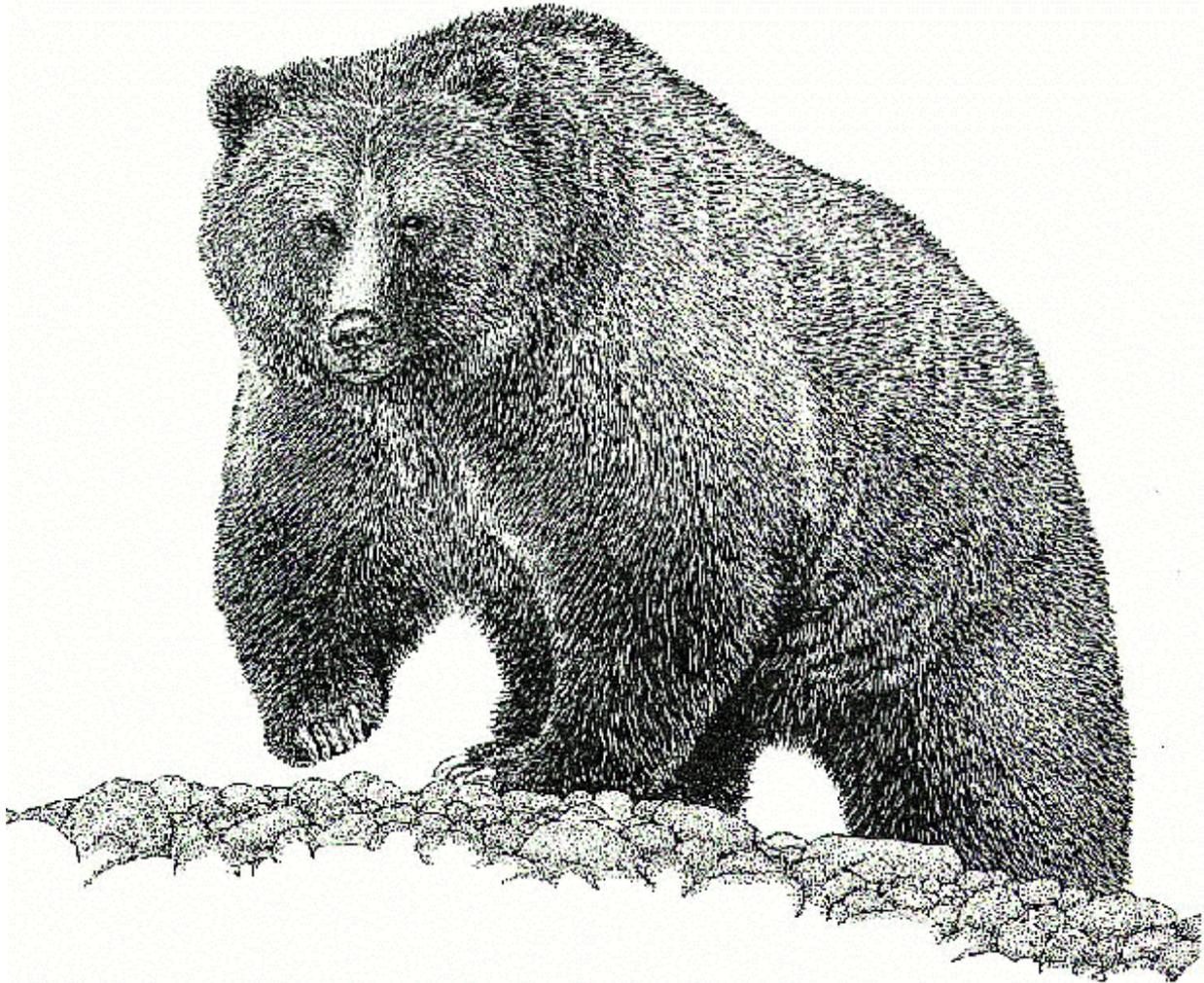


# **CABINET-YAAK GRIZZLY BEAR RECOVERY AREA 2009 RESEARCH AND MONITORING PROGRESS REPORT**



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**Abstract:**

Numbers of females with cubs in the Cabinet-Yaak recovery zone varied from 1-4 per year and averaged 2.0 per year from 2004-09. One adult female is known to have died during 2009 in a self defense incident. Known and probable human caused mortality averaged 1.2 total bears per year and 0.7 females per year during 2004-09. Seven known or probable human caused mortalities of grizzly bears have occurred in the recovery zone or within 10 miles since 2004. Human caused mortalities during 2004-09 were 2 adult females (self defense), 2 subadult females (1 under investigation, but human caused and a train collision), 1 subadult male (black bear mistaken identity), and 2 bears of unknown sex (under investigation, but human caused). Eleven of 22 bear management units had sightings of females with young during 2004-09.

Minimum number of grizzly bears during 2004-09 was estimated to be 42 individuals in the Cabinet-Yaak recovery zone based on current and previous captures and sightings of unique individuals. This estimate assumes all other bears not known to be dead have survived the six year period. Mortality causes, timing, and locations were analyzed for 1983-09. Estimates of cause specific mortality rates, reproductive rates, and population trend were updated with new information.

Grizzly bear research in the Cabinet Mountains indicated that only a small population remained as of 1988. Furthermore, it was believed that this population would not persist unless intensive management steps were taken. An effort to test population augmentation techniques began in 1990. Four subadult female bears with no history of conflicts with humans were captured in southeast British Columbia and moved to the Cabinet Mountains for release during 1990-94. Three of four transplanted bears remained within the target area for at least one year. Hair snag sampling and DNA analysis during 2002-09 identified one of the transplanted bears. The animal was a 2 year-old female when released in 1993. Genetic analysis also identified at least 2 female offspring from the 1993 release and a female offspring from one of those bears. The success of the augmentation test program prompted additional augmentation by Montana Fish Wildlife and Parks in the form of 5 female bears moved from the Flathead River to the Cabinet Mountains during 2005-09. Two of these individuals died during their first year from human related causes. One was illegally shot and one was struck by a train. Individual and monitoring data was summarized.

Thirty-eight individual grizzly bears and 362 black bears were captured by research trapping from 1986-2009 in the Yaak River drainage. Mean trap nights per individual grizzly bear captured was 207 and mean trap nights per individual black bear captured was 22. Eight grizzly bears and 286 black bears were captured from 1983-09 in the Cabinet Mountains. Mean trap nights per individual grizzly bear captured were 868 and mean trap nights per individual black bear captured were 24. Annual and life range adaptive kernel and minimum convex polygon grizzly bear home ranges are reported. Grizzly bear use of elevation, aspect and vegetation type was analyzed for seasonal trends. Berry counts indicated greater than average Serviceberry and Mountain-ash production during 2009 and significantly greater than average production of Huckleberry and Buffaloberry in 2009.

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## INTRODUCTION

Grizzly bear (*Ursus arctos*) populations south of Canada are currently listed as Threatened under the terms of the 1973 Endangered Species Act (16 U.S.C. 1531-1543). In 1993 a revised Recovery Plan for grizzly bears was adopted with specific measures to aid recovery were identified (USFWS 1993). Seven areas were identified in the Recovery Plan as ecosystems in which grizzly bears or their habitat was thought to occur (Fig. 1). One area identified was the Cabinet-Yaak Grizzly Bear recovery zone (CYGBRZ) of extreme northwestern Montana and northeast Idaho. This area lies directly south of Canada and encompasses approximately 6800 km<sup>2</sup>. The Kootenai River bisects the area with the Cabinet Mountains portion to the south and the Yaak River portion to the north. The degree of grizzly bear movement between the two portions is unknown but thought to be minimal. The U.S. Fish and Wildlife Service issued a 12-month finding of warranted for endangered status but precluded by other listing actions on February 12, 1993 (58 FR 8250-8251).

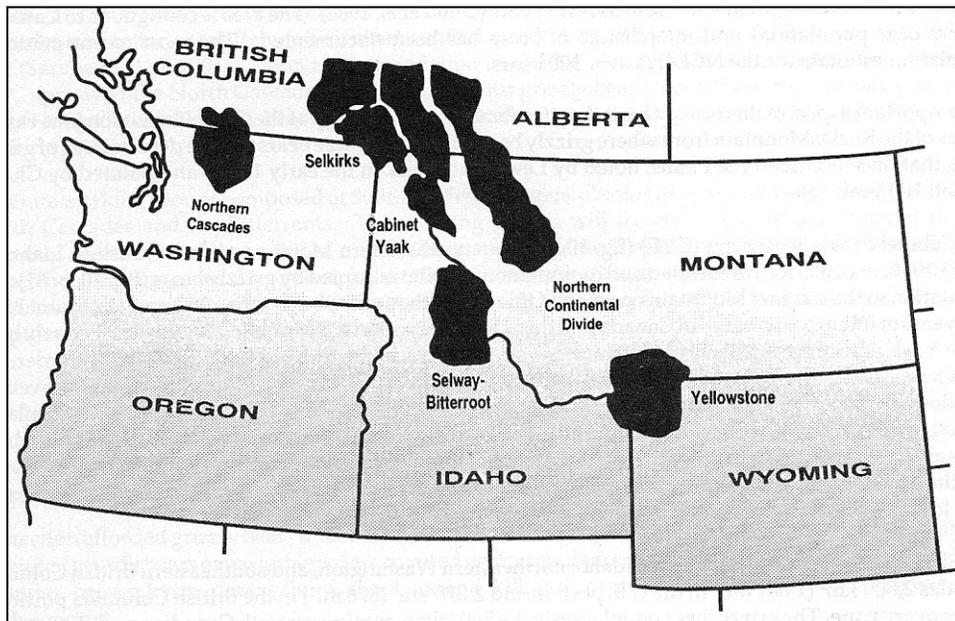


Figure 1. Grizzly bear recovery areas in the U.S., southern British Columbia, and Alberta, Canada.

Research on native grizzly bears began south of the Kootenai River during the late 1970's. Erickson (1978) reported the results of a survey he conducted for bears and their sign in the Cabinet Mountains and concluded the population consisted of approximately a dozen animals. A trapping effort in 1979 and 1980 in the same area failed to capture a grizzly bear, but a female and yearling were observed (Thier 1981). In 1983 trapping efforts were resumed and intensified (Kasworm and Manley 1988). Three individual grizzly bears were captured and radio-collared during 1983-1987. Minimal reproduction was observed during the period and the population was believed to be declining toward extinction. To reverse this trend, a formal plan was proposed in 1987 to augment the Cabinet Mountains portion of the population with subadult female bears from outside the area (USFWS 1990, Servheen et al. 1987).

Two approaches for augmenting grizzly bears were proposed. The first involved transplanting adult or subadult grizzly bears from other areas of similar habitat to the Cabinet Mountains. Transplants would involve bears from remote areas that would have no history of conflict with humans. The use of subadult females was recommended because of their smaller home ranges and potential reproductive contribution. The second approach relied on the cross fostering of grizzly bear cubs to American black bear (*Ursus americanus*) females. Under this approach, grizzly bear cubs from zoos would be placed in the maternal dens of black bear females during March or April. The fostering of orphaned black bear cubs to surrogate black bear females has been used successfully in several areas (Alt and Beecham 1984, Alt 1984).

During public review, many concerns were expressed which included: human safety, conflicts with other land-uses, and long-term grizzly bear population goals. A citizen's involvement committee was formed to aid information exchange between the public and the agencies. Representatives of several local organizations donated their time to further this purpose. The first product of this group was a question and answer brochure regarding grizzly bears in the CYGBRZ. This brochure was mailed to all box holders in Lincoln and Sanders counties. In response to concerns expressed by the committee, the augmentation proposal was modified to eliminate cross fostering and to reduce total numbers of transplanted bears to four individuals over five years. The beginning date of augmentation was also postponed for one year to allow additional public information and education programs.

Prior to 1986, little work was conducted on grizzly bears in the Yaak River portion of the CYGBRZ. Bears that used the area were thought to be largely transitory from Canada. However, a black bear study in the Yaak River drainage in 1986 and 1987 resulted in the capture and radio-collaring of five individual grizzly bears (Thier 1990).

The Yaak River area has traditionally been an important source of timber for area mills, with timber harvesting the dominant use of the area. A pine beetle (*Dendroctonus ponderosae*) epidemic began in the mid 1970's. Large stands of lodgepole pine (*Pinus contorta*) were infected, which resulted in an accelerated timber-harvesting program with clearcutting the dominant silvicultural technique. A concern of environmental degradation, as well as the effects of timber harvesting on the local grizzly bear population, prompted a lawsuit against the Forest Service by a local citizen's group in 1983 (USFS 1989). To obtain additional information on the population status and habitat needs of grizzlies using the area, the U.S. Forest Service and Montana Department of Fish, Wildlife, and Parks cooperated with the U.S. Fish and Wildlife Service in initiating a long term study, with field work began in June of 1989.

## **OBJECTIVES**

### **A. Cabinet Mountains Population Augmentation:**

Test grizzly bear augmentation techniques in the Cabinet Mountains to determine if transplanted bears will remain in the area of release and ultimately contribute to the population through reproduction.

### **B. Recovery Zone Research and Monitoring:**

1. Document grizzly bear distribution in the Cabinet/Yaak Grizzly Bear Ecosystem.
2. Describe and monitor the grizzly bear population in terms of reproductive success, age structure, mortality causes, population trend, and population estimates.
3. Determine habitat use and movement patterns of grizzly bears. Determine habitat preference

by season and assess the relationship between habitats affected by man such as logged areas and grizzly bear habitat use. Evaluate grizzly bear movement permeability of the Kootenai River valley between the Cabinet Mountains and the Yaak River drainage and across the Moyie River Valley in British Columbia.

4. Determine the relationship between human activity and grizzly bear habitat use through the identification of areas used more or less than expected in relation to ongoing timber management activities, open and closed roads, and human residences.
5. Identify mortality sources and management techniques to limit human-caused mortality of grizzly bears.
6. Conduct black bear studies incidental to grizzly bear investigations to determine interspecific relations. Data on black bear densities, reproduction, mortality, movements, habitat-use, and food habits relative to grizzly bears will be gathered and analyzed.

## STUDY AREA

The CYGBRZ (48° N, 116° W) encompasses approximately 6,800 km<sup>2</sup> of northwest Montana and northern Idaho (Fig. 2). The Cabinet Mountains constitute about 58% of the CYGBRZ and lie south of the Kootenai River. The Yaak River portion borders Canadian grizzly populations to the north. There are two potential linkage areas between the Yaak and the Cabinets – one between Libby and Troy and one between Troy and the Idaho line. However, we have yet to document any grizzly bear movement between these areas or grizzly bear use within these linkage zones. Approximately 90% of the recovery area is on public land administered by the Kootenai, Lolo, and Panhandle National Forests. Plum Creek Timber Company Inc. and Stimson Corp. are the main corporations holding a significant amount of land in the area. Individual ownership exists primarily along major rivers, and there are numerous patented mining claims along the Cabinet Mountains Wilderness boundary. The Cabinet Mountains Wilderness encompasses 381 km<sup>2</sup> of higher elevations of the study area in the Cabinet Mountains. Bonners Ferry, Libby, Noxon, Sandpoint, Troy, Thompson Falls, and Trout Creek are the primary communities adjacent to the Cabinet Mountains.

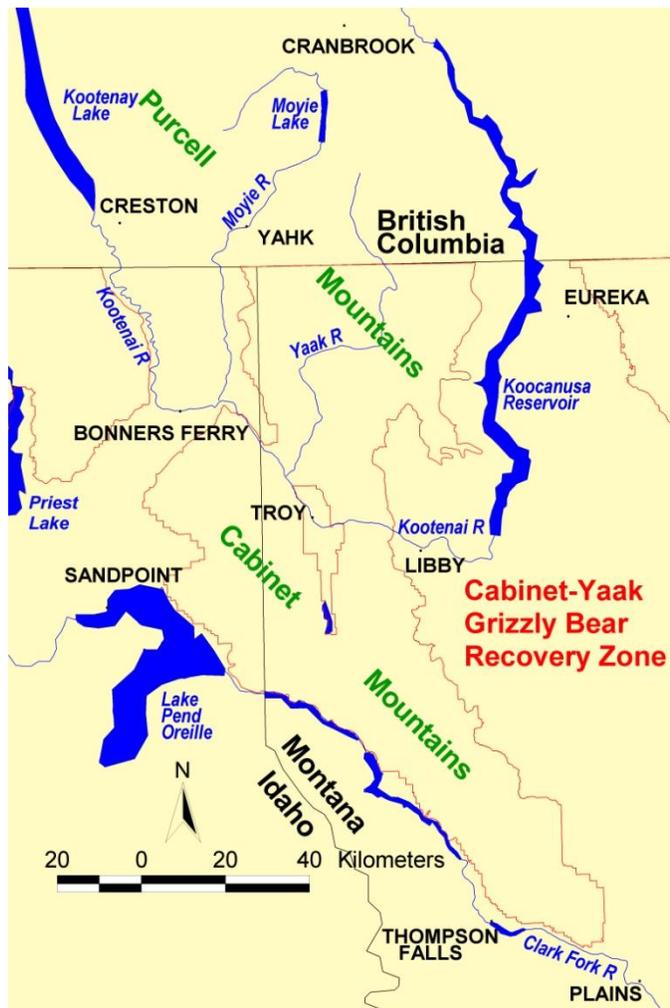


Figure 2. Cabinet Yaak grizzly bear recovery zone.

Elevations in the Cabinet Mountains range from 610 m along the Kootenai River to 2,664 m at Snowshoe Peak. The area has a Pacific maritime climate characterized by short, warm summers and heavy, wet winter snowfalls. Lower, drier slopes support stands of ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*), whereas grand fir (*Abies grandis*), western red cedar (*Thuja plicata*), and western hemlock (*Tsuga heterophylla*) dominate lower elevation moist sites. Subalpine fir (*Abies lasiocarpa*), spruce (*Picea spp.*), and mountain hemlock (*Tsuga mertensiana*) dominate stands between 1,500 m and timberline. Mixed coniferous and deciduous tree stands are interspersed with riparian shrubfields and wet meadows along major drainages. Huckleberry (*Vaccinium spp.*) and mixed shrubfields are partially a result of wildfires that occurred in 1910 and 1929 and more recent stand replacing fires. Fire suppression has reduced wildfires as a natural force creating or maintaining berry-producing shrubfields.

The Yaak River drainage lies in the extreme northwestern corner of Montana, northeastern Idaho, and southern British Columbia and is bounded on the east and south by Lake Kooconusa and the Kootenai River, to the west by the Moyie River, and to the north by the international boundary. Two north-south trending mountain ranges dominate the landscape - the McGillivray range in the east and the Purcell range to the west. Topography is varied, with rugged, alpine glaciated peaks present in the Northwest Peaks Scenic Area. Rounded peaks and ridges cover most of the remaining area, a result of continental glaciation. Coniferous forests dominate, with cutting units the primary source of diversity. Much of the Yaak River is low gradient and the river tends to meander, creating lush riparian zones and meadows. Elevations range from 550 m at the confluence of the Kootenai and Moyie Rivers to 2348 m atop Northwest Peak. Vegetation is diverse, with an overstory of western hemlock and western red cedar the indicated climax species on much of the study area. Ponderosa pine and Douglas-fir are common at lower elevations on south and west slopes. Subalpine fir and spruce dominate the upper elevations and cirque basins. Large stands of lodgepole pine and western larch (*Larix occidentalis*) occur at mid and upper elevations and are largely the result of extensive wildfires in the past. In recent years, several stand altering fires have occurred in the Yaak River.

Understory and non-forested habitats include graminoid parks consisting primarily of fescue (*Festuca spp.*) and bluebunch wheatgrass (*Agropyron spicatum*), which occur at moderate to high elevations. Riparian shrubfields of red-osier dogwood (*Cornus stolonifera*) and hawthorn (*Crataegus douglasii*) are prevalent along major drainages. Buffaloberry (*Shepherdia canadensis*) is common under stands of open lodgepole pine while serviceberry (*Amelanchier alnifolia*) and chokecherry (*Prunus virginiana*) prevail on drier, rockier sites. Huckleberry shrubfields are often found under open timber canopies adjacent to graminoid parks, in old burns, in cutting units, and intermixed with beargrass (*Xerophyllum tenax*).

During 1990-1994, Cabinet Mountains population augmentation trapping was conducted in the upper North Fork of the Flathead River drainage and the Wigwam River drainage in southeast British Columbia, approximately 10-40 km north of the U.S. border. During 1992 trapping was conducted south of the international border in the North Fork of the Flathead River. Subalpine fir was the indicated climax species throughout most of the area, with lodgepole pine the most prevalent. Recent wildfires at upper elevations have had more influence on habitat in the CYGBRZ. An outbreak of pine bark beetles resulted in logging large areas at lower elevations during the 1980's. Large portions of upper elevations had been logged earlier in response to a spruce bark beetle (*Dendroctonus obesus*) epidemic.

## **METHODS**

### **Grizzly Bear Observations**

All grizzly bear observations and reports of sign (tracks, digs, etc.) by study personnel and the public were recorded. Grizzly bear sighting forms were sent to a variety of field personnel from different agencies to maximize the number of reports received. Sightings of grizzly bears were rated 1-5 with 5 being the best quality and 1 being the poorest. General definitions of these categories are presented below, but it was difficult to describe all circumstances under which sightings were reported. Only sightings receiving ratings of 4 or 5 were judged credible and used in reports. Sightings that rate 1 or 2 may not always be recorded in the database.

5 - Highest quality reports typically from study personnel or highly qualified observers. Sightings not obtained by highly qualified observers must have physical evidence such as pictures, track measurements, hair, or sightings of marked bears where marks are accurately described.

4 - Good quality reports that provide credible, convincing descriptions of grizzly bears or their sign. Typically these reports include a physical description of the animal mentioning several characteristics. The observer had sufficient observation time and was close enough or had binoculars to aid in identification. Observer demonstrates sufficient knowledge of identification characteristics to be regarded as a credible observer. Background or experience of observer may influence credibility.

3 - Moderate quality reports that do not provide convincing descriptions of grizzly bears. Reports may mention 1 or 2 characteristics, but the observer does not demonstrate sufficient knowledge of characteristics to make a reliable identification. Observer may have gotten a quick glimpse of the bear or been too far away for a good quality observation.

2 - Lower quality observations that provide little description of the bear other than the observer's judgment that it was a grizzly bear.

1 - Lowest quality observations of animals that may not have been grizzly bears. This category may also involve second hand reports from other than the observer.

### **Survival Calculation**

Survival rates for all age classes except cubs were calculated by use of the Kaplan-Meier procedure as modified for staggered entry of animals (Pollock et al. 1989, Wakkinen and Kasworm 2004). Assumptions of this method include: marked individuals were representative of the population, individuals had independent probabilities of survival, capture and radio collaring did not affect future survival, censoring mechanisms were random, a time origin could be defined, and newly collared animals had the same survival function as previously collared animals. Censoring was defined as radio-collared animals lost due to radio failure, radio loss, or emigration of the animal from the study area. Kaplan-Meier estimates may differ slightly from Booter survival estimates used in the trend calculation.

Our time origin for each bear began at capture. If a bear changed age classification while radio-collared (i.e., subadult to adult), the change occurred on the first of February (the assigned birth date of all bears). Weekly intervals used in the Kaplan-Meier procedure during

which survival rates were assumed constant. No mortality was observed during the denning season. Animals were intermittently added to the sample over the study. Mortality dates were established based on radio telemetry, collar retrieval, and mortality site inspection. Radio failure dates were estimated using the last radiolocation date when the animal was alive.

Cub survival rates were estimated by  $1 - (\text{cub mortalities} / \text{total cubs observed})$ , based on observations of radio-collared females (Hovey and McLellan 1996). Mortality was assumed when a cub disappeared or if the mother died. Cubs were defined as bears < 1.0 year old.

Bears captured and relocated to the Cabinet Mountains as a test of population augmentation (Kasworm et al. 1998) were not included in the analyzed sample. None of these animals had any prior history of nuisance activity. Several bears that were captured as part of a preemptive move to avoid nuisance activity were included.

## Reproduction

Reproduction data was gathered through observations of radio-collared females with offspring. Because of possible undocumented neonatal loss of cubs, no determination of litter size was made if an observation was made in the summer or fall. Interbirth interval was defined as the length of time between subsequent births if the offspring lived at least to the end of breeding season (late July). If cubs were produced but lost in the first year, that year was included in any subsequent interbirth interval. Age of first parturition was calculated using techniques described by Garshelis et al. (1998). Presence or lack of cubs was determined by observations of known-age radio-collared females or measurements and coloration of mammary glands at capture.

## Population Growth Rate

We used the software program Booter 1.0 (© F. Hovey, Simon Fraser University, Burnaby, B.C.) to estimate the finite rate of increase ( $\lambda$  or lambda) for the study area's grizzly bear populations. The estimate of  $\lambda$  was based on adult and subadult female survival, yearling and cub survival, age at first parturition, reproductive rate, and maximum age of reproduction.

Booter uses the following revised Lotka equation (Hovey and McLellan 1996), which assumes a stable age distribution:

$$(1) \quad 0 = \lambda^a - S_a \lambda^{a-1} - S_c S_y S_s^{a-2} m [1 - (S_a / \lambda)^{w-a+1}],$$

where  $S_a$ ,  $S_s$ ,  $S_y$ , and  $S_c$  are adult female, subadult female, yearling, and cub survival rates, respectively,  $a$  = age of first parturition,  $m$  = rate of reproduction, and  $w$  = maximum age. Booter calculates annual survival rates with a seasonal hazard function estimated from censored telemetry collected through all years of monitoring in calculation of  $\lambda$ . Point estimates and confidence intervals may be slightly different from those produced by Kaplan-Meier techniques (differences in Tables 14 and 15). Survival rate for each class was calculated as:

$$(2) \quad S_i = \prod_{j=1}^k e^{-L_j (D_{ij} - T_{ij})}$$

where  $S_i$  is survival of age class  $i$ ,  $k$  is the number of seasons,  $D_{ij}$  is the number of recorded deaths for age class  $i$  in season  $j$ ,  $T_{ij}$  is the number of days observed by radio telemetry, and  $L_j$

is the length of season  $j$  in days. Cub survival rates were estimated by  $1 - (\text{cub mortalities} / \text{total cubs born})$ , based on observations of radio-collared females. Intervals were based on the following season definitions: spring (1 April - 31 May), summer (1 June - 31 August), autumn (1 September - 30 November), and winter (1 December - 31 March). Intervals defined seasons when survival rates were assumed constant and corresponded with traditional spring and autumn hunting seasons and the denning season.

Booter provides several options to calculate a reproductive rate ( $m$ ) and we selected three to provide a range of variation (McLellan 1989). The default calculation requires a reproductive rate for each bear based upon the number of cubs produced divided by the number of years monitored. We input this number for each adult female for which we had at least one litter size and at least three successive years of radio monitoring, captures, or observations to determine reproductive data. We ran the model with this data and produced a trend calculation. Among other options, Booter allows use of paired or unpaired litter size and birth interval data with sample size restricted to the number of females. If paired data is selected, only those bears with both a known litter size and associated interbirth interval are used. The unpaired option allows the use of bears from which accurate counts of cubs were not obtained but interval was known, for instances where litter size was known but radio failure or death limited knowledge of intervals. To calculate reproductive rates under both these options, the following formula was used (from Booter 1.0):

$$(3) \quad m = \frac{\sum_{i=1}^n \frac{\sum_{j=1}^p L_{ij}}{\sum_{j=1}^k B_{ij}}}{n}$$

where  $n$  = number of females;  $j$  = observations of litter size ( $L$ ) or interbirth interval ( $B$ ) for female  $i$ ;  $p$  = number of observations of  $L$  for female  $i$ ; and  $k$  = number of observations of  $B$  for female  $i$ . Note  $k$  and  $p$  may or may not be equal. Cub sex ratio was assumed to be 50:50 and maximum age of female reproduction ( $w$ ) was set at 27 years (Schwartz et al. 2003). Average annual exponential rate of increase was calculated as  $r = \log_e \lambda$  (Caughley 1977).

### Capture and Marking

Bears were captured with leg-hold snares following the techniques described by Johnson and Pelton (1980) and Jonkel (1993). The snares were manufactured by Aldrich Snare Co. (Clallam Bay, WA) and consist of 6.5 mm braided steel aircraft cable. All bears were immobilized with Telazol (tiletamine hydrochloride and zolzapam hydrochloride), a mixture of Ketaset (ketamine hydrochloride) and Rompun (xylazine hydrochloride), or a combination of Telazol and Rompun. Drugs were administered intramuscularly with a syringe mounted on a pole (jab-stick), a homemade blowgun, a modified air pistol or a cartridge powered dart gun. Immobilized bears were measured, weighed, and a first premolar tooth was extracted for age determination (Stoneberg and Jonkel 1966). Blood, tissue and/or hair samples were taken from

most bears for genetic studies.

Prior to 1998, each bear was marked with an individually numbered ear tag in each ear. A 4 X 13 cm streamer of rubberized fabric (Armatite or Ritcey Material) was attached to each ear tag. Ear streamer color varied by species and year to identify when the animal was captured. All grizzly bears and some adult black bears ( $\geq 4.0$  years old) were fitted with radio collars or ear tag transmitters when captured. Some bears were collared with Global Positioning System (GPS) radio collars. Collars were manufactured by Telonics (Mesa, AZ) and ear tag transmitters were manufactured by Advanced Telemetry Systems (Isanti, MN). To prevent permanent attachment, a canvas or polypropylene spacer was placed in the collars so that they would drop off in 1-3 years (Hellgren et al. 1988).

Trapping efforts were typically conducted from May through September. In 1986-87, snares were placed in areas where black bear captures were maximized on a defined study area of 214 km<sup>2</sup> (Thier 1990). Snares were placed over a broader area during 1989-94 to maximize grizzly bear captures. Trap sites were usually located within 200 m of an open road to allow vehicle access. Beginning in 1995, an effort was made to capture and re-collar known grizzly bears in the Yaak River and augmentation bears in the Cabinet Mountains. In 2003, trapping was initiated in the Salish Mountains, south of Eureka, Montana to investigate bear movements in the intervening area between the Northern Continental Divide and Cabinet-Yaak recovery zones. Trapping was conducted along Highway 2 in northwest Montana and along Highway 3 in southeast British Columbia to collar bears with GPS radio collars during 2004-2009. Both studies were designed to examine bear population connectivity across river valleys with highways, railways, and human habitation. The Highway 2 study utilized black bears as surrogates for grizzly bears because of the small number of grizzly bears in the valley. The Highway 3 effort in British Columbia collared grizzly bears and black bears. Much of the trapping effort in the Yaak and Cabinet Mountains areas involved the use of horses on backcountry trails and closed logging roads. Traps were checked daily. Bait consisted primarily of road-killed ungulates.

Trapping for population augmentation was conducted in the North Fork of the Flathead River in British Columbia during 1990-94. Only unmarked female grizzly bears < 6 years old (or prior to first reproduction) and > 35 kg were deemed suitable for transplant. All other captured grizzly bears were released with some collared to aid an ongoing bear study in British Columbia. Capture efforts for bears transplanted in 2005-09 occurred primarily in the North Fork and South Fork of the Flathead River in the US. No suitable bears were captured in 2007.

### **Hair Sampling for DNA Analysis**

This project seeks evidence of grizzly bears in the Cabinet Mountains using DNA to understand the fates of 4 bears transplanted between 1990-94. The program used genetic information from a hair-snagging and remote camera program to identify transplanted bears or their offspring living in the Cabinet Mountains. Project objectives include: a minimum estimate of the number of bears inhabiting the area, sex ratio of captured bears, and relatedness and genetic diversity measures of captured bears. Population estimates utilizing capture-recapture techniques were not thought to be appropriate because expected sample sizes from the Cabinet Mountains population ( $n \leq 15$ ) would not likely provide population estimates with reasonable precision. Capture-recapture estimates would require at least 4 sessions of sampling the entire area, and sufficient funds were not available to implement this approach.

Sampling occurred from June-August of 2002-08 in the Cabinet-Yaak recovery zone south of the Kootenai River in Idaho and Montana following standard hair snagging techniques (Woods et al. 1999). Sampling sites were established based on the location of previous

sightings, sign, and radio telemetry from bears in the Cabinet Mountains. A 5 km x 5 km grid (25 km<sup>2</sup>) was used to distribute sample sites across the area in 2003 (n=184). Each grid cell contained a single sample point near the center of the cell. Actual site location was modified on the basis of access to the site and habitat quality near the site. Sites were baited with 2 liters of a blood and fish mixture to attract bears across a barbwire perimeter placed to snag hair. Sites were deployed for 2 weeks prior to hair collection. One third of the sites were sampled during each of the months of June, July, and August. Sample sites were stratified by elevation with lowest elevation sites sampled in June and highest elevation sites sampled in August. Remote cameras were used at some sites. Hair was collected and labeled to indicate: the number and color of hairs collected, site location, date, and barb number. These data aided sorting hair to minimize lab costs. Samples collected as a part of this effort and other hair samples collected in the Cabinet Mountains in previous years that were either from known grizzly bears or samples that outwardly appeared to be grizzly bear were sent to the Wildlife Genetics International Laboratory in Nelson, British Columbia for DNA extraction and genotyping. Hairs visually identified as black bear hair by technicians at the Laboratory were not processed and hairs processed and determined to be black bear were not genotyped. Dr. Michael Proctor is a cooperater on this project and assisted with genetic interpretations. He has previously analyzed genetic samples from the Yaak portion of this recovery zone (Proctor 2003).

### **Radio Monitoring**

Attempts were made to obtain aerial radiolocations on all instrumented grizzly bears at least once each week during the 7-8 month period in which they were active. GPS collars obtained a location every hour and collars were retrieved in October. Augmentation bears were monitored daily following release for at least the first two weeks and usually three times per week following. In addition, efforts were made to obtain as many ground locations as possible on all bears, usually by triangulating from a vehicle. Annual and composite home ranges (minimum convex polygons; Hayne 1959, adaptive kernel; Worton 1989) were calculated for all grizzly bears for the entire study period. We generated home range polygons using the Animal Movement extension for Arcview GIS (Hooge and Eichenlaub 1997).

Grizzly and black bears were collared during 2004-09 with GPS collars to study movements across the Moyie River Valley and Highway 3 in British Columbia. Black bears were tested for their potential to act as surrogates that would predict grizzly bear movements. Collars attempted locations every 1-2 hours depending on configuration and data were stored within the collar. Collars were equipped with a release mechanism to allow them to be retrieved in October prior to denning. Weekly aircraft radio monitoring was conducted to check for mortality signals and approximate location. From 2004 to 2008, black bears were fitted with similar GPS radio collars to study movements across the Kootenai River Valley and Highway 2 in Montana, as part of linkage monitoring between the Yaak River and Cabinet Mountains. In 2009, black bears were fitted with GPS collars in the Yaak River study area and along the Clarks Fork River on the south end of the Cabinet Mountains study area.

### **Berry Transects**

Quantitative comparisons of annual fluctuations and site-specific influences on fruit production of huckleberry and buffaloberry were made using methods similar to those established in Glacier National Park (Kendall 1986). Transect line origins were marked by a painted tree or by surveyors' ribbon. A specific azimuth was followed from the origin through homogenous habitat. At 0.5 m intervals, a 0.04 m<sup>2</sup> frame (2 x 2 decimeter) was placed on the

ground or held over shrubs and all fruits and pedicels within the perimeter of the frame were counted. If no portion of a plant was intercepted, the frame was advanced at 0.5 meter intervals and empty frames were counted. Fifty frames containing the desired species were counted on each transect. Two habitat components were sampled (Timbered Shrubfields and Mixed Shrub/Cutting Units), primarily to examine the influence of timber harvesting on berry production on a variety of aspects and elevations. Notes on berry phenology, berry size, and plant condition were recorded. Nineteen huckleberry and 5 buffaloberry transects were sampled from 1990-99, however, only 18 huckleberry transects were sampled in 2000. Two new transects were added in 2001, one was added in 2002, 2 were added in 2004, 7 were dropped in 2005, 2 were added in 2006, and 2 more were added in 2008 for a total of 18 sites. Some transects were eliminated because plant succession had affected production. Monitoring goals identified an annual trend of berry production and did not include documenting the effects of succession.

Due to the dioecious (separate male and female plants) nature of buffaloberry all frame count transects were dropped in 2007 in favor of marking 10 plants per site and counting the berries on the marked plants in order to be consistent with counts made from 1990 to 2003 on 5 plants per site. One new buffaloberry plot was established in both 2007 and 2008.

Serviceberry productivity was estimated by counting berries on 5 marked plants in 1990. In 1991 the number of marked plants sampled was increased to 10 at each site. Five serviceberry sites were sampled from 1990-96, and one site was added in 1997, and another was added in 2005. Six sites were sampled in 2007-09.

In 2001, three new plots were established to document berry production of mountain ash (*Sorbus scopulina*). Ten plants were permanently marked at each site, similar to the serviceberry plots. Counts at the same plots were recorded 2001-09.

## RESULTS AND DISCUSSION

### Grizzly Bear Observations and Recovery Plan Criteria

Grizzly bear observations and mortality from public and agency sightings or records were appended to databases. These databases include information from the U.S. and Canada. The file includes over 1,200 credible sightings, tracks, scats, digs, and hair dating from 1960 (Fig. 3) and 128 mortalities dating from 1949 (Appendix Table 1, Fig. 3). Credible sightings were those rating 4 or 5 on the 5 point scale (see page 8). Fifty-three instances of grizzly bear mortality were detected inside or within 16 km of the Cabinet-Yaak recovery zone (including Canada) during 1982-2009 (Table 1).

Forty credible sightings were reported to this study that rated 4 or 5 (most credible) during 2009. Fifteen of these sightings occurred in the Yaak portion of the recovery zone and 12 sightings occurred in the Cabinet Mountains portion of the recovery zone. Nine sightings came from outside the recovery zone with 1 sighting in the Clark Fork zone, 1 in the Fisher zone, 2 sightings in the Tobacco zone, 4 in the West Kootenai zone, and 5 from British Columbia (Table 2 and Fig. 3).

Cubs are offspring in the first 12 months of life and yearlings are offspring in their second 12 months. The recovery plan (USFWS 1993) indicates that females with cub sightings within 10 miles of the recovery zone count toward recovery goals. Three credible sightings of a female with cubs occurred during 2009 in BMUs 5 and 14 (Tables 2, 3, 4, 5, Fig. 4). Two sightings were judged to be the same family group. There appeared to be only 2 unduplicated females with cubs in the recovery area during 2009. Two credible sightings of a female with yearlings or 2-year-olds occurred in BMUs 4 and 5. Unduplicated sightings of females with cubs (excluding

Canada) varied from 1-4 per year and averaged 2.0 per year from 2004-09 (Tables 3, 4). Recovery plan criteria require an running 6 year average of 6.0 females with cubs per year (USFWS 1993).

Eleven of 22 BMUs in the recovery zone had sightings of females with young (cubs, yearlings, or 2-year-olds) during 2004-09 (Figs. 4, 5, Table 6). Occupied BMUs were: 2, 3, 4, 5, 6, 11, 13, 14, 16, 17, and 18. Recovery plan criteria indicate the need for 18 of 22 BMUs to be occupied. Sightings of females with young in BMUs 2, 3, 4, 5, 6, and 18 were indicative of recent reproduction in the Cabinet Mountains.

Seven known or probable human caused mortalities of native grizzly bears have occurred in or within 10 miles of the CYGBRZ in the U.S. during 2004-09 (Table 1, Appendix Table 2). Two additional mortalities of augmentation bears occurred south of the Clark Fork River. These two individuals were counted as mortalities when they were removed from the Northern Continental Divide Recovery Zone and are not counted again as mortalities in the CYGBRZ. Mortalities in Canada are not be counted toward recovery goals (USFWS 1993) even though bears initially marked within the recovery zone have died in Canada. Seven human caused mortalities include 4 females, 1 male, and two bears of unknown sex (to be determined by genetic analysis). Human caused mortalities during 2004-09 were two adult females (both self defense), 2 subadult females (1 illegal under investigation and 1 train collision), 1 subadult male (black bear mistaken identity), one adult bear of unknown sex (illegal under investigation), and one subadult bear of unknown sex (illegal under investigation). Population levels were calculated by dividing observed females with cubs (9) minus any human-caused adult female mortality (2) from 2007-09 by 0.6 (sightability) then dividing by 0.284 (adult female proportion of population) as specified in the recovery plan (Tables 3, 4) (USFWS 1993). This resulted in a minimum population of 41 individuals. The recovery plan states; "any attempt to use this parameter to indicate trends or precise population size would be an invalid use of these data". Applying the mortality limit of 4% to the minimum calculated population resulted in a total mortality limit of 1.6 bears per year. The female limit is 0.5 females per year (30% of 1.6). Average annual human caused mortality for 2004-09 was 1.2 bears/year and 0.7 females/year (however the sex of two bears was not known at the time of this report). These preliminary mortality levels for total bears were within calculated limits, but female mortality exceeded calculated limits during 2004-09. It should be noted that the recovery plan established a goal of zero human-caused mortality for this recovery zone due to the initial low number of bears.

Table 1. Known and probable grizzly bear mortality in the Cabinet-Yaak recovery area and British Columbia, 1982-2009.

Mortality Date	Tag #	Sex	Age	Mortality Cause	Location	<500 m to Open Road	Public Reported	Owner <sup>1</sup>
October, 1982	None	M	AD	Human, Poaching	Grouse Creek, ID	No	Yes	USFS
October, 1984	None	Unk	Unk	Human, Mistaken Identity, Black bear	Harvey Creek, ID	Yes	Yes	USFS
9/21/1985	14	M	AD	Human, Self Defense	Lyons Gulch, MT	No	Yes	USFS
7/14/1986	106 cub	Unk	Cub	Natural	Burnt Creek, MT	Unk	No	USFS
10/25/1987	None	F	Cub	Human, Mistaken Identity, Elk	Flattail Creek, MT	No	Yes	USFS
5/29/1988	134	M	AD	Human, Hunting	Moyie River, BC	Yes	Yes	BC
10/31/1988	None	F	AD	Human, Self Defense	Seventeen Mile Creek, MT	No	Yes	USFS
7/6/1989	129	F	3	Human, Research	Burnt Creek, MT	Yes	No	USFS
1990	192	M	2	Human, Poaching	Poverty Creek, MT	Yes	Yes	USFS
1992	678	F	37	Unknown	Trail Creek, MT	No	Yes	USFS
7/22/1993	258 <sup>2</sup>	F	7	Natural	Libby Creek, MT	No	No	USFS
7/22/1993	258-cub	Unk	Cub	Natural	Libby Creek, MT	No	No	USFS
10/4/1995	None	M	AD	Human, Management	Ryan Creek, BC	Yes	Yes	PRIV
5/6/1996	302	M	3	Human, Under Investigation	Dodge Creek, MT	Yes	No	USFS
October, 1996	355	M	AD	Human, Under Investigation	Gold Creek, BC	Yes	No	BC
June? 1997	None	M	AD	Human, Poaching	Libby Creek, MT	Unk	Yes	PRIV
6/4/1999	106	F	21	Natural, Conspecific	Seventeen Mile Creek, MT	No	No	USFS
6/4/1999	106-cub	Unk	Cub	Natural, Conspecific	Seventeen Mile Creek, MT	No	No	USFS
6/4/1999	106-cub	Unk	Cub	Natural, Conspecific	Seventeen Mile Creek, MT	No	No	USFS
10/12/1999	596	F	2	Human, Self Defense	Hart Creek, BC	Yes	Yes	BC
11/15/1999	358	M	15	Human, Management	Yaak River, MT	Yes	Yes	PRIV
6/1/2000	538-cub	Unk	Cub	Natural	Hawkins Creek, BC	Unk	No	BC
6/1/2000	538-cub	Unk	Cub	Natural	Hawkins Creek, BC	Unk	No	BC
7/1/2000	303-cub	Unk	Cub	Natural	Fowler Creek, MT	Unk	No	USFS
11/15/2000	592	F	3	Human, Under Investigation	Pete Creek MT	Yes	No	USFS
5/5/2001	None	F	1	Human, Mistaken Identity, Black Bear	Spread Creek, MT	Yes	Yes	USFS
6/18/2001	538-cub	Unk	Cub	Natural	Cold Creek, BC	Unk	No	BC
6/18/2001	538-cub	Unk	Cub	Natural	Cold Creek, BC	Unk	No	BC
October, 2001	None	F	AD	Human, Train collision	Elk Creek, MT	Yes	Yes	MRL
6/24/2002	None	Unk	Unk	Human, Mistaken Identity, Hounds	Bloom Creek, BC	Yes	Yes	BC
7/1/2002	577	F	1	Natural	Marten Creek, MT	Yes	No	USFS
10/28/2002	None	F	4	Human, Under Investigation	Porcupine Creek, MT	Yes	Yes	USFS
11/18/2002	353/584	F	7	Human, Poaching	Yaak River, MT	Yes	Yes	PRIV
11/18/2002	None	F	Cub	Human, Poaching	Yaak River, MT	Yes	Yes	PRIV
11/18/2002	None	Unk	Cub	Human, Poaching	Yaak River, MT	Yes	No	PRIV
11/18/2002	None	Unk	Cub	Human, Poaching	Yaak River, MT	Yes	No	PRIV
10/15/2004	None	F	AD	Human, Management	Newgate, BC	Yes	Yes	PRIV
2005?	?	?	AD	Human, Under Investigation	Curley Creek, MT	Yes	Yes	PRIV
5/15/2005	31	M	AD	Human, Hunting	Russell Creek, BC	Yes	Yes	BC
10/9/2005	694	F	2	Human, Under Investigation	Pipe Creek, MT	Yes	No	PRIV PCT
10/9/2005	None	F	2	Human, Train collision	Government Creek, MT	Yes	Yes	MRL
10/19/2005	688	M	3	Human, Mistaken Identity, Black bear	Yaak River, MT	Yes	Yes	PRIV
5/28/2006	None	F	8	Human, Research	Cold Creek, BC	Yes	No	BC
6/1/2006	292	F	5	Human, Management	Moyie River, BC	Yes	Yes	PRIV
9/22/2007	354	F	11	Human, Self Defense	Canuck Creek, MT	Yes	Yes	USFS
9/24/2008	?	Unk	3	Human, Under Investigation	Fishtrap Creek, MT	Yes	Yes	PRIV PCT
10/20/2008	790 <sup>2</sup>	F	3	Human, Poaching	Clark Fork River. MT	Yes	Yes	PRIV
10/20/2008	635 <sup>2</sup>	F	4	Human, Train collision	Clark Fork River. MT	Yes	Yes	MRL
11/15/2008	651	M	13	Human, Mistaken Identity, Trapping	NF Yahk River, BC	Yes	Yes	BC
6/5/2009	675-cub	Unk	Cub	Natural	Copper Creek, ID	Unk	No	USFS
6/5/2009	675-cub	Unk	Cub	Natural	Copper Creek, ID	Unk	No	USFS
6/7/2009	None	M	3-4	Human, Mistaken Identity, Black bear	Bentley Creek, ID <sup>3</sup>	Yes	Yes	PRIV
11/1/2009	?	F	Adult	Human, Self Defense	EF Bull River, MT	No	Yes	USFS

<sup>1</sup>The recovery plan (USFWS 1993) specifies that human-caused mortality or female with young sightings from Canada will not be counted toward recovery goals in this recovery zone. BC – British Columbia, MRL – Montana Rail Link, PRIV – Individual Private, PCT – Plum Creek Timber Company, and USFS – U.S. Forest Service.

<sup>2</sup>Bears transplanted to the Cabinet Mountains under the population augmentation program were counted as mortalities in their place of origin and are not counted toward recovery goals in this recovery zone.

<sup>3</sup>Bear Killed more than 10 miles outside recovery zone and not counted in recovery calculations.

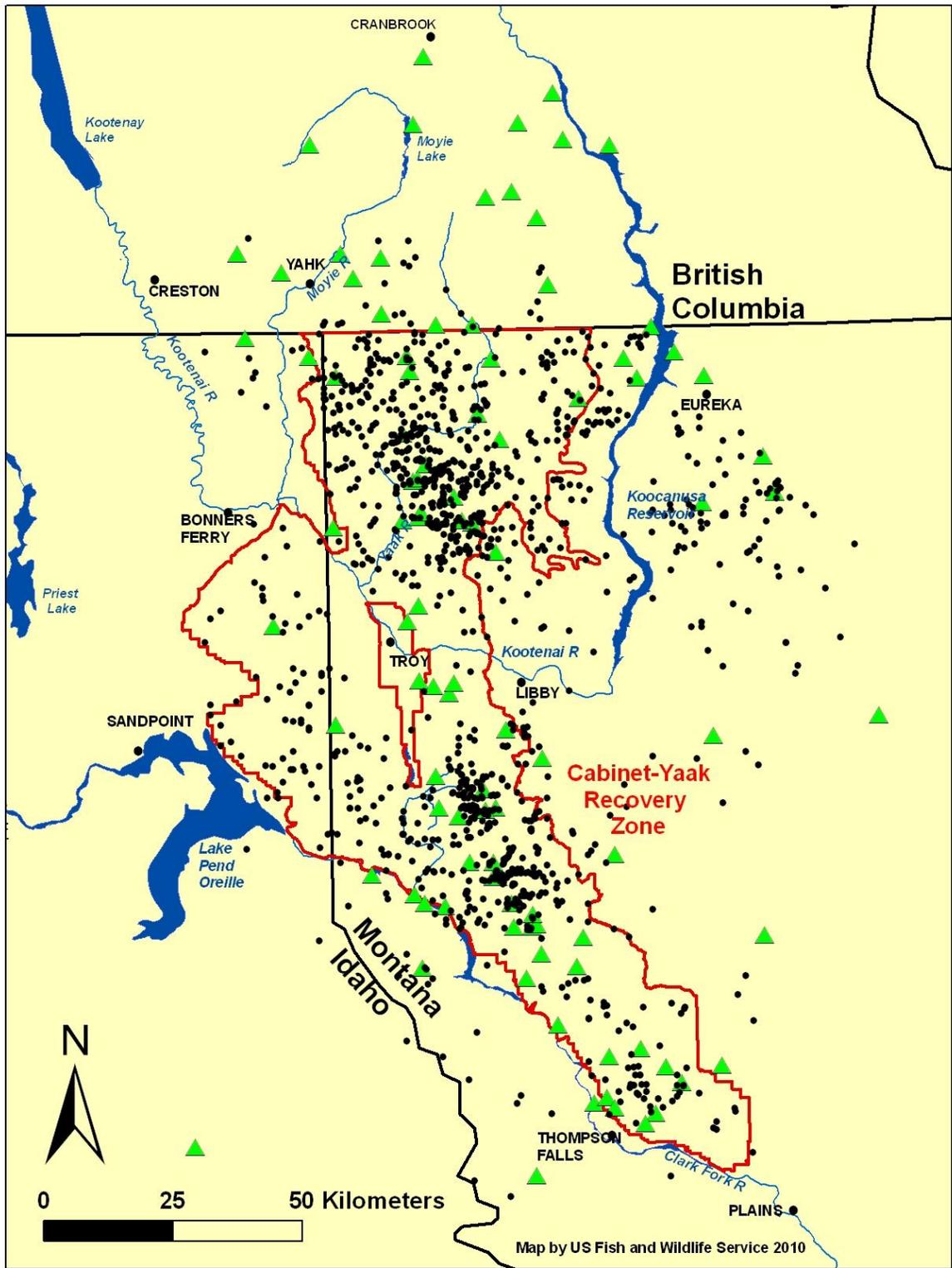


Figure 3. Grizzly bear observations (1959-2009, circles) and known or probable mortalities from all causes (1949-2009, triangles) in the Cabinet-Yaak recovery area.

Table 2. Credible grizzly bear sightings, credible female with young sightings, and known human caused mortality by bear management unit (BMU) or area, 2009.

BMU or Area	2009 Credible Grizzly Bear Sightings <sup>1</sup>	2009 Female with Cub sightings (total) <sup>2</sup>	2009 Female with Cub sightings (Unduplicated)	2009 Sightings of Females with Yearlings or 2-year-olds (total) <sup>3</sup>	2009 Sightings of Females with Yearlings or 2-year-olds (unduplicated)	2009 Human Caused Mortality
2	1	0	0	0	0	0
3	1	0	0	0	0	0
4	1	0	0	1	1	0
5	8	2	1	1	1	1
9	1	0	0	0	0	0
11	6	0	0	0	0	0
12	3	0	0	0	0	0
14	2	1	1	0	0	0
15	1	0	0	0	0	0
16	3	0	0	0	0	0
British Columbia <sup>3</sup>	5	0	0	0	0	0
Clark Fork <sup>4</sup>	1	0	0	0	0	0
Fisher <sup>4</sup>	1	0	0	0	0	0
Tobacco <sup>4</sup>	2	0	0	0	0	0
West Kootenai <sup>4</sup>	4	0	0	0	0	0
2009 TOTAL	40	3	2	2	2	1

<sup>1</sup>Credible sightings are those rated 4 or 5 on a 5 point scale (see page 8).

<sup>2</sup>Sightings may duplicate the same animal in different locations. Only the first sighting of a duplicated female with cubs is counted toward total females (Table 3), however subsequent sighting contribute toward occupancy (Table 8).

<sup>3</sup>Areas in Canada outside of Cabinet-Yaak recovery zone that do not count toward recovery goals.

<sup>4</sup>Areas with portions <16 km outside the Cabinet-Yaak recovery zone that count toward recovery goals.

Table 3. Status of the Cabinet-Yaak recovery zone during 2004-2009 in relation to the demographic recovery targets from the grizzly bear recovery plan (USFWS 1993).

Recovery Criteria	Target	2009
Females w/cubs (6-yr avg)	6	2.0 (12/6)
Human Caused Mortality limit (4% of minimum estimate)	1.6	1.0 (6 yr avg)
Female Human Caused mortality limit (30% of total mortality)	0.5	0.7 (6 yr avg)
Distribution of females w/young	18 of 22	11 of 22

Table 4. Annual Cabinet-Yaak recovery zone (excluding Canada) grizzly bear minimum unduplicated counts of females with cubs and known human-caused mortality, 1988-2009.

YEAR	ANNUAL FWC'S	ANNUAL HUMAN CAUSED ADULT FEMALE MORTALITY	ANNUAL HUMAN CAUSED ALL FEMALE MORTALITY	ANNUAL HUMAN CAUSED TOTAL MORTALITY	4% TOTAL HUMAN CAUSED MORTALITY LIMIT <sup>1</sup>	30% ALL FEMALE HUMAN CAUSED MORTALITY LIMIT <sup>1</sup>	TOTAL HUMAN CAUSED MORTALITY 6 YEAR AVERAGE	FEMALE HUMAN CAUSED MORTALITY 6 YEAR AVERAGE
1988	1	1	1	1	0	0		
1989	0	0	1	1	0	0		
1990	1	0	0	1	0	0		
1991	1	0	0	0	0	0		
1992	1	0	0	0	0	0		
1993	2	0	0	0	0.9	0.3	0.5	0.3
1994	1	0	0	0	0.9	0.3	0.3	0.2
1995	1	0	0	0	0.9	0.3	0.2	0
1996	1	0	0	1	0.7	0.2	0.2	0
1997	3	0	0	1	1.2	0.4	0.3	0
1998	0	0	0	0	0.9	0.3	0.3	0
1999	0	0	0	1	0.7	0.2	0.5	0
2000	2	0	1	1	0.5	0.1	0.7	0.2
2001	1	1	2	2	0.5	0.1	1.0	0.5
2002	4	1	4	5	1.2	0.4	1.7	1.2
2003	2	0	0	0	1.2	0.4	1.5	1.2
2004	1	0	0	0	1.4	0.4	1.5	1.2
2005	1	0	2	4 <sup>2</sup>	0.9	0.3	1.8	1.5
2006	1	0	0	0	0.7	0.2	1.7	1.3
2007	4	1	1	1	1.2	0.4	1.5	1.2
2008	3	0	0	1 <sup>2</sup>	1.6	0.5	0.8	0.5
2009	2	1	1	1	1.6	0.5	1.0	0.7

<sup>1</sup> Presently grizzly bear numbers are so small in this ecosystem that the mortality goal shall be zero known human-caused mortality.

<sup>2</sup> The sex of this mortality was not known at the time of this report.

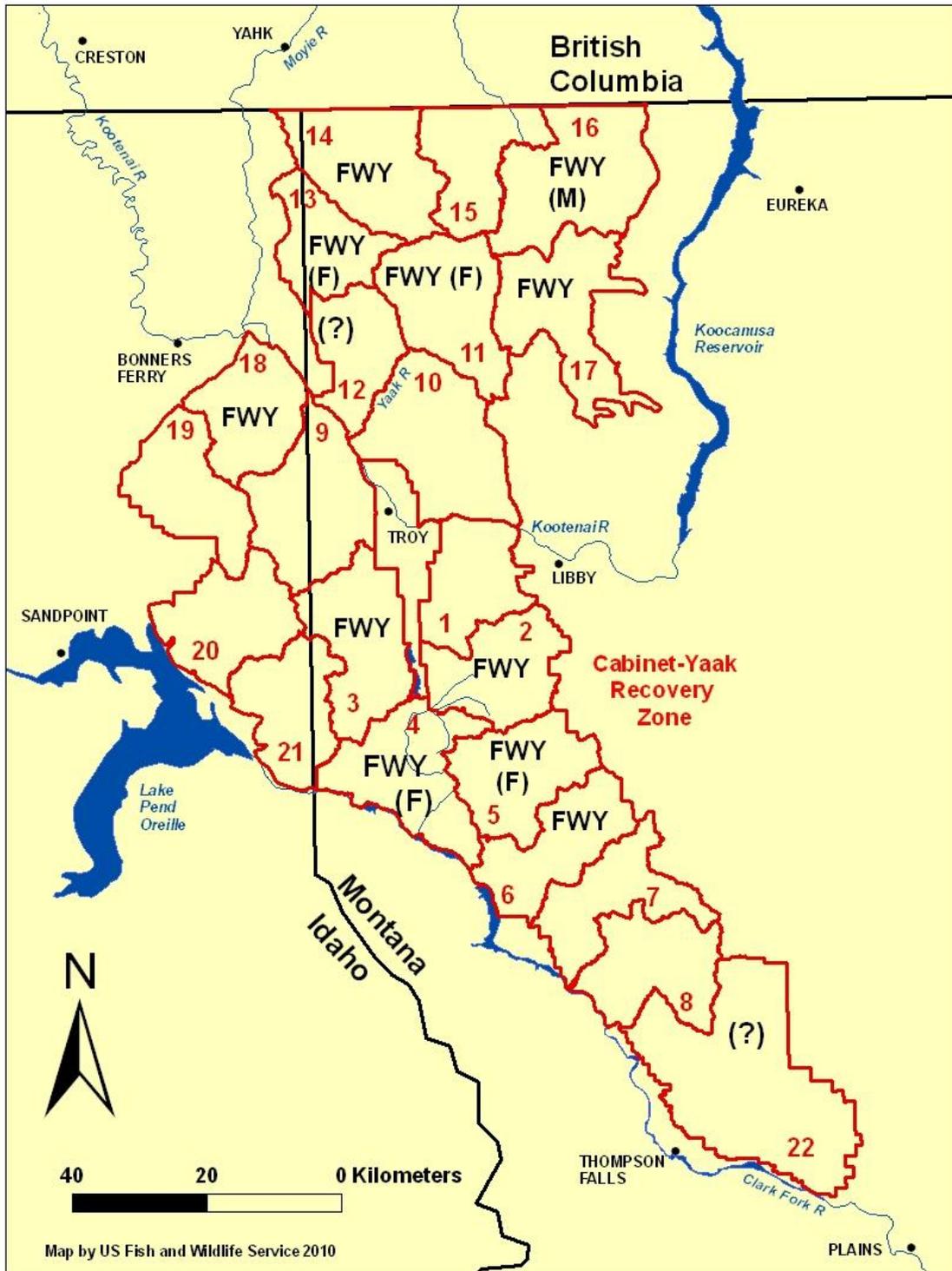


Figure 4. Female with young occupancy and known or probable mortality within Bear Management Units (BMUs) in the Cabinet-Yaak recovery zone 2004-2009. (FWY indicates occupancy of a female with young, sex of any mortality is indicated in parentheses, and “?” indicates a mortality of yet to be determined sex).

Table 5. Credible observations of females with young in or within 10 miles of the Cabinet-Yaak recovery zone, 1988-2009. Other credible observations from Canada are shown in parentheses.

Year	Total credible sightings females with young	Unduplicated females with cubs	Unduplicated females with yearlings or 2-year-olds	Minimum probable adult females
1988	3	1	1	2
1989	13	0	3	3
1990	9	1	2	3
1991	4	1	1	2
1992	8	1	5	6
1993	6	2	1	3
1994	5	1	2	3
1995	8	1	2	3
1996	5	1	1	2
1997	14 (1)	3	4	7
1998	6 (1)	0	2 (1)	2 (1)
1999	2	0	2	2
2000	6 (1)	2 (1)	1	3 (1)
2001	5 (2)	1 (1)	3	4 (1)
2002	10 (1)	4 (1)	1	5 (1)
2003	11	2	4	6
2004	11	1	4	5
2005	10 (1)	1	4 (1)	5 (1)
2006	7 (1)	2 (1)	2	4 (1)
2007	17	4	2	6
2008	7 (1)	3 (1)	3	6 (1)
2009	5 (0)	2 (0)	2 (0)	4 (0)

<sup>1</sup>Credible sightings are those rated 4 or 5 on a 5 point scale (see page 8).

Table 6. Occupancy of bear management units by grizzly bear females with young in the Cabinet-Yaak recovery zone 1988-2009.

BMU	1989	1990	1991	1992	1993	1988	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1 CEDAR	No																					
2 SNOWSHOE	No	Yes	No	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes	No	No	No						
3 SPAR	No	Yes	No	No																		
4 BULL	Yes	No	Yes	No	No	No	No	No	No	Yes	No	Yes	No	No								
5 ST. PAUL	No	No	No	No	Yes	No	Yes	No	No	Yes												
6 WANLESS	No	No	No	Yes	Yes	No	No	No	Yes	Yes	No	No	No	No	No	Yes	Yes	Yes	No	Yes	No	No
7 SILVER BUTTE	Yes	No	Yes	No																		
8 VERMILION	No	Yes	No																			
9 CALLAHAN	No																					
10 PULPIT	No																					
11 RODERICK	Yes	No	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	No	No									
12 NEWTON	No	Yes	No	No	No	No	No	No	Yes	No	No	No	No	No	Yes	No						
13 KENO	Yes	No	No	Yes	No	No	No	No	Yes	No	No	No	No	Yes	Yes	Yes	No	No	No	Yes	No	No
14 NORTHWEST PEAK	Yes	Yes	No	Yes	No	No	Yes	Yes	No	Yes	No	No	No	No	Yes	No	No	No	No	Yes	No	Yes
15 GARVER	Yes	Yes	No	No	No	No	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	No						
16 EAST FORK YAAK	No	Yes	Yes	No	No	No	No	Yes	No	No	Yes	No	Yes	No								
17 BIG CREEK	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No	No						
18 BOULDER	No	Yes	No	No	No	No	Yes	No														
19 GROUSE	No																					
20 NORTH LIGHTNING	No	No	No	Yes	No	No	Yes	No														
21 SCOTCHMAN	No	Yes	No	No	No	No	No	Yes	No	No	No	No	No	No								
22 MT HEADLEY	No	Yes	No																			

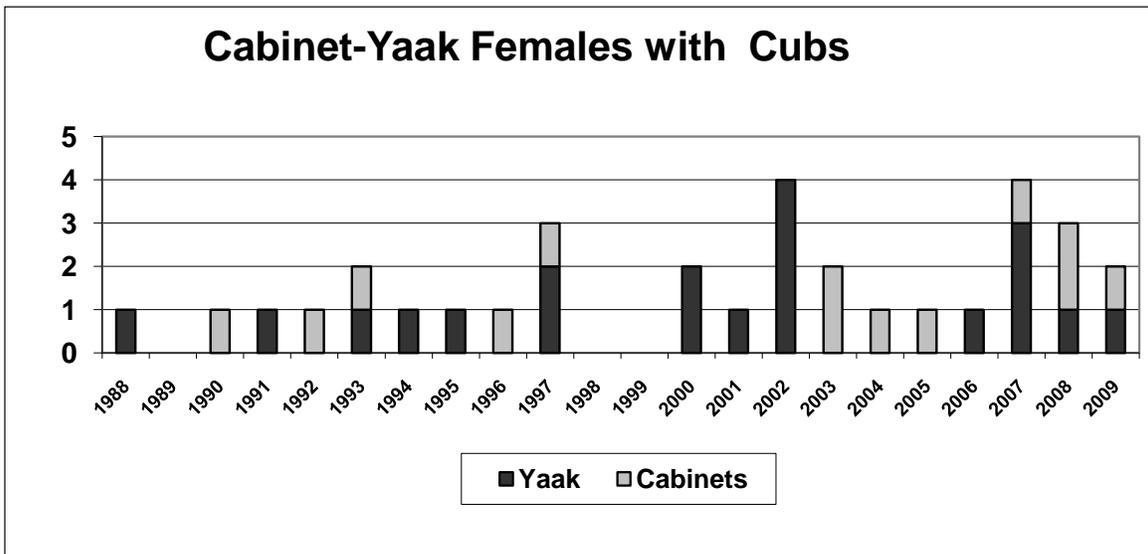


Figure 5. Credible observations of females with cubs in or within 10 miles of the Cabinet-Yaak recovery zone (excluding Canada), 1988-09. Credible sightings are those rated 4 or 5 on a 5 point scale (page 8)

### Grizzly Bear Minimum Numbers

Captures, genotypes from hair or tissue, and observations of grizzly bears by study personnel in the Yaak study area were examined to evaluate minimum population size for the 1986-2009 time period. Individuals not radio collared or genotyped were conservatively separated by size, age, location, coloration, genetic information, or reproductive status. Conservative classification of sightings may result in some sightings listed as same individual being actually of separate additional individuals. In addition, new information may result in changes in individual status or relationships.

Eighty individuals were identified with 59 bears captured or genotyped and 21 unmarked individuals observed, 1986-2009 (Table 7). Thirty-five of these animals are known or suspected to have died, 1986-09. Human causes were linked to 22 of these mortalities. One bear left the recovery zone and went to the Selkirk Mountains. The remaining 12 are believed to have died of natural causes. Seven of these 11 mortalities involved cubs, 1999-2001.

Total Yaak River animals identified during 1986-2009 (80 bears) less known mortality (35 bears) would leave at least 45 animals. It is unlikely that all identified animals have survived the entire period. However choosing a time period for counting the minimum number of animals may lead to biases in the estimate. A long time period may count bears that have not survived. A short time frame may miss some bears that have survived. A six year period was selected because it is the same as that used in the Grizzly Bear Recovery Plan (USFWS 1993). Using only animals identified during 2004-2009 (34) less known mortality (8) suggests a population of at least 26. This estimate assumes all other bears not known to be dead have survived the six year period. This estimate may also be conservative because study personnel observations alone would not likely sample all bears in the area, some sightings classified as the same animal may represent different animals, and the study has received several credible public reports of additional bears not included in this analysis. Since 2000 there have been credible sightings of bears in all 8 BMUs that make up the Yaak portion of the recovery area, with

sightings of females with young in 7 BMUs. About half of the credible observations of females with young in these BMUs did not appear to come from marked bears. The actual number of unmarked females represented is unknown.

Similar observations, captures, and photographic information from the Cabinet Mountains was collected and summarized for the 1983-2009 time period (Table 8). Total animals identified, 1983-2009 (35) less known mortality (12) would leave at least 23 animals. It is unlikely that all identified animals have survived the entire period. However choosing a time period for counting the minimum number of animals may lead to biases in the estimate. A long time period may count bears that have not survived. A short time frame may miss some bears that have survived. A six year period was selected because it is the same as that used in the Grizzly Bear Recovery Plan (USFWS 1993). Using only animals identified during the 2004-2009 time period (21) less known mortality (5) suggests a population of at least 16. This estimate assumes all other bears not known to be dead have survived the six year period. The Cabinet Mountains population was estimated to be 15 bears or fewer in 1988 (Kasworm and Manley 1988). However, the minimum number of bears identified 2004-09 was 16 individuals. Additionally, since 1988 the population was augmented with 9 females, credible sightings of individual bears have occurred in 13 of 14 BMUs from the Cabinet Mountains since 2000 and sightings of females with young occurred in 7 of 14 BMUs since 2000. These data suggest a minimum of 16 individuals in the Cabinet Mountains and 26 individuals in the Yaak during 2004-2009 with a total minimum population for the Cabinet-Yaak recovery area of 42 grizzly bears.

Table 7. Grizzly bears captured, observed, photographed, or genotyped by study personnel in the Yaak study, 1986-2009.

Bear <sup>1</sup>	Sex	Years detected	Comments
101	M	1986-87	Born 1978. Monitored 1986-87.
106	F	1986-1999	Born 1978. Monitored 1986-99. Natural Mortality 1999.
129	F	1986-89,	Born 1986. Monitored 1986-89. Mortality 1989.
?	?	1986	Born 1986. Natural mortality 1986.
Gt Unk 3	F	1987,	Born 1987. Cub female Mis-ID Mortality 17-mile Cr. 1987
128	M	1987-92, 1997, 2001	Born 1983. Monitored 1987-92 and 1997. Natural Mortality 2001 East of Koocanusa.
134	M	1987-88	Born 1978. Monitored 1987-88. Human mortality 1988 BC hunt.
Gt 025	F	1988,	Self Defense Adult female mortality 1988. 17 mile Cr.
193	M	1988-1990	Born 1988. Offspring 106. Monitored 1988-90. Human mortality 1990.
192	M	1988-1990	Born 1988. Offspring 106. Monitored 1988-90.
206	F	1988-95, 1997	Born 1988. Offspring 106. Monitored 1988-95. Observed 1997.
Gt UNK 22	M	1991,	DNA 1991, 17-mile Creek.
?	?	1991-92	Born 1991. Monitored 1991-92. Offspring of 106.
?	?	1991-92	Born 1991. Monitored 1991-92. Offspring of 106.
244	M	1992-94, 2003-04	Born 1986. Monitored 1992-94 & 2003-04.
34	F	1993,	Transplanted to Bloom Creek by BC 1993, captured in US 1993.
355	M	1993, 1996	Born 1990? Possible 1993 consort of 206. Monitored 1996. Human Mortality 1996.
358	M	1993, 1996-98	Born 1988. Possible 1993 consort of 206. Monitored 1996-98. Human Mortality 1999.
302	M	1993-96	Born 1993. Offspring of 106. Monitored 1993-96. Human Mortality 1996.
303	F	1993-96, 1998-01, 2003, 2007	Born 1993. Offspring of 106. Monitored 1994-96, 1998-01. Possibly observed 2003, 2007.
?	F	1994, 1998, 2007	Unmarked female consort of 244 and 363. Observed with cubs Roderick in 2007?
?	?	1994-95, 1998	Born 1994. Offspring 206, sibling of bear 505. Monitored 1994-95, Observed 1998?
505	F	1994-95, 1998, 2007	Born 1994. Offspring 206. Monitored 1994-95. Observed 1998?
353	F	1995-1999, 2002	Born 1995. Offspring 106. Monitored 1995-97, 2002. Observed 1998-99. Human mortality 2002.
354	F	1995-99, 2007	Born 1995. Offspring bear 106. Monitored 1995-99. Human mortality 2007.
342	M	1996-99, 2002, 2003-04	Born 1992. Monitored 1996-99 & 2003-04. DNA 2002.
363	M	1996-99, 2005	Born 1992. Monitored 1996-99. DNA 2005.
Gt 68853	F	1997	1997 mortality, Wardner, BC Management removal.

Bear <sup>1</sup>	Sex	Years detected	Comments
Gt 72832	M	1997	1998 mortality, Mayook, BC Unknown .
384	M	1997,	Born 1990. Monitored 1997.
596	F	1997, 1999	Born 1997. Offspring of 206? Monitored 1999. Human Mortality 1999.
538	F	1997-02	Born 1991. Monitored 1997-02.
?	?	1997-98, 2001	Born 1997. Offspring of 538. Monitored 1997-98. Observed 2001?
386	M	1997-98, 2000-01, 2005	Born 1992. Monitored 1997-98. Possibly consort of 538 in 2000 , 2001. DNA 2005.
592	F	1998, 1999-00	Born 1997. Offspring of 206? Monitored 1999. DNA 1999. Human Mortality 2000.
Gt UNK 55	F	1999	Found skull 1999 near site of 386 lost radio collar Moyie River, BC.
Gt 106 cub 1	M	1999,	Born 1999. Offspring 106. Natural Mortality 1999.
Gt 106 cub 2	F	1999,	Born 1999. Offspring bear 106. Natural Mortality 1999.
?	?	2000,	Born 2000. Offspring 538. Natural Mortality 2000.
?	?	2000,	Born 2000. Offspring bear 538. Natural Mortality 2000.
?	?	2000,	Born 2000. Offspring 303. Natural Mortality 2000.
552	F	2000, 2001	Born 2000. Offspring bear 303. Monitored 200-01. DNA 2001
Gt R178	M	2001	DNA Ryan Creek, BC 2001
?	?	2001,	Born 2001. Offspring 538. Natural Mortality 2001.
?	?	2001,	Born 2001. Offspring 538. Natural Mortality 2001.
Gt UNK 37	F	2001,	Born 2000. Unmarked yearling mortality mistaken identity, 2001
Gt M-0235	F	2002	DNA 2002. NF Sullivan Cr. Mortality 2002. Porcupine Creek.
Gt 7434	F	2002	DNA 2002. Pete Cr.
?	?	2002,	Born 2002. Offspring 538.
?	?	2002,	Born 2002. Offspring 538.
?	?	2002,	Born 2002. Offspring 353. Assumed Human mortality 2002.
?	?	2002,	Born 2002. Offspring 353. Assumed Human mortality 2002.
Gt UNK 43	F	2002,	Born 2002. Offspring 353. Human Mortality 2002.
651	M	2002, 2005-06, 2008	Born 1995. Monitored 2002 and 2005-06. Mortality 2008.
787	M	2002-04	Born 2000. Radio collared 2003-04. DNA 2002 4th July Cr.
Gt 10165b	F	2005, 2006	DNA 2004-05, Norge, Malpass, and Spruce Cr., BC. Human mortality 2006.
Gt 10252c	F	2005	DNA 2005, Teepee, BC
Gt 10252b	M	2005	DNA 2005, Teepee, BC
Gt 10303g	M	2005	DNA 2005, Teepee, BC
576	M	2004-06	Born 2002. Monitored 2004-06. DNA 2005.
675	F	2004-09	Born 2002. Monitored 2004-09. Lost 2 cubs in 2009.
M1	M	2005	Born 2003? Monitored 2005 Pipe Creek. Relocated NW Peak. Lost contact.
292	F	2005-06	Born 2001. Monitored 2005. Human Mortality 2006.
677	M	2005,	Born 1999. Monitored 2005.
694	F	2005,	Born 2003. Monitored 2005. Human Mortality 2005.
17	M	2005,	Born 1997. Monitored 2005. DNA 2002 Solo Joe.
668	M	2005,	Born 2002. Monitored 2005.
103	M	2006,	Born 2003. Monitored 2006. Went to Selkirk Mountains 2006
5381	M	2006,2009	Born 2002. Monitored 2006.
Gt 200730	F	2007	DNA 2007. Meadow Creek
?	?	2007,	Born 2007. Cub of family group observed 2007, Roderick Mt.
?	?	2007,	Born 2007. Cub of family group observed 2007, Roderick Mt.
?	?	2007,	Born 2007. Photographed 2007. Offspring 303? EF Pipe Cr.
?	?	2007,	Born 2007. Photographed 2007. Offspring 303? EF Pipe Cr.
784	F	2007-09	Born 2006. Radio collared 2007-09
785	F	2007-08	Born 2006. Radio collared 2007-08
?	?	2009	Born 2009. Offspring of 675. Natural mortality 2009.
?	?	2009	Born 2009. Offspring of 675. Natural mortality 2009.
731	F	2009	Radio collared 2009
Gt UNK 83	M	2009	DNA 2009

<sup>1</sup>Entires with numbers indicate bears captured and tagged. Entries with Gt signify a genotype obtained from hair.

Table 8. Grizzly bears captured, observed, photographed, or genotyped by study personnel in the Cabinet Mountains, 1983-2009.

Bear <sup>1</sup>	Sex	Years detected	Comments
678	F	1983-89, 1993	Born 1955. Collared in Cabinets 1983-89. Claws from mortality 1993.
680	M	1984-86	Born. 1973. Collared in Cabinets 1984-85. Observed 1986.
14	M	1985,	Born 1959. Collared in Cabinets 1985. Mortality 1985.
218	F	1990-92	Born 1985. Augmentation, monitored 1990-91. Observed 1992.
258	F	1992-93	Born 1986. Augmentation, monitored 1992-93. Produced cub 1993. Natural mortality 1993.
?	?	1993	Born 1993. Probable natural mortality 1993.
286	F	1993-95, 2002, 2005, 2009	Born 1991. Augmentation, monitored 1993-95. 3 cubs 2002 video? DNA 2005. Mortality 2009.
311	F	1994-95	Born 1991. Augmentation, monitored 1994-95.
Gt UNK 39	M	1997,	Claws from Double N Lake Mortality 1997.
770	M	2000, 2002, 2005-08	Born 1994. Photo 2002? Collared 2005-06. DNA 2000, 2005-08
Gt UNK 38	F	2001,	Adult female train mortality 2001.
Gt 2024	F	2001-02, 2007	Born 1997? Sibling 772. DNA 2001-02, 2007
577	F	2002,	Born 2001. Mortality 2002. Sibling 578 and 579.
578	M	2002,	Born 2001. Sibling 577 and 579.
579	M	2002,	Born 2001. Sibling 577 and 578. Observed 2003.
Gt 200618415	M	2002, 2006	One of 3 young video in 2002. DNA 2006?
?	?	2002,	One of 3 young video in 2002.
?	?	2002,	One of 3 young video in 2002.
780	M	2002, 2006-08	Born 2000. Adult male collared 2006-08. DNA 2002.
772	F	2002-03, 2007-08.	Born 1997. Sibling 2024118. DNA 2002-03, 2007. Collared 2007 with 2 cubs. Observed 2008.
?	?	2004,	One of two yearlings 2004 video (Brown) with adult female?
Gt 403	M	2004, 2007	Born 2004. At least 1 cub photographed with adult female. Mortality 2007 in NCDE.
Gt 3119	?	2003-05	Born 2003. One of two yearlings 2004 video (Brown) with adult female? Train mortality 2005.
?	?	2005,	At least 1 cub photographed with 286.
A1	F	2005-08	Born 1997? Augmentation monitored 2005-07. Observe with 780 2008?
782	F	2006-08	Born 2004. Augmentation monitored 2006-08. DNA 2008.
Gt 200721009	M	2007,	Born 2007. DNA 2007
Gt 200721053	F	2007,	Born 2007. DNA 2007
789	F	2007,	Born 2007. Marked 2007. DNA 2007. Observed 2008.
791	M	2007,	Born 2007. Marked 2007. DNA 2007. Observed 2008.
790	F	2008,	Born 2005. Augmentation monitored 2008. Mortality 2008 at Noxon residence.
635	F	2008,	Born 2004. Augmentation monitored 2008. Mortality 2008 on Noxon railroad.
715	F	2009,	Born 1998? Augmentation monitored 2009.
Gt 2009001005	F	2009,	Born 2008. Yearling offspring of 286, DNA and Photo 2009
Gt 2009001002	F	2009,	Born 2008. Yearling offspring of 286, DNA and Photo 2009

<sup>1</sup>Entires with numbers indicate bears captured and tagged. Entries with Gt signify a genotype obtained from hair.

## Grizzly Bear Mortality and Population Trend Estimate

This report segment updates information on survival rates, cause-specific mortality and population trend following the methods used in a peer reviewed journal paper (Wakkinen and Kasworm 2004). These survival and reproductive estimates super cede all previous calculations and are based on the most current information.

### Total Known Mortality

Fifty-two instances of known and probable grizzly bear mortality from all causes were detected inside or within 16 km of the Cabinet-Yaak recovery zone (including Canada) during 1982-2009 (Table 1, Table 9, Fig. 6). This summary included radio collared bears regardless of

where they died. Eleven adult females, 9 adult males, 8 subadult females, 3 subadult males, 2 yearling females, and 2 female cubs were included in the known sex and age individuals. Mortality cause frequency in descending order was natural (14), poaching (8), unknown but human-caused (7), defense of life (4), mistaken identity (5), management removal (4), trap predation (2), train collision (3), legal hunting in Canada (2), hound hunting (1), and unknown (1). Six mortalities were known to have occurred during spring, 17 during summer, 26 during autumn, and 3 unknown. All 14 natural mortalities occurred during summer. One poaching mortality occurred during spring, 6 occurred during autumn, and one was unknown. One unknown specific cause but known to be human related mortality occurred during spring, 5 occurred during autumn, and 1 was unknown. One mistaken-identity mortality occurred during spring and 4 occurred in autumn. All defense of life and train collisions occurred during autumn. One management removal occurred during summer and 3 occurred during autumn. Legal hunting mortalities in Canada occurred during spring and one trap predation death occurred during spring and one occurred during summer. The hound hunting mortality occurred in British Columbia and occurred during summer. The public reported 29 of 52 (56%) total mortality incidents and 28 of 37 (76%) human-caused mortalities to management authorities. Other mortalities were discovered by agency personnel or with the aid of radio telemetry. Nine of 14 (64%) human caused mortalities occurring on the National Forests were within 500m of an open road. Sixteen instances of known mortality occurred during the 17-year period from 1982-1998 with 12 (75%) of these mortalities being human-caused. Thirty-six instances of known mortality occurred during the 11 year period from 1999-2009 with 25 (69%) of these mortalities human-caused. Rates of total human-caused mortality were 0.71 mortalities per year from 1982-1998 and 2.27 mortalities per year from 1999-2009. Twenty-seven human-caused mortalities occurred within the US during 1982-2009. Rates of US human-caused mortality were 0.53 mortalities per year from 1982-1998 and 1.6 mortalities per year from 1999-2009.

Table 9. Causes and timing of known and probable grizzly bear mortalities in or within 16 km of the Cabinet-Yaak recovery zone (including Canada) and all radio collared bears, 1982-2009.

Age / sex / season	Mortality cause											Total
	Defense of life	Legal Hunt	Hound hunting	Management removal	Mistaken identity	Natural	Poaching	Trap predation	Train Collision	Unknown, human	Unknown	
Adult female	3			2		2	1	1	1		1	11
Subadult female	1						1	1	2	3		8
Adult male	1	2		2	1		2			1		9
Subadult male					1		1			1		3
Yearling					1	1						2
Cub					1	11	3					15
Unknown			1		1					2		4
<b>Total</b>	<b>5</b>	<b>2</b>	<b>1</b>	<b>4</b>	<b>5</b>	<b>14</b>	<b>8</b>	<b>2</b>	<b>3</b>	<b>7</b>	<b>1</b>	<b>52</b>
<b>Season<sup>1</sup></b>												
Spring		2			1		1	1		1		6
Summer			1	1		14		1				17
Autumn	5			3	4		6		3	5		26
Unknown							1			1	1	3

<sup>1</sup>Spring = April 1 – May 31, Summer = June 1 – August 31, Autumn = September 1 – November 30

The increase in natural mortality beginning in 1999 may be linked to poor food production during 1998-04 (Fig. 6). Huckleberry production during these years was about half the 20-year average (see pages 67-70). Poor berry production years can be expected at various times, but in this case there were several successive years of poor production. Huckleberries are the major source of late summer food that enables bears to accumulate sufficient fat to survive the denning period and females to produce and nurture cubs. Poor nutrition often causes females to not produce cubs in the following year. Poor food production may also cause females to travel further for food, which may expose young to greater risk of mortality from predators or accidental deaths. Four of 7 cub mortalities were from one female bear that lost litters of 2 cubs each during spring of 2000 and 2001. Another mortality incident involved a female with 2 cubs that appeared to have been killed by another bear in 1999. The effect of cub mortality may be greatest in succeeding years when some of these animals might have been recruited to the reproductive segment of the population.

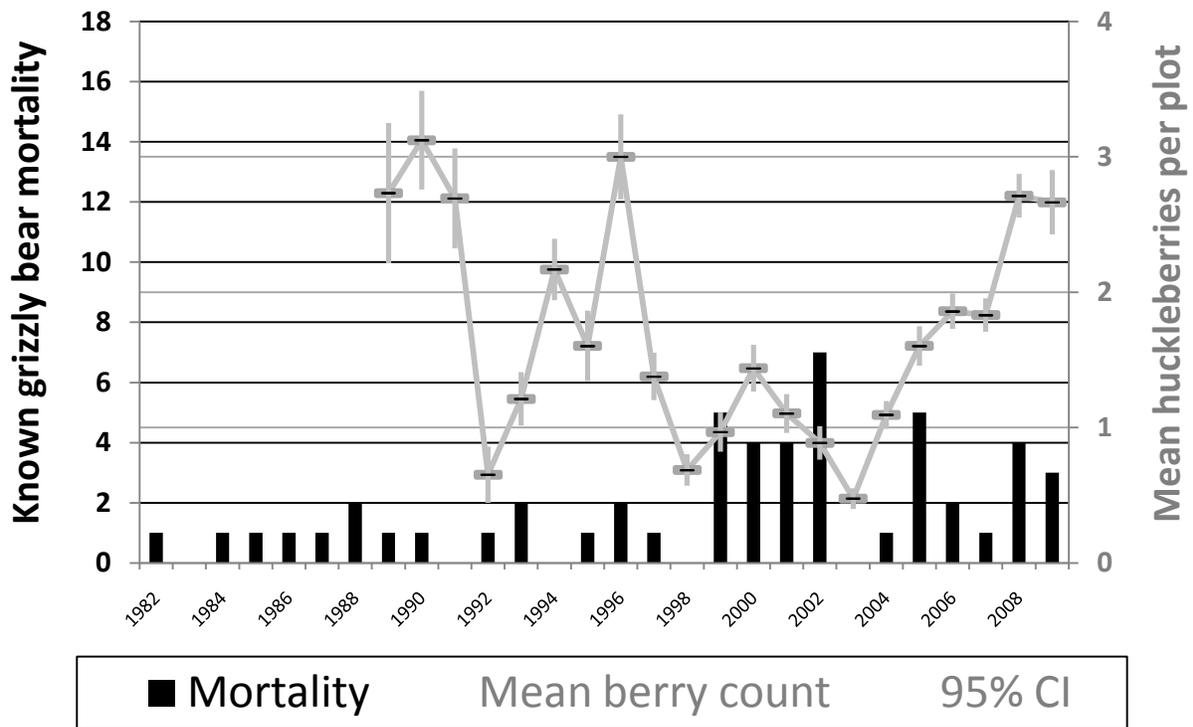


Figure 6. Known and probable grizzly bear annual mortality from all causes in or within 16 km of the Cabinet-Yaak recovery zone (including Canada) and all radio collared bears by cause, 1982-2009 and huckleberry production counts, 1989-2009.

#### Native Grizzly Bear Survival and Cause-Specific Mortality

Kaplan-Meier survival and cause-specific mortality rates were calculated for 6 sex and age classes of native grizzly bears from 1983-2009 (Table 10). Adult female survival was 0.9353 (95% CI 0.852-1.0, n=8) with 1 instance of natural mortality and 1 of poaching among 8 radio-collared bears monitored for 30.0 bear-years. The natural mortality occurred during

summer and the poaching mortality occurred during autumn. Adult male survival was 0.883 (95% CI 0.767-0.999, n=17) with 1 legal hunting mortality in Canada, 1 defense of life, and 1 unknown but human-caused mortality among 17 radio collared bears monitored for 25.9 bear-years. The hunting mortality occurred during spring in an area 35 km northwest of the recovery zone in British Columbia. The defense of life and the unknown but human-caused mortality occurred during autumn. Subadult female survival was 0.772 (95% CI 0.602-0.942, n=13) among 13 bears monitored for 16.2 bear-years. The trap predation mortality occurred in summer when a bear captured in a foot snare was killed by another grizzly bear. A defense of life and 2 unknown but human-caused mortalities occurred during autumn. Eleven subadult males were monitored for 8.6 years and produced a survival rate of 0.762 (95% CI 0.487-1.0, n=11). There was 1 spring unknown but human-caused mortality and a mistaken identity during autumn. Yearling survival was 0.875 (95% CI 0.661-1.0, n=19) among 19 bears monitored for 10.1 bear-years. One bear died during summer from natural causes. Thirteen of 31 cubs died resulting in a survival rate of 0.581 (95% CI 0.419-0.742, n=31). Three cubs died by poaching during autumn and 8 cubs were believed to have died of natural causes with 2 during spring and 8 during summer.

Table 10. Survival and cause-specific mortality rates of native grizzly bear sex and age classes based on censored telemetry data in the Cabinet–Yaak recovery zone, 1983–2009.

Parameter	Demographic parameters and mortality rates					
	Adult female	Adult male	Subadult female	Subadult male	Yearling	Cub
Individuals / bear-years	8 / 30.0	17 / 25.9	13 / 16.2	11 / 8.6	19 / 10.1	31 / 31 <sup>a</sup>
Survival <sup>b</sup> (95% CI)	0.935 (0.852–1.0)	0.883 (0.767-0.999)	0.772 (0.602–0.942)	0.762 (0.472-1.0)	0.875 (0.660–1.0)	0.581 (0.419–0.742)
Mortality rate by cause						
Legal Hunt Canada	0	0.044	0	0	0	0
Natural	0.035	0	0	0	0.125	0.323
Defense of life	0	0.037	0.051	0	0	0
Mistaken ID	0	0	0	0.127	0	0
Poaching	0.030	0	0	0	0	0.097
Trap predation	0	0	0.083	0	0	0
Unknown	0	0.037	0.093	0.111	0	0

<sup>a</sup> Cub survival based on counts of individuals alive and dead.

<sup>b</sup>Kaplan-Meier survival estimate which may differ from BOOTER survival estimate.

Mortality rates of all sex and age classes of radio collared grizzly bears were summarized by cause and location of death (Table 11). Rates were categorized by public or private land and human or natural causes. Rates were further stratified by death locations in British Columbia or U.S. and broken into two time periods. The two periods (1983-1998 and 1999-2009) correspond to a decline in population trend ( $\lambda$ ) beginning in 1999. Grizzly bear survival of all sex and age classes decreased from 0.915 during 1983-1998 to 0.637 during 1999-2009. Most of this increase was attributed to a dramatic increase in point estimates for natural mortality probably related to poor berry production during 1998-2004. A large increase in mortality occurring on private lands within the U.S. also contributed heavily to this increase in overall mortality and may also be related to poor berry production that may have caused bears to search more widely for foods that may occur on private lands. Several mortalities occurring during 1999-2009 were associated with sanitation issues on private lands. Point estimates for human caused mortality occurring on public lands in the U.S. and British Columbia decreased from 1983-1998 to 1999-2009. This apparent decrease in mortality rates on public lands is particularly noteworthy given the dramatic increase in overall mortality rates.

Table 11. Survival and cause-specific survival rates of all sex and age classes of native grizzly bears by location of death based on censored telemetry data in the Cabinet–Yaak recovery zone, 1983–2009.

Parameter	1983-1998	1999-2009
Individuals / bear-years	29 / 70.8	47 / 42.5
Survival <sup>b</sup> (95% CI)	0.915 (0.852–0.977)	0.637 (0.510-0.764)
Mortality rate by location and cause		
Public / natural	0.015	0.223
U.S. public / human	0.043	0.017
B.C. public / human	0.028	0.018
U.S. private / human	0	0.105
B.C. private / human	0	0

### Augmentation Grizzly Bear Survival and Cause-Specific Mortality

Kaplan-Meier survival and cause-specific mortality rates were calculated for 9 female augmentation grizzly bears from 1990-2009. Bears ranged in age from 2-10, but were pooled for this calculation because of small sample size and the lack of mortality in the adult age class. Female survival for augmentation bears was 0.725 (95% CI 0.490-0.961, n=9) with 1 instance of natural mortality, 1 poaching, and 1 train collision among 9 radio-collared bears monitored for 9.3 bear-years. The natural mortality occurred during summer, the poaching and train mortality occurred during autumn. The female that died of a natural mortality produced a cub before her death, but it is believed that the cub died at the same time.

### Native Grizzly Bear Reproduction

Mean age of first parturition among native grizzly bears was 6.5 years (95% CI; 6.0-7.0, n=4, Table 11). Sex ratio of 12 bears captured as cubs or yearlings was 8 females and 4 males. Sixteen litters comprised of 33 cubs were observed through monitoring radio-collared bears, for a mean litter size of 2.06 (95% C.I. 1.91-2.21, n=16, Table 11). Three radio-collared adult female bears provided 7 complete interbirth intervals (Table 11). Two successive instances of a female losing a complete litter of cubs prior to the end of breeding season (late July) and producing another litter the following year were observed. This scenario could be treated as an interval from cub birth to cub birth of 3 years or an interval of 5 years from cub birth to successful cub survival on August 1. Mean interbirth interval would be calculated as 2.71 years (95% C.I. 2.0-3.4, n=7) or as 3.0 years (95% C.I. 1.9-4.1, n=7) using these respective calculations of birth interval. We used the successful cub survival to August 1 option in the following calculations using Booter software to calculate reproductive rate. Booter software provides several options to calculate a reproductive rate (*m*) and we selected unpaired litter size and birth interval data with sample size restricted to the number of females. The unpaired option allows the use of bears from which accurate counts of cubs were not obtained but interval was known, or instances where litter size was known but radio failure or death limited knowledge of birth interval. Estimated reproductive rate using the unpaired option was 0.302 female cubs/year/adult female (95% C.I. 0.214-0.459, n=16, Table 12). In all calculations the sex ratio of cubs born was assumed to be 1:1.

Table 12. Captured grizzly bear reproductive information from the Cabinet-Yaak 1983-09.

Bear	Year	Cubs	Age at first reproduction	Reproductive Interval <sup>1</sup>	Cubs (relationship and fate, if known)
106	1986	2		2	1 dead in 1986, ♀ #129 dead in 1989
106	1988	3		3	♂ #192 dead in 1991, ♂ #193, ♀ #206
106	1991	2		2	2 cubs of unknown sex and fate
106	1993	2		2	♂ #302 dead in 1996, ♀ #303
106	1995	2		4	♀ #353 dead in 2002, ♀ #354
106	1999	2		-	♀ #106 and 2 cubs dead in 1999
206	1994	2	6	3	♀ #505
206	1997	2		-	suspected offspring ♀ #596 dead in 1999, ♀ #592 dead in 2000
538	1997	1	6	2 (5) <sup>2</sup>	1 cub separated from ♀ #538 in 1998
538	2000	2		1	2 cubs dead in 2000
538	2001	2		1	2 cubs dead in 2001
538	2002	2		-	2 cubs of unknown sex and fate
303	2000	2	7	-	1 cub dead in 2000, ♀ #552
353	2002	3		-	♀ #353 dead in 2002, 3 cubs (1 female) all assumed dead in 2002
772	2007	2		-	♀ #789, ♂ #791
675	2009	2	7	-	2 cubs dead in 2009

<sup>1</sup>Number of years from birth to subsequent birth.

<sup>2</sup>Number of years from birth to surviving litter of cubs.

## Population Trend

Approximately 90% of the data used in population trend calculations came from bears monitored in the Yaak River portion of this population and the result is most indicative of that portion of the recovery area. The estimated finite rate of increase ( $\lambda$ ) for 1983-2009 using Booter software with the unpaired litter size and birth interval data option was 0.963 (95% C.I. 0.855-1.052, Table 12). Subadult female survival and adult female survival accounted for most of the uncertainty in  $\lambda$ , with reproductive rate, yearling survival, cub survival, and age at first parturition contributing much smaller amounts. The sample sizes available to us to calculate population trend are small and small samples sizes yield wide confidence intervals around any calculated trend estimate ( $\lambda$ ). The probability that the population was declining was 78%.

Sample size allowed calculation of point estimates for cumulative annual rate of change beginning in 1998 (Fig. 7). Finite rates of increase calculated for the period 1983-1998 ( $\lambda = 1.067$ ) suggested an increasing population (Wakkinen and Kasworm 2004). Survival rates for adult and subadult females were 0.948 and 0.901 respectively, at that time. Adult and subadult female survival rates declined to 0.926 and 0.740 respectively in 2006. Human caused mortality has accounted for much of this decline and appears to be largely responsible for the decline in the rate of increase. During 2009, adult female survival and subadult female survival had increased to 0.933 and 0.781 respectively and resulted in an improving population trend estimate since 2006. Improving survival by reducing human-caused mortality is crucial for recovery of this population (Proctor et al 2004).

Table 13. Booter unpaired method estimated annual survival rates, age at first parturition, reproductive rates, and population trend of native grizzly bears in the Cabinet–Yaak recovery zone, 1983–2009.

Parameter	Sample size	Estimate (95% CI)	SE	Variance (%) <sup>a</sup>
Adult female survival <sup>b</sup> ( $S_a$ )	8 / 29.9 <sup>c</sup>	0.933 (0.809–1.0)	0.050	35.4
Subadult female survival <sup>b</sup> ( $S_s$ )	13 / 16.2 <sup>c</sup>	0.781 (0.562–0.952)	0.099	49.0
Yearling survival <sup>b</sup> ( $S_y$ )	19 / 9.9 <sup>c</sup>	0.851 (0.529–1.0)	0.140	4.0
Cub survival <sup>b</sup> ( $S_c$ ) <sup>d</sup>	31/31	0.581 (0.419–0.742)	0.090	3.6
Age first parturition ( $a$ )	4	6.5 (6.0–7.0)	0.251	0.6
Maximum age ( $w$ )	Fixed	27		
Unpaired Reproductive rate ( $m$ ) <sup>e</sup>	7/7/16 <sup>f</sup>	0.302 (0.214–0.459)	0.067	7.4
Unpaired Lambda ( $\lambda$ )	5000 bootstrap runs	0.963 (0.855–1.052)	0.050	

<sup>a</sup> Percent of lambda explained by each parameter

<sup>b</sup>Booter survival calculation which may differ from Kaplan-Meier estimates

<sup>c</sup>individuals/bear-years

<sup>d</sup>Cub survival based on counts of individuals alive and dead

<sup>e</sup>Number of female cubs produced/year/adult female. Sex ratio assumed to be 1:1.

<sup>f</sup>Sample size for individual adult females / sample size for birth interval / sample size for litter size

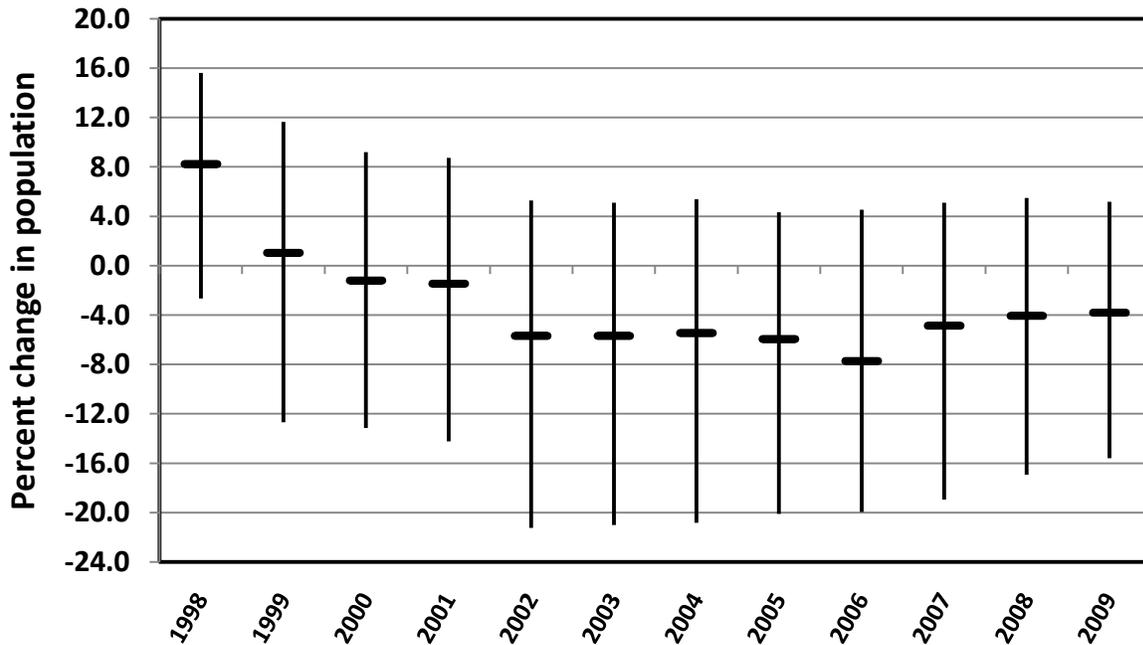


Figure 7. Point estimate and 95% confidence intervals for cumulative annual calculation of population rate of change for native grizzly bears in the Cabinet-Yaak recovery area, 1983-2009. Each entry represents the annual rate of change from 1983 to that date.

## Capture and Marking

### Cabinet Mountains Research

Research trapping was conducted in the Cabinet Mountains portion of the CYGBRZ from 1983-87. Three adult grizzly bears were captured during this effort (1 female and 2

males). No trapping efforts occurred from 1988-1994. In 1995 an effort was begun to recapture relocated bears in order to determine success of the population augmentation program and capture any native bears in the Cabinet Mountains. During 1983-2009, 6,942 trap nights were expended to capture 8 individual grizzly bears and 286 individual black bears (Table 13 and 14, Fig. 8). Rates of capture by individual were 1 grizzly bear/868 trap-nights and 1 black bear/24 trap-nights. A trap night was defined as one site with one or more snares set for one night. None of the augmentation bears were captured during subsequent trapping efforts. Much of the trapping effort before 2002 involved use of horses on backcountry trails and closed roads. In 2003, two culvert traps were airlifted to the East Fork of Rock Creek by helicopter. Traps were operated during the last week of August and first week of September. Three black bears were captured. No grizzly bears were captured, though one was observed near the traps. In 2005 one adult male grizzly bear (770) was captured in the Cabinet Mountains north of the Clark Fork River. In 2006 an adult male grizzly bear (780) was captured in the West Cabinet Mountains. Three yearling grizzly bears (1 female and 2 males) were captured in May 2002 south of the Clark Fork River near human habitation. These siblings weighed 50-65 pounds and were fitted with ear tag transmitters. The yearlings were preemptively moved away from humans. There were no indications that these bears had received human foods, but the agencies were concerned that they may become conditioned to human foods if they remained in that area. The yearling female died of natural causes in June 2002. A grizzly bear that apparently died in 2001 was found along the railroad tracks in May 2002 and was presumed to be their mother.

#### Yaak River Research

Trapping was conducted in the Yaak portion of the CYGBRZ during 1986-87 as part of a black bear graduate research study (Thier 1990), and from 1989-09 by the U.S. Fish and Wildlife Service. Seventy three captures of 38 individual grizzly bears and 430 captures of 362 individual black bears were made during 7,856 trap nights during 1986-09 (Tables 13 and 14, Fig. 8). Rates of capture by individual were 1 grizzly bear/207 trap-nights and 1 black bear/22 trap-nights. A trap night was defined as one site with one or more snares set for one night.

Trapping effort was concentrated in home ranges of known bears during 1995-2009 to recapture adult females with known life histories. Much of the effort involved using horses in areas inaccessible to vehicles, such as backcountry trails and closed roads.

#### Salish Mountains Research

Trapping occurred in the Salish Mountains, south of Eureka, Montana, in 2003. An adult female grizzly bear (5 years old), and 5 black bears were captured during 63 trap nights of effort (Tables 13, 14).

#### Selkirk Mountains Research

Trapping occurred in the Selkirk Mountains, west of Creston, British Columbia, in 2008-09 under a cooperative study with Dr. Michael Proctor (Birchdale Ecological Consultants), and the BC Ministry of Environment. The primary objective of the project is to examine linkage and population connectivity among the Selkirk and Purcell Mountains in BC and the US. Five grizzly and 6 black bears were captured during 2008 and 8 grizzly and 2 black bears during 2009.

Table 14. Capture effort and success for grizzly bears and black bears in the Yaak, Cabinet Mountains, Salish Mountains, and North of Highway 3, British Columbia, study areas, 1983-09.

Area / Year	Trap Nights	Grizzly Bear Captures	Black Bear Captures	Trap Nights / Grizzly Bear	Trap Nights / Black Bear
<u>Cabinet Mountains, 1983-09</u>					
Total Captures	6942	11	401	631	17
Individuals <sup>1</sup>	6942	8	286	868	24
<u>Salish Mountains, 2003</u>					
	63	1	5	63	13
<u>Yaak River South Hwy 3, 1986-09</u>					
Total Captures	7856	73	430	108	18
Individuals <sup>1</sup>	7856	38	362	207	22
<u>N. Hwy 3, BC 2004-08</u>					
Total Captures	259	9	37	29	7
Individuals <sup>1</sup>	259	8	32	32	8

<sup>1</sup>Individual new bears captured during the indicated time.

Table 15. Grizzly bear capture information from the Cabinet-Yaak 1983-09. Multiple captures of a single bear during a given year are not included.

Bear	Capture Date	Sex	Age (Est.)	Weight kg (Est.)	Location
678	6/29/83	F	28	86	Bear Cr.
680	6/19/84	M	11	(181)	Libby Cr.
680	5/12/85	M	12	(181)	Bear Cr.
678	6/01/85	F	30	79	Cherry Cr.
14	6/19/85	M	27	(159)	Cherry Cr.
101	4/30/86	M	(8)	(171)	N Fk 17Mile Cr.
678	5/21/86	F	31	65	Cherry Cr.
106	5/23/86	F	8	92	Otis Cr.
128	5/10/87	M	4	(114)	Lang Cr.
129	5/20/87	F	1	32	Pheasant Cr.
106	6/20/87	F	9	(91)	Grizzly Cr.
134	6/24/87	M	8	(181)	Otis Cr.
129	7/06/89	F	3	(80)	Grizzly Cr.
192	10/14/89	M	1	90	Large Cr.
193	10/14/89	M	1	79	Large Cr.
193	6/03/90	M	2	77	Burnt Cr.
206	6/03/90	F	2	70	Burnt Cr.
106	9/25/90	F	12	(136)	Burnt Cr.
206	5/24/91	F	3	77	Burnt Cr.
244	6/17/92	M	6	140	Yaak R.
106	9/04/92	F	14	144	Burnt Cr.
34	6/26/93	F	(15)	158	Spread Cr.
206	10/06/93	F	5	(159)	Pete Cr.
505	9/14/94	F	Cub	45	Jungle Cr.
302	10/07/94	M	1	95	Cool Cr.
303	10/07/94	F	1	113	Cool Cr.
106	9/20/95	F	17	(169)	Cool Cr.
353	9/20/95	F	Cub	43	Cool Cr.
354	9/20/95	F	Cub	47	Cool Cr.
302	9/24/95	M	2	113	Cool Cr.

Bear	Capture Date	Sex	Age (Est.)	Weight kg (Est.)	Location
342	5/22/96	M	4	(146)	Zulu Cr.
363	5/27/96	M	4	(158)	Zulu Cr.
303	5/27/96	F	3	(113)	Zulu Cr.
355	9/12/96	M	(6)	(203)	Rampike Cr.
358	9/22/96	M	8	(225)	Pete Cr.
353	9/23/96	F	1	83	Cool Cr.
354	9/23/96	F	1	88	Cool Cr.
384	6/12/97	M	7	(248)	Zulu Cr.
128	6/15/97	M	14	(270)	Cool Cr.
386	6/20/97	M	5	(180)	Zulu Cr.
363	6/26/97	M	5	(180)	Cool Cr.
538	9/25/97	F	6	(135)	Rampike Cr.
354	9/27/97	F	2	99	Burnt Cr.
354	8/20/98	F	3	(90)	Cool Cr.
106	8/29/98	F	20	(146)	Burnt Cr.
363	8/30/98	M	6	(203)	Burnt Cr.
342	9/17/98	M	6	(203)	Clay Cr.
303	9/21/98	F	5	(113)	Clay Cr.
592	8/17/99	F	2	(91)	Pete Cr.
596	8/23/99	F	2	(91)	French Cr.
538	7/16/00	F	9	(171)	Movie River, BC
552	7/16/01	F	1	(36)	Copeland Cr.
577	5/22/02	F	1	23	Elk Cr.
578	5/22/02	M	1	23	Elk Cr.
579	5/22/02	M	1	30	Elk Cr.
353	6/15/02	F	7	(136)	Burnt Cr.
651	9/25/02	M	7	(227)	Spread Cr.
787	5/17/03	M	3	71	Deer Cr. ID
342	5/23/03	M	11	(227)	Burnt Cr.
648	8/18/03	F	5	(159)	McGuire Cr., Salish Mtns.
244	9/25/03	M	17	(205)	N Fk Hellroaring Cr.
576	10/21/04	M	2	(114)	Young Cr.
675	10/22/04	F	2	100	Young Cr.
677	5/13/05	M	6	105	Canuck Cr., BC
576	6/17/05	M	3	133	Teepee Cr., BC
17	6/18/05	M	8	175	Norae Pass. BC
292	7/6/05	F	4	(114)	Mission Cr., ID
694	7/15/05	F	2	73	Kelsey Cr.
770	9/20/05	M	11	(250)	Chippewa Cr.
M1	10/4/05	M	(2)	(80)	Pipe Cr.
668	10/11/05	M	3	120	Yaak R.
103	5/23/06	M	3	125	Canuck Cr., BC
---	5/28/06	F	4	(125)	Cold Cr., BC (Trap predation) trap)
5381	6/6/08	M	4	(200)	Hellroaring Cr., ID
651	6/28/06	M	11	198	Cold Cr., BC
780	9/22/06	M	6	(250)	S Fk Callahan Cr.
784	9/23/07	F	2	(175)	Spread Cr.
785	10/15/07	F	2	165	Pete Cr.
675	5/23/09	F	(6-8)	195	Elmer Cr. BC
784	7/24/09	F	4	(300)	Hensley Cr.
731	9/17/09	F	(3)	(275)	Fowler Cr.

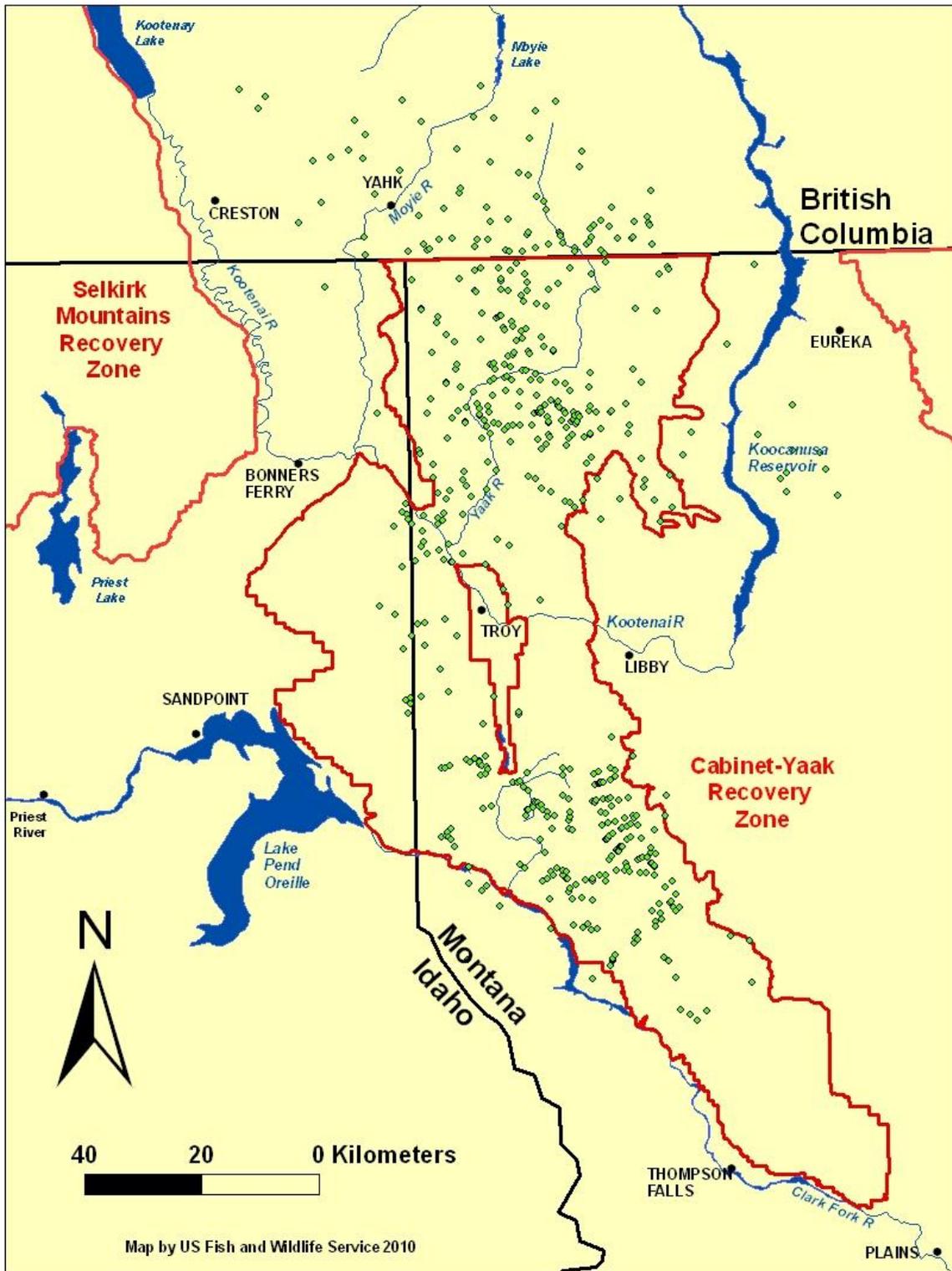


Figure 8. Trap site locations in the Cabinet-Yaak study area 1983-2009.

#### Linkage Area Research, Kootenai River Valley, Montana

Eight black bears were captured in 2004 to determine bear crossing patterns of the Kootenai River valley near the junction of Highway 2 and 508. Seven of these bears were fitted with GPS radio collars that store location data and detach in early October. These captures were distributed north (2 females and 2 males) and south of the Kootenai River (1 female and 2 males). Three black bears were captured and collared in 2005. All three bears (2 females and 1 male) were captured north of the river. During July 2006 2 female black bears were collared north of the river. In 2007, no bears were captured during 183 trap nights of effort.

#### Linkage Area Research, Moyie River and Kootenay River Valleys, British Columbia

Three grizzly bears and 19 black bears were captured in the Moyie River valley along Highway 3 in BC in 2004. Grizzly bears (2 females and 1 male) were fitted with GPS radio collars that store location data and later detach. All 3 bears were captured north of Highway 3. Six grizzly bears and 18 black bears were captured during 2005. Three grizzly bears (1 female and 2 males) were captured north of Highway 3, and 3 males were captured south of Highway 3. Five bears were collared; however the female was too small. In 2006, four grizzly bears and 20 black bears were captured. North of Highway 3, a yearling female was captured and released without collaring due to its small size. South of Highway 3, a female and two males were captured. The males were collared but the female was found dead in the snare. This estrous female was killed by another grizzly bear. Seven black bears (6 males and 1 female) were collared in 2006. One grizzly bear (captured twice north of Highway 3) and 10 black bears (11 captures) were caught in 2007. The grizzly bear and 7 black bears were fitted with GPS collars. Three black bears, 2 of which were collared, were captured in the Selkirk Mountains to examine linkage across the Kootenay River Valley. During 2008, 5 grizzly bears and 8 black bears were captured and in 2009 1 grizzly bear and 3 out of 11 captured black bears were collared. All grizzly bears were fitted with radio collars.

#### Linkage Area Research, Clark Fork River Valley, Montana

Six black bears were captured in 2008 in the Clark Fork River Valley to examine bear crossing opportunities of the valley near the junction of Highway 200 and 56. Four of these bears (2 females and 2 males) were fitted with GPS radio collars that store location data and detach in early October of 2009. All collars were placed on bears north of the Clark Fork River. In 2009 three black bears were captured and collared; 2 north and 1 south of the river. Additional collars will be placed during 2010.

#### Cabinet Mountains Population Augmentation

From 1990-94 four female grizzly bears were captured in the Flathead River Valley of British Columbia and released in the Cabinet Mountains to augment the existing population. Twenty-two different grizzly bears were captured during 840 trap-nights, to obtain the 4 subadult females transplanted. Capture rates were 1 grizzly bear/38 trap-nights, and 1 suitable subadult female/210 trap-nights. One of the transplanted bears and her cub died of unknown causes a year after release (Kasworm et al. 1998). The remaining three bears were monitored until their collars fell off. A short history of these bears follows later in this report. The program was designed to determine if transplanted bears would remain in the target area and ultimately contribute to the population through reproduction. Three of four transplanted bears remained

within the target area for more than one year. Though one of the transplanted bears produced a cub, the animal had likely bred prior to translocation and did not satisfy our criteria for reproduction with native males.

In 2005 an adult female grizzly bear (A1) was captured in the North Fork of the Flathead River drainage by Montana Dept. of Fish, Wildlife and Parks (MTFWP) personnel and relocated to the West Cabinet Mountains near Spar Lake. In 2006 a subadult female (782) was captured in the South Fork of the Flathead River drainage by MTFWP personnel and released in the same area near Spar Lake. Bear 782 was fitted with a GPS radio collar whose data can be downloaded from a remote location. No bears were transplanted in 2007 as no suitable females were captured. Two female grizzly bears were released in the East Fork of the Bull River during 2008 as part of the population augmentation program during late July and early August, respectively. The first (4 year-old) came from the upper Stillwater drainage of the Whitefish Range and the second (3 year-old) came from Swan River. Both bears were equipped with downloadable GPS radio collars. In October 2008 both of these bears were killed. In September 2009 an adult female from Big Cr in the North Fork of the Flathead River drainage was released in the Spar Lake area. A short history of these bears follows later in this report.

### **Cabinet Mountains Hair Sampling and DNA Analysis**

During August and September of 2002, barbwire hair snag enclosures were placed at 26 sites in the Cabinet Mountains and 7 sites in the Yaak River drainage as a pilot study for wider use of the technique. Sites were selected based on previous grizzly bear telemetry, sightings, and access. Four sites (Middle Fork Bull River, Lower West Fisher River, East Fork of Rock Creek, and Bunker Hill) produced pictures of grizzly bears, but no hair was observed at one site (Middle Fork Bull River). Two additional sites produced hair that appeared to be grizzly bear, but cameras malfunctioned and no pictures were obtained (Upper West Fisher River and Orr Creek). Additional samples of hair that may be grizzly bear were collected at other sites. Approximately 175 hair samples were collected.

During 2003, 184 sites were sampled on approximately 4,300 km<sup>2</sup> in the Cabinet Mountains portion of the recovery zone (Fig. 9). Approximately 900 hair samples were collected. Cameras were placed at 12 sites during August. At one site a picture of a grizzly bear was obtained, but none of the hair samples appeared to be grizzly bear. Three sites planned for sampling could not be utilized because of a lack of access across private land or ongoing forest fires.

Fourteen hair snag sites were operated during late July and early August in the Cabinet Mountains during 2004 (Fig. 9). All sites were equipped with remote cameras. A site in the East Fork of the Bull River produced hair that was visually identified as grizzly bear, but the camera malfunctioned. At a site in Rock Creek, pictures of a grizzly bear and hair were obtained. No other sites produced hair or pictures that appeared to be grizzly bear. Only 14 hair samples from these 2 sites were analyzed by the laboratory.

During 2005, 17 hair snag sites were operated during July and August in the Cabinet Mountains (Fig. 9). All sites were equipped with remote cameras. A site in the East Fork of the Bull River produced hair that was visually identified as grizzly bear, and the camera provided a picture of a female grizzly bear and cub. At a site in Libby Creek, pictures of a grizzly bear and hair were obtained.

Nineteen hair snag sites were operated during April, May, June, August and September of 2006 in the Cabinet Mountains (Fig. 9). All sites were equipped with remote cameras. Four sites produced either pictures of grizzly bears or hair that appeared to be grizzly bear. These sites were located Cub Creek, Silverbutte Creek, Bear Creek, and East Fork of Rock Creek.

Thirty six hair snag sites were established during May, August, and September of 2007 in the Cabinet Mountains and Yaak River drainage (Fig. 9). Most sites were equipped with remote cameras. Seven sites had pictures of grizzly bears or hair that appeared to be grizzly bear. These sites were located in Devils Club Creek, East Fork Rock Creek, Bear Creek, West Fork Rock Creek, West Fisher Creek, Pete Creek, and the North Fork Meadow Creek. The East and West Fork of Rock Creek sites produced pictures of female grizzly bears with young.

Twenty-one hair snag sites were established during May, August, and September of 2008 in the Cabinet Mountains (Fig. 9). Most sites were equipped with remote cameras. One site in the East Fork of the Bull River had a picture of grizzly bear and grizzly bear hair.

During 2009, 24 hair snag sites were operated during June, July, and August in the Cabinet Mountains (Fig. 9). All sites were equipped with remote cameras. Four sites had pictures of grizzly bears or hair that appeared to be from a grizzly bear. Sites that produced grizzly bear pictures or hair were located in Bear Creek, Libby Creek, North Fork of Callahan Creek, and West Fisher River.

Numerous other hair or tissue samples were collected from mortalities, captured native bears, captured bears transplanted to the Cabinet Mountains, or opportunistically collected field samples from signs, bridges, or trees during 1983-2009.

In 1993, claws from a grizzly bear were discovered in Baree Creek of the Cabinet Mountains. Analysis of DNA from these claws matched bear 678 originally captured in the Cabinet Mountains in 1983 when 28 years-old. Tissue present on the claws suggested that she died no earlier than 1992. Bear 678 would have been at least 37 years old at the estimated time of death. Pedigree analysis also indicated that the 3 bears captured in the Cabinet Mountains from 1983-1988 were a triad with bear 680 being the offspring of bears 678 and 14.

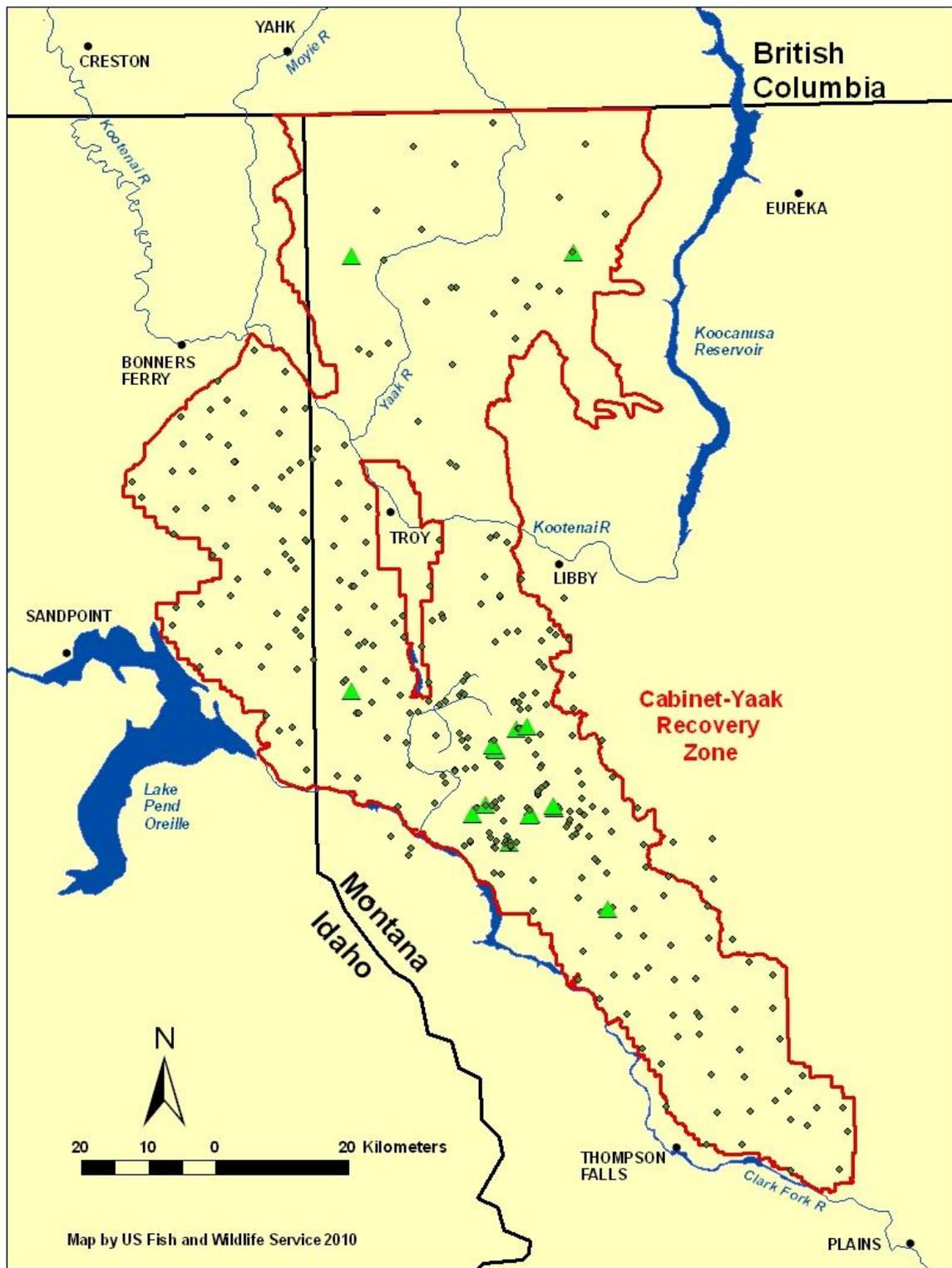


Figure 9. Location of hair snag sample sites in the Cabinet Mountains, 2002-09. Triangles denote sites that snagged grizzly bear hair.

All samples from the Cabinet Mountains were analyzed and determined to originate from 28 different grizzly bears. Three of these were from captures during 1983-1988, 7 were from augmentation bears during 1990-2009, and 18 from captures, mortalities, or hair snagging during 1997-2009. Hair snagging alone identified 15 genotypes from 2002-2009. One of these genotypes was from grizzly bear 286. She was released in the Cabinet Mountains as part of population augmentation in 1993 (Kasworm et al. 2007). She was 2 years old at the time of her release and would have been 13 years-old when the first hair sample was obtained during 2004. Pedigree analysis indicates that bear 286 has produced at least 6 offspring and two of those female offspring have also reproduced (Fig. 10) The female grizzly bear with 2 cubs captured near Noxon in 2007 (bear 772) was determined to be the offspring of bear 286 by the genetic analysis. Bear 286 was killed in a self defense incident with a hunter in November of 2009.

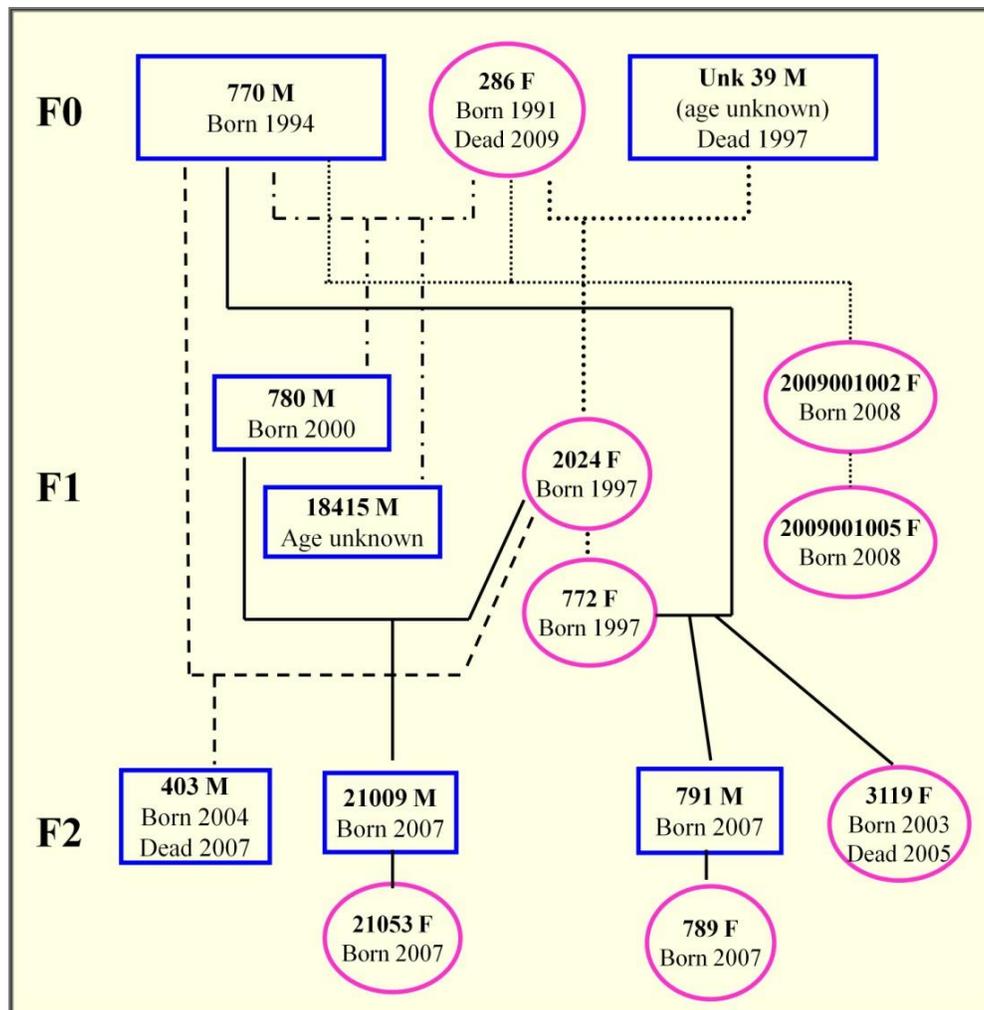


Figure 10. Most likely pedigree resulting from translocated female grizzly bear 286 into the Cabinet Mountains, USA, 1993-2009. Squares indicate males and circles represent females. Lines indicate a parent-offspring relationship. F0 is the initial generation, F1 is the first generation of offspring for translocated female 286, and F2 is the second generation.

## **Radio Telemetry Monitoring**

### **Grizzly Bear**

Four grizzly bears were monitored portions of 2009. Three bears were females in the Yaak River and one was female augmentation bear 715 in the Cabinet Mountains. The three females in the Yaak River were one adult and two subadults.

### **Black Bear**

Seven black bears were monitored with GPS collars for portions of 2009 (4 in the Yaak River and 3 in the Clark Fork River). The objective of this effort is to compare black bear movements near highways with sympatric grizzly bears. Black bears may prove to be useful surrogates for grizzly bears when evaluating linkage areas across valleys with highways and human habitation. Monitoring of black bears along Highway 2 near the confluence of the Kootenai and Yaak Rivers was conducted from 2004-06. Eleven black bears were monitored with GPS radio collars. Locations from these animals did not detect any crossing of the valley, but the data will be modeled with several habitat variables to predict areas of probable use with logistic regression (Fig. 11).

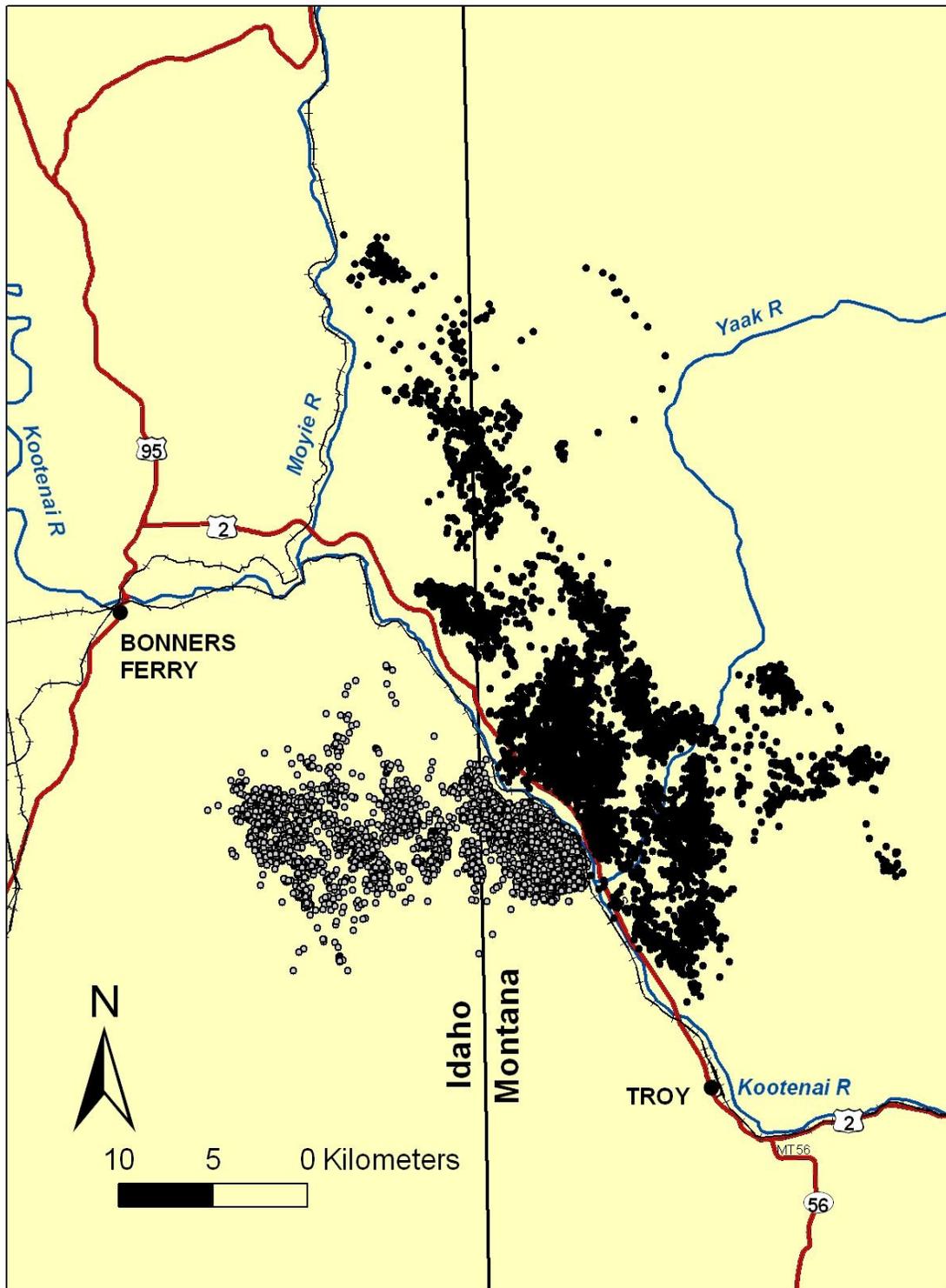


Figure 11. Black bear GPS radio locations along the Kootenai River, northwest Montana, 2004-06. Black dot are bears captured north of the Kootenai River and gray dots are bears captured south of the Kootenai River.

## Monitoring Summary of Each Adult Female Grizzly Bear

### Cabinet Mountains Native Adult Female Bears

Grizzly 678--This adult female was first captured in Bear Creek on 30 June 1983. She weighed 87 kg at capture and was 28 years old. Bear 678 was monitored until spring of 1989 when she lost her collar. During 1983-89 she was recaptured twice for collar replacement. She was not accompanied by cubs at capture and was never seen with cubs during monitoring though both radio collared males spent time with her during the spring breeding seasons of 1984 and 1985. She may have come into estrous, but could not complete a pregnancy. During 1983 and 1984 her home range extended south to the Vermilion River, but during subsequent years she remained further north of that area with the core of her range within or near the Cabinet Mountains Wilderness. When she lost her collar during the spring of 1989, but was still alive. In 1993 several claws were discovered in the Cabinet Mountains in Baree Creek. Analysis of the DNA in these claws indicated that they were from bear 678. The presence of dried tissue on the claws suggested that the bear had died during 1993 or the previous year. If bear 678 died during 1992 she would have been 37 years old and one of the oldest known grizzly bears recorded in the wild.

Grizzly 772—This female was captured on 18 September 2007 at Pilgrim Creek, south of the Clark Fork River with 2 cubs. They were released the next day at Marten Creek. Before denning she moved north across the river into the Cabinet Mtns. Her collar malfunctioned prior to getting a den location. A Bull River resident reported seeing a collared grizzly bear with 2 young near his home in 2008.

### Cabinet Mountains Augmentation Bears

Grizzly 218--This animal was captured in the North Fork of the Flathead River in British Columbia on 21 July 1990 as a 5-year-old and released near the west edge of the Cabinet Mountains Wilderness in Lost Girl Creek the following day. Bear 218 weighed 71 kg when captured. She was monitored for remainder of 1990 and denned in the upper reaches of Big Cherry Creek at an elevation of about 2100 m. Contact with bear 218 was lost in August of 1991 when the canvas spacer on her collar separated. On 2 July 1992, she was observed crossing a road in the Midas Creek area. Although she was of potential reproductive age, she was not observed with cubs. She has not been observed since and her fate at this time is unknown.

Grizzly 258--This animal was captured in the North Fork of the Flathead in British Columbia on 21 July 1992 as a 6-year-old and released near the west edge of the Cabinet Mountains Wilderness in Lost Girl Creek the following day. Bear 258 weighed 70 kg at capture. She was monitored from release through denning in the East Fork of Rock Creek during early November of 1992. She emerged from her den between 12 and 19 May. Small tracks were later observed in the snow from the air, indicating young accompanied her. The presence of one cub was confirmed on 17 June when she and a cub were observed on a radio monitoring flight. Bear 258 was seven years old in 1993 and had apparently bred in British Columbia prior to being moved the previous year. Bear 258 traveled fairly extensively in 1993 (considering the age of her cub) and utilized upper elevations in the East Fork of Rock Creek, Swamp Creek, Libby Creek, and East Fork of the Bull River. In mid-July her movements ceased near the vicinity of Libby Lakes (in upper Libby Creek drainage) and it was assumed she had cast her collar. An examination of the site was made on 22 July. Bear 258 was found dead, lying on her stomach in a daybed she had made in a small patch of trees at 2000 m elevation on an otherwise open

slope. It was estimated she had been dead for 8-10 days. There was no evidence of a traumatic death at the site, nor was there any evidence of her cub. The carcass was removed the following day via helicopter and sent to the Montana Department of Fish, Wildlife and Parks Wildlife Laboratory in Bozeman for analysis. Laboratory personnel were unable to determine a cause of death, though several factors such as parasites, physical trauma, physical abnormalities, fast acting poisons, and starvation were ruled out.

Grizzly 286--This animal was 2 years old when captured in the upper North Fork of the Flathead River on 14 July 1993. She was released in the Lost Girl drainage in the Cabinet Mountains on 15 July. She weighed 36 kg at capture. Bear 286 stayed in the vicinity of the release site for 10 days before moving south. She spent the remainder of the summer and fall at higher elevations in the Cabinet Mountains with most of her movements centered within 10 km of the release site. The one long movement she made occurred in late August when she moved north along the crest of the Cabinet Mountains about 25 km and then returned to the vicinity of the release site. These movements occurred over 7-8 days. Bear 286 denned during early November of 1993 in Snowshoe Creek at about 2100 m elevation. Bear 286 emerged from her den during late April of 1994. She remained at higher elevations during most of the year. Her home range was quite similar to that of 1993. Bear 286 denned in Granite Creek during early November and lost her radio collar during late April of 1995 shortly after den emergence. During 2004, 2005, and 2007 hair from this bear was collected in the East Fork of the Bull River at a hair snag site and identified by DNA analysis.

Grizzly 311--This 3-year-old female was captured on 12 July 1994 in the North Fork of the Flathead River. She weighed 75 kg and was released at the Lost Girl site on 13 July. She remained near the release site for 4 days before moving east about 15 km to an area near Horse Mountain. On 25 July she lost her radio collar in the vicinity of Standard Lake. Bear 311 was sighted again on 7 September in the East Fork of Rock Creek. There were no additional sightings reported after that date. On 2 October 1995 this bear was captured at Lydia Creek approximately 80 km northeast of her last known sighting in the Cabinet Mountains. She was moved back to the Cabinet Mountains and released in Lost Girl Creek with a new radio collar. She was monitored for approximately one month, after which the signal was lost.

Grizzly A1—This adult female (approximately 7-8 years old) was captured at Spruce Creek in the North Fork of the Flathead River on 30 Sept. 2005 by Montana Dept of Fish, Wildlife and Parks personnel. She was released near Spar Lake in the West Cabinet Mountains and was monitored within an 8 km radius of the release site until late November when she moved north to within 3 km of the Kootenai River along the Idaho-Montana border before denning in Goat Creek in mid December. In October 2006 she was observed from the aircraft in the North Fork of Lightning Creek chasing a wolf away from an apparent kill. She denned near Katka Peak. She was monitored in 2007 until September when she dropped her collar.

Grizzly 782---This subadult female (2 years old) was captured at Ball Creek in the South Fork of the Flathead River on 17 August 2006 by Montana Dept of Fish, Wildlife and Parks personnel. She was released near Spar Lake in the West Cabinet Mountains. Since her release she has stayed fairly close (8-10 km) to the release site despite a move east to the main Cabinet Mountains and near Highway 2 during 14-20 September, 2006. She denned near Spar Lake. She was monitored throughout 2007 to her den. She lost her radio collar in August of 2008.

Grizzly 635---This subadult female (4 years old) was captured in Fitzsimmons Creek in the Stillwater drainage of the Whitefish Range on 23 July 2008 by Montana Dept of Fish, Wildlife and Parks personnel. She was released in the East Fork of the Bull River near the Cabinet

Mountains Wilderness on 24 July 2008. She was monitored in the Cabinet Mountains until October 15 when she and bear 790 began traveling together. They moved down the Bull River from Bull Lake and on October 21 approached the Clark Fork River west of Noxon, MT. At this point the animals split up and bear 635 moved downstream on the south side of the Clark Fork River along the Montana Rail Link tracks. At approximately 8 PM on the evening of 21 October Montana Rail Link officials reported striking a bear on the tracks. Flights on 22 October located the transmitter on the north shore of the Clark Fork River about 10 km west of the reported strike. Ground investigation located and recovered the body of bear 635. Necropsy and x-rays reported heavy bruising on the carcass in the head and rear legs of the bear, but no significant broken bones. Water was located in the lungs and it was suggested that the animal died from drowning after blunt force trauma possibly rendering her unconscious.

Grizzly 790---This subadult female (3 years old) was captured in Swan River on 7 August 2008 by Montana Dept of Fish, Wildlife and Parks personnel. She was released in the East Fork of the Bull River near the Cabinet Mountains Wilderness on 8 August 2008. She was monitored in the Cabinet Mountains until October 15 when she and bear 635 began traveling together. They moved down the Bull River from Bull Lake and on October 21 approached the Clark Fork River west of Noxon, MT. At this point the animals split up and bear 790 moved south of the Clark Fork River. At approximately 6 PM on the evening of 21 October a Noxon resident reported killing a radio collared bear that was getting garbage in his yard. The individual said he thought the animal was a black bear. Wardens from MDFWP investigated the incident. GPS radio telemetry did not show complete agreement with the animal location and reported timing of the garbage incident. Furthermore, no garbage was found in the stomach of the bear during necropsy. The individual did not possess a 2008 black bear tag. The individual was cited and convicted of illegally killing a grizzly bear.

Grizzly 715---This adult female (~10 years old) was captured on 17 September 2009 in the Big Cr. drainage of the North Fork of the Flathead River by Montana dept. of Fish, Wildlife and Parks personnel. She was released on 18 September near Spar Lake. She was monitored until she denned in late November.

#### Yaak Drainage Adult Female Bears

Grizzly 106--An adult female bear was captured on 23 May 1986 in the Yaak River near the confluence with Pheasant Creek. Two 5-month-old cubs accompanied the 8-year-old female, although the cubs were not captured. She weighed 92 kg and her body condition was judged to be good. She was recaptured in 1986, 1987, 1990, 1992, 1995, and 1998. She was accompanied by only 1 cub when captured in the fall of 1986. A sibling cub apparently died in early July. Bear 106 produced 3 cubs in 1988 (bears 192, 193, and 206). These cubs remained with her until the spring of 1990. She was recaptured in the fall of 1990 and her collar was replaced. In 1991, bear 106 was accompanied by 2 cubs, from which she separated during June of 1992 during the breeding season. She was observed consorting with male bear 128 during 1992. She was recaptured on 4 September and weighed 144 kg. Bear 106 produced two cubs again in 1993. Those cubs remained with her until June of 1994 when she was observed in the company of an unmarked adult male and at a later time, grizzly 244. She lost her collar during July of 1994. Bears 302 and 303 were believed to be her 1993 offspring. On 20 September 1995 she was recaptured and collared. Two female cubs (bears 353 and 354) were captured with her. These two cubs remained with her until 1997. She was captured and re-collared on 29 August 1998. She was alone and was not lactating at the time of capture. She was monitored until June 1999 at which time the radio signal came from the same location on two consecutive flights. Upon examination of the site, bear 106 was found dead along with two

cubs of unknown sex. Evidence at the site indicated that she had likely been killed by an adult male grizzly bear while defending an elk carcass and/or her cubs.

Grizzly 206--Female 206 was the offspring of bear 106 and had 2 litter mates (Bears 192 and 193). Sibling grizzly bears 206 and 192 were captured on 3 June 1990 in Burnt Creek. She was in good condition and weighed 70 kg. Bear 206 was monitored throughout 1991 and 1992. During 1992 she was observed consorting with male bear 128 during breeding season. Bear 206 was 4 years-old at that time. She did not emerge with cubs in 1993 and was seen consorting with at least 2 male grizzly bears during breeding season. She was recaptured in October 1993 and was in excellent condition weighing in excess of 150 kg. Since separating from her mother bear 206 has centered her home range in the West Fork of the Yaak River and Pete Creek. She lost her radio collar at the den during April of 1994. On 14 September 1994 a female cub (505) was captured in Jungle Creek. Bear 206, and another cub were present at the trap site. In 1997 a female believed to be bear 206 was sighted with two cubs.

Grizzly 34--On 26 June 1993 this female bear was captured in Spread Creek. She was approximately 15 years old and weighed 158 kg. She had yellow tags in her ears from British Columbia Wildlife Branch. She had been moved from a garbage dump to Bloom Creek north of the border in British Columbia with 2 yearlings. There were no young with her at capture and due to her large neck, the collar dropped off within a week.

Grizzly 538--This female bear was captured on 25 September 1997 in Rampike Creek. A single cub was with her at the trap site but was not captured. She was estimated to be 6 years old and weighed approximately 135 kg. She separated from the yearling in May of 1998 and was observed with male bear 358. She did not produce cubs in spring 1999, possibly due to the very poor berry crop in 1998. She was seen with an adult male in June of 1999. In late May of 2000 she emerged from the den with two cubs, however, both cubs were not seen with her after June 2000 and were presumed dead. She was captured on 16 July 2000 in the Moyie River drainage in British Columbia. She emerged from her den with 2 cubs in May of 2001, but they were not seen with her after June 2001 and are also presumed to be dead. In May of 2002 she emerged from her den with 2 cubs, which survived to den with her in the fall. Her collar ceased transmitting during the denning period of 2002-2003.

Grizzly 303--This female is the offspring of bear 106. She was captured on 27 May 1996 in Zulu Creek and recaptured on 21 September 1998 in Clay Creek. Her home range is centered around the South Fork of the Yaak River. As a 5 year old she was seen with an adult male during breeding season in 1998. She did not have cubs in the spring of 1999, but was seen with an adult male during breeding season. In May 2000 she emerged from the den with two cubs however, after June 2000 one of the cubs was no longer observed with her and was presumed dead. The remaining cub survived and entered the den with her mother in November 2000. She emerged from the den in April 2001, with her yearling. She was monitored until July 2001 when her collar ceased transmitting.

Grizzly 353--This female is the offspring of bear 106. She was captured on 20 September 1995 as a yearling, and on 23 September 1996 as a 2 year old. She wore a transmitter from 1995-97. On 15 June 2002 she was recaptured. She was seen with 3 cubs shortly after capture. She was killed in November of 2002 and the remains of 1 cub were also found. The other 2 cubs are assumed to be dead.

Grizzly 675--This female was captured on 10 October 2004 at Young Creek, as a two year old. She was released in the Northwest Peaks area and has established her home range there in

the US and Canada. She did not produce cubs during 2008 as a 6 year old. In 2009 she had two cubs with her at den emergence, but both died in June of 2009.

#### Salish Mountains Adult Female Bears

Grizzly 648—This female bear was captured on 18 August 2003 in the McGuire Creek drainage of the Salish Mountains. She was followed until 13 November 2003. She was located in a den in spring of 2004 in the Williams Creek drainage, east of Highway 93, in the Whitefish Range. She emerged from the den in May 2004 with one cub. They were monitored throughout the field season until they denned in Deep Creek in the Whitefish Range again in November 2004. She was located in both the Salish Mountains and the Whitefish Range in 2004. She emerged from the den with the yearling in the spring of 2005 and was monitored until she denned in Williams Creek. She dropped her collar in May 2006.

#### Grizzly Bear Home Ranges

Specific and general locations were obtained on collared bears, but only aerial, specific locations were used to calculate home ranges. The convex polygon and 95% and 50% fixed kernel estimators for life ranges were computed for bears monitored during 1983-2009 (Table 15 and Figs. 12-49).

Four subadult female grizzly bears were transplanted to the Cabinet Mountains during 1990-94. One was transplanted in 2005 and another in 2006. Life range convex polygon estimators averaged 604 km<sup>2</sup> ( $n=5$ , 95% CI  $\pm$  281).

Native CYGBRZ adult male life range averaged 1,172 km<sup>2</sup> (95% CI  $\pm$  393) using the minimum convex polygon estimator ( $n = 12$ , bears 14, 680, 101, 128, 134, 244, 342, 358, 363, 386, 770, and 780). Native adult female life range averaged 539 km<sup>2</sup> (95% CI  $\pm$  201) using the minimum convex polygon estimator ( $n = 7$ , bears 678, 106, 206, 303, 353, 538, and 675). The minimum convex polygon estimator for bear 106 was 852 km<sup>2</sup> during her 1986-99 life time. Her home range was smallest during 1986, 1988, 1991, 1993, and 1995 when she had cubs. The minimum convex polygon home range of native adult female bear 678 in the Cabinet Mountains from 1983-88 was 658 km<sup>2</sup>. The 2003-2005 range for female bear 648, in the Salish Mountains, was 948 km<sup>2</sup> (minimum convex polygon).

Four known female offspring of bear 106 established home ranges around their maternal range. Female offspring 206 has established a home range adjacent to and north of her mother's home range. Bear 303 has established a home range east of her mother's old home range and female 354 may have established her home range west of her mothers. Bear 353 lived within her mother's old range, before her death.

Home ranges of collared grizzly bears overlap extensively on a yearly and lifetime basis. However, bears typically utilize the same space at different times. Male home ranges overlap several females to increase breeding potential, but males and females consort only during the brief period of courtship and breeding. Adult male bears whose home ranges overlap seldom use the same habitat at the same time to avoid conflict. For example, bear 128 was captured in the central part of the study area in 1987, but has used this area on a limited basis since capture. He was recaptured in this area in 1997 but promptly moved north into British Columbia. Adult male bears 101, 134, 244, 342, and 363 used a large portion of the study area from 1986 to 1998, but were not consistently located in close proximity except for bears 342 and 363. These two animals were located together on 4 occasions between 1996 and 1998 and were in close proximity on other occasions. Bears 342 and 363 are believed to be siblings, and were 4-7 years old during 1996-99.

Fourteen of twenty-seven bears (52 percent) captured south of the international boundary in the Yaak study area of northwest Montana and northern Idaho were monitored crossing into Canada between 1987 and 2009. Six of these animals were adult males that spent portions of spring breeding season in Canada during various years between 1987 and 2008 (128,134, 355, 358, 386, and 651). One of these males (358) was observed courting an adult female (538) whose home range occurs largely in Canada, but was initially captured in the United States. Another adult female (206) whose home range occurs largely in the United States was observed in association with 2 different unmarked adult males in Canada and subsequently produced a litter of cubs. Furthermore, 2 adult males (134 and 128) originally captured in the United States were monitored up to 20 miles north of the border and north of the Moyie River in the Purcell Mountains during breeding season of 1987 and 1992.

Table 16. Home range sizes of native and transplanted grizzly bears in the Cabinet-Yaak recovery zone, and the Salish Mountains, 1983-08.

Bear	Year	Age (Est.)	Radio Locations	100% Convex Polygon (km <sup>2</sup> )	95% Fixed Kernel (km <sup>2</sup> )	50% Fixed Kernel (km <sup>2</sup> )
678 ♀	1983-1989	28-34	173	658	264	32
680 ♂	1984-1985	11-12	75	1,947	1,908	217
14 ♂	1985	27	23	589	1,763	485
218 <sup>1</sup> ♀	1990-1991	5-6	95	541	322	29
258 <sup>1</sup> ♀	1992-1993	6-7	54	400	226	19
286 <sup>1</sup> ♀	1993-1994	2-3	82	266	326	61
311 <sup>1</sup> ♀	1994-1995	3-4	17	209	379	35
101 ♂	1986	8	38	787	671	75
106 ♀	1986-1999	8-20	379	852	238	24
128 ♂	1987-1997	4-14	204	2,895	1,108	96
128 ♂	Subadult	4	21	394	661	122
128 ♂	Adult	5-14	183	2,895	33	91
129 ♀	1987-1989	1-3	42	60	88	13
134 ♂	1987-1988	8-9	20	594	1,923	379
192 ♂	1990	2	10	574	1,467	258
193 ♂	1990	2	34	642	1,055	164
206 ♀	1990-1995	2-7	208	1,332	1,059	112
206 ♀	Subadult	2-4	136	1,288	1,177	253
206 ♀	Adult	5-7	72	549	680	104
244 ♂	1992-2004	6-18	158	1,406	935	103
302 ♂	1994-1996	1-3	60	514	221	29
303 ♀	1994-2001	1-8	237	337	289	38
303 ♀	Subadult	1-4	110	193	211	17
303 ♀	Adult	5-8	127	295	227	26
342 ♂	1996-2004	4-12	134	1,653	1,199	187
342 ♂	Subadult	4	26	711	753	99
342 ♂	Adult	5-12	108	867	11	157
354 ♀	1997-1999	2-4	70	537	584	87
355 ♂	1996	(6)	5	N/A	N/A	N/A
358 ♂	1996-1998	8-10	55	1,442	1,176	120
363 ♂	1996-1999	4-7	120	538	532	66
363 ♂	Subadult	4	40	384	29	75
363 ♂	Adult	5-7	81	525	563	59
386 ♂	1997-1998	5-6	29	1,895	2,071	295
538 ♀	1997-2002	6-11	232	835	572	54

Bear	Year	Age (Est.)	Radio Locations	100% Convex Polygon (km <sup>2</sup> )	95% Fixed Kernel (km <sup>2</sup> )	50% Fixed Kernel (km <sup>2</sup> )
592 ♀	1999-2000	2-3	59	471	536	62
596 ♀	1999	2	10	283	446	58
552 ♀	2001	1	6	N/A	N/A	N/A
353 ♀	2002	7	37	119	163	30
577 ♀	2002	1	11	2	5	1
578 ♂	2002	1	3	N/A	N/A	N/A
579 ♂	2002	1	10	5	16	2
651 ♂	2002-2003,06	(8-9)	12	69	313	71
787 ♂	2003-2004	(2-3)	84	1,369	923	144
576 ♂	2004	(3)	7	N/A	N/A	N/A
675 ♀	2004-2008	(2-6)	137	578	496	64
675 ♀	Subadult	(3-4)	24	424	758	102
675 ♀	Adult	(5-6)	113	468	411	65
694 ♀	2005	(2-3)	11	89	231	41
770 ♂	2005-2006	(12)	20	326	468	70
A1 <sup>1</sup> ♀	2005-2007	(7-8)	73	725	1072	231
782 <sup>1</sup> ♀	2006-2008	(2-4)	225 <sup>2</sup>	1,089	165	27
780 ♂	2006-2008	(7-9)	56	1374	1563	182
Salish Mountains						
648 ♀	2003-2005	(5-7)	85	948	943	121

<sup>1</sup> Bear transplanted to Cabinet Mountains from north Fork of the Flathead River, British Columbia or Flathead River, Montana.

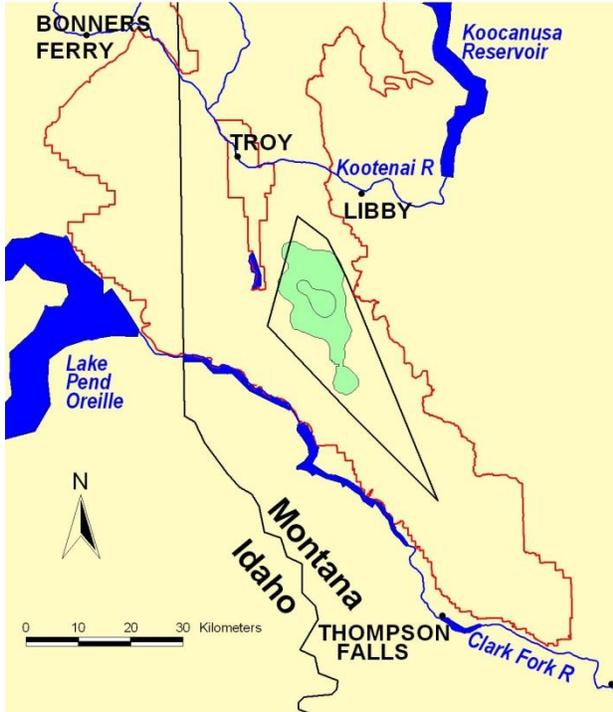


Figure 12. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female grizzly bear 678 in the Cabinet Mountains, 1983-89.

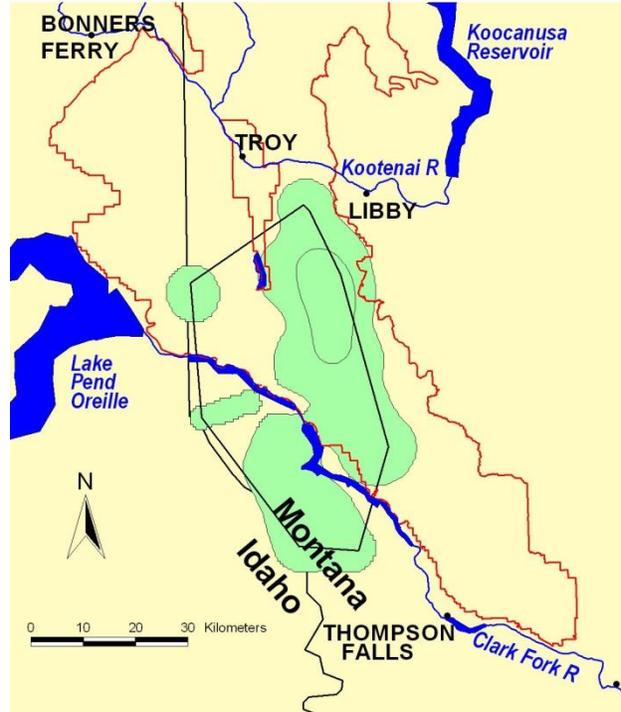


Figure 13. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 680 in the Cabinet Mountains, 1984-85.

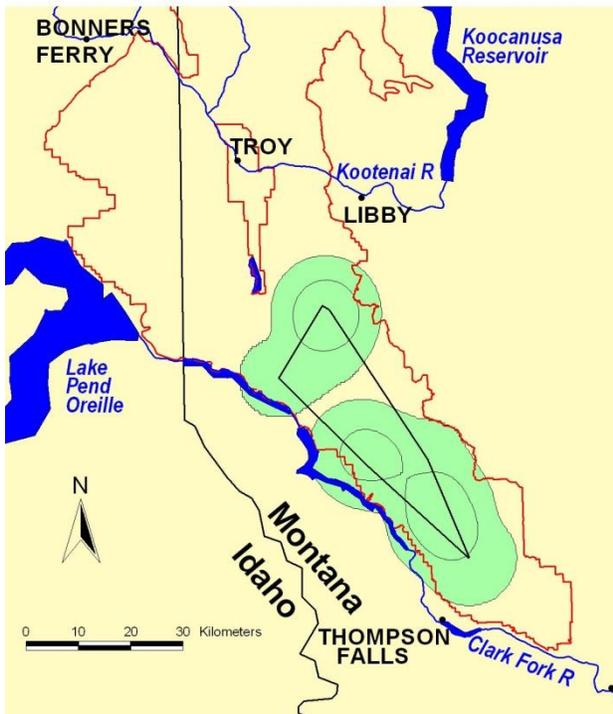


Figure 14. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 14 in the Cabinet Mountains, 1985.

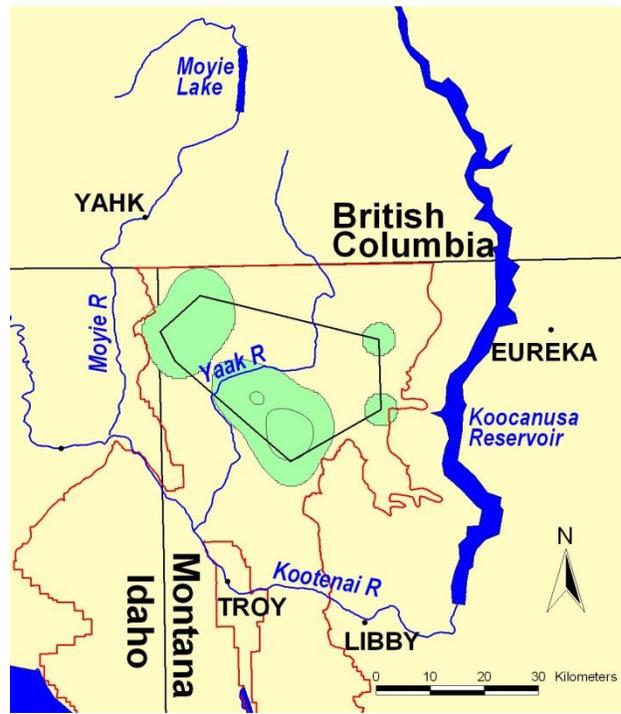


Figure 15. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 101 in the Yaak River, 1986-87.

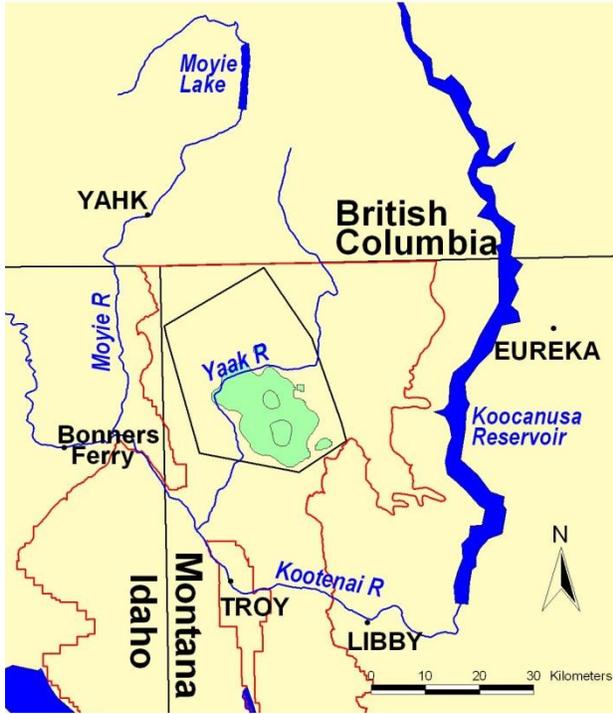


Figure 16. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female grizzly bear 106 in the Yaak River, 1986-99.

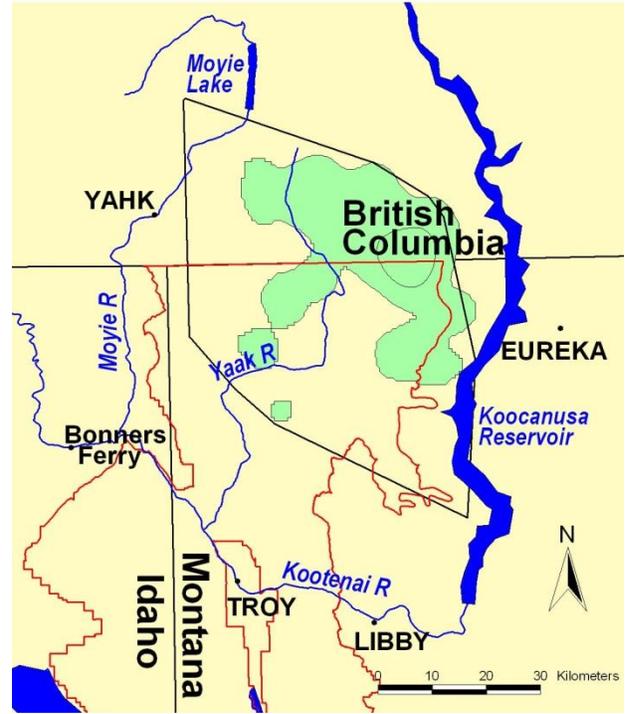


Figure 17. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 128 in the Yaak River, 1987-97.

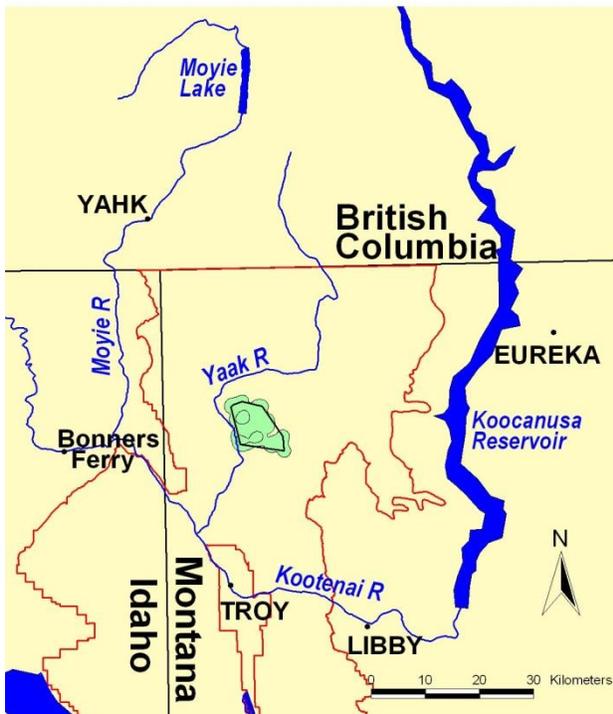


Figure 18. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female grizzly bear 129 in the Yaak River, 1987-89.

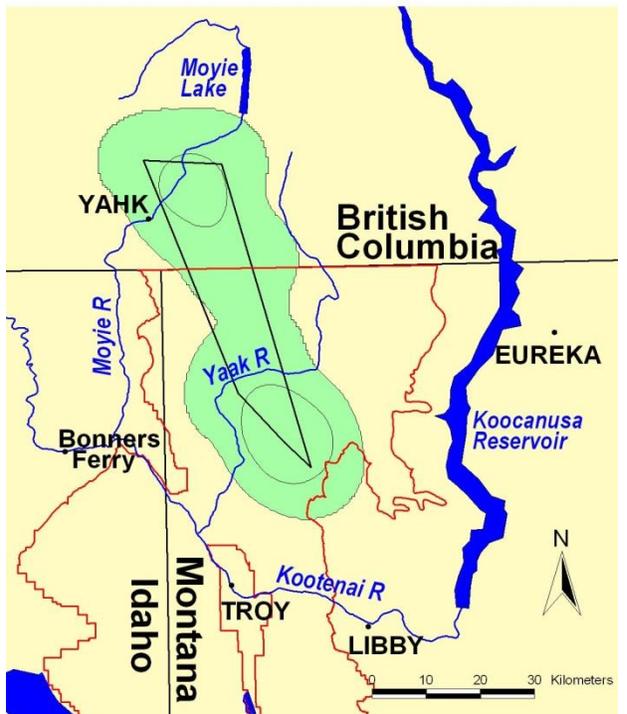


Figure 19. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 134 in the Yaak River, 1987-88.

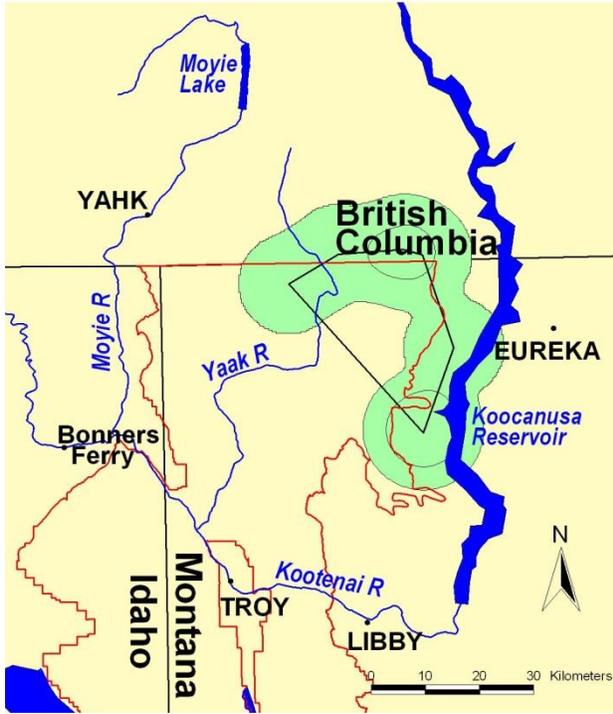


Figure 20. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 192 in the Yaak River, 1990.

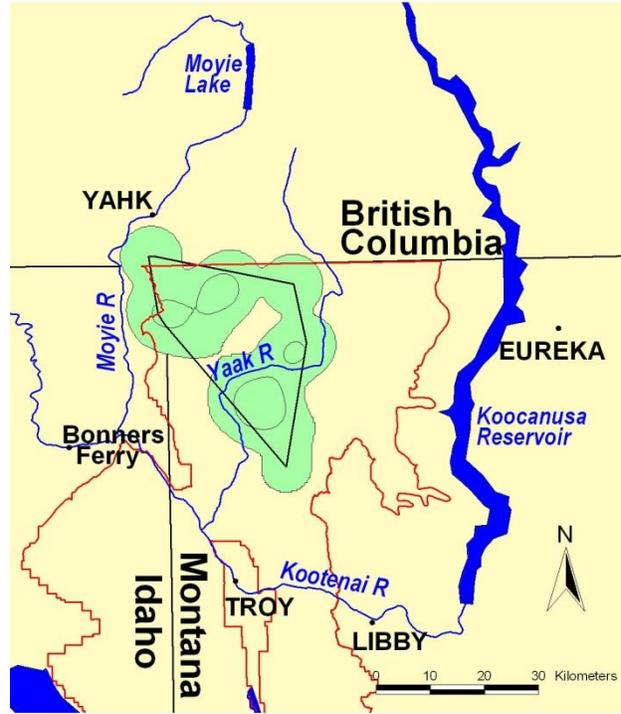


Figure 21. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 193 in the Yaak River, 1990.

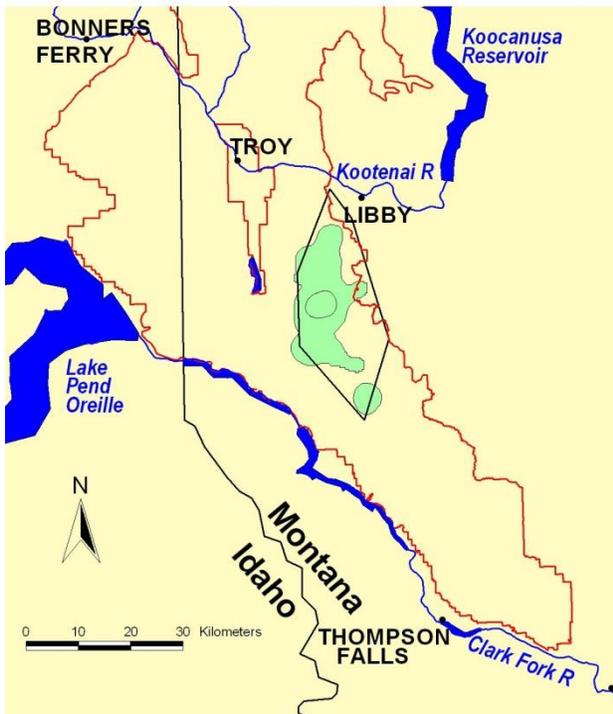


Figure 22. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female augmentation grizzly bear 218 in the Cabinet Mountains, 1990-91.



Figure 23. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female grizzly bear 206 in the Yaak River, 1991-94.

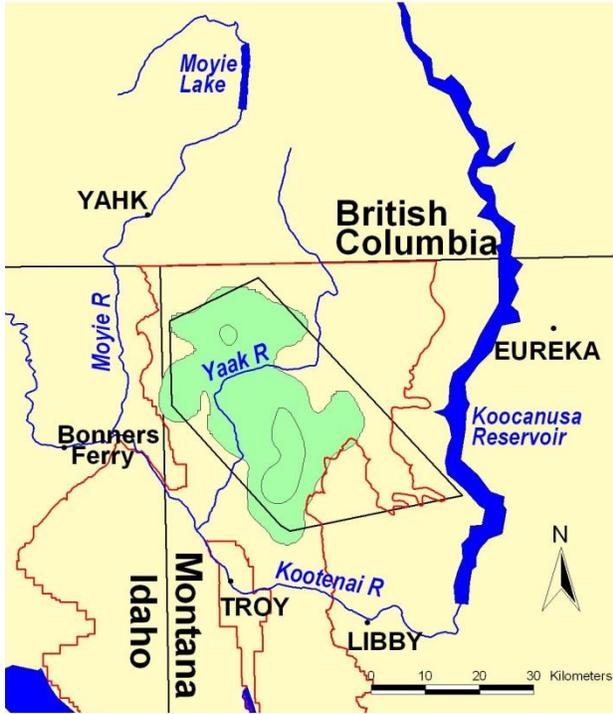


Figure 24. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 244 in the Yaak River, 1992-03.

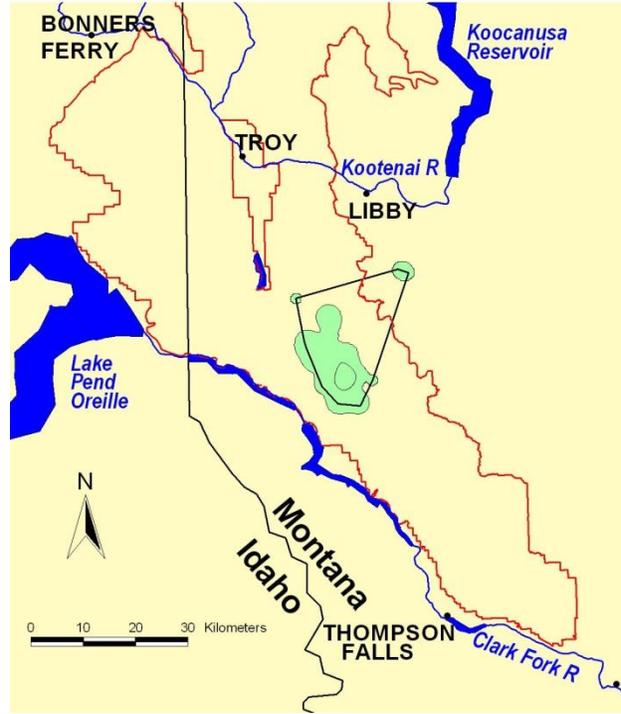


Figure 25. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female augmentation grizzly bear 258 in the Cabinet Mountains, 1992-93.

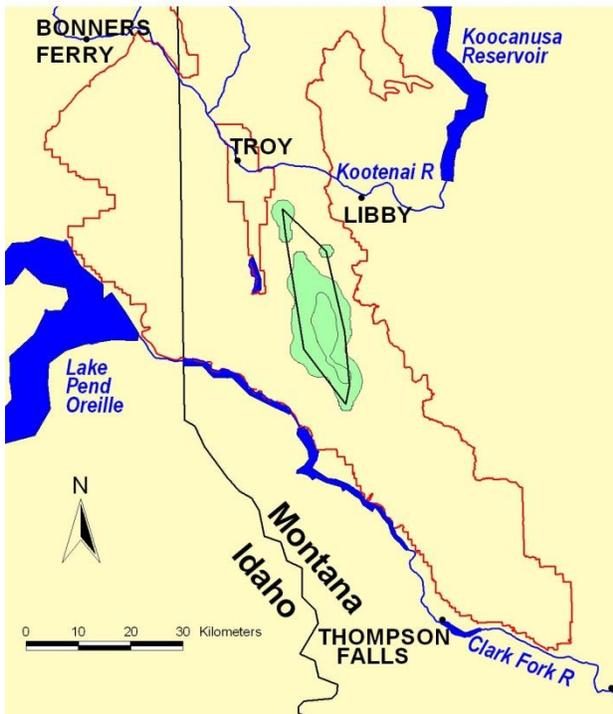


Figure 26. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female augmentation grizzly bear 286 in the Cabinet Mountains, 1993-95.

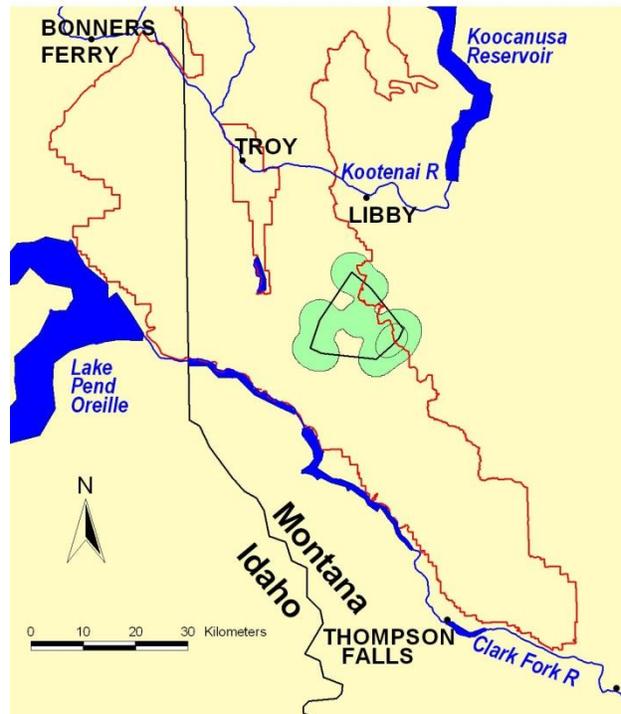


Figure 27. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female augmentation grizzly bear 311 in the Cabinet Mountains, 1994-95.

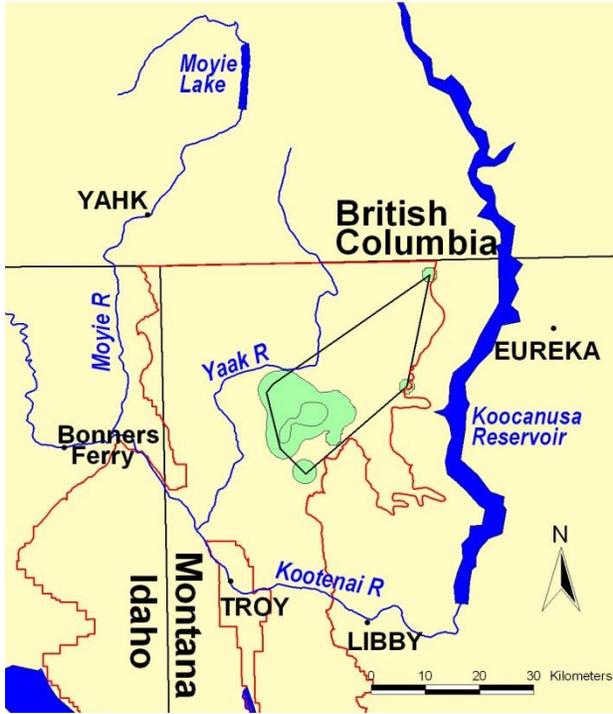


Figure 28. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 302 in the Yaak River, 1994-96.

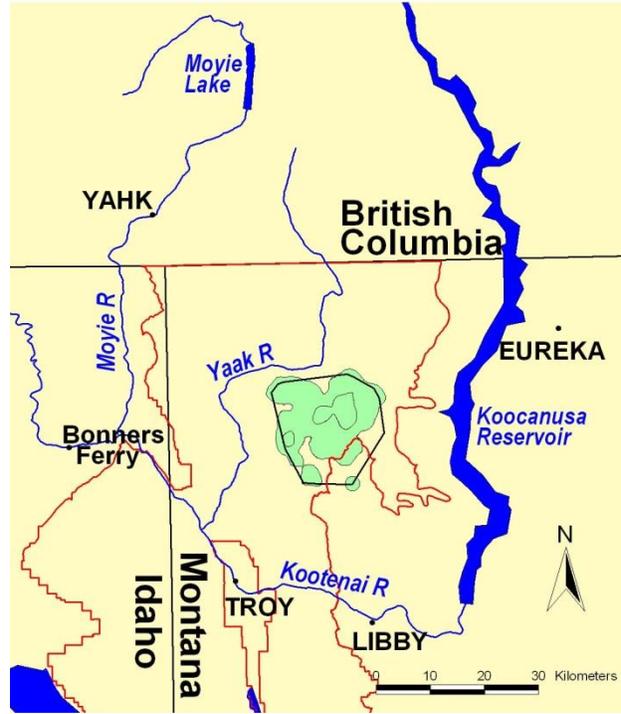


Figure 29. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female grizzly bear 303 in the Yaak River, 1994-01.



Figure 30. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 342 in the Yaak River, 1995-01.

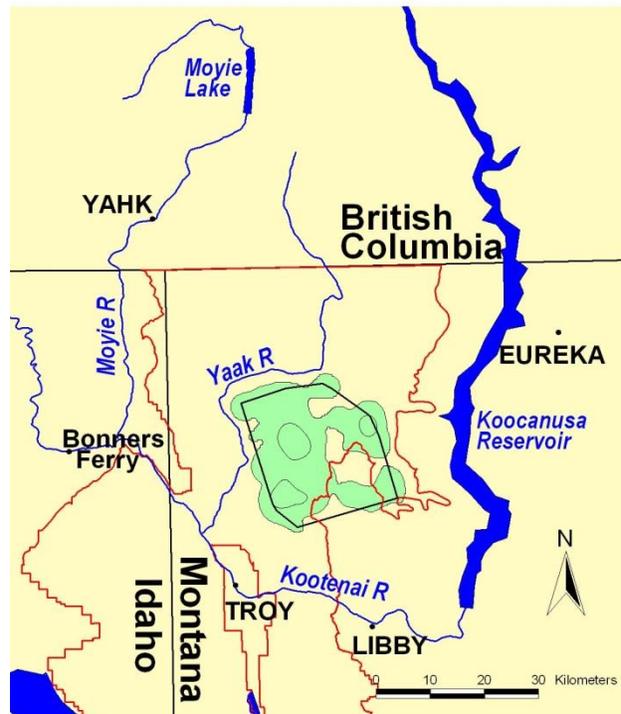


Figure 31. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 363 in the Yaak River, 1996-99.

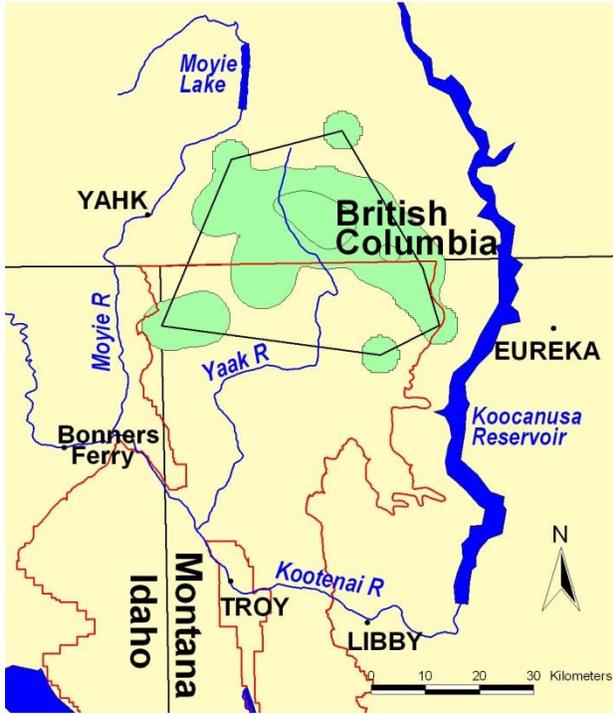


Figure 32. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 358 in the Yaak River, 1996-98.

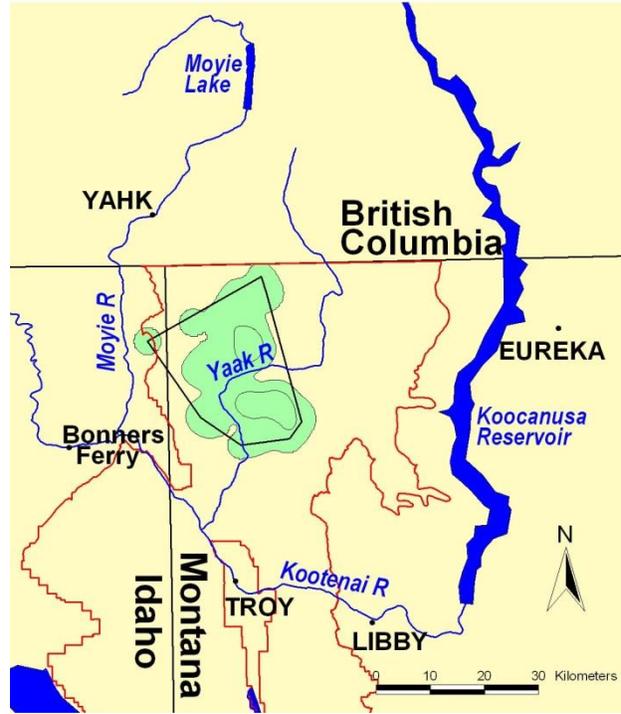


Figure 33. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female grizzly bear 354 in the Yaak River, 1997-99.

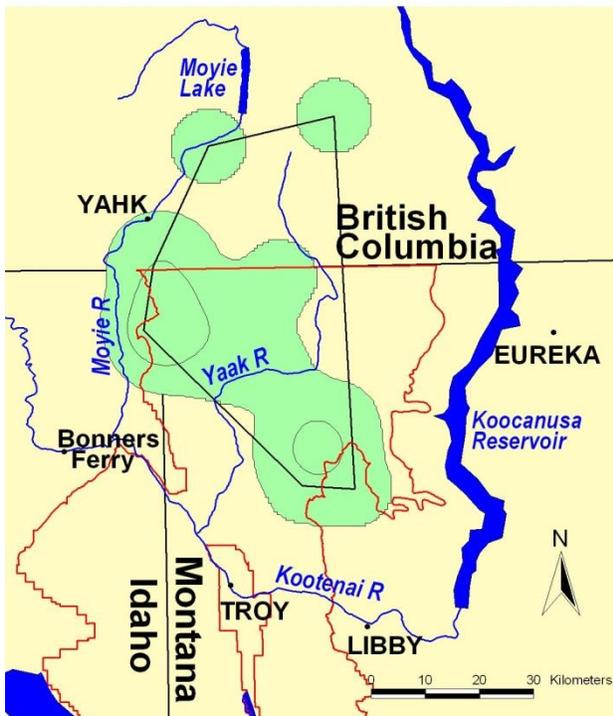


Figure 34. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 386 in the Yaak River, 1997-99.

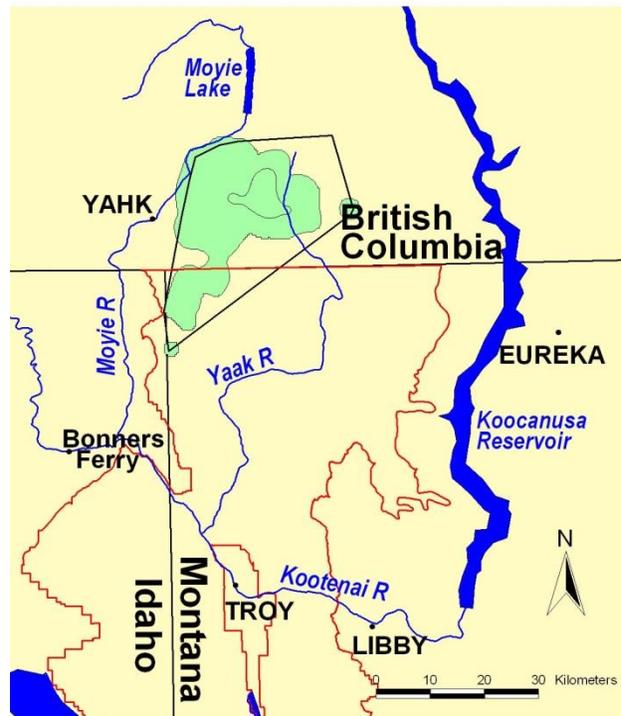


Figure 35. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female grizzly bear 538 in the Yaak River, 1997-02.

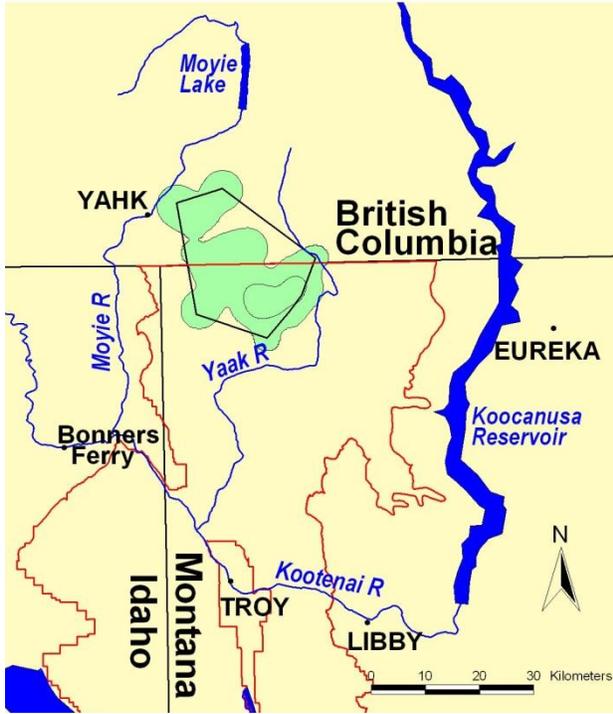


Figure 36. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female grizzly bear 592 in the Yaak River, 1999-00.

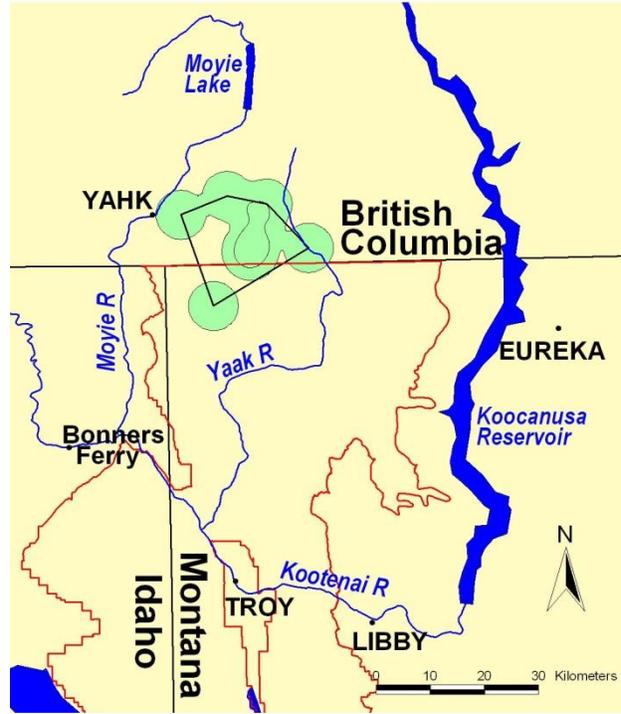


Figure 37. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female grizzly bear 596 in the Yaak River, 1999.

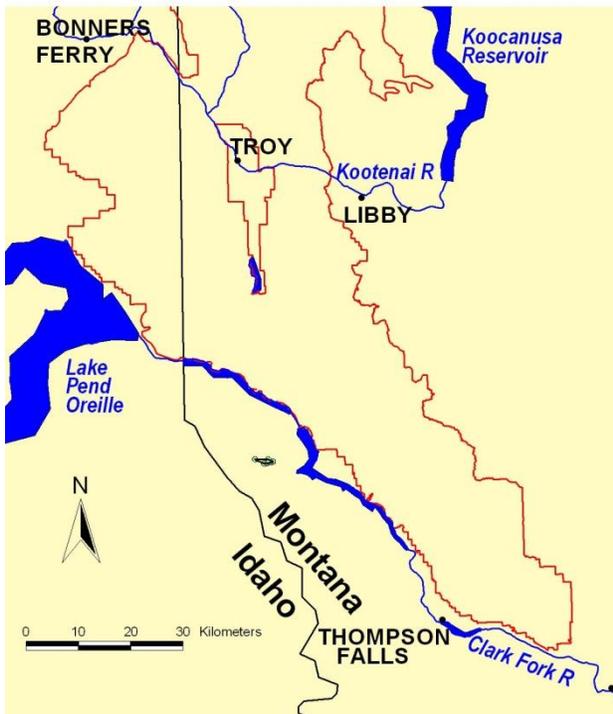


Figure 38. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female grizzly bear 577 in the Cabinet Mountains, 2002.

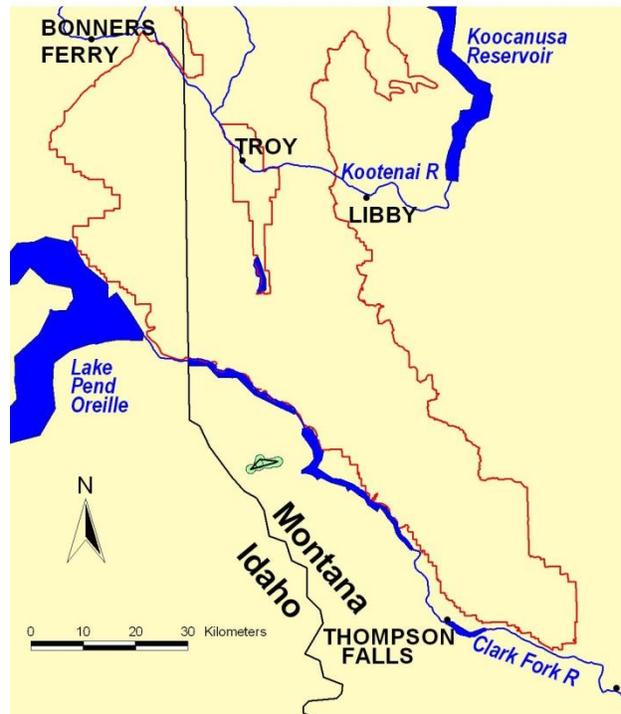


Figure 39. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 579 in the Cabinet Mountains, 2002.

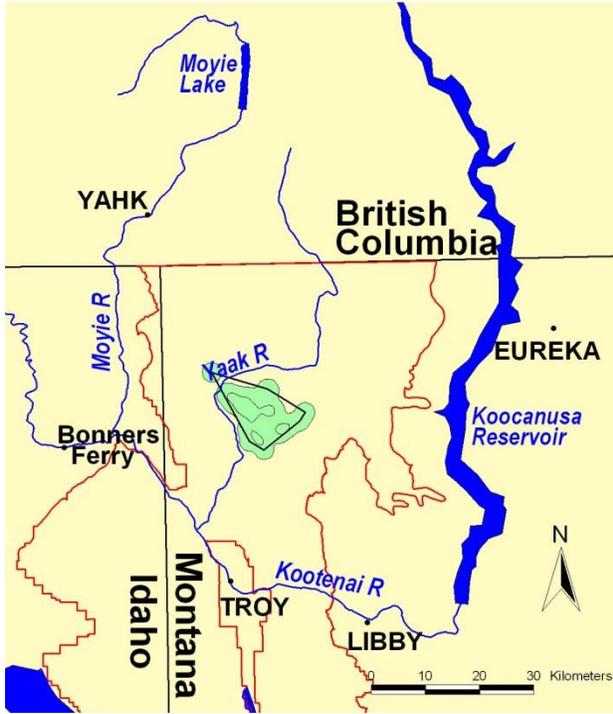


Figure 40. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female grizzly bear 353 in the Yaak River, 2002.

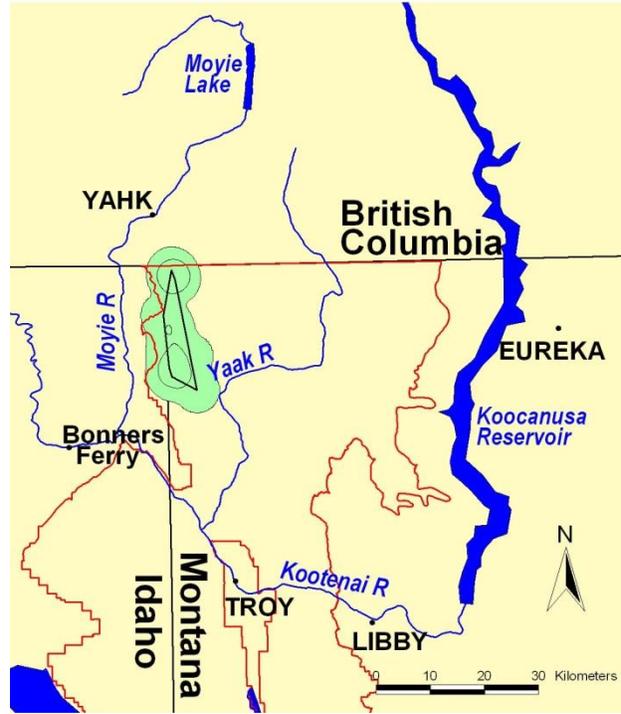


Figure 41. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female grizzly bear 651 in the Yaak River, 2002-06.

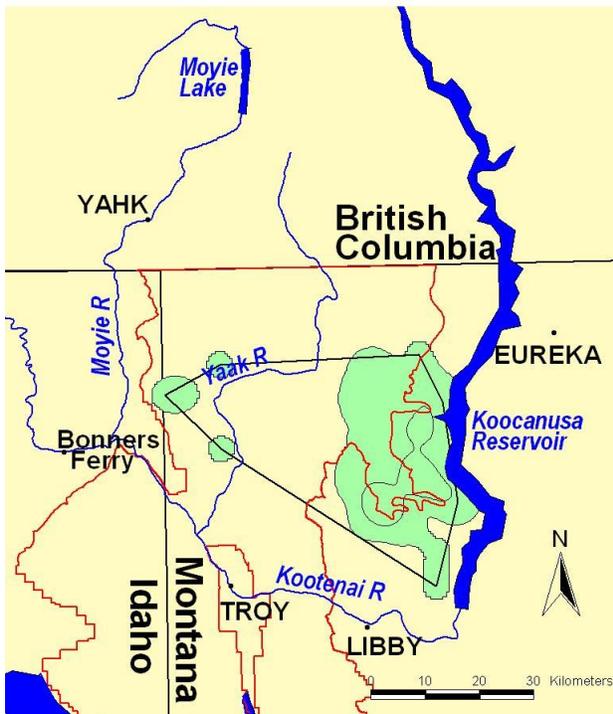


Figure 42. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 787 in the Yaak River, 2003-04.

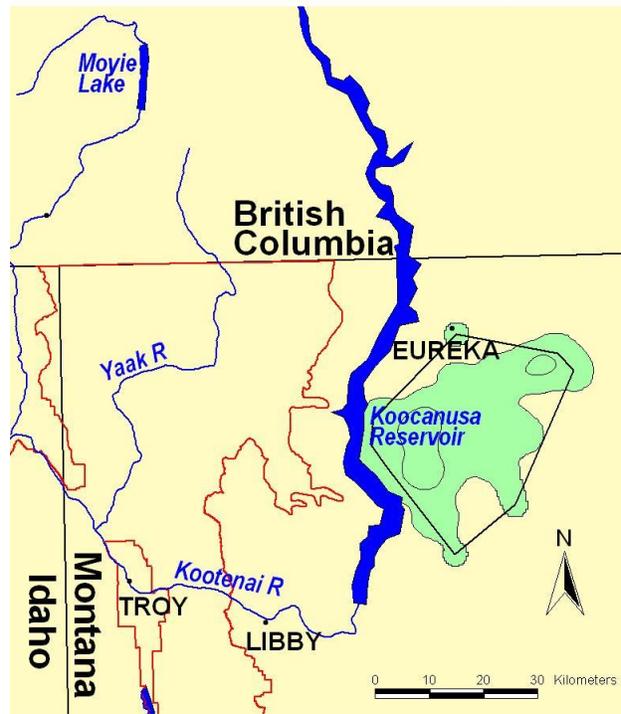


Figure 43. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female grizzly bear 648 in the Yaak River, 2003-05.

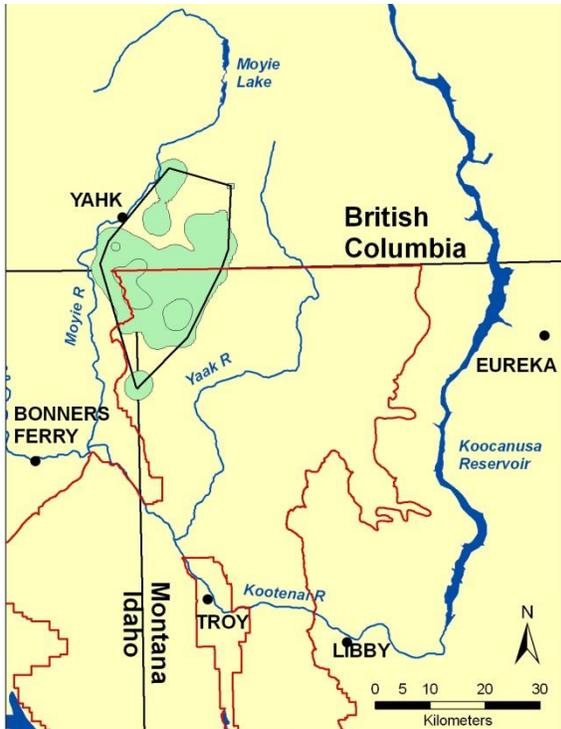


Figure 44. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female grizzly bear 675 in the Yaak River, 2004-08.

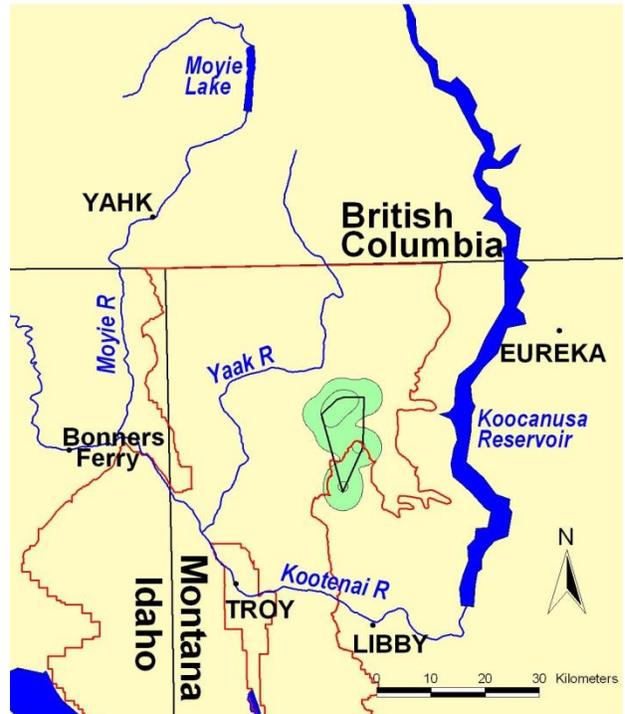


Figure 45. Minimum convex, 95%, and 50% kernel (shaded) life ranges of female grizzly bear 694 in the Yaak River, 2005.

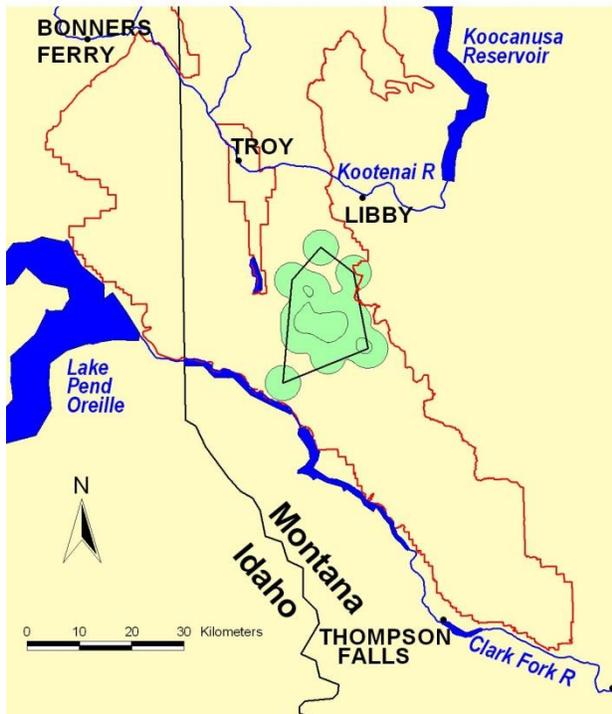


Figure 46. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 770 in the Cabinet Mountains, 2005-06.

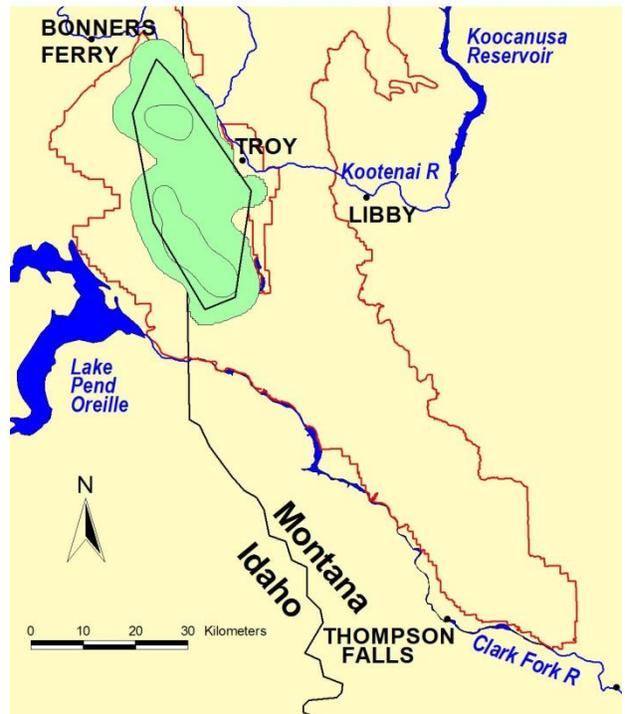


Figure 47. Minimum convex, 95%, and 50% kernel (shaded) life ranges of augmentation female grizzly bear A1 in the Cabinet Mountains, 2005-07.

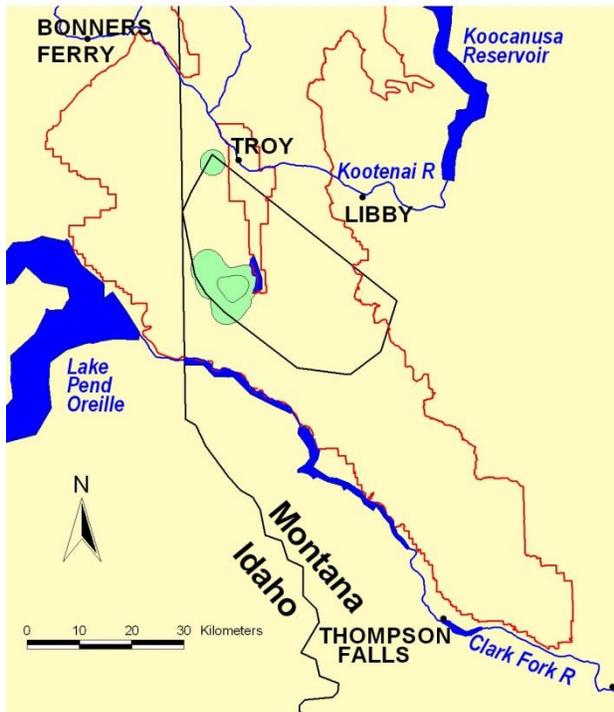


Figure 48. Minimum convex, 95%, and 50% kernel (shaded) life ranges of augmentation female grizzly bear 782 in the Cabinet Mountains, 2006-07.

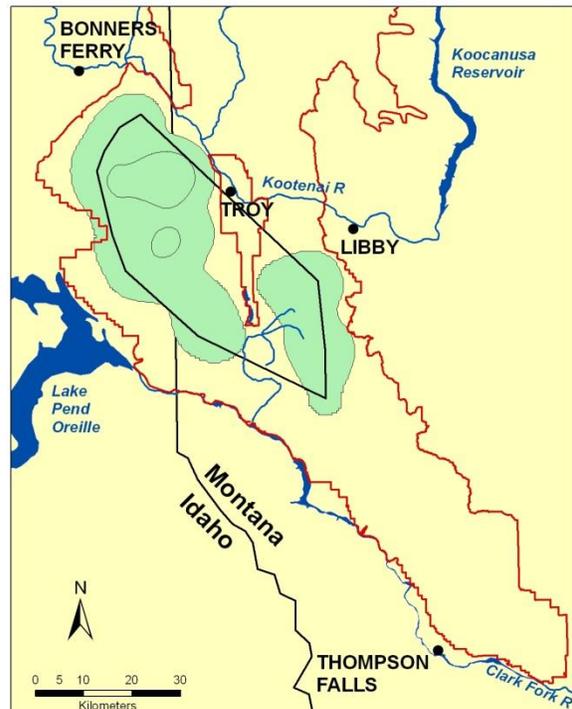


Figure 49. Minimum convex, 95%, and 50% kernel (shaded) life ranges of male grizzly bear 780 in the Cabinet Mountains, 2006-08.

### Grizzly Bear Denning Chronology

Den entry and exit dates were summarized by week during 1983-09. Sixty-two den exit dates were available for summarization. Dates ranged from the third week of March to the third week of May (Figure 50). Fifty (81%) exit dates occurred from the first through fourth weeks of April. Grizzly bears in the Cabinet Mountains generally exited dens at least one week later than bears in the Yaak river drainage. Males generally exited dens earlier than females. Females with cubs appear to exit dens later than other females.

Seventy den entry dates ranged from the third week of October to the last week of December. Fifty-eight (83%) of these entry dates occurred from the first week of November to the second week of December (Figure 51). Grizzly bears in the Cabinet Mountains generally entered dens at least 2 to 3 weeks earlier than bears in the Yaak river drainage. Males generally entered dens later than females.

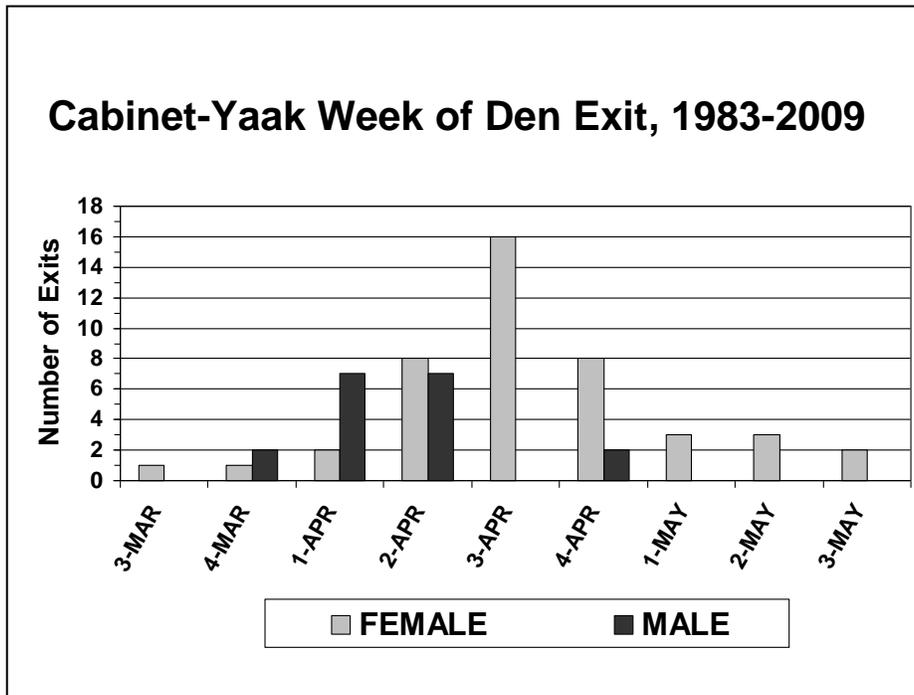


Figure 50. Week of indicated month for den exit of radio collared grizzly bears in the Cabinet-Yaak recovery zone 1983-2009.

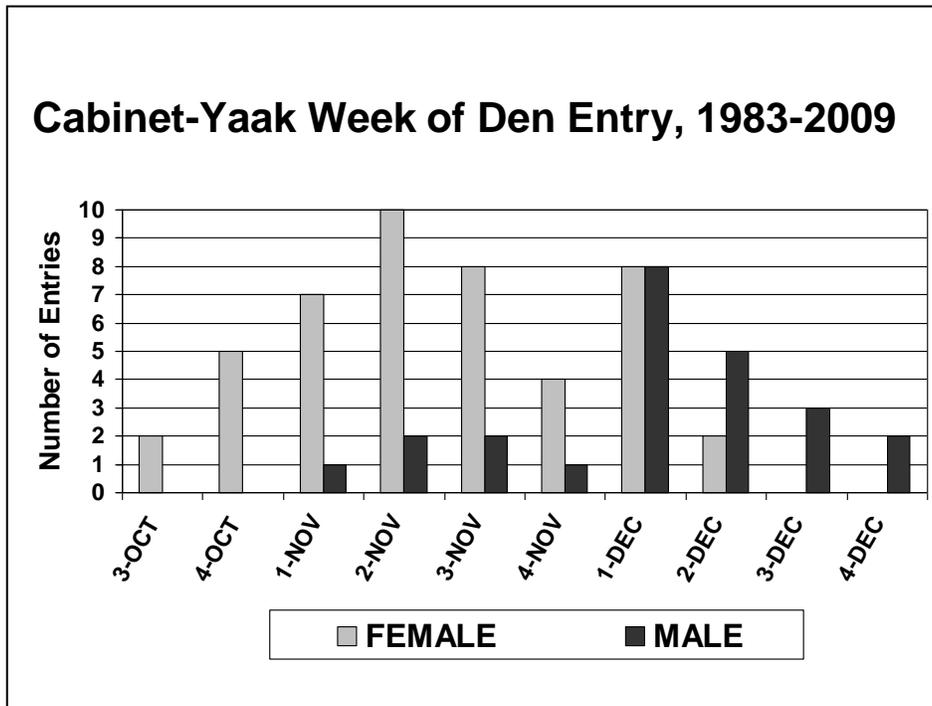


Figure 51. Week of indicated month for den entry of radio collared grizzly bears in the Cabinet-Yaak recovery zone 1983-2009.

## Grizzly Bear Use of Habitat Components

Grizzly bear use of habitat components was summarized on a seasonal basis during 1983-2009. Spring was defined as den exit through 15 June, summer was 16 June through 15 September, and autumn was 16 September through den entry. VHF radiolocation sample sizes for the Cabinet Mountains were: 152 in spring, 379 in summer, and 130 in autumn. Radiolocation sample sizes for the Yaak River were: 480 in spring, 1061 in summer, and 713 in autumn. Den site sample sizes were 17 in the Cabinet Mountains and 54 in the Yaak River.

Radio collared grizzly bears in the Cabinet Mountains and Yaak River made greatest annual use of closed timber, timbered shrubfields, mixed shrub snowchutes, mixed shrub/cutting units, alder shrubfields, huckleberry shrubfields, and graminoid and beargrass sidehill parks (Fig. 52). Primary differences in annual use of habitat components include greater use of mixed shrub snowchutes, alder shrubfields, huckleberry shrubfields, and beargrass sidehill parks in the Cabinet Mountains and greater use of closed timber, timbered shrubfields, mixed shrub/cutting units, and graminoid sidehill parks in the Yaak River. A brief description of all 19 habitat components is provided in Appendix 2.

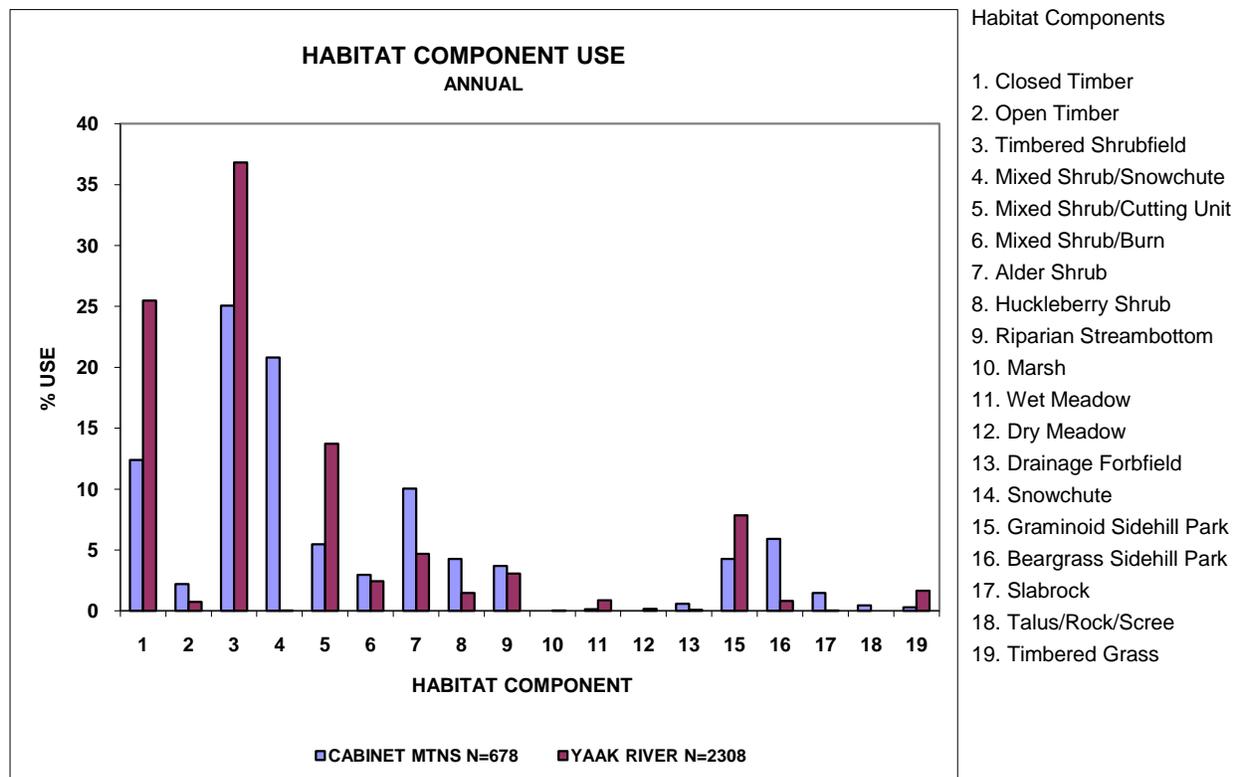


Figure 52. Annual habitat component use in the Cabinet Mountains and Yaak River, 1983-2009.

Spring use of habitat components by radio collared grizzly bears in the Cabinet Mountains and the Yaak River drainage was dominated by closed timber, timbered shrubfields, mixed shrub snowchutes, mixed shrub cutting units, alder shrubfields, and graminoid sidehill parks (Fig. 53). Notable differences between the two study areas include heavier use of snowchutes, alder, and graminoid parks in the Cabinet Mountains and heavier use of closed timber, timbered shrubfields, and cutting units in the Yaak River. Food habits indicate that bears are utilizing grasses, sedges, succulent forbs, and the corms of glacier lily and biscuitroot at this time of the year (Kasworm and Thier 1993). Snowchutes, cutting units, alder, and graminoid parks provide many of these items at this time.

Summer use of habitat components by radio collared grizzly bears in the Cabinet Mountains and the Yaak River drainage was dominated by closed timber, timbered shrubfields, mixed shrub snowchutes, mixed shrub cutting units, mixed shrub burns, alder shrubfields, huckleberry shrubfields, graminoid sidehill parks, and beargrass sidehill parks (Fig. 54). Differences between the two study areas include heavier use of snowchutes, huckleberry shrubfields, and beargrass parks in the Cabinet Mountains and heavier use of closed timber, timbered shrubfields, cutting units, and graminoid parks in the Yaak River. Food habits indicate heavy use of succulent forbs, insects, and berries (mostly huckleberries) (Kasworm and Thier 1993).

Autumn use of habitat components by radio collared grizzly bears in the Cabinet Mountains and the Yaak River drainage was dominated by closed timber, timbered shrubfields, mixed shrub snowchutes, mixed shrub cutting units, mixed shrub burns, alder shrubfields, huckleberry shrubfields, graminoid sidehill parks, and beargrass sidehill parks (Fig. 55). Differences between the two study areas include heavier use of snowchutes, huckleberry shrubfields, and beargrass parks in the Cabinet Mountains and heavier use of closed timber, timbered shrubfields, cutting units, and graminoid parks in the Yaak River. Autumn bear diets reverted back to grasses and sedges during late rains and subsequent green-up. Berries can still be important at this time of year when huckleberries are still available at higher elevations or mountain ash berries which persist on plants beyond first snowfall. Bears also utilize carrion and gut piles from hunter harvested or wounded deer and elk.

Many of the differences in use between the Cabinet Mountains and the Yaak River study areas appear related to amounts or availability of these components in each study area. Much of the use of closed timber and timbered shrubfields occurred adjacent to other components that provided food and may have been used for cover or bedding areas.

Den use of habitat components by radio collared grizzly bears in the Cabinet Mountains and the Yaak River drainage was dominated by closed timber, timbered shrubfields, graminoid sidehill parks, and beargrass sidehill parks (Fig. 56). Differences between the two study areas include heavier use of beargrass parks in the Cabinet Mountains and heavier use of closed timber, timbered shrubfields, and graminoid parks in the Yaak River.

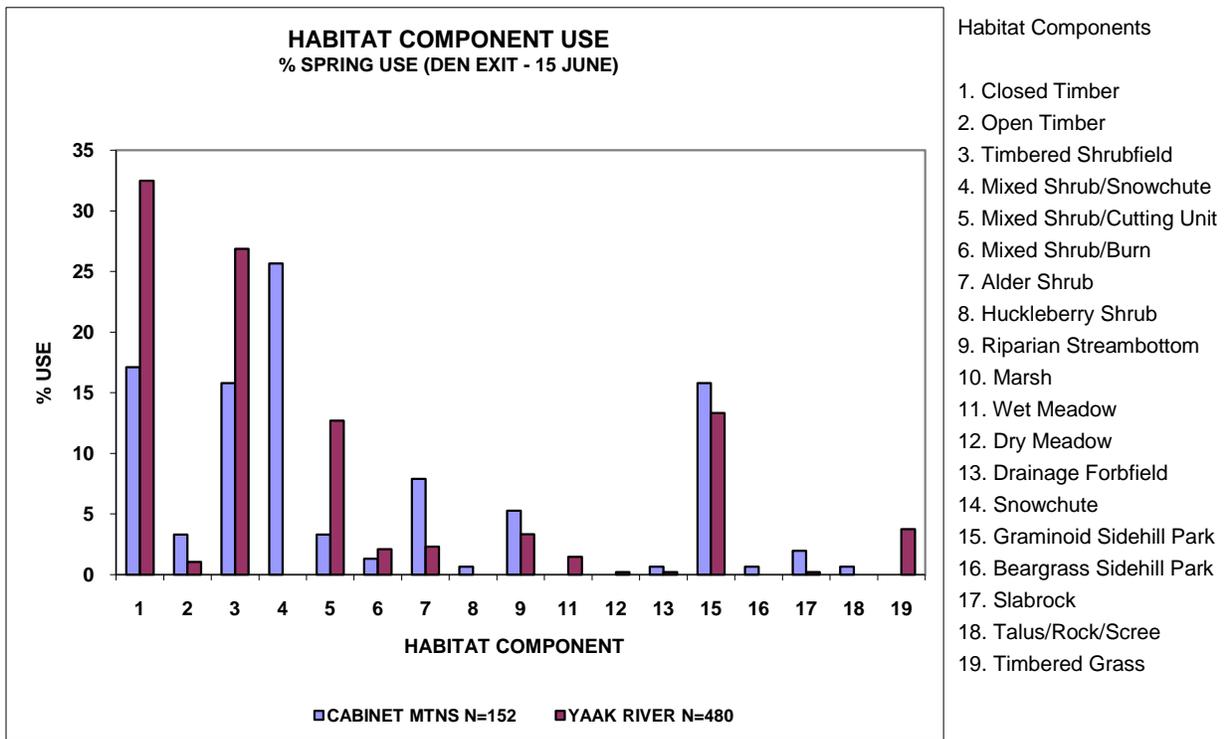


Figure 53. Spring habitat component use in the Cabinet Mountains and Yaak River, 1983-2009.

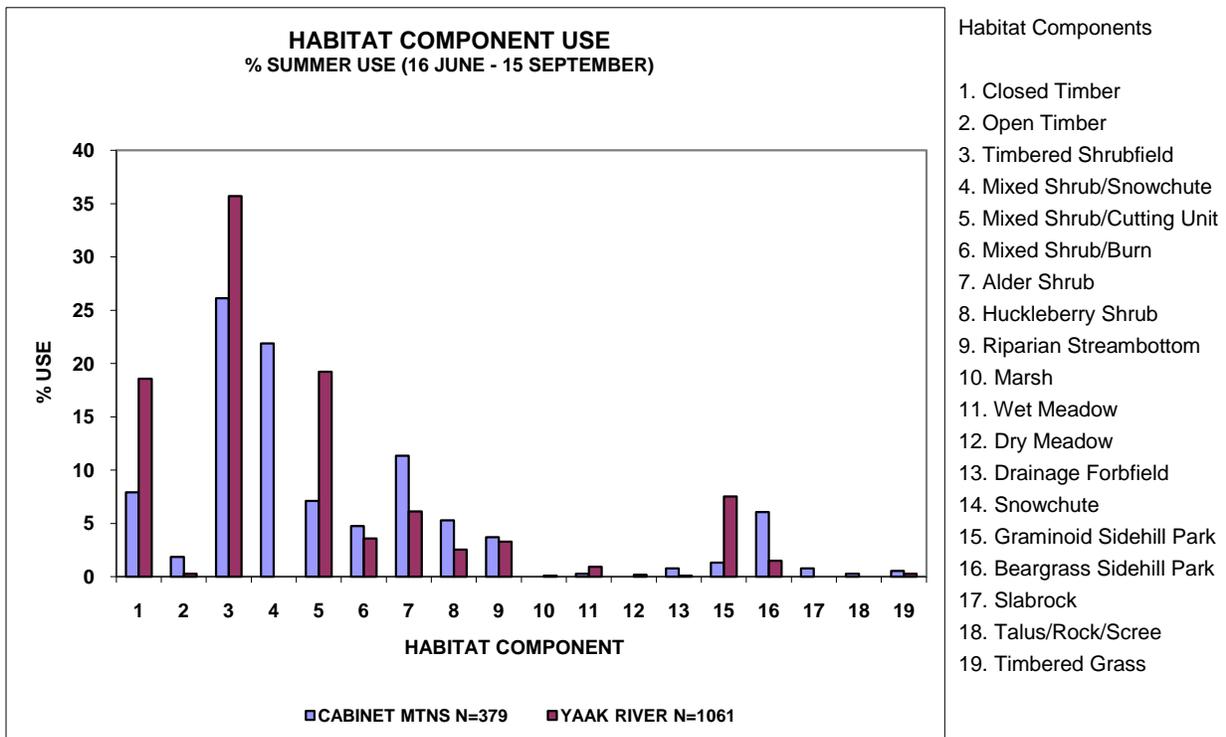


Figure 54. Summer habitat component use in the Cabinet Mountains and Yaak River, 1983-2009.

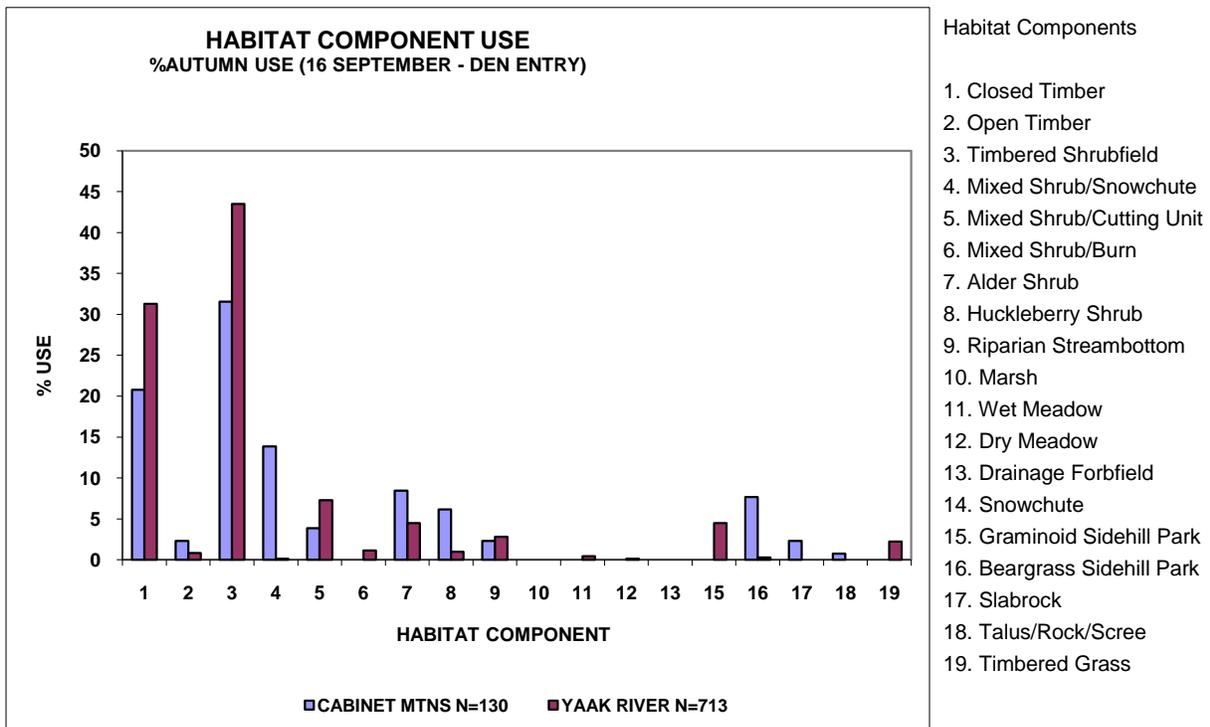


Figure 55. Autumn habitat component use in the Cabinet Mountains and Yaak River, 1983-2009.

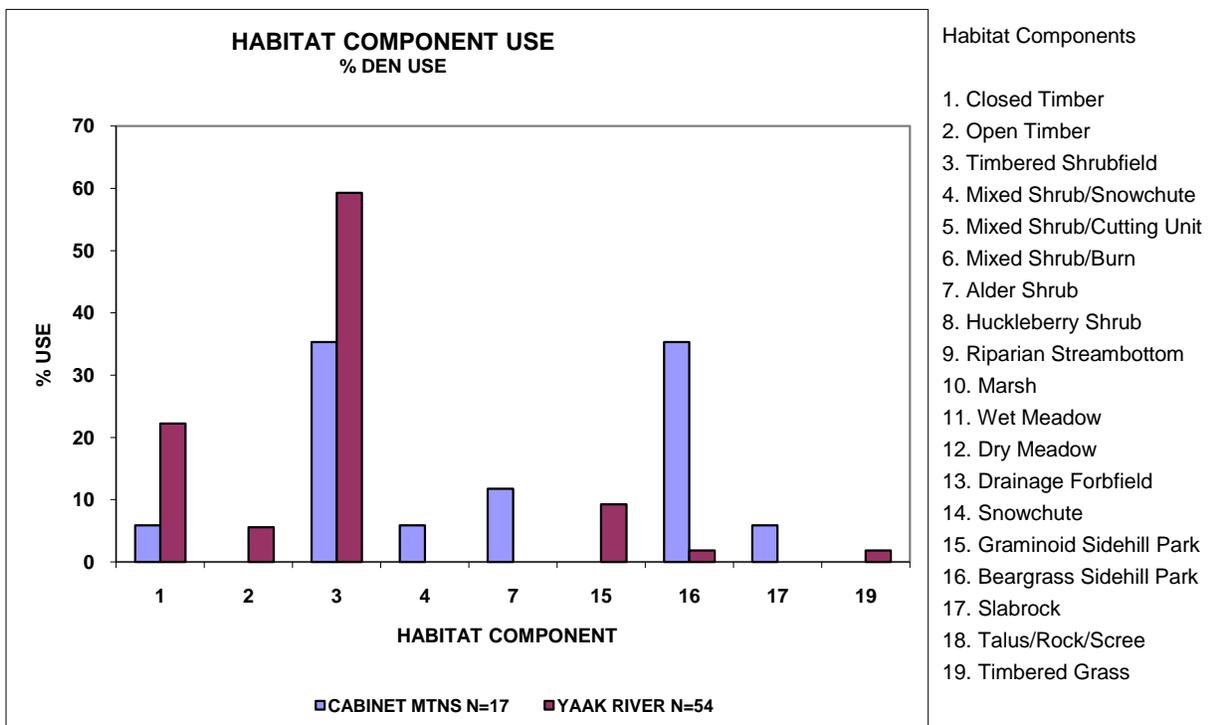


Figure 56. Den habitat component use in the Cabinet Mountains and Yaak River, 1983-2009.

## Grizzly Bear Use by Elevation

Differences in elevation between the Cabinet Mountains and the Yaak River study areas are reflected in the bear location data from both areas (Fig. 57-58). Annual mean elevation used by grizzly bears in the Cabinets Mountains was 1,575 meters compared to 1,497 meters for the Yaak River. Monthly mean elevation followed similar patterns with Cabinet Mountain grizzly bears utilizing higher elevations during most months except November. Sample size in the Cabinet Mountains during November was small, but bears were generally forced into lower elevations by snowfall prior to den entry and may have been responding to increased amount of carrion in the form of gut piles and wounded animals from hunters. Mean den elevation in the Cabinet Mountains was 1,875 meters and 1,698 meters in the Yaak River.

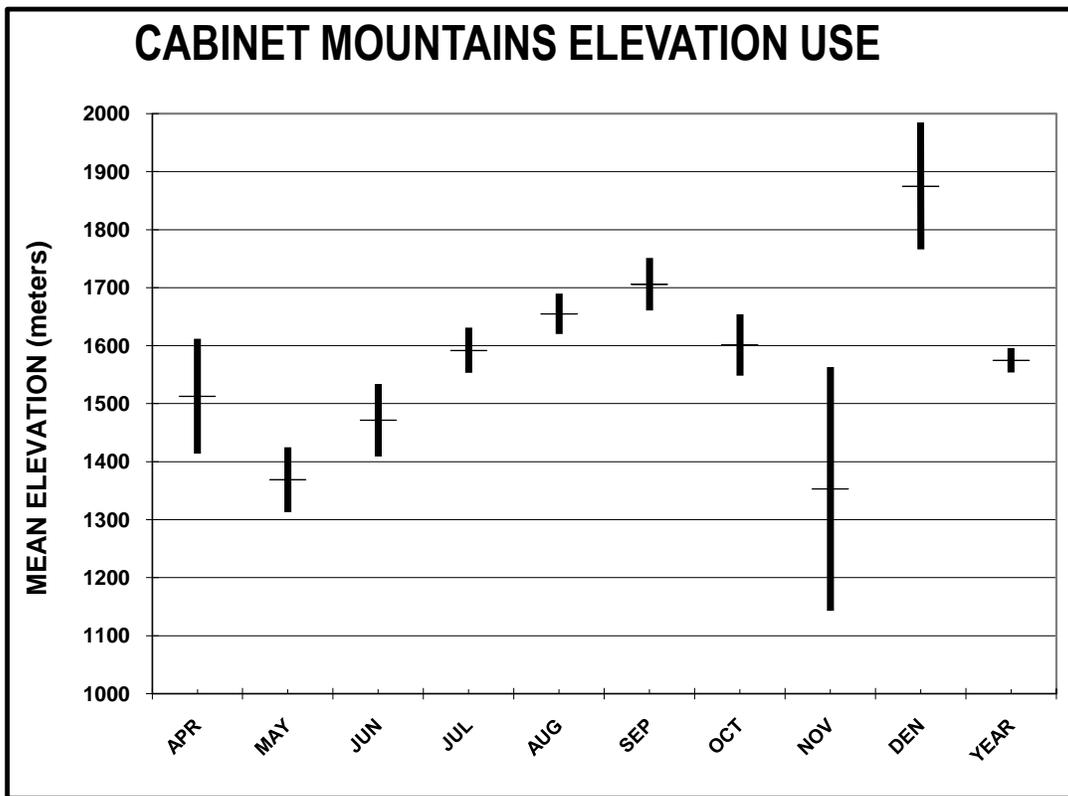


Figure 57. Mean elevation and 95% confidence intervals of radiolocations in the Cabinet Mountains, 1983-2009.

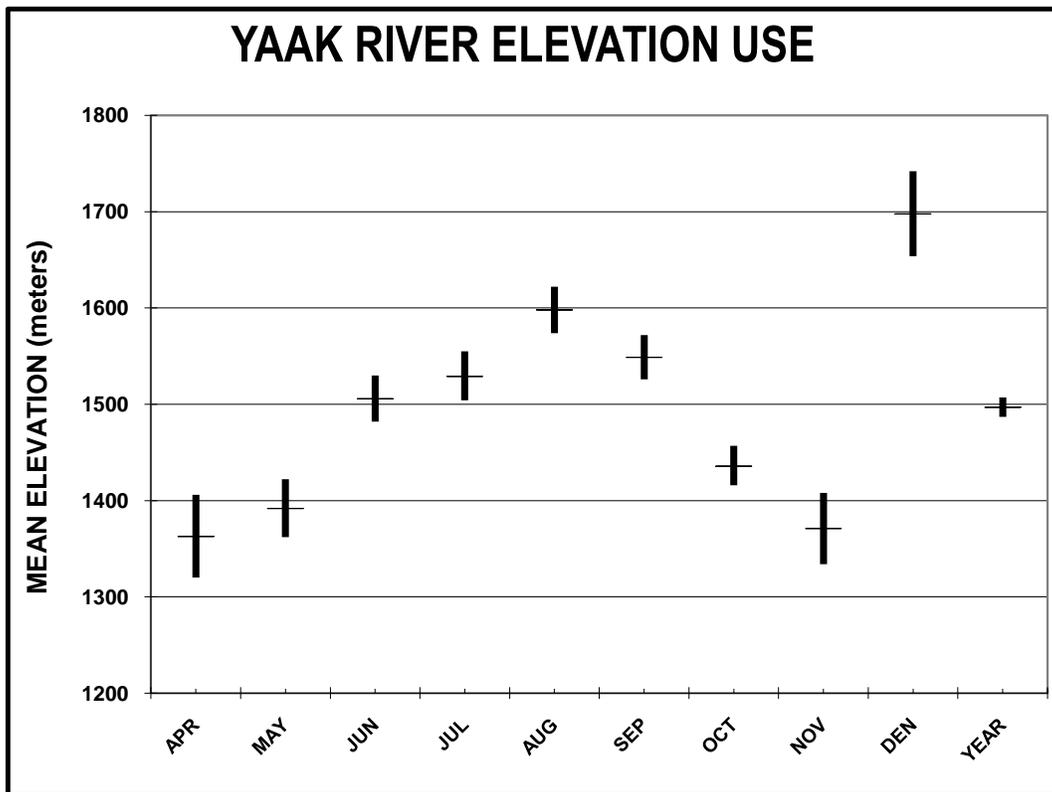


Figure 58. Mean elevation and 95% confidence intervals of radiolocations in the Yaak River, 1986-2009.

### Grizzly Bear Use by Aspect

Use of aspect by grizzly bears varied between the Cabinet Mountains and Yaak River study areas, particularly during early spring (Figs. 59-60). South aspects received greatest use by grizzly bears in the Cabinet Mountains during April and May. However, grizzly bears in the Yaak area showed more balanced use of all aspects during that time. Generally grizzly bears in the Cabinet Mountains made greater use of southerly slopes during all months than grizzly bears in the Yaak River. South aspects were most heavily used by grizzly bears in the Cabinet Mountains for den sites, but used least in the Yaak River. Elevation, slope, and the resultant vegetation in addition to snow melt likely interacted to produce the observed patterns of use.

### Grizzly Bear Spring Habitat Description

After den emergence in spring, bears seek sites that melt snow early and produce green vegetation. These sites can often overlap with ungulate winter range and provide winterkill carrion. Spring habitat use in both study areas (April and May) indicated use of low elevation sites. Cabinet Mountain radio locations indicated most use below 1,600 m with primary use of southerly facing snowchutes, alder shrubfields, grassy sidehill parks, and closed timber. Yaak River radio locations indicated most use below 1,400 m with primary use of closed timber, timbered shrubfields, cutting units, and grassy sidehill parks on virtually all aspects. Lower elevation of the Yaak River area may allow snow to melt and vegetation to green-up earlier.

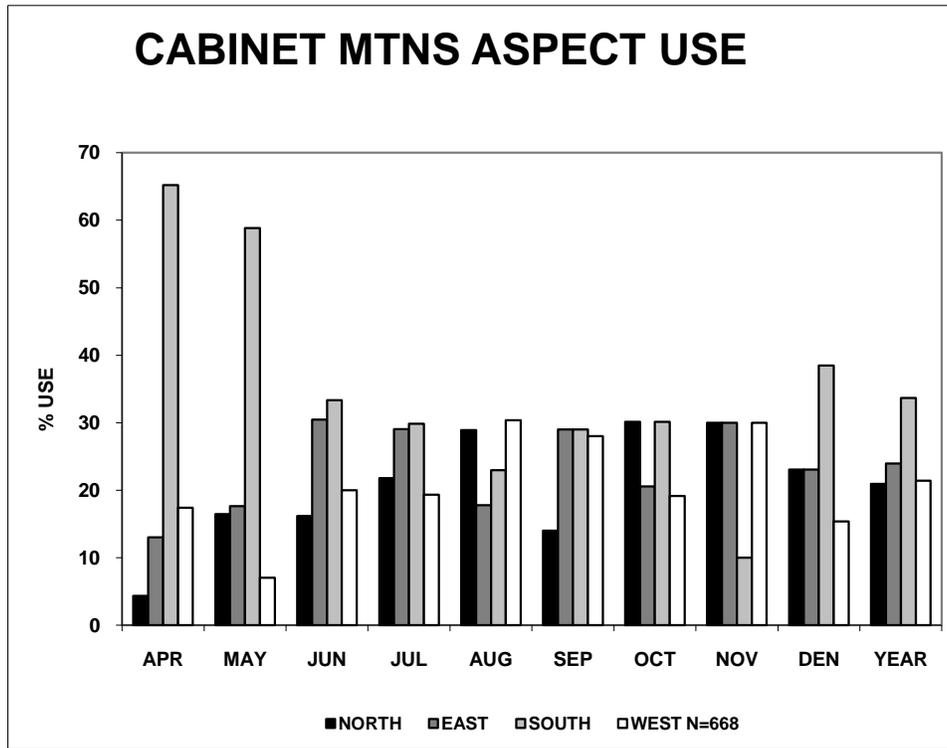


Figure 59. Aspect of radiolocations in the Cabinet Mountains, 1983-2009.

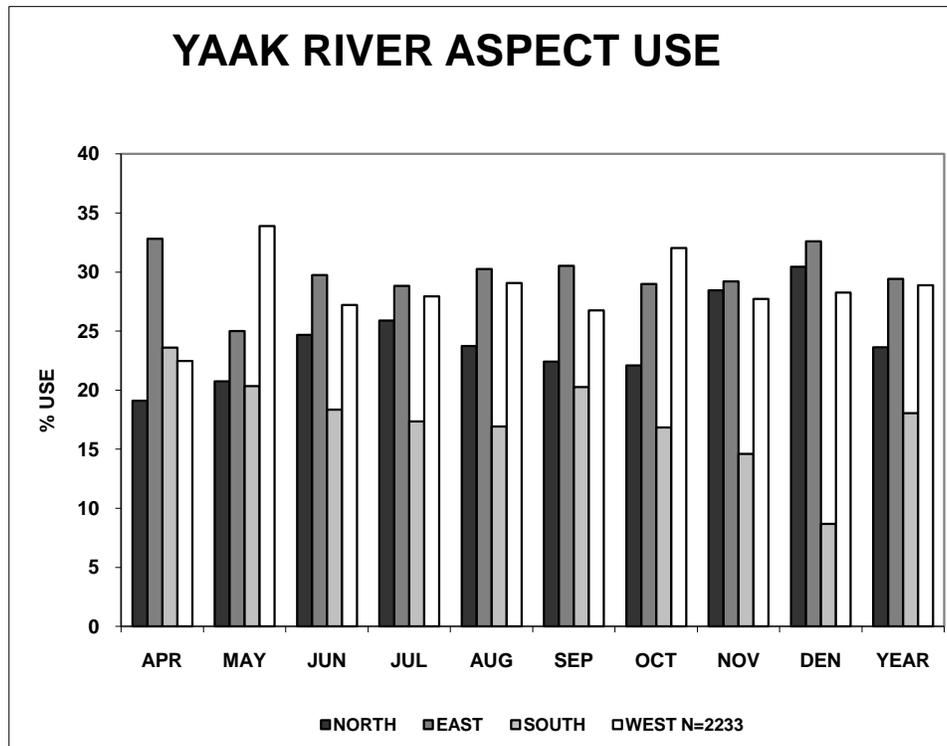


Figure 60. Aspect of radiolocations in the Yaak River, 1986-2009.

## Berry Production

### Huckleberry

Eleven huckleberry transects were evaluated during 1989, 19 during 1990-99, 18 in 2000, 20 in 2001, 21 in 2002-03, 23 in 2004, 16 in 2005, 18 in 2006, 16 in 2007, and 18 in 2008 and 2009. Mean berry count per plot for all transects was 1.67 (95% CI  $\pm$  0.048) during the study period. Mean annual berry counts during 1989-2009 ranged from 0.5-3.1 (Fig. 61). Low berry counts occurred in 1992, 1998-99, and 2002-03. High counts occurred in 1989-91, 1996, 2008, and 2009.

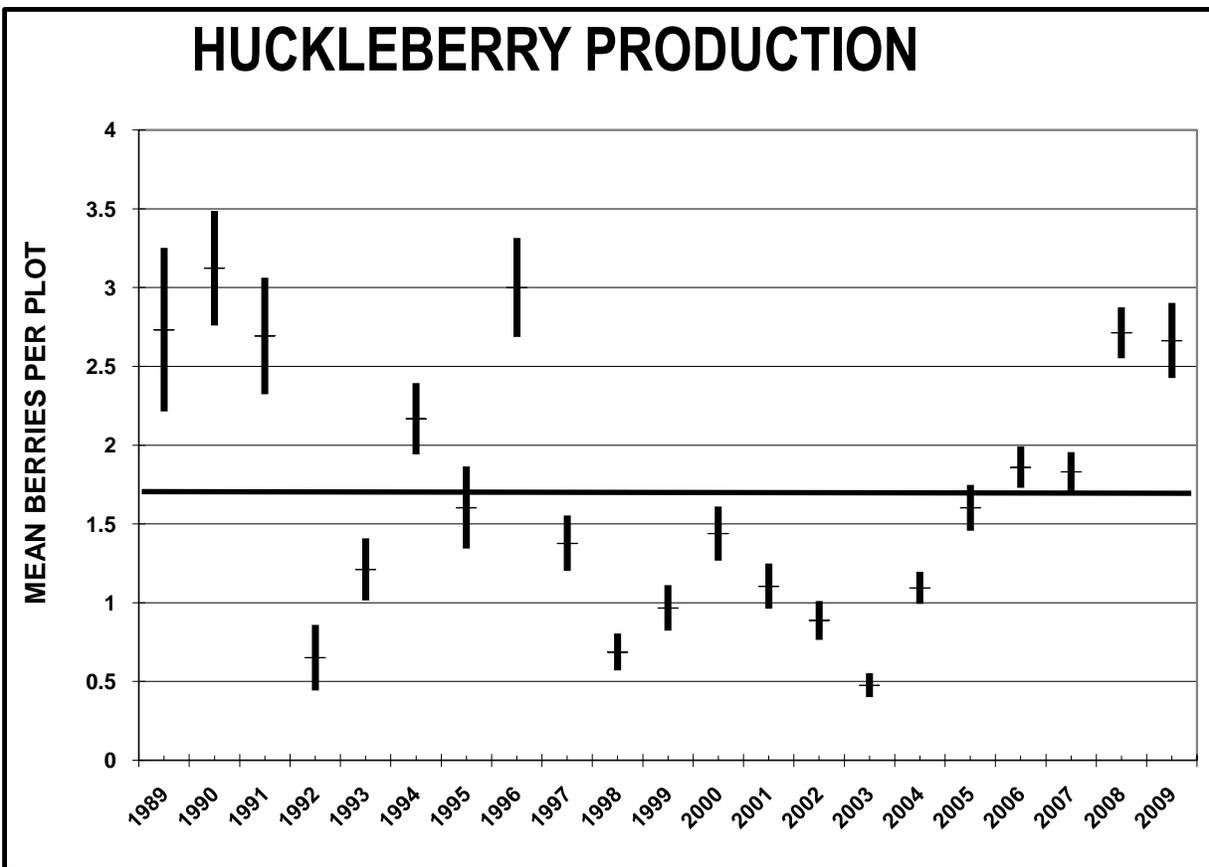


Figure 61. Mean berries per plot and 95% confidence intervals for huckleberry transects in the Cabinet-Yaak, 1989-2009. Horizontal line indicates mean production during study.

## Buffaloberry

Five buffaloberry plots were evaluated during 1990-99, and 2002-03 with 5 plants marked at each site. One plot was set up in 2007 and 2008 with 10 marked plants and these 2 plots were counted in 2009. Mean berry counts per plant from all plots was 179 (95% CI  $\pm$  31.8) during the study period. Mean berry counts ranged from 15 to 467 berries per plot from 1990 to 2009 (Fig. 62) with low counts occurring in 1998, 1999, 2003 and 2007. High counts occurred in 1990, 1993 and 2009.

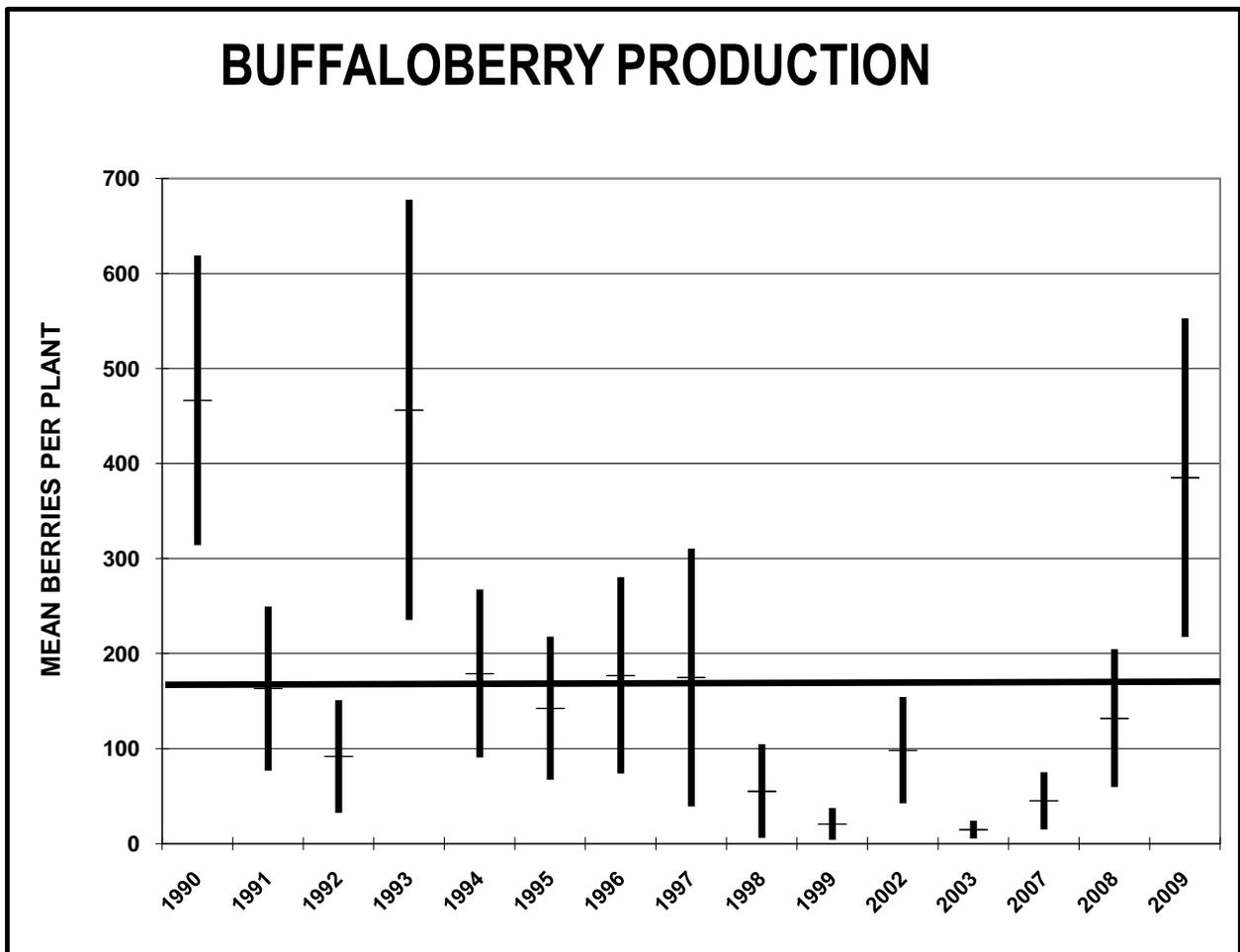


Figure 62. Mean berries per plot and 95% confidence intervals for buffaloberry transects in the Cabinet-Yaak, 1989-2009. Horizontal line indicates mean production during study.

## Serviceberry

Five sites were evaluated for serviceberry production during 1990-96. One more site was added in 1997 and 2005, and one site was dropped in 2007. Mean berry count per plant was 122 (95% CI  $\pm 15$ ) during the study. Mean berry counts per plant varied from 12 to 355 during the years 1990 to 2009 (Fig. 63). Low counts occurred during 1992, 1994, 1998-99, 2002, and 2004-08. High counts occurred during 1990 and 1995.

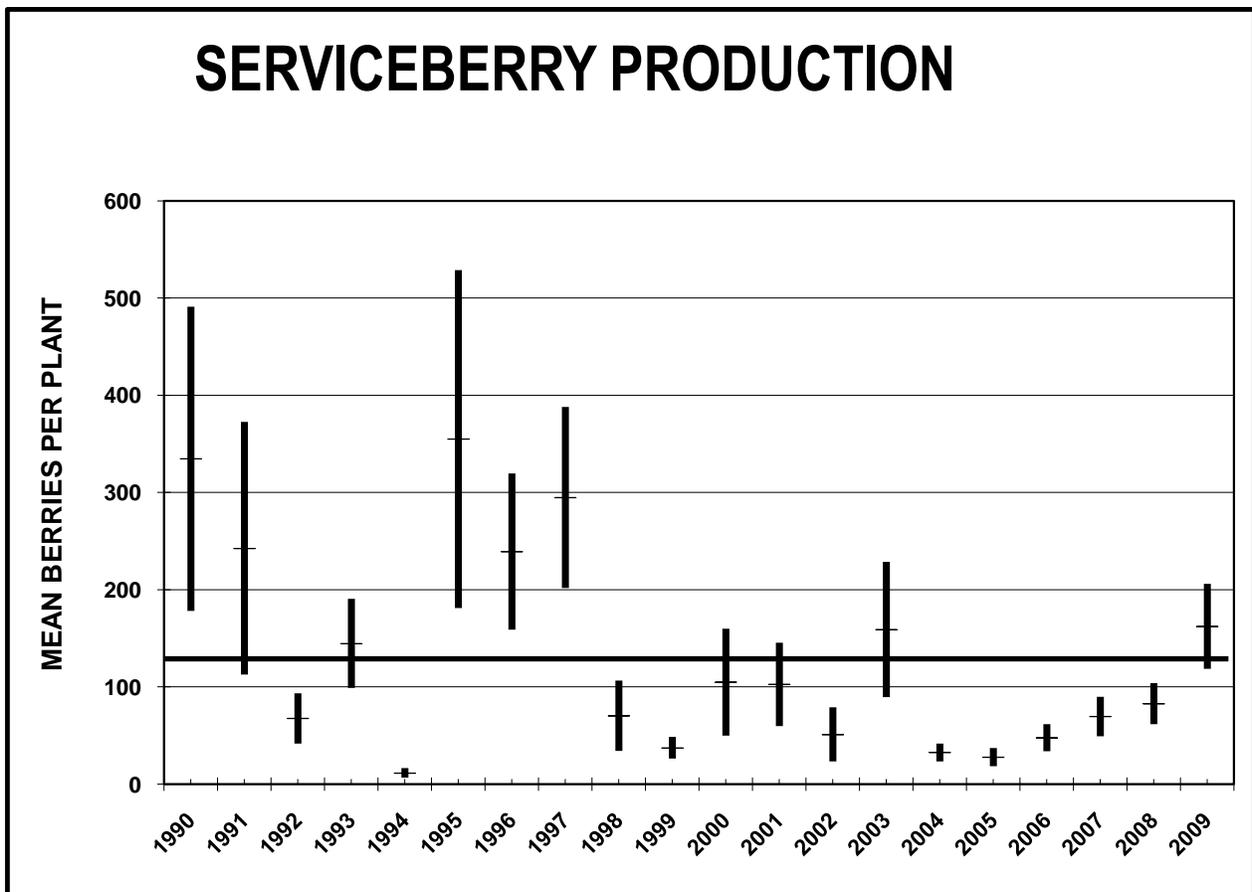


Figure 63. Mean berries per plot and 95% confidence intervals for serviceberry transects in the Cabinet-Yaak, 1989-2009. Horizontal line indicates mean production during study.

## Mountain Ash

Three sites were evaluated for mountain ash production in 2001-09 (Fig. 64). Total mean berry counts for each year were 392, 147, 66, 141, 226, 59, 105, 205, and 180 respectively, with the lowest elevation site producing the most berries. The mean berry count for six years combined was 169 (95% CI  $\pm$  28).

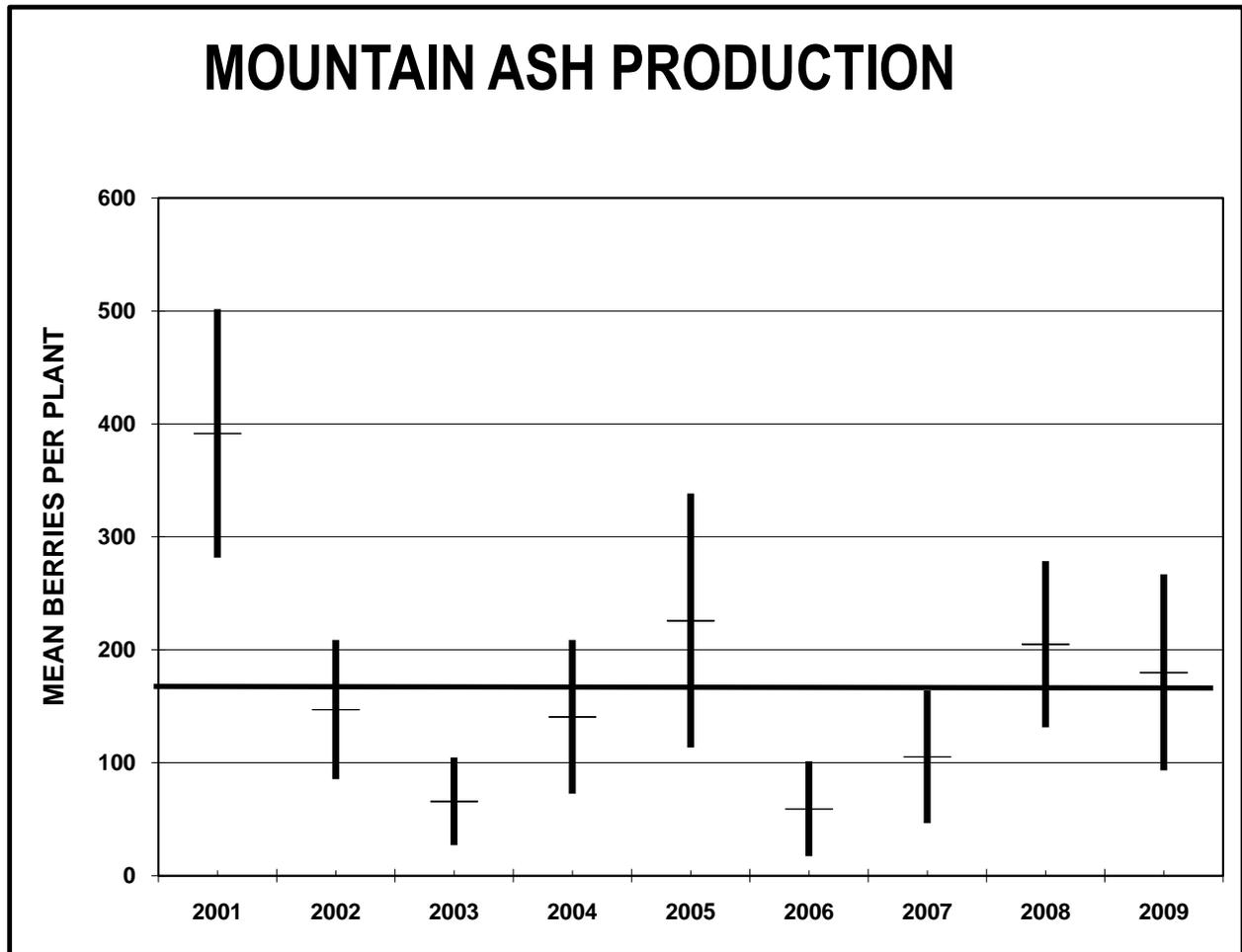


Figure 64. Mean berries per plot and 95% confidence intervals for mountain ash transects in the Cabinet-Yaak, 1989-2009. Horizontal line indicates mean production during study.

Huckleberries appear to provide the most prevalent food for bears and excellent production occurred in 1989-91, 1996, 2008, and 2009. However Serviceberries and Mountain Ash can provide a significant food source in some years. Mountain Ash may be particularly valuable to bears in years of low food production because the berries are persistent and remain on the plants until after frost and leaf drop. Low berry counts for all three of these species would appear most detrimental for bears attempting to store fat for winter denning. Low production among all species occurred in 1992, 1998, and 2003.

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## LITERATURE CITED

- Alt, G. L. 1984. Cub adoption in the black bear. *Journal of Mammalogy* 65:511-512.
- Alt, G. L. and J. J. Beecham. 1984. Reintroduction of orphaned black bear cubs into the wild. *Wildlife Society Bulletin* 12:169-174.
- Caughley, G. 1977. *Analysis of vertebrate populations*. John Wiley and Sons, New York.
- Erickson, A. W. 1978. Grizzly bear management in the Cabinet Mountains of western Montana. U.S. Forest Service Contract 242-46, Kootenai National Forest.
- Garshelis, D.L., K.V. Noyce, and P.L. Coy. 1998. Calculating average of first reproduction free of the biases prevalent in bear studies. *Ursus* 10:437-447.
- Hayne, D. W. 1959. Calculation of size of home range. *Journal of Mammalogy* 30:1-18.
- Hellgren, E. C., D. W. Carney, N. P. Garner, and M. R. Vaughn. 1988. Use of breakaway cotton spacers on radio collars. *Wildlife Society Bulletin* 16:216-218.
- Hooge, P. N. and B. Eichenlaub. 1997. Animal movement extension to Arcview version 2.04. Alaska Science Center – Biological Science Office, U.S. Geological Survey, Anchorage, Alaska, USA.

- Hovey, F. W. and B. N. McLellan. 1996. Estimating growth of grizzly bears from the Flathead River drainage using computer simulations of reproductive and survival rates. *Canadian Journal of Zoology* 74:1409-1416.
- Johnson, K. G. and M. R. Pelton. 1980. Prebaiting and snaring techniques for black bears. *Wildlife Society Bulletin* 8:46-54.
- Jonkel, J. J. 1993. A manual for handling bears for managers and researchers. Edited by T.J. Thier, U.S. Fish and Wildlife Service, Missoula, Montana.
- Kasworm, W. F. and T. Manley. 1988. Grizzly bear and black bear ecology in the Cabinet Mountains of northwest Montana. Montana Department of Fish, Wildlife, and Parks, Helena.
- Kasworm, W. F. and T. J. Thier. 1993. Cabinet-Yaak ecosystem grizzly bear and black bear research, 1992 progress report. U.S. Fish and Wildlife Service, Missoula, Montana.
- Kasworm, W. F., T. J. Thier, and C. Servheen. 1998. Grizzly bear recovery efforts in the Cabinet/Yaak ecosystem. *Ursus* 10:147-153.
- Kasworm, W. F., M. F. Proctor, C. Servheen, and D. Paetkau. 2007. Success of grizzly bear population augmentation in northwest Montana. *Journal of Wildlife Management* 71:1261-1266.
- Kendall, K. C. 1986. Grizzly and black bear feeding ecology in Glacier National Park, Montana. National Park Service Progress Report. 42 pp.
- McLellan, B. N. 1989. Dynamics of a grizzly bear population during a period of industrial resource extraction. III Natality and rate of increase. *Canadian Journal of Zoology* 67:1861-1864.
- Pollock, K. H., S. R. Winterstein, C. M. Bunck, P. D. Curtis. 1989. Survival analysis in telemetry studies: the staggered entry design. *Journal of Wildlife Management* 53:7-15.
- Proctor, M.F., 2003. Genetic analysis of movement, dispersal and population fragmentation of grizzly bears in southwestern Canada. PhD Thesis. University of Calgary. 147 pp.
- Proctor, M.F., C. Servheen, S.D. Miller, W.F. Kasworm, and W.L. Wakkinen. 2004. A comparative analysis of management options for grizzly bear conservation in the U.S.-Canada trans-border area. *Ursus* 15:145-160.
- Schwartz, C. C., K. A. Keating, H. V. Reynolds III, V. G. Barnes, Jr. , R. A. Sellars, J. E. Swenson, S. D. Miller, B. N. McLellan, J. Keay, R. McCann, M. Gibeau, W. L. Wakkinen, R. D. Mace, W. Kasworm, R. Smith, and S. Herrero. 2003. Reproductive maturation and senescence in the female brown/grizzly bear. *Ursus*. 14:109-119.

- Servheen, C., W. Kasworm, and A. Christensen. 1987. Approaches to augmenting grizzly bear populations in the Cabinet Mountains of Montana. *International Conference on Bear Research and Management* 7:363-367.
- Stoneberg, R. and C. Jonkel. 1966. Age determination in black bears by cementum layers. *Journal of Wildlife Management* 30:411-414.
- Thier, T. J. 1981. Cabinet Mountains grizzly bear studies, 1979-1980. *Border Grizzly Project Special Report 50*. University of Montana, Missoula.
- Thier, T. J. 1990. Population characteristics and the effects of hunting on black bears in a portion of northwestern Montana. M.S. Thesis. University of Montana, Missoula.
- U.S. Fish and Wildlife Service. 1990. Final environmental assessment - grizzly bear population augmentation test, Cabinet-Yaak ecosystem. U.S. Fish and Wildlife Service, Missoula, Montana.
- U.S. Fish and Wildlife Service. 1993. Grizzly bear recovery plan. U.S. Fish and Wildlife Service, Missoula, Montana.
- U.S. Forest Service. 1989. Upper Yaak draft environmental impact statement. U.S. Forest Service, Kootenai National Forest.
- Wakkinen, W. L. and W. F. Kasworm. 2004. Demographics and population trends of grizzly bears in the Cabinet-Yaak and Selkirk ecosystems of British Columbia, Idaho, Montana, and Washington. *Ursus* 15 65-75.
- Woods, J.G., D. Paetkau, D. Lewis, B.N. McLellan, M. Proctor, and C. Strobeck. 1999. Genetic tagging of free-ranging black and brown bears. *Wildlife Society Bulletin*. 27:616-627.
- Worton, B. J. 1989. Kernel methods for estimating the utilization distribution in home-range studies. *Ecology* 70:164-168.

### **Publications or Reports Involving this Research Program**

- Kasworm, W. F. and T. L. Manley. 1988. Grizzly bear and black bear ecology in the Cabinet Mountains of Northwest Montana. Montana Department Fish, Wildlife, Parks, Helena.
- Kasworm, W. F. 1989. Telling the difference. *Wyoming Wildlife*. Volume 53, No. 8, pages 28-33.
- Kasworm, W. F. and T. L. Manley. 1990. Influences of roads and trails on grizzly bears and black bears in Northwest Montana. *International Conference on Bear Research and Management* 8:79-84.
- Kasworm, W. F. and T. J. Thier. 1994. Adult black bear reproduction, survival, and mortality sources in northwest Montana. *International Conference on Bear Research and Management* 9:223-230.

- Kasworm, W. F., T. J. Thier, and C. Servheen. 1998. Grizzly bear recovery efforts in the Cabinet-Yaak ecosystem. *Ursus* 10:147-153.
- Kasworm, W. F., M. F. Proctor, C. Servheen, and D. Paetkau. 2007. Success of grizzly bear population augmentation in northwest Montana. *Journal of Wildlife Management* 71:1261-1266.
- Knick, S. T. and W. Kasworm. 1989. Shooting mortality in small populations of grizzly bears. *Wildlife Society Bulletin* 17:11-15.
- McLellan, B. N., F. W. Hovey, R. D. Mace, J. G. Woods, D. W. Carney, M. L. Gibeau, W. L. Wakkinen, and W. F. Kasworm. 1999. Rates and causes of grizzly bear mortality in the interior mountains of British Columbia, Alberta, Montana, Washington, and Idaho. *Journal of Wildlife Management* 63:911-920.
- Proctor, M.F., C. Servheen, S.D. Miller, W.F. Kasworm, and W.L. Wakkinen. 2004. A comparative analysis of management options for grizzly bear conservation in the U.S.-Canada trans-border area. *Ursus* 15:145-160.
- Schwartz, C. C., K. A. Keating, H. V. Reynolds III, V. G. Barnes, Jr., R. A. Sellers, J. E. Swenson, S. D. Miller, B. N. McLellan, J. Keay, R. McCann, M. Gibeau, W. L. Wakkinen, R. D. Mace, W. F. Kasworm, R. Smith and S. Herrero. 2003. Reproductive maturation and senescence in the female brown bear. *Ursus* 14:109-119.
- Servheen, C., W. Kasworm, and A. Christensen. 1987. Approaches to augmenting grizzly bear populations in the Cabinet Mountains of Montana. *International Conference on Bear Research and Management* 7:363-367.
- Servheen, C., W. F. Kasworm, and T. J. Thier. 1995. Transplanting grizzly bears *Ursus arctos horribilis* as a management tool - results from the Cabinet Mountains, Montana, USA. *Biological Conservation* 71:261-268.
- Swensen, J. E., W. F. Kasworm, S. T. Stewart, C. A. Simmons, and K. Aune. 1987. Interspecific applicability of equations to predict live weight in black bears. *International Conference on Bear Research and Management* 7:359-362.
- Thier, T. J. and W. F. Kasworm. 1992. Recovery of a Grizzly Bear From a Serious Gunshot Wound. *The Montana Game Warden* 4(1):24-25.
- Wakkinen, W. L. and W. F. Kasworm. 1997. Grizzly bear and road density relationships in the Selkirk and Cabinet-Yaak recovery zones. U.S. Fish and Wildlife Service, Missoula, Montana.
- Wakkinen, W. L. and W. F. Kasworm. 2004. Demographics and population trends of grizzly bears in the Cabinet-Yaak and Selkirk ecosystems of British Columbia, Idaho, Montana, and Washington. *Ursus* 15 65-75.

Appendix Table 1. Known grizzly bear mortality in or near the Cabinet-Yaak recovery zone and the Yahk grizzly bear population unit in British Columbia, 1949-09.

YEAR	LOCATION	TOTAL	SEX / AGE	MORTALITY CAUSE
1949	COPPER CR, MT	1	ADULT FEMALE	HUMAN, HUNTER KILL
1950	SQUAW CR, MT	1	SUBADULT	UNKNOWN
1951	PETE CR, MT	1	ADULT MALE	HUMAN, MANAGEMENT REMOVAL
1951	PAPOOSE CR, MT	2	SUBADULTS	UNKNOWN
1951	GOAT CR, MT	1	SUBADULT MALE	UNKNOWN
1952	FELIX CR, MT	6	2 ADULT FEMALES, 4 YEARLINGS	HUMAN, MANAGEMENT REMOVAL
1953	OBRIEN CR, MT	1	SUBADULT MALE	HUMAN, HUNTER KILL
1953	KENELTY MT, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1953	20-ODD MT, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1953	BURNT CR, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1953	17-MILE CR, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1954	N F BULL R, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1954	S F BULL R, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1954	CEDAR LK, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1954	CEDAR LK, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1954	TAYLOR PK, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1954	SILVERBUTTE CR, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1954	SILVERBOW CR, MT	1	ADULT FEMALE	HUMAN, HUNTER KILL
1955	WOLF CR, MT	1	ADULT MALE	HUMAN, MANAGEMENT REMOVAL
1955	MT HEADLEY, MT	1	SUBADULT	HUMAN, MANAGEMENT REMOVAL
1955	BAREE LK, MT	1	ADULT MALE	UNKNOWN
1955	BAREE LK, MT	1	ADULT FEMALE	UNKNOWN
1955	BEAR CR, MT	1	SUBADULT MALE	HUMAN, HUNTER KILL
1958	SQUAW CR, MT	1	ADULT FEMALE	HUMAN, MANAGEMENT REMOVAL
1959	E F ROCK CR, MT	2	ADULT FEMALE, 1 CUB	HUMAN, HUNTER KILL
1959	W F THOMPSON R, MT	4	ADULT FEMALE, 3 CUBS	UNKNOWN
1959	CLIFF CR, MT	1	UNKNOWN	UNKNOWN
1960	PROSPECT CR, MT	2	ADULT FEMALE, 1 CUB	UNKNOWN
1964	GRAVES CR, MT	2	SUBADULTS	UNKNOWN
1964	WANLESS LK, MT	3	SUBADULTS (ADULT WOUNDED)	UNKNOWN
1965	SNOWSHOE CR, MT	2	SUBADULTS	UNKNOWN
1965	PINKHAM CR, MT	1	UNKNOWN	UNKNOWN
1967	SOPHIE LK, MT	1	UNKNOWN	UNKNOWN
1968	BEAR CR, MT	1	ADULT FEMALE	HUMAN, ILLEGAL KILL
1968	GRANITE CR, MT	1	SUBADULT MALE	HUMAN, MANAGEMENT REMOVAL
1969	PRISCILLA PK, MT	1	ADULT FEMALE	UNKNOWN
1970	THOMPSON R, MT	1	UNKNOWN	UNKNOWN
1970	CAMERON CR, MT	1	SUBADULT MALE	UNKNOWN
1970	SQUAW CR, MT	2	ADULT FEMALE, SUBADULT FEMALE	HUMAN, MANAGEMENT REMOVAL
1971	MURR CR, MT	1	ADULT FEMALE	UNKNOWN
1972	ROCK CR, MT	1	SUBADULT	HUMAN, MISTAKEN IDENTITY (Black Bear)
1974	SWAMP CR, MT	1	ADULT MALE	HUMAN, HUNTER KILL
1977	RABBIT CR, MT	1	ADULT MALE	HUMAN, DEFENSE OF LIFE BY HUNTER
1978	MOYIE LAKE, BC	1	SUBADULT MALE	HUMAN, MANAGEMENT
1982	GROUSE, ID	1	ADULT MALE	HUMAN, ILLEGAL KILL
1984	HARVEY CR, ID	1	UNKNOWN	HUMAN, MISTAKEN IDENTITY (Black Bear)
1985	LYONS CR, MT	1	ADULT MALE	HUMAN, DEFENSE OF LIFE BY HUNTER
1986	BURNT CR, MT	1	CUB	UNKNOWN (NATURAL)
1987	FLATTAIL CR, MT	1	FEMALE CUB	HUMAN, MISTAKEN IDENTITY (Eik)

YEAR	LOCATION	TOTAL	SEX / AGE	MORTALITY CAUSE
1988	LEWISBY CR, BC	1	ADULT MALE	HUMAN, HUNTER KILL (BC)
1988	N F 17-MILE CR, MT	1	ADULT FEMALE	HUMAN, DEFENSE OF LIFE BY HUNTER
1989	BURNT CR, MT	1	SUBADULT FEMALE	HUMAN, RESEARCH TRAP (Predation)
1990	POVERTY CR, MT	1	SUBADULT MALE	HUMAN, ILLEGAL
1992	TRAIL CR, MT	1	ADULT FEMALE	UNKNOWN
1993	LIBBY CR, MT	2	ADULT FEMALE AND CUB	UNKNOWN (NATURAL)
1994	JIM CR, BC	1	SUBADULT MALE	HUMAN, MANAGEMENT
1994	SOUTHWEST CRANBROOK, BC	3	2 FEMALES AND 1 MALE	HUMAN, MANAGEMENT
1995	RYAN CR, BC	1	ADULT MALE	HUMAN, MANAGEMENT REMOVAL
1996	DODGE CR, MT	1	SUBADULT MALE	HUMAN, UNDER INVESTIGATION
1996	GOLD CR, BC	1	ADULT MALE	HUMAN, UNDER INVESTIGATION
1997	LIBBY CR, MT	1	ADULT MALE	HUMAN, ILLEGAL
1997	PLUMBOB CR, BC	1	MALE	HUMAN, MANAGEMENT
1997	WARDNER, BC	1	ADULT FEMALE	HUMAN, MANAGEMENT
1997	MAYOOK, CR,BC	1	SUBADULT MALE	HUMAN, ILLEGAL KILL
1999	17 MILE CR, MT	3	ADULT FEMALE, 2 CUBS	NATURAL MORTALITY (Predation)
1999	W FK YAHK R, BC	1	SUBADULT FEMALE	HUMAN, DEFENSE OF LIFE BY HUNTER
1999	E FK YAAK R, MT	1	ADULT MALE	HUMAN, MANAGEMENT REMOVAL
2000	HAWKINS CR, BC	2	2 CUBS	UNKNOWN (NATURAL)
2000	FOWLER CR, MT	1	1 CUB	UNKNOWN (NATURAL)
2000	PETE CR, MT	1	SUBADULT FEMALE	HUMAN, UNDER INVESTIGATION
2001	COLD CR, BC	2	2 CUBS	UNKNOWN (NATURAL)
2001	SPREAD CR, MT	1	SUBADULT FEMALE	HUMAN, MISTAKEN IDENTITY (Black Bear)
2001	ELK CR, MT	1	ADULT FEMALE	HUMAN, TRAIN COLLISION
2002	MARTEN CR, MT	1	SUBADULT FEMALE	NATURAL
2002	PORCUPINE CR, MT	1	SUBADULT FEMALE	HUMAN, UNDER INVESTIGATION (Illegal)
2002	YAAK R, MT	4	ADULT FEMALE, 3 CUBS	HUMAN, ILLEGAL
2002	BLOOM CR, BC	1	UNKNOWN	HUMAN, BLACK BEAR HOUND HUNTERS
2002	KOOTENAY R, BC	1	FEMALE	HUMAN, DEFENSE OF LIFE
2004	WEST FORT STEELE, BC	1	MALE	HUMAN, DEFENSE OF LIFE AT DUMP
2004	JIM CR, BC	1	ADULT MALE	HUMAN, MISTAKEN IDENTITY
2004	NEWGATE,BC	1	ADULT FEMALE	HUMAN, MANAGEMENT REMOVAL
2005	RUSSELL CR, BC	1	ADULT MALE	HUMAN, HUNTER KILL (BC)
2005	GOVERNMENT CR, MT	1	SUBADULT FEMALE	HUMAN, TRAIN COLLISION
2005	PIPE CR, MT	1	SUBADULT FEMALE	HUMAN, ILLEGAL
2005	YAAK R, MT	1	SUBADULT MALE	HUMAN, ILLEGAL
2005?	CURLEY CR, MT	1	ADULT	HUMAN, UNDER INVESTIGATION
2006	COLD CR, BC	1	ADULT FEMALE	HUMAN, RESEARCH TRAP (Predation)
2006	RAINY CR, BC	1	ADULT FEMALE	HUMAN, MANAGEMENT REMOVAL
2007	SPREAD CR, MT	1	ADULT FEMALE	HUMAN, DEFENSE OF LIFE
2008	FISTRAP CR, MT	1	UNKNOWN SUBADULT	HUMAN, UNDER INVESTIGATION
2008	CLARK FORK RIVER, MT	1	SUBADULT FEMALE	HUMAN, TRAIN COLLISION
2008	CLARK FORK RIVER, MT	1	SUBADULT FEMALE	HUMAN, POACHING
2008	NF YAHK RIVER, BC	1	ADULT MALE	HUMAN.MISTAKEN IDENTITY, WOLF TRAP
2009	COPPER CR, ID	2	2 CUBS	UNKNOWN (NATURAL)
2009	BENTLEY CR, ID	1	SUBADULT MALE	HUMAN, MISTAKEN IDENTITY (Black Bear)
2009	EF BULL R, MT	1	ADULT FEMALE	HUMAN, DEFENSE OF LIFE

## Appendix 2. Description of Habitat Components.

1. Closed Timber - Timber stands with tree cover greater than 60%, and a variable but often sparse understory.
2. Open Timber - Timbered sites with tree canopy cover of from 30 to 60%, and a sparse grass - forb understory. Commonly found on dry exposures, limiting undergrowth to a few rhizomatous species.
3. Timbered Shrubfield - Open timbered sites with tree cover of 30 to 60%, and a shrub dominated understory. Except for more xeric aspects, the shrub layer is well developed, and the forb layer is characteristically sparse due to limited light penetration.
4. Mixed Shrub/Snowchute - Shrub dominated communities resulting from, and often maintained by sudden snowslides on steep timbered drainages. They exist as narrow, linear openings in the forest canopy, or as extensive, broad chutes covering an entire slope.
5. Mixed Shrub/Cutting Unit - Open sites which have been harvested and are currently dominated by shrubs. Structure and composition is variable depending on harvest method, site treatment, habitat type, topographic position and time since harvest.
6. Mixed Shrub/Burn - Open sites, dominated by shrubs, which have developed following fire. Structure and composition is dependent on fire intensity, habitat type, topographic position and time since burn.
7. Alder Shrub - Tall shrub community dominated by alder (*Alnus sinuata*), almost to the exclusion of all other shrub species, with a herbaceous understory. Component can develop as a result of disturbance, but is often restricted to mesic sites.
8. Huckleberry Shrub - Seral shrubfields dominated by *Vaccinium* species. This open, low structured shrubfield is created and at times maintained by fire. Timber harvest and snowslides may have the same developmental effect.
9. Riparian Stream bottom - Stream bottom habitat is identified by riparian plant associations, which reflect the influence of increased soil moisture. Considerable variation in vegetation composition and structure exist, with some site being open and some timbered. The development and extent of riparian habitat is dependent on timber canopy and stream channel gradient.
10. Marsh - Open sedge dominated communities that are perennially moist, often containing standing water. Can exist as either unbroken monotypic communities or as infringing zones around open shallow lakes and ponds.
11. Wet Meadow - Mesic graminoid dominated communities along flat low elevation watersheds, and in slightly concave depressions at high elevations. Floristic composition varies between and within open meadows depending on slight differences in soil moisture.

12. Dry Meadow - Open graminoid dominated sites with level or gradual sloping topography, most commonly occurring at low elevations. Can be created by timber harvest, livestock grazing and fire. Vegetation composition is variable depending on the severity of soil disturbance and topographic position of the site, and unless maintained, most sites reestablish shrub or regenerating conifer canopies.

13. Drainage Forbfield - High elevation herbaceous fields with gradual to steep topography. Forbfields exist where sufficient soils have accumulated and where snowmelt percolating through shallow stony soils provides an endless supply of water through the growing season. Late in phenological development, a number of forbs continue to grow and flower into September and October.

14. Snowchute - Open, forb dominated snowchutes are the result of recent massive snowslides that remove both tree and shrub cover. Snowchutes in early successional herbaceous stages are uncommon, and occupy a site for a few years prior to shrub development.

15. Graminoid Sidehill Park - Graminoid dominated communities on moderate to steep slopes with convex topography, from mid to high elevations. Local topographic, edaphic and climatic influences combine to limit tree growth.

16. Beargrass Sidehill Park - Beargrass (*Xerophyllum tenex*) dominated communities on moderate to steep slopes with convex topography, from mid to high elevations. Generally located on shallow, well drained soils of south to west aspects. They exist as large homogenous openings along upper slopes and ridges, and small patches on basin headwalls.

17. Slabrock - Open sites of exposed blocks of scoured - glaciated bedrock, occurring at high elevations on steep to gentle topography.

18. Talus/Rock/Scree - Very steep to moderate slopes and benches of loose rock fragments of variable size, with very sparse vegetation.

19. Timbered Grass - Open timbered sites with 30 to 60% tree canopy coverage and a graminoid dominated understory. Generally occur on well-drained soils, with gentle to steep slopes with south to west aspects.