears were captured in YNP (12) than in KNP (9). A summary of black bear captures is shown in Table 4.1.5.

4.2 TELEMETRY MONITORING

A total of 967 relocations were obtained on the collared grizzly bears in the three years of study (Table 4.2.1). One hundred and sixty-four incidental visuals and site-specific relocations of grizzly bears were also made by wardens and park visitors. For all relocations, 360 (31.8%) were site-specific, 466 (41.2%) were remote, 111 (10.2%) were home-range-only and 190 (16.8%) were incidental. There were 334 fixes obtained by aerial telemetry.

Brief descriptions of the chronological activities of each of the collared bears is outlined below.

BEAR 1:

<u>1987</u>

Bear 1, a 6-year-old male, was captured near Castle Junction in BNP in 1987 during trapping for the Banff Black Bear Study (Kansas *et al.* 1989b). He was ear tagged but not radio-collared at that time.

Table 4.1.4. Seasonal weight gains/losses of grizzly bears in Yoho and Kootenay National Parks, 1987 - 1990.

Bear ID	Sex	Age	Date	Weight kg	Weight lb.	Weight Gain (kg(lb.)/#days)	Rate of Gain/Loss kg(lb)/day
01	M	6	15 Aug. 1987	112	247		
		7	30 July 1988	100	220	12(27)/349	- [a]
		7	13 Oct. 1988	123	270	23(50)/75	.31(.67)/day
09	F	3	18 May 1989	45	100		
		4	22 May 1990	47	103	2(3)/369	- [a]
23	F	3	06 June 1989	45	100		
		4	23 May 1990	84	185	39(85)/351	.11(.23)/day
		4	28 July 1990	91	200	7(15)/66	.11(.23)/day
		4	5 Sept. 1990	119	262	28(62)/39	.72(1.6)/day

[a] Insignificant

Table 4.1.5. Summary of black bear captures in Yoho and Kootenay National Parks, 1988 - 1990.

Year	Park	Bear ID	Sex	Age	Capture Date	Trap Location	Method	Weight kg	Weight lb
1988	YNP	20	M		22 May	NG346917	Culvert	148	325
		20	M		2 June	NG302918	Snare		
		22	M		3 June	NG321867	Culvert	68	150
		20	M		10 June	NG365938	Snare		
					1 July	NG363041	Culvert		
	KNP	-	F		14 June	NG660594	Culvert		
		-			16 June	NG614645	Culvert		
		24	M		28 June	NG719522	Culvert	90[a]	200[a]
		-			15 July	NG660594	Culvert		
		25	F	10	10 Aug.	NG586666	Snare	73[a]	160[a]
		26	F	15	12 Aug.	NG678397	Snare	80[a]	175[a]
1989	YNP	25	M		20 May		Culvert	68[a]	150[a]
	KNP	-			October				
1990	YNP	-			9 June	NG260971	Culvert		
		-			17 June	NG282897	Culvert		
		-			17 June	NG342858	Culvert		
		-			2 July	NG342858	Culvert		
	KNP	17	F	14	14 May	NG708329	Snare	50	110
		18	M	4	19 May	NG755139	Free Range	50	110
		-	F	4	22 June	Kimpton	Culvert		

[a] Estimated

Table 4.2.1. Number of locations[a] of collared and incidentally observed grizzly bears by fix type in the Yoho and Kootenay National Parks study area, 1988 - 1990.

Fix Type	Number of Locations	
	Bear Study	Warden Cards
Home Range	115	N/A
Remote	466	N/A
Site Specific	317[a]	43
Incidental	69	121
TOTAL	**967**	**164**

a Includes 18 trap related locations

1988

Bear 1 was recaptured and collared near the Paint Pots in KNP on 30 July 1988. He was subsequently relocated 26 times before he denned in the fall (Figure 4.2.1). He travelled from Twin Lakes in BNP to Numa Pass in KNP, but spent most of his time in the Vermilion burn, where he fed upon buffaloberries and blueberries (*Vaccinium* spp.) during the summer.

1989

Early aerial telemetry flights in April 1989 did not determine Bear 1's denning site. He was first relocated on 30 April on Mt. Whymper above Marble Canyon and was subsequently relocated 70 times before he denned in the fall. He spent the majority of May digging for hedysarum (*Hedysarum* spp.) on Mt. Whymper and on the avalanche slopes of the Stanley Creek bowl.

He then travelled to the Pipestone River in BNP and spent June feeding between Hector Lake and the headwaters of the Red Deer River. In July, he returned to the Paint Pots area of KNP and fed on grasses, cow parsnip, and other vegetation until berry season. Later in July, he began feeding primarily in the Vermilion burn on buffaloberries and blueberries through until early September. At this time he returned to the Pipestone River near Molar Creek and was found to feed mainly on crowberries (*Empetrum nigrum*).

Bear 1 returned to KNP and denned in late November near the Paint Pots. Although his radio transmitter first went on inactive mode on 10 November, he still was active on 22 November. Bear 1's total minimum home range for 1989 was 1179 km^2 (Figure 4.2.1, Table 4.2.2).

1990

Bear 1 was relocated with some regularity from the end of April to August. On 17 August his break-away collar disengaged after 26 months of use. The single layer of cotton fire hose had evidently deteriorated to the point of failure.

No specific den emergence date was established for this bear. The first telemetry location was obtained on 30 April in the lower Baker Creek drainage of BNP. The upper half of this drainage still had complete snow cover at that time. Investigation of this location revealed

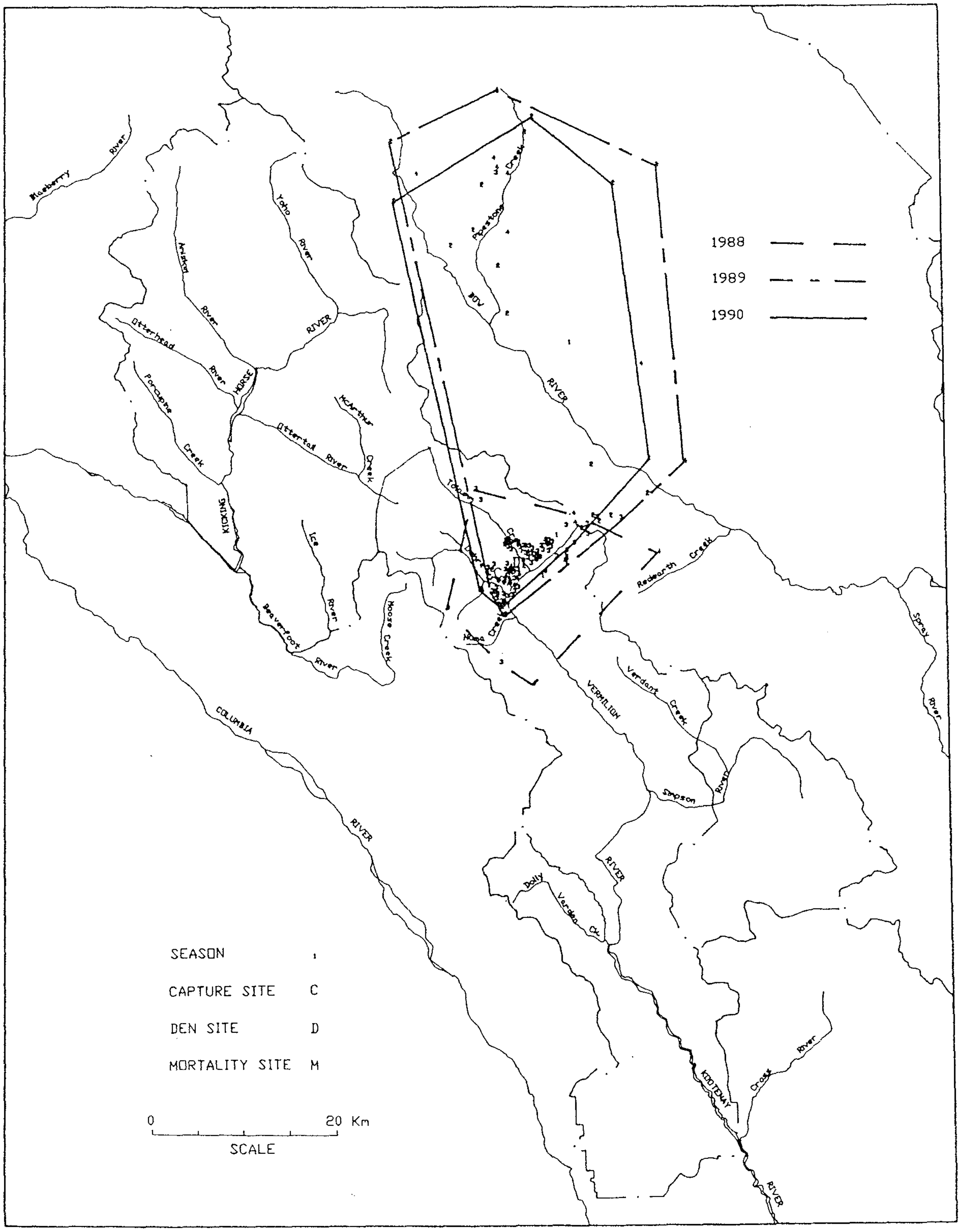

Figure 4.2.1. Annual home ranges of adult male grizzly bear 1, 1988 - 1990.

Table 4.2.2. Minimum home range sizes (km^2) of and number of jurisdictions used by radio-collared grizzly bears in Yoho and Kootenay National Parks, 1988 - 1990.

Sex and Age	Bear ID	Year			Total	Number of Jurisdictions Used
		1988	1989	1990		
Adult Female	2			115 (54)	115 (54)	1
	5	86 (3)	295 (51)	231 (53)	366 (107)	3
	7	98 (29)	25 (31)		114 (60)	1
Sub-adult Female	9		183 (89)	165 (65)	361 (98)	2
	9[a]			867 (33)	867 (65)	3
	23		371 (108)	627 (35)	627 (143)	2
Adult Male	1	272 (27)	1,179 (70)	941 (34)	1,478 (131)	2
	4	14 (4)	1,475 (78)	686 (19)	1,475 (101)	4
	11			420 (22)	420 (22)	2
Sub-adult Male	8	183 (19)	674 (19)		1,097 (38)	3
	10	365 (28)	67 (11)		466 (39)	3

a [illegible]st-relocation

snow free openings with snow thickness of 10 - 30 cm in the adjacent woods. Although tracks were found there was no evidence of feeding.

It was noted that due to heavy winter snow conditions, hedysarum avalanche paths used the previous year in the Marble Canyon (KNP) area were still mostly snow packed. The root crops they supported were thus generally unavailable to grizzly bears until well into May. Snow depths in the last week of April at Marble Canyon Warden Station (elevation = 1463 m) averaged 35 cm.

Bear 1 continued to move northwest to areas he had utilized in 1989 in the Pipestone River drainage. Widespread, thick snow cover was seen throughout most of the Pipestone drainage at this time. As spring melt occurred, he ranged more widely through this drainage. His spring home range included points south of Mt. Drummond at the Red Deer River, east of Ski Louise and southeast of Hector Lake. Telemetry locations were only obtained by air and few ground investigations of these locations were possible.

In the first week of June, Bear 1 moved to the Paint Pots area of KNP. On 7 June, he was located by aerial telemetry south of Taylor Creek, BNP. Then, on 11 June, he was relocated 2 km south of Paint Pots.

Once Bear 1 had moved back into KNP most telemetry relocations were investigated on the ground. Two well used day beds were located at the base of a large avalanche slide 2 km south of the Paint Pots. Analysis of scats collected on site and investigation of feeding sign indicated that Bear 1 had foraged largely on grass and cow parsnip. Some use of stinging nettle (*Urtica dioica*) and fireweed (*Epilobium angustifolium*) was also detected. During the berry season tall huckleberry (*Vaccinium membranaceum*) in the C14 vegetation type, and various blueberry species in the S05 early successional Vermilion burn, were utilized.

Of particular note, regarding field investigations of relocations of Bear 1, was the identification of a well established game trail at the base of the avalanche slopes immediately south of the Paint Pots. There appeared to be extensive use of this trail by bears travelling from Tumbling Creek to Numa Creek areas.

Bear 1 continued to make use of the Paint Pots area and Mt. Whymper through the Vegetation Season and well into the Berry Season. He was then relocated near Vermilion

Pass in mid-August, where he subsequently dropped his radio-collar. Based on a large set of tracks later found in the Marble Canyon area in early November, it is suspected that this bear is alive and utilizing his traditional northern KNP range.

The 34 locations obtained for Bear 1 in 1990 yielded a minimum home range size of 941 km^2. His total home range for 1988 - 1990 was 1,478 km^2.

BEAR 2:

1990

This 7 year old female was captured on 25 June 1990 in a culvert trap positioned part way up the Otterhead River drainage. She was found to use the southern and eastern slopes of Mt. King through to the early part of July. Feeding sign attributed to her indicated that she had fed primarily on cow parsnip and graminoids.

After travelling up the Otterhead drainage to Snow Drift Creek she then returned to the lower south facing slopes of Mt. King and the Kicking Horse River north of the Ottertail View Point. At the end of July this female moved to the headwaters of the Porcupine River and at this time appeared to be frequenting burns to a considerable extent.

On 16 August Bear 2 was seen resting on a high elevation snow patch on the north side of Tocher Ridge. From this time to the end of August she continued to use the Amiskwi Valley in the vicinity of Fire Creek. Site investigations of this area indicated a productive berry crop in the burn located there. However, very little feeding sign was seen. Berries present included oval-leaf blueberry (*Vaccinium ovalfolium*), buffaloberry, honeysuckle (*Lonicera* spp.) and gooseberry (*Ribes* spp.). Investigations also revealed the remains of a moose carcass that had been consumed by a bear near the abandoned saw mill site. Bear 2 was relocated several hundred metres further north at that time and possibly had fed on this carcass.

In early September Bear 2 was relocated by telemetry in Oreamnos basin where subsequent investigations indicated that she had fed on a mountain goat. She then was relocated in the upper Porcupine River at the base of Mt. Deville on 11 September. Early snows restricted feeding sign investigations at this time.

She had returned to the Oreamnos basin by 11 October, and then frequented the first drainage south of Oreamnos Creek. She remained in this area from 13 October to the end of October when her collar began to periodically transmit on mortality mode, indicating that she was denning. Mortality mode was first detected on 24 October.

Bear 2 was relocated 54 times before denning and her minimum home range of 115 km^2 fell entirely within YNP boundaries (Figure 4.2.2).

BEAR 4:

1988

This adult male was trapped near Floe Lake parking lot in KNP in October, 1988. He was only located four times before the end of the 1988 field season. No den site location was determined for this bear in the fall of 1988.

1989

Bear 4 was first located in 1989 near the Simpson River, upstream of Verdant Creek on 30 April. He travelled to the Wardle Mountain area and then north to Vermilion Crossing. Four days later he was located in the Ice River drainage of YNP, accompanied by another bear . He was seen on many occasions accompanied by another bear(s) through to 17 July. These sightings with other bears, presumably female, occurred in the Ice River, Symond Creek and Serac Creek drainages (see also Section 4.7).

For the duration of the growing season Bear 4 continued to range widely from Wardle Mountain north to the Paint Pots and from the Simpson River west to Moose Creek. In late fall he fed upon a goat north of the Paint Pots and also was relocated in close proximity to elk rutting grounds for about a week where he possibly was actively hunting. Next, he travelled south to Pitts Creek and was found to have fed on a road killed elk near Crooks Meadows. He was last relocated near Daer Creek on 3 December before being located at his den site near Lachine Creek in early February, 1990. A total of 78 telemetry locations (home range = 1475 km^2) were made for Bear 4 in 1989 (Figure 4.2.3).

1990

It is unknown when Bear 4 emerged from his den in the Lachine River drainage in the spring of 1990. The first telemetry relocation for 1991 was obtained some 4 km north of the Simpson Monument on 21 April. He was next found 4 km south of Kootenay Crossing

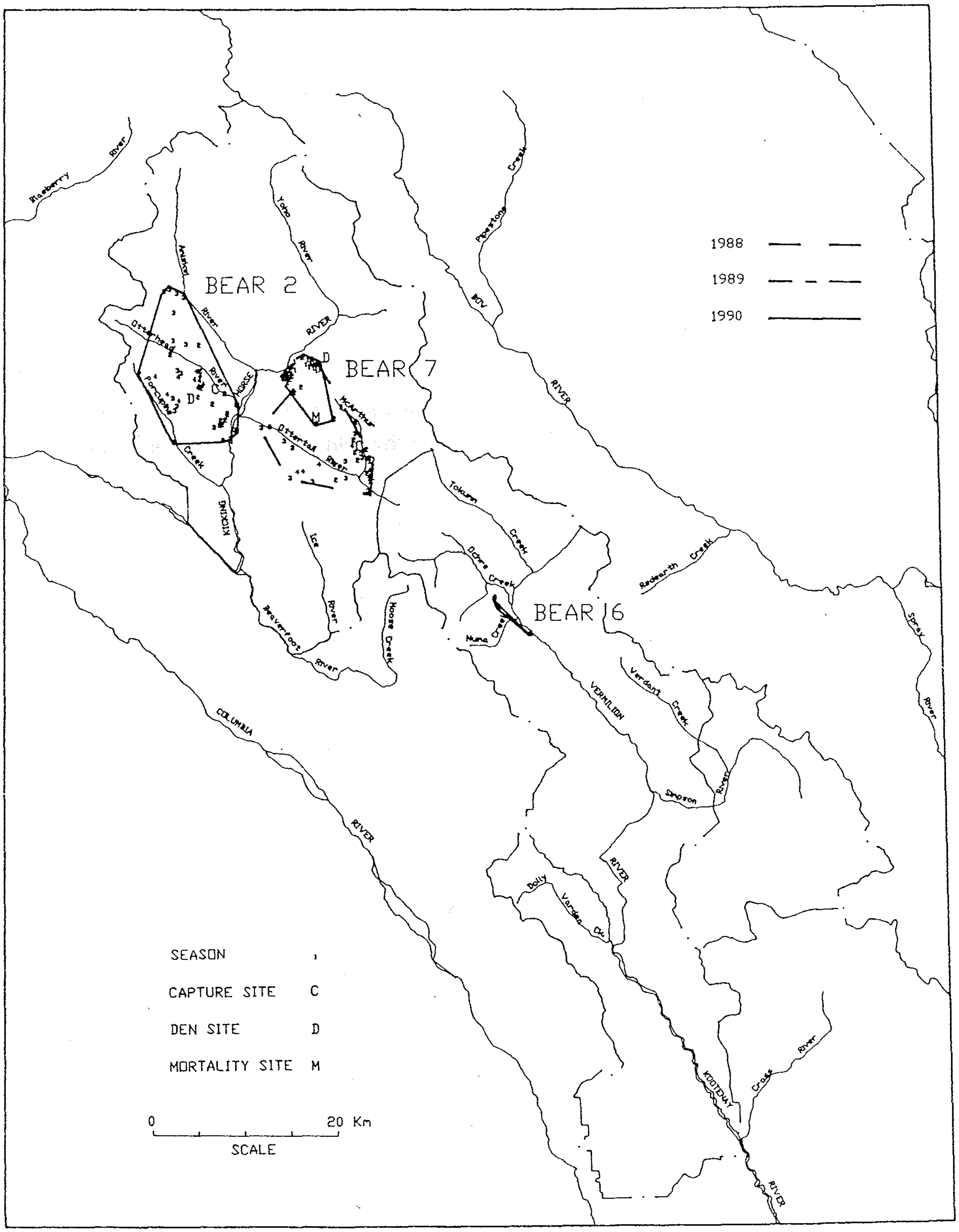

Figure 4.2.2 Annual home ranges of adult female grizzly bears 2, 6 and 7, 1988 - 1990.

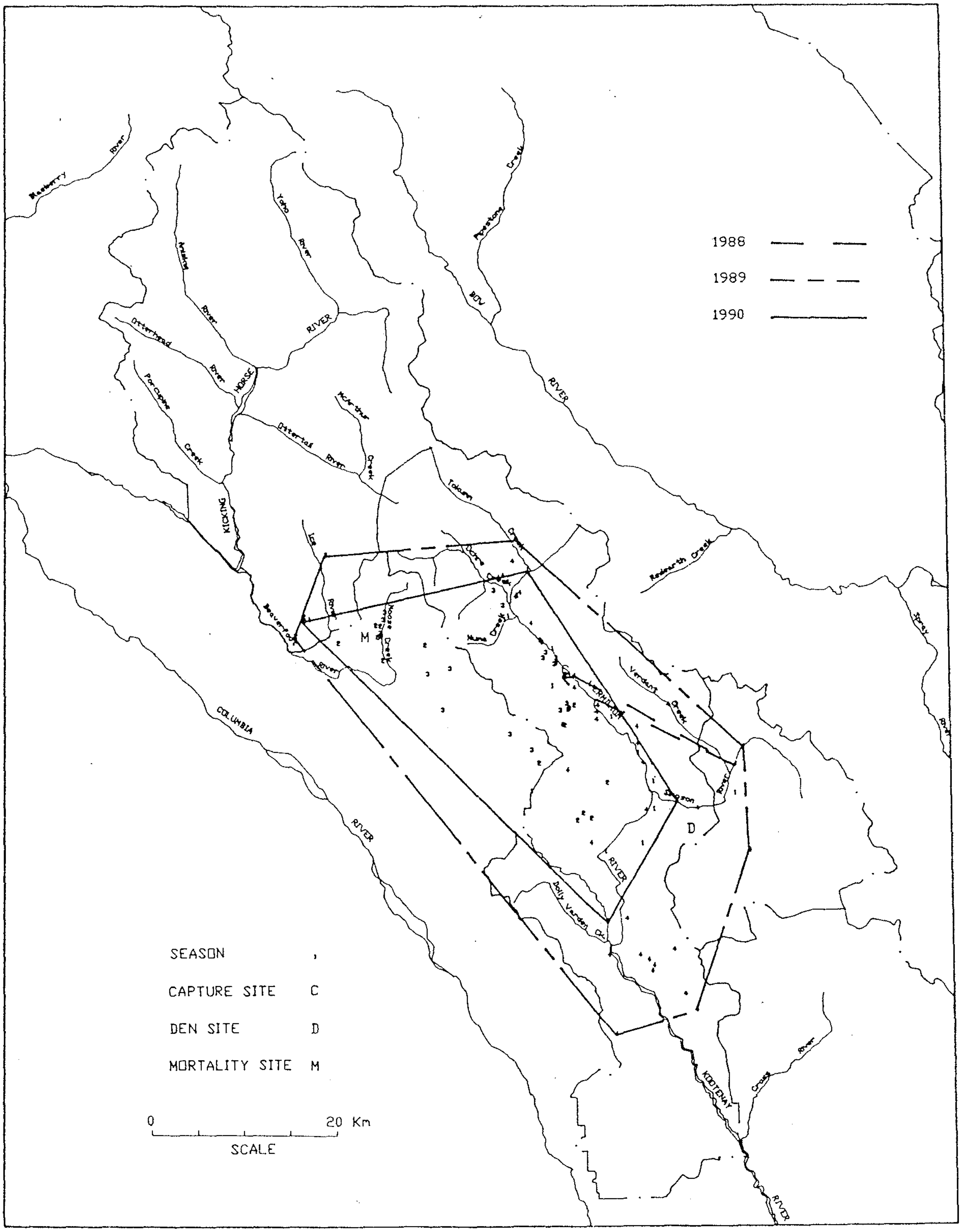

Figure 4.2.3 Annual home ranges of adult male grizzly bear 4, 1988 - 1990.

on the east side of Hwy. #93. Telemetry and investigations of this area indicated that he had likely fed on an ungulate carcass east of Hector Gorge. He then continued his travels along several fire roads digging for roots of milk vetch *(Astragulus* spp.).

Bear 4 then travelled to White Tail Creek before crossing to the Simpson Monument area and heading north in early May. Six days later, he was detected near Marble Canyon. Investigations of several locations, at this time, revealed no feeding sign but rather indicated that he was primarily travelling. There was in the range of 30 to 60 cm of snow in most forested areas at this time.

Three days after being relocated at Marble Canyon he was relocated on the lower slopes of Mt. Clawson east of the Ice River in YNP. Here he was seen near a group of elk but appeared to feed mainly on grass. It is thought that Bear 4 likely travelled through Wolverine Pass based on the short time lapse between telemetry locations and a set of tracks attributed to him found at the Ochre-Tumbling Creek junction in KNP.

Over the next few days he moved south to Moose Creek. A site investigation for his 18 May location (Moose Creek) indicated that he had fed on glacier lily (*Erythronium grandiflora*), cow parsnip, grass, fireweed and possibly one false hellebore (*Veratrum viride*) root. It was noted that this slope provided a number of preferred grizzly bear foods and generally was very good quality habitat.

Five days after being relocated in Moose Creek he was detected in the Serac Creek headwaters, where he was found to have fed on grass and animal matter. Within the next five days he returned to Moose Creek and was subsequently killed on 28 May by a guided hunter possessing a spring grizzly bear permit. It was noted that he was accompanied by a second bear (presumably a female) before being shot.

Nineteen telemetry relocations were obtained for Bear 4 in 1990. His minimum home range based on these few locations was 686 km^2. His three-year range encompassed 1,475 km^2.

BEAR 5:

1988

Bear 5, an adult female with a two year old cub, was captured along Goodsir Creek on 29 August 1988. Only three locations were obtained on her before winter. She denned on Misko Mountain in the McArthur Creek drainage.

1989

This female emerged from her den site on Misko Mountain still accompanied by her cub (then likely 3 years old). Her den was at the 2073 m (6800') level on a north facing slope. From spring to fall, Bear 5 and her cub repeatedly visited the McArthur, Tokumm, Ottertail, Misko and Goodsir drainages. Before the berry season started, they fed upon glacier lily corms to a considerable extent on the north side of Ottertail Pass and in the headwaters of Tokumm Creek.

This pair also dug extensively for hedysarum in the Goodsir Basin and on the south side of Odaray Mountain in YNP. A well used resting location was found on a rock out-cropping mid-way up a gravel dry wash above the McArthur Trail approach to McArthur Pass. Numerous scat deposits were found at this particular location which warrants future monitoring of the site.

After the berry season had passed Bear 5 and cub were found feeding on hedysarum approximately 4 km north of Lake O'Hara on Mt. Victoria. Later in October, they fed on a goat carcass halfway up the road to Lake O'Hara. From here they travelled closer towards Highway #1 and fed on a moose carcass upslope of Narao Lakes. Later in October, they fed again on another goat carcass near the washout on the Ottertail Fire Road.

By 26 November, Bear 5 had denned on the east side of Mt. Owen at the 2164 m (7100') level on an east-facing slope. There were 51 locations determined for her and her cub with the majority being from aerial telemetry due to their use of more remote locations. Inability to obtain more ground telemetry relocations was complicated by fire road closures in YNP. Her minimum home range size was 295 km^2 (Figure 4.2.4).

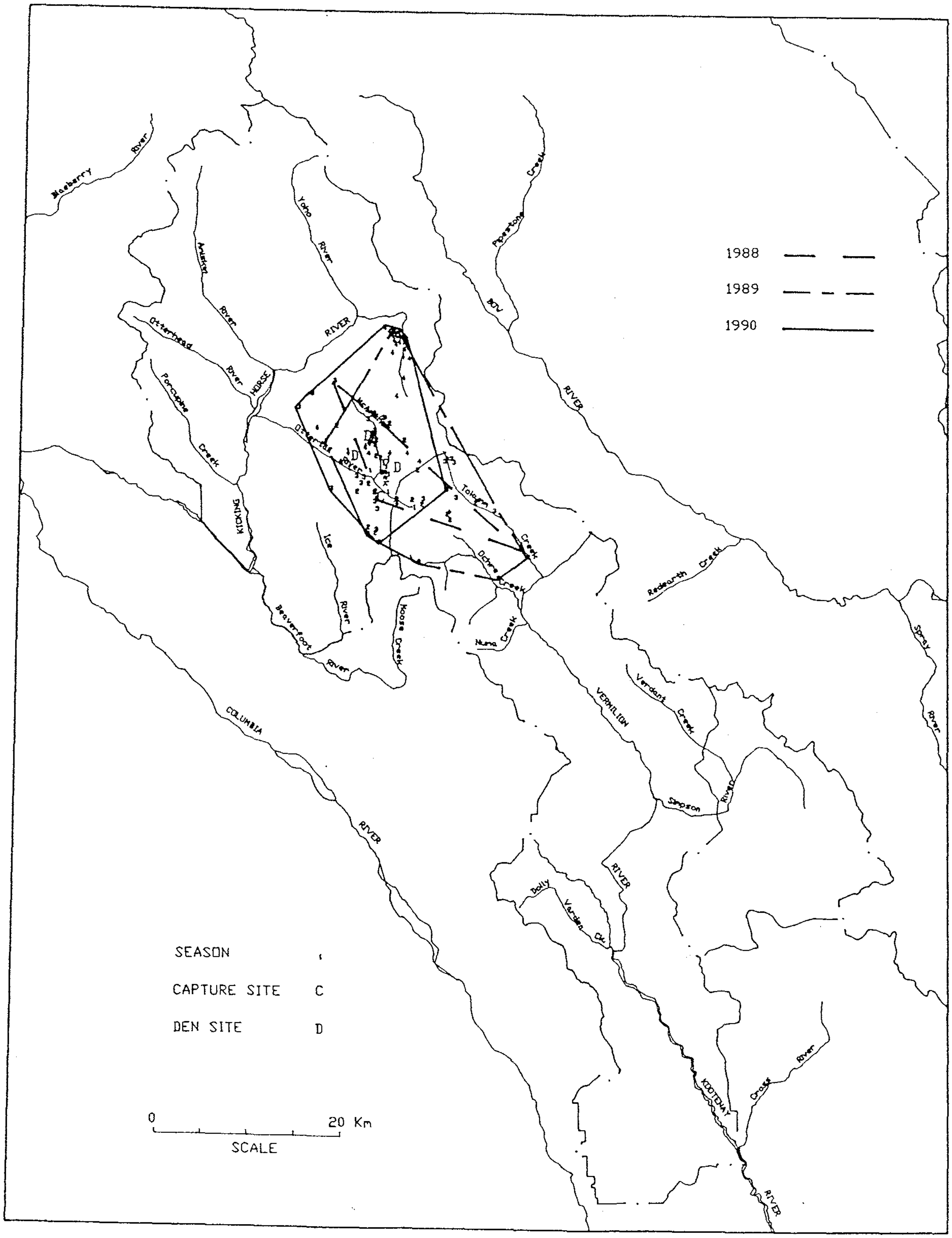

Figure 4.2.4. Annual home ranges of adult female grizzly bear 5, 1988 - 1990.

1990

In 1990, Bear 5 was found unaccompanied by her offspring. She was first detected on 30 April on the avalanche slopes of Misko Mt. opposite McArthur Creek. She also used avalanche slopes on the west side of Mt. Owen and above Ottertail Falls at this time. Site investigations of these slopes indicated that she had been feeding on hedysarum roots.

On 23 May, Bear 5 was observed in deep snow at the base of a steep avalanche slope at the head of Misko Creek. She was found at the 2438 m (8000') level surrounded by snow and rock for several hundred metres around her. It appeared that she had located a winter carcass, possibly an avalanche-killed mountain goat.

For the duration of the year she made extensive use of the McArthur Creek valley, Mt. Fulmen slopes opposite the Ottertail River, Silverslope Creek and Goodsir Creek. Interpretation of feeding sign indicated that she fed on grasses, cow parsnip, triangular-leaved ragwort (*Senecio triangularis*) and other succulent vegetation from June to August.

On an aerial flight of 3 June, Bear 5 was seen in association with a second large dark bear. It is believed that this second bear was Bear 11, based on his use of the area and general close proximity to Bear 5 over the summer. At this point Bear 11 was not radio-collared.

In August and early September, Bear 5 consumed buffaloberry and blueberry crops on the southwest face of Odaray Mountain. In 1989, she was sighted in the same location feeding on berry crops and hedysarum.

Her multi-year home range was extended, in 1990, to include the Boulder Creek drainage. A site investigation in the headwaters of Giddie Creek during late September indicated that she was feeding on white bark pine (*Pinus albicaulis*) nuts and some grouseberry (*Vaccinium scoparium*).

As in 1989, Bear 5 used the Cataract Creek drainage in late fall. Again, we detected an extension of her multi-year home range north to the north slopes of Cathedral Mountain immediately opposite Sherbrooke Creek. Tracking efforts revealed that she had been lured to an elk carcass near Highway #1. However, she did not cross the railroad tracks to take advantage of this carcass. On the west side of Narao Peak north of Watch Tower Peak, she was found to have dug up red squirrel middens to feed on stored whitebark pine nuts.

Next, Bear 5 travelled to her den site on Mt. Owen in the McArthur Valley. On 30 October, denning activity was confirmed by a mortality mode signal received from her collar.

A total of 53 telemetry relocations were obtained for Bear 5 prior to denning. Her minimum home range was 231 km^2 for 1990, a year during which she was unaccompanied by offspring. In 1989, she and her cub had utilized an area of 295 km^2 (Table 4.2.2). Her total range for 1988 - 1990 encompassed 366 km^2.

BEAR 6:

<u>1988</u>

This 6-year-old sow was captured south of the Numa parking lot in October of 1988. The few fixes possible in 1988 indicated her home range included Floe Creek, the Paint Pots area, Tumbling Creek and Ochre Creek (Figure 4.2.2). Insufficient relocations were obtained on this bear to warrant the calculation of a minimum home range estimate.

<u>1989 - 1990</u>

No signal was obtained in 1989 or 1990 despite extensive telemetry flights from the town of Radium to Hector Lake and from Sunshine Meadows west to the Columbia River. Frequency bracketing during these flights failed to detect her signal. To date, the whereabouts of the collar and/or Bear 6 are unknown.

BEAR 7:

<u>1988</u>

Bear 7, an adult female, was captured in McArthur Creek drainage, in YNP, on 27 June 1988. She was relocated 29 times before she denned on the northwest slopes of Mt. Stephen in early November (Figure 4.2.2). Her range encompassed the McArthur Creek and Ottertail River drainages. The den appeared to be located in a west-facing patch of spruce-fir forest at about 2225 m (7300').

1989

Bear 7 emerged from her den later than the other study bears and spent the early part of May in close proximity to her den site. Investigation of these slopes revealed several older dens but not her 1988/1989 den. An abundance of hedysarum diggings found near her den site would explain why she had remained near her den for such an extended period upon emergence.

During May, Bear 7 fed on hedysarum and then switched to feeding on green vegetation on the slopes of Mt. Stephen and Mt. Dennis and west to the avalanche slopes opposite the community ranch. A few times she was seen feeding on grass and horsetails at the ranch and in close proximity to the two sub-adult females, #9 and #23. This overlap of home ranges and shared pelage colourations of the three bears suggested that perhaps Bears 9 and 23 were the offspring of Bear 7.

In early June, Bear 7 moved further into the back-country, using the Boulder Creek, Ottertail River and Float Creek drainages. On 18 June, a mortality signal from her collar originated from the Float Creek drainage. Subsequent investigation indicated that she had been consumed by a large bear presumed to be another grizzly (based on scats and a day bed found). Thirty-one relocations were obtained for Bear 7 before her death (Figure 4.2.2).

BEAR 8:

1988

Bear 8, a young male estimated to be three years of age, was captured in the McArthur Creek drainage on 21 June 1988. He was located with Bear 10 for 7 of the 19 locations that were obtained prior to denning. He spent most of his time in the McArthur, Goodsir and Ottertail drainages, but also made excursions to the Otterhead and Ochre watersheds. A third, unmarked sibling was observed with Bears 8 and 10 on two occasions.

Both Bear 8 and his sibling, Bear 10, denned in the steep Porcupine drainage within about 1 km of each other at the 1951 m (6400') level. Bear 8's denning slope faced north while #10's faced east.

1989

Upon emerging from his den, Bear 8 ranged widely but initially spent most of his time in the areas of Mt. Hunter, Chancellor Peak, and Wapta Falls. He then travelled west and was relocated near tree line immediately southeast of the town of Golden, B.C. on 31 May. Extensive telemetry flights did not locate him again until 23 June in the headwaters of Waitabit Creek, north of the Blaeberry River.

On 21 July, Bear 8 was found dead and badly decomposed. He had travelled some 800 m from his last known location of 17 July. Due to the state of decomposition, the carcass was not removed and cause of death is still unknown. There was no apparent problem with the fit of the collar and no obvious gross injuries observed. A recent, normal looking scat composed of cow parsnip was found near the carcass. Bear 8 possibly suffered from a major infection as a result of an injury from natural or possibly firearm related origin. Only 19 relocations were obtained for him before his death (Figure 4.2.5) His minimum home range for 1989 was 674 km^2.

BEAR 9:

1989

Bear 9 was a sub-adult female of 3 years of age. She first appeared in early spring and summer, on the Mt. Dennis avalanche slides and at the Field community pasture in the company of Bear 23. Bear 9 was first captured near Field on 18 May 1989. Her diet at that time consisted primarily of grasses and horsetails foraged at and near the community pasture. After Bear 23 had been translocated (see below) Bear 9 was relocated over several days in close proximity to Bear 7 in the Boulder Creek drainage.

Her movements for the duration of the summer were generally quite limited and predictable (Figure 4.2.6). She spent the early part of July in the Hoodoo Creek Basin apparently feeding on cow parsnip and other vegetation. Other drainages used for short periods included the Ottertail River, Hagarth Creek, Silverslope Creek, lower and upper McArthur Creek. In upper McArthur Creek she appeared to have fed mainly on hedysarum and possibly ground squirrels. During the late summer she was relocated on the northeast shoulder of Mt. Hurd, and in late fall she moved to the Kicking Horse River flats and west to the Porcupine River.

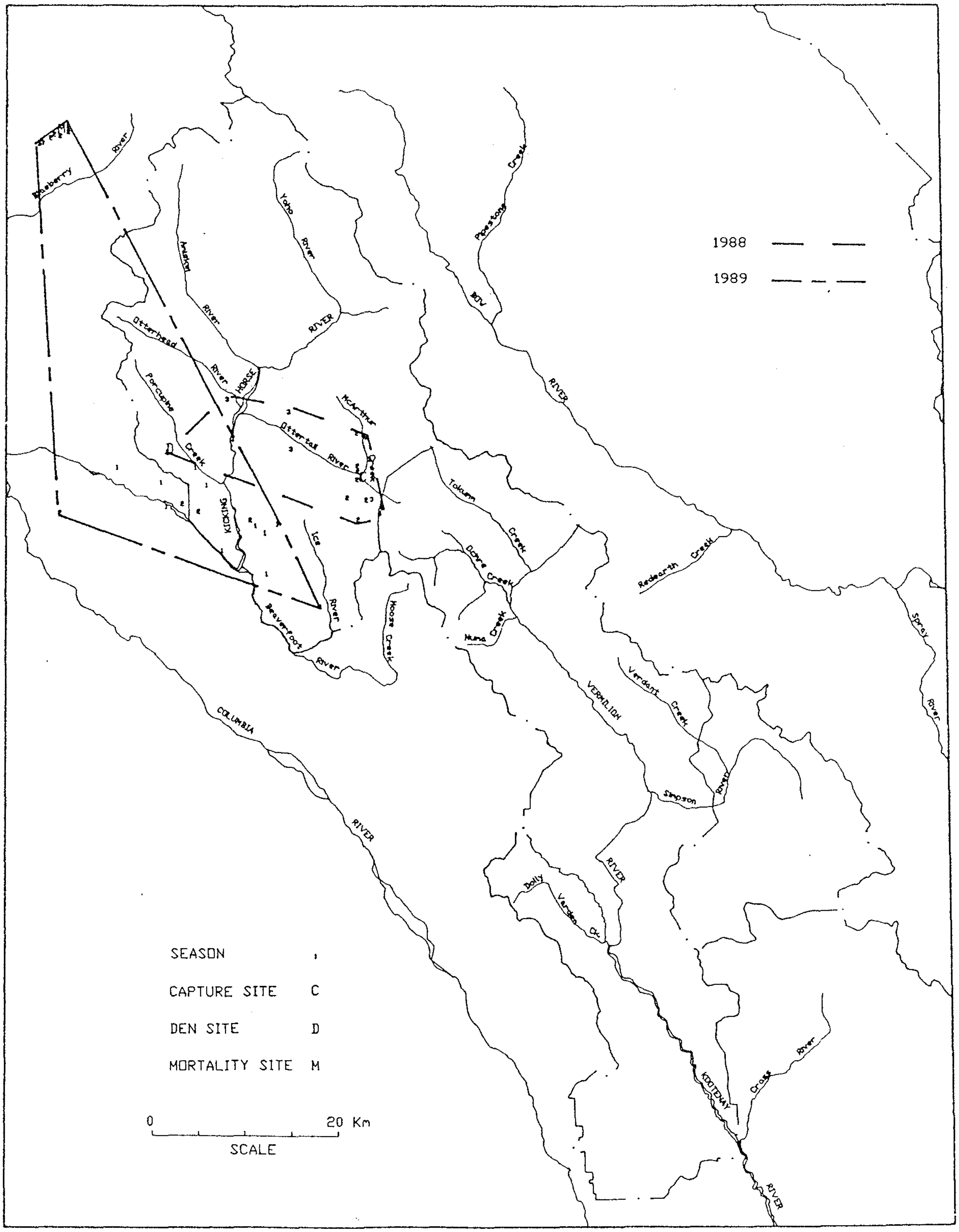

Figure 4.2.5. Annual home ranges of sub-adult male grizzly bear 8, 1988 - 1989.

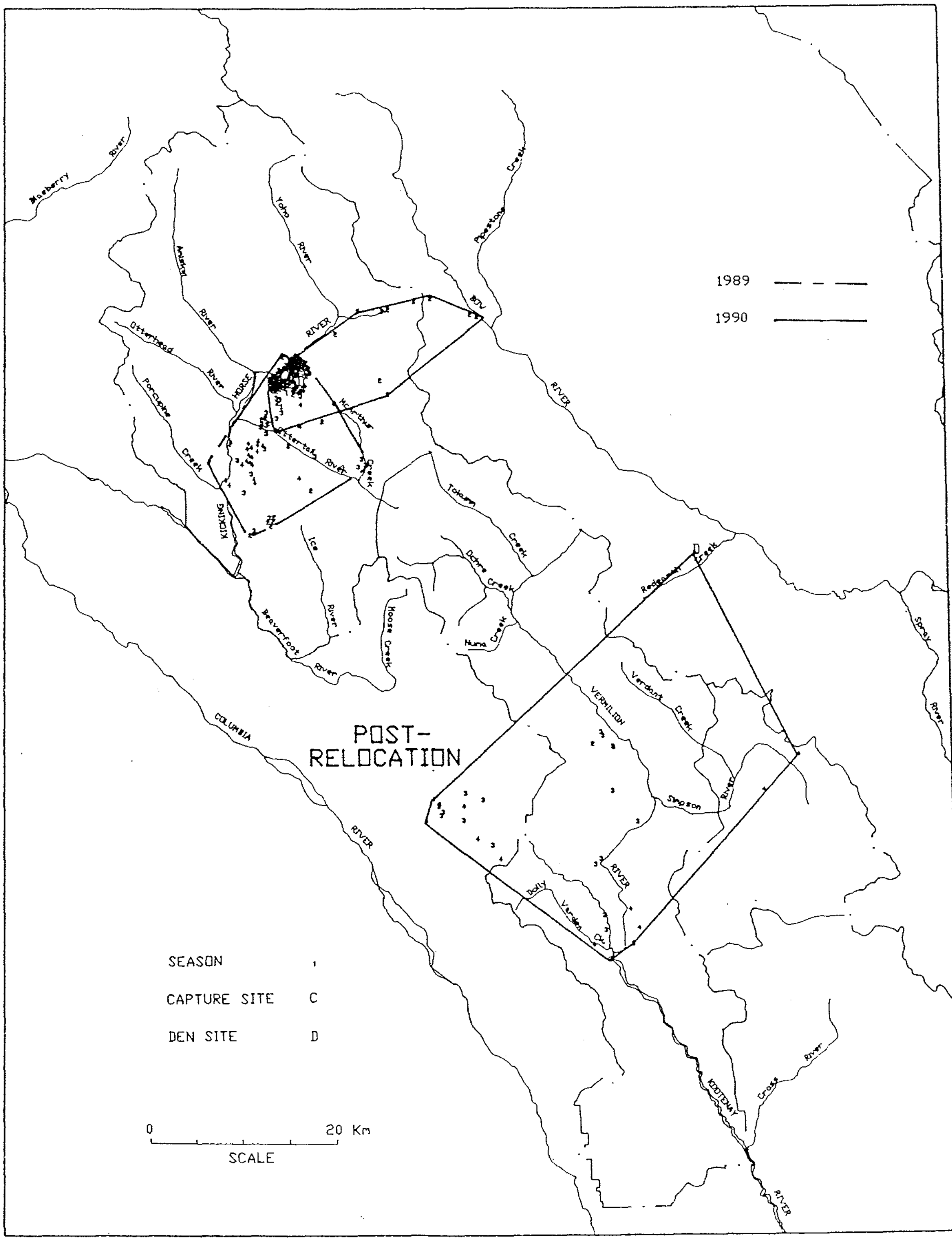

Figure 4.2.6. Annual home ranges of sub-adult female grizzly bear 9, 1989 - 1990.

On 26 October, during an aerial telemetry flight, it became evident that Bear 9 was excavating a den on the Boulder Creek side of Mt. Dennis near tree line. On a previous morning her transmitter had been noted to be on inactive mode, changing to active mode later in the day. It is believed that she denned in early to mid-November. There were 89 relocations obtained for Bear 9 in 1989 before she denned. Her home range size was 183 km^2 in 1989 (Figure 4.2.6).

1990

Bear 9 emerged from her den on approximately 2 May, based on her collar's activity mode and tracks seen in the snow. After emerging she was relocated several times in the Hagarth Creek area before she travelled to the Mt. Dennis slides above the Field government ranch. She used these slides for the duration of May. She was retrapped in May and her collar was refitted. At this time she weighed 47 kg (103 lbs), only 2 kg (3 lbs) heavier than the previous spring. Bear 9 continued to feed on graminoids and horsetails in the Field townsite area through to the end of June.

Through the first half of July she travelled along the Highway #1 corridor to just west of the Lake Louise government horse barns. Three days later she was seen at the Lake O'Hara campground where she fed on grass near the Warden's Cabin. Four days later, on 14 July, she had returned to the Field townsite. On 16 July Bear 9 was trapped, after breaking into a house porch, and was translocated to Serac Creek in KNP.

After being released in the Serac drainage she gradually moved south to the Kootenay Crossing area and then further south to Crook's meadows. She occupied this area for the first week of August, feeding on buffaloberries and ants. Near Crook's Meadows she also fed on a carcass which possibly was that of a road-injured deer that had been reported at the same time. On several occasions Bear 9 fed on carrion left at the carrion pit immediately north of Kootenay Crossing.

On 13 August, she was relocated at the west boundary of KNP near the Kootenay River. For the remainder of the summer she spent her time on provincial lands north of Diana Lake on the north end of the Brisco Range. No information is available regarding her food habits from this time period.

On 17 October, an aerial flight detected Bear 9 on the Dolly Varden fire road near Highway #93. From here she travelled to Mt. Assiniboine Provincial Park where it is believed that she fed on the remains of a bighorn sheep killed by a hunter. Her next relocation was at her den site on the southeast side of Copper Mountain in the Red Earth Creek drainage. On 14 November, during the last telemetry flight of the year, her collar was found to still be on active mode. She was presumed to be in the den at this time since no tracks were observed in the snow.

Ninety-eight relocations were obtained for Bear 9 in 1990. Her pre-translocation minimum home range was 165 km^2, while her post-translocation home range was 867 km^2 (Figure 4.2.6).

BEAR 10:

1988

Bear 10, a sub-adult male, was snared in the McArthur Creek drainage on 24 June 1988. He was relocated 29 times before he denned. He travelled extensively in the McArthur, Goodsir and Ottertail drainages. Bears 8 and 10 both fed on cow parsnip and graminoids on avalanche paths during June and July. In August, they travelled to the headwaters of Goodsir Creek where they fed on buffaloberries. In late fall, Bear 10 was found at the headwaters of Paul Creek outside of KNP, and he was later recaptured on 21 September in Rockwall Pass. All three siblings were observed feeding on hedysarum roots in the upper reaches of Helmet Creek in mid-October. Bear 10 was again recaptured at this time. The 28 relocations obtained for Bear 10 in 1988 yielded a minimum home range of 365 km^2.

1989

Bear 10 spent the early spring of 1989 feeding in the area of Mt. Hunter and Mt. Hurd and showed limited daily movements. The last telemetry fix was taken on 16 May and his radio signal was not detected on a subsequent telemetry flight. On 27 May, Bear 10 was shot by a hunter on an avalanche slope in the Glenogle Creek drainage located west of Yoho. This mortality occurred during the spring grizzly season and was thus a legal kill. The hunters responsible were interviewed and the hide was examined. The actual kill site and remaining carcass were also investigated. There were 11 relocations obtained for Bear 10 before his death (Figure 4.2.7).

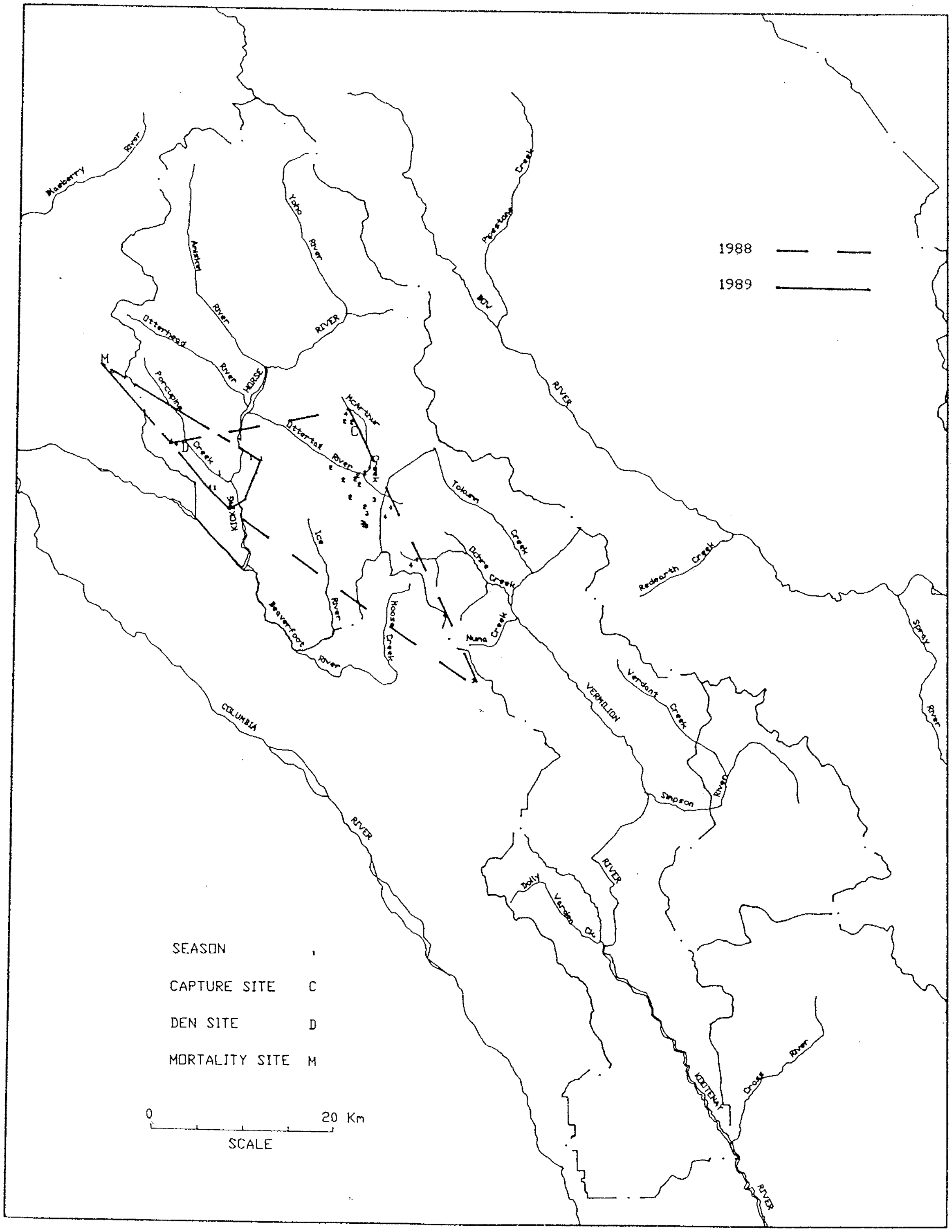

Figure 4.2.7. Annual home ranges of sub-adult male grizzly bear 10, 1988 - 1989.

BEAR 11:

1990

Bear 11 was trapped using a fly-in trap, in the mid McArthur Valley on 20 June. He weighed 127 kg (280 lbs) and was 15 years old.

This male used the McArthur Valley, Goodsir Basin, Silverslope Creek headwaters and Float Creek areas. He appeared to feed primarily on succulent vegetation through to mid August. These foods included cow parsnip, graminoids, triangular-leaved ragwort and fireweed. Some use of ants, rodents and buffaloberry was also detected during site investigations.

On a number of occasions Bear 11 was found within 1 km of Bear 5 although they were never actually seen in close proximity. As noted above, on an earlier flight for Bear 5 (3 June) she was seen with a large dark bear presumed to be a male. The second bear was possibly Bear 11.

Bear 11 frequently used the lush avalanche slopes of Mt. Owen near the McArthur Creek foot bridge. These same slopes were also used by Bear 5 periodically through the vegetation period.

Two days after relocating Bear 11 in the McArthur drainage of YNP, he was located by air in the Pipestone drainage of BNP. At this time he was seen in a confrontation with two wolves. Another seven individuals of the pack were seen within several hundred metres. Bear 11 gradually moved off upslope as the two wolves followed.

During 11-13 September, Bear 11 was relocated several times just south of Hector Lake. Feeding sign at the south tip of Hector Lake indicated that he had fed on buffaloberries and hedysarum roots. No signal was obtained from him on 14 September nor on subsequent extensive aerial telemetry flights. At present, the reason for the disappearance of this bear's radio signal is unknown.

The 22 relocations obtained for Bear 11 in 1990, resulted in his having a minimum home range size of 420 km^2 for that year (Figure 4.2.8).

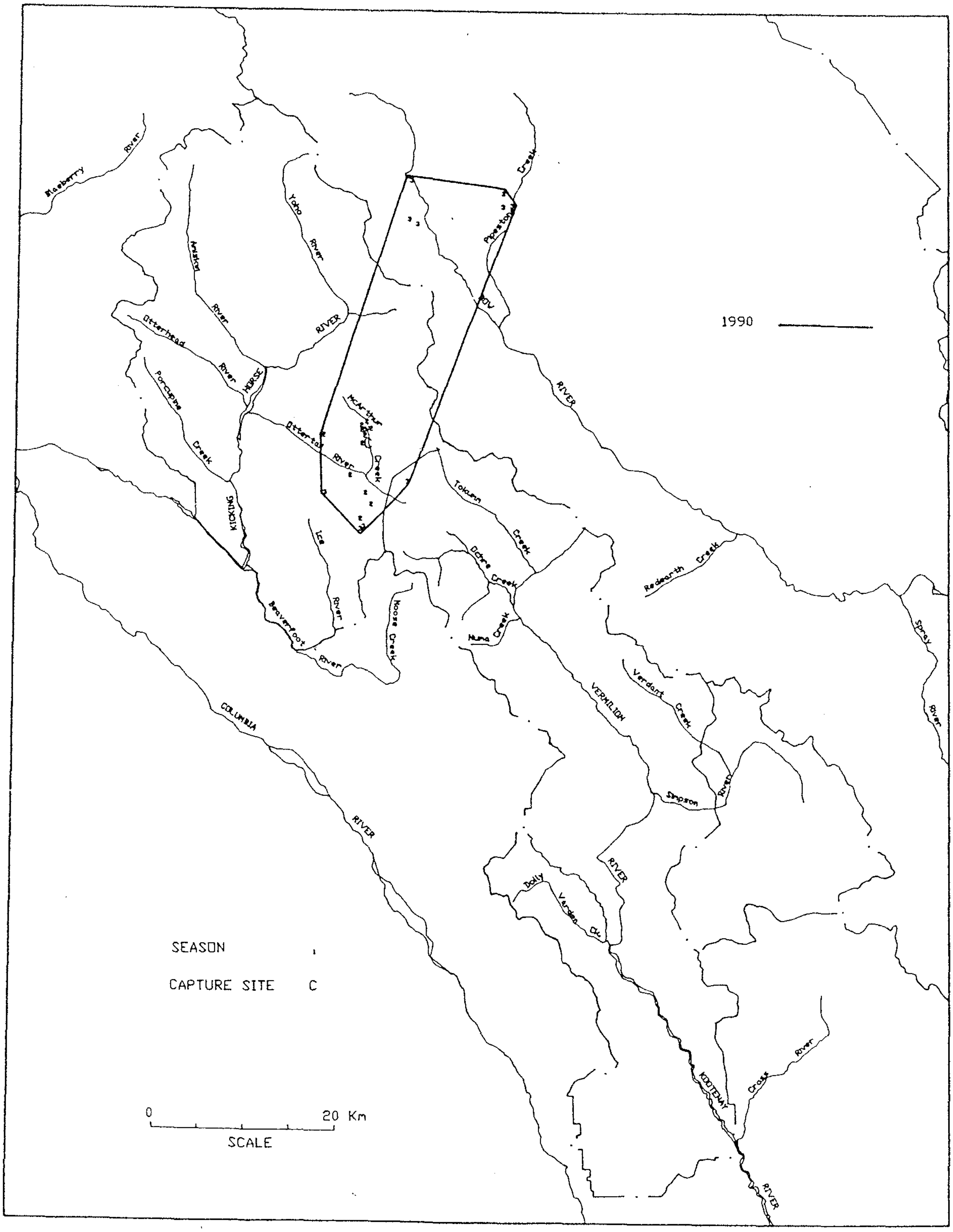

Figure 4.2.8. Annual home range of adult male grizzly bear 11, 1990.

BEAR 23:

1989

Bear 23, a 3-year-old female, was often accompanied by Bear 9 during the early spring and summer. She was first captured near Field on 23 May. After she entered the townsite of Field several times and appeared aggressive towards a dog on one occasion, she was trapped on 6 June and was translocated to the upper Porcupine Creek drainage by the Warden Service. On 11 June she reappeared at the community ranch and continued to feed in the area for several days before making use of the avalanche slopes of Wapta Mountain in the Yoho River Valley. At this time she became accustomed to tourists viewing her at close range. She did not appear to be distressed or aggressive in these situations. Subsequently, she was trapped again on 16 July in this same vicinity and was then fitted with a radio transmitter. At this time she began feeding on the ripening buffaloberries on Mt. Stephen, in the Yoho River Valley and around the Kicking Horse Campground.

Around 24 July she moved into BNP and fed on buffaloberries alongside Highway #1. Soon after this, and continuing through to late fall, Bear 23 fed almost exclusively on the abundant roadside buffaloberries from Wapta Lake to Lake Louise along Highway #1 and also along #93 north to Hector Lake. She made numerous forages along these routes and became a primary tourist attraction and caused repeated "bear jams". Even though she came into frequent close proximity to unwary tourists and was subjected to some harassment she displayed no antagonistic behaviour by her towards the public.

In September, Bear 23 fed for about two weeks on the Lake Louise ski slopes amongst intense clearing and development activity. Here she apparently fed on pockets of lush graminoids and horsetails in areas where ground water surfaced, and also fed on remnant buffaloberries. After travelling to Hector Lake and then to the Lake Louise area she returned to the town of Field and eventually to the Kicking Horse Campground where she fed on hedysarum in late October. She then appeared to den near the switchbacks in the Yoho River Valley and remained there until mid-November. However, a telemetry flight on 26 November showed that Bear 23 had moved to the opposite side of the ridge (ie. the north side) on Mt. Dennis from where Bear 9 was denned. It is believed that she denned in this area. There were 108 telemetry fixes obtained on Bear 23 by 28 of November. Her home range for 1989 was 371 km^2 (Figure 4.2.9).

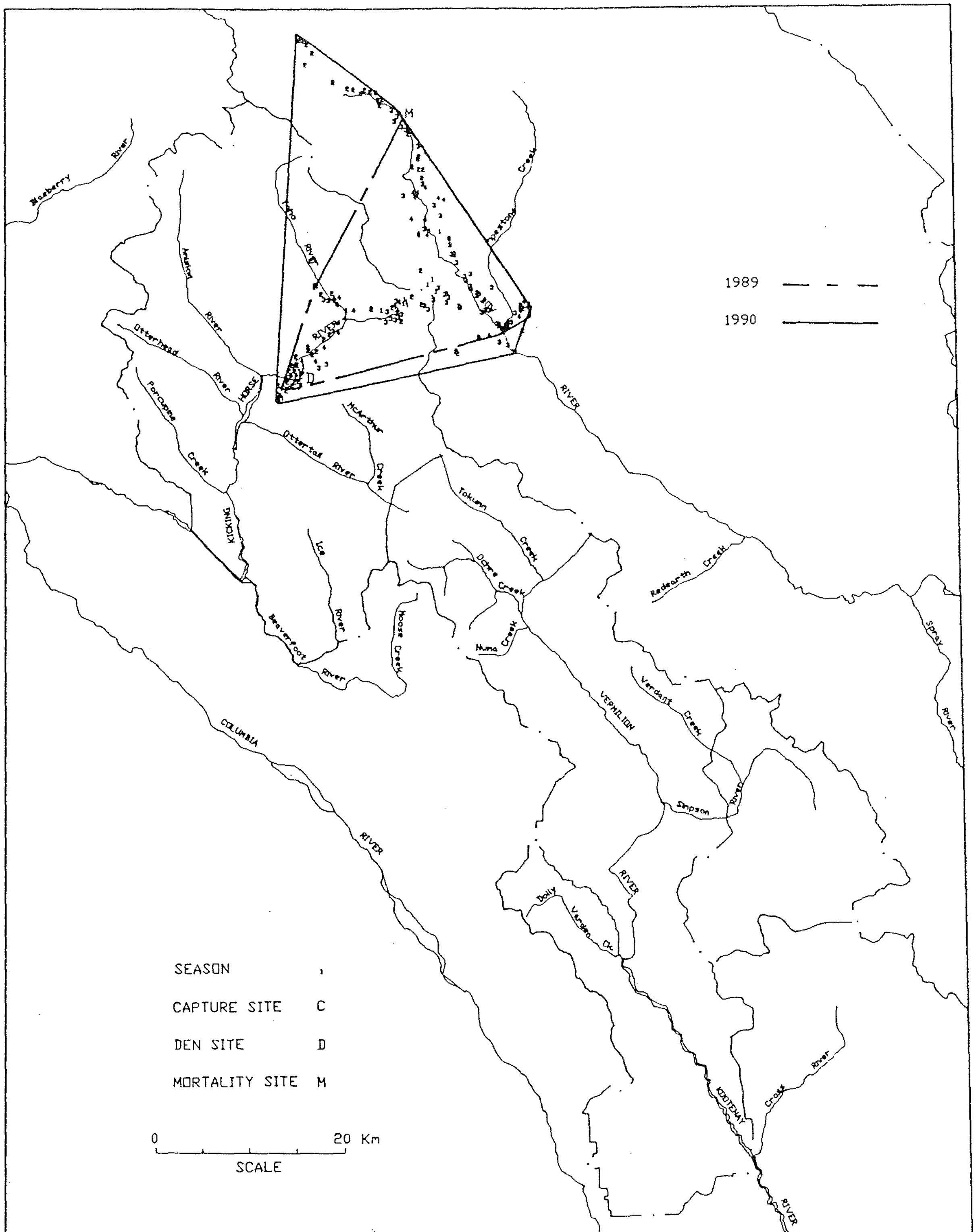

Figure 4.2.9. **Annual home ranges of sub-adult female grizzly bear 23, 1989 - 1990.**

1990

Bear 23 appeared to have been active at various times through the winter. Tracks were observed in the vicinity of the den on 29 March and no signals were obtained for several evenings. A strong active signal came from the den area on 4 April, and from then she appeared to be active in the vicinity of the den until 18 April.

On 23 April, Bear 23 was located near Boulder Creek about 1 km upstream of Highway #1. She was next found near the highway and remained there for at least 4 days. Subsequent investigation of this site indicated that she had fed on an elk carcass. Between 5 - 7 May, she also fed on a goat carcass located on Mt. Bosworth above the Lake O'Hara turn off.

Bear 23 travelled to Bath Creek and on to Hector Lake area where she began to feed on roadside grasses, horsetail fruiting shoots and other vegetation. By 24 May she had returned to the Field townsite and was captured in a culvert trap at the government ranch. At this time she weighed 84 kg (185 lbs). This represented a 39 kg (85 lbs) weight gain over a one year period.

Generally, this bear repeated her previous year's use of the highway corridors from Field to Lake Louise and north to Bow Lake. The only 1990 extension of her known life home range was towards Bow Summit, The Plain of Six Glaciers and a slight extension east of the Lake Louise townsite.

Investigation of her feeding habits indicated that she relied upon grasses, horsetails, and dandelions until early July. Several investigations subsequent to this revealed that she fed heavily upon ants at times. Numerous ant logs and hills were fed upon within a localized area on the north side of Lake Louise townsite.

She was trapped on 28 July near a campground on the east side of Lake Louise after she had was found feeding on a deer carcass. She was then translocated to the headwaters of the Panther River in BNP. At this time, she was found to weigh 91 kg (200 lbs). This represented a weight gain of 7 kg (15 lbs) in 66 days(.11 kg/day).

Ten days after being translocated she had returned to Highway #93 approximately 6 km north of Highway #1. She then fed upon roadside buffaloberries south to Lake Louise and Hector Lake. On 31 August she was found feeding on a roadside deer carcass near Hector near Hector Lake. This deer had been struck by a vehicle on the evening of 30 August. She fed on this carcass for three days and then moved north. On 5 September Bear 23 was struck and killed by a tour bus.

Examination of her carcass indicated that she was in good condition and weighed 119 kg (262 lbs). Since being translocated on 28 July she had gained 28 kg (62 lbs) in 39 days for a rate of weight gain of .72 kg (1.6 lb) per day.

The 102 relocations obtained for Bear 23 prior to her death, excluding her point of translocation, indicated a minimum home range of 627 km^2 (Figure 4.2.9).

TOTAL HOME RANGES

Collared grizzly bears were found to have extensive home ranges and to frequent up to four different jurisdictional areas (Table 4.2.2.). Adult and sub-adult females had ranges of up to 366 and 627 km, respectively (Figure 4.2.10). Adult male bears had home ranges of up to 1,478 square km, while sub-adult males had ranges of up to 1,097 square km (Figure 4.2.11). The different jurisdictional areas that bears from the study could utilize included YNP, KNP, BNP, Mount Assiniboine Provincial Park and British Columbia and Alberta provincial lands. On average, the home ranges of the bears encompassed 2.5 different jurisdictions. This number is undoubtedly an underestimate as two bears were not followed for a full year, and only three bears were followed for greater than one year. One adult male utilized portions of four jurisdictions within his home range.

The home range size of bears in this study are comparable to the ranges found for grizzly bears in other studies in the Canadian Rockies (e.g. Russell *et al.* 1979, Carr 1989). The ranges, however are quite large relative to YNP and KNP. The two adult males, in fact, had ranges larger (1475 - 1478 square km) than the size of either of the two parks (roughly 1300 and 1400 square km, respectively). It is, therefore, not surprising that most of the collared bears had greater than one jurisdiction within their home ranges. This high rate of trans-boundary movement means that managers within the different jurisdictions must act in concert to properly manage grizzly bears in the area. The national parks cannot be considered in isolation. The recent initiative of the World Wildlife Fund, the Carnivore Conservation Strategy (Dueck 1990, Hummel 1990), recognizes this fact. We strongly encourage the establishment of a Carnivore Conservation Area (CCA) for the Rocky Mountain parks complex described by the above strategy (Section 5.0). A necessary

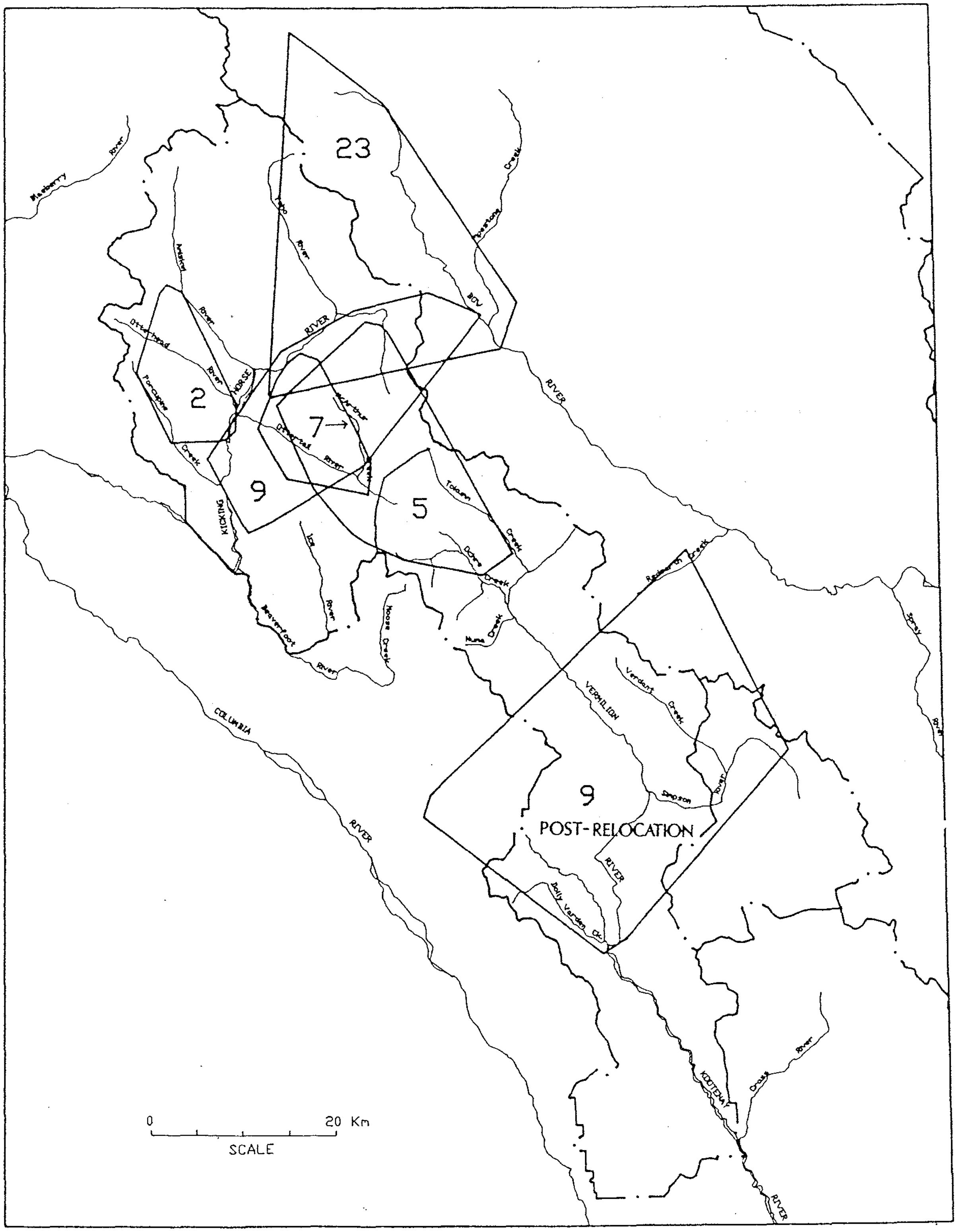

Figure 4.2.10. Total home ranges of female grizzly bears, 1988 - 1990.

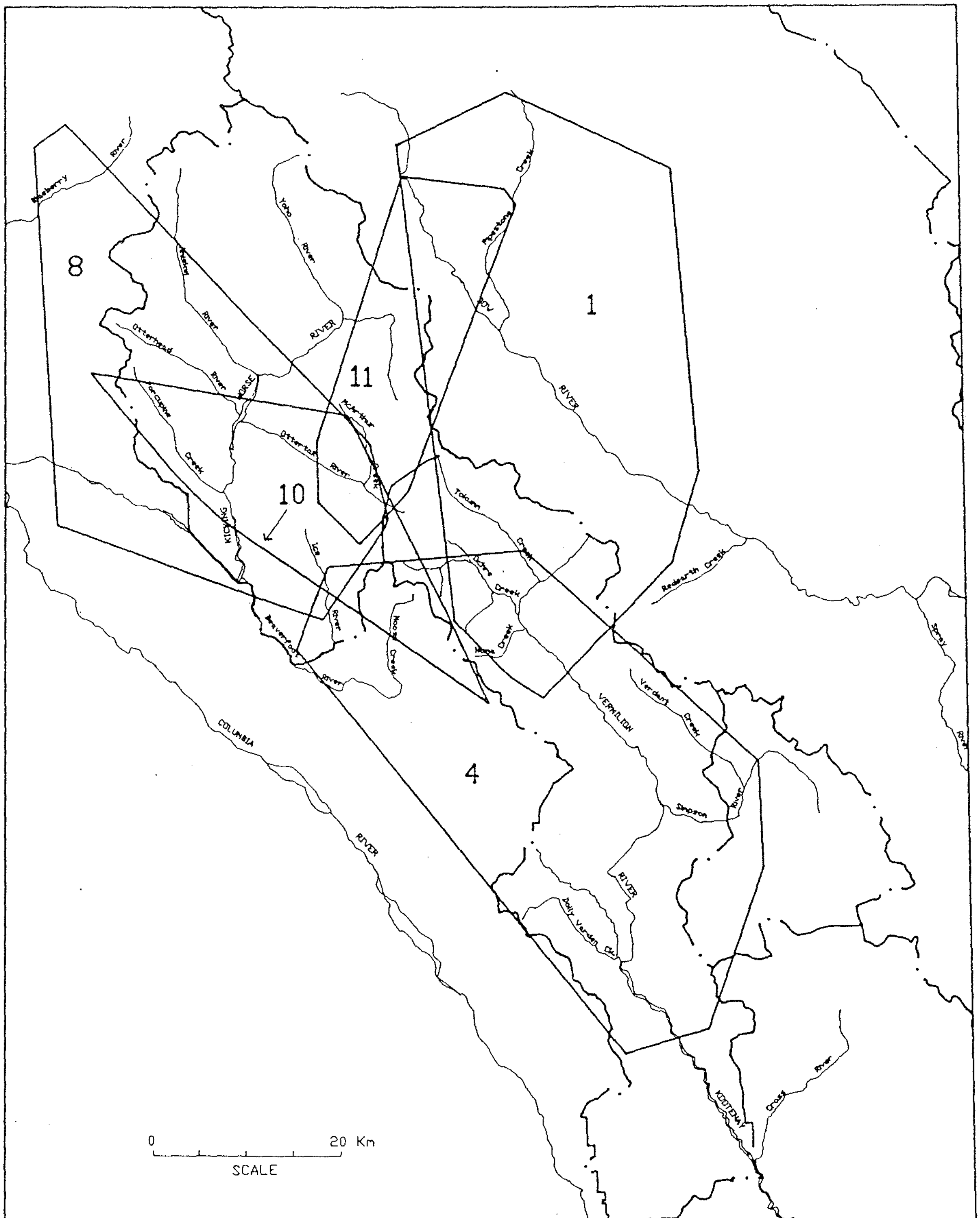

Figure 4.2.11. Total home ranges of male grizzly bears, 1988 - 1990.

precursor to the establishment of a CCA will be the development of an inter-agency working group for grizzly bears and other carnivores.

4.3 BEAR SEASONS

Four bear seasons (Table 4.3.1) were derived for each year from an analysis of feeding signs (Table 4.3.2) and bear food phenology observed during site-specific locations and phenology transects. The timing of the seasons will vary by up to 10 days from year to year in response to variations in phenology.

Pre-Vegetation Season. Hedysarum spp. were observed to be the main species fed upon at feeding sites investigated during early spring, stressing the importance of this plant as the main spring food of grizzly bears in the two parks. Nineteen of 29 feeding sites were of hedysarum feeding. Hedysarum has also been found to be important to grizzly bears in other areas of the Rockies (Hamer and Herrero 1987). Hamer and Herrero also found that grizzly bears fed on overwintered bearberries (*Arctostaphylos uva-ursi*), graminoids and ants in the early spring. Ungulate carcasses were also found to be fed upon in early spring. Bears were found to have fed on elk carcasses on six occasions and on goat carcasses three times. In each of these cases, it could not be determined whether the bears involved had killed the animals or not.

This season was found to end with green-up of vegetation in the two parks. This was found to occur between 13 and 31 May during the three years.

Vegetation Season. During this season the 11 study bears fed primarily on lush green vegetation such as graminoids (64 observations), horsetails (24), cow parsnip stalks and flowerheads (30), fireweed (7), and dandelion (*Taraxacum* spp.). The high use of graminoids observed during this season was influenced by the easily observed feeding behaviour of Bears 9 and 23. These two bears were regularly seen to feed on grasses at the community pasture in YNP during late May and well into June of 1989. Hedysarum (10) continued to be an important food for grizzly bears during this season, and ants were found to have been fed upon by grizzly bears on 10 occasions. Bears also made isolated use of bearberries, spring beauty (*Claytonia lanceolata*) and glacier lily bulbs.

This season ended with the ripening of various berry species, which occurred between 15 and 20 July during the three years.

Table 4.3.1. **Grizzly bear feeding seasons for the Yoho and Kootenay National Parks study area, 1988 - 1990.**

Year	Season		Period	
	No.	Description	Start	Finish
1988	1	Pre-vegetation	den emergence	31 May
	2	Vegetation	1 June	20 July
	3	Berry	21 July	15 Sept.
	4	Post berry	16 Sept.	den entry
1989	1	Pre-vegetation	den emergence	21 May
	2	Vegetation	22 May	15 July
	3	Berry	16 July	8 Sept.
	4	Post-berry	9 September	den entry
1990	1	Pre-vegetation	den emergence	13 May
	2	Vegetation	14 May	19 July
	3	Berry	20 July	13 Sept.
	4	Post-berry	14 Sept.	den entry

Table 4.3.2 Seasonal observations of grizzly bear feeding sign in the Yoho and Kootenay National Parks study area, 1988-1990.

Food Item	SEASON 1	2	3	4
Vegetal Parts				
Horsetail (*Equisetum arvense*)		22	5	6
Horsetail spp.		2	4	
Lady Fern			1	
Sub-alpine Fir (buds)		1		
Graminoids		64	14	7
False Hellebore			1	
Twisted Stalk		1		
Nettle		3	1	1
Meadow Rue		2		1
Globe Flower		1		
Fireweed		7	1	
Cow Parsnip		30	21	2
Sweet Cicely		1	3	
Bracted Lousewort		1		
Bed Straw		2	7	
Triangular-leaved Ragwort		3	3	
Dandelion		6		
Roots/Corms/Bulbs				
Glacier Lily		1	3	
False Hellebore (root)		1		
Spring Beauty		2		
Vetch (*Astragalus* spp.)	1	2		
Hedysarum (*H. sulphurescens*)	1	1		
Hedysarum spp.	21	12	11	17
Unidentified Root		1		
Fruit				
White Bark Pine				2
Gooseberry			2	
Crowberry				1
Buffaloberry		2	56	8
Bearberry		4		3
Grouseberry			2	2
Huckleberry			2	
Blueberry spp.			9	
Elderberry			1	
Berries[a]			2	
Mammal/Insect				
Ants		10	30	
Ground Squirrel		4	8	5
Rodents			1	
Moose			1	4
Elk	6			1
Whitetail Deer			3	
Deer spp.			1	
Mountain Goat	3		1	6
Bighorn Sheep				1
Ungulate			1	
Carrion		1		
Other				
Dogfood		1		

a Presumed feeding on numerous berries at two sites where presence was confirmed.

Berry Season. Collared bears were found to feed principally on buffaloberries in this season (56 observations). Blueberries (9) were the second most common berry fed upon during this season. Bear 1 fed almost exclusively on blueberries for several weeks during 1989, indicating that this food, when present in abundance, can be as important as buffaloberries. Vegetative foods such as cow parsnip (21), graminoids (14), horsetails (9) continued to be fed on regularly. Hedysarum (12) was also still utilized regularly by some bears during this season. Ants were commonly fed upon at many of the feeding sites investigated but did not make up a large percentage, by volume, of the scats analyzed (see Section 4.4.). Commonly, the bears would flip rocks in search of ant colonies as they traveled through an area feeding on one of the more primary foods. Eight diggings for ground squirrels were also investigated in this season.

The berry season was found to end when the majority of the buffaloberries had dropped from the bushes. This was found to occur between 8 and 15 September during the three years.

Post-Berry Season. With diminishing buffaloberry and blueberry crop availability the bears again turned to feed mainly on hedysarum roots (17 observations). Pockets of remaining buffaloberries (8) were fed on as were patches of graminoids (7), horsetails (6) and cow parsnip (2) which were unaffected by frost. Bearberry (3) was also utilized to some degree. In 1989, Bear 1 appeared to have actively sought out an area of the Pipestone River in BNP where crowberry was abundant. In 1990, Bear 5 fed upon whitebark pine nuts (2) on high elevation slopes above Cataract Brook and Giddie Creek in YNP. Possible predation upon ground squirrels (5), goats (6) and moose (4) by bears was detected during this season. Some of these observation were of bears seen on the same carcass over several days. In total, 3 goats and 1 moose were fed upon and possibly killed by the study bears. Also, a road-killed young of the year elk was scavenged by Bear 4 in early December 1989 near Crooks Meadows, KNP. The carcass was dragged into the woods a short distance to be fed upon.

The number of seasonal locations made on radio-collared bears is outlined in Table 4.3.3. Fewest locations (114 or 11.0%) were obtained during the pre-vegetation season, in part due to its short length and in part to the fact that individual bears were only active for a portion of this season. Most locations were obtained in the vegetation (360 or 34.7%) and berry (338 or 32.6%) seasons. Only 225 (21.7%) locations were obtained during the relatively short post-berry season.

Table 4.3.3. **Percent of locations by ecoregion and season for radio-collared and incidentally observed grizzly bears in the Yoho and Kootenay National Parks study area, 1988 - 1990.**

	Ecoregion					
Season	Montane	Montane/ Subalpine	Lower Subalpine	Upper Subalpine	Alpine	(n)
1	43.0	0.9	41.2	7.9	7.0	114
2	38.3	1.7	52.8	5.8	1.4	360
3	11.8	3.3	66.9	13.9	4.1	338
4	17.3	0.5	52.0	24.9	5.3	225
Year	**25.7**	**1.8**	**55.9**	**12.8**	**3.8**	**1037**

4.4 SCAT ANALYSIS

<u>1988 - 1990</u>

Four hundred and forty-nine scats were collected in total. The vast majority of these were collected from radio-collared bears. The analysis (Tables 4.4.1 - 4.4.2; Figure 4.4.1) indicated that hedysarum was the most important food during the pre-vegetation season (75.2% importance value). Graminoid vegetation (20.1%) was the second most widely used food category during this season. Once green vegetation began to grow, in mid to late May, bears were found to feed predominantly upon graminoid vegetation (75.0%), horsetails (10.6%) and cow parsnip (9.9%). During the berry season, buffaloberries (42.2%), cow parsnip (22.0%), blueberries (12.7%) and graminoid vegetation (11.8%) were found to be the most common food items in grizzly bear scats. In the post-berry season, hedysarum (41.8%) again became important in the diets of bears. Other important foods during this season included buffaloberries (33.6%) and blueberries (10.4%). One bear (#5) was found to raid red squirrel middens for whitebark pine nuts during this season.

The results of the scat analysis indicate that grizzly bears in YNP and KNP have many similarities in their diets to grizzly bears in other areas of the Rocky Mountains (Servheen 1987).

Scat analysis in this study indicated that graminoid vegetation was important for grizzly bears in June. Graminoid vegetation was also found to be an important food of grizzly bears in the front ranges of BNP (Hamer and Herrero 1987), Jasper National Park (JNP) (Russell *et al.* 1979), Kluane National Park (Pearson 1975), Waterton Lakes National Park (Hamer *et al.* 1985) and in northwestern Montana (Aune and Kasworm 1987).

Cow parsnip was found to be an important bear food from June through August in Waterton Lakes National Park (Hamer *et al.* 1985), as it was from June through July in this study. Likewise, horsetails were found to be eaten by grizzly bears through spring and summer in YNP and KNP, as they were in Banff (Hamer and Herrero 1987), Jasper (Russell *et al.* 1979) and Waterton Lakes National Parks (Hamer *et al.* 1985).

Buffaloberries and blueberries were found to be important for grizzly bears during August and September in this study. They were also found to be the main summer foods of grizzly bears in Jasper and Banff.

Table 4.4.1. **Percent volume and frequency of occurrence of food items found in grizzly bear scats collected in the Yoho and Kootenay National Parks study area, by season, 1988 - 1990.**

Food Item	SEASON			
	Pre-Vegetation n = 51	**Vegetation 167**	**Berry 170**	**Post-Berry 61**
Horsetail	5.5[a] (15.7)[b]	15.7 (36.5)	7.1 (18.8)	1.7 (8.2)
Graminoid	22.0 (31.4)	47.7 (85.0)	10.4 (41.2)	7.1 (24.6)
Whitebark Pine				4.8 (4.9)
Locoweed		tr[c]		
Glacier Lily			0.1 (0.6)	
Nettle		tr	0.1 (1.2)	
Gooseberry			0.9 (5.8)	1.8 (4.9)
Hedysarum	50.8 (51.0)	9.6 (13.2)	9.1 (19.4)	30.0 (45.9)
Astragalus	1.5 (2.0)			
Crowberry				6.7 (18.0)
Buffaloberry	0.1 (2.0)	0.5 (1.2)	28.6 (53.5)	21.1 (52.5)
Fireweed		tr	tr	
Twisted Stalk			0.2 (0.6)	
Cow Parsnip	2.0 (2.0)	20.3 (26.3)	21.2 (37.6)	5.7 (9.8)
Bearberry	1.1 (2.0)	tr	tr	
Blueberry		tr	14.6 (31.6)	11.0 (31.1)
Honeysuckle			0.2 (1.2)	
Dryas			tr	
Willow			tr	
Dandelion		tr		
Ants	0.1 (9.8)	0.9 (15.0)	2.5 (22.9)	0.6 (8.2)
Ground Squirrel	2.0 (2.0)	0.2 (0.6)	0.4 (1.2)	0.1 (1.6)
Moose				1.6 (1.6)
Deer			0.6 (0.6)	
Elk	5.9 (4.0)	0.3 (0.6)		
Mountain Goat	3.9 (4.0)	0.9 (1.8)	0.6 (0.6)	6.5 (6.6)
Small Mammal	1.8 (2.0)		0.6 (1.2)	
Unid. Mammal	2.5 (5.9)	0.5 (1.2)	0.8 (2.9)	0.2 (1.6)
Unid. Vegetation	0.8 (4.0)	3.4 (29.3)	1.3 (21.2)	0.5 (19.7)
Garbage		tr	0.6 (0.6)	

a Percent volume
b Percent frequency of occurrence.
c Trace: percent volume < 0.1%

Table 4.4.2. **Percent importance values of food items found in grizzly bear scats collected in the Yoho and Kootenay National Parks study area, by season, 1988 - 1990.**

Food Item	**SEASON** **Pre-Vegetation** **n = 51**	 **Vegetation** **167**	 **Berry** **170**	 **Post-Berry** **61**
Horsetail	2.5	10.6	3.7	0.7
Graminoid	20.1	75.0	11.8	5.3
Whitebark Pine				0.7
Locoweed		tr		
Glacier lilly			tr	
Nettle		tr	tr	
Gooseberry			0.1	0.3
Hedysarum	75.2	2.3	4.9	41.8
Astragalus	0.1			
Crowberry				3.7
Buffaloberry	tr	tr	42.2	33.6
Fireweed		tr	tr	
Twisted Stalk			tr	
Cow Parsnip	0.1	9.9	22.0	1.7
Bearberry	0.1	tr	tr	
Blueberry		tr	12.7	10.4
Honeysuckle			tr	
Dryas			tr	
Willow			tr	
Dandelion		tr		
Ants	tr	0.2	1.6	0.1
Ground Squirrel	0.1	tr	tr	tr
Moose				0.1
Deer			tr	
Elk	0.7	tr		
Mountain Goat	0.4	tr	tr	1.3
Small Mammal[b]	0.1		tr	
Unid. Mammal	0.4	tr	tr	tr
Unid. Vegetation	0.1	1.8	0.8	0.3
Garbage		tr	tr	

a Trace: importance value < 0.1%.
b Red squirrel, microtines.

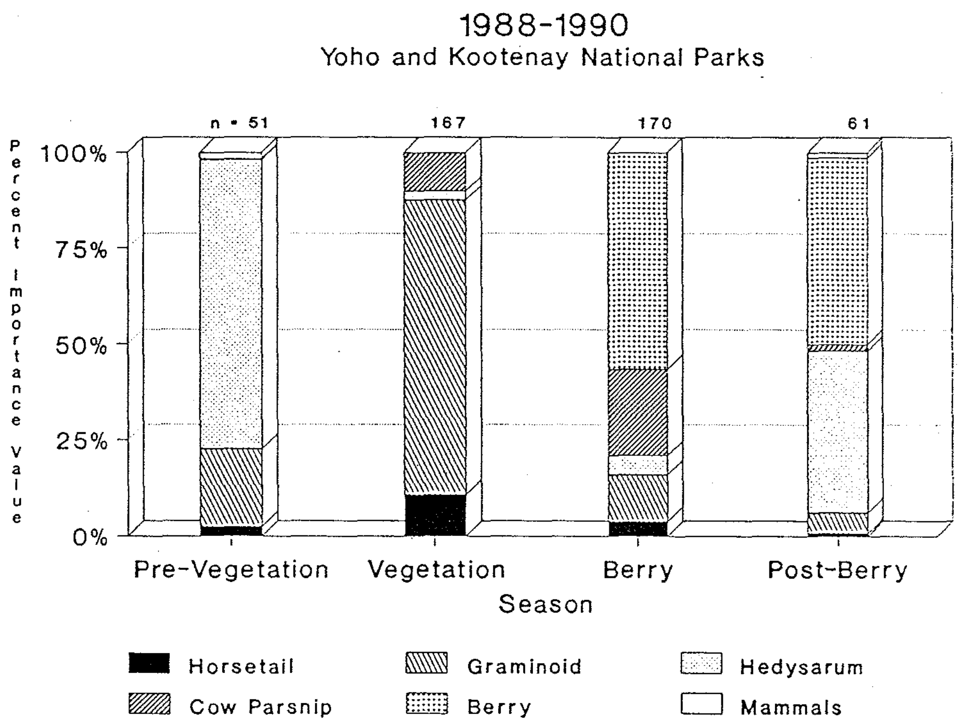

Figure 4.4.1. Percent importance values of major food items found in grizzly bear scats collected in the Yoho and Kootenay National Parks study area, by season, 1988 - 1990.

In BNP, Hamer and Herrero (1987) found that grizzly bears fed upon hedysarum roots during the spring and summer and fall. Russell *et al.* (1979) also found hedysarum to be a major food of grizzly bears in JNP.

Several authors (e.g. Kendall 1983, Mattson and Jonkel 1990) have documented grizzly bear use of red squirrel middens to obtain whitebark pine nuts in the United States.

Between - Year Comparisons

Between - year differences in the food habits of grizzly bears (Tables 4.4.3 - 4.4.5, Figure 4.4.2), as determined from scat analysis, are most likely attributable to small sample sizes and to the individual bears followed in each year. In 1988, collared bears were not available until the vegetation season, thus scat analysis is only available for the last three seasons. The high importance value of cow parsnip (43.3%) found for the vegetation season in this year was primarily due to the fact that most of the collared bears in that year were captured in the McArthur Creek valley. This valley has a high occurrence of cow parsnip plants on its many avalanche paths. When scats collected from all of the study bears over the three years of the study are considered (Table 4.4.2), the importance value for cow parsnip for the vegetation season drops to only 9.9%. Although this figure is probably more representative of the food habits of all grizzly bears in the two parks, cow parsnip must still be considered as being of prime importance for some bears in some areas.

The percent importance value of buffaloberries in the diets of grizzly bears was 50.9% in 1988, 64.2% in 1989 and 19.8% in 1990. This between-year variation in use of buffaloberries by grizzly bears did not appear to be related to the level of buffaloberry production in the two parks. The mean weight of berries produced on 120 marked bushes was highest in 1988 (15.0 gm), lowest in 1989 (10.6 gm) and between the 1988 and 1989 levels in 1990 (13.3 gm: see Section 4.5). Conversely, the amount of buffaloberries found in the diets of black bears in BNP were found to be roughly correlated to the production measured on transects (Kansas *et al.* 1989b).

Whitebark pine nuts were only found in the scats of grizzly bears in the post-berry season of 1990. The high (89.0%) percent importance value found for that season was biased by the small sample size (n = 4). In fact, all of the scats collected during this season in 1990 were obtained from one bear (#5). A food habits analysis more typical of grizzly bears in

Table 4.4.3. **Percent importance values of food items found in grizzly bear scats collected in the Yoho and Kootenay National Parks study area, by season, 1988.**

Food Item	SEASON		
	Vegetation n = 25	Berry 12	Post-Berry 12
Horsetail	15.8	7.1	tr[a]
Graminoid	40.3	tr	3.3
Gooseberry		0.9	3.8
Hedysarum		14.2	82.3
Buffaloberry		50.9	9.5
Cow Parsnip	43.3	7.4	
Blueberry		17.9	1.1
Ants	tr	0.3	
Ground Squirrel		0.3	
Elk	tr		
Ungulate	tr		
Small Mammal[b]		tr	
Unid. Vegetation		0.9	

a Trace: importance value < 0.1%.

Table 4.4.4. **Percent importance values of food items found in grizzly bear scats collected in the Yoho and Kootenay National Parks study area, by season, 1989.**

Food Item	SEASON Pre-Vegetation n = 21	Vegetation 96	Berry 93	Post-Berry 29
Horsetail	0.1	7.9	0.8	1.2
Graminoid	2.9	72.4	10.0	1.1
Locoweed		tr		
Glacier lily			tr	
Nettle		tr	tr	
Gooseberry			tr	
Hedysarum	95.0	6.5	3.8	29.3
Crowberry			tr	19.4
Buffaloberry		tr	64.2	17.9
Fireweed			tr	
Cow Parsnip	0.3	12.0	12.2	1.2
Bunchberry			tr	tr
Bearberry		tr	tr	
Blueberry			6.3	18.7
Dryas			tr	
Willow			tr	
Dandelion		tr		
Ants	tr[a]	0.4	2.3	0.3
Ground Squirrel	1.0		tr	
Moose				0.4
Elk				
Mountain Goat		tr		10.4
Grizzly Bear		tr		
Small Mammal	0.3			
Unid. Vegetation	0.3	0.8	0.3	0.2

a Trace: importance value < 0.1%.

Table 4.4.5. **Percent importance values of food items found in grizzly bear scats collected in the Yoho and Kootenay National Parks study area, by season, 1990.**

Food Item	SEASON Pre-Vegetation n = 12	Vegetation 69	Berry 50	Post-Berry 4
Horsetail		15.5	5.2	
Whitebark Pine				89.0
Graminoid		76.8	11.8	
Twisted Stalk			tr	
Nettle		tr		
Gooseberry			0.3	
Astragalus	1.8		tr	
Hedysarum	61.8	2.0		0.8
Crowberry			tr	
Buffaloberry			19.8	
Fireweed		tr		
Cow Parsnip		3.2	31.5	
Bearberry		tr		
Bunchberry		tr		
Blueberry			29.2	10.2
Ants		tr	0.5	
Ground Squirrel				
Elk	22.4			
Deer	2.5		tr	
Mountain Goat	10.0	tr	tr	
Small Mammal				
Unid. Mammal	1.4	tr	0.6	
Unid. Vegetation		2.4	0.8	

[a] Trace: importance value < 0.1%.

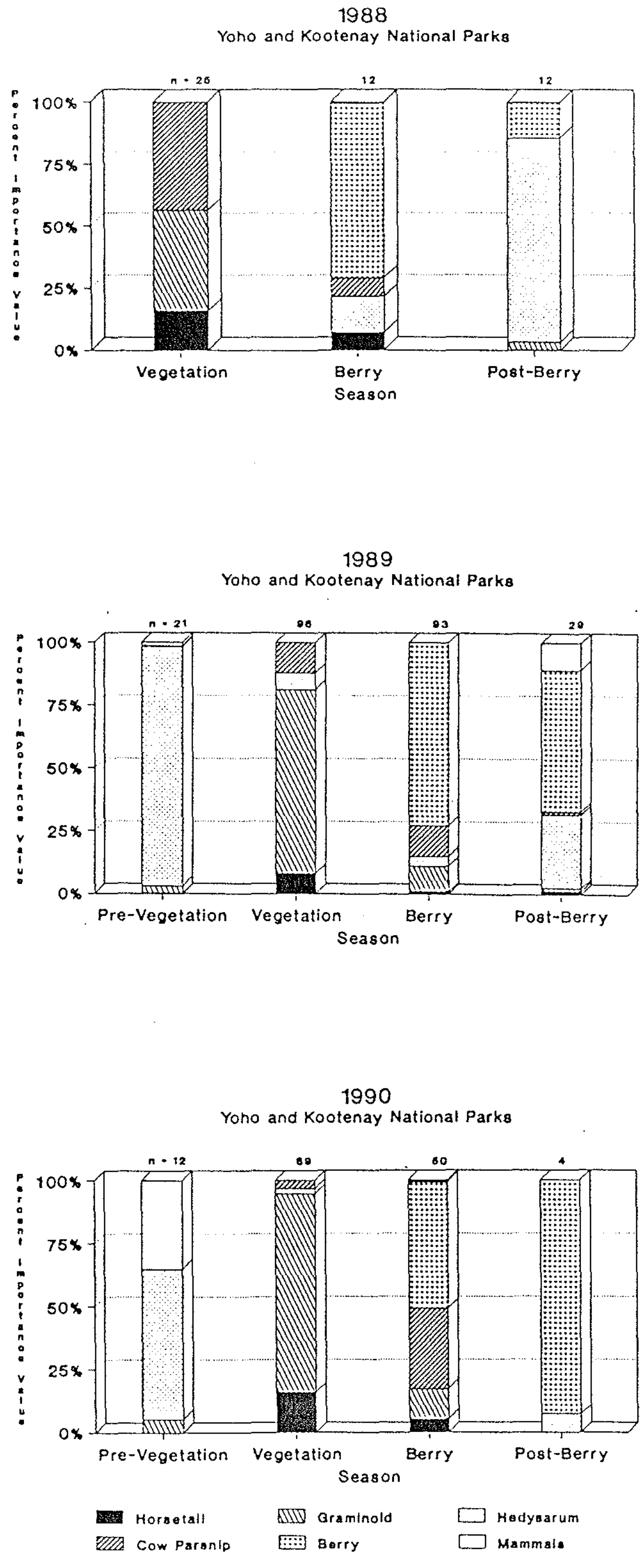

Figure 4.4.2. Percent importance values of major food items found in grizzly bear scats collected in the Yoho and Kootenay National Parks study area, by season, 1988, 1989 and 1990.

the post-berry season would have been obtained if more collared bears had been available to follow in the fall of 1990.

4.5 FOOD AVAILABILITY TRANSECTS

The phenology and productivity of three key grizzly bear food species (buffaloberry, cow parsnip and horsetail) were investigated in each year through the use of permanent transects. Changes in these parameters have been shown to influence bear movements and habitat use (Hamer and Herrero 1987, Hamilton and Bunnell 1987). Three transects for each species were placed in each park at a range of different elevations and latitudes. These transects are mapped in Figure 4.5.1.

Buffaloberry. Buffaloberry production was highest in 1988, the first year of study (Table 4.5.1, Figure 4.5.2). In that year, the mean weight of berries per plant averaged from 4.8 to 25.5 gm, and the overall average was 15.0 gm. In 1989, the overall average dropped to 10.6 gm per plant, and the response of plants on the different transects was varied. The production of plants on two transects (Reservoir and Ottertail) dropped over 10 fold, while some transects had similar productivity in both years (Sink Lake and Wardle Creek) and one transect (Marble Canyon) had a substantial increase in production. The overall mean weight of berries per plant on all six transects increased slightly to 13.3 gm in 1990. Again, plants on each transect responded differently. One transect (Sink Lake) had a decrease in production, three transects (Reservoir, Ottertail and Radium) had an increase in production and two transects (Marble Canyon and Wardle Creek) had roughly the same production in 1990. Analysis of grizzly bear food habits (Section 4.4) indicated that, for those scats sampled, the proportion of buffaloberries in the diet of grizzly bears in the berry season of 1990 was low compared to the same season in 1988 and 1989. This may have been due to the fact that many scats were collected from bear 23, who fed extensively on roadside buffaloberry bushes in 1988 and 1989. She died in the late summer of 1989. The decreased incidence of buffaloberries in 1990 scats may also have been due to the lowered production of buffaloberries in some areas of the two parks.

Elevation appeared to have a strong influence on the date at which berries became ripe on the six transects that were monitored in this study. The transect at Radium Hot Springs had an elevation of 1005 m (3300') and the berries were ripe between the dates of 7 - 15 July in each year. Berries on the highest transect, situated at 1650 m (5400') at Sink Lake,

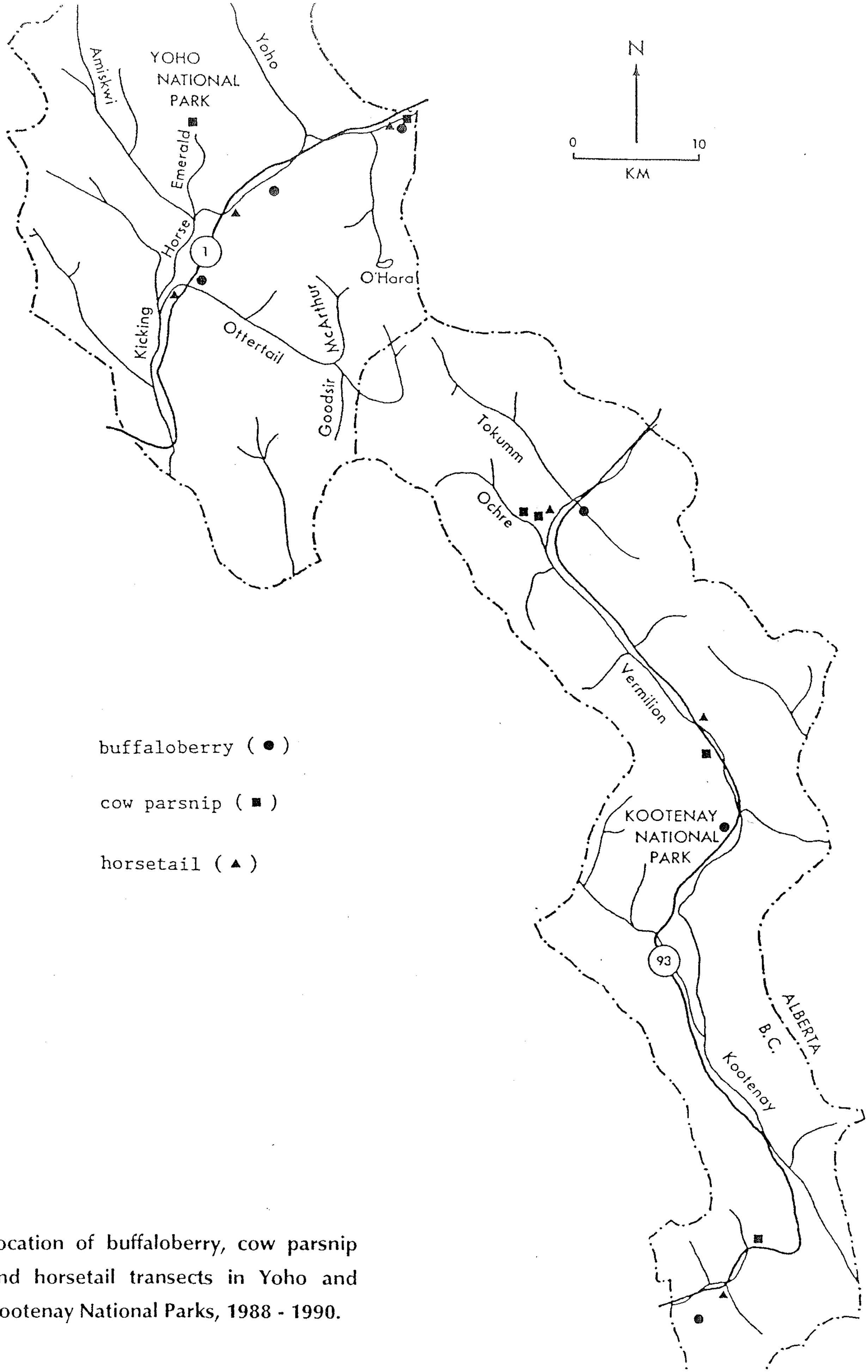

Figure 4.5.1. Location of buffaloberry, cow parsnip and horsetail transects in Yoho and Kootenay National Parks, 1988 - 1990.

Table 4.5.1. Production of buffaloberry transects in Yoho and Kootenay National Parks, 1988 - 1990.

			1988			1989			1990		
Location	Elev. (m)	Aspect	Date First Ripe	Mean Number of Berries per Plant	Mean Weight (gm) of Berries per Plant	Date First Ripe	Mean Number of Berries per Plant	Mean Weight (gm) of Berries per Plant	Date First Ripe	Mean Number of Berries per Plant	Mean Weight of Berries per Plant
Yoho											
Sink Lake	1646	NW	11 Aug.	175 ± 56[a]	25.5 ± 10.3	17 Aug.	135 ± 50	25.0 ± 11.2	19 Aug.	64 ± 25	10.6 ± 3.9
Reservoir	1310	NW	05 Aug.	137 ± 57	13.6 ± 5.6	31 July	11 ± 9	1.0 ± 1.0	05 Aug.	74 ± 38	11.5 ± 6.4
Ottertail	1189	W	22 July	116 ± 45	15.2 ± 5.7	21 July	5 ± 8	0.6 ± 0.8	21 July	103 ± 39	14.3 ± 5.6
Kootenay											
Marble Canyon	1463	-	25 July	87 ± 39	10.1 ± 4.4	04 Aug.	185 ± 73	27.2 ± 11.0	09 Aug.	116 ± 53	25.5 ± 19.1
Wardle Creek	1250	SE	19 July	37 ± 19	4.8 ± 2.4	27 July	31 ± 20	4.3 ± 3.8	26 July	28 ± 15	4.8 ± 3.4
Radium	1006	-	07 July	146 ± 62	20.7 ± 7.7	15 July	60 ± 36	5.8 ± 3.6	18 July	88 ± 55	13.1 ± 7.9

a 95% confidence limits.

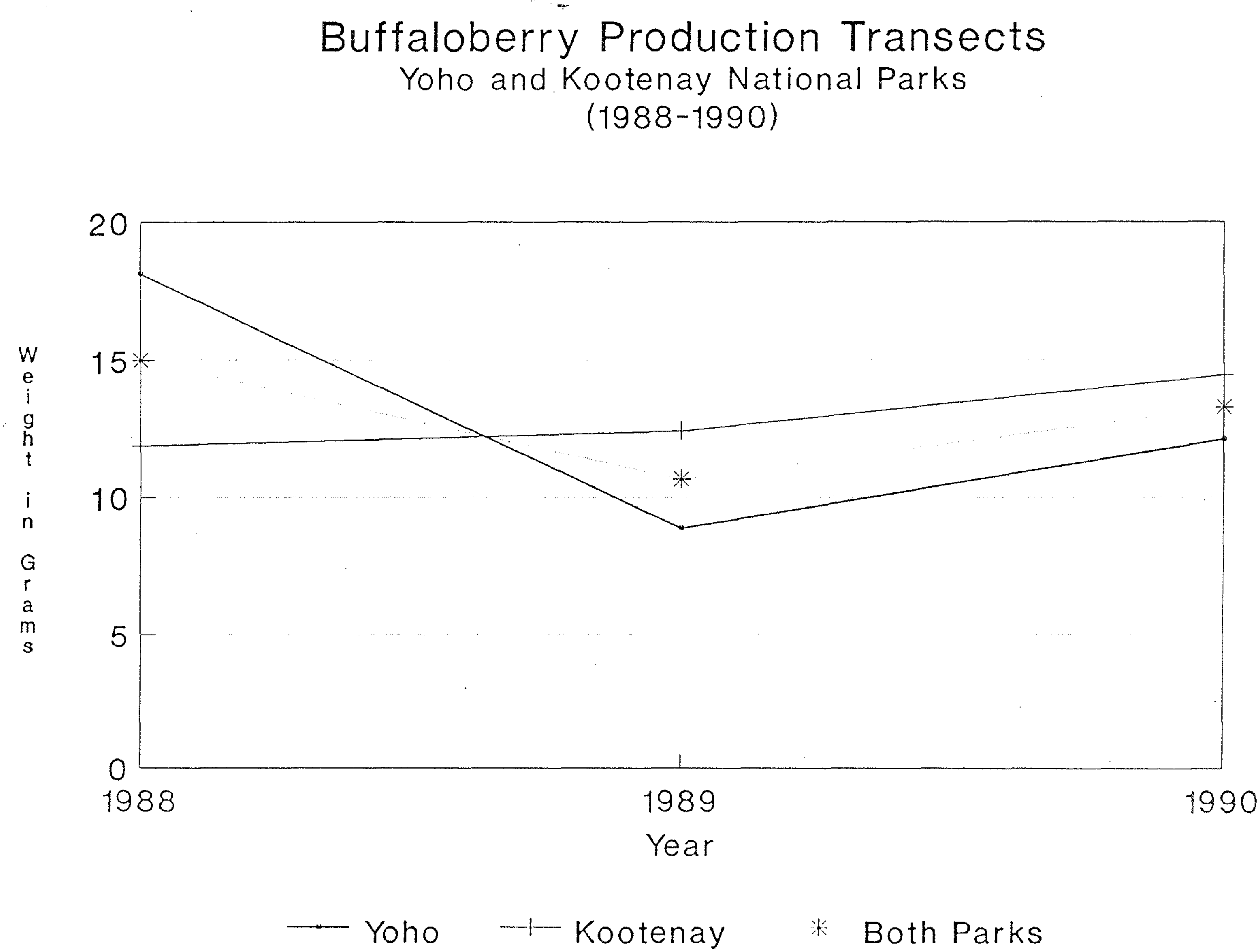

Figure 4.5.2. **Production of buffaloberry transects in Yoho and Kootenay National Parks, 1988 - 1990.**

did not ripen until 11 - 19 August. Effects of aspect and latitude undoubtably also played a role in the timing of berry ripening.

Horsetail. Horsetails began to grow in late May of each year, and reached their maximum height by mid to late July. This time period corresponded roughly to the timing of the vegetation season (Section 4.3), which was the season in which grizzly bears had the largest proportion of horsetails in their diet (Section 4.4). Horsetails on the Kimpton Creek transect, situated at 1280 m (4200'), were found to grow roughly two weeks ahead, in terms of their height, of horsetails on the Sink Lake transect, situated at 1646 m (5400': Figure 4.5.3). Transects situated at intermediate elevations between these two showed a similar trend of delayed growth with increased elevation. Differences in growth patterns between years did not appear to be large. For the Sink lake transect, horsetails appeared to grow at an earlier date in 1988 than in either 1989 or 1990. However, by early July, the mean heights of plants on the transects in all three years were similar.

Cow Parsnip. Cow parsnip plants were found to begin growing in late May and reach their maximum height in late July of each year (Figure 4.5.4). Flowers bloomed from early to mid-July, and seeds were formed by late July to early August of each year. Differences in the growth patterns of cow parsnip plants on the lowest (Olive Lake: 1494 m or 4900') and highest (Sink Lake: 1646 m or 5400') transects were not pronounced. Neither were differnces in between-year growth patterns.

4.6 SEASONAL GRIZZLY BEAR HABITAT USE

Ecoregions

Grizzly bears were located most often in the Lower Subalpine Ecoregion (Figure 4.6.1; 55.9% of 1037 locations where ecoregion use could be ascertained: Table 4.3.3). The Montane Ecoregion was the second most highly used zone, with 25.7% of the locations being made there. The Upper Subalpine and Alpine Ecoregions received the least amount of use (12.8 and 3.8%, respectively). The study bears appeared to use the Montane Ecoregion more in seasons 1 and 2 (43.0 and 38.3%, respectively) than in seasons 3 and 4 (11.8 and 17.3%, respectively). Grizzly bear use of the Lower Subalpine Ecoregion was greatest in the berry season, while use of the Alpine Ecoregion was lowest during the vegetation season. Use of the Upper Subalpine Ecoregion appeared to increase from spring to fall.

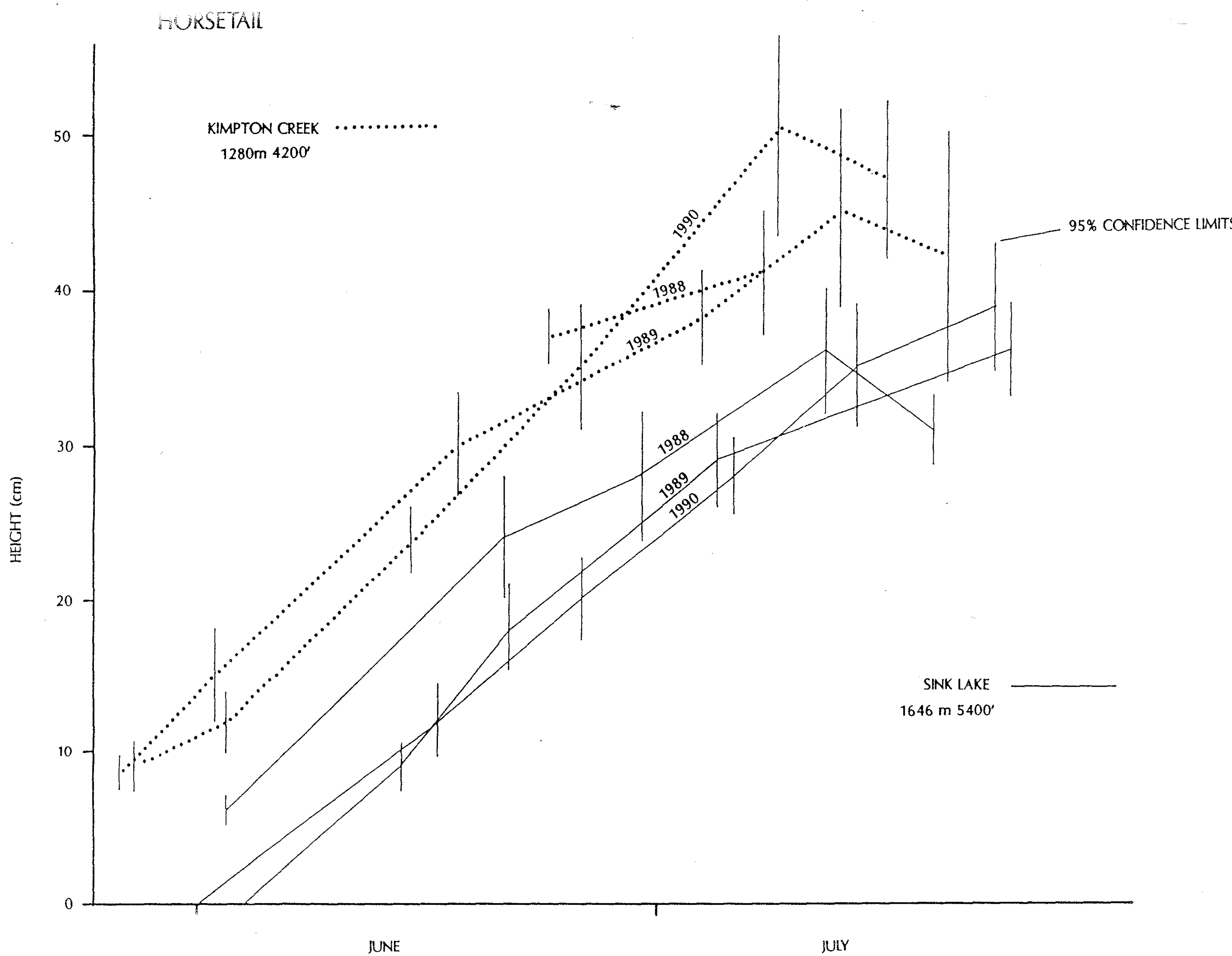

Figure 4.5.3. Growth of horsetails at the Kimpton Creek and Sink Lake transect sites, 1988 - 1990.

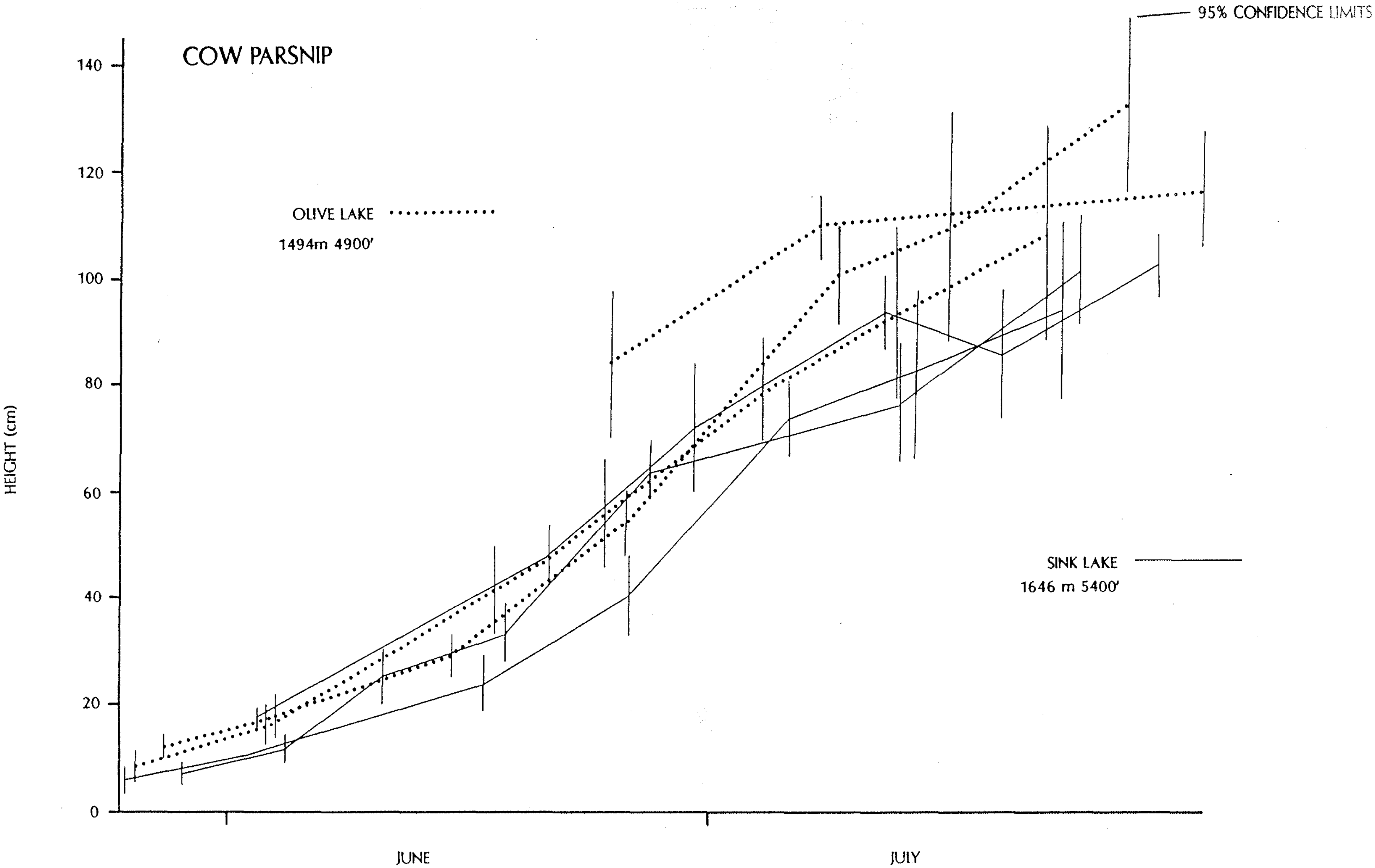

Figure 4.5.4. Growth rates of cow parsnip plants at the Olive and Sink Lake transect sites, 1988 - 1990.

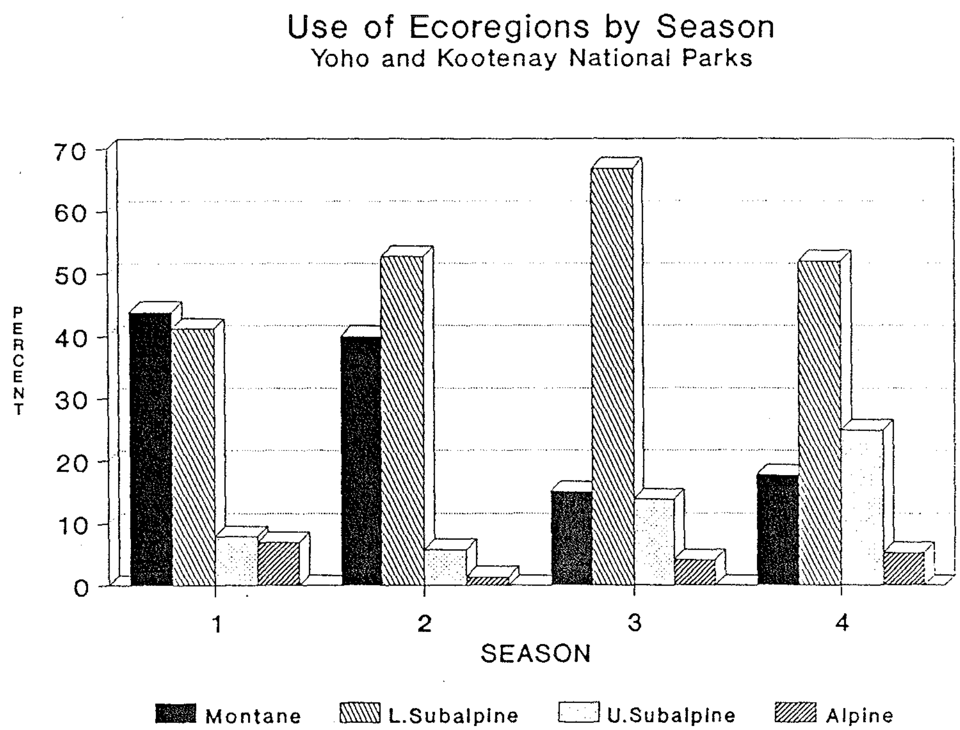

Figure 4.6.1. Percent of locations by ecoregions and season for radio-collared and incidentally observed grizzly bears in Yoho and Kootenay National Parks, 1988 - 1990.

Ecosite Use

YNP and KNP are currently mapped with different ELC systems (Coen and Kuchar 1982 and Achuff *et al.* 1984, respectively). In order to facilitate analysis of ecosite use, all YNP biophysical units were converted to KNP ecosites (Table 4.6.1) based on the work conducted by Kansas *et al.* (1989a) and Achuff *et al.* (1984). New ecosites found in YNP during that study are described in Appendix II.

Eight hundred and twenty-two grizzly bear locations could be confidently assigned to ecosites (Table 4.6.2). This data could not be used in any statistical way to test for bear preference or avoidance of ecosites due to the low sample size relative to the number of ecosites (n = 98). This number of ecosites could be reduced in a test if only those ecosites encompassed by the composite home ranges of the study bears were considered, as a number of ecosites are unique to southern KNP where no bears were collared. However, this reduction in the number of cells for a test would still not be sufficient to conduct a statistical test. Rather, the results could be evaluated subjectively, as was done for the Banff Black Bear Study (Kansas *et al.* 1989b).

In the pre-vegetation season, bears were most often located in BG1, BV2, SB1 and SB2 ecosites. The BG1 unit occurs in the Montane Ecoregion in YNP and is composed primarily of pine forests C06, C19, C20 and C38. The BV2 ecosite occurs in the Lower Subalpine Ecoregion on terraced landforms of glaciofluvial origin (Achuff *et al.* 1984). It is found along the valley floor of the Vermilion River. Hedysarum and ungulates, two early spring foods of grizzly bears, are common in this ecosite. The SB1 and SB2 ecosites are often influenced by avalanches. Bears frequented these slopes for their occurrence of hedysarum.

Highly used ecosites in the vegetation season included BG1, HD5, SB1 and SB2. The relatively high use of BG1 was primarily due to three bears (#'s 7, 9 and 23) that frequented the community ranch near Field during this season. There they were found to feed on grasses, dandelions and horsetails. HD5 includes fluvial fan, apron and terrace landforms. The pine forests C03, C56 and C58 commonly found within this ecosite provided bears with grasses and horsetails. The avalanche slopes found within the SB1 and SB2 ecosites provided bears with graminoid vegetation and cow parsnip.

Table 4.6.1. Yoho National Park legend conversion (biophysical map units to ecological land classification ecosites). *Polygons of these units which were "Montane and Subalpine" become either Montane (VL) or Lower Subalpine (HC) depending on their elevation.

Biophysical Map Unit	Ecosite
BC-Se	VL1, VL6
BC-w*	VL2/HC4
BG-a	SB1
BG-DN	DB3
BG-DP	BG1
BG-P	BG1
BG-SD	BG2
BG-SD(LS)	GA2
BG-SF	SB2
BG-SF(LS)	IB4
BG-TB	BG4
BG-TD	BG3
BG-TS	BG3
CM-SF	CA2,CA4
CM-TS	DR4
CO-SDP	FR3
CO-SF	AL3
DS-PS	RK1
DS-SF	SP1
FL-D	DG1
FL-PD	DG6
FL-SF	FL1
KI-Hm	NT2, NT3
KI-PSj	HD5
KI-SF	BV3
M	HE2
NA-w*	VL1/HC2
OD-aL	PL3
OD-F	PL1,PL4,PL6
OG-SF	BY1
OH-SF	ML1
OL-D	DR3
OL-P	DR2
OL-PT	DR4
OL-SDC	DR6
OL-SF	CV1
CL-SFDy	DR6
OL-SPD	DR3
OO-H	BS1
R+H	HE2
R-aL	WF3

Table 4.6.1 continued

Biophysical Map Unit	Ecosite
R-whP	WF3
R-F	WF3
R-F(D)	DG3
SI-aL	SI2
SI-aL(LS)	BP2
SI-whP	WF3
SI-F	SI1
SK-H	JN1
TA-DSP	AT4
TA-P	AT1
TA-SF	BV2,BV3
TO-PD	NY2
TO-SF	GT3
WR-GSd	HD2
WR-P	HD5
WR-SC	HD3
WR-SF	PP3
WR-SPDT	HD3
WR-ST	HD3
X	HE2

From Kansas *et al.* 1989a.

Table 4.6.2. Number of locations by ecosite of radio-collared and incidentally observed grizzly bears in the Yoho and Kootenay National Parks study area, 1988 - 1990.

MONTANE

SEASON	AT1	AT4	BG1	BG2	BG4	DB3	DG1	DG6	DR1	DR2	DR3	DR4	DR5	DR6	DR7	DR8	FR3	G*	HD2	HD3	HD5	RK1	VL6	Z
1			16	5	1		1	2		5	1		1								1			2
2	1		41	9	7	2	1	3		12	2		1	2	1	1	1	2	4	6	24	1		5
3	4		2	4		1		2		4		1		1					8	2	2	2	1	
4	2	1	2	6		1		2	2	3	1	2			2		2		1	1	3		1	1
TOTAL	7	1	61	24	8	4	2	9	2	24	4	3	2	3	3	1	3	2	13	9	30	3	2	8

LOWER SUBALPINE

SEASON	AL1	AL3	AL4	BK1	BK4	BK4+R	BV1	BV2	BY1	BY3	BY4	BY5	BY7	CA1	CA2	CA4	CV1	FL1	FR3	FV3	FV4	FV5	FV6	GT3	HC1	HC4	IB4	MC1	ML1	PP1	PP3	PP4	PR1	PR3	PR4	R	SB1	SB2	SB3	SB6	SP1	VD1	VD2
1								11	5	2	1	1			1			1	1			3	1		2												7	11					
2		1			1			8	10		2		3		10	1	2	11				3	1		1	1	1		3		4				1		26	30			1		
3	3	1			3	3	3	10	17	3	2		11	1	10		4	10		3	1	10	2	1	5	2	1		1	1	3	1	1		4		15	23	7				1
4		5	1	3	2		2		3	1			1		1		6	8		1		1	3	2	7	3		1	1	1				3		3	17	16	4	1		1	
TOTAL	3	7	1	3	6	3	5	29	35	6	5	1	15	1	22	1	12	30	1	4	1	17	7	3	15	6	2	1	5	2	7	1	1	3	5	3	65	80	11	1	1	1	1

	UPPER SUBALPINE																										ALPINE						
SEASON	BP2	EG1	EG4	EN2	EN3	LV1	LV2	LV3	NT2	PL1	PL4	PL6	R	SI1	SI2	SX1	SX2	T	WF1	WF3	WF5	WH1	WH4	WH6	WH7	WH8	BS1	HE2	JN1	R	RD2	RD2+CR	T
1													6					1	1	6										3			
2										1				1	2					2						2	1	1		21		1	
3	1	1	1		1	1	1	1	1	6	1	5	2	2		6	1		7	4			1		2		4	1	6	1			1
4		7		3		1		3		1	1		10	2	4	1		1	1	4	2	2	4	1	1		2	4	1		1		1
TOTAL	1	8	1	3	1	2	1	4	1	8	2	5	18	5	6	7	1	2	9	16	2	2	5	1	3	2	7	6	7	25	1	1	2

In the berry season, bears were found to use BY1, SB1 and SB2 ecosites most often. BY1 is vegetated predominantly by C14, and has C21 and C25 as accessory vegetaton types. The tall bilberry component of the C21 vegetation type (Engelmann spruce-subalpine fir/tall bilberry/liverwort) may have been one of the reasons that bears frequented this ecosite. Again, the avalanche habitat in the SB1 and SB2 ecosites were the main attraction for bears in these ecosites in the berry season. Berry production is generally much higher on avalanche paths, where there is no canopy cover, than in closed forest. Sub-adult Bears 9 and 23 were often found feeding on buffaloberries at forest edges along roadsides during this season. As with avalanche paths, buffaloberry productions was higher at forest edges on right-of-ways due to increased light availability.

The SB1 and SB2 ecosites were also the most often used by grizzly bears in the post-berry season. Bears were found to forage for hedysarum roots on avalanche paths during this season.

Subjective and Modelled Assessment

Results of the subjective assessments of ecosite importance to grizzly bears by the two primary authors were compared and a final subjective rating was arrived at through concensus (Table 4.6.3). Agreement between the authors was relatively high, with 81% of the ratings being equal or out by only one category. Eighteen percent of the ratings disagreed by two classes and 1% differed by three classes.

Landform type, vegetation type, food species occurrence (including ungulates and ground squirrels), bear food habits and the authors' knowledge of bear habitat were all used to derive the subjective ratings. Avalanche paths, however, were not considered in the assessment unless avalanche terrain was included as the definition of the ecosite in question (eg. SB1). Avalanche paths were not mapped or included in most ecosite descriptions in the ELCs of the parks. Instead, those ecosites that were mapped as having from 20 - 50% of their area composed of frequently avalanched terrain were given the modifier 'A'. As avalanche paths are extremely important as habitat to grizzly bears in YNP and KNP (Section 4.7), it is important to remember that the value of an ecosite in any season is increased significantly if it is influenced by avalanches. This increase in value may be as high as two class values. Similarly, those ecosites that are modified by fire for 50% of their area or more are given a 'B' modifer in the ELCs. Insufficient data was collected to determine what age of burns was best suited for grizzly bears. Until such facts

Table 4.6.3. Comparison of seasonal ecosite evaluation results for subjective and food habits model methods[a].

Ecosite	Season	Subjective	Model
AL3	1	L	L
	2	L	L
	3	M	L
	4	L	L
AL4	1	L	L
	2	L	L
	3	L	M
	4	L	M
AT1	1	M	M
	2	L	L
	3	H	H
	4	L	VH
AT4	1	M	L
	2	M	L
	3	M	M
	4	L	M
BG1	1	M	L
	2	M	L
	3	H	H
	4	M	H
BG2	1	H	L
	2	M	L
	3	H	M
	4	H	M
BG3	1	M	VH
	2	M	M
	3	VH	M
	4	M	H
BG4	1	M	L
	2	M	L
	3	H	M
	4	M	M
BP2	1	L	L
	2	L	L
	3	M	L
	4	M	L

Table 4.6.3. Continued.

Ecosite	Season	Subjective	Model
BS1	1	L	L
	2	L	L
	3	L	L
	4	L	L
BS2	1	L	L
	2	L	L
	3	L	L
	4	L	L
BV2	1	M	L
	2	M	L
	3	L	M
	4	L	L
BV3	1	M	L
	2	M	L
	3	M	L
	4	H	L
BY1	1	L	L
	2	L	L
	3	M	L
	4	L	L
BY3	1	L	L
	2	L	L
	3	M	M
	4	L	M
BY4	1	L	L
	2	L	L
	3	M	L
	4	L	L
BY5	1	L	L
	2	L	L
	3	M	L
	4	L	L
BY6	1	L	L
	2	L	L
	3	M	L
	4	L	L

Table 4.6.3. Continued.

Ecosite	Season	Subjective	Model
BY7	1	L	L
	2	L	L
	3	M	L
	4	L	L
CA1	1	M	L
	2	M	L
	3	H	L
	4	M	L
CA2	1	M	L
	2	L	L
	3	M	L
	4	L	L
CA4	1	L	L
	2	L	L
	3	M	M
	4	L	M
CV1	1	L	L
	2	M	L
	3	L	L
	4	M	L
DG1	1	M	L
	2	L	L
	3	L	M
	4	L	M
DG3	1	M	H
	2	L	M
	3	M	M
	4	M	M
DG6	1	L	L
	2	L	L
	3	VH	H
	4	L	H
DR1	1	M	L
	2	L	L
	3	M	M
	4	M	M

Table 4.6.3. Continued.

Ecosite	Season	Subjective	Model
DR2	1	L	L
	2	L	L
	3	H	H
	4	L	H
DR3	1	L	L
	2	M	L
	3	VH	M
	4	M	M
DR4	1	L	L
	2	M	L
	3	H	VH
	4	L	VH
DR5	1	L	L
	2	L	L
	3	H	H
	4	M	H
DR6	1	L	L
	2	M	L
	3	VH	VH
	4	L	H
DR7	1	L	L
	2	L	L
	3	H	H
	4	L	H
DR8	1	L	L
	2	M	L
	3	H	H
	4	L	H
EF1	1	L	L
	2	M	L
	3	H	L
	4	H	L
EG1	1	L	L
	2	L	L
	3	H	L
	4	M	L

Table 4.6.3. Continued.

Ecosite	Season	Subjective	Model
EG2	1	L	L
	2	M	L
	3	M	L
	4	M	L
EG3	1	L	L
	2	M	L
	3	M	L
	4	M	L
EG4	1	L	L
	2	M	L
	3	H	L
	4	H	L
EN3	1	L	L
	2	L	L
	3	M	L
	4	VH	L
FL1	1	L	L
	2	L	L
	3	M	L
	4	L	L
FR1	1	M	L
	2	M	L
	3	H	H
	4	M	VH
FR3	1	M	L
	2	H	L
	3	VH	H
	4	M	H
FV3	1	L	L
	2	M	L
	3	M	L
	4	L	L
FV4	1	M	L
	2	M	L
	3	M	L
	4	H	L

Table 4.6.3. Continued.

Ecosite	Season	Subjective	Model
FV5	1	H	L
	2	VH	L
	3	H	L
	4	H	L
FV6	1	L	L
	2	M	L
	3	M	L
	4	L	L
GA2	1	L	L
	2	M	L
	3	M	L
	4	L	L
GT3	1	L	L
	2	L	L
	3	M	L
	4	L	L
HC1	1	M	M
	2	H	M
	3	M	M
	4	M	M
HD2	1	H	VH
	2	M	M
	3	M	M
	4	H	VH
HD3	1	H	L
	2	H	L
	3	VH	M
	4	M	M
HD5	1	M	H
	2	M	L
	3	H	M
	4	M	H
HD6	1	M	M
	2	M	L
	3	L	L
	4	M	L

Table 4.6.3. Continued.

Ecosite	Season	Subjective	Model
HE2	1	L	L
	2	L	L
	3	L	L
	4	L	L
IB4	1	L	L
	2	M	L
	3	M	L
	4	L	L
JN1	1	L	L
	2	M	L
	3	M	L
	4	M	L
LV2	1	L	L
	2	M	L
	3	M	L
	4	M	L
LV3	1	L	L
	2	M	L
	3	M	L
	4	M	L
ML1	1	L	L
	2	M	L
	3	M	L
	4	M	L
NT2	1	M	L
	2	M	L
	3	L	L
	4	M	L
NT3	1	M	L
	2	M	L
	3	L	L
	4	M	L
NY2	1	M	L
	2	M	L
	3	H	M
	4	M	M

Table 4.6.3. Continued.

Ecosite	Season	Subjective	Model
PL1	1	L	L
	2	M	L
	3	M	L
	4	L	L
PL3	1	M	L
	2	M	L
	3	H	L
	4	M	L
PL4	1	L	L
	2	M	L
	3	M	L
	4	M	L
PL6	1	L	L
	2	M	L
	3	H	L
	4	M	L
PP3	1	VH	L
	2	M	L
	3	M	M
	4	VH	M
PP4	1	VH	L
	2	M	L
	3	H	L
	4	VH	L
RD2	1	L	N
	2	M	N
	3	M	N
	4	M	N
RK1	1	M	L
	2	M	L
	3	H	M
	4	M	M
SB1	1	VH	M
	2	H	L
	3	H	L
	4	VH	M

Table 4.6.3. Continued.

Ecosite	Season	Subjective	Model
SB2	1	L	L
	2	M	L
	3	M	L
	4	L	M
SB3	1	M	M
	2	L	L
	3	H	M
	4	M	H
SB4	1	H	VH
	2	M	M
	3	M	M
	4	H	VH
SB6	1	L	L
	2	M	L
	3	M	L
	4	L	L
SB7	1	L	L
	2	M	L
	3	H	L
	4	M	L
SI1	1	M	L
	2	M	L
	3	H	L
	4	M	L
SI2	1	M	L
	2	M	L
	3	H	L
	4	H	L
SP1	1	M	L
	2	M	L
	3	H	L
	4	M	L
SX1	1	L	L
	2	M	L
	3	M	L
	4	M	L

Table 4.6.3. Continued.

Ecosite	Season	Subjective	Model
SX2	1	L	L
	2	H	L
	3	M	L
	4	M	L
TK1	1	L	L
	2	L	L
	3	L	L
	4	L	L
VL1	1	H	M
	2	H	L
	3	M	L
	4	H	L
VL2	1	M	L
	2	H	M
	3	L	M
	4	L	M
VL6	1	M	L
	2	H	L
	3	M	L
	4	M	L
WF1	1	M	L
	2	M	L
	3	H	L
	4	M	L
WF2	1	VH	L
	2	H	L
	3	VH	L
	4	VH	L
WF3	1	M	M
	2	M	L
	3	M	L
	4	VH	L
WF5	1	L	L
	2	H	L
	3	M	L
	4	M	L

Table 4.6.3. Continued.

Ecosite	Season	Subjective	Model
WF6	1	H	L
	2	H	L
	3	H	L
	4	VH	L
WH1	1	M	L
	2	M	L
	3	M	L
	4	M	L
WH4	1	M	L
	2	M	L
	3	M	L
	4	H	L
WH6	1	L	L
	2	M	L
	3	H	M
	4	M	M
WH7	1	H	L
	2	VH	L
	3	H	L
	4	VH	L
WH8	1	M	L
	2	VH	L
	3	H	L
	4	VH	L
WY1	1	M	M
	2	VH	L
	3	H	M
	4	H	M
WY2	1	M	H
	2	M	L
	3	M	L
	4	M	M

a Increase rating by two class values, to the maximum rating of VH, for ecosites modified by avalanches. Similarly, increase ratings by one class value for those ecosites modified by burns.

are known, ratings for ecosites with a burn modifier should be thought of as being at least one class value higher than is shown in Table 4.6.3.

The final subjective evaluation is compared with the results of the four mountain parks food habits model (Kansas *et al.* 1989a) in Table 4.6.3. Results are less consistent between the subjective and modelled assessments than between the two, independently conducted subjective assessments. Ratings differed by zero or one class for 77% of the sample, by two classes for 17%, and by three classes for 6%. Unfortunately, too few radio-locations were made on grizzly bears to be able to test rigorously which assessment is more accurate. Future analysis of this data could include conducting use versus availability tests for the composite home ranges of the study bears, or for only the home ranges of one or two bears for which sufficient data was collected (e.g. #5). Until this is done, it is the opinion of the authors that the final subjective assessment is more accurate and therefore best suited for management purposes. In any event, the ratings should be boosted by two or one class(es) when the ecosite is heavily influenced by avalanches or burns, respectively. Additional future work (Section 5.0) should be directed towards mapping and classifying of avalanche paths and burns as grizzly bear habitat.

Vegetation Types

Vegetation types were determined for most site specific investigations of bear locations (Table 4.6.4). Three new vegetation types found during the study are outlined below.

S80 (Willow-Hedysarum)

S80 occurs on scoured avalanche slopes in the Lower and Upper Subalpine Ecoregions. Sites are usually subxeric - mesic with steep slopes and commonly have a high degree of exposed soil. Aspects are variable. Tree cover is negligible (0-5%) with occasional *Picea engelmannii* and/or *Abies lasocarpa* growth. Shrub cover is often patchy (0-20%) with *Salix* spp., *Betula glandulosa*, *Amelanchier alnifolia*, *Populas tremuloides*, *Shepherdia canadensis* and *Abies lasiocarpa* having occasional occurrence. The herb layer is variable (5-50%) with *Hedysarum sulphurescens* (2-8%) always present, and commonly includes *Salix artica*, *S. nivalis*, *Potentilla fruticosa*, *P. diversifolia*, *Arctostaphylos uva*-ursi, and *Zygadenus elegans*.

Table 4.6.4. Number of locations by vegetation type for radio-collared and incidentally observed grizzly bears in the Yoho and Kootenay National Park study area, 1988 - 1990.

	CLOSED FOREST																			OPEN FOREST								
SEASON	03	06	13	14	15	17	18	19	20	21	23	29	30	32	37	38	41	42	55	03	04	05	06	12	13	17	18	23
1	3		1	2			6	1														1	1					
2	2			4	1						1	2	2	2	1	1	1	1	2	1			1	1		2		
3		1		10		1				2				3		4									4	1		1
4	2			2					2	3											1						1	
TOTAL	7	1	1	18	1	1	6	1	2	5	1	2	2	5	1	5	1	1	2	1	1	1	2	1	4	3	1	1

	SHRUB							HERB-DWARF SHRUB						OTHER		
SEASON	01	02	05	11	12	80	90	5	8	11	16	17	98	PIT	ROCK	SNOW
1			3			12							3			
2	1		2		1	2	2					1	34		1	
3		2	12	1		1	2		1	2	1		13	1		1
4		1	1			5		1					2			
TOTAL	1	3	18	1	1	20	4	1	1	2	1	1	52	1	1	1

The S80 vegetation type is found as an inclusion within other classified vegetation types and as a distinct vegetation type when coverage is more extensive. Intergrades occur with S16 and other vegetation types. Examples of this vegetation type are found on the upper portion of the Dennis slide southwest of Field, on the west side of the Mt. Owen and on the west side of Mt. Victoria in YNP.

S90 (Willow-Buffaloberry-Hedysarum)

S90 occurs on well drained fluvial sites in headwater basins. Sites are level to gently sloped with little soil cover over an aggregate base. Commonly several meltwater stream channels meander over the landscapes maintaining the vegetation in an early successional stage.

S90 usually has some tree cover (0-10%) of *Picea engelmannii* and *Abies lasiocarpa*. The shrub layer is variable (10-60%) with *Salix* spp. most common (5-50%), and *Abies lasiocarpa* (2-15%), *Shepherdia canadensis* (0-25%), and *Betula glandulosa* (0-20%) also being common. The herb layer is generally restricted (5-20%) but may have substantial growth of *Dryas* spp. Common to all S90 vegetation types is the growth of *Hedysarum* spp. (1-10%) with *Hedysarum sulphurescens* being most common. Often there is patchy bryoid growth (0-30%).

Examples of this vegetation type are located in the Goodsir Basin, Helmet Basin and in the Tokumm Creek tributatry basin to the east of Faye Hut.

H98 (Cow Parsnip-Aster-Fireweed)

The H98 vegetation type identifies a broad range of avalanche slope plant associations. Common to all of these is the relatively high occurrence of *Heracleum lanatum* (3-50%). Generally these sites fell within the Sub-Alpine Ecoregion, on variable aspects with mesic to hygric moisture regimes. The tree layer (0-10%) is generally non-existent with the occasional presence of *Picea engelmannii* and/or *Abies lasiocarpa*. The shrub layer is quite variable (0-60%) and often includes *Salix glauca* (0-50%), *Alnus crispa* (0-50%), *Abies lasiocarpa* (0-50%), *Lonicera involucrata* (0-5%), *Ribes lacustre* (0-5%) and *Sambucus racemosa* (0-5%). The herb layer (80-100%) is diverse with various graminoids dominant (40-90%). *Heracleum lanatum* occurs at 3-50%, *Epilobium angustifolium* 1-20%, *Thalictrum occidentale* 0-5%, *Fragaria virginiana* 1-10 and *Galium borealis* 1-3%. The bryoid layer cover is generally very low. H98 intergrades with H22 although *Heracleum lanatum* and graminoids are more prevalent in the former vegetation type. Intergrades with numerous other vegetation types does occur. Examples of H98 vegetation types are common in most of YNP (e.g. McArthur Creek, Mt. King) and in the north half of KNP (e.g. Tumbling Creek, Helmut Creek, Floe Creek, and Assiniboine Slide Paths). The H98 vegetation type is often found as an inclusion within other vegetation types and especially in those which are subject to avalanching.

Vegetation types that were used the most included C14 (Engelmann spruce - subalpine fir/false azalea (*Menziesia glabella*), S05 (lodgepole pine/twinflower (*Linnaea borealis*)/fireweed), S80 (willow/hedysarum) and H98 (cow parsnip - aster - fireweed). The high use of C14 may have simply been due to the high availability of this vegetation type in the study area. S05 is the typical vegetation type of the Vermilion burn in the Vermilion Pass area. Its high use by bears was due primarily to the abundance of berries in the burn. S80 was mostly utilized by bears during the pre-vegetation and post-berry seasons. These seasons are when hedysarum, a main component of S80, was found to be an important part of the diets of grizzly bears. H98 was mostly used by grizzly bears in the vegetation season, where they fed upon cow parsnip and grasses.

4.7 IMPORTANT AREAS FOR GRIZZLY BEARS

Areas that were found to be important to grizzly bears will be discussed under the following headings: elevation, avalanche slopes, burns, hedysarum feeding sites, den sites and mating areas.

Use of Elevation

The average elevations at which radio-collared and incidentally observed bears were observed during the course of the study are portrayed in Table 4.7.1. When data from all three years are combined, it appears that bears may have been found at slightly higher elevations during the pre-vegetation and post-berry seasons. However, the confidence limits are sufficiently wide that the real differences between seasons may be quite small. In addition, the use of higher elevations in spring and fall may have been a function of bear denning behaviour. Most grizzly bear dens were found above 1900 m (6234': see below). Black bears in BNP were found to frequent higher elevations in the fall (Kansas *et al.* 1989b). Black bears were found to feed upon crowberries, whitebark pine

Table 4.7.1. Location of collared and incidentally observed grizzly bears by elevation in the Yoho and Kootenay National Parks study area, 1988 - 1990.

Year	Seasons	Mean Elevation + 95% CL		
		Feet	Metres	n
1988	1	4670 ± 540	1423 ± 165	10
	2	5191 ± 239	1582 ± 73	35
	3	5850 ± 201	1783 ± 61	85
	4	5984 ± 358	1824 ± 109	31
1989	1	5567 ± 268	1697 ± 82	64
	2	4957 ± 157	1511 ± 48	128
	3	5717 ± 156	1742 ± 48	147
	4	5815 ± 176	1772 ± 54	136
1990	1	5317 ± 364	1621 ± 111	42
	2	5281 ± 129	1610 ± 39	197
	3	5398 ± 161	1645 ± 49	108
	4	6240 ± 269	1902 ± 82	41
1988 - 1990	1	5399 ± 204	1646 ± 62	116
	2	5157 ± 93	1572 ± 28	360
	3	5649 ± 99	1722 ± 30	340
	4	5925 ± 138	1806 ± 42	208
	All Seasons	5504 ± 61	1678 ± 19	1024

nuts and buffaloberries at higher elevations in the fall. In the post-berry season of 1990, one female grizzly bear (#5) was found at higher elevations where she fed upon whitebark pine nuts.

Female grizzly bears appeared to use higher elevations in the pre-vegetation and post-berry seasons, while males did not appear to significantly change their use of elevation with season (Figure 4.7.1, Table 4.7.2). However, only during Season 2 did the 95% confidence limits for each sex not overlap. Russell *et al.* (1979) determined that adult male grizzly bears in JNP used the bottoms and lower slopes of valleys to a greater extent than did females with young and independent sub-adults. They felt that the latter category of bears actively avoided adult males.

Use of Avalanche Slopes

Grizzly bears were found to make extensive use of avalanche paths in the study area (Table 4.7.3). Use of avalanche terrain was greater in YNP than in KNP. In YNP, use varied from a low of 11.9% of locations made in the berry season to a high of 41.7% in the pre-vegetation season. The low figure for the berry season was in part due to the large number of roadside locations made on Bears 9 and 23 during the buffaloberry season. In KNP, use ranged from a low of 5.0% in the post-berry season to a high of 11.9% in the pre-vegetation season. Use of avalanche paths was highest in the pre-vegetation season in both parks as this is where bears were found to feed upon hedysarum roots, the main early spring food of grizzly bears in the study area. Bears were also found to feed upon graminoid vegetation and berries on avalanche paths. The importance of avalanche paths to grizzly bears within the study area should not be underestimated. The ELCs of the two parks are sorely lacking, at least in their ability to describe grizzly bear habitat, in the way in which they describe and measure the extent of avalanched terrain in the study area. Mapping and a better vegetative description of avalanche paths will have to be undertaken before grizzly bear habitat can be fully understood in the two parks.

Use of Burns

Grizzly bears were most often found to frequent burns during the berry season (Table 4.7.4). During this season, 5.5% and 2.5% of all locations were made in burns in KNP and YNP, respectively. Although these percentages are low relative to bear use of avalanche slopes, it must be remembered that the areal extent of recent burns in the study area is

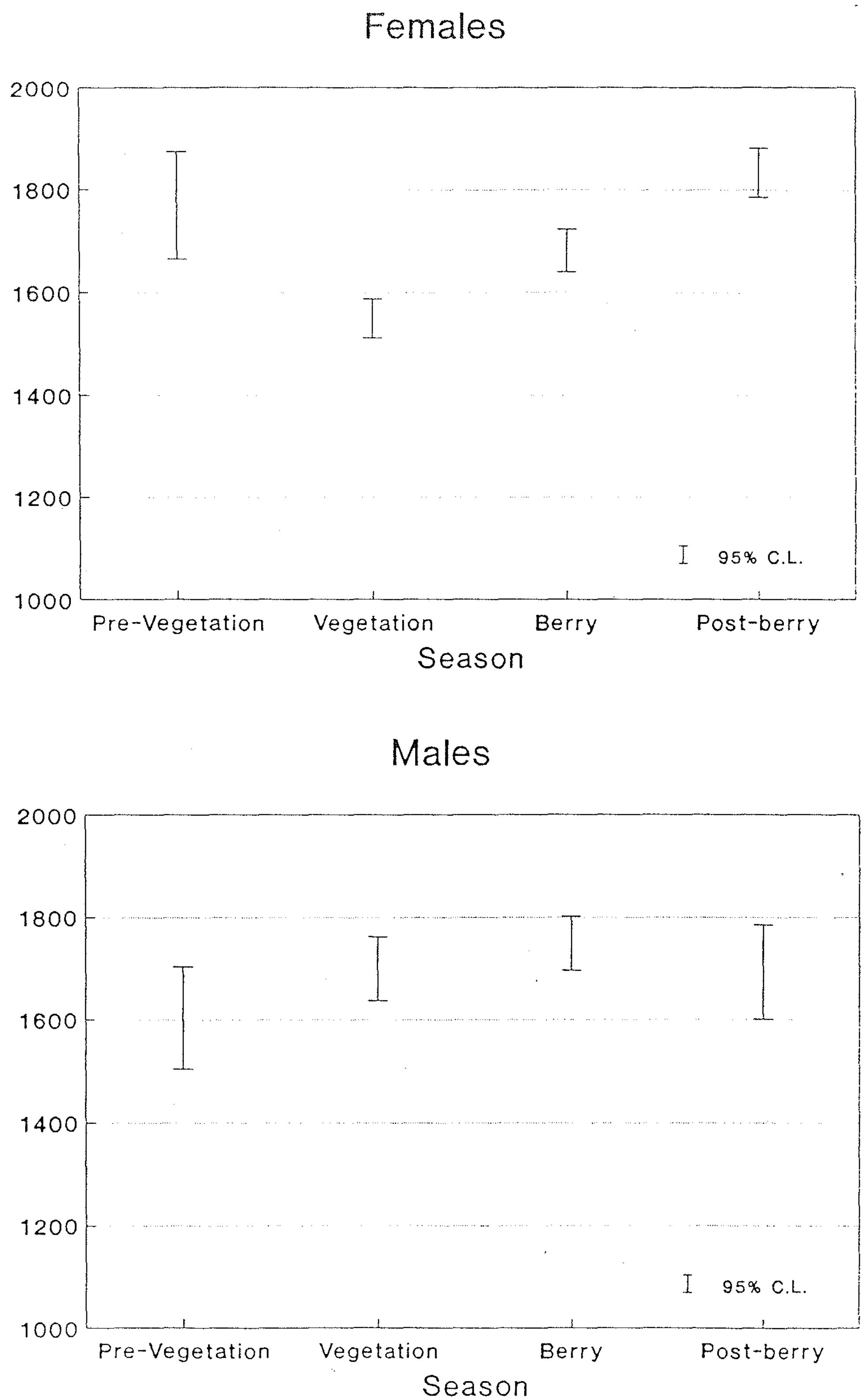

Figure 4.7.1. **Mean elevations at which radio-collared female and male grizzly bears were located in the Yoho and Kootenay Parks study area, 1988 - 1990.**

Table 4.7.2. Location of female and adult male radio-collared grizzly bears by elevation (± 95% C.L.) in the Yoho and Kootenay National Parks study area, by season, 1988 - 1990.

Season	Females			Males		
	Feet	Metres	n	Feet	Metres	n
1	5808 ± 346	1770 ± 105	50	5264 ± 329	1604 ± 100	28
2	5086 ± 125	1550 ± 38	221	5577 ± 202	1700 ± 62	53
3	5514 ± 134	1681 ± 41	168	5737 ± 173	1749 ± 53	92
4	6013 ± 159	1833 ± 48	130	5556 ± 303	1693 ± 92	52

Table 4.7.3. Percent of telemetry locations of radio-collared grizzly bears on avalanche slopes within the Yoho and Kootenay National Parks study area , 1988 - 1990.

Season	Jurisdiction				n
	Kootenay	Yoho	Banff	Province	
1	11.9	41.7			84
2	6.5	22.2	1.7	3.4	293
3	8.6	11.9	0.4	1.6	244
4	5.0	18.2	1.3	1.3	159

Table 4.7.4. Percent of telemetry locations of radio-collared grizzly bears in burns within the Yoho and Kootenay National Parks study area, 1988 - 1990.

Season	Jurisdiction				n
	Kootenay	Yoho	Banff	Province	
1	3.4				119
2	0.5		0.8		381
3	5.5	2.5	2.2	0.3	325
4		2.6	0.5		193

also quite low. Masters (1989), for example, found that the mean fire return interval for KNP was 127 years. Blueberry and buffaloberry bushes generally produced a greater abundance of fruit in burns than in adjacent, closed forests. Zager *et al.* (1983) found that in Montana, the canopy cover of six berry-producing shrubs was higher on burns 35 - 70 years old than in old-growth sites. Some bears (e.g. #1) spent considerable amounts of time in burns feeding on berries. Hamer and Herrero (1986), in the front ranges of BNP, also found that grizzly bears fed to a large extent within burns. They found that shrub fields of 40 - 45 years of age were of particular importance to their study animals. They believed that grizzly bear habitat quality had decreased with the policy of active fire suppression that had been implemented in BNP.

Hedysarum Feeding Sites

Sixty-three observations were made where grizzly bears had fed upon hedysarum roots during site specific investigations. The Lower Kicking Horse River (KHL) and the Ottertail River (OTL) watersheds were where grizzly bears were most often found to feed upon hedysarum (Table 4.7.5). This, however, may be in part due to the fact that more bears were collared in these watersheds than in others.

Most hedysarum feeding sites were found within the Lower Subalpine Ecoregion (41.3%: Table 4.7.6). The Montane Ecoregion was used with the second highest frequency (31.8%). Most of these locations were on the avalanche paths of Mt. Dennis near the town of Field, where Bears 7, 9 and 23 were often found in the pre-vegetation season. The Upper Subalpine Ecoregion was used for 20.6% of the hedysarum feeding activity and the Alpine Ecoregion was only used for 2.0% of the same activity. When these figures are compared with the overall bear use of ecoregions (Table 4.3.3), it appears that use of the Upper Subalpine Ecoregion for hedysarum digging may be higher than expected. This, however, may simply be due to the greater incidence of avalanche paths at higher elevations.

Use of different elevations for hedysarum feeding did not show any significant trends (Table 4.7.6). Bears appeared to feed upon hedysarum roots at a wide range of elevations, which led to large confidence limits. A larger sample size would be required in order to more fully ascertain the influence, if any, of elevation on hedysarum feeding.

Table 4.7.5. Seasonal use of watersheds by radio-collared and incidentally observed grizzly bears for hedysarum feeding in the Yoho and Kootenay National Parks study area, 1988 - 1990.

	YOHO				KOOTENAY					BANFF	
SEASON	CAT	OTL	KHL	KHU	OCR	OTU	KTL	TKM	VRU	BWM	BWU
1		2	15				1		4		
2		3	3	2		1	2	1	1		
3		5	1					1	3		1
4	1	3	6		3			1		3	
TOTAL	1	13	25	2	3	1	3	3	8	3	1

Table 4.7.6. Percent use of ecoregions, elevation and avalanche slopes, by season, for radio-collared and incidentally observed grizzly bears feeding on hedysarum in the Yoho and Kootenay National Parks study area, 1988 - 1990.

	ECOREGION					MEAN ELEVATION ± 95% C.L.		PERCENT ON AVALANCHE SLOPES	
SEASON	MO	MS	LS	US	A	METRES	FEET		n
1	45.5		22.7	27.3	4.5	1710 ± 168	5609 ± 550	25.4	22
2	38.5		61.5			1538 ± 143	5046 ± 469	9.5	13
3		27.3	45.4	27.3		1804 ± 164	5918 ± 538	9.5	11
4	29.4		47.1	23.5		1735 ± 161	5694 ± 528	11.1	17
TOTAL	31.8	4.7	41.3	20.6	2.0				63

Edge *et al.* (1990) found that hedysarum feeding sites of grizzly bears in southeastern B.C. and northwestern Montana did not appear to be related to any particular elevation or aspect. Instead, they found that ease of digging was the main factor in determining where grizzly bears would dig for hedysarum roots. Holcroft and Herrero (1984) reached much the same conclusion for bears in BNP. Therefore, soil type may be an important factor in where bears seek hedysarum.

Vegetation type S80 (willow-hedysarum) was the most common vegetation type (Table 4.7.7) in which bears were found to dig for hedysarum roots. This vegetation type had a very high percent cover of hedysarum relative to other vegetation types. Only one (C38) of the 12 vegetation types found to have the greatest incidence of hedysarum present during the development of the Four Mountain Parks Grizzly Bear Habitat Evaluation Project (Table 6, Kansas *et al.* 1989) was found to be used by collared bears during this study. This may be in large part due to the small sample size of vegetation types recorded as hedysarum feeding sites.

Den Locations

Few attempts were made to visit den sites due to their inaccessibility and emphasis of the project on other aspects of bear biology. Some information, however, was collected for 12 den sites (Table 4.7.8). All den sites were in either the Lower or Upper Subalpine Ecoregions, at a range in elevation from 1768 - 2316 m (5800 - 7600'). The average elevation of the den sites recorded (2085 m or 6840') is substantially higher than the mean elevation at which bears were located during any of the four seasons (Table 4.7.1: 1572 - 1806 m or 5157 - 5925'). Vroom *et al.* (1977) found that the mean elevation of 47 grizzly bear dens in BNP was 2280 m (7482'). Ten dens in JNP had a mean elevation of 2225 m (7300': Russel *et al.* 1979). In Montana, 2 of 41 dens investigated were at 1250 m (4101'), while the remainder ranged between 2050 and 2500 m (6726 - 8202') in elevation (Servheen and Klaver 1983).

Most dens were on steep slopes (slope classes of 7 - 9, or 30 - 70+%) and on or near avalanche paths. Vroom *et al.* (1977) also found grizzly bear dens in BNP to be on steep slopes (mean of 66%). Russell *et al.* (1979) found that grizzly bear dens in JNP ranged on slopes from 30 - 80%.

Table 4.7.7. Number of hedysarum feeding sites investigated in each vegetation type, by season, in the Yoho and Kootenay National Park study area, 1988 - 1990.

	CLOSED FOREST				OPEN FOREST	SHRUB					HERB-DWARF SHRUB
SEASON	03	17	19	38	17	02	05	11	80	90	98
1			1						15		
2	1			1	1				3	1	1
3		1					3	1		2	
4						1	2		5		
TOTAL	1	1	1	1	1	1	5	1	23	3	1

TABLE 4.7.8. Characteristics of grizzly bear den sites and approximate den entry/emergence dates in the Yoho and Kootenay National Parks study area, 1988-1990.

Bear ID	Entry Date	Emergence Date	Park[a]	Location		Ecoregion	Ecosite	Elevation		Aspect	Habitat	Slope Class	Avalanche Slope
				UTM	Description			Metres	Feet				
1988 - 89													
05	-	30/04[b]	Y	NG444813	McArthur Creek - Misko Mtn.	US	R-whP	2073	6800	N		8[c]	Y
07	7/11	9/05	Y	NG384934	Mt. Stephen - Field Townsite	US	R-whP	2164	7100	W	treeline; closed spruce subalpine fir	9	Y
08	-	30/04[b]	Y	NG219831	Porcupine Creek - Mt. Hunter	LS	BG-A	1920	6300	SE			
10	-	30/04[b]	Y	NG215840	Porcupine Creek - Mt. Hunter	LS	BG-A	1951	6400	N			
1989 - 90													
01	13/11	17/04[b]	K	NG587701	Paint Pots	US	WH4	2012	6600	SE	rocky outcropping at treeline; open white bark pine-subalpine fir	9	Y
04	-	17/04[b]	K	NG783423	Lachine Creek	US	WH6	2134	7000	E	treeline; closed conifer	8	
05	26/11	30/04[b]	Y	NG417841	McArthur Creek - Mt. Owen	US	SI-al	2164	7100	S			Y
09	31/11	02/05	Y	NG359908	Boulder Creek - Mt. Dennis	US	R	2286	7500	S	treeline; open white bark pine-subalpine fir	9[c]	Y
23	15-26/11	4-18/04	Y	NG358911	Mt. Dennis - Field Ranch	US	R	2255	7400	N	ridge; conifer clump	8	N
1990 - 91													
02	5/11	-	Y	NG253903	Otterhead River - Mt. King	LS	OG-SF	1768	5800	E	mid to upper slopes; closed spruce subalpine fir	8[c]	Y
05	1/11	-	Y	NG421847	McArthur Creek - Mt. Owen	LS	BG-SF	1981	6500	E	mid slope; closed spruce-subalpine fir	7[c]	Y
09	14/11	-	B	NG786733	Red Earth Creek - Copper Mtn.	US	WF3	2316	7600	SE			

[a] Y = Yoho; K = Kootenay; B = Banff
[b] Den emergence occurred prior to this date.
[c] Estimated

Mating Areas

Collared bears were seen in close association with other adult bears on 11 occasions (Table 4.7.9). The unmarked bears were assumed to be of the opposite sex to those of the marked bears. This activity was observed between the dates of 21 May and 17 July. Russell *et al.* (1979) found similar results: they considered the mating season to run from mid-May to early July. In contrast to the observations of others (e.g. Herrero and Hamer 1977), male - female pairs did not appear to seclude themselves in out-of-the-way places. What is important to note is the use of Moose Creek, on B.C. provincial lands, as a mating area for Bear 4 during two successive springs. This area is open to hunters, and is in fact where Bear 4 was later shot and killed.

Other Important Areas

The following areas are considered to be very important to grizzly bears in the two parks. The list is only derived from the activities of radio-collared bears, and thus is not inclusive.

Pre-vegetation Season:

The **Mount Dennis avalanche paths** west of Field, and the **Mount Stephen avalanche paths** above Field, were found to be of considerable importance to three of the radio-collared bears (#'s 7, 9 and 23) during the pre-vegetation season. These bears dug for hedysarum roots on these slide paths at this time.

The **Upper McArthur Valley**, and the **avalanche paths on the Southface of Mt. Odaray**, were found to be heavily used by grizzly bears for hedysarum feeding in the spring.

In Kootenay National Park the avalanche slopes of Mt. Whymper and on the northeast side of the **Stanley Glacier bowl** were used extensively in 1989 by Bear 1.

Many other areas in the two parks are very important for hedysarum digging activities of grizzly bears. Unfortunately, the number and distribution of bears radio-collared during this study was insufficient to determine many of these areas.

Table 4.7.9. **Dates and locations of radio-collared adult grizzly bears that were located with accompanied by other grizzly bears in the Yoho and Kootenay National Parks study area, 1989 - 1990.**

Bear ID	Sex	Date	Drainage
1989			
4	M	21 May	Ice River
		25 May	Beaverfoot River [a]
		27 May	Ice River
		31 May	Moose Creek
		5 June	Lost Creek
		10 June	Serac Creek
		23 June	Serac Creek
		17 July	Symond Creek [b]
1990			
1	M	3 June	Red Deer River [c]
4	M	28 May	Moose Creek
5	F	3 June	Good Sir Creek

a On Mt. Clawson near mouth of the Ice River.
b Third grizzly bear seen approximately 200 m from Bear 4 and accompanying grizzly bear.
c Red Deer River headwaters south of Mt. Drummond.

Vegetation Season:

The **Avalanche Paths of the McArthur Creek and Ottertail River Drainages** were found to be very important for grizzly bears during the vegetation season. Bears utilized these slopes to feed on graminoid vegetation and cow parsnip.

The **Avalanche Paths of Moose Creek**, although outside of the two parks, were very important to some study bears, and therefore important to the park population as a whole. Bears fed upon graminoid vegetation and cow parsnip on these slopes. This site is the only area where study personnel saw three adult grizzly bears at one time and was used by study bears for mating purposes.

The **Avalanche Paths of Tumbling Creek, Helmet Creek, Ochre Creek, Serac Creek, Tokumm Creek and south of the Paint Pots** were all important for grizzly bears during this season. On these slopes graminoids and cow parsnips were mostly fed upon.

Berry Season:

The **Goodsir Flats** area was found to be a very important area for bears feeding upon buffaloberries. The **Vermilion Burn** was very important for bears for blueberries, and the **Rockwall and Goodsir Pass** areas were found to be utilized by bears for ground squirrels during this season. Grizzly bears were also found to feed upon buffaloberries on the **Right-of-ways of Highways # 1 and 93** during this season. Buffaloberry production was noted to be higher along the forest edges created by these right-of-ways than within the forests. Bear 23, in particular, was found to utilize highway edges, and was ultimately killed by a vehicle.

Post-Berry Season:

Important hedysarum-feeding areas included **Goodsir Flats, Upper Helmut Creek** and the **Avalanche Paths of Upper McArthur Creek.** The Helmut Creek area is of particular concern to park managers due to its' high levels of visitor use. Warning signs should be placed at the start of the trail to Helmut Falls to inform hikers of the high likelihood of encountering bears during this season. It is of concern that recent trail routing was conducted without input from study personnel.

The **Junction of Molar Creek and the Pipestone River** in BNP was found to be an important area for crowberries, and was used extensively by one study bear (#1). Crowberries were also used by this bear on the **North Slopes Below Twin Lakes**.

Whitebark Pine Stands above Cataract Brook and Giddie Creek headwaters were important to one bear (#5) in 1990. It is likely that whitebark pine stands elsewhere in the two parks are also of high importance to grizzly bears.

<u>Denning:</u>

Dens were found at the following locations:

- Porcupine River
- Mount Stephen above Field
- Misko Mountain above McArthur Creek
- ridge above the Paint Pots
- east side of Mount Owen
- west side of Mount Dennis
- east side of Mount King
- Lachine Creek

4.8 POPULATION SIZE AND MONITORING TRENDS IN NUMBERS

Population Characteristics

Eleven grizzly bears were captured and radio-collared during the three years of study. The age and sex distribution of the collared animals and their family groups (siblings and young) are presented in Table 4.8.1 with the ages of bears captured in 1989 and 1990 dated back to 1988. The ratio of males to females was 0.83 : 1, and adults comprised 46% of the population sample, sub-adults 31%, and young (aged 1 - 2 years) 23%. One young-of-the-year, 1 group of 3, 3 year old siblings and 1 pair of 3 year old siblings were included in the marked population. When data from Warden Service records of unmarked bear observations are included, the mean young-of-the-year to female ratio for 1988 - 1990 was 1.3 : 1 (n = 6), and the mean young (ages 0 - 3) to female ratio was 1.5 : 1 (n = 18: Table 4.8.2).

Table 4.8.1. Age and sex distribution of captured grizzly bears and their associated siblings or young in the Yoho and Kootenay National Parks, 1988 - 1990.

Age[a]	Sex			Total
	Male	Female	Unknown[b]	
13	1			1
12	1			1
11				
10				
9		1		1
8		1[c]		1
7	1			1
6		1		1
5		1		1
4				
3	2		1	3
2		2		2
1			1	1

a Backdated to 1988.
b Bears associated with collared individuals.
d Estimated

Table 4.8.2. Summary of grizzly bear family units observed in Yoho and Kootenay National Parks, 1988-1990.

Year ID	Month	Location: Watershed(s)	Location: Description	Sow	Cub Age: YoY	1	2	3	Unknown
1988									
8, 10[a]	June	Ottertail	Goodsir Creek	0				3	
	Oct.	Ochre	Helmet Creek						
5[b]	Sept.-	Ottertail	Goodsir Creek	1			1		
	Nov.		McArthur Creek						
		Tokumm	Tokumm Creek						
		Cataract	Cataract Creek						
		Ochre	Helmet Falls						
	May	Upper Vermilion	Numa Creek	1	1				
50	Aug.	Ochre	Helmet Falls	1	1				
51	Sept.	Ochre	Tumbling Falls						
			Wolverine Meadows	1	2				
52[c]	May	Lower	Mt. Dennis slide path	1			2		
	June	Kicking Horse	Field Backroad						
	June	Emerald	Emerald Lake	1					1
	Sept.	Yoho	Little Yoho Valley, west						
			side of Kiwetinok Pass	1		2			
Mean Litter Size					1.3 (n=3)	2.0 (n=1)	1.5 (n=2)	3.0 (n=1)	1.0 (n=1)
1989									
9,23	May-Nov.	Lower Kicking Horse	Field Townsite					2	
54	June	Sinclair	Kimpton Creek	1		2			
55	June	Ochre	Helmet Basin	1					1
	Sept.								
	Aug	Upper Vermilion	Floe Creek	1	1				
	Oct.	Lower Kootenay	Luxor Pass	1					2
Mean Litter Size					1.0 (n=1)	2.0 (n=1)		2.0 (n=1)	1.5 (n=2)
1990									
57		Emerald	Emerald Lake	1	1				
58		Ochre	Tumbling Creek	1	2				
			Ochre Creek						
			Helmet Creek						

Table 4.8.2. continued.

ear ID	Month	Location: Watershed(s)	Location: Description	Sow	Cub Age: YoY	1	2	3	Unknown
59		Amiskwi	Kiwetinok Ridge	1					1
60		Ice River	Upper Ice River	1		1			
61		Ottertail	Goodsir Basin	1		1			
Mean Litter Size					**1.5** (n=2)	**1.0** (n=2)			**1.0** (n=1)
MEAN LITTER SIZE, 1988-1990.					**1.3** (n=6)	**1.5** (n=4)	**1.5** (n=2)	**2.5** (n=2)	**1.3** (n=4)

MEAN LITTER SIZE FOR ALL CUBS, 1988 - 1990 (n=17) = 1.5

a Bears #8 and 10 were observed travelling with a third individual thought to be a sibling.

b Bear #5 was radio-collared as part of the study. One incidental observation was obtained for McArthur Creek was thought to be bear #5 with her cub.

Based on records and photographs this family group may have been bear #7 with her cubs bears #9 and 23.

The age distribution of collared bears appears to indicate that recruitment to the population is adequate, with six bears of a sample of 13 being under the age of four. However, the mean cub to female and young to female ratios for marked and unmarked bears of 1.3 : 1 and 1.5 : 1, respectively, are low relative to most other studies. A mean litter size of two was found for four studies in Alberta and the Yukon Territories (Nagy and Haroldson 1990), and a mean litter size of 1.6 was the lowest recorded in 31 North American studies summarized by LeFranc *et al.* (1987).

Population Estimates

Grizzly bear populations are notoriously difficult to census for the following reasons (LeFranc *et al.* 1987):

- they are difficult to see due to their use of forested habitat.
- individual bears have different probabilities of capture, therefore, capture-recapture population estimate techniques are suspect.
- they have large home ranges and low population densities, thus sample sizes for estimates are usually small.
- age and sex classes are difficult to determine without handling.
- black bear sign can be mistaken for that of grizzly bears.

Deriving population estimates for YNP and KNP was difficult due to the relatively low numbers of bears captured (11) during the study. From 11 to 15 bears, excluding young-of-the-year, were estimated to occur within YNP, and from 9 - 16 bears were estimated to occur within KNP (Table 4.8.3). These subjective estimates represent the number of bear ranges that might be expected to occur within each park based on the amount of habitat available and are thus, at best, minimum estimates. More bears may be expected to use the parks at any one time. Undoubtedly, bears whose ranges are centered outside of YNP and KNP use portions of the parks at certain times of the year. These bears represented fractions of bears in the population estimate, based on the estimated proportion of their time spent within either park.

Despite the different methods used, the different estimates arrived at independently by different study personnel (Table 4.8.3) are quite close. This lends credence to the results. Important to note is the relatively few number of adult female bears that are estimated to live in the two parks. As few as three adult females may occur in KNP. As adult females

Table 4.8.3. **Population estimates of grizzly bears for Yoho and Kootenay National Parks.**

		Age/Sex Class				
		Female		Male		
Park	**Estimate**	Adult[a]	Sub-Adult[b]	Adult[a]	Sub-Adult[b]	**Total**
Yoho	1	5.3	4.1	1.9	3.6	14.9
	2	5.3	3.3	1.8	1.1	11.5[c]
	3	-	-	-	-	14.0[d]
Kootenay	1	4.6	3.0	3.3	3.0	13.9[d]
	2	2.8	1.6	3.1	1.6	9.1
	3	5.9	4.6	2.7	3.1	16.3
	4	5.7	3.6	1.9	1.2	12.4[c]

a Adult: 6+ years
b Sub-adult: 2-5 years
c Estimate based on home range data.
d. Participants considered their estimates to be liberal.

are the most important segment of the population from a reproductive point of view, it can be seen that even the loss of one adult female could be very detrimental to the park population. This is especially true given the low litter sizes and the high levels of mortality (Section 4.9) prevalent in the two parks.

It can also be concluded that the two parks are not sufficiently large enough to contain a minimum viable population of grizzly bears. The best work on estimating minimum viable populations of grizzly bears has been conducted in Yellowstone National Park. While the Yellowstone population is isolated from other grizzly bear populations, and the habitat is different from that of the Canadian Rockies, minimum viable population estimates for Yellowstone can be used as ball park figures for management of grizzly bears in YNP and KNP. Shaffer and Sampson (1985) considered that, for the Yellowstone grizzly bear population, a minimum population of from 50 - 90 bears was necessary to maintain its population. Other authors (Suchy *et al.* 1985) calculated the minimum viable population for Yellowstone to be 125. These results indicate that a bear population considerably larger than that estimated for YNP and KNP is most likely necessary to maintain grizzly bears in the area.

A previous population estimate for YNP (McCrory and Blood 1978) considered that from 37 - 53 grizzly bears may have used the park during the course of a year, and that roughly 40 bears could be considered as permanent residents. This estimate was based on sightings of bears and bear sign. Even though the grizzly bear population may have been higher in the 1970's due to the availability of garbage, this estimate appears to have been high.

Density figures based on Table 4.8.3 indicate that there is an estimated one bear (adult or sub-adult) per 87 - 113 square km in YNP and one bear per 86 - 154 square km in KNP. Russell *et al.* (1979) estimated a similar density of one grizzly bear per 85.5 - 101.6 square km in JNP.

Monitoring Trends in Numbers

Numerous methods exist for monitoring trends in grizzly bear numbers, but few are precise and many are expensive or not practical within a park setting. The brief review that follows is taken in large part from LeFranc *et al.* 1987).

Second Hand Reports are currently been used by both YNP and KNP with their computerized, bear monitoring form system. This system is advantageous as it is relatively inexpensive and is already in place. Disadvantages include the unreliability of some of the records and the fluctuating interest by staff in filling out reports. Numbers of observations have to be correlated with some index of staff effort in the field. For example, the incidence of bear observations increases dramatically with the arrival of summer staff. In spite of these problems, the use of bear monitoring forms is probably the best method for the Warden Service to use in monitoring bear numbers. One person in each park should be assigned to keeping track of the forms, and interviewing all personnel that report bears to obtain more information on the bear in question. An attempt should be made to differentiate between individual bears as each summer progresses, and a population estimate as was conducted for this study should be completed each fall. Particular note should be made of all female - young groups. All staff should be informed that any female - young groups should be observed for a sufficient length of time to obtain an accurate count of the young and a reasonable guess as to their age.

Sole reliance on counts of female - young groups as a means of assessing trends in bear numbers should be avoided, due to the differential viewability of these groups over time (D. Mattson, pers. comm.). The following three scenarios can each affect the viewability of female - young groups. 1). The sightability of female - young groups increases at a faster rate than the rate of population growth as they have to use less secure habitat as the population approaches carrying capacity. 2). Bears travel greater distances during years of food scarcity, therefore sightability can be inversely proportional to habitat quality. 3). Females with young are often found in less than prime habitat due to the presence of adult males and lone females and what is prime habitat can vary with habitat conditions.

Nevertheless, female - young groups are the most readily identifiable segment of any bear population, as well as being the most important segment from a reproductive standpoint. Therefore, special care should be taken in monitoring numbers of female - young groups, and the results should be interpreted in light of the above cautions.

Harvest Data can also be used to monitor population sizes and trends. As hunting of wildlife is not permitted in YNP and KNP this method will not be discussed. However, harvest statistics are kept by the B.C. Wildlife Branch, and these should be reviewed by park staff on a regular basis. Many bears are shot, both legally and possibly illegally, on the periphery of the two parks each year.

Bear Sign Surveys, and **Bait and Scent Stations** have been used to monitor trends in bear numbers in several areas (e.g. Edwards and Green 1959, Klein 1959, Ball 1977), but the results have been mixed. It is the opinion of the authors that very large sample sizes would be needed in order to adequately monitor population trends, and that the current bear monitoring programs are a much better method.

Aerial Surveys for grizzly bears can be successful if the bears are known to concentrate in certain areas at certain times of the year, or if the study area is not heavily treed. Neither case holds true for YNP and KNP.

Mark - Recapture Studies can be employed to determine the population size of grizzly bears, but this method is labour intensive, costly and uncompatible with Parks objectives.

4.9 BEAR MORTALITY

Adult and sub-adult bears were followed for a total of 7.8 and 4.9 bear-years, respectively, during the study. Of the 11 collared bears, five were known to have died, one had been translocated by the Warden Service and two were missing by the fall of 1990. Two male bears, as sub-adult and an adult, were legally shot in late May of 1989 and 1990, respectively, by hunters in B.C. provincial lands adjacent to YNP. These deaths occurred despite the fact that both bears had roughly 90% of their home ranges within national park land. An adult female was found dead in mid-June roughly 16 km inside YNP. Although the cause of death could not be determined, her carcass was consumed by another, unmarked bear. The cause of death could also not be determined for a sub-adult male that was found badly decomposed in mid-July on B.C. provincial lands. Two sub-adult female bears were translocated by the Warden Service after they persisted in frequenting townsites. One of these bears returned to her former range, but subsequently was killed by a collision with a vehicle. The second relocated bear had not returned to its former range by the fall of 1990. Its movements will continue to be monitored in 1991. The signals from two of the radio-collars attached to study animals were lost despite extensive searching by air. The fate of these animals is not known. Although only preliminary home range data was acquired on these animals, their ranges did not border provincial lands during the time that they were followed.

These deaths resulted in an annual mortality rate for sub-adults of 61% excluding the loss of the translocated bear that survived to the fall of 1990, and 81% if this bear is included in the calculation. Adult mortality rates were calculated at 26%, assuming that the missing bears were still alive, and 51% assuming the missing bears were dead.

The authors recognize that the sample sizes for much of the data presented are low. Pollock *et al.* (1989) for example, recommends that over 20 animals, and preferably 40 - 50 animals, should be monitored to provide good mortality estimates. Miller (1990) suggests that many years of study of more than 10 adult females should be conducted to obtain accurate estimates of birth, death and reproductive rates of bears. Nevertheless, the data is the best that is available for YNP and KNP, and likely will be the only data available for some time to come.

The mortality rates determined in this study, of a minimum of 61% for sub-adults and 26% for adults, are much higher than those found for most other studies. McLellan (1989) collected 110 grizzly bear-years of data in southeastern B.C. and found that both adults and sub-adults had annual mortality rates of 7%. Carr (1989) estimate male and female mortality, for bears greater than two years of age, in Alberta's Kananaskis Country at 9.8 and 3.4% respectively. Nagy *et al.* (1989) determined that grizzly bears in a west-central Alberta study area had a mean annual death rate of 11%. In JNP, Russell *et al.* (1979) found that the mean annual mortality rate for marked animals was 15%.

Eberhardt (1990) suggests that adult female grizzly bears should not be subjected to greater than 10% mortality per year in order for a population to remain constant, and that even this rate may be too high if the habitat is poor or if there is high juvenile mortality. Carr (1989) recommends that annual mortality not exceed 10 - 11% while Nagy *et al.* (1989) consider that man-caused mortality should not exceed 6%. As mortality rates found in YNP and KNP exceed these suggested maximum rates, grizzly bears should be managed in a conservative fashion in and around the study area.

Man-caused mortality is often found to be the main cause of death for grizzly bears. In this study, three of five known deaths were caused by man. Carr (1989) determined that all ten deaths recorded in his study were the result of man. McLellan (1989) found that, of nine mortalities, eight were man-induced and one was natural. Restrictions on the number of grizzly bear permits or the length of the bear season in areas adjacent to the parks, or the creation of no-hunting buffer zones around the parks, are examples of how managers could reduce the number of grizzly bear deaths. This is especially important in light of the increased access near the park boundaries provided by logging roads. Increased access can be detrimental to bear populations if legal and possibly illegal hunting is not controlled (McLellan 1990). Five of the deaths in McLellan's (1989) study were illegal kills, while three of the bears that died in Carr's (1989) study were shot by hunters in claimed self defense. Increased surveillance for poachers by the Warden Service and Fish and Wildlife personnel, and more critical review of claims of bears shot in self-defense, should be instigated.

5.0 RECOMMENDATIONS

This study was of insufficient length to adequately assess grizzly bear ecology in the two parks. The first year of the study was in essence a start-up year, where most effort was placed on attempting to capture bears and less effort was placed on following the bears captured. Therefore, only two full years (1989 and 1990) of data collection were obtained. In addition to this, the very high mortality rates encountered by the collared bears resulted in less data being collected. Any study of a long-lived species such as the grizzly bear should be conducted for at least five years (D. Mattson, pers. comm.). If information on birth, death and recruitment rates are desired, at least ten adult female bears must be radio-collared (Miller 1989). Unfortunately, the present study was conducted just long enough to provide a tantalizing glimpse of grizzly bear ecology in the two parks. The population estimates and mortality rates presented in this report are only rough estimates. However, the population estimates were low enough, and the mortality rates high enough, to warrant that extreme care be taken with grizzly bear management in the two parks and adjacent lands until more information is obtained. The short length of the study also resulted in insufficient information being collected on grizzly bear habitat. The following recommendations are forwarded to help rectify the above concerns.

1. Further study of the population parameters of grizzly bears in the two parks and adjacent lands is required. This study should involve the cooperation of the Canadian Parks Service with provincial governments, municipal governments, special interest groups (i.e. environmental groups, hunting and trapping groups) and industry. Capture and monitoring of grizzly bears should be conducted to determine if the mortality rates found during this study accurately reflect the mortality rates of bears over a wider area. This should be undertaken in conjunction with park monitoring efforts and Fish and Wildlife harvest data. These should be analyzed annually by a team of park and Fish and Wildlife personnel to identify possible early warning signals such as skews in population age and sex structure. Negative trends may indicate a stressed grizzly bear population.

   Consideration should be given to conducting this study from Waterton Lakes National Park in the south, to Jasper, Revelstoke and Glacier National Parks in the north. Increased surveillance of legal and illegal hunting along the park borders should be conducted by both park and Fish and Wildlife staff.

2. Refinement of the subjective and modelled habitat assessments presented in this report should be conducted through mapping and analysis (in terms of bear foods) of avalanche paths, burns and riparian areas. New vegetation types should be developed for these habitats, and they should be correlated to different slopes, aspects and elevations and soil types. This could be done in conjunction with the proposed 1992 ELC study for YNP. As the main objective of this new study will be to map YNP so that its ELC units can be directly compared to those of Kootenay, Banff and Jasper national parks, avalanche paths and burns will not be mapped as separate units. With the advent of GIS technology, however, it would make sense to map avalanche paths and burns and include this information is a separate GIS layer. If sufficient releves are conducted in these habitat types, their seasonal use for bears may better be understood.

3. A standardized method for mapping grizzly bear habitat should be developed for the Canadian Rockies from Jasper, Revelstoke and Glacier National Parks in the north to Waterton Lakes National Park in the south. Means of equating different habitat maps (e.g. Achuff *et al.* 1984, Fuhr and Demarchi 1990, this study) should be developed, preferably in a digital environment. An example of such an integration is currently being conducted for sharing of data between BNP, which has an ecological land classification map, and the Siffleur Wilderness Area, which has a thematic overlay habitat map produced in a GIS (Kansas *et al.* 1991). These kinds of mapping products could then be used in cumulative effects models (e.g. Christensen 1985) to predict future impacts on grizzly bears.

4. No future study that seeks to determine the population parameters of grizzly bears in an area should be of less than five years duration. Funding should be sufficient to allow researchers to travel in the back country in pairs, and for helicopter-assisted telemetry and site investigation in mountainous terrain.

5. Results of this and the future studies outlined above should be used to create buffer zones of prime protection around the parks. An inter-agency working group for grizzly bears and other carnivores should be established to assist with this recommendation. The World Wildlife Fund's Carnivore Conservation Area for the Rocky Mountain parks complex would make a good starting point for discussions (Hummel 1990).

The remaining recommendations pertain directly to the two parks:

6. The current hiking trail and back-country campground system in the two parks should be reviewed in light of recent and future grizzly bear studies. Re-routing of certain trails and relocation of campgrounds should be considered. For example, McArthur Creek Trail would be more suitable located on the opposite side of the valley downstream of the foot bridge. In this way it would be placed opposite the prime grizzly bear habitat on avalanche slopes where the trail is presently located. Theoretically, this would increase the amount of available habitat through reduced spatial and temporal displacement, and simultaneously reduce potential bear-human conflicts. In some cases, seasonal closures of access to certain prime grizzly bear habitat areas should be considered. For example, Goodsir Basin is heavily used by grizzly bears for the buffaloberry and hedysarum crops it supports. Therefore, seasonal closures may be appropriate during early spring (hedysarum), late July and August (buffaloberry) and/or possibly again restricting access in the fall (hedysarum). Closures in other areas will be more specifically tied to one particular season depending on the grizzly bear foods and life requisites that area supports.

7. The use of interpretive signs in regions of high bear densities could be a cost effective method of reducing potential conflicts. These signs would identify bear sign and inform visitors of which food species and habitats are preferred by grizzly bears. Precautions to be taken while hiking should also be highlighted. Recommended places for such signs include the McArthur Valley, Goodsir Basin and Helmut Falls area, Rockwall Pass, Tumbling Creek and other high grizzly bear use areas.

8. The present lenient approach to dealing with "problem bears" is encouraged. Current human management in regards to garbage controls, visitor education, appropriate area restrictions and continued inspection and enforcement are the favoured approaches. Individual bears which appear likely to habituate to people should be promptly and regularly subjected to aversive conditioning. This technique is only likely to be effective if a problem situation is given early attention. Translocation of problem bears is generally not an effective method of resolving human-bear conflicts (Kansas and Raine 1987b) and therefore, the preferred

approach is to institute preventative measures, and have prompt aversive conditioning as a back-up measure.

9. The Environmental Assessment Review Process should be used to assess the impacts of all development projects on grizzly bears and their habitat. Changes in trail and facility placement can have a negative impact on bears either directly through habitat loss and/or harassment or indirectly through management actions on bears involved in human-bear confrontations resulting from poor development decisions. Work being conducted in or near good grizzly bear habitat should be scheduled for times of the year when grizzly bear use in that area is low.

10. Park Fire Management Policies need to be sensitive to the habitat requirements of wildlife. As evidenced in this study, burns in YNP and the northern part of KNP were used extensively by certain grizzly bears. A fire management plan which simulates natural fire regimes is encouraged.

11. Placement of road-killed animals in centralized disposal pits could potentially affect the movements, behaviour and habitat use of grizzly bears. Therefore, this aspect should be monitored and whenever possible and feasible, carrion should be disposed of outside of the parks. For example, road-killed ungulates in BNP are sent to a vendering plant in Calgary for processing.

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APPENDIX I

1990 TABLES

Table 1. **Trap Locations In Yoho National Park, 1990.**

No.	Name	Location	Trap Type[a]	Ecoregion[b]	Ecosite	Elevation m.	Elevation ft.
1	Boulder Creek Road	NG335896	C	MO	OL-P	1341	4400
2	Ottertail Fire Road #1	NG330861	C	MO	TA-P	1219	4000
3	Yoho Valley Road	NG404988	C	MO	OL-SPD	1341	4400
4	Otterhead Fire Road	NG282897	C	MO	OL-SPD	1291	4000
5	Community Pasture #1	NG344915	C	MO	WR-P(Z)	1249	4100
6	Amiskwi Fire Road #1	NG280946	C	MO	DS-PS	1341	4400
7	Ottertail Fire Road #2	NG342858	C	MO	OL-P	1341	4400
8	Amiskwi Gravel Pit	NG295916	C	MO	DS-PS	1280	4200
9	Amiskwi Fire Road #2	NG260971	C	LS	OL-SF	1463	4800
10	Field Townsite West	NG356929	C	MO	BG-TB	1280	4200
11	Field Townsite East	NG358937	C	MO	Z	1280	4200

[a] C = culverts
[b] Ecoregions (MO = montane, LS = lower subalpine)

Table 2. Trap locations In Kootenay National Park, 1990.

No.	Name	Location	Trap Type	Ecoregion[a]	Ecosite	Elevation m	Elevation ft
1	Assiniboine Slide #2	NG728499	Snare	MO	DR3	1311	4300
2	Carrion Pit	NG680397	Culvert	MO	Pit	1250	4100
3	Dolly Varden	NG651343	Culvert	MO	DRG	1280	4200
4	Kimpton Creek	NG745089	Snare/Fly-In	MO	DR5	1402	4600
5	Settler's Road	NG807145	Snare	MO	AT1	1128	3700
6	Vermilion Bridge	NG697328	Snare	MO	DR8	1189	3900
7	Numa South	NG611639	Snare	LS	BY7	1402	4600
8	Numa North	NG586666	Snare	LS	FV5	1494	4900
9	Helmet Creek East	NG504719	Snare	LS	FV6	1737	5700
10	Helmet Creek West	NG498720	Snare	LS	BY1	1769	5800
11	Vermilion Pit	NG660752	Culvert	LS	Pit	1646	5400

a Ecoregions (MO = montane, LS = lower subalpine)

Table 3. **Trap nights and capture success of bear trapping efforts in Yoho and Kootenay National Parks, 1990.**

Park	Month	Trap Nights		Bear Captures	
		Snare	Culvert	Grizzly	Black
Yoho	April		5		
	May	4	75	2 [a]	
	June		89	2	5
	July		8	1	1
Kootenay	May	52	27		2 [b]
	June	27	52		
	July	20	83		1
TOTAL		**103**	**339**	**5**	**9**

a Includes the recapture of Bears 9 and 23.
b Note that the Assiniboine trap was also sprung twice by a black bear(s).

Note: In addition, Bear 23 was captured in a culvert trap in Banff during July.

Table 4. Number of seasonal locations obtained for radio-collared grizzly bears in the Yoho and Kootenay National Parks study area, 1990.

Bear ID	Season				Total
	Pre-Vegetation	Vegetation	Berry	Post-Berry	
1	2	15	16		**33**
2		15	16	22	**53**
4	13	6			**19**
5	3	19	10	20	**52**
9	10	56	20	12	**98**
11		11	11		**22**
23	18	56	28		**102**
Total	**46**	**178**	**101**	**54**	**379**

Table 7. NUMBER OF LOCATIONS BY ECOSITE FOR RADIO-COLLARED AND INCIDENTALLY OBSERVED GRIZZLY BEARS IN YOHO NATIONAL PARK, 1990.

	MONTANE																MONTANE & SUBALPINE		
SEASON	BG-DN	BG-DP	BG-P	BG-SD	BG-TB	CM-TS	DS-PS	FL-PD	G	OL-P	OL-SPD	WAP	WR-P(2)	WR-SC	WR-ST	Z	BC-W	CO-SDP	WR-GSd
1		2	3	1				2	2	1									
2	2	18	2	4	6		1			4	1		10	1	1	5	1	1	
3				1		1	2			1		1					2		1
4										1			1						
TOTAL	2	20	5	6	6	1	3	2	2	7		1	11	1	1	5	3	1	1

	LOWER SUBALPINE										UPPER SUBALPINE									ALPINE		
SEASON	BG-A	BG-SF	CM-SF	FL-SF	M	OG-SF	OH-SF	OL-SF	TA-S	WR-SF	OD-aL	OD-F	R	R-aL	R-whP	SI-a	SI-F	SI-whP	X	OO-H	R	SK-H
1	4	4		1									1	1							3	
2	15	10	5	3	1	4	3	2	11	1						2	1	1		1	2	
3	5	5		2		5			2								1			1		
4	4	6	4	2		1					1	2	1		1	1	2		1			1
TOTAL	28	25	9	8	1	10	3	2	13	1	1	2	2	1	1	3	4	1	1	2	5	1

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Table 8. Number of locations by ecosite for radio-collared and incidentally observed grizzly bears in Kootenay National Park, 1990.

	MONTANE									
SEASON	AT1	DG6	DR2	DR5	DR6	DR7	FR3	HD3	HD6	VL6
1	1		2		2	1		1	1	1
2		1		4		1				
3	3		1	1	1	2	1			
4				1	1					
TOTAL	4	1	3	6	4	4	1	1	1	1

	LOWER SUBALPINE													
SEASON	AL3	BY1	BY3	BY4	BY5	BY6	BY7	CA2	FV5	FV6	HC1	IB4	SB1	SB3
1				2			1			2				
2	1			1				1	5	3			3	
3	1	2	1	1	3	1	1		2	1	2	2	3	1
4														
TOTAL	2	2	1	4	3	1	2	1	7	6	2	2	6	1

	UPPER SUBALPINE			
SEASON	EG4	PL6	WH4	WH7
1				
2			1	2
3	1	1		
4				
TOTAL	1	1	1	2

Table 9. Number of locations by ecosite for radio-collared grizzly bears in Banff National Park, 1990.

LOWER SUBALPINE

SEASON	AL1	BK1	BY4	BV1	BV2	CA4	CV1	FV1	HC1	HC4	MC1	ML1	PP1	PP3	PP6	PR1	PR3	PR4	PR4+R	PR6	SB1	VD2
1									1	1				1						2		
2		1		1	1		9	2	2	1	1	2	2	5	1		3	1			1	
3	1	2	1	3	1	1	4		3	1		1	2	5		1	3	1	1	1		1
4																						
TOTAL	1	3	1	4	2	1	13	2	6	3	1	3	4	11	1	1	6	2	1	3	1	1

UPPER SUBALPINE

SEASON	EG1	EN2+R	LV2	NT2	SX2	SX3	WF2	WF3+R	WH5
1									
2			1	4	3	1	3		2
3	1	1							
4								1	
TOTAL	1	1	1	4	3	1	3	1	2

Table 10. Number of locations by vegetation type for radio-collared and incidentally observed grizzly bears in the Yoho and Kootenay National Parks study area, 1990.

	CLOSED FOREST												OPEN FOREST				
SEASON	03	14	15	18	19	21	23	37	38	41	42	55	04	05	06	12	13
1	3	1		6	1									1	1		
2	2	1	1				1	1		1	1	2			1	1	
3		5				2			2								1
4	1	2											1				
TOTAL	6	9	1	6	1	2	1	1	2	1	1	2	1	1	2	1	1

	SHRUB						HERB-DWARF SHRUB	OTHER		
SEASON	02	05	11	12	80	90	98	PIT	ROCK	SNOW
1					3		1			
2				1	1	2	14		1	
3	1	3	1				3	1		1
4										
TOTAL	1	3	1	1	4	2	18	1	1	1

Table 5. **Seasonal observations of grizzly bear feeding in the Yoho and Kootenay National Parks study area, 1990.**

Food Item	SEASON			
	Pre-Vegetation	Vegetation	Berry	Post-Berry
Horsetail (*Equisetum arvense*)		11		
Horsetail spp.		1		
Lady Fern			1	
Sub-Alpine Fir		1		
White Bark Pine				2
Graminoids		33	4	
Glacier Lily		1		
False/Hellebore (root)		1		
Nettle			1	
Spring Beauty		1		
Meadow Rue				
Globe Flower		1		
Vetch (*Astragulus*)	1	2		
Hedysarum (*Hedysarum sulphurescens*)		1		
Hedysarum spp.	4	2	1	
Buffaloberry		1	10	
Fireweed		3	1	
Cow Parsnip		15	8	
Grouseberry			1	1
Huckleberry			2	
Blueberry spp.			2	
Bracted Lousewort		1		
Elderberry			1	
Triangular-leaved Ragwort			2	
Dandelion		5		
Roots		1		
Berries[a]			2	
Ants		4	7	
Ground Squirrel		1		
Rodents			1	
Moose			1	
Elk	6			
Whitetail Deer			3	
Deer spp.			1	
Mountain Goat	3		1	
Bighorn Sheep				1
Ungulate			1	
Carrion		1		
Dog Food		1		

a Presumed feeding on numerous berries at two sites where presence was confirmed.

Table 6. **Percent volume and frequency of occurrence of food items found in grizzly bear scats collected in the Yoho and Kootenay National Parks study area, by season, 1990.**

	SEASON			
Food Item	**Pre-Vegetation**	**Vegetation**	**Berry**	**Post-Berry**
n=	**12**	**69**	**50**	**4**
Horsetail		19.6[a] (47.8)[b]	7.7 (24.0)	
Whitebark Pine				73.0 (75.0)
Graminoid		54.3 (85.5)	7.8 (54.0)	
Twisted Stalk			0.5 (2.0)	
Nettle		tr[c]		
Gooseberry			0.8 (12.0)	
Astragalus	6.2 (8.3)			
Hedysarum	41.3 (41.7)	8.2 (14.5)	0.1 (2.0)	2.0 (25.0)
Crowbery			0.1 (4.0)	
Buffaloberry		tr	15.3 (46.0)	
Fireweed		0.1 (1.4)		
Cow Parsnip		11.0 (17.4)	28.0 (40.0	
Bearberry		tr	tr	
Bunchberry		tr	tr	
Blueberry			23.6 (44.0)	25.0 (25.0)
Ants		0.4 (11.6)	2.3 (8.0)	
Ground Squirrel			0.2 (2.0)	
Elk	25.0 (25.0)			
Deer	8.3 (8.3)		2.0 (2.0)	
Mountain Goat	16.7 (16.7)	1.0 (2.8)	2.0 (2.0)	
Small Mammal		tr		
Unid. Mammal	2.3 (16.7)	0.8 (1.4)	3.8 (6.0)	
Unid. Vegetation		4.4 (33.3)	1.2 (24.0)	
Garbage		tr		
Carrion			2.0 (2.0)	

a Percent volume.
b Percent frequency of occurrence.
c Trace: percent volume <0.1%

Table 11. Number of locations by ecoregion for radio-collared and incidentally observed grizzly bears in the Yoho and Kootenay National Parks study area, 1990.

	ECOREGION				
Season	Montane	Montane/ Subalpine	Lower Subalpine	Upper Subalpine	Alpine
1	19		17		5
2	65	2	112	15	4
3	16	3	77	8	2
4	6		24	14	1
Total	**106**	**5**	**228**	**37**	**12**

APPENDIX II

NEW ECOLOGICAL LAND CLASSIFICATION UNITS FOR YOHO NATIONAL PARK DESCRIBED IN KANSAS ET AL. 1989A

New Ecological Land Classification Units

Three new Ecosections and ten new Ecosites were recognized in YNP to account for combinations of landscape components (landform, soils, vegetation) not covered in the ecological land classifications of BNP-JNP (Holland and Coen 1982) and KNP (Achuff *et al.* 1984). This current legend conversion is not fully satisfactory, but summarizes the present information and provides a starting point for final, additional work.

Burgess (BG) Ecosection

The Burgess (BG) Ecosection occurs throughout the Montane Ecoregion of YNP and includes Montane forest vegetation on calcareous, colluvial landforms with Regosolic soils more common than Brunisolic soils. Four BG Ecosites are differentiated by vegetation, landform and soil features:

Ecosite	Landform	Soils	Vegetation
BG1	Cv, Cb/Ri	OR OEB	lodgepole pine forest (C06, C19, C20, C38)
BG2	Cv, Cb/Ri	CuR, OR	Douglas fir and white spruce forest (CO1, CO5, C55)
BG3	Cv, Cb/Ri	OR, CuR	aspen and mixedwood forest (C22, C44)
BG4	Ff/Cv, Cb-a	CuR, OR	aspen, paper birch and mixed wood forest (C22, C44, O01)

The BG1 Ecosite is characterized by a soil pattern of Orthic Regosols being more common than Orthic Eutric Brunisols and by mesic lodgepole pine forests (C06, C19, C20 and C38). Other lodgepole pine vegetation types (C03, C10 and C39) are minor components. BG1 is similar to DG6 in KNP but in DG6, Brunisolic soils are more common than Regosolic ones. The YNP biophysical map units BG-P and BG-DP are equivalent to BG1.

BG2 contains only Regosolic soils (Cumulic and Orthic Regosols) and the vegetation is Douglas fir and white spruce forest (C01, C05, C55). The lodgepole pine types C03 and C38 are a minor component. BG2 is derived largely from the YNP biophysical map unit BG-SD.

The BG3 Ecosite has soils similar to BG2 (Cumulic and Orthic Regosols) but the vegetation is characterized by aspen and mixedwood forests (C22 and C44). O05 is a minor vegetation type. BG3 occurs primarily in the Porcupine Creek area and includes the BG-TD and BG-TS biophysical map units.

BG4 differs from the other BG ecosites primarily in landform characteristics. BG4 occurs on fluvial veneers over colluvial veneers and blankets, and the sites are often affected by snow avalanching. The soils are typical Orthic and Cumulic Regosols, and the vegetation includes aspen, paper birch and mixedwood forests (C22, C44 and O01). S15 and other avalanche shrub communities occur in avalanched portions of some polygons. The YNP biophysical map unit BG-TB is included in BG4.

Float (FL) Ecosection

The Float (FL) Ecosection is characterized by landforms of calcareous, colluvial veneers and blankets over inclined bedrock, by Orthic Eutric Brunisols and Orthic Humo-Ferric Podzols, and by Lower Subalpine spruce-fir forests (C13, C14 and C21). Minor vegetation types include Douglas fir-lodgepole pine forests (C55) and the avalanche shrub types S02 and S13 which occur in portions of some polygons. FL is similar to the Sawback (SB) Ecosection of BNP, JNP and KNP but SB has Brunisols and Regosolic soils as contrasted with Brunisolic and Podzolic soils in FL. One ecosite (FL1) is recognized and it is equivalent to the YNP biophysical map units FL-SF and FL-SF(b).

Garonne 2 (GA2) Ecosite

The GA2 Ecosite consists of hummocky, colluvial landforms (landslide) with calcareous Orthic and Cumulic Regosols, and Montane white spruce and white spruce-Douglas fir forest (C05, C13). The single polygon of this ecosite occurs near the confluence of the Yoho and Kicking Horse Rivers on the east side of Mount Field. The GA Ecosection, with one ecosite (GA1), was originally described in BNP and JNP. The two ecosites have different vegetation; GA1 has lodgepole pine forest while GA2 has white spruce and white spruce-Douglas fir forest. The YNP biophysical map unit counterpart of GA2 is BG-SD (LS).

Hillsdale 5 (HD5) Ecosite

#6813

HD5 includes fluvial fan, apron and terrace landforms with calcareous Orthic and Cumulic Regosols (some gleyed phases) and lodgepole pine forest (C57, C58, C03) in the Montane Ecoregion. Minor vegetation types include C11, C19, C39 and O03. Other HD ecosites occur in BNP, JNP and KNP but HD5 differs in having lodgepole pine vegetation. The YNP biophysical map unit equivalents to HD5 are WR-P and KI-PSj.

Norquay 2 Ecosite

NY2 is characterized by morainal blankets with calcareous Cumulic Regosols and mesic lodgepole pine forest (C55, C55 and C20) in the Montane Ecoregion. NY2 occurs on steep river banks and valley walls. Other NY ecosites occur in BNP and JNP but NY2 differs in having only Regosolic soils and different lodgepole pine forest vegetation types. TO-PD is the YNP biophysical map unit equivalent of NY2.

Silverslope (SI) Ecosection

The Silverslope (SI) Ecosection is characterized by colluvial veneer and blanket landforms with Podzolic and Brunisolic soils developed in a calcareous parent material and by Upper Subalpine forest vegetation. SI is similar to the Wildflower (WF) Ecosection of BNP, JNP and KNP but differs primarily in having Podzolic and Brunisolic soils versus Brunisolic and Regosolic soils in WF. Two ecosites, SI1 and SI2, are recognized:

Ecosite	Landform	Soil	Vegetation
SI1	Cv, Cb/Ri	OHFP, OEB (+ lithic)	spruce-fir open forest (O10, O10 + L05)
SI2	Cv, Cb/Ri	OHFP, OEB (+ lithic)	subalpine larch forest (C23, O13)

SI1 occurs throughout YNP on calcareous, colluvial sites with Orthic Humo-Ferric Podzols and Orthic Eutric Brunisols, including lithic phases shallow over bedrock. The vegetation component differentiates SI1 from SI2 and typically consists of spruce-fir open forest (O10, O10 and L05). Related spruce-fir closed forests (C15, C21 and C34) occur in small amounts. Some tracts are affected by snow avalanches and contain the typical vegetation types of Avalanche Complex 2 including S02, H16, L07 and intergrades. Some SI1 tracts in the Amiskwi Valley have been heavily burned and currently contain a post-fire community dominated by grouseberry and fireweed. SI-F and SI-F (b) are the YNP biophysical map unit counterparts to SI1.

SI2 occurs on calcareous, colluvial blanket and veneer landforms with Orthic Humo-Ferric Podzols and Orthic Eutric Brunisols, including lithic phases. It is differentiated from SI1 by having subalpine larch forests (C23, O13) rather than spruce-fir forests. The YNP biophysical map unit equivalent is SI-aL.