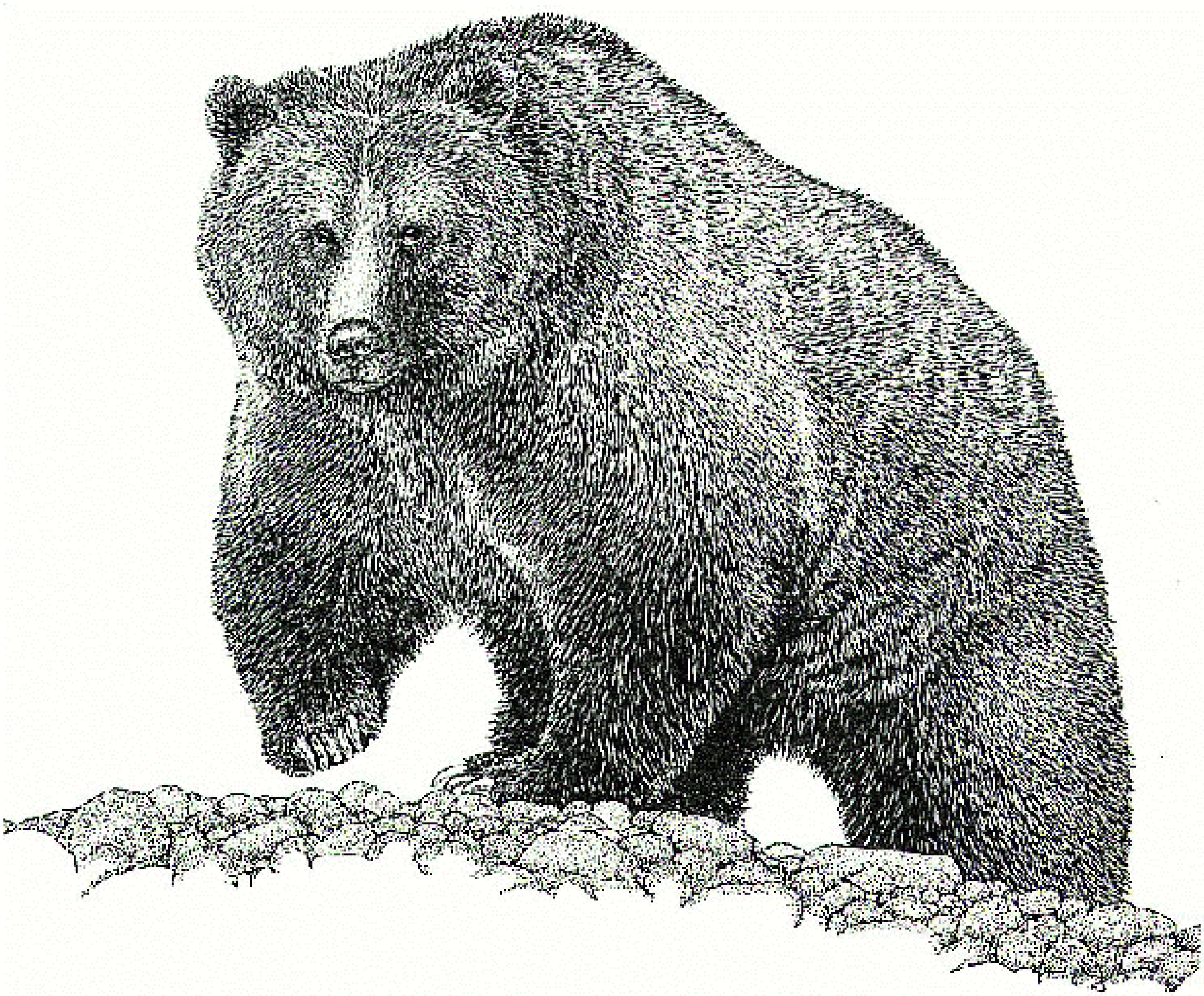
CABINET-YAAK GRIZZLY BEAR RECOVERY AREA 2013 RESEARCH AND MONITORING PROGRESS REPORT



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2014

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<u>Abstract</u>:

Grizzly bear research in the Cabinet Mountains indicated that only a small population remained as of 1988. Concern over persistence of grizzly bear populations within this area resulted in a pilot program in 1990 that tested population augmentation techniques. 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 2002–12 identified one of the original transplanted bears. The animal was a 2 year-old female when released in 1993. Genetic analysis also identified at least 9 first generation offspring and 8 second generation offspring from this individual. The success of the augmentation test program prompted additional augmentation in cooperation with Montana Fish Wildlife and Parks. Seven female bears and 4 male bears were moved from the Flathead River to the Cabinet Mountains during 2005–13. Two of these individuals died during their first year from human related causes. One was illegally shot and one was struck by a train. Four bears left the target area for the augmentation effort. Research and monitoring in the Yaak River began in 1986 with the capture and collaring of 2 grizzly bears. Including those captures, 43 bears have been captured and monitored through telemetry, 1986–2013.

Numbers of females with cubs in the Cabinet-Yaak grizzly bear recovery zone (CYGBRZ) varied from 1–4 per year and averaged 2.5 per year from 2008–13. Human caused mortality averaged 1.5 bears per year and 0.3 females per year. Nine known or probable human caused mortalities have occurred in or within 10 miles of the CYGBRZ in the U.S. during 2008–13. Human caused mortalities during 2008-13 were two adult females (one self-defense and one under investigation), 3 adult males (two illegal under investigation and a black bear mistaken identity), 2 subadult males (black bear mistaken identity and self-defense), and one subadult bear and a cub, both of unknown sex and under investigation. Twelve of 22 bear management units had sightings of females with young during 2008–13.

A minimum of 37 bears were identified in the CYGBRZ during 2007–12 after known mortality was subtracted. This minimum was based on captures, genetic information, mortality, and sightings of unique individuals. Sixty-five known and probable grizzly bear mortalities from all causes were documented inside or within 16 km of the CYGBRZ (including Canada) during 1982–2013. Mortality causes, timing, and locations were analyzed for 1983–13. Sex and age specific survival and reproductive rates were updated and reported. Trend monitoring of population vital rates indicated a finite rate of increase (l) for 1983–2013 of 1.000 (95% C.I. 0.907–1.076). For 1983–2013, the population experienced a mean annual finite rate of change of 0.0%. Subadult female survival and adult female survival accounted for most of the uncertainty in l . The probability that the population was declining was 50%. However data from the last 6 years suggest recent positive population growth rates.

Capture, monitoring, and habitat use data were updated and reported for 1983–2013. Berry counts indicated greater than average production for huckleberry and lower than average serviceberry, buffaloberry and mountain ash production in 2013.

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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 to aid the recovery of this species within ecosystems that they or their habitat occupy (USFWS 1993). Seven areas were identified in the Recovery Plan, one of which was the Cabinet-Yaak Grizzly Bear Recovery Zone (CYGBRZ) of extreme northwestern Montana and northeast Idaho (Fig. 1). This area lies directly south of Canada and encompasses approximately 6800 km^2. The Kootenai River bisects the CYGBRZ, with grizzly bear habitat within the Cabinet Mountains to the south and the Yaak River drainage to the north (Fig. 2). The degree of grizzly bear movement between the two portions is unknown but thought to be minimal.

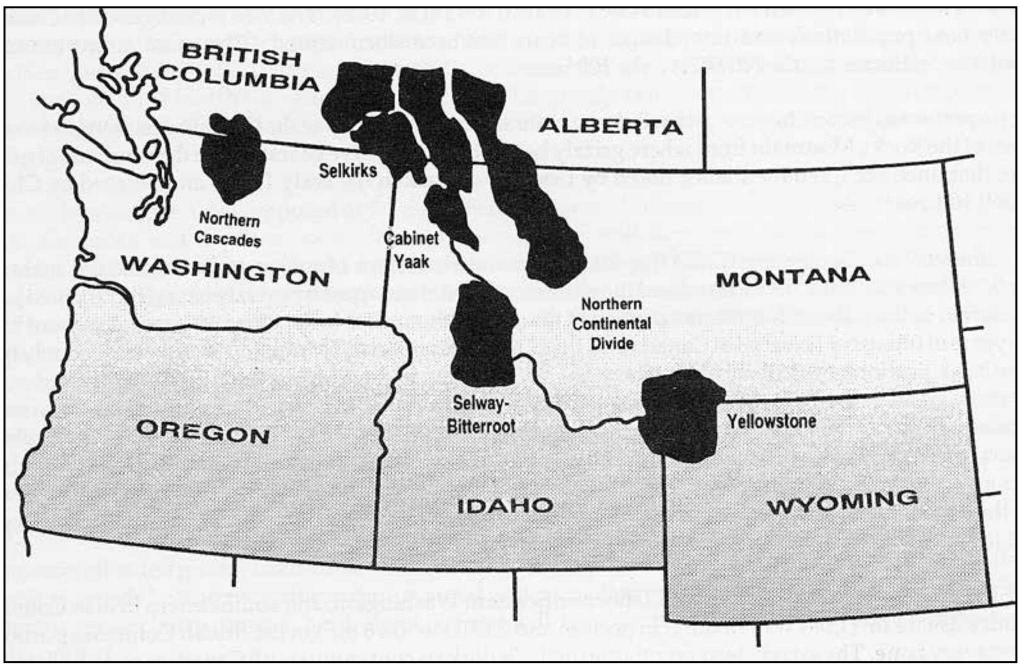


Figure 1. Grizzly bear recovery areas in the U.S., southern British Columbia, and Alberta, Canada.

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 of the augmentation program, 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 (MFWP) cooperated with the U.S. Fish and Wildlife Service in initiating a long term study. 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^{o} N, 116^{o} W) encompasses approximately 6,800 km^2 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^2 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.

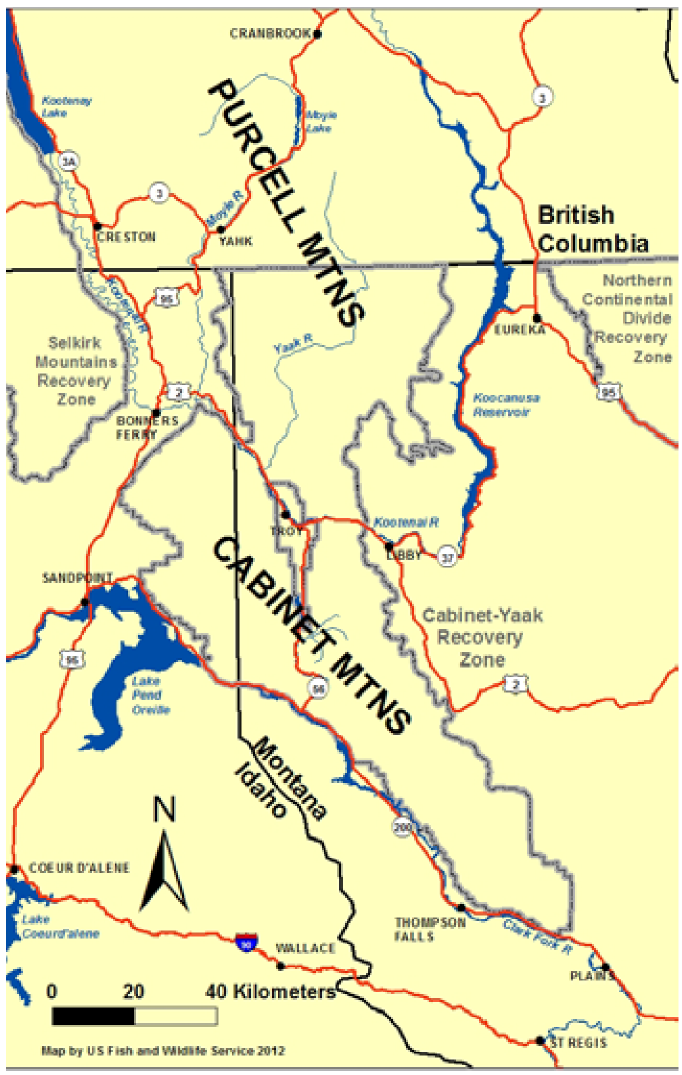


Figure 2. Cabinet-Yaak grizzly bear recovery zone.

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 shrub fields and wet meadows along major drainages. Huckleberry (*Vaccinium spp*.) and mixed shrub fields 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 shrub fields.

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 Koocanusa 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 decades, several stand altering fires have occurred in the Yaak River. Additionally, the Kootenai and Idaho Pandhandle National Forests have implemented prescribed fire to promote grizzly bear habitat in recent years.

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 shrub fields of red-osier dogwood (*Cornus stolonifera*) and hawthorn (*Crataegus douglasii*) are prevalent along major drainages. Buffalo berry (*Shepherdia canadensis*) is common under stands of open lodgepole pine while serviceberry (*Amelanchier alnifolia*) and chokecherry (*Prunus virginiana*) prevail on drier, rockier sites. Huckleberry shrub fields are often found under open timber canopies adjacent to graminoid parks, in old burns, in cutting units, and intermixed with beargrass (*Xerophyllum tenax*). 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.

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.

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. Observer had sufficient time and was close enough or had binoculars to aid identification. Observer demonstrates sufficient knowledge of 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 and Mortality Calculations

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. Survival rates were calculated separately for native, augmentation, and management bears because of biases associated with initial capture and expected differences in survival functions.

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 were 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 recruitment rates to 1 year of age were estimated by 1 - (cub mortalities / 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 population trend calculation. None of these animals had any prior history of nuisance activity. Several native bears that were captured as part of a preemptive move to avoid nuisance activity were included.

Estimates of unreported mortality were based on the public reporting rate of radio collared animals >1 year of age (Cherry et al 2002). The correction factor was applied to public reported mortalities. Correction was unnecessary for known removals (management removals, capture related mortalities, or mortalities of radio-collared bears).

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 late summer or fall. Inter-birth interval was defined as length of time between subsequent births. Age of first parturition was determined by presence or lack of cubs from observations of aged radio-collared bears (Garshelis et al. 1998).

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 (λ, or lambda) for the study area's grizzly bear populations. The estimate of λ 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) $$0 = \lambda^{a} - S_a \lambda^{a-1} - S_c S_y S_s^{a-2} m[1 - (S_a / \lambda)^{w-a+1}],$$

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 λ. This technique was used on adults, subadults, and yearlings. 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) $$S_i = \prod_{j=1}^{k} e^{-L_j(D_{ij} - T_{ij})}$$

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 - (cub mortalities / 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 were defined by 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 inter-birth 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 inter-birth 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 $r = \log_e$ l (Caughley 1977).

Capture and Marking

Capture and handling of bears followed an approved Animal Use Protocol through the University of Montana, Missoula, MT (007-009CFC-021009). Capture of black bears and grizzly bears was performed under state permits 2013-087 and 2013-096 and federal permit TE704930-0. Bears were captured with leg-hold snares following the techniques described by Johnson and Pelton (1980) and Jonkel (1993). Snares were manufactured in house following the Aldrich Snare Co. (Clallam Bay, WA) design and consist of 6.5 mm braided steel aircraft cable. All bears were immobilized with either Telazol (tiletamine hydrochloride and zolazepam hydrochloride), a mixture of Ketaset (ketamine hydrochloride) and Rompun (xylazine hydrochloride), or a combination of Telazol and Rompun. Yohimbine and Atipamezole were the primary antagonists for Rompun. Drugs were administered intramuscularly with a syringe mounted on a pole (jab-stick), homemade blowgun, modified air pistol, or 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 and food use studies. Immobilized bears were given oxygen at a rate of 2–3 liters per minute. Recovering bears were dosed with Atropine and Diazepam.

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 (≥ 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^2 (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 2004–2010. During 2011, trapping was initiated along Highway 95 near McArthur Lake in northern Idaho and along Interstate 90 near Lookout Pass in Montana and Idaho. All 4 studies were designed to examine bear population connectivity across river valleys with highways and human habitation. Highway 2, 95, and I-90 studies 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 2005–13 occurred primarily in the North Fork and South Fork of the Flathead River in the US. No suitable bears were captured in 1992 or 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 during 1990–94. The program used genetic information from a hair-snagging with remote-camera photo verification 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 as well as 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 ≤ 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 2002–13 in the CYGBRZ in Idaho and Montana following standard hair snagging techniques (Woods *et al.* 1999). Sampling sites were established based on location of previous sightings, sign, and radio telemetry from bears in the Cabinet Mountains. A 5 km x 5 km grid (25 km^2) 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 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: 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 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 cooperator on this project and assisted with genetic interpretations. He has previously analyzed genetic samples from the Yaak portion of this recovery zone (Proctor 2003). Hair snag sampling effort during 2012 was altered and reduced to avoid conflicts with the US Geological Survey (USGS) study to estimate CYGBRZ grizzly bear population size (http://www.nrmsc.usgs.gov/research/CYEbeardna.htm).

A USGS study established and sampled 1373 rub trees across the recovery area during 2012. The study made preliminary data available regarding the success of this effort by providing us the coordinates of all trees and those trees that produced grizzly bear samples. Sites that produced grizzly bear hair and adjacent sites that were easily sampled in conjunction with successful sites were resampled 2-4 times during 2013. Collected hairs were evaluated by study personnel and samples not judged to be probable black bear were sent to Wildlife Genetics International Laboratory in Nelson, British Columbia for DNA extraction and genotyping.

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 attempted a location fix 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. Life home ranges (minimum convex polygons; Hayne 1959) were calculated for grizzly bears during the study period. We generated home range polygons using the Hawth's Tools for ArcGIS (Beyer, H. L. 2004).

Grizzly and black bears were collared during 2004–10 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 2007, 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 2008–2010, black bears were fitted with GPS collars in the Yaak River study area and along the Clark Fork River on the south end of the Cabinet Mountains study area.

Scat analysis

Bear scats were collected, tagged, and either dried or frozen. We only considered scats associated with definite grizzly bear sign (tracks, hair, radio location of instrumented bear) as from grizzly bears. Food habits analysis was completed by William Callaghan (Helena, MT) and Kevin Frey (Bozeman, MT). Samples were hot and cold rinsed over 2 different size mesh screens (0.40 and 0.24 cm). The retained contents were identified to species with the aid of microscopes. We recorded plant part and visually estimated percent volume. We corrected scat volumes with correction factors that incorporate different digestibilities of various food items (Hewitt and Robbins 1996).

Isotope analysis

Hair samples from known age, captured grizzly bears were collected and analyzed for stable isotopic ratios. Stable isotope signatures indicate source of assimilated (i.e., digested) diet of grizzly bears. Nitrogen stable isotope ratios (^{15}N) indicate trophic level of the animal; an increased amount of ingested animal matter yields higher nitrogen isotope ratios while lower values tie to more plant-based diets. In our ecosystem, carbon isotope signatures vary depending on the amount of native C3 vs. C4 plant matter ingested. Corn, a C4 plant, has elevated $^{13}C/^{12}C$ ratios relative to native C3 plants. Because much of the human food stream is composed of corn, carbon stable isotope signatures allow for verification or identification of human food conditioned bears.

Hair samples were rinsed with a 2:1 chloroform:methanol solution to remove surface contaminants. Samples were then ground in a ball mill to homogenize the sample. Powdered hair was then weighed and sealed in tin boats. Isotope ratios of $\delta^{13}C$ and $\delta^{15}N$ were assessed by continuous flow methods using an elemental analyzer (ECS 4010, Costech Analytical, Valencia, California) and a mass spectrometer (Delta PlusXP, Thermofinnigan, Bremen, Germany) (Brenna et al. 1997, Qi et al. 2003).

Berry Production

Quantitative comparisons of annual fluctuations and site-specific influences on fruit production of huckleberry and buffalo berry 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^2 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. Timbered shrub fields and mixed shrub cutting units were the primary sampling areas to examine the influence of timber harvesting on berry production within a variety of aspects and elevations. Notes on berry phenology, berry size, and plant condition were recorded. Service berry, mountain ash, and buffaloberry production was estimated from 10 marked plants at several sites scattered across the recovery area. Since 1989 several sites have been added or relocated to achieve goals for geographic distribution. Some transects were eliminated because plant succession or fire had affected production. Monitoring goals identified an annual trend of berry production and did not include documenting the effects of succession.

Huckleberry sampling began in 1989 at 11 transect sites. Fifteen sites were sampled in 2013. Buffaloberry sampling began in 1990 at 5 sites. Due to the dioecious (separate male and female plants) nature of buffalo berry all frame count transects were dropped in 2007 in favor of marking 10 plants per site and counting the berries on the marked plants. Two sites were sampled in 2013. Serviceberry productivity was estimated by counting berries on 10 marked plants at 5 sample sites beginning in 1990. Six sites were sampled in 2013. In 2001, three new plots were established to document berry production of mountain ash (*Sorbus scopulina*). Ten plants were permanently marked at each site for berry counts, similar to the serviceberry plots. Production counts occurred at 3 sites in 2013.

Temperature and relative humidity data recorders (LogTag) were placed at sites beginning in 2011. These devices record conditions at 90 minute intervals and will be retrieved, downloaded, and replaced at annual intervals. We used a berries/plot or berries/plant calculation as an index of berry productivity. Transects were treated as the independent observation unit. For each year observed, mean numbers of berries/plant (berries/plot) were used as our transect productivity indices. For each year, we indicate whether berry productivity is above or below the study-wide mean production (Figs. 103 and 104). We define a "berry failure" as an instance in which the annual 95% confidence interval of berries per plot (or plant) is below and does not overlap the study-wide mean.

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 1,600 credible sightings, tracks, scats, digs, and hair dating from 1960 (Fig. 3) and 141 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). Sixty-six instances of grizzly bear mortality were detected inside or within 16 km of the CYGBRZ (including Canada) during 1982-2013 (Table 1).

Thirty-nine credible sightings were reported to this study that rated 4 or 5 (most credible) during 2013. Twenty of these sightings occurred in the Yaak portion of the recovery zone and 7 sightings occurred in the Cabinet Mountains portion of the recovery zone. Ten sightings came from outside the recovery zone in the U.S. and two sightings were 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. Two credible sightings of a female with cubs occurred during 2013: one in BMU 15 and one outside the recovery zone in the Libby (within 10 miles of BMU 6) unit (Tables 2, 3, 4, 5, Fig. 4 and 5). There appeared to be 2 unduplicated females with cubs in the recovery area or within 10 miles during 2013. Seven credible sightings of a female with yearlings or 2-year-olds occurred in BMUs 5, 11, 14, 17, and the West Kootenai unit. Unduplicated sightings of females with cubs (excluding Canada) varied from 1–4 per year and averaged 2.5 per year from 2008–13 (Tables 3, 4). Recovery plan criteria require a running 6 year average of 6.0 females with cubs per year.

Twelve of 22 BMUs in the recovery zone had sightings of females with young (cubs, yearlings, or 2-year-olds) during 2008–13 (Figs. 4, 5, Table 6). Occupied BMUs were: 2, 3, 5, 6, 7, 11, 13, 14, 15, 16, 17, and 18. Recovery plan criteria indicate the need for 18 of 22 BMUs to be occupied.

Nine 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 2008–13 (Table 1). Two additional mortalities of augmentation bears occurred south of the Clark Fork River in 2008. 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 if they die. Mortalities in Canada are not counted toward recovery goals (USFWS 1993) even though bears initially marked within the recovery zone have died in Canada. Nine human caused mortalities include 2 females (BMU 5 and Deer Ridge), 5 males (BMUs 2, 11, 12, 13, and West Kootenai unit), and two bears of unknown sex (BMU 22 and Deer Ridge; to be determined by genetic analysis). Human caused mortalities during 2008-13 were two adult females (one self-defense and one under investigation), 3 adult males (two illegal under investigation and a black bear mistaken identity), 2 subadult males (black bear mistaken identity and self-defense), and one subadult bear and a cub of unknown sex (under investigation). Population levels were calculated by dividing observed females with cubs (6) minus any human-caused adult female mortality (1) from 2011–13 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 29 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 4% mortality limit to the minimum calculated population resulted in a total mortality limit of 1.2 bears per year. The female limit is 0.4 females per year (30% of 1.2). Average annual human caused mortality for 2008–13 was 1.5 bears/year and 0.3 females/year (however, sex of two bears was not known at the time of this report). These preliminary mortality levels for total bears were in excess of calculated limit during 2008-13, and female mortality was below the calculated limit. However 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, 1982–2013.

Mortality Date	Tag #	Sex	Age	Mortality Cause	Location	Open Road <500 m	Public Reported	Owner[1]
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[1]	134	M	AD	Human, Legal Hunter kill	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[2]	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[1]	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[1]	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	M	Cub	Natural, Conspecific	Seventeen Mile Creek, MT	No	No	USFS
6/4/1999	106-cub	F	Cub	Natural, Conspecific	Seventeen Mile Creek, MT	No	No	USFS
10/12/1999[1]	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[1]	538-cub	Unk	Cub	Natural	Hawkins Creek, BC	Unk	No	BC
6/1/2000[1]	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[1]	538-cub	Unk	Cub	Natural	Cold Creek, BC	Unk	No	BC
6/18/2001[1]	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[1]	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[1]	None	F	AD	Human, Management	Newgate, BC	Yes	Yes	PRIV
2005?	363	M	14	Human, Under Investigation	Curley Creek, MT	Yes	Yes	PRIV
5/15/2005[1]	31	M	AD	Human, Legal Hunter Kill	Russell Creek, BC	Yes	Yes	BC
10/9/2005	694	F	2	Human, Under Investigation	Pipe Creek, MT	Yes	No	PCT
10/9/2005	None	F	2	Human, Train collision	Government Creek, MT	Yes	Yes	MRL
10/19/2005	668	M	3	Human, Mistaken Identity, Black bear	Yaak River, MT	Yes	Yes	PRIV
5/28/2006[1]	None	F	4	Human, Research	Cold Creek, BC	Yes	No	BC
6/1/2006[1]	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	PCT
10/20/2008	790[2]	F	3	Human, Poaching	Clark Fork River. MT	Yes	Yes	PRIV
10/20/2008	635[2]	F	4	Human, Train collision	Clark Fork River. MT	Yes	Yes	MRL
11/15/2008[1]	651	M	13	Human, Mistaken Identity, Wolf Trap	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[3]	None	M	3-4	Human, Mistaken Identity, Black bear	Bentley Creek, ID[3]	Yes	Yes	PRIV
11/1/2009	286	F	Adult	Human, Self Defense	EF Bull River, MT	No	Yes	USFS

Mortality Date	Tag #	Sex	Age	Mortality Cause	Location	Open Road <500 m	Public Reported	Owner[1]
6/25/2010	675-cub	Unk	Cub	Natural	American Creek, MT	Unk	No	USFS
9/6/2010[1]	1374	M	2	Human, Under Investigation	Hawkins Creek, BC	Yes	No	BC
9/24/2010[1]	None	M	2	Human, Wolf Trap, Selkirk Relocation	Cold Creek, BC	Yes	Yes	BC
10/11/2010	None	M	AD	Human, Under Investigation	Pine Creek, MT	No	Yes	USFS
2011	None	F	1	Unknown	EF Rock Creek, MT	No	Yes	USFS
9/16/2011	None	M	AD	Human, Mistaken Identity	Faro Creek, MT	No	Yes	USFS
11/13/2011	799	M	4	Human, Mistaken Identity	Cherry Creek, MT	Yes	Yes	USFS
11/24/2011	732	M	3	Human, Defense of life	Pipe Creek, MT	Yes	Yes	PRIV
November 2011?	342	M	19	Human, Under Investigation	Little Creek, MT	Yes	Yes	PRIV
5/18/2012	None	F	AD	Human, Under Investigation	Mission Creek, ID	Yes	Yes	USFS
5/18/ 2012	None	?	Cub	Human, Under Investigation	Mission Creek, ID	Yes	Yes	USFS
October 2012[1]	5381	M	8	Human, Management	Duck Creek, BC	Yes	Yes	BC

[1]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.
[2]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.
[3]Bear Killed more than 10 miles outside recovery zone in the US and not counted in recovery calculations.

Table 2. Credible grizzly bear sightings, credible female with young sightings, and known human caused mortality by bear management unit (BMU) or area, 2013.

BMU OR AREA	2013 Credible[1] Grizzly Bear Sightings	2013 Sightings of Females with Cubs (Total)	2013 Sightings of Females with Cubs (Unduplicated[2])	2013 Sightings of Females with Yearlings or 2-year-olds (Total)	2013 Sightings of Females with Yearlings or 2-year-olds (unduplicated[2])	2013 Total Human Caused Mortality
2	3	0	0	0	0	0
4	1	0	0	0	0	0
5	2	0	0	2	2	0
9	1	0	0	0	0	0
11	1	0	0	1	0	0
12	2	0	0	0	0	0
13	4	0	0	0	0	0
14	2	0	0	1	1	0
15	2	1	1	0	0	0
16	2	0	0	0	0	0
17	7	0	0	1	1	0
British Columbia[3]	2	0	0	0	0	1[3]
Cabinet Face	4	0	0	0	0	0
Libby	1	1	1	0	0	0
Tobacco[4]	12	3	2	1	1	0
West Kootenai	5	0	0	2	1	0
2013 TOTAL	39	2	2	7	5	1[3]

[1]Credible sightings are those rated 4 or 5 on a 5 point scale (see methods).
[2]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).
[3]Areas in Canada outside of Cabinet-Yaak recovery zone that do not count toward recovery goals.
[4] Areas with portions <16 km outside the Cabinet-Yaak recovery zone that do not count toward recovery goals.

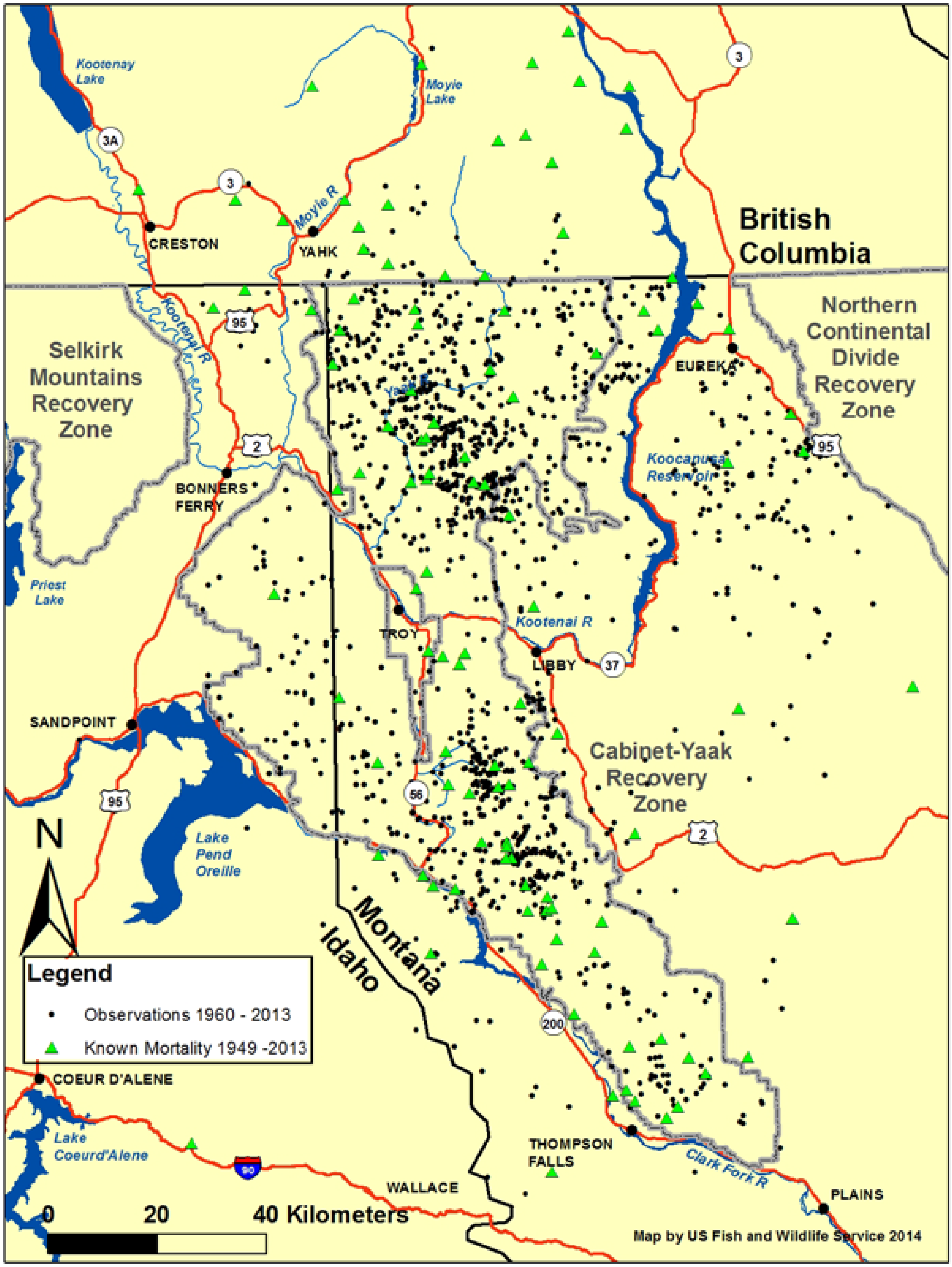


Figure 3. Grizzly bear observations (1960–2013) and known or probable mortalities from all causes (1949–2013) in the Cabinet-Yaak recovery area.

Table 3. Status of the Cabinet-Yaak recovery zone during 2008–2013 in relation to the demographic recovery targets from the grizzly bear recovery plan (USFWS 1993).

Recovery Criteria	Target	2013
Females w/cubs (6-yr avg)	6	2.5 (15/6)
Human Caused Mortality limit (4% of minimum estimate)	1.2	1.5 (6 yr avg)
Female Human Caused mortality limit (30% of total mortality)	0.4	0.3 (6 yr avg)
Distribution of females w/young	18 of 22	12 of 22

Table 4. Annual Cabinet-Yaak recovery zone (excluding Canada) grizzly bear unduplicated counts of females with cubs (FWC's) and known human-caused mortality, 1988–2013.

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[1]	30% ALL FEMALE HUMAN CAUSED MORTALITY LIMIT[1]	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	0.9	0.3	2.0	1.5
2006	1	0	0	0	0.7	0.2	1.8	1.3
2007	4	1	1	1	1.2	0.4	1.7	1.2
2008	3	0	0	1[2]	1.6	0.5	1.0	0.5
2009	2	1	1	1	1.6	0.5	1.2	0.7
2010	4	0	0	1	1.9	0.6	1.3	0.7
2011	1	0	0	4	1.4	0.4	1.3	0.3
2012	3	1	1	2[2]	1.6	0.5	1.7	0.5
2013	2	0	0	0	1.2	0.4	1.5	0.3

[1] Presently grizzly bear numbers are so small in this ecosystem that the mortality goal shall be zero known human-caused mortality.
[2] The sex of this mortality was not known at the time of this report.

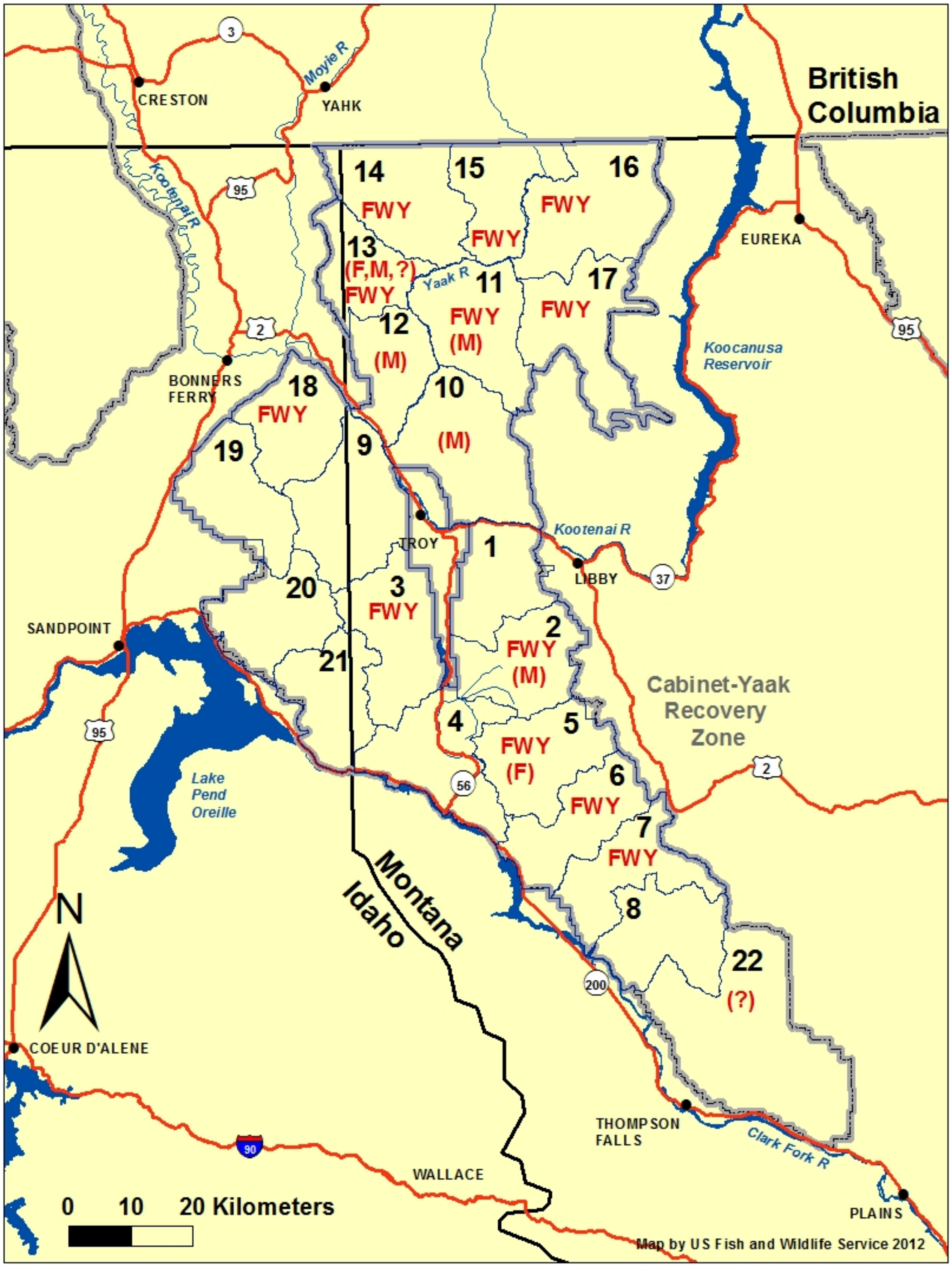


Figure 4. Female with young occupancy and known or probable mortality within Bear Management Units (BMUs) in the Cabinet-Yaak recovery zone 2008–2013. (FWY indicates occupancy of a female with young, sex of any mortality is indicated in parentheses, and "?" indicates a mortality of yet to be determined sex).

Table 5. Credible observations of females with young in or within 10 miles of the Cabinet-Yaak recovery zone, 1988–2013. Canadian credible observations 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
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)
2010	14 (0)	4 (0)	2 (0)	6 (0)
2011	4 (0)	1 (0)	1 (0)	2 (0)
2012	12 (0)	3 (0)	3 (0)	6 (0)
2013	9 (0)	2 (0)	5 (0)	7 (0)

[1]Credible sightings are those rated 4 or 5 on a 5 point scale (see page 8).

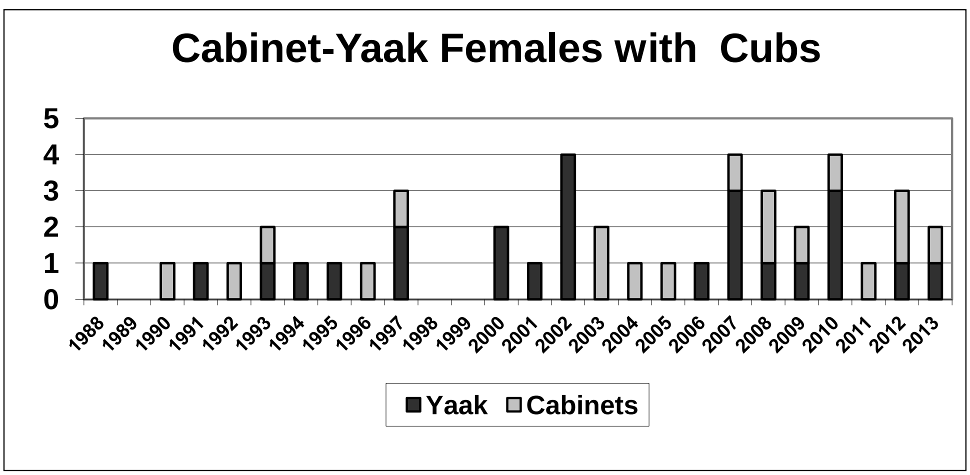


Figure 5. Credible observations of females with cubs in or within 10 miles of the Cabinet-Yaak recovery zone (excluding Canada),1988–13. Credible sightings are those rated 4 or 5 on a 5 point scale (Methods).

Table 6. Occupancy of bear management units by grizzly bear females with young in the Cabinet-Yaak recovery zone 1990–2013.

	1 - CEDAR	2 - SNOWSHOE	3 - SPAR	4 - BULL	5 - ST. PAUL	6 - WANLESS	7 - SILVER BUTTE	8 - VERMILION	9 - CALLAHAN	10 - PULPIT	11 - RODERICK	12 - NEWTON	13 - KENO	14 - NORTHWEST PEAK	15 - GARVER	16 - EAST FORK YAAK	17 - BIG CREEK	18 - BOULDER	19 - GROUSE	20 - NORTH LIGHTNING	21 - SCOTCHMAN	22 - MT HEADLEY
1988	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N
1989	N	N	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	N	N	N	N	N	N	N
1990	N	Y	N	N	N	N	N	Y	N	N	Y	Y	N	Y	Y	N	N	N	N	N	N	Y
1991	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N
1992	N	N	N	N	N	Y	N	N	N	N	Y	N	Y	Y	N	N	Y	N	N	Y	N	N
1993	N	N	N	N	Y	Y	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N
1994	N	N	N	N	N	N	N	N	N	N	Y	N	N	Y	Y	N	N	N	N	Y	N	N
1995	N	N	N	N	N	N	N	N	N	N	Y	N	N	Y	Y	N	N	N	N	N	N	N
1996	N	N	N	N	N	Y	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N
1997	N	Y	N	Y	N	Y	Y	N	N	N	Y	N	N	Y	Y	Y	N	N	N	N	Y	N
1998	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N	N	N	N	N
1999	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N	N
2000	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N
2001	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N	N	N	Y	N	N	N	N	N
2002	N	Y	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	N	Y	N	N	N	N	N
2003	N	Y	N	N	Y	Y	N	N	N	N	N	N	Y	N	N	Y	N	Y	N	N	Y	N
2004	N	Y	N	N	Y	Y	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N	N
2005	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N
2006	N	Y	N	N	Y	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N
2007	N	N	Y	Y	Y	Y	N	N	N	N	Y	N	Y	Y	N	N	Y	N	N	N	N	N
2008	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N	N	N	N
2009	N	N	N	N	Y	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N
2010	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N	N	Y	N	N	N	N	N
2011	N	N	N	N	Y	N	N	N	N	N	Y	N	N	N	Y	N	Y	N	N	N	N	N
2012	N	Y	N	N	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	N	N	N
2013	N	N	N	N	Y	Y	N	N	N	N	Y	N	N	Y	Y	Y	Y	N	N	N	N	N

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 (Table 7). 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. 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 the augmentation program was reinitiated by MFWP personnel. During 2005–13, 7 female and 4 male grizzly bears have been released in the Cabinet Mountains (Table 7). Of 15 bears released through 2013, 5 are known to have left the target area (one was recaptured and brought back and one returned to the Cabinets Mountains a year after leaving), two were killed within 4 months of release, and one was killed 16 years after release. One animal is known to have produced at least 9 first generation offspring 8 second generation offspring. A short history of these bears follows later in this report.

Table 7. Sex, age, capture date, capture location, release location, and fate of augmentation grizzly bears moved to the Cabinet Mountains, 1990–2013.

Bear	Sex	Age	Capture date	Capture Location	Cabinet Mts Release Location	Fate
218	F	5	7/21/1990	NF Flathead R, BC	EF Bull River	Denned in Cabinet Mts 1990, Lost collar August, 1991, observed July 1992
258	F	6	7/21/1992	NF Flathead R, BC	EF Bull River	Denned in Cabinet Mts 1992 Produce 1 cub 1992, Natural mortality July 1993
286	F	2	7/14/1993	NF Flathead R, BC	EF Bull River	Denned in Cabinet Mts 1993-95, Lost collar at den April 1995, hair snag 2004-2009, self-defense mortality November 2009
311	F	3	7/12/1994	NF Flathead R, BC	EF Bull River	Lost collar July 1994, recaptured October 1995 south of Eureka, MT, released in EF Bull River, Signal lost November 1995
A1	F	7-8	9/30/2005	NF Flathead R, MT	Spar Lake	Denned West Cabinet Mts 2005 and 2006, Lost collar September 2007
782	F	2	8/17/2006	SF Flathead R, MT	Spar Lake	Denned West Cabinet Mts 2006-07, Lost collar August 2008
635	F	4	7/23/2008	Stillwater R, MT	EF Bull River	Killed by train near Heron, MT October, 2008
790	F	3	8/7/2008	Swan R, MT	EF Bull River	Illegally killed near Noxon, MT October, 2008
715	F	10	9/17/2009	NF Flathead R, MT	Spar Lake	Denned in West Cabinet Mts 2009-10, returned to NF Flathead R, May 2010
713	M	3	7/18/2010	NF Flathead R, MT	Spar Lake	Denned in Cabinet Mts 2010, Lost collar September 2011
714	F	3	7/24/2010	NF Flathead R, MT	Silverbutte Cr	Returned to NF Flathead July 2010
725	F	2	7/25/2011	MF Flathead R, MT	Spar Lake	Moved to Glacier National Park, September 2011 and denned, returned to Cabinet Mts August 2012 and denned, ,oved to Glacier National Park and returned to Cabinet Mts, lost collar October 2013
723	M	2	8/18/2011	Whitefish R, MT	Spar Lake	Denned in Cabinet Mts 2011. Lost collar June 2012.
918	M	2	7/6/2012	Whitefish R, MT	EF Bull River	Denned in Cabinet Mts 2012 and 2013
919	M	2	7/30/2013	NF Flathead R, MT	Spar Lake	Denned in Cabinet Mts 2013

Cabinet-Yaak Hair Sampling and DNA Analysis

Hair snag sampling occurred at barb wire corrals baited with a scent lure during 2000–2012 (Table 8 and Fig. 6). Sampling occurred from May through October, but varied within years. Sites were selected based on previous grizzly bear telemetry, sightings, and access. Remote cameras supplemented hair snagging at numerous sites and were useful in identifying family groupings and approximate ages of sampled bears. Hair snag sampling effort during

2012 was altered and reduced to avoid conflicts with the US Geological Survey study to estimate grizzly bear population size.

In 2002 study personnel also assisted with an MDFWP black bear population hair snag estimate that sampled 285 sites in the Yaak River portion of the study area. During 2003, 184 sites on a 5 km^2 grid were sampled on approximately 4,300 km^2 in the Cabinet Mountains portion of the recovery zone. In 2009, 98 sites were sampled south of the Clark Fork River. Other years had much lower numbers of sampled sites.

Eight hundred and sixty-six sites were sampled with this technique from 2000–2013 (Table 80 and Fig. 6). Thirty-three sites provided grizzly bear hair from at least 33 individuals. 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 1983–2013.

Table 8. Grizzly bear hair snagging sites and success in the Cabinet-Yaak study area, 2000–2012.

Year	Number of sites	Sites with grizzly bear pictures	Sites with grizzly bear hair	Individual grizzly bear genotypes	Locations with grizzly bear pictures or hair	Comments
2000	1	0	0	0		
2001	3	0	0	0		
2002	319	4	7	6	MF Bull R., W Fisher Cr., EF Rock Cr., NF Big Cr., NF Sullivan, Pete Cr., 4th July Cr., Spread Cr., Solo Joe Cr.	
2003	184	1	1	1	WF Rock Cr., W Fisher Cr.	
2004	14	1	2	3	EF Bull R., EF Rock Cr.	
2005	17	2	1	1	EF Bull R., Libby Cr.	
2006	19	1	3	3	Cub Cr., Silverbutte Cr., Bear Cr., and EF Rock Cr.	
2007	36	4	4	9	Devils Club Cr., EF Rock Cr., Bear Cr., W F Rock Cr., W Fisher Cr., Pete Cr., NF Meadow Cr.	Female with young EF Rock Cr., Female with young WF Rock Cr.
2008	21	1	1	1	EF Bull R.	
2009	122	4	2	4	Bear Cr., Libby Cr., NF Callahan Cr., W Fisher Cr.	Female with young Bear Cr.
2010	24	4	3	5	EF Rock Cr., W Fisher Cr., Cub Cr., Drift Cr.	Female with young EF Rock Cr.
2011	72	8	8	13	EF Rock Cr., Bear Cr., W Fisher Cr., NF 17-mile Cr., Spruce Cr., Hensley Cr., Chippewa Cr., Solo Joe Cr.	Siblings Spruce Cr., Female with young Solo Joe Cr.
2012	31	1	1	1	Beaver Cr.,	
2013	3	1	N/A	N/A	W. Fisher Cr.	Female with young W Fisher Cr.
Total	866	32	33	33[1]		

[1]Some individuals captured multiple times among years.

During 2012 the USGS established and sampled hair from 1,373 rub trees across the CYGBRZ (Kendall 2013). The study made preliminary data available regarding the success of this effort by providing us the coordinates of all trees and those trees that produced grizzly bear samples. Sites that produced grizzly bear hair and adjacent sites that were easily sampled in conjunction with successful sites were resampled 2-4 times during 2013. Visits to 524 rub tree sites resulted in removal of 75 sites largely due tree growth around and over wire and staples. The remaining 449 rub trees provided collection of 1,038 hair samples. Samples were evaluated during cataloging and 480 were judged not to be from black bears and sent to Wildlife Genetics International Laboratory in Nelson, British Columbia for DNA extraction and genotyping. Additionally, 16 opportunistically collected hair samples from CYGBRZ and 25 from the Selkirk Mountains Recovery zone were also submitted. Genetic results for 2013 samples had not been received at the writing of this report.

Genetic samples from the Cabinet Mountains (1983–2012) were analyzed and determined to originate from 39 different grizzly bears. Three of these were from captures during 1983–1988, 12 were from augmentation bears during 1990–2012, and 24 from captures, mortalities, or hair snagging during 1997–2012. One of these genotypes identified by hair snagging 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 9 first generation offspring and 8 second generation offspring. Three of those first generation offspring are adult females that have also reproduced (Fig. 7) 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.

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. All genetic samples from this study will continue to undergo parentage analysis. We expect to be able to identify numerous additional mother – father – offspring triads with this information.

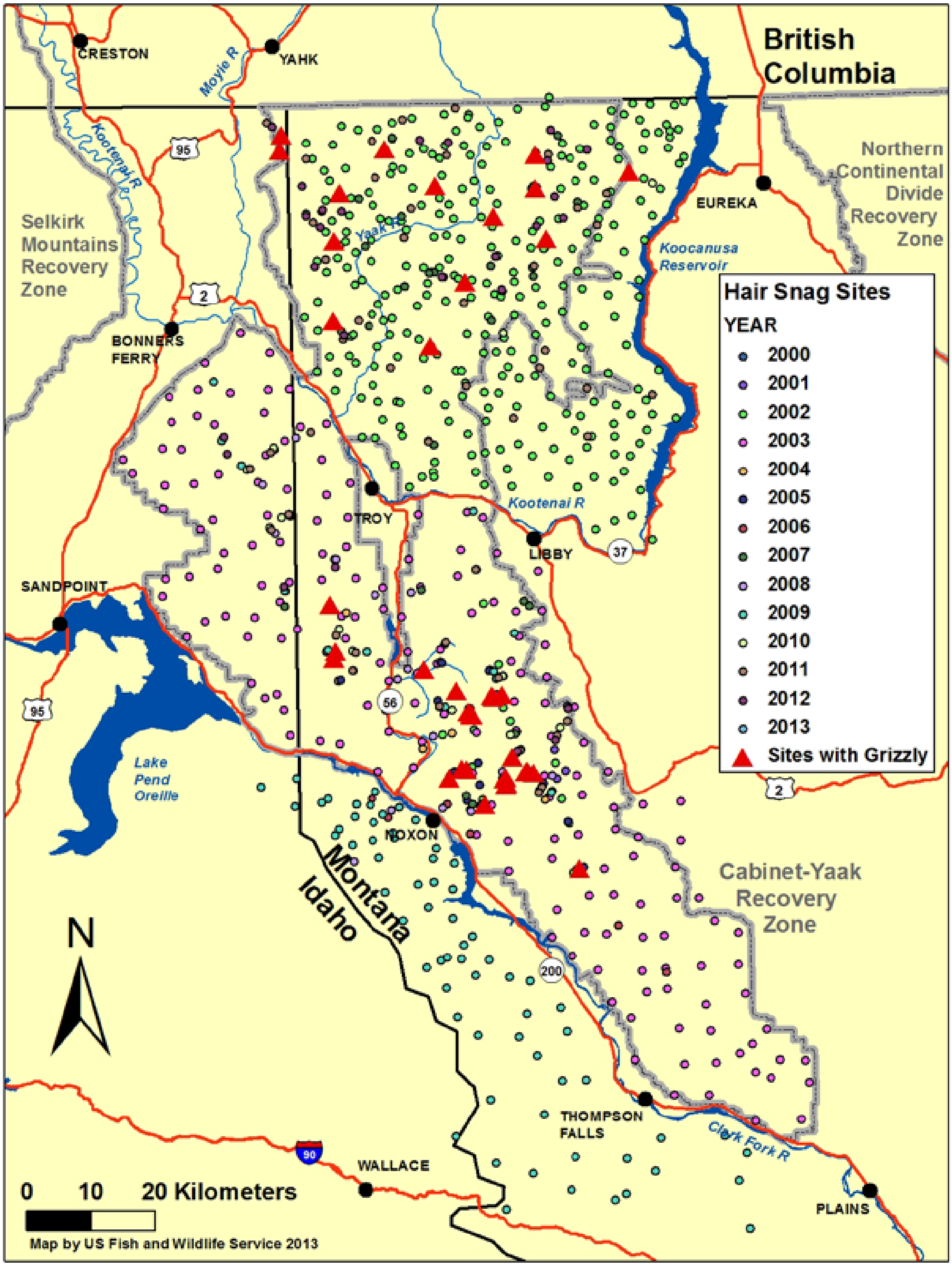


Figure 6. Location of hair snag sample sites in the Cabinet Mountains, 2000–13. Triangles denote sites that snagged grizzly bear hair.

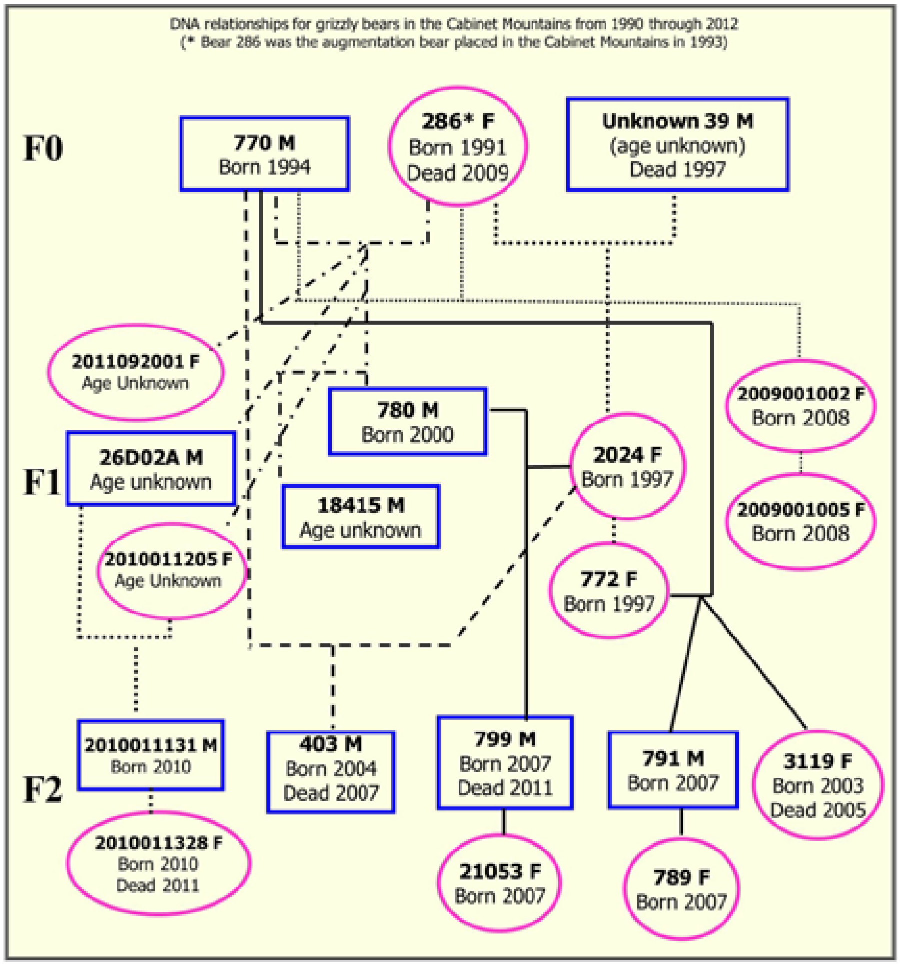


Figure 7. Most likely pedigree resulting from translocated female grizzly bear 286 into the Cabinet Mountains, 1993–2012. Squares indicate males and circles represent females. Lines indicate a parent-offspring relationship. F0 is the initial generation, F1 is the first generation of offspring for translocated female 286, and F2 is the second generation.

In early August of 2010, Mines Management Inc. (operator of Montanore Mine) issued a press release.

"Mines Management Receives Results of Groundbreaking Grizzly Bear Study - DNA Analysis of Grizzly Bear Scat Suggests a Larger Population of Bears in Cabinet/Yaak Ecosystem Than Previously Estimated. During the summer of 2009, scientists from the University of Washington and Kline Environmental Research were contracted by the Company to conduct a study in and around the Montanore Project area to assess the current condition of the grizzly bear population using DNA analysis of grizzly bear scat.

From the results of the study, a number of conclusions were reached, including the following:

- *-- There are very likely significantly more grizzly bears in the Cabinet Mountains than has been previously reported.*
- *-- Either through augmentation or transient bears, the region may be at a stable condition and at its natural carrying capacity for grizzly bears.*
- *-- Current grizzly bear management activities in the recovery area should be reviewed due to recent grizzly mortalities and the increase of bears leaving the recovery area.*
- *-- DNA studies can identify individual grizzly bears from collected scat samples, which can be used to assess habitat and numbers of bears in the study area. The method*

proved to be an effective, non-intrusive method for monitoring grizzly bears, as compared to radio collars or hair sampling."

A review of that report noted errors in the use of data from this study and contacted the authors regarding these problems (Kline 2010). The authors made population estimates for the Cabinet Mountains of 37 bears based on hair snag data from this study. This study pointed out an error in their calculation which reduced their estimate to 6.5 bears. The author of the Montanore study agreed that an error was made and the calculation was actually 6.5 bears.

The University of Washington (UW) was contracted by Montanore Minerals Corporation to use scat sniffing dogs to collect scats which were later analyzed by a genetics lab for species and individual Identification. The report (Wasser 2010) stated that they had collected 998 scats, identified 23 of these as grizzly bear, and genotyped 11 scats to individuals (8 in the Cabinets and 3 in the Yaak). All 11 scats that could be genotyped were reported to be from different individuals. The techniques used by UW do not allow direct comparison with our genetics database for the CYGBRZ and a request was made for subsamples to be analyzed by Wildlife Genetics International (WGI) in British Columbia.

It was agreed that WGI could test the samples, but upon arrival at UW on 20 January 2011 our personnel were then told that 2 of the 23 samples previously identified as grizzly bear and genotyped to an individual were now "too weak to confirm". We requested all 23 samples that were reported to be grizzly bear, but received only 16. These 16 samples were tested by WGI and results were returned to this study. Of the 16 samples identified by the UW as grizzly bear and provided to us, 10 were confirmed by WGI as grizzly bear, but 6 were identified as black bear. Both of the samples subsequently judged "too weak to confirm" by the UW were identified as black bear. Of the 10 sampled identified as grizzly bear by WGI, only one could be genotyped to an individual identification level. Though 11 samples were originally identified as grizzly bear and genotyped to an individual level by UW, only one was able to be genotyped by WGI. This bear was not in our database and represents a different individual, but the genetics appear to suggest a high degree of similarity to bears in our database and may be directly related as an offspring of bear 286.

Grizzly Bear Minimum Numbers

Processing of genetic material from samples collected in 2013 had not been completed by Wildlife Genetics International at the time this report was prepared. Therefore results presented here do not include data from 2013.

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 during 1986–2012. 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 unique individuals being documented as one individual. Individual status or relationships may change with new information. Hair snag sampling effort during 2012 was altered and reduced to avoid conflicts with the US Geological Survey study to estimate grizzly bear population size.

Ninety-six individuals were identified in the Yaak River portion of the study area with 75 bears captured or genotyped and 21 unmarked individuals observed from 1986 to 2012 (Appendix 2). Fifty of these animals are known or suspected to have died. Human causes were linked to 34 of these mortalities. Fourteen are believed to have died of natural causes. Twelve of these 14 mortalities involved cubs. Two mortalities were from unknown causes. Two bears were known to have left the population with one going north of Highway 3 into the Purcell Mountains and one going to the Selkirk Mountains.

Total Yaak River animals identified during 1986–2012 (96 bears), less known mortality

(50) and emigration (2) would leave at least 44 animals. It is unlikely that all identified animals have survived the entire 25 year 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 calculated because it is the same as that used in the Grizzly Bear Recovery Plan (USFWS 1993). Using only animals identified during 2007–2012 (32) less known mortality and emigration (14) suggests a population of at least 18. These estimates may be liberal because they assume all other bears not known to be dead have survived the entire period. These estimates 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 2003 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 6 BMUs.

Similar observations, captures, and genetic information from the Cabinet Mountains were collected and summarized for 1983–2012 (Appendix 2). Using the same calculations as with the Yaak study area, total animals identified between 1983 and 2012 (44), less known mortality and emigration (19) would leave at least 25 animals. Using only animals identified during the 2007–2012 time period (30) less known mortality (7) and bears that left the recovery area (4) suggests a population of at least 19. The same limitations identified with the Yaak study area minimum estimates also apply to these numbers. The population was augmented with 11 females since 1990, credible sightings of individual bears have occurred in 13 of 14 BMUs in the Cabinet Mountains since 2003, and sightings of females with young occurred in 6 of 14 BMUs since 2003.

The amount of effort expended to collect these estimates has varied from year to year. Numbers of corral and camera stations, capture success, field observations, or the collection of opportunistic hair samples in a given year has been quite variable. Therefore, use of these estimates from multiple years to infer a population trend would be inappropriate.

The Cabinet Mountains population was estimated to be 15 bears or fewer in 1988 (Kasworm and Manley 1988). However the lack of native bears identified since 1989 suggests that the population may have been well below the level of 15 individuals. Twenty-eight of 35 bears genotyped since 1997 are known to be augmentation bears or their offspring. Only 7 genotyped bears not known to be augmentation bears or their offspring have been identified in the Cabinet Mountains since 1989. Of these 7, 3 are known to be dead. The augmentation effort appears to be the primary reason that grizzly bears remain in the Cabinet Mountains.

Known Grizzly Bear Mortality

Sixty-five instances of known and probable grizzly bear mortality from all causes were detected inside or within 16 km of the CYGBRZ (including Canada) during 1982–2013 (Tables 1 and 9, Fig. 8). There were no known grizzly bear mortalities detected inside or within 16 km of the CYGBRZ (including Canada) during 2013. This summary included radio-collared bears regardless of where they died. Seasons were defined as follows: April 1 to May 31 (spring), June 1 to August 31 (summer), and September 1 to November 30 (autumn).

Forty-five individuals were of known sex and age (Table 9). Eleven were adult females, 14 adult males, 9 subadult females, 7 subadult males, 2 yearling females, and 2 female cubs. Mortality causes (and frequency) were natural (16), unknown but human-caused (12), poaching (8), mistaken identity (7), management removal (6), defense of life (6), train collision (3), trap predation (2), legal hunting in Canada (2), black bear hunting with hounds in Canada(1), and unknown (2). Nine mortalities were known to have occurred during spring, 19 during summer, 33 during autumn, and 4 at unknown time of year. All 16 natural mortalities occurred during summer. One unknown but human-caused mortality occurred during spring, 8 occurred during autumn, and 1 was unknown. Three poaching mortalities occurred during spring, 8 occurred during autumn, and one was unknown. One mistaken identity mortality occurred during spring and 6 occurred in autumn. All defense of life and train collisions occurred during autumn. One management removal occurred during spring, one during summer, and 4 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 black bear hound hunting mortality occurred in British Columbia and occurred during summer.

Table 9. Cause, timing, and location of known and probable grizzly bear mortality in or within 16 km of the Cabinet-Yaak recovery zone (including Canada) and radio collared bears, 1982–2013.

	Mortality cause											
Age / sex / season / ownership	Defense of life	Legal Hunt	Hound hunting	Management removal	Mistaken identity	Natural	Poaching	Trap predation	Train Collision	Unknown, human	Unknown	Total
Adult female	3			2		2	1		1	1	1	11
Subadult female	1						1	2	2	3		9
Adult male	1	2		3	2		2			4		14
Subadult male	1			1	2		1			2		7
Yearling					1	1						2
Cub					1	13	3			1		18
Unknown			1		1					1	1	4
Total	6	2	1	6	7	16	8	2	3	12	2	65
Season[1]												
Spring		2		1	1		1	1		3		9
Summer			1	1		16		1				19
Autumn	6			4	6		6		3	8		33
Unknown							1			1	2	4
Ownership												
BC Private		1		4								5
BC Public	1	1	1	1	1	4		1		2		12
US Private	1			1	1		6		3	3		15
US Public	4				5	12	2	1		7	2	33

[1]Spring = April 1 – May 31, Summer = June 1 – August 31, Autumn = September 1 – November 30

Sixty-three percent (12 of 19) of known human-caused mortalities occurring on the National Forests were <500m of an open road and 37% were >500m from an open road (7 of 19). Thirty-seven percent of known human caused mortalities occurring on the National Forests were located within core habitat (7 of 19). Sixteen instances of known mortality occurred during the 17-year period from 1982–1998 with 12 (75%) of these mortalities being human-caused. During this time of a high rate of population increase (pages 37–38 and Fig. 9), the annual rate of known mortality was 0.71 mortalities per year. Twenty-eight instances of known mortality occurred during the 8 year period from 1999–2006 with 19 (68%) of these mortalities human-caused. Annual rate of known human-caused mortality was 2.38 per year from 1999–2006. This was a time of population decrease because of the high mortality (pages 38-39 and Fig. 9). Twenty-one instances of known mortality occurred during the 7 year period from 2007–2013 with 16 (76%) of these mortalities human-caused. Annual rate of known human-caused mortality was 2.29 per year from 2007–2013. This was a time of improving rate of increase in the population (pages 38–39 and Fig. 9). Though the rate of known human caused mortality dropped only slightly between the two most recent time periods, it is important to consider the rate of female mortality. The loss of females is the most critical factor affecting the trend because of their reproductive contribution to current and future growth. Total known female mortality rate decreased from 1.88 during 1999–2006 to 0.86 during 2007–2013 and known human caused female mortality rate decreased from 1.50 to 0.71. This decline of female mortality is largely responsible for the improving population trend from 2007–2013.

The increase in total known mortality beginning in 1999 may be linked to poor food production during 1998–04 (Fig. 8). Huckleberry production during these years was about half the 20-year average (see pages 70-72). 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 conflicts with humans, predators, or accidental deaths. Four 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.

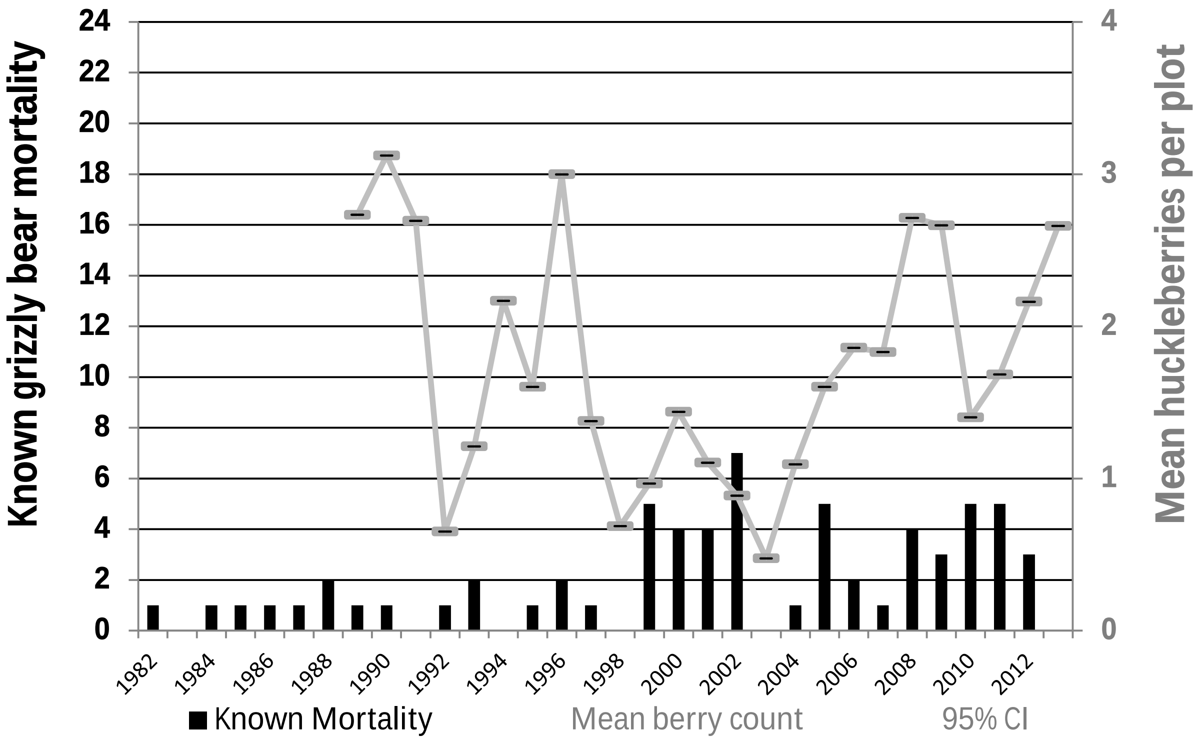


Figure 8. Known grizzly bear annual mortality from all causes in or within 16 km of the Cabinet-Yaak recovery zone (including Canada) and all radio collared bears by cause, 1982–2013 and huckleberry production counts, 1989–2013.

Use of known human-caused mortality counts probably results in under estimates of total human-caused mortality. Numerous mortalities identified by this study were reported only because animals wore a radio collar at the time of death. The public reporting rate of bears wearing radio-collars can be used to develop a correction factor to estimate unreported mortality (Cherry et al. 2002). The correction factor was not applied to natural mortality, management removals, mortality of radio collared bears or bears that died of unknown causes. All radioed bears used to develop the correction were >2 years-old and died from human related causes. factor to estimate unreported mortality (Cherry et al. 2002). Fourteen radio-collared bears died from human causes during 1982–2013. Seven of these were reported by the public and 7 were unreported. The Bayesian statistical analysis described by Cherry et al. (2002) was used to calculate unreported mortality (Table 10). The unreported estimate added 33 mortalities to the 65 known mortalities from 1982–2013.

Table 10. Annual grizzly bear mortality in or within 16 km of the Cabinet-Yaak recovery zone (including Canada) and estimates of unreported mortality, 1982–2013.

Year	Management or research	Radio monitored	Unknown cause	Public reported	Unreported estimate	Total
1982	0	0	0	1	1	2
1983	0	0	0	0	1	1
1984	0	0	0	1	1	2
1985	0	1	0	0	1	2
1986	0	1	0	0	1	2
1987	0	0	0	1	1	2
1988	0	1	0	1	1	3
1989	1	0	0	0	1	2
1990	0	0	0	1	1	2
1991	0	0	0	0	1	1
1992	0	0	1	0	1	2
1993	0	2	0	0	1	3
1994	0	0	0	0	1	1
1995	1	0	0	0	1	2
1996	0	2	0	0	1	3
1997	0	0	0	1	1	2
1998	0	0	0	0	1	1
1999	1	4	0	0	1	6
2000	0	4	0	0	1	5
2001	0	2	0	2	1	5
2002	0	5	0	2	1	8
2003	0	0	0	0	1	1
2004	1	0	0	0	1	2
2005	0	2	0	3	2	7
2006	2	0	0	0	1	3
2007	0	0	0	1	1	2
2008	0	2	0	2	1	5
2009	0	2	0	1	1	4
2010	0	3	0	2	1	6
2011	0	2	1	2	1	6
2012	1	0	0	2	1	4
2013	0	0	0	0	1	1
Total	7	33	2	23	33	98

Grizzly Bear Mortality, Reproduction, and Population Trend

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 supersede all previous calculations.

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 1983–2013 (Table 11). Adult female survival was 0.946 (95% CI 0.875–1.0, n=10) with 1 instance of natural mortality and 1 poaching among 10 radio-collared bears monitored for 36.1 bear-years. The natural mortality occurred during summer and the poaching occurred during autumn. Adult male survival was 0.897 (95% CI 0.792–1.0, n=19) with 1 legal hunting mortality in Canada, 1 defense of life, and 1 unknown but human-caused mortality among 19 radio-collared bears monitored for 29.7 bear-years. The hunting mortality occurred during spring 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 0.813 (95% CI 0.651–0.976, n=16) among 16 bears monitored for 21.2 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 9.0 years and produced a survival rate of 0.750 (95% CI 0.472–1.0, n=11). There was 1 spring unknown but human-caused mortality and two mistaken identities during autumn. Yearling survival was 0.890 (95% CI 0.734–1.0, n=23) among 21 bears monitored for 12.1 bear-years. One bear died during summer from natural causes. Fifteen of 35 cubs died, resulting in a survival rate of 0.571 (95% CI 0.407–0.735, n=35). Three cubs died by poaching during autumn, and 12 cubs were believed to have died of natural causes during summer.

Table 11. 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, 1983–2013.

	Demographic parameters and mortality rates					
Parameter	Adult female	Adult male	Subadult female	Subadult male	Yearling	Cub
Individuals / bear-years	10 / 36.1	19 / 29.7	16 / 21.2	11 / 9.0	23 / 12.1	35 / 35[a]
Survival[b] (95% CI)	0.946 (0.875–1.0)	0.897 (0.792-1.0)	0.813 (0.651–0.976)	0.750 (0.472-1.0)	0.890 (0.734–1.0)	0.571 (0.407–0.735)
Mortality rate by cause						
Legal Hunt Canada	0	0.037	0	0	0	0
Natural	0.029	0	0	0	0.111	0.343
Defense of life	0	0.033	0.043	0	0	0
Mistaken ID	0	0	0	0.107	0	0
Poaching	0.026	0	0	0	0	0.086
Trap predation	0	0	0.056	0	0	0
Unknown human	0	0.033	0.088	0.143	0	0

[a] Cub survival based on counts of individuals alive and dead.
[b]Kaplan-Meier survival estimate which may differ from BOOTER survival estimate.

Mortality rates of all sex and age classes of native, non-management radio collared grizzly bears ≥2 years old were summarized by cause and location of death (Table 12). 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 1999–2013) correspond to a decline in long term population trend (I) beginning in 1999. Grizzly bear survival of all sex and age classes decreased from 0.899

during 1983–1998 to 0.864 during 1999–2013. Some of this decrease could be attributed to an 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 1999–2013 were associated with sanitation issues on private lands. Several deaths of management bears occurred on private lands, but were not included in this calculation. Capture biases occur for management bears because traps were set only once a conflict occurred and removed after the animal was captured. Point estimates for human caused mortality occurring on public lands in the U.S. and British Columbia decreased from 1983–1998 to 1999–2013. This apparent decrease in mortality rates on public lands is particularly noteworthy given the increase in overall mortality rates. Implementation of access management on U.S. public lands could be a factor in this apparent decline.

Table 12. Survival and cause-specific survival rates of native radio collared grizzly bears ≥2 years old by location of death based on censored telemetry data in the Cabinet–Yaak recovery zone, 1983–2013.

Parameter	1983–1998	1999–2013
Individuals / bear-years	23 / 48.9	35 / 44.4
Survival[b] (95% CI)	0.899 (0.819–0.979)	0.864 (0.770–0.958)
Mortality rate by location and cause		
Public / natural	0	0.020
U.S. public / human	0.061	0.039
U.S. private / human	0	0.058
B.C. public / human	0.040	0.019
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 15 augmentation grizzly bears from 1990–2013. Bears that left the area, but did not die were censored. Eleven female and four male 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. Survival for augmentation bears was 0.825 (95% CI 0.661–0.989, n=15) with 1 instance of natural mortality, 1 poaching, and 1 train collision among 15 radio-collared bears monitored for 15.5 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.

Management Grizzly Bear Survival and Cause-Specific Mortality

Kaplan-Meier survival and cause-specific mortality rates were calculated for 7 management grizzly bears from 2003–13. All bears were males aged 2–5, but were pooled for this calculation because of small sample size. Survival rate was 0.480 (95% CI 0.141–0.819, n=7) with 1 instance of mistaken identity, 1 defense of life, and 1 unknown but human-caused mortality among 7 radio-collared bears monitored for 4.0 bear-years. All mortality occurred during autumn.

Native Grizzly Bear Reproduction

Mean age of first parturition among native grizzly bears was 6.2 years (95% CI; 5.7–6.7, n=6, Table 13). Three of four bears used in the calculation were radio-collared from ages 2–8. The fourth individual was captured with a cub at age 6 years old. We assumed this was her first reproductive event given her age. Two other first ages of reproduction were established through genetic parentage analysis and known age of offspring. Sex ratio of 13 bears captured as cubs or yearlings was 9 females and 4 males. Eighteen litters comprised of 37 cubs were observed through monitoring radio-collared bears, for a mean litter size of 2.06 (95% C.I. 1.93–2.27, n=18, Table 13). Three radio-collared adult female bears provided 7 complete inter-birth intervals (Table 13). One female experienced two successive instances of 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 was treated as an interval from cub birth to cub birth of 3 years. Subsequent one year intervals between births were not counted as intervals though cub mortality was counted in cub survival calculations. Mean inter-birth interval would be calculated as 2.71 years (95% C.I. 2.0–3.4, n=7) using these respective calculations of birth interval. 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 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 0.372 female cubs/year/adult female (95% C.I. 0.279–0.490, n=7 adult females, Table 13). In all calculations the sex ratio of cubs born was assumed to be 1:1.

Table 13. Radio collared grizzly bear reproductive information from the Cabinet-Yaak 1983–2013.

Bear	Year	Cubs	Age at first reproduction	Reproductive Interval[1]	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 dead in 2007
106	1999	2		-	♀ #106 and 2 cubs dead in 1999
206	1994	2	6	3	♀ #505
206	1997	2		-	♀ #596 dead in 1999, ♀ #592 dead in 2000
538	1997	1	6	3	1 yearling 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
303	2010	3		-	1 cub dead in 2010
354	2002		5		Genetic data indicated reproduction of at least two cubs in 2000
353	2002	3		-	♀ #353 dead in 2002, 3 cubs (1 female) all assumed dead in 2002
772	2003		6		Genetic data indicated reproduction of at least one cub in 2003
772	2007	2	6	-	♀ #789, ♂ #791
675	2009	2	7	-	2 cubs dead in 2009
675	2010	1		-	1 cub dead in 2010

[1]Number of years from birth to subsequent birth.

Population Trend

Approximately 90% of the data used in population trend calculations came from bears monitored in the Yaak River portion of this population, hence this result is most indicative of that portion of the recovery area. The estimated finite rate of increase (l) for 1983–2013 using Booter software with the unpaired litter size and birth interval data option was 1.000 (95% C.I. 0.907–1.076, Table 14). Finite rate of change in the population was an annual 0.0% for the period. Subadult female survival and adult female survival accounted for most of the uncertainty in l , with reproductive rate, yearling survival, cub survival, and age at first parturition contributing much smaller amounts. The sample sizes available to calculate population trend are small and small sample sizes yield wide confidence intervals around any calculated estimate of trend (i.e., l). The probability that the population was declining was 50%.

Sample size concerns limited calculation of point estimates of cumulative annual rate of change until 1998 (Fig. 9). Finite rates of increase calculated for the period 1983–1998 (l = 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 2013, adult female survival and subadult female survival had increased to 0.943 and 0.814 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 14. 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, 1983–2013.

Parameter	Sample size	Estimate (95% CI)	SE	Variance (%)[a]
Adult female survival[b] (S_a)	10 / 35.0[c]	0.943 (0.849–1.0)	0.041	33.0
Subadult female survival[b] (S_s)	15 / 21.0[c]	0.814 (0.631–0.957)	0.085	50.3
Yearling survival[b] (S_y)	23 / 11.9[c]	0.880 (0.629–1.0)	0.111	4.2
Cub survival[b] (S_c)[d]	32/32	0.571 (0.400–0.743)	0.084	5.7
Age first parturition (*a*)	6	6.2 (5.7–6.7)	0.284	1.1
Maximum age (*w*)	Fixed	27		
Unpaired Reproductive rate (*m*)[e]	7/7/17[f]	0.372 (0.279–0.490)	0.055	5.7
Unpaired Lambda (l)	5000 bootstrap runs	1.000 (0.907–1.076)	0.043	

[a] Percent of lambda explained by each parameter
[b]Booter survival calculation which may differ from Kaplan-Meier estimates
[c]individuals / bear-years
[d]Cub survival based on counts of individuals alive and dead
[e]Number of female cubs produced/year/adult female. Sex ratio assumed to be 1:1.
[f]Sample size for individual adult females / sample size for birth interval / sample size for litter size

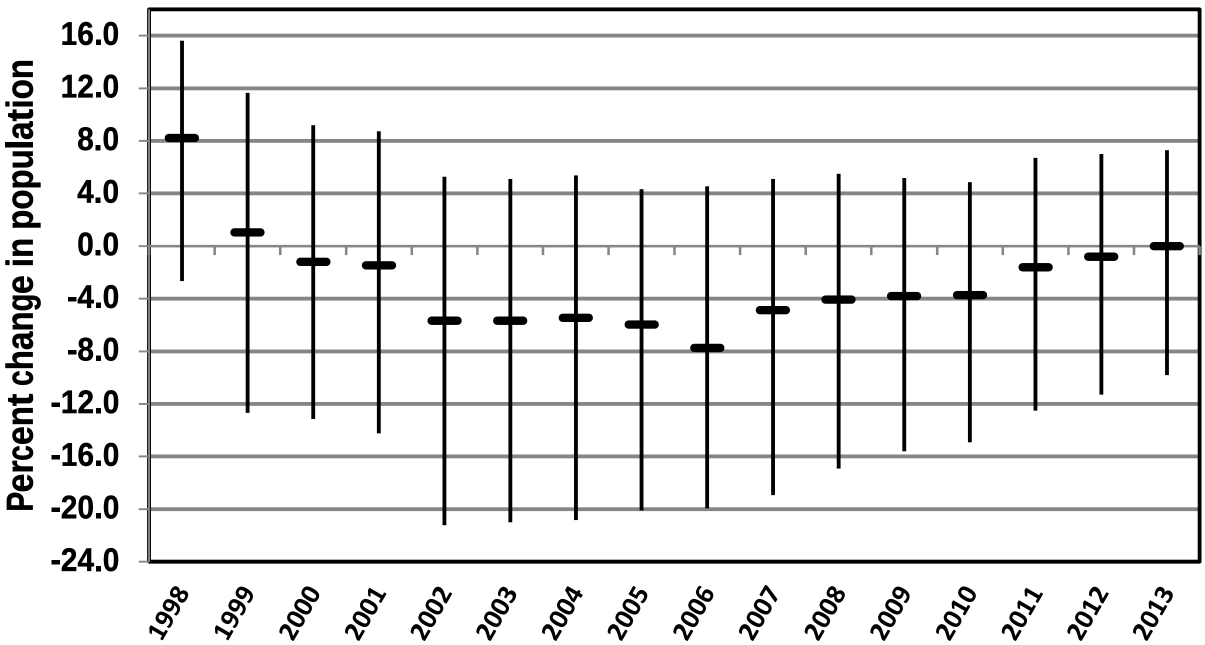


Figure 9. Point estimate and 95% confidence intervals for cumulative annual calculation of population rate of change for native grizzly bears in the Cabinet-Yaak recovery area, 1983–2013. Each entry represents the annual rate of change from 1983 to that date.

Capture and Marking

Cabinet Mountains

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 initiated to recapture relocated bears in order to determine success of the population augmentation program and capture any native bears in the Cabinet Mountains. During 1983–2011, 7,336 trap-nights were expended to capture 9 individual grizzly bears and 301 individual black bears (Table 15 and 18, Fig. 10). Rates of capture by individual were 1 grizzly bear/815 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.

Yaak River

Trapping was conducted in the Yaak portion of the CYGBRZ during 1986–87 as part of a black bear graduate research study (Thier 1990). Trapping was continued from 1989–2013 by the U.S. Fish and Wildlife Service. Eighty-three captures of 43 individual grizzly bears and 483 captures of 405 individual black bears were made during 9,465 trap-nights during 1986–2013 (Tables 15 and 18, Fig. 10). Rates of capture by individual were 1 grizzly bear/220 trap-nights and 1 black bear/23 trap-nights.

Trapping effort was concentrated in home ranges of known bears during 1995–2013 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

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 15, 16).

Moyie River and Goat River Valleys North of Highway 3, British Columbia

Eight grizzly bears and 32 black bears were captured in the Moyie and Goat River valleys north of Highway 3 in BC in 2004-08 (Table 15 and Fig. 10). Trapping was conducted in cooperation with M. Proctor (Birchdale Ecological Consultants) and BC Ministry of Environment. Rates of capture by individual were 1 grizzly bear/32 trap-nights and 1 black bear/8 trap-nights.

Population Linkage Kootenai River Valley, Montana

Twelve black bears were captured and fitted with GPS radio collars during 2004-07 to determine bear crossing patterns of the Kootenai River valley near the junction of Highway 2 and 508. These captures were distributed north (6 females and 3 males) and south of the Kootenai River (1 female and 2 males).

Population Linkage Clark Fork River Valley, Montana

Seventeen black bears were captured and fitted with GPS radio collars in the Clark Fork River Valley during 2008–11 to examine bear crossing opportunities near the junction of Highways 200 and 56. Eleven of these bears (3 females and 8 males) were north of the Clark Fork River and 6 bears (6 males) south of the river.

Population Linkage Interstate 90 Corridor, Montana and Idaho

In 2011 and 2012, we collared black bears with GPS radio collars along I-90 between St. Regis, MT and the MT-ID border (near Lookout Pass). Twenty bears were captured 23 times during 446 trap-nights of effort, resulting in 19 trap-nights/capture (Table 15). A total of 16 bears were collared (15 in Montana, 1 in Idaho). Eight of the bears (2 females and 6 males) were collared north of the interstate highway and 8 (3 females and 5 males) were collared south of the highway.

Population Linkage Highway 95 Corridor, Idaho

We began an effort in 2011 to collar black bears with GPS radio collars along Highway 95 between Bonners Ferry and Sandpoint, Idaho. The effort centered on the McArthur Lake State Wildlife Management Area. Nineteen black bears were captured during 413 trap-nights of effort, or 22 trap-nights/capture (Table 15). Fourteen bears were collared. Nine of those bears (4 females and 5 males) were collared west of the highway, and 5 (5 males) were east of the highway.

Selkirk Mountains, Idaho

We conducted research trapping in the Selkirk Mountains of Idaho in 2012–13. Trapping effort was centered northwest of Priest Lake, ID. Seven female grizzly bears (5 adults, 2 subadults) were trapped and GPS radio-collared (Table 15). Six black bears (28 trap-nights/capture) were also captured.

Table 15. Capture effort and success for grizzly bears and black bears within project study areas, 1983–2013.

Area / Year(s)	Trap-nights	Grizzly Bear Captures	Black Bear Captures	Trap-nights / Grizzly Bear	Trap-nights / Black Bear
Cabinet Mountains,1983–11					
Total Captures	7336	12	418	611	18
Individuals[1]	7336	9	301	815	24
Salish Mountains, 2003[1]	63	1	5	63	13
Yaak River South Hwy 3, 1986–13					
Total Captures	9465	83	483	114	20
Individuals[1]	9465	43	405	220	23
N. Hwy 3, BC 2004–08					
Total Captures	259	9	37	29	7
Individuals[1]	259	8	32	32	8
Interstate 90, 2011–12					
Total Captures	446	0	23	0	19
Individuals[1]	446	0	20	0	22
Hwy 95, ID, 2011					
Total Captures	408	0	19	0	21
Individuals[1]	408	0	19	0	21
Selkirks, ID, 2012–13					
Total Captures	187	7	6	27	31
Individuals[1]	187	7	6	27	31

[1]Only captures of individual bears included. Recaptures are not included in summary.

Table 16. Grizzly bear capture information from the Cabinet-Yaak, Purcell, and Selkirk Mountain populations, 1983–2013. Multiple captures of a single bear during a given year are not included.

Bear	Capture Date	Sex	Age (Est.)	Mass kg (Est.)	Location	Capture Type
678	6/29/83	F	28	86	Bear Cr., MT	Research
680	6/19/84	M	11	(181)	Libby Cr., MT	Research
680	5/12/85	M	12	(181)	Bear Cr., MT	Research
678	6/01/85	F	30	79	Cherry Cr., MT	Research
14	6/19/85	M	27	(159)	Cherry Cr., MT	Research
101	4/30/86	M	(8)	(171)	N Fk 17 Mile Cr., MT	Research
678	5/21/86	F	31	65	Cherry Cr., MT	Research
106	5/23/86	F	8	92	Otis Cr., MT	Research
128	5/10/87	M	4	(114)	Lang Cr., MT	Research
129	5/20/87	F	1	32	Pheasant Cr., MT	Research

Bear	Capture Date	Sex	Age (Est.)	Mass kg (Est.)	Location	Capture Type
106	6/20/87	F	9	(91)	Grizzly Cr., MT	Research
134	6/24/87	M	8	(181)	Otis Cr., MT	Research
129	7/06/89	F	3	(80)	Grizzly Cr., MT	Research
192	10/14/8	M	1	90	Large Cr., MT	Research
193	10/14/8	M	1	79	Large Cr., MT	Research
193	6/03/90	M	2	77	Burnt Cr., MT	Research
206	6/03/90	F	2	70	Burnt Cr., MT	Research
106	9/25/90	F	12	(136)	Burnt Cr., MT	Research
206	5/24/91	F	3	77	Burnt Cr., MT	Research
244	6/17/92	M	6	140	Yaak R., MT	Research
106	9/04/92	F	14	144	Burnt Cr., MT	Research
34	6/26/93	F	(15)	158	Spread Cr., MT	Research
206	10/06/9	F	5	(159)	Pete Cr., MT	Research
505	9/14/94	F	Cub	45	Jungle Cr., MT	Research
302	10/07/9	M	1	95	Cool Cr., MT	Research
303	10/07/9	F	1	113	Cool Cr., MT	Research
106	9/20/95	F	17	(169)	Cool Cr., MT	Research
353	9/20/95	F	Cub	43	Cool Cr., MT	Research
354	9/20/95	F	Cub	47	Cool Cr., MT	Research
302	9/24/95	M	2	113	Cool Cr., MT	Research
342	5/22/96	M	4	(146)	Zulu Cr., MT	Research
363	5/27/96	M	4	(158)	Zulu Cr., MT	Research
303	5/27/96	F	3	(113)	Zulu Cr., MT	Research
355	9/12/96	M	(6)	(203)	Rampike Cr., MT	Research
358	9/22/96	M	8	(225)	Pete Cr., MT	Research
353	9/23/96	F	1	83	Cool Cr., MT	Research
354	9/23/96	F	1	88	Cool Cr., MT	Research
384	6/12/97	M	7	(248)	Zulu Cr., MT	Research
128	6/15/97	M	14	(270)	Cool Cr., MT	Research
386	6/20/97	M	5	(180)	Zulu Cr., MT	Research
363	6/26/97	M	5	(180)	Cool Cr., MT	Research
538	9/25/97	F	6	(135)	Rampike Cr., MT	Research
354	9/27/97	F	2	99	Burnt Cr., MT	Research
354	8/20/98	F	3	(90)	Cool Cr., MT	Research
106	8/29/98	F	20	(146)	Burnt Cr., MT	Research
363	8/30/98	M	6	(203)	Burnt Cr., MT	Research
342	9/17/98	M	6	(203)	Clay Cr., MT	Research
303	9/21/98	F	5	(113)	Clay Cr., MT	Research
592	8/17/99	F	2	(91)	Pete Cr., MT	Research
596	8/23/99	F	2	(91)	French Cr., MT	Research
358	11/15/9	M	11	279	Yaak R., MT	Management, open freezer, killed goats
538	7/16/00	F	9	(171)	Moyie River, BC	Research
552	7/16/01	F	1	(36)	Copeland Cr., MT	Research
577	5/22/02	F	1	23	Elk Cr., MT	Management, pre-emptive move
578	5/22/02	M	1	23	Elk Cr., MT	Management, pre-emptive move
579	5/22/02	M	1	30	Elk Cr., MT	Management, pre-emptive move
353	6/15/02	F	7	(136)	Burnt Cr., MT	Research
651	9/25/02	M	7	(227)	Spread Cr., MT	Research
787	5/17/03	M	3	71	Deer Cr. ID	Management, garbage feeding
342	5/23/03	M	11	(227)	Burnt Cr., MT	Research
648	8/18/03	F	5	(159)	McGuire Cr., MT, Salish Mtns.	Research
244	9/25/03	M	17	(205)	N Fk Hellroaring Cr., MT	Research
10	6/17/04	F	11	(159)	Irishman C., BC	Research
11	6/20/04	M	7	(205)	Irishman C., BC	Research
12	7/22/04	F	11	(148)	Irishman C., BC	Research
576	10/21/0	M	2	(114)	Young Cr., MT	Management, garbage feeding

Bear	Capture Date	Sex	Age (Est.)	Mass kg (Est.)	Location	Capture Type
675	10/22/0	F	2	100	Young Cr., MT	Management, pre-emptive move
677	5/13/05	M	6	105	Canuck Cr., BC	Research
688	6/13/05	M	3	93	EF Kidd Cr., BC	Research
576	6/17/05	M	3	133	Teepee Cr., BC	Research
690	6/17/05	F	1	52	EF Kidd Cr., BC	Research
17	6/18/05	M	8	175	Norge Pass, BC	Research
2	6/20/05	M	7+	209	EF Kidd Cr., BC	Research
292	7/6/05	F	4	(114)	Mission Cr., ID	Research
694	7/15/05	F	2	73	Kelsey Cr., MT	Research
770	9/20/05	M	11	(250)	Chippewa Cr., MT	Research
M1	10/4/05	M	(2)	(80)	Pipe Cr., MT	Management, garbage feeding
668	10/11/0	M	3	120	Yaak R., MT	Management, garbage feeding
103	5/23/06	M	3	125	Canuck Cr., BC	Research
---	5/28/06	F	4	(125)	Cold Cr., BC (Trap predation)	Research
5381	6/6/06	M	4	(200)	Hellroaring Cr., ID	Research
651	6/28/06	M	11	198	Cold Cr., BC	Research
780	9/22/06	M	6	(250)	S Fk Callahan Cr., MT	Research
119	4/21/07	M	19	205	Duck Lake, BC	Research
130	6/18/07	F	26	113	Arrow Cr., BC	Research
131	6/28/07	F	(5)	(80)	Arrow Cr., BC	Research
784	9/23/07	F	1	(80)	Spread Cr., MT	Research
772	9/18/07	F	10	116	Pilgrim Cr., MT	Management, fruit trees
789	9/18/07	F	Cub	36	Pilgrim Cr., MT	Management, fruit trees
791	9/18/07	M	Cub	39	Pilgrim Cr., MT	Management, fruit trees
785	10/15/0	F	1	75	Pete Cr., MT	Research
138	5/20/08	F	2	100	Corn Cr., BC	Research
144	6/16/08	M	12	(205)	Next Cr., BC	Research
150	6/21/08	F	7	71	Elmo Cr., BC	Research
151	6/23/08	F	20	82	Cultus Cr., BC	Research
155	6/27/08	M	11	(170)	Next Cr., BC	Research
675	5/23/09	F	7	89	Elmer Cr. BC	Research
149	6/12/09	M	10	216	Wildhorse Cr., BC	Research
161	6/15/09	F	18	82	Wildhorse Cr., BC	Research
163	6/16/09	F	7	(102)	Wildhorse Cr., BC	Research
8005	6/16/09	F	4	(90)	Salmo River, BC	Management, pig feed
165	6/19/09	F	14	(80)	Apex Cr., BC	Research
169	6/23/09	F	20	(80)	Wildhorse Cr., BC	Research
171	6/25/09	F	14	91	Seaman Cr,, BC	Research
784	7/24/09	F	3	(136)	Hensley Cr., MT	Research
731	9/17/09	F	2	(125)	Fowler Cr., MT	Research
5381	11/21/0	M	4	(273)	Kidd Cr., BC	Research
799	5/21/10	M	3	(102)	Rock Cr., MT	Research
177	6/22/10	F	9	84	Hidden Cr., BC	Research
183	6/29/10	F	11	102	Sheep Cr., BC	Research
737	7/21/10	M	4	129	Messler Cr., MT	Research
1374	8/30/10	M	2	98	Young Cr., MT	Management, garbage feeding
1017	9/17/10	M	3	100	Nelson Golf Course, BC	Management, non-target capture
154	9/18/10	M	(4)	(91)	Summit Cr., BC	Research
7	9/25/10	F	13	132	Nelson Golf Course, BC	Management, grease bin
726	5/24/11	M	2	77	Meadow Cr., MT	Research
152	5/26/11	M	10	148	Cottonwood Cr., BC	Research
149	5/31/11	M	12	>205	Cottonwood Cr., BC	Research
722	5/31/11	M	12	261	Otis Cr., MT	Research
201	6/13/11	M	5	91	St. Mary River, BC	Research
202	6/14/11	M	4	76	St. Mary River, BC	Research
203	6/16/11	M	5	77	Dewar Cr., BC	Research

Bear	Capture Date	Sex	Age (Est.)	Mass kg (Est.)	Location	Capture Type
729	6/18/11	F	1	33	Beulah Cr., MT	Research
204	6/18/11	M	5	122	Dewar Cr., BC	Research
205	6/18/11	M	??	168	Dewar Cr., BC	Research
724	7/13/11	M	2	159	Graves Cr., MT	Management, killed pigs
2	8/19/11	M	26	178	Creston Valley, BC	Research
732	10/27/1	M	5	139	Otis Cr., MT	Management, killed chickens
174	5/25/12	M	6	84	Cottonwood Cr., BC	Research
166	5/30/12	M	3	56	Cottonwood Cr., BC	Research
170	6/5/12	M	6	130	Salmo River, BC	Management, cat food
183	6/8/12	F	11	--	Lost Cr., BC	Research
204	6/23/12	M	6	132	St. Mary River, BC	Research
729	6/26/12	F	2	(80)	Pipe Cr., MT	Research
201	6/29/12	M	6	95	St.Mary River, BC	Research
1200	8/15/12	F	8	111	Trapper Cr. ID	Research
156	8/17/12	M	2	125	Creston Valley, BC	Management, fruit trees
1200	8/26/12	F	15	114	Trapper Cr. ID	Research
1200	8/29/12	F	2	60	Trapper Cr. ID	Research
221	8/29/12	M	4	149	Creston Valley, BC	Research
737	9/19/12	M	6	(159)	Basin Cr., MT	Research
552	9/24/12	F	12	(136)	Basin Cr., MT	Research
219	5/19/13	F	(10)	85	Dewar Cr., BC	Research
223	5/20/13	M	(7)	144	Dewar Cr., BC	Research
225	5/22/13	M	(11)	181	Dewar Cr., BC	Research
210	5/27/13	M	(11)	158	Dewar Cr., BC	Research
226	6/6/13	F	(6)	115	Creston Valley, BC	Management, frequenting dump
228	6/14/13	F	(7)	103	Meachen Cr., BC	Research
826	6/28/13	M	(5)	(136)	Pipe Cr., MT	Research
1301	7/22/13	F	(1)	58	Trapper Cr., ID	Research
303	7/23/13	F	20	132	Pipe Cr., MT	Research
1302	7/30/13	F	(5)	76	Bugle Cr., ID	Research
1302	7/30/13	F	(8)	94	Trapper Cr., ID	Research
1201	8/23/13	F	(8)	104	Grass Cr., ID	Research

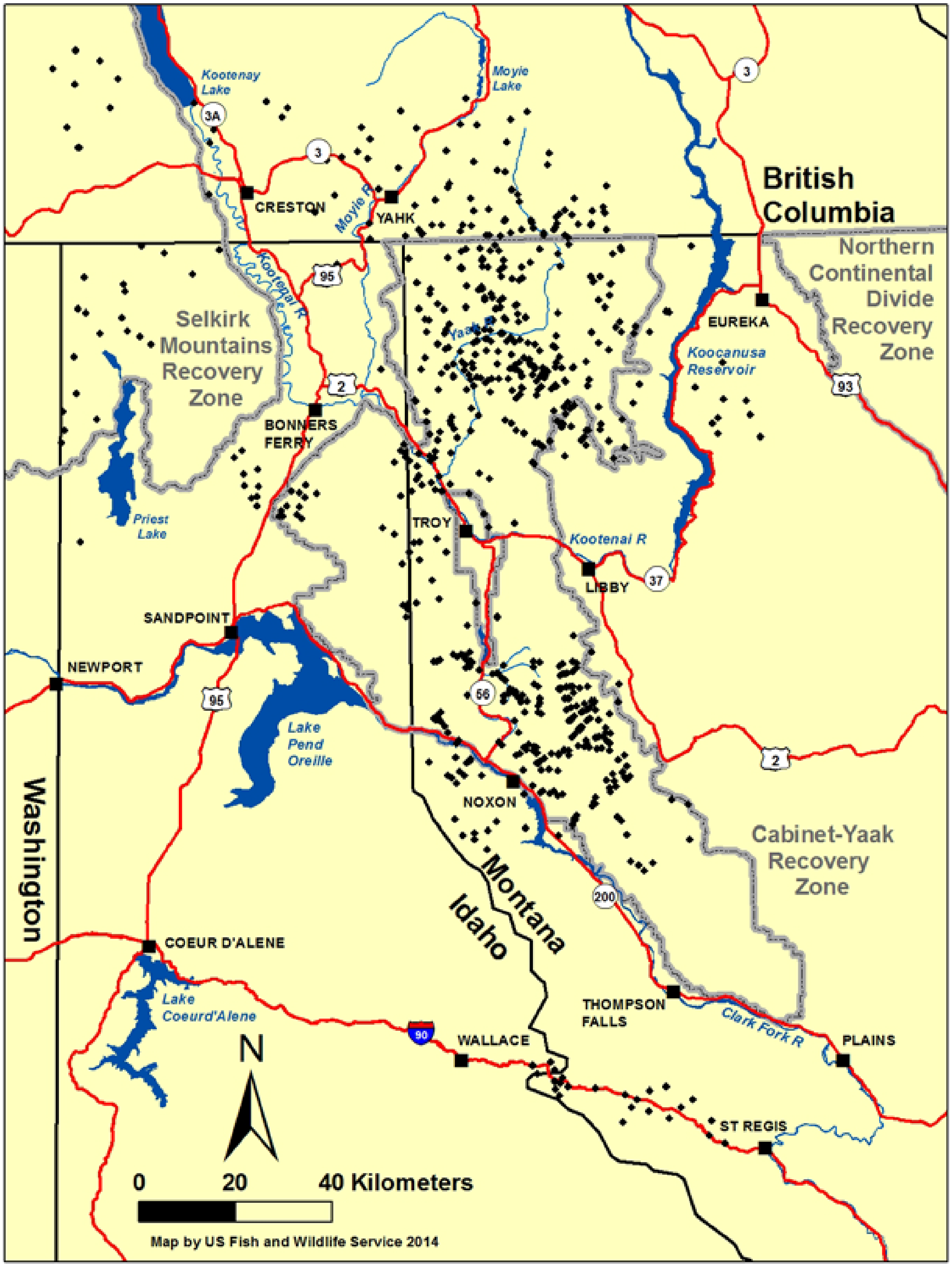


Figure 10. Trap site locations in the Cabinet-Yaak and Selkirk Mountains study areas 1983–2013.

Cabinet Mountains Augmentation Captures Flathead River, Montana and British Columbia

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. A transplanted bear 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. 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 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 state personnel and released in the same area near Spar Lake with a GPS radio collar. 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 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 GPS radio collars. In October 2008 both of these bears were killed. In September 2009 an adult female from Big Creek in the North Fork of the Flathead River drainage was released in the Spar Lake area. In July 2010, two subadult bears, a male (5-year-old) and a female (4-year-old), were transplanted to the Cabinet Mountains. A male from Dead Horse Creek was released near Spar Lake and a female from Spruce Creek was released at Silverbutte Creek. Two, 2 year old bears were released in 2011. A female (725) from Puzzle Creek in the Middle Fork of the Flathead River drainage was released near Spar Lake and a male (723) from Stryker Ridge, near Antice Creek was also released near Spar Lake. A 2-year-old male grizzly bear (918) was caught in the East Fork of Swift Creek and was moved to the Cabinet Mountains during 2012 and released in the East Fork of the Bull River. In late July 2013, a 3-year-old male grizzly bear (919) was released west of Spar Lake. This bear was captured in Coal Creek within the North Fork Flathead drainage. A short history of these bears follows later in this report.

Radio Telemetry Monitoring

Black Bear – Linkage Research

We previously collected radio collar data for black bears on three study areas around Highways 3 in BC (18 bears), Highway 2 in northwest Montana(16 bears), and Highway 95 in northern Idaho (23 bears, Lewis 2007) (Fig. 11). We are planning a comprehensive RSF analysis that will examine habitat variables associated with telemetry data from to identify probable linkage areas across highways for black bears.

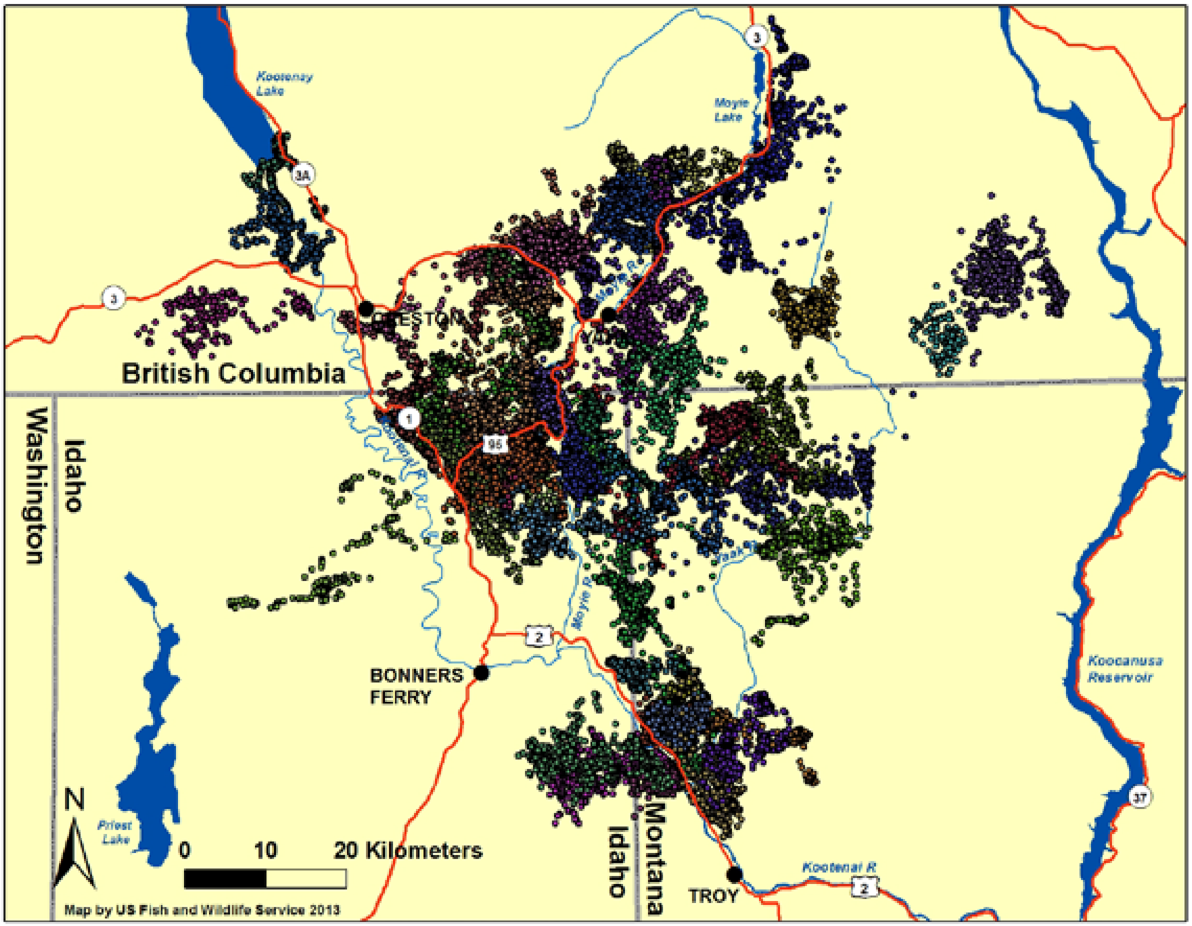


Figure 11. Telemetry locations from 57 collared black bears along Highways US 2, BC 3, and US 95 in southeast British Columbia, north Idaho, and northwest Montana during 2004–2011.

We completed black bear monitoring on 3 additional study areas during 2012. The Clark Fork / Highway 200 study area is near the confluence of the Bull River and Clark Fork Rivers near Noxon, Montana. The Lookout Pass / Interstate 90 study area is between St. Regis, Montana and Wallace, Idaho. The McArthur Lake / Highway 95 study area is 15 miles south of Bonners Ferry, Idaho.

In the Clark Fork River / Highway 200 study area we retrieved collars during October from 4 black bears that wore collars from 2011–12. These monitoring data have been added to previously collected data from another 10 black bears collared during 2008–11. All collar data has been entered in a database and has been reviewed. Initial analysis and summary is complete and files were prepared for RSF modeling (Fig.12). Telemetry data indicated that 2 of these animals crossed Highway 200 and two other bears crossed Highway 56.

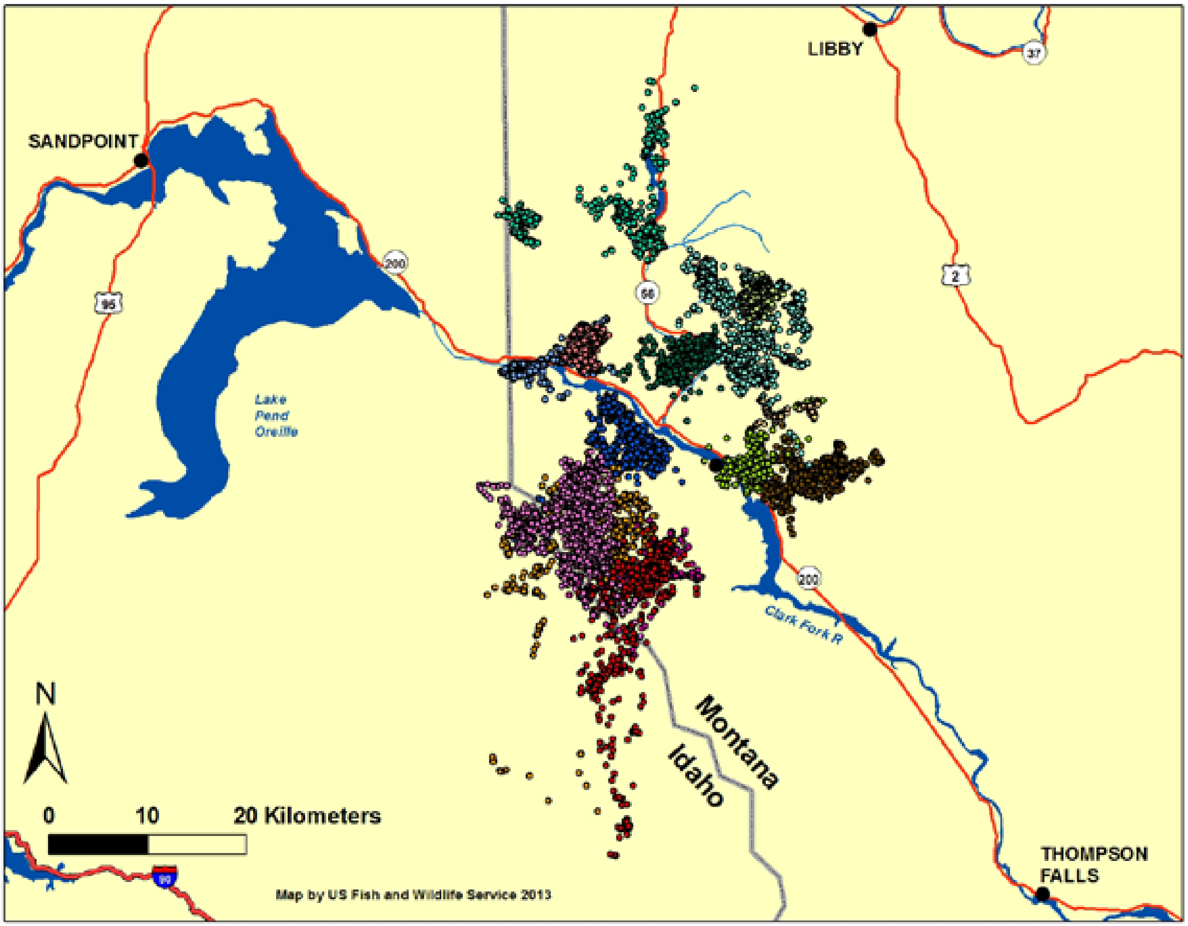


Figure 12. Telemetry locations from 14 black bears collared near Highways 200 and 56 near the Idaho-Montana border during 2008–12.

Fourteen radio collars were placed on black bears in the I-90 study site near Lookout Pass during 2011. Several collared black bears were lost to hunter harvest during the fall of 2011 and the spring of 2012 and two additional collars were placed on bears in 2012 as replacements. One collar and data were lost when a hunter accidentally shot the radio collar while attempting to kill a bear. Fifteen collars were retrieved in October of 2012 and that data has been prepared for RSF analysis (Fig. 13). Monitoring dated indicated that four bears crossed I-90 and one of these moved north and crossed Highway 200.

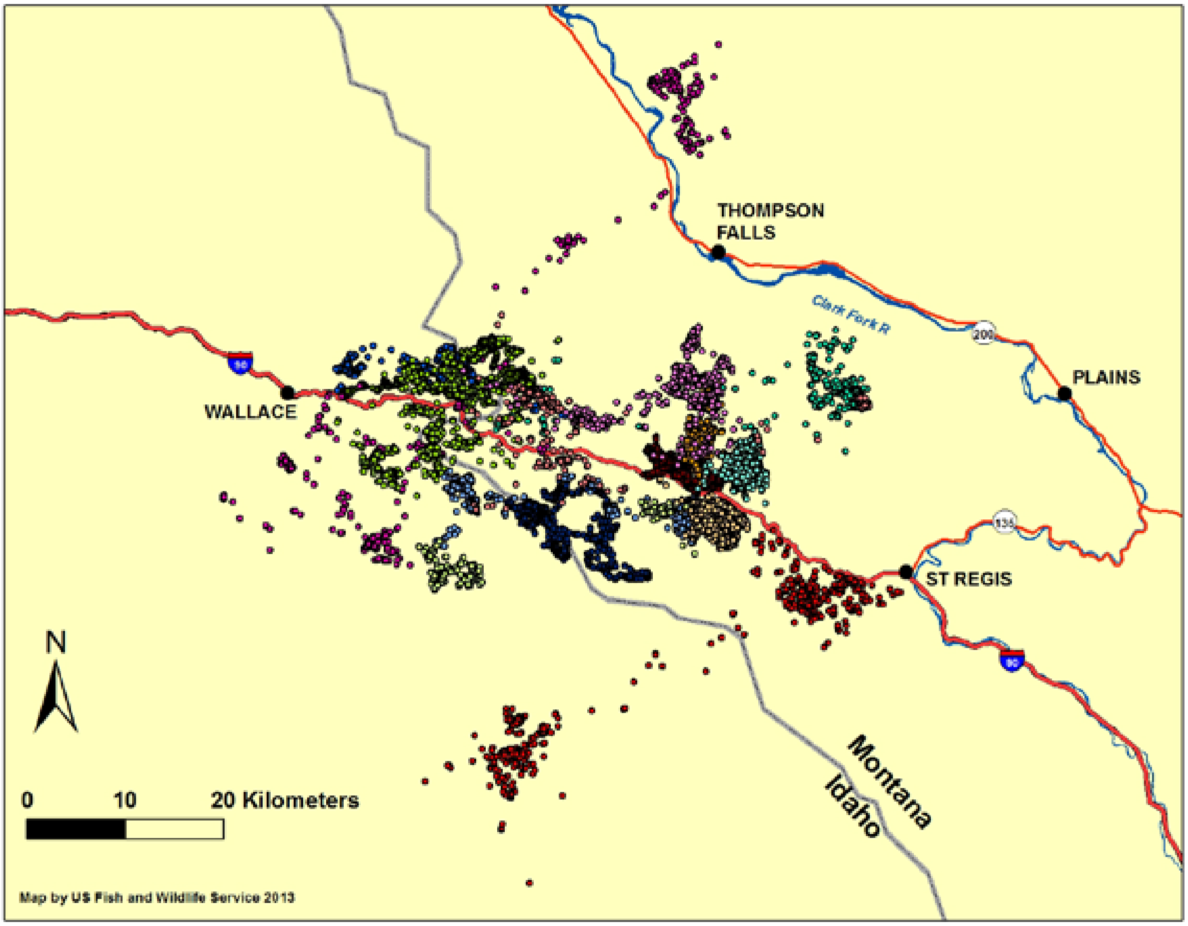


Figure 13. Telemetry locations from 15 black bears collared along Interstate 90 near the Idaho-Montana border during 2011–12.

Fourteen collars were placed on black bears along Highway 95 near McArthur Lake in 2011. No animals were harvested by hunters in 2011, but one bear was killed by hunters in 2012. Another bear was killed by a neck snare set for coyotes in 2012 and a third bear was found dead and is under investigation by IDFG. Data from collars has been initially analyzed and prepared for RSF analysis (Fig. 14). Monitoring data indicated that two of these animals crossed Highway 95.

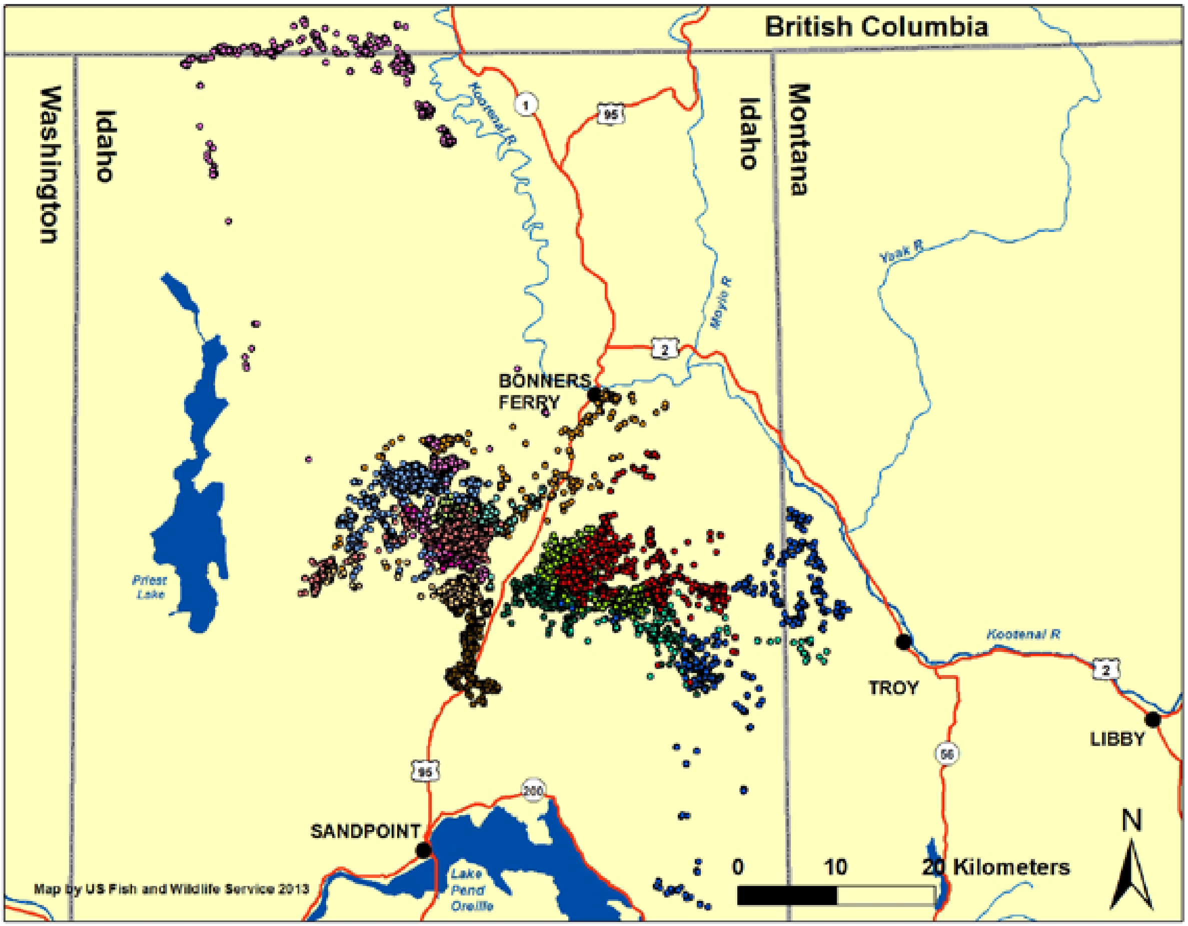


Figure 14. Telemetry locations from 14 collared black bears near highway 95 in north Idaho during 2011–12.

Our analysis will be combined with data from Highways BC 3, US 95 north, and US 2. The comprehensive RSF analysis will examine habitat variables associated with telemetry data from 99 black bears collared from all highways and attempt to identify probable linkage areas across highways for black bears. We will use a suite of seamless GIS layers, and will identify key variables that depict black bear linkage habitat. Ultimately, we will compare these results with grizzly bear linkage habitat. All data (GPS bear locations, layers, etc.) has been organized and analysis is underway.

Our goal in comparing grizzly and black bear linkage areas across major highways was to determine the ability of black bears to potentially act as surrogates for grizzly bears in areas where grizzly bear data is lacking (i.e., Highway I-90). Another goal is to identify black bear linkage areas to initiate development of a multi-species approach in linkage management.

Monitoring Summary of Native Adult Female Grizzly Bears and each Augmentation 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 with the core of her range in 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 Clark Fork River into the Cabinet Mountains. 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 Midas Creek. 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. 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 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 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 MFWP Laboratory in Bozeman for analysis. MFWP 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 North Fork of the Flathead River on 14 July 1993. She was released in Lost Girl Creek 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 north along the crest of the Cabinet Mountains about 25 km and then returned to the release site vicinity. These movements occurred over 7-8 days. Bear 286 denned during early November of 1993 in Snowshoe Creek at 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 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, 2007, and 2009 hair from this bear was collected in the Cabinet Mountains at hair snag sites and identified by DNA analysis. This analysis also identified at least 9 offspring. In 2009, she was shot by an elk hunter in a reported case of self-defense.

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 MFWP 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 lost 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 MFWP 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 MFWP 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 MFWP 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 valid black bear tag and 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 MDFWP personnel. She was released on 18 September near Spar Lake. She was monitored until she denned in the West Cabinet Mountains in late November. She emerged in late April and her signal was lost in late May 2010. On 5 August she was located northeast of Big Mountain ski area near where she was originally captured in 2009.

Grizzly 713—This subadult male (~3-4 years old) was captured on 18 July 2010 in the Dead Horse Cr. drainage of the North Fork of the Flathead River by MDFWP personnel. He was released on 18 July near Spar Lake. He moved extensively through the Cabinet Mountains, crossed the Kootenai River moving north, and used the Fisher River drainage during 2010 and prior to denning in November of 2010 on the east side of the Cabinet Mountains. He made extensive movements east during 2011 into the Fisher River before returning to the Cabinet Mountains in August and lost his radio collar on the east side of the Cabinet Mountains. During 2012 bear 713 was recaptured in the North Fork of the Flathead River.

Grizzly 714—This subadult female (~3-4 years old) was captured on 24 July 2010 in the Spruce Cr. drainage of the North Fork of the Flathead River by MDFWP personnel. She was released on 25 July at Silverbutte Creek. On 5 August she was located back in the North Fork near her original capture location.

Grizzly 725—This subadult female (~2 years old) was captured on 25 July 2011 in the Puzzle Cr. Drainage of the Middle Fork of the Flathead River By MDFWP personnel. She was released on 26 July near Spar Lake. In August she moved north of the Kootenai River and in September she crossed Koocanusa Reservoir moving first to the Whitefish Range and then into Glacier National Park. She denned near upper Quartz Lake within Glacier National Park during the winter of 2011-12. In 2012 she left her den and moved northeast across the continental divide into Waterton National Park in Alberta. During July of 2012 she reversed he course and moved back to the West Cabinet Mountains along much of the same path she used in 2011. During the winter of 2012-13 she denned within 5 km of the 2011 release site near Spar Lake. Bear 725 repeated her move from the Cabinet Mountains to Waterton National Park in Alberta and returned to the Cabinet Mountains during 2013. She lost her radio collar during October of 2013 within 3 km of the 2011 release site. The distance between extreme location points in the Cabinet Mountains to Waterton Park was approximately 300 km.

Grizzly 723—This subadult male (2 years old) was captured on 18 August 2011 on Stryker Ridge in the Antice Creek drainage of the Whitefish River by MDFWP personnel. He was released on 19 August 2011 near Spar Lake. In late September he moved into the east Cabinet Mountains and denned in November. He emerged from the den in April of 2012, but lost his radio collar in late June.

Grizzly 918— This subadult male (2 years old) was captured on 8 July 2012 on Stryker Ridge in the Antice Creek drainage of the Whitefish River by MDFWP personnel. He was released on the following day in the East Fork of the Bull River near Snake Creek Pass. He denned in the Cabinet Mountains during 2012 and 2013.

Grizzly 919— This subadult male (4 years old) was captured on 30 July 2013 in Coal Creek drainage of the North Fork of the Flathead River by MDFWP personnel. He was released on the following day near Spar Lake. In late October he moved into the east Cabinet Mountains and denned in 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, she was observed with two cubs and was identified by her ear streamers.

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 on 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. Her yearling female was captured on June 2011. Bear 303 was monitored via that collar until the family group denned in 2012. She was captured and fitted with a radio collar on 23 July of 2013 shortly after family group break up.

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 as part of a management action though she was not believed to be the conflict animal. She was released in the Northwest Peaks area as a preemptive move 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. In 2010 she produced one cub, but lost it in early June.

Grizzly 552—This female was captured as a yearling in July of 2001 and fitted with an ear tag transmitter. The transmitter came off the bear in August of the same year. She was recaptured in September of 2012 and was accompanied by two yearlings. During 2013 this family separated and bear 552 was seen in the company of a courting male during June.

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 Monitoring and Home Ranges

Eight grizzly bears were monitored by GPS radio collars during portions of 2013. Research monitoring included three females (two adults and 1 subadult) and two males (2 adults) in the Yaak River and one female (subadult) and three males (subadults) in the Cabinet Mountains. Three bears from the Cabinet Mountains (2 subadult males and 1 subadult female) were part of the augmentation program

Specific and general locations were obtained on collared bears, but only aerial, specific locations and GPS collar locations were used to calculate home ranges. The convex polygon life ranges were computed for bears monitored during 1983-2013 (Table 17 and Appendix 3 Figs. 32-131).

Native adult male life range averaged 1,540 km^2 (95% CI $\pm$ 375, n = 27) using the minimum convex polygon. Native adult female life range averaged 450 km^2 (95% CI $\pm$ 146, n = 25) using the minimum convex polygon estimator.

The minimum convex polygon estimator for bear 106 was 852 km^2 during her 1986–99 life time. Her home range was smallest during 1986, 1988, 1991, 1993, and 1995 when she had cubs. 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.

Table 17. Home range sizes of native (independent or family groups) and transplanted grizzly bears in the Cabinet-Yaak recovery zone, the Salish Mountains, the Selkirk Mountains of northern Idaho and southern British Columbia, and the Purcell Mountains of southern British Columbia 1983–2013.

Bear # and Sex	Years	Age (Est.)	Area of use	Collar Type	Radio Locations	100% Convex Polygon (km^2)
678 ♀	1983-89	28-34	Cabinet Mts, MT	VHF	173	658
680 ♂	1984-85	11-12	Cabinet Mts, MT	VHF	75	1,947
14 ♂	1985	27	Cabinet Mts, MT	VHF	23	589
101 ♂	1986	8	Yaak River, MT	VHF	38	787
106 ♀	1986-99	8-20	Yaak River, MT	VHF	379	852
128 ♂	1987-97	4-14	Yaak River, MT	VHF	204	2,895
129 ♀	1987-89	1-3	Yaak River, MT	VHF	42	60
134 ♂	1987-88	8-9	Yaak River, MT	VHF	20	594
192 ♂	1990	2	Yaak River, MT	VHF	10	574
193 ♂	1990	2	Yaak River, MT	VHF	34	642
206 ♀	1990-95	2-7	Yaak River, MT	VHF	208	1,332
218[1]♀	1990-91	5-6	Cabinet Mts, MT	VHF	95	541
244 ♂	1992-04	6-18	Yaak River, MT	VHF	158	1,406
258[1]♀	1992-93	6-7	Cabinet Mts, MT	VHF	54	400
286[1]♀	1993-94	2-3	Cabinet Mts, MT	VHF	82	266
311[1]♀	1994-95	3-4	Cabinet Mts, MT	VHF	16	209
302 ♂	1994-96	1-3	Yaak River, MT	VHF	60	514
303 ♀	1994-01, 2011-13	1-19	Yaak River, MT	GPS & VHF	11,122	468
342 ♂	1996-04	4-12	Yaak River, MT	VHF	134	1,653
355 ♂	1996	(6)	Yaak River, MT & BC	VHF	5	N/A
358 ♂	1996-98	8-10	Yaak River, MT & BC	VHF	55	1,442
363 ♂	1996-99	4-7	Yaak River, MT	VHF	120	538
386 ♂	1997-98	5-6	Yaak River, MT	VHF	29	1,895
354 ♀	1997-99	2-4	Yaak River, MT	VHF	70	537
538 ♀	1997-02	6-11	Yaak River, MT & BC	VHF	232	835
592 ♀	1999-00	2-3	Yaak River, MT & BC	VHF	59	471
596 ♀	1999	2	Yaak River, MT & BC	VHF	10	283
577 ♀	2002	1	Cabinet Mts, MT	VHF	11	2
578 ♂	2002	1	Cabinet Mts, MT	VHF	3	N/A
579 ♂	2002	1	Cabinet Mts, MT	VHF	10	5
353 ♀	2002	7	Yaak River, MT	VHF	37	119
651 ♂	2002-03,06	7-11	Yaak River, MT & BC	GPS & VHF	1,827	1,004
787 ♂	2003-04	3-4	Yaak River, MT	VHF	84	1,862
648 ♀	2003-05	5-7	Salish Mts, MT	VHF	85	948
576 ♂	2005-06	3-4	Yaak River, MT & BC	GPS & VHF	2,290	1,320
675 ♀	2004-10	2-8	Yaak River, MT & BC	GPS & VHF	1,827	714
10 ♀	2004	11	Moyie River, BC	GPS	1,977	176
11 ♂	2004	7	Moyie River, BC	GPS	894	1,453
12 ♀	2004	11	Moyie River, BC	GPS	1,612	333
17 ♂	2005	8	Yaak River, MT & BC	GPS	1,903	3,074
677 ♂	2005	6	Yaak River, MT & BC	GPS	519	3,361
688 ♂	2005-06	3-4	Moyie & Goat River, BC	GPS	3,421	1,544
694 ♀	2005	2	Yaak River, MT	VHF	11	89

Bear # and Sex	Years	Age (Est.)	Area of use	Collar Type	Radio Locations	100% Convex Polygon (km^2)
292 ♀	2005	4	Moyie & Goat River, BC & ID	GPS	7,062	253
770 ♂	2005-06	11-12	Cabinet Mts, MT	VHF	20	326
2 ♂	2005-06	(7-9)	Moyie / Yahk, BC	GPS	1,337	2,860
A1[1] ♀	2005-07	(8-10)	Cabinet Mts, MT	VHF	73	725
782[1] ♀	2006-08	2-5	Cabinet Mts, MT	GPS	1,126	1,932
780 ♂	2006-08	6-8	Cabinet Mts, MT	VHF	56	1,374
103 ♂	2006-07	3-4	Kootenai, & Pend Oreille River, BC, ID, & WA	GPS	4,872	6,545
5381 ♂	2006-07	4-5	Moyie & Goat River, BC & ID	GPS	11,491	1,949
130 ♀	2007-08	26-27	Goat River, BC	GPS	3,986	281
131 ♀	2007-08	(5)	Goat River, BC	GPS	3,270	276
784 ♀	2007-09	1-3	Yaak River, MT	GPS	2,606	524
785 ♀	2007-08	1-2	Yaak River, MT	GPS	362	207
772 ♀	2007	10	Cabinet Mts, MT	VHF	14	446
119 ♂	2007-08	19-20	Selkirk Mts., BC	GPS	2,115	1,830
138 ♀	2008-09	2-3	Kootenay River, BC	GPS	3,232	750
635[1] ♀	2008	4	Cabinet Mts, MT	GPS	285	451
790[1] ♀	2008	3	Cabinet Mts, MT	GPS	227	423
144 ♂	2008	9	Selkirk Mts., BC	GPS	1,648	883
7005 ♂	2008	4	Selkirk Mts., BC	GPS	229	1,144
150 ♀	2008-09	6-7	Selkirk Mts., BC	GPS	2,911	362
155 ♂	2008-10	11-13	Selkirk Mts., BC	GPS	2,175	1,479
715[1] ♀	2009-10	(10-11)	Cabinet Mts, MT	GPS	437	6,666
161 ♀	2009-10	6-7	Selkirk Mts., BC	GPS	2,008	126
163 ♀	2009-10	6-7	Selkirk Mts., BC	GPS	4,144	271
165 ♀	2009-10	15-16	Selkirk Mts., BC	GPS	416	169
171 ♀	2009-10	15-16	Selkirk Mts., BC	GPS	2,740	227
8005[2] ♀	2009-10	4-5	Selkirk Mts., BC	GPS	1,649	4,511
731 ♀	2009-11	2-4	Yaak River, MT	GPS	1,652	852
799 ♂	2010-11	3-4	Cabinet Mts, MT	GPS	1,422	805
713[1] ♂	2010-11	5-6	Cabinet Mts, MT	GPS & VHF	562	5,999
714[1] ♀	2010-12	4-6	Cabinet Mts & Flathead, MT, BC, AB	GPS	1,684	2,389
737 ♂	2010-13	4-6	Yaak River, MT & BC	GPS & VHF	680	2,351
1374 ♂	2010	2	Yaak River, MT & BC	GPS	14	381
177 ♀	2010	9	Selkirk Mts., BC	GPS	486	72
154 ♂	2010	4	Selkirk Mts., BC	GPS	396	178
183 ♀	2010, 12-13	9	Selkirk Mts., BC	GPS	616	362
7[2] ♀	2010	9	Selkirk Mts., BC	GPS	35	75
17[2] ♂	2010	3	Selkirk Mts., BC	GPS	255	106
726 ♂	2011-12	2-3	Kootenai & Yaak River, MT	GPS	2,430	1,613
722 ♂	2011-12	12-13	Yaak River, MT & BC	GPS	1,121	3,068
724[2] ♂	2011-12	2-3	Cabinet Mts, MT	VHF	29	873
723[1] ♂	2011-12	2-3	Cabinet Mts, MT	GPS	430	1,063
725[1] ♀	2011-13	2	Cabinet Mts & Flathead, MT	GPS	739	5,846
152 ♂	2011-12	6-7	Selkirk Mts., BC	GPS	1,189	340
732[2] ♂	2011	5	Yaak River, MT	GPS	875	458
149 ♂	2011	11	Selkirk Mts., BC	GPS	737	2,114
918[1] ♂	2012-13	2	Cabinet Mts, MT	GPS	428	563

Bear # and Sex	Years	Age (Est.)	Area of use	Collar Type	Radio Locations	100% Convex Polygon (km^2)
12003 ♀	2012-13	5	Selkirk Mts, ID	GPS	698	418
12006 ♀	2012-13	2-3	Selkirk Mts, ID	GPS	512	209
12008 ♀	2012-13	15	Selkirk Mts, ID	GPS	366	275
221 ♂	2012-13	4-5	Selkirk Mts., BC	GPS	47	140
174 ♂	2012-13	4-5	Selkirk Mts., BC	GPS	676	378
552 ♀	2001, 12-13	1-12	Yaak River, MT	VHF	783	1,255
826 ♂	2013	(5)	Yaak& Kootenai River, MT & BC	GPS	164	1,820
729 ♀	2013	3	Yaak River, MT	GPS	1,701	201
12016 ♀	2013	(12)	Selkirk Mts, ID	GPS	455	128
13017 ♀	2013	(3)	Selkirk Mts, ID	GPS	462	128
13021 ♀	2013	(6)	Selkirk Mts, ID	GPS	445	155
13023 ♀	2013	(8)	Selkirk Mts, ID	GPS	NA	NA
919[1] ♂	2013	4	Cabinet Mts, MT	GPS	175	436

[1] Bear transplanted to Cabinet Mountains from North Fork of the Flathead River, British Columbia or Flathead River, Montana.

[2] Bear captured and monitored for conflict management purposes.

Grizzly Bear Denning Chronology

We used VHF and GPS location data from radio-collared grizzly bears (1983–2013) to summarize den entry and exit dates by month and week. Den entry dates (n = 83) ranged from the third week of October to the last week of December. Seventy-nine (95%) entries occurred between the 4th week of October and the 3rd week of December (Fig. 15). Grizzly bears in the Cabinet Mountains (median entry between 1st and 2nd week of November) entered dens 2 to 3 weeks earlier than bears in the Yaak river drainage (median entry during 4th week of November). Males generally enter dens later than females (Fig. 15). Female-offspring family groups tend to enter dens later than independent adult females (Fig. 16). By December 1, 36% of Cabinet and Yaak grizzly bears have not yet entered winter dens.

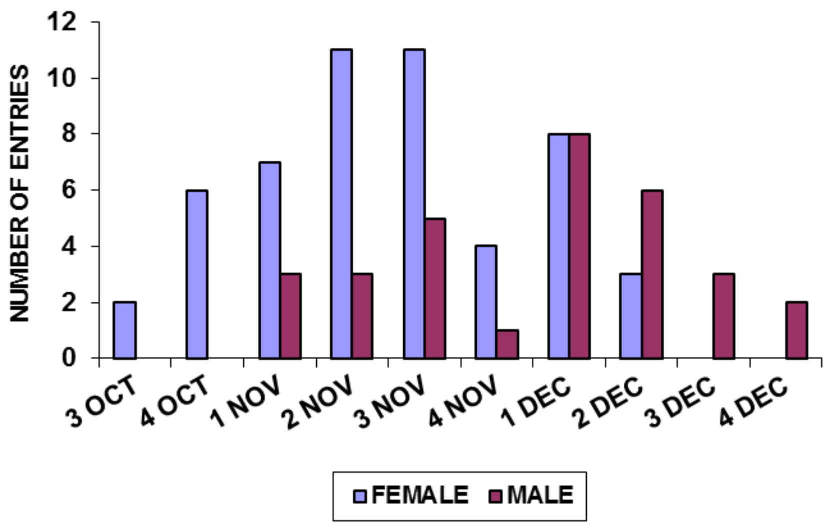


Figure 15. Month and week of den entry for male and female radio-collared grizzly bears in the Cabinet-Yaak grizzly bear recovery zone, 1983–2013.

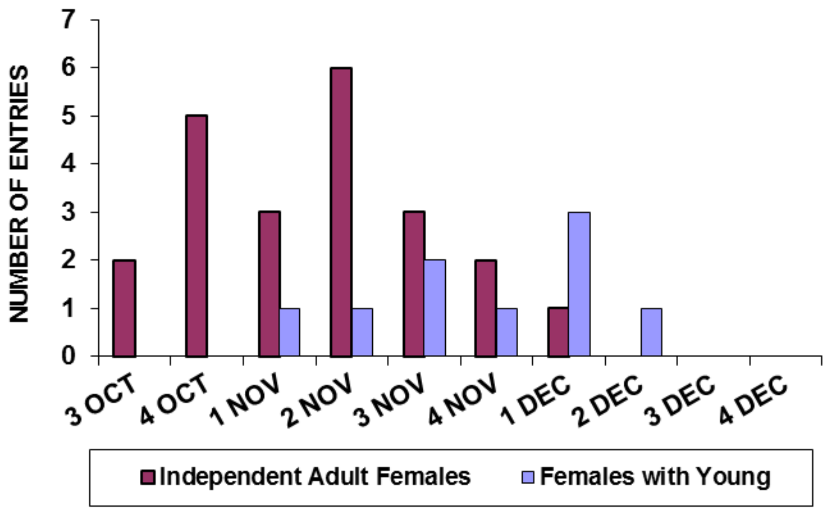


Figure 16. Month and week of den entry for adult female, radio-collared grizzly bears in the Cabinet-Yaak grizzly bear recovery zone, 1983–2013.

Den exit dates (*n* = 74) ranged from the third week of March to the third week of May (Fig. 17). Seventy-one (96%) exit dates occurred from the 4th week of March through the 2nd week of May. Grizzly bears in the Cabinet Mountains generally exited dens one week later than bears in the Yaak river drainage. Males tend to exit dens one week earlier than females (Fig. 17). Eighty-one percent of den exits occurred during the month of April. By May 1, 12% of Cabinet and Yaak grizzly bears are still in dens, one-third of which are females with cubs-of-the-year (COY). Females with cubs appear to exit dens later than other adult females (median exit during 1st week of May; Fig. 18). All adult females with COY remained at dens until at least the 15th of April (Fig. 18).

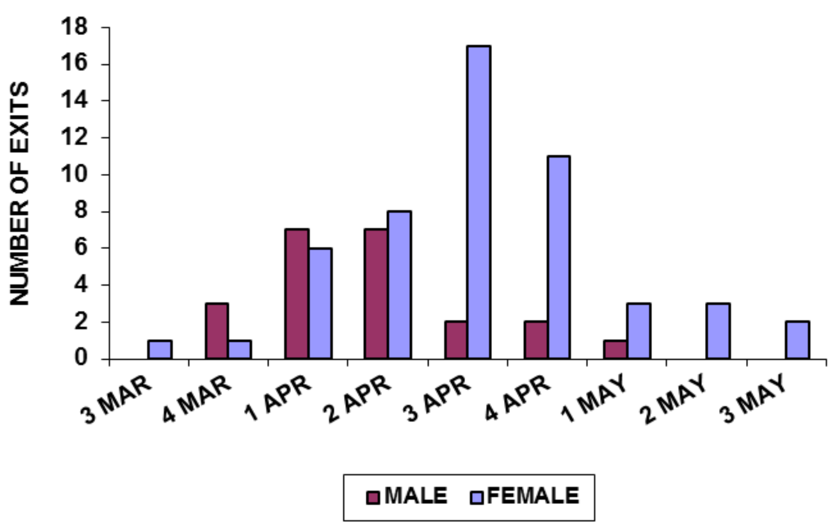


Figure 17. Month and week of den exit for male and female radio-collared grizzly bears in the Cabinet-Yaak grizzly bear recovery zone, 1983–2013.

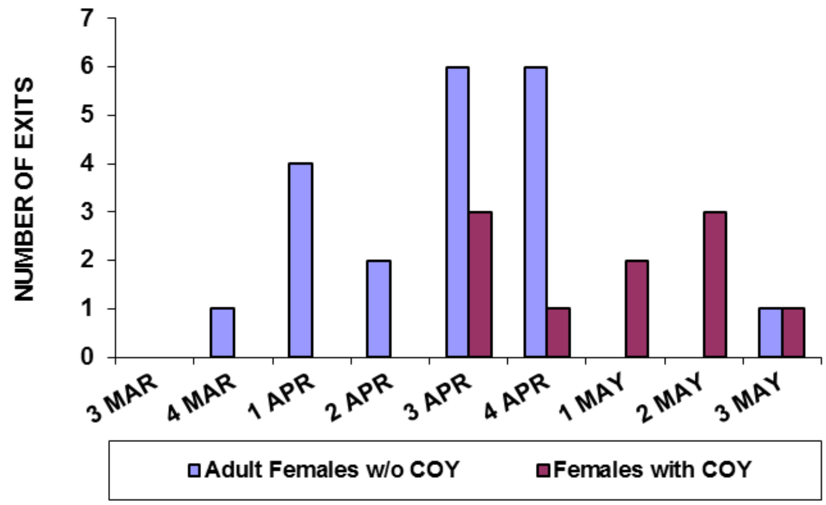


Figure 18. Month and week of den exit for adult female, radio-collared grizzly bears (with and without cubs-of-the year [COY]) in the Cabinet-Yaak grizzly bear recovery zone, 1983–2013.

Grizzly Bear Use of Habitat Components

Grizzly bear use of habitat components was summarized on a seasonal basis during 1983–2009. Only VHF radio locations (1983–2009) were used in this analysis. Radio locations derived from GPS radio collars will be analyzed separately through resource selection function techniques in the future. 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 shrub fields, mixed shrub snow chutes, mixed shrub/cutting units, alder shrub fields, huckleberry shrub fields, and graminoid and beargrass sidehill parks (Fig. 19). Primary differences in annual use of habitat components include greater use of mixed shrub snow chutes, alder shrub fields, huckleberry shrub fields, and beargrass sidehill parks in the Cabinet Mountains and greater use of closed timber, timbered shrub fields, mixed shrub/cutting units, and graminoid sidehill parks in the Yaak River. A brief description of all 19 habitat components is provided in Appendix 3.

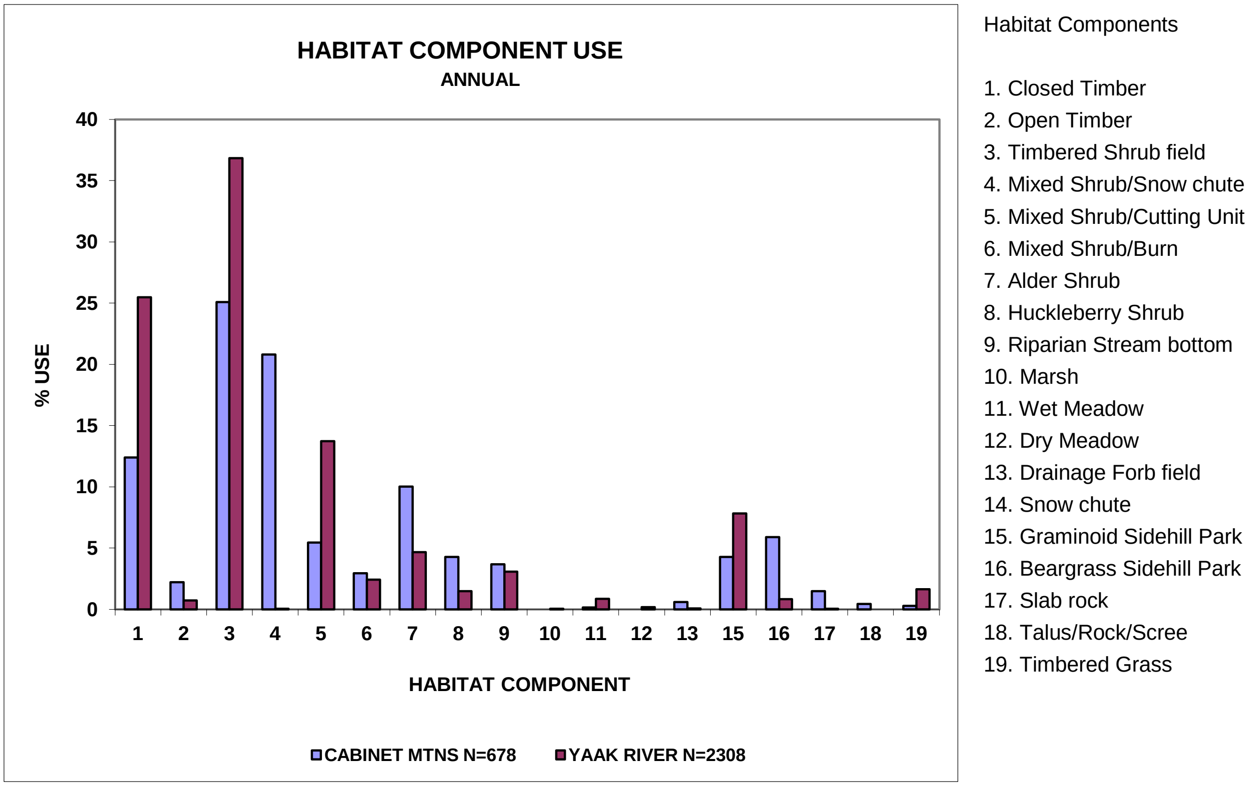


Figure 19. Annual habitat component use in the Cabinet Mountains and Yaak River, 1983–2009.

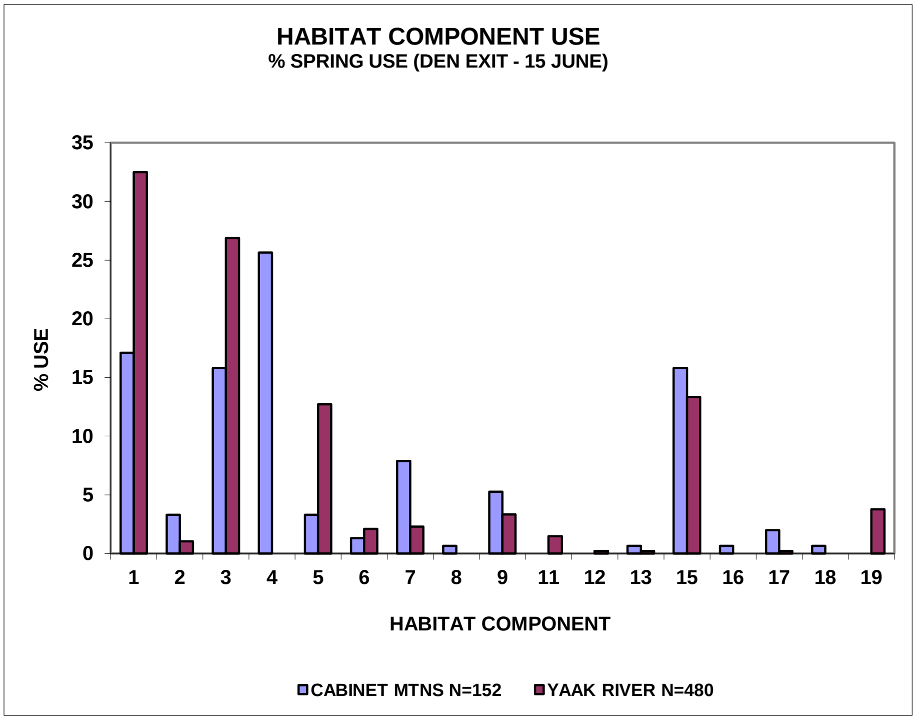
Spring use of habitat components by radio-collared grizzly bears in the Cabinet Mountains and the Yaak River drainage was dominated by closed timber, timbered shrub fields, mixed shrub snow chutes, mixed shrub cutting units, alder shrub fields, and graminoid sidehill parks (Fig. 20). Notable differences between the two study areas include heavier use of snow chutes, alder, and graminoid parks in the Cabinet Mountains and heavier use of closed timber, timbered shrub fields, 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). Snow chutes, 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 shrub fields, mixed shrub snow chutes, mixed shrub cutting units, mixed shrub burns, alder shrub fields, huckleberry shrub fields, graminoid sidehill parks, and beargrass sidehill parks (Fig. 21). Differences between the two study areas include heavier use of snow chutes, huckleberry shrub fields, and beargrass parks in the Cabinet Mountains and heavier use of closed timber, timbered shrub fields, 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 shrub fields, mixed shrub snow chutes, mixed shrub cutting units, mixed shrub burns, alder shrub fields, huckleberry shrub fields, graminoid sidehill parks, and beargrass sidehill parks (Fig. 22). Differences between the two study areas include heavier use of snow chutes, huckleberry shrub fields, and beargrass parks in the Cabinet Mountains and heavier use of closed timber, timbered shrub fields, 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 shrub fields occurred adjacent to other components that provided food and may have been used for cover or bedding areas.

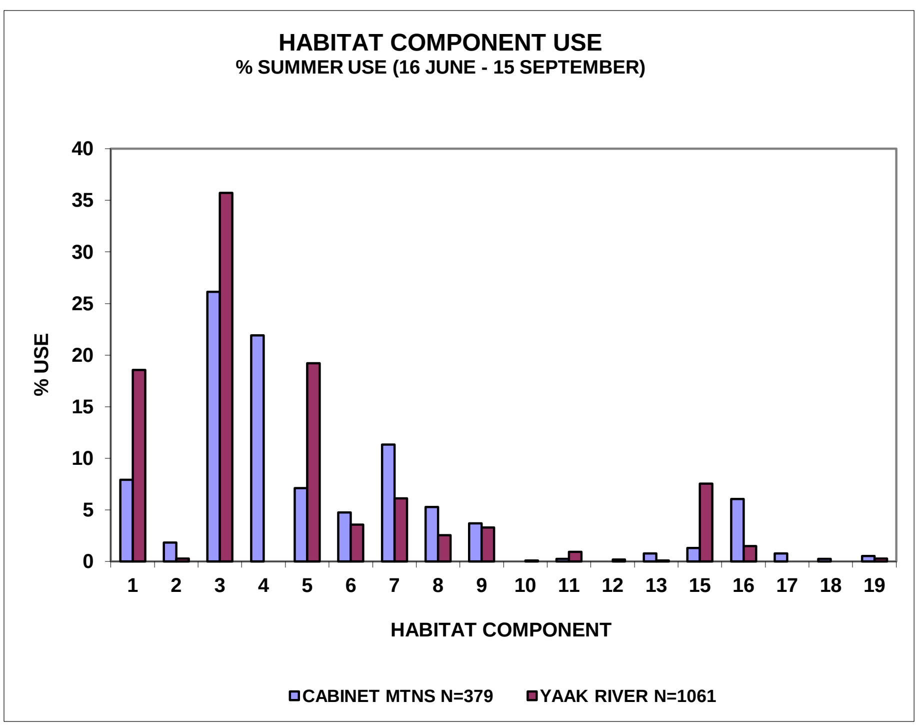
Den use of habitat components by radio collared grizzly bears in the Cabinet Mountains and the Yaak River drainage was dominated by closed timber, timbered shrub fields, graminoid sidehill parks, and beargrass sidehill parks (Fig. 23). Differences between the two study areas include heavier use of beargrass parks in the Cabinet Mountains and heavier use of closed timber, timbered shrub fields, and graminoid parks in the Yaak River.



Habitat Components

1. Closed Timber
2. Open Timber
3. Timbered Shrub field
4. Mixed Shrub/Snow chute
5. Mixed Shrub/Cutting Unit
6. Mixed Shrub/Burn
7. Alder Shrub
8. Huckleberry Shrub
9. Riparian Stream bottom
10. Marsh
11. Wet Meadow
12. Dry Meadow
13. Drainage Forb field
14. Snow chute
15. Graminoid Sidehill Park
16. Beargrass Sidehill Park
17. Slab rock
18. Talus/Rock/Scree
19. Timbered Grass

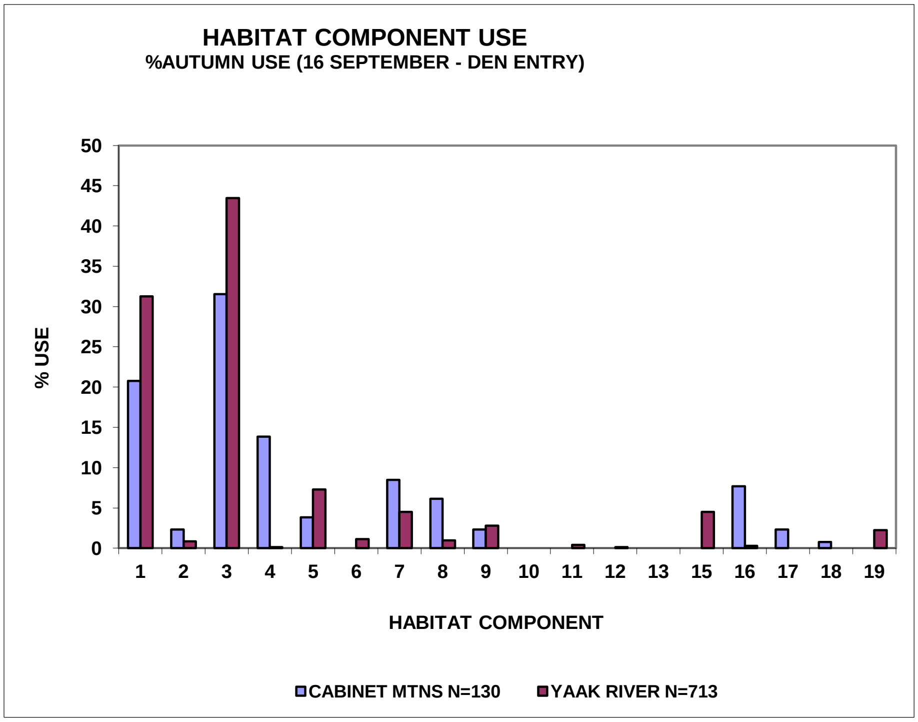
Figure 20. Spring habitat component use in the Cabinet Mountains and Yaak River, 1983-2009.



Habitat Components

1. Closed Timber
2. Open Timber
3. Timbered Shrub field
4. Mixed Shrub/Snow chute
5. Mixed Shrub/Cutting Unit
6. Mixed Shrub/Burn
7. Alder Shrub
8. Huckleberry Shrub
9. Riparian Stream bottom
10. Marsh
11. Wet Meadow
12. Dry Meadow
13. Drainage Forb field
14. Snow chute
15. Graminoid Sidehill Park
16. Beargrass Sidehill Park
17. Slab rock
18. Talus/Rock/Scree
19. Timbered Grass

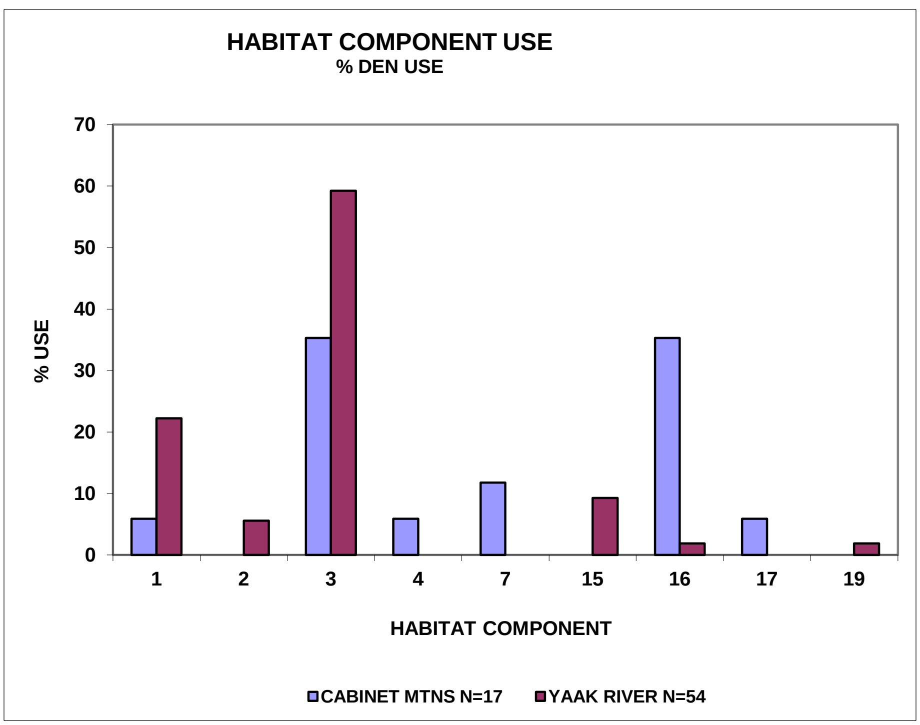
Figure 21. Summer habitat component use in the Cabinet Mountains and Yaak River, 1983-2009.



Habitat Components

1. Closed Timber
2. Open Timber
3. Timbered Shrub field
4. Mixed Shrub/Snow chute
5. Mixed Shrub/Cutting Unit
6. Mixed Shrub/Burn
7. Alder Shrub
8. Huckleberry Shrub
9. Riparian Stream bottom
10. Marsh
11. Wet Meadow
12. Dry Meadow
13. Drainage Forb field
14. Snow chute
15. Graminoid Sidehill Park
16. Beargrass Sidehill Park
17. Slab rock
18. Talus/Rock/Scree
19. Timbered Grass

Figure 22. Autumn habitat component use in the Cabinet Mountains and Yaak River, 1983-2009.



Habitat Components

1. Closed Timber
2. Open Timber
3. Timbered Shrub field
4. Mixed Shrub/Snow chute
5. Mixed Shrub/Cutting Unit
6. Mixed Shrub/Burn
7. Alder Shrub
8. Huckleberry Shrub
9. Riparian Stream bottom
10. Marsh
11. Wet Meadow
12. Dry Meadow
13. Drainage Forb field
14. Snow chute
15. Graminoid Sidehill Park
16. Beargrass Sidehill Park
17. Slab rock
18. Talus/Rock/Scree
19. Timbered Grass

Figure 23. 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 (Figs. 24 and 25). Annual mean elevation used by grizzly bears in the Cabinet 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 ungulate hunters. Mean den elevation in the Cabinet Mountains was 1,875 meters and 1,698 meters in the Yaak River.

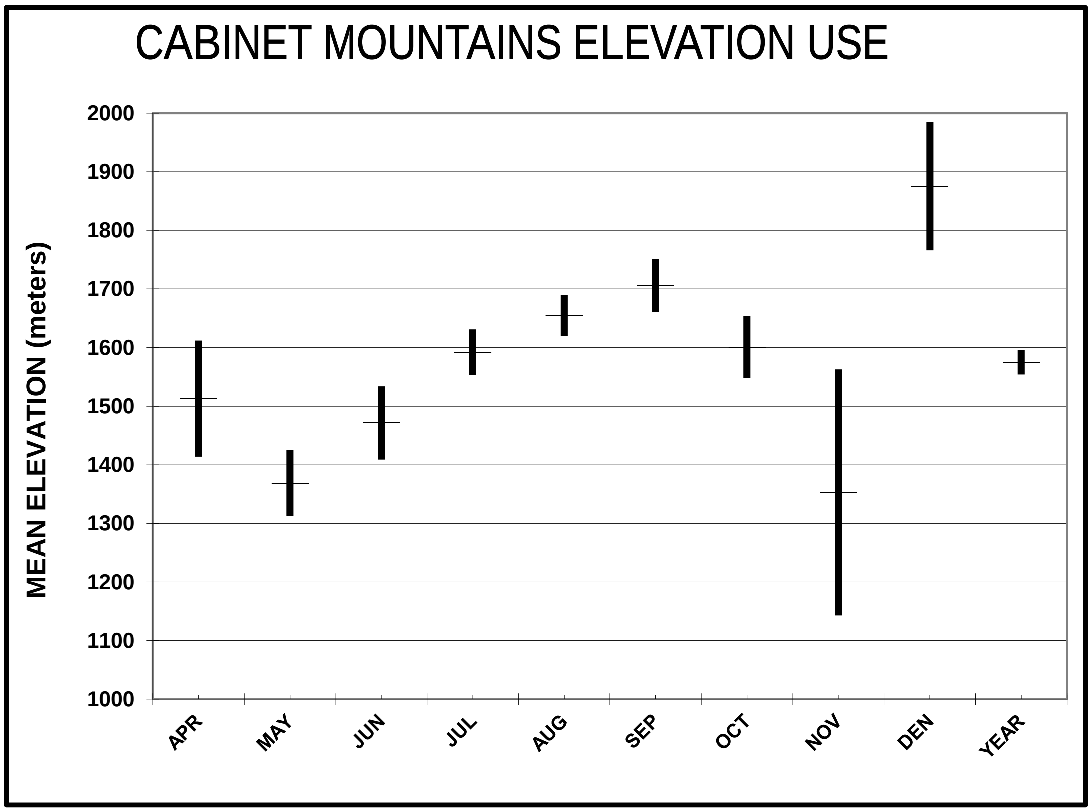


Figure 24. Mean elevation and 95% confidence intervals of radiolocations in the Cabinet Mountains, 1983–2009.

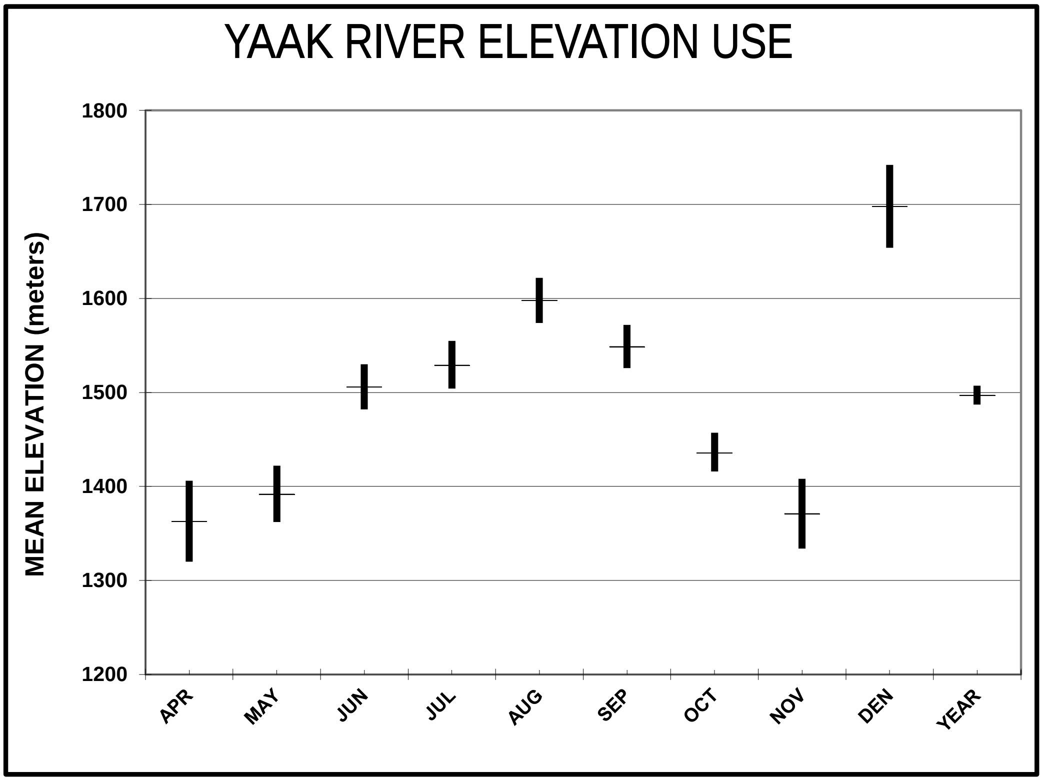


Figure 25. Mean elevation and 95% confidence intervals of radiolocations in the Yaak River, 1986–2009.

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. 26 and 27). South aspects received greatest use 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 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 snow chutes, alder shrub fields, grassy sidehill parks, and closed timber. Yaak River radio locations indicated most use below 1,400 m with primary use of closed timber, timbered shrub fields, 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.

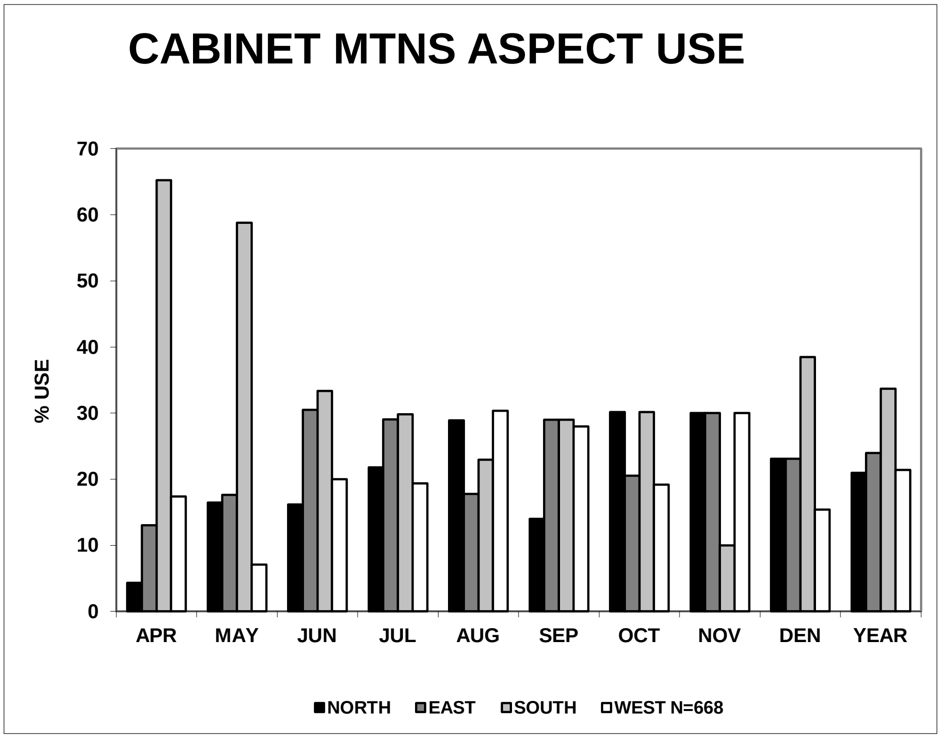


Figure 26. Aspect of radiolocations in the Cabinet Mountains, 1983-2009.

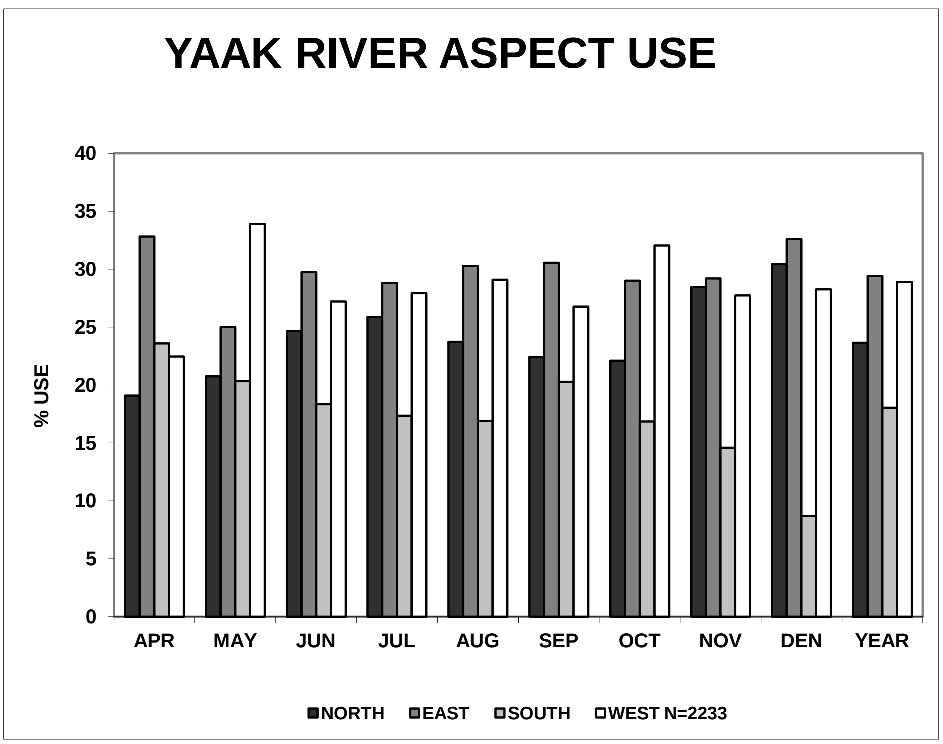


Figure 27. Aspect of radiolocations in the Yaak River, 1986-2009.

Isotope analysis

Six grizzly bear hair samples were analyzed for carbon and nitrogen isotope signatures in the Cabinet Mountains. Seventeen percent of the diet of sampled Cabinet Mountain grizzly bears is derived from animal matter. Adult males had slightly higher $\delta^{15}N$ stable isotope signatures (4.5‰) than did adult females (3.5‰), indicating greater use of available animal matter. Yaak and Cabinet grizzly bears have, on average, similar dietary proportions. Yaak grizzly bear diets contain nearly 15% animal matter. $\delta^{15}N$ values ranged as low as 2.0‰ (~6% meat) for two sibling subadult bears in the Yaak. However, one adult male grizzly bear did consume approximately 37% meat.

Sampled grizzly bears in the Selkirk Ecosystem consumed more animal matter than Cabinet and Yaak bears (30%). However, Selkirk bears varied more widely in meat use (range = 8–97%); our small sample size may have been skewed by 3 bears in particular. One subadult female bear had stable isotope signatures that indicate she ate 97% meat. Two other males fed on meat at rates of 59% and 77% of digested diet. We can only suspect that these bears were gaining meat from bone piles and dead livestock from nearby dairy operations in the Creston Valley.

We are currently analyzing ~150 additional samples from the Cabinet-Yaak and Selkirk ecosystems. A a more wide-scale and detailed investigation of stable isotope signatures will be available next year.

Food Habits from Scat Analysis

Grizzly bear scats (n = 180) were collected in the Cabinet Mountains between 1981 and 1992. Graminoids (grasses and sedges) were consumed frequently (43% of scats) by grizzly bears in May. Additionally, meat, presumably from winter-killed deer and moose, accounted for 40% of all dry matter consumed in April and May (Fig. 129). In June, the use of forbs increased markedly, yet grasses and sedges were still a dominant food category. Cow parsnip (*Heracleum lanatum*), clover (*Trifolium spp.*), and dandelion (*Taraxacum officinale*) were commonly used in June; over half (52%) of scats in June included parts of at least one of these three forbs. By July, forbs (mainly *Heracleum*) comprised 32% of dry matter consumed by grizzly bears. Only 8% of dry matter consumed in July came from grasses and sedges; graminoids begin to cure in July and provide far less digestible nutrition. Grizzly bears began to feed upon foods from shrubs (huckleberry and whortleberry [*Vaccinium spp.*], serviceberry [*Amelanchier alnifolia*]) and insects (mainly ants) in July. Food habits during August and September were dominated by use of shrub (*Vaccinium* spp., in particular), yet September habits include an increased use of animal matter. Unlike black bears, grizzly bears targeted animal matter (deer, elk, moose) in October. We suspect hunter-discarded gut piles or other remains account for a fair amount of the available animal meat. Fall regrowth of forbs (mainly clover) and graminoids contributed 25% of dry matter consumed by sampled grizzly bears in October. Mammal and shrub food items (i.e., the most calorie-dense foods available in Cabinet-Yaak Ecosystem) constitute 64% of total dry matter consumed annually by grizzly bears.

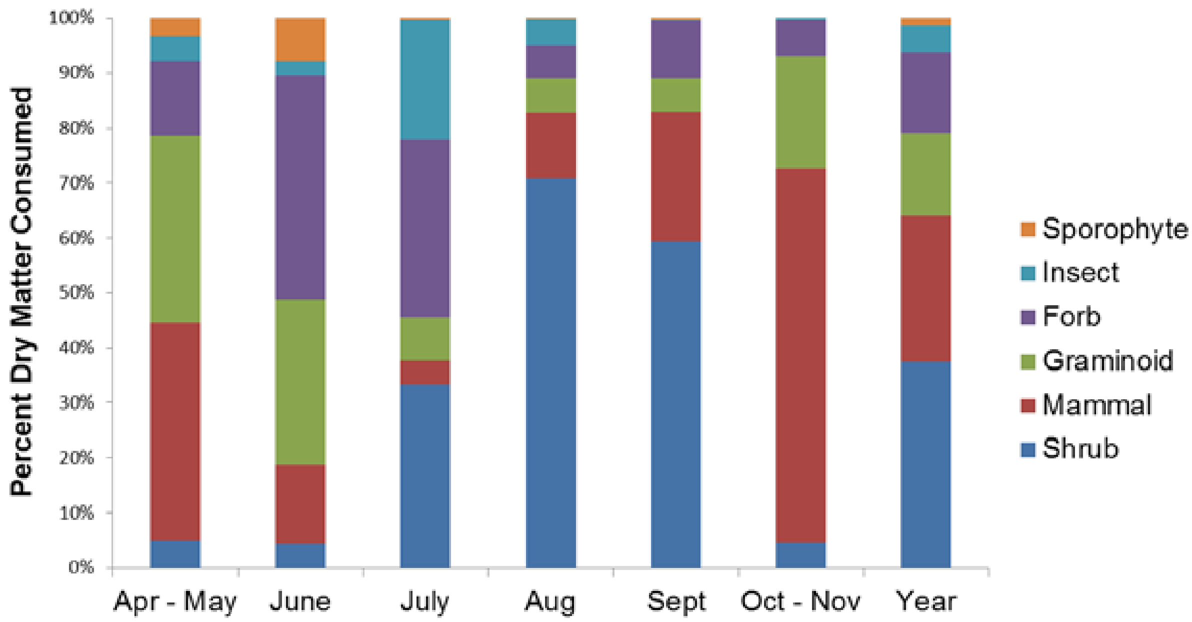


Figure 28. Monthly percent of total dry matter of foods consumed by grizzly bears in the Cabinet Mountains and Yaak River, 1981-1992.

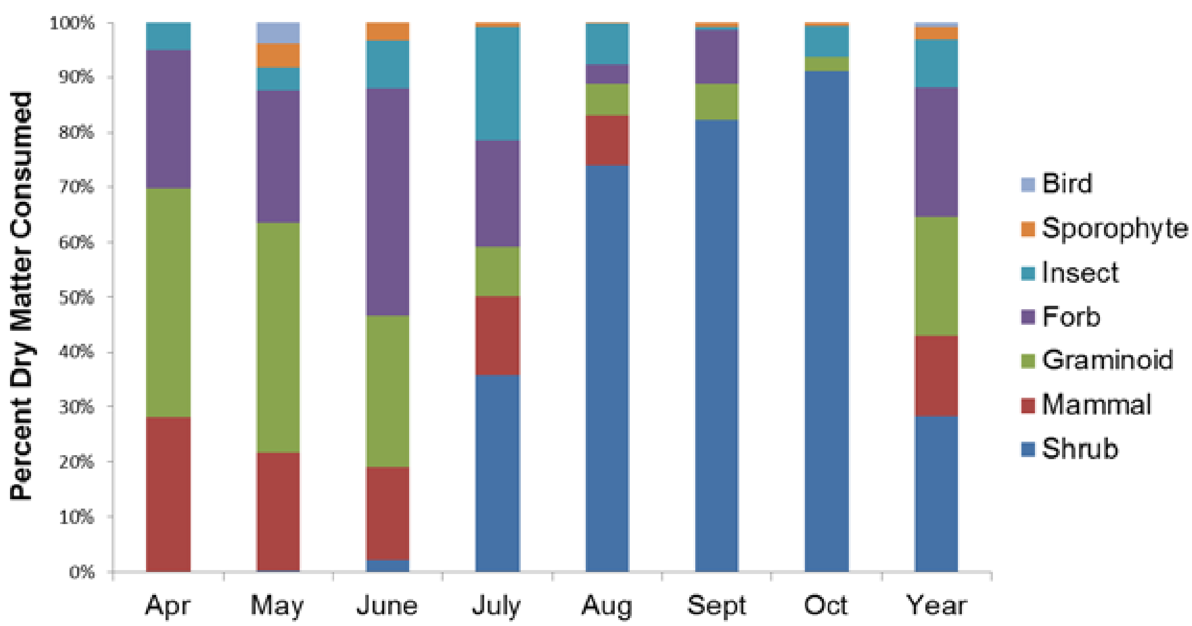


Figure 29. Monthly percent of total dry matter of foods consumed by black bears in the Cabinet Mountains and Yaak River, 1984-1992.

Black bear scats (n = 618) were collected between 1984 and 1992. Relative use of foods was quite similar to that of grizzly bears between April and August. However, black bear food habits in September and October were quite different from grizzly bears. Black bears tend to use berries of shrubs (*Vaccinium* spp., *Sorbus* spp. [mountain-ash], *Amelanchier alnifolia,* and *Arctostaphylos* spp. [bear berry]) more frequently as fall progresses (percent dry matter consumed, August = 74%; September = 82%; October = 91%). In October, black bears fed heavily on mountain-ash. In contrast, grizzly bears increase relative dry matter consumption of animal meat in fall months (August = 12%, September = 24%; October = 68%). We suggest this difference in food use may be explained by either 1) early den entrance dates for black bears (i.e., den entrance before open of big game hunting season), 2) higher energetic demand of larger grizzly bears (i.e., consumption of calorie-dense foods is metabolically preferred by larger bears; Welch et al. 1997), 3) interspecific exclusion of black bears by grizzly bears (i.e., exploitative competition), and/or 4) differences in risk behavior between the two species. On a annual basis, black bears consumed less high-quality, calorie-dense foods (meat and berries; 42%) relative to lower-quality foods such as graminoids and forbs (46%).

Berry Production

Huckleberry

We evaluated eleven huckleberry transects 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, 18 in 2008-09,17 in 2010, 15 in 2011, 16 in 2012, and 15 in 2013. During the entire study period (1989–2013), the mean number of berries per plot was 1.7 (95% CI ± 0.14). Mean annual berry counts between 1989 and 2013 ranged from 0.5–3.1 (Fig. 30). Low berry counts occurred in 1992, 1998–99, and 2001–04. Above average counts occurred in 1989–91, 1994, 1996, 2006–09, and 2012–13.

Serviceberry

We evaluated five sites for serviceberry production during 1990–96. We added one site in 1997 and another in 2005. We discontinued one site in 2007 and another in 2013. The overall mean berry count per plant was 115 (95% CI ± 27) during the study. Mean berry counts per plant varied from 12 to 355 during the years 1990 to 2013 (Fig. 30). Low counts occurred during 1992, 1994, 1999, 2002, 2004–07, 2010, and 2012–13. Above average counts occurred during 1990–91, 1993, 1995–97, 2003, 2009, and 2011.

Mountain Ash

Three sites were evaluated for mountain ash production in 2001–13 (Fig. 30). Total mean berry count was 176 berries per plant (95% CI ± 70), with the highest elevation site producing the most berries in the most years (2003, 2005–07, 2010). Sites with eastern and northern aspects exhibited considerably lower variation in berry counts from one year to the next than those with southern aspects. Poor production years occurred in 2003, 2006, 2010–11, and 2013. Above average production occurred in 2001, 2005, 2008, and 2012.

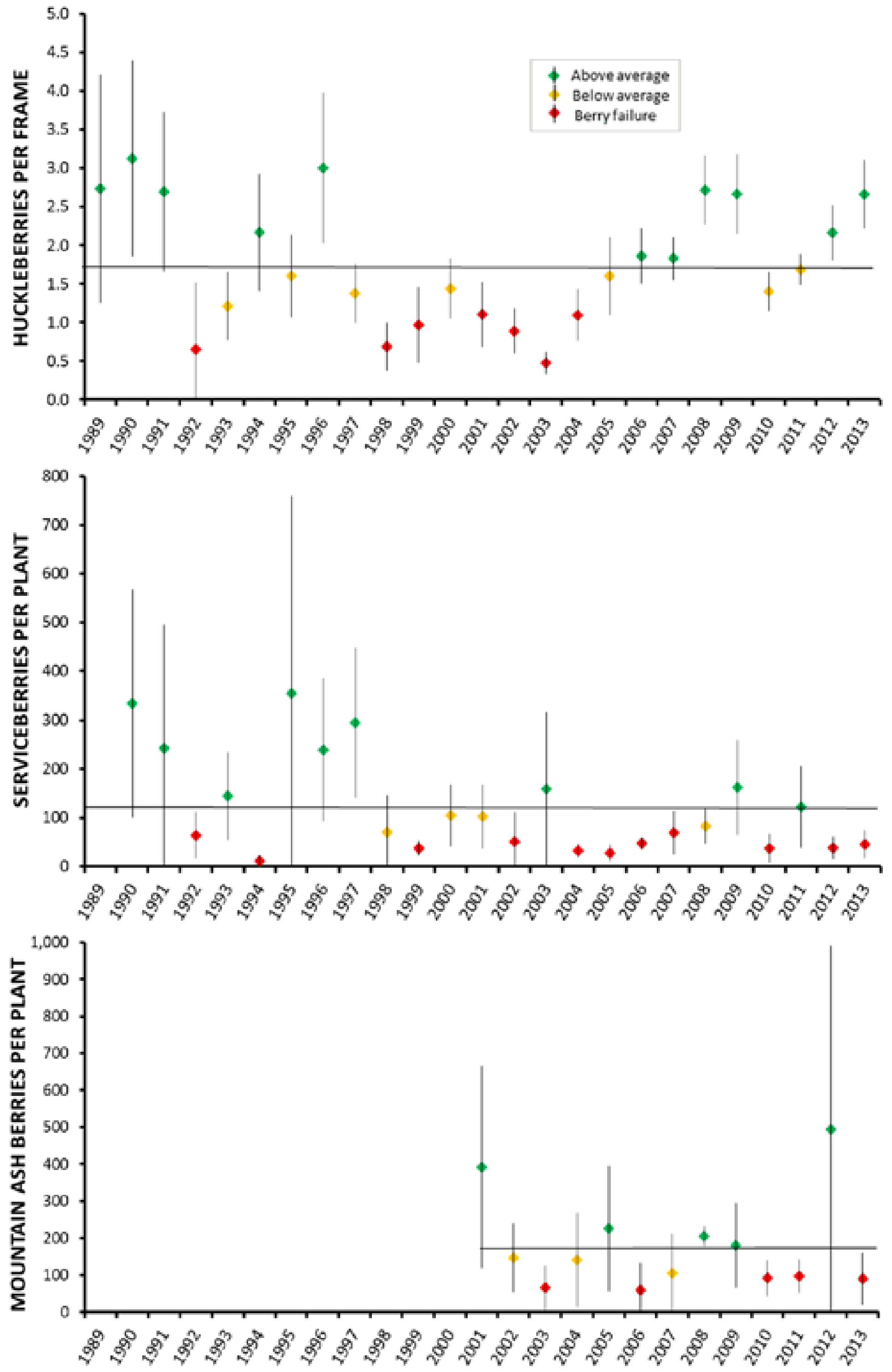


Figure 30. Mean berries per plot (or plant) and 95% confidence intervals for huckleberry, serviceberry, and mountain ash transects in the Cabinet-Yaak, 1989–2013. The horizontal line indicates study-wide mean production.

Buffalo berry

Five buffalo berry transects (5 plants at each transect) were evaluated during 1990–99 and 2002–03. No sites were sampled during 2004–06 seasons. One new transect (10 plants) was established in 2007; this was the only transect sampled in 2007. Another transect (10 plants) was added in 2008. These two transects were observed in 2008–13. Mean berry count per plant from all transects was 188 (95% CI ± 52) during the study period. Mean berry counts ranged between 15 to 627 berries per plot from 1990 to 2013 (Fig. 31), with low counts in 1998-99, 2002–03, 2007, and 2013. High counts occurred in 1990, 1993, and 2009–12.

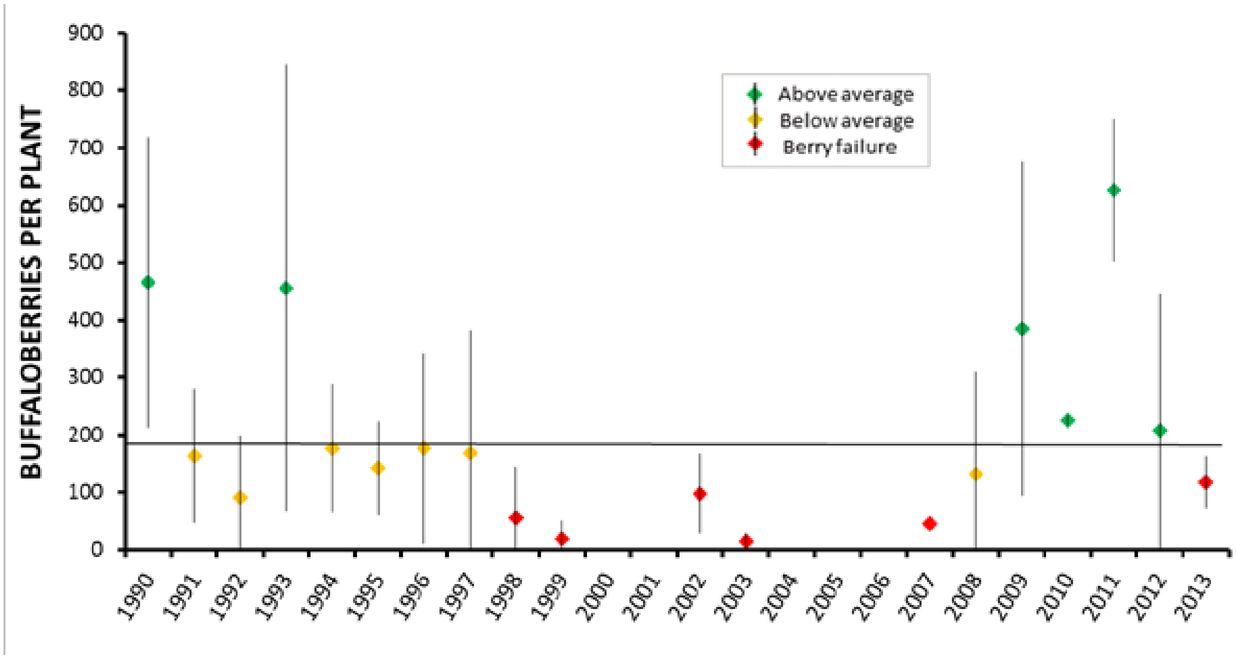


Figure 31. Mean berries per plant (±95% confidence interval) for buffalo berry transects in the Cabinet-Yaak, 1990–2013. Horizontal line indicates mean production, 1990–2013.

Because of its relatively far-ranging distribution in the Cabinet-Yaak and life history of inhabiting larger areas (e.g. shrub fields) than other berry-producing plants, huckleberries appear to provide a greater amount of food for bears in the Cabinet-Yaak. However, serviceberry and mountain ash may provide significant secondary food sources in some years when huckleberry crops have failed (e.g. 2001 and 2003). Mountain ash may be particularly valuable to bears in years of low food production because the berries persist 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 (e.g., 2002 and 2004). Because of its sparse distribution, buffalo berries appear to be the least-available berry food for grizzly bears in the Cabinet-Yaak. Below-average production among all species surveyed occurred in 1992, 1998–2000, 2002, and 2004.

Fluctuations in berry production in the Cabinet-Yaak may be influenced by climatic variables. Holden et al. (2012) found huckleberry production in the Cabinet-Yaak to be highest in years with cool springs and high July diurnal temperature ranges. Serviceberry production was also highest in years with cool springs and high winter snowpack. Future changes in climate may influence the availability of these foods to Cabinet-Yaak grizzly bears.

ACKNOWLEDGMENTS

Numerous individuals and agencies have contributed to bear research in the Cabinet-Yaak area since 1983. We are indebted to all of the following that have assisted this study. This study has been aided with administrative assistance from K. Smith, E. Diaz-Hansen, and M. Franich. We thank field biologists C. Bechtold, K. Bertelloti, M. Burcham, H. Carriles, P. Feinberg, J. Frey, J. Fuller, B. Giddings, M. Gould, T. Graves, S. Greer, M. Grode, B. Hastings, M. Hooker, M. Jacobs, D. Johnson, S. Johnston, K. Kunkel, C. Lowe, M. Madel, D. Marsh T. Manley, D. Marsh, M. McCollister, G. Miller, C. Miller, C. Nicks, A. Orlando, M. Parker, T. Parks, R. Pisciotta, J. Picton, M. Proctor, .F. Robbins, K. Roy, C. Schloeder, C. Schwartzkopf R. Shoemaker, S. Smith, A. Snyder, T. Thier, T. Vecchiolli, T. Vent, A. Welander, C. Whitman, R. Williamson, S. T. Wong, and C. Wultsch. M. Proctor and D. Paetkau assisted with genetic analysis and interpretation.

Montana Department of Fish, Wildlife, and Parks personnel K. Annis, J. Brown, T. Chilton, T. Manley, B. Sterling, T. Thier, and J. Williams provided field and administrative assistance. Idaho Fish and Game personnel W. Wakkinen provided field support. D. Bennett, B. Groom, K. Kinden, and D. Parker provided exceptional services as aircraft pilots. Numerous individuals from the U.S. Forest Service have provided agency support and contributed their assistance to this project. These include: P. Bradford and J. Carlson. B. McLellan (B.C. Forest Service), M. Proctor (Birchdale Ecological), and G. Mowat (B.C. Fish and Wildlife Branch) provided invaluable assistance in planning, permitting, and trapping for research.

The Claiborne-Ortenberg Foundation, Mr. E.O. Smith, National Fish and Wildlife Foundation, Turner Endangered Species Fund, U.S. Borax and Chemical Corp., Kootenai National Forest, Montana Department of Fish, Wildlife, and Parks, Federal Highway Administration, and the U.S. Fish and Wildlife Service provided funding and support for this project. We wish to extend a special thanks to the citizens of the province of British Columbia for allowing us to remove grizzly bears from the Flathead River drainage to augment populations in the Cabinet Mountains.

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.

Beyer, H. L. 2004. Hawth's Analysis Tools for ArcGIS. http://www.spatialecology.com/htools.

Brenna, J. T., T.N. Corso, H.J. Tobias and R.J. Caimi. 1997. High-precision continuous-flow isotope ratio mass spectrometry. Mass Spectrometry Reviews. 16:227–258.

Caughley, G. 1977. Analysis of vertebrate populations. John Wiley and Sons, New York.

Cherry, S., M.A. Haroldson, J. Robison-Cox, and C.C. Schwartz. 2002. Estimating total human-caused mortality from reported mortality using data from radio-instrumented grizzly bears. Ursus 13:175-184.

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.

Hewitt, D. G., and C. T. Robbins. 1996. Estimating grizzly bear food habits from fecal analysis. Wildlife Society Bulletin 24:547–550.

Holden, Z. A., W. F. Kasworm, C. Servheen, B. Hahn, and S. Dobrowski. 2012. Sensitivity of berry productivity to climatic variation in the Cabinet-Yaak grizzly bear recovery zone, northwest United States, 1989–2010. Wildlife Society Bulletin 36:226–231.

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.

Kline,E. 2010.Grizzly bears and the montanore mine project: analysis of bear scat monitoring, agency data, and literature. Kline Environmental Research. Milltown, WI. 28 pp.

Lewis, J. S. 2007. Effects of human influences on black bear habitat selection and movement patterns within a highway corridor. MS Thesis University of Idaho, Moscow. 152 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.

Qi, H., Coplen, T.B., Geilmann, H., Brand, W.A. and Böhlke, J.K. 2003. Two new organic reference materials for δ13C and δ15N measurements and a new value for the δ13C of NBS 22 oil. Rapid Communications in Mass Spectrometry. 17:2483–2487.

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.

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.

U.S. Geological Survey [USGS]. 2014. USGS Cabinet-Yaak Grizzly Bear Project homepage. http://www.nrmsc.usgs.gov/research/CYEbeardna.htm. Accessed 12 Dec 2014.

Wasser, S. 2010. 2009 progress report to Montanore Mineral Corp. grizzly and black bear project. Center for Conservation Biology, University of Washington. 16 pp.

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.

Welch, C.A., J. Keay, K.C. Kendall, and C.T. Robbins. 1997. Constraints on frugivory by bears. Ecology 78:1105–1119.

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.

Publications or Reports Involving this Research Program

Canepa, S., K. Annis, and W. Kasworm. 2008. Public opinion and knowledge survey of grizzly bears in the Cabinet-Yaak Ecosystem. Cabinet-Yaak and Selkirk Mountains Subcommitte of the Interagency Grizzly bear Committee, Missoula, Montana. 88 pp.

Holden, Z. A., W. F. Kasworm, C. Servheen, B. Hahn, and S. Dobrowski. 2012. Sensitivity of berry productivity to climatic variation in the Cabinet-Yaak grizzly bear recovery zone, northwest United States, 1989–2010. Wildlife Society Bulletin 36:226–231.

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.

Proctor, M. P., D. Paetkau, B. N. Mclellan, G. B. Stenhouse, K. C. Kendall, R. D. Mace, W. F. Kasworm, C. Servheen, C. L. Lausen, M. L. Gibeau, W. L. Wakkinen, M. A. Haroldson, G. Mowat, C. Apps, L. M. Ciarniello, R. M. R. Barclay, M. S. Boyce, C. C. Schwartz, and C. Strobeck. 2012. Population fragmentation and inter-ecosystem movements of grizzly bears in Western Canada and the Northern United States. Wildlife Monographs 180:1-46.

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. Interpopulation 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, MT.

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, 1949-13.

YEAR	LOCATION	TOTAL	SEX / AGE	MORTALITY CAUSE
1949	COPPER CR, MT	1	ADULT FEMALE	HUMAN, LEGAL 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, LEGAL HUNTER KILL
1953	KENELTY MT, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1953	20-ODD MT, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1953	BURNT CR, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1953	17-MILE CR, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1954	N F BULL R, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1954	S F BULL R, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1954	CEDAR LK, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1954	CEDAR LK, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1954	TAYLOR PK, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1954	SILVERBUTTE CR, MT	1	UNKNOWN	HUMAN, LEGAL HUNTER KILL
1954	SILVERBOW CR, MT	1	ADULT FEMALE	HUMAN, LEGAL 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, LEGAL HUNTER KILL
1958	SQUAW CR, MT	1	ADULT FEMALE	HUMAN, MANAGEMENT REMOVAL
1959	E F ROCK CR, MT	2	ADULT FEMALE, 1 CUB	HUMAN, LEGAL 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, LEGAL 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 (Elk)
1988	LEWISBY CR, BC	1	ADULT MALE	HUMAN, LEGAL HUNTER KILL (BC)
1988	N F 17-MILE CR, MT	1	ADULT FEMALE	HUMAN, DEFENSE OF LIFE BY HUNTER

YEAR	LOCATION	TOTAL	SEX / AGE	MORTALITY CAUSE
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, LEGAL 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
2010	AMERICAN CREEK, MT	1	CUB	NATURAL
2010	HAWKINS CREEK, BC	1	SUBADULT MALE	HUMAN, UNDER INVESTIGATION
2010	COLD CR, BC	1	SUBADULT MALE	HUMAN, WOLF TRAP, SELKIRK RELOCATION
2010	PINE CR, MT	1	ADULT MALE	HUMAN, POACHING
2011	EF ROCK CR, MT	1	SUBADULT	UNKNOWN
2011	FARO CR, MT	1	ADULT MALE	HUMAN, MISTAKEN IDENTITY (Black Bear)
2011	CHERRY CR, MT	1	SUBADULT MALE	HUMAN, MISTAKEN IDENTITY (Black Bear)
2011	PIPE CR, MT	1	SUBADULT MALE	HUMAN, DEFENSE OF LIFE
2011	LITTLE CR, MT	1	ADULT MALE	HUMAN, UNDER INVESTIGATION

YEAR	LOCATION	TOTAL	SEX / AGE	MORTALITY CAUSE
2012	MISSION CR, ID	2	ADULT FEMALE, 1 CUB	HUMAN, UNDER INVESTIGATION
2012	DUCK CR., BC	1	ADULT MALE	HUMAN, MANAGEMENT REMOVAL

Appendix 2. Grizzly bears captured, observed, photographed, or genotyped by study personnel in the Yaak River and Cabinet Mountains, 1986–2013.

Yaak River

Bear	Sex	Years detected	Comments
?	?	1986	Born 1986. Natural mortality 1986.
Gt106	F	1986-99	Born 1978.Monitor 1986-99. Natural mortality 17-mile Cr. 1999.
101	M	1986-87	Born 1978.Monitor 1986-87.
Gt129	F	1986-89,	Born 1986.Monitor 1986-89. Trap predation mortality Burnt Cr. 1989.
GtUnk3	F	1987,	1987 cub of 25. Cub female Mis-ID mortality 17-mile Cr. 1987
134	M	1987-88	Born 1978.Monitor 1987-88. BC hunting mortality Moyie R. 1988.
Gt128	M	1987-92, 97, 01	Born 1983.Monitor 1987-92 and 1997. Natural Mortality 2001 East of Koocanusa.
Gt25	F	1988,	Self Defense Adult female mortality 1988, 17 mile Cr.
Gt193	M	1988-90	1988 cub of 106. Monitor 1988-90.
192	M	1988-90	1988 cub of 106. Monitor 1988-90. Poaching mortality 1990.
Gt206	F	1988-95, 97	1988 cub of 106. Monitor 1988-95. Observed 1997.
GtUNK22	M	1991,	DNA 1991, 17-mile Cr.
GtR178	M	1991-92, 01	1991 cub of 106.Monitor 1991-92. DNA Ryan Cr, BC 2001
?	?	1991-92	1991 cub of 106.Monitor 1991-92.
Gt244	M	1992-94, 03-04	Born 1986.Monitor 1992-94 & 2003-04.
34	F	1993,	Transplanted to Bloom Cr by BC 1993, captured in US 1993.
Gt355	M	1993, 96	Born 1990? 1993 consort of 206? Monitor 1996. Human, under investigation mortality 1996.
Gt358	M	1993, 96-99	Born 1988. 1993 consort of 206? Monitor 1996-98. Management removal mortality 1999.
302	M	1993-96	Born 1993. Cub of 106. Monitor 1993-96. Human under investigation mortality 1996.
Gt303	F	1993-01, 03,07, 10-13	1993 cub of 106. Monitor 1994-2001, 2010-13. Observe 2003? 2 cubs Roderick 2007? 3 cubs EF Pipe 2010.
?	F	1994, 98	Unmarked female consort of 244 and 363.
?	?	1994-95, 98	1994 cub of 206, sibling of bear 505. Monitor 1994-95, Observed 1998?
505	F	1994-95, 98	1994 cub of 206.Monitor 1994-95. Observed 1998?
Gt353	F	1995-99, 02	1995 cub of 106.Monitor 1995-97, 2002. Observed 1998-99. Poaching mortality 2002.
Gt354	F	1995-99, 07	1995 cub of 106. Monitor 1995-99. Self-defense mortality 2007.
Gt342	M	1996-99, 02-04, 11	Born 1992.Monitor 1996-99 & 2003-04. DNA 2002. DNA 2011. Human, under investigation mortality 2011.
Gt363	M	1996-99, 05	Born 1992.Monitor 1996-99. DNA 2005, wounded. Human under investigation mortality Curley Cr.2005?
?	?	1997	Born 1997. Cub of 206.
?	?	1997	Born 1997. Cub of 206.
Gt68853	F	1997	1997 mortality, Wardner, BC Management removal.
Gt72832	M	1997	1998 mortality, Mayook, BC Unknown.
Gt384	M	1997,	Born 1990.Monitor 1997.
Gt596	F	1997, 99	1997 cub of 206. Monitor 1999. Self-defense mortality 1999.
Gt538	F	1997-02	Born 1991.Monitor 1997-02.
Gt386	M	1997-98, 00-01, 05	Born 1992.Monitor 1997-98. Possibly consort of 538 in 2000, 2001. DNA 2005.
Gt592	F	1998, 99-00	1997 cub of 206. Monitor 1999. DNA 1999. Human under investigation mortality 2000.
GtUN 55	F	1999	1997 cub of 538. Monitor 1997-98. Found skull 1999 site of 386 lost radio collar Moyie River, BC.
Gt106cub1	M	1999,	1999 cub of 106. Natural Mortality 1999.
Gt106cub2	F	1999,	Born 1999. cub of bear 106. Natural Mortality 1999.
?	?	2000,	2000 cub of 538. Natural Mortality 2000.
?	?	2000,	2000 cub of 538. Natural Mortality 2000.
?	?	2000,	2000 cub of 303. Natural Mortality 2000.

Yaak River

Bear	Sex	Years detected	Comments
Gt552	F	2000-01, 11-13	2000 cub of 303. Monitor 2000-01, 2012-13. DNA 2011 Mt Henry w/young
?	?	2001,	2001 cub of 538. Natural Mortality 2001.
?	?	2001,	2001 cub of 538. Natural Mortality 2001.
GtUNK37	F	2001,	2000 cub of 354. Unmarked yearling mistaken identity mortality Spread Cr., 2001
GtM-0235	F	2002	DNA 2002. NF Sullivan Cr. Human under investigation mortality Porcupine Cr. 2002.
Gt7434	F	2002	DNA 2002. Pete Cr.
Gt688	?	2002, 05-06	2002 cub of 538. Crossed Highway 3 to North. Monitor 2005-06.
Gt10165b	F	2005-06	2002 cub of 538, DNA 2004-05, Norge, Malpass, and Spruce Cr., BC. Trap predation mortality BC 2006.
?	?	2002,	2002 cub of 353. Assumed Human mortality 2002.
?	?	2002,	2002 cub of 353. Assumed Human mortality 2002.
GtUNK43	F	2002,	2002 cub of 353. Poaching mortality 2002.
Gt651	M	2002, 05-06, 08	Born 1995.Monitor 2002 and 2005-06. Mortality 2008.
Gt787	M	2002-04	2000 cub of 354. DNA 2002 4th July Cr. Radio collared 2003-04.
Gt576	M	2004-06	Born 2002.Monitor 2004-06. DNA 2005.
Gt675	F	2004-11	Born 2002.Monitor 2004-10. Lost 2 cubs in 2009. Lost 1 cub 2010. DNA 2011 Canuck
?	F	2004	Management capture and removal 2004 Newgate Cr., BC.
Gt10252c	F	2005	DNA 2005, Teepee, BC
Gt10252b	M	2005	DNA 2005, Teepee, BC
Gt10303g	M	2005	DNA 2005, Teepee, BC
GtM1	M	2005	2003 cub of 303.Monitor 2005 Pipe Creek. Relocated NW Peak. Lost contact.
Gt677	M	2005,	Born 1999.Monitor 2005.
Gt694	F	2005,	2003 cub of 303.Monitor 2005. Human under investigation mortality 2005.
Gt17	M	2005,	Born 1997. DNA 2002 Solo Joe. Monitor 2005.
Gt668	M	2005,	Born 2002.Monitor 2005.
Gt31	M	2005	Immigrant from Selkirk Mtns. Hunter harvest 2005. Russell Cr., BC.
Gt292	F	2005-06	Born 2001.Monitor 2005. Human Mortality 2006.
Gt103	M	2006,	Born 2003.Monitor 2006. Went to Selkirk Mtns 2006
GtY10165F	F	2006	Born 2002. Research mortality 2006, Cold Cr., BC.
5381	M	2006,09-10, 12	Born 2002.Monitor 2006, 2009-10. Management removal 2012.
Gt200730	F	2007-08	Cub of 354. DNA 2007. Meadow Creek. Female with Yearling track 2008.
?	?	2007,	Born 2007. Cub of 303, Roderick Mt. and EF Pipe 2007
Gt731	F	2007, 10-13	Born 2007. Cub of 303, Roderick Mt. and EF Pipe 2007. Collared 2009-11. DNA 2011, 2012
Gt785	F	2007-08	2006 cub of 354. Radio collared 2007-08
Gt784	F	2007-09	2006 cub of 354. Radio collared 2007-09
?	?	2009	Born 2009. Cub of 675. Natural mortality 2009.
?	?	2009	Born 2009. Cub of 675. Natural mortality 2009.
GtUNK83	M	2009, 11-12	DNA 2009 Flattail Cr, Collared 2011-12
Gt737	M	2010-13	Monitored 2010-13
?	?	2010	Born 2010. cub of 675. Natural mortality 2010.
Gt1374	M	2010	Monitored 2010. Human under investigation mortality Hawkins Cr. 2010
GtUnk107	M	2010	Human under investigation mortality Newton Mtn 2010.
Gt726	M	2011-12	Born 2009. Monitor 2011-12.
?	?	2010	Born 2010. EF Pipe cubs cub of 303? Natural mortality 2010.
Gt729	?	2010-13	Born 2010. EF Pipe cubs cub of 303? Monitor 2011-13
?	?	2010-13	Born 2010. EF Pipe cubs cub of 303? Photo 2011-13
Gt732	M	2011	Born 2006. Management capture 2011. Self-defense mortality 2011 Pipe Cr.
Gt2011038306	M	2011	DNA/Photo 2011 Copper
Gt2011038311	F	2011	Cub of 354. DNA/Photo 2011 Copper
Gt2011049118	M	2011-13	DNA 2011 Mt Henry cub of 552, photo 2012
Gt2011049122	F	2011-13	DNA 2011 Mt Henry cub of 552, photo 2012

Yaak River

Bear	Sex	Years detected	Comments
Gt200354a	M	2011	DNA 2011 Faro Cr mortality
GtUnk123	M	2011	DNA 2011 Flagstaff
Gt10569c1	F	2012	Mortality 2012 Hall Mtn
10569c1cub	?	2012	Mortality 2012 Hall Mtn
?	?	2013	Photo of young grizzly; NF Meadow Cr.
826	M	2013	Research capture; EF Pipe Cr.
?	M	2013	Photo of adult grizzly; Hellroaring Cr.

Cabinets

Bear	Sex	Years detected	Comments
Gt678	F	1983-89, 93	Born 1955. Collared in Cabinets 1983-89. Unknown cause mortality Baree Cr. 1993.
Gt680	M	1984-86	Born. 1973. Collared in Cabinets 1984-85. Observed 1986.
Gt14	M	1985,	Born 1959. Collared in Cabinets 1985. Self-defense mortality 1985.
218	F	1990-92	Born 1985. Augmentation, Monitor 1990-91. Observed 1992.
Gt258	F	1992-93	Born 1986. Augmentation, Monitor 1992-93. Produced cub 1993. Natural mortality 1993.
?	?	1993	Born 1993. Probable natural mortality 1993.
Gt286	F	1993-95, 02, 05, 09	Born 1991. Augmentation, Monitor 1993-95. DNA 2005. Self-defense mortality 2009.
311	F	1994-95	Born 1991. Augmentation, Monitor 1994-95.
GtUNK 39	M	1997,	Claws from Double N Lake Human under investigation mortality 1997.
Gt770	M	2000, 02, 05-12	Born 1994. Photo 2002? Collared 2005-06. DNA 2000, 2005-12
GtUNK 38	F	2001,	Adult female train mortality 2001.
Gt2024	F	2001-02, 07, 11	Born 1997? Sibling 772. DNA 2001-02, 2007, 2011-W Fisher
Gt577	F	2002,	Born 2001. Natural mortality 2002. Sibling 578 and 579.
Gt578	M	2002,	Born 2001. Sibling 577 and 579.
Gt579	M	2002-03	Born 2001. Sibling 577 and 578. Observed 2003.
Gt200618415	M	2006	DNA 2006.
Gt780	M	2002, 06-08, 10-11	Born 2000. Adult male collared 2006-08. DNA 2002, 2010-11
Gt772	F	2002-03, 07-08.	Born 1997. Sibling 2024118. DNA 2002-03, 2007. Collared 2007 with 2 cubs. Observed 2008.
Gt403	M	2004, 07	Born 2004. At least 1 cub photographed with adult female. Mortality 2007 in NCDE.
Gt3119	?	2003-05	Born 2003. Train mortality 2005.
GtA1	F	2005-08	Born 1997? Augmentation. Monitor 2005-07. Observe with 780 2008?
Gt782	F	2006-08	Born 2004. Augmentation. Monitor 2006-08. DNA 2008.
Gt200721009	M	2007, 10-11	Born 2007. DNA 2007,2011. Monitor 2010-11 as 799. Mortality 2011.
Gt200721053	F	2007, 11-12	Born 2007. DNA 2007, 2011-12
Gt789	F	2007, 08	Born 2007. Marked 2007. DNA 2007. Observed 2008.
Gt791	M	2007, 08	Born 2007. Marked 2007. DNA 2007. Observed 2008.
?	?	2008	Born 2005. Human under investigation mortality 2008. Fishtrap Cr.
Gt790	F	2008,	Born 2005. Augmentation. Monitor 2008. Poaching mortality 2008 Noxon residence.
Gt635	F	2008,	Born 2004. Augmentation. Monitor 2008. Train mortality 2008 Noxon
Gt715	F	2009-10	Born 1998? Augmentation. Monitor 2009. Returned to Flathead 2010.
G 2009001005	F	2009-10	Born 2008. Yearling cub of 286, DNA and Photo 2009, DNA and Photo 2010-W Fisher
Gt2009001002	F	2009, 11	Born 2008. Yearling cub of 286, DNA and Photo 2009, 2011-Bear
Gt26D02a	M	2009, 11	Scat located by Montanore / Wasser dogs DNA 2009. Cub photo with 286 in 2005? DNA 2011 Rock Cr.
Gt713	M	2010-11	Monitored 2010-11, Augmentation. DNA 2011. Flathead capture 2012
Gt714	F	2010	Monitored 2010, Augmentation. Returned to Flathead 2010.
Gt2010011328	F	2010-11	Born 2010, DNA and photo Rock Cr. 2010, Unknown mortality 2011
Gt2010011205	F	2010	Adult 2010, DNA and photo Rock Cr. 2010

Cabinets

Bear	Sex	Years detected	Comments
Gt2010011131	M	2010	Born 2010, DNA and photo Rock Cr. 2010
?	?	2011	Unknown cause mortality 2011. Rock Lake.
Gt2011092001	F	2011	DNA 2011 Chippewa
GB724	M	2011-12	Management 2011
GB725	F	2011-13	Augmentation 2011, returned to Flathead then back to Cabinets
GB723	M	2011-12	Augmentation 2011
GB918	M	2012-13	Augmentation 2012
GB919	M	2013	Augmentation 2013
?	?	2013	Adult female with 2 young photo W. Fisher
?	?	2013	1 of 2 young with Adult female photo W. Fisher
?	?	2013	1 of 2 young with Adult female photo W. Fisher

[1]Entries with numbers indicate bears captured and tagged. Entries with Gt signify a genotype obtained from hair.

Appendix 3. Grizzly Bear Home Ranges

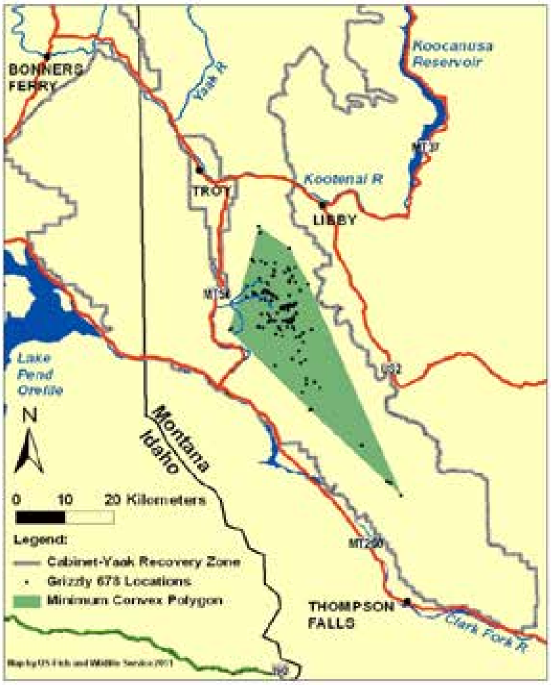


Figure 32. Radio locations and minimum convex (shaded) life range of female grizzly bear 678 in the Cabinet Mountains, 1983-89.

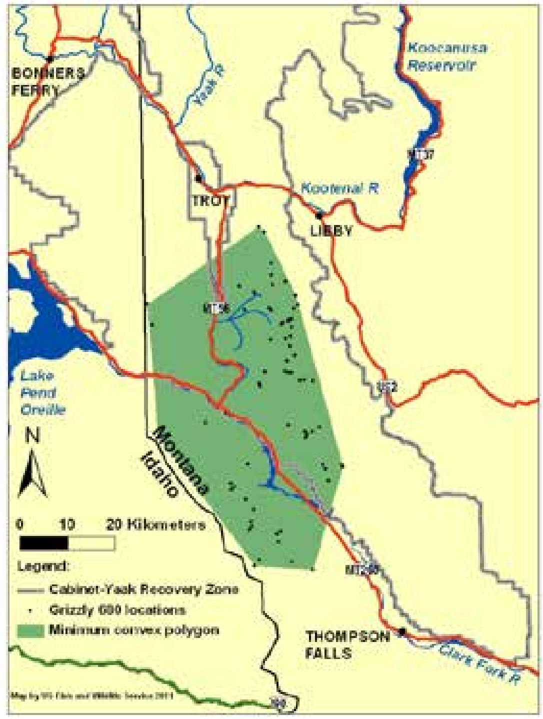


Figure 33. Radio locations and minimum convex (shaded) life range of male grizzly bear 680 in the Cabinet Mountains, 1984-85.

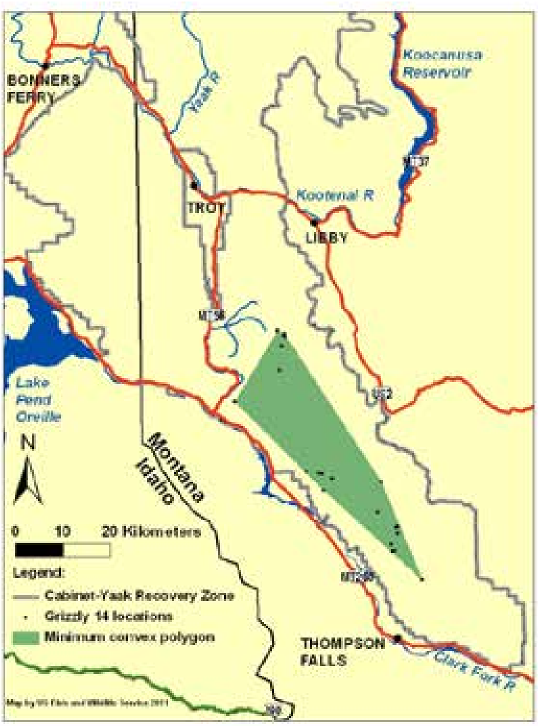


Figure 34. Radio locations and minimum convex (shaded) life range of male grizzly bear 14 in the Cabinet Mountains, 1985.

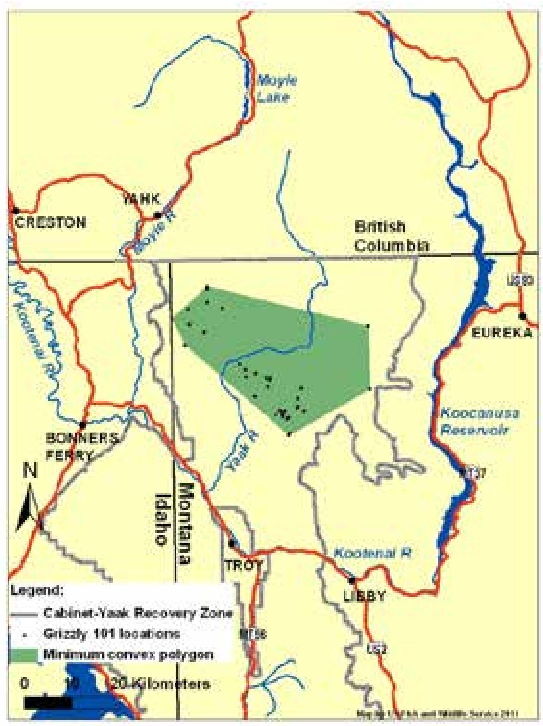


Figure 35. Radio locations and minimum convex (shaded) life range of male grizzly bear 101 in the Yaak River, 1986-87.

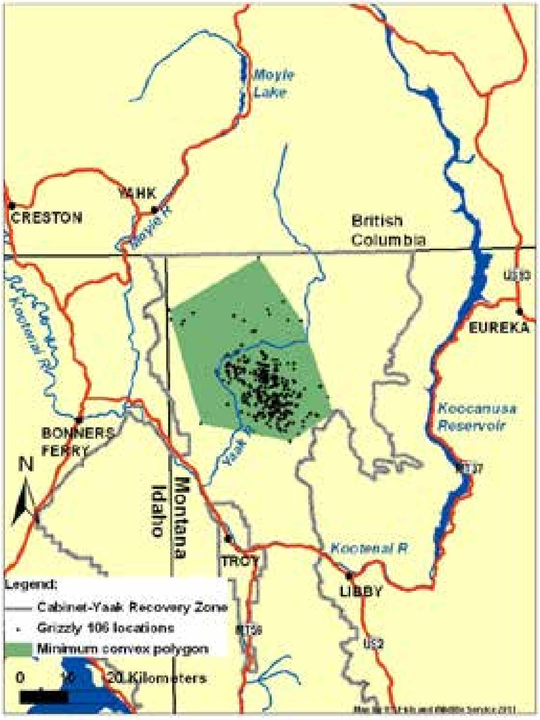


Figure 36. Radio locations and minimum convex (shaded) life range of female grizzly bear 106 in the Yaak River, 1986-99.

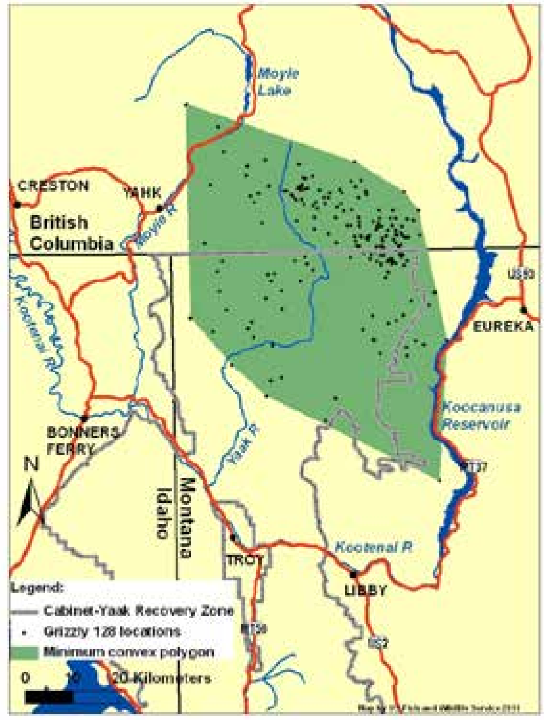


Figure 37. Radio locations and minimum convex (shaded) life range of male grizzly bear 128 in the Yaak River, 1987-97.

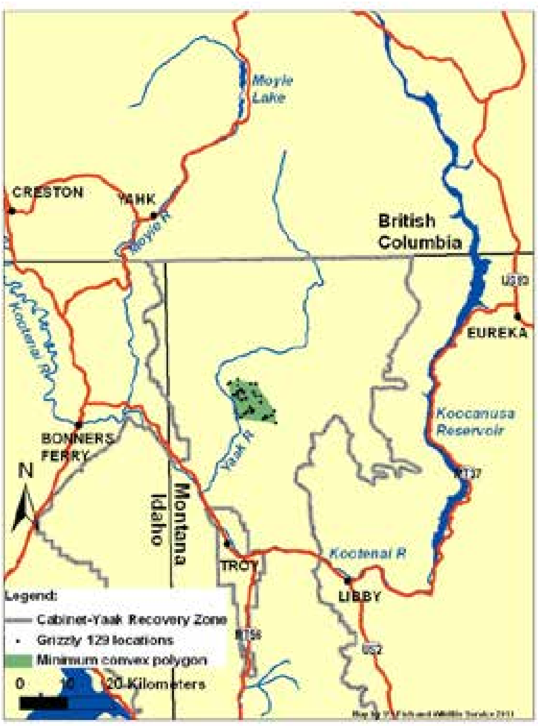


Figure 38. Radio locations and minimum convex (shaded) life range of female grizzly bear 129 in the Yaak River, 1987-89.

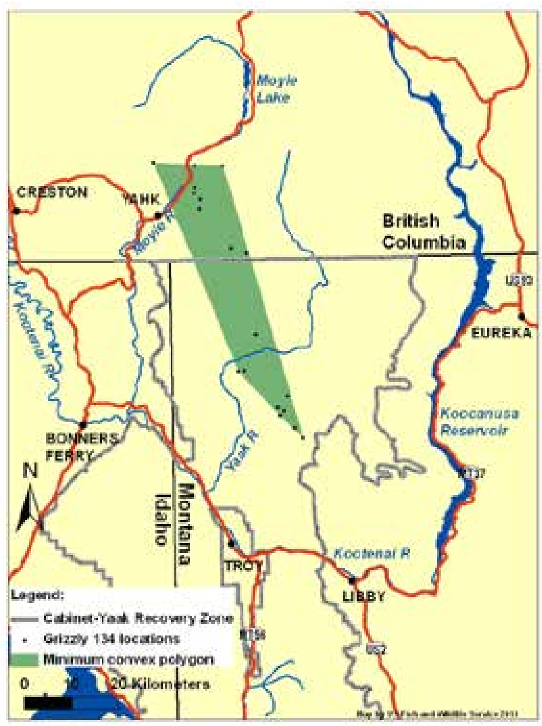


Figure 39. Radio locations and minimum convex (shaded) life range of male grizzly bear 134 in the Yaak River, 1987-88.

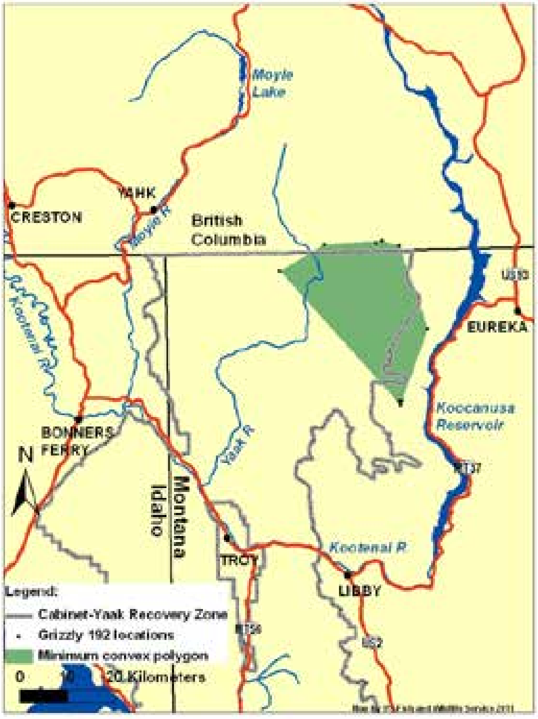


Figure 40. Radio locations and minimum convex (shaded) life range of male grizzly bear 192 in the Yaak River, 1990.

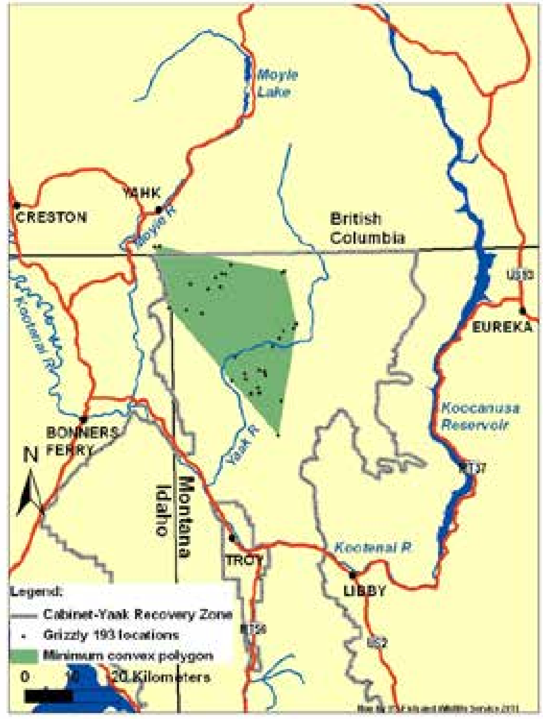


Figure 41. Radio locations and minimum convex (shaded) life range of male grizzly bear 193 in the Yaak River, 1990.

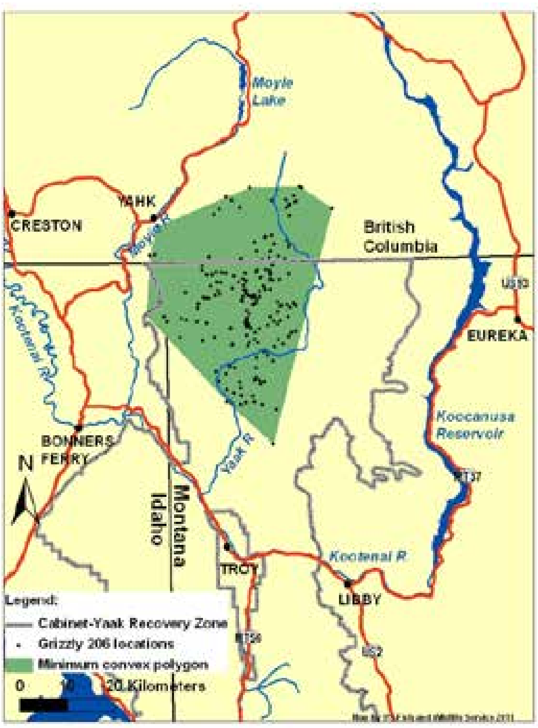


Figure 42. Radio locations and minimum convex (shaded) life range of female grizzly bear 206 in the Yaak River, 1991-94.

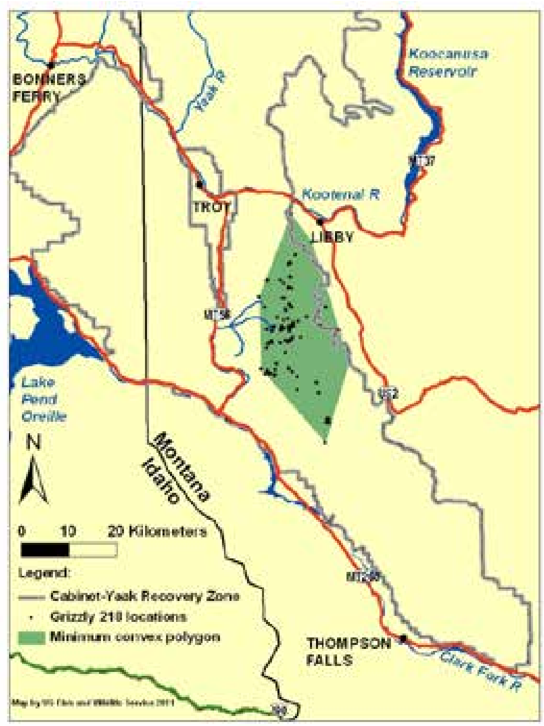


Figure 43. Radio locations and minimum convex (shaded) life range of female augmentation grizzly bear 218 in the Cabinet Mountains, 1990-91.

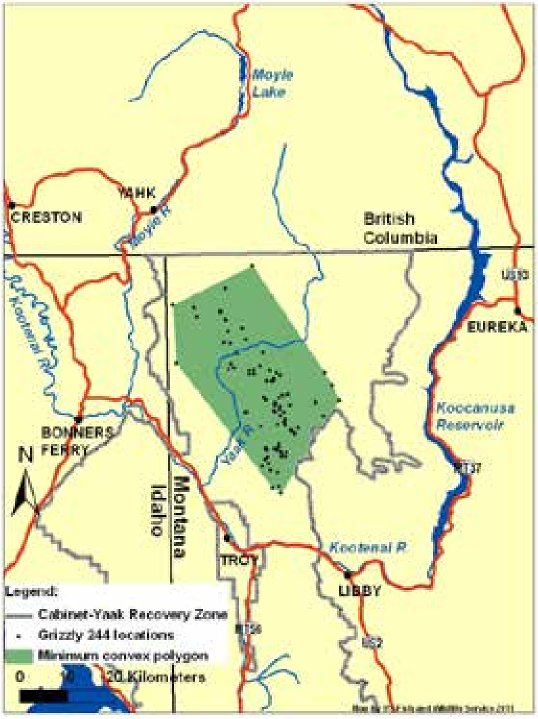


Figure 44. Radio locations and minimum convex (shaded) life range of male grizzly bear 244 in the Yaak River, 1992-03.

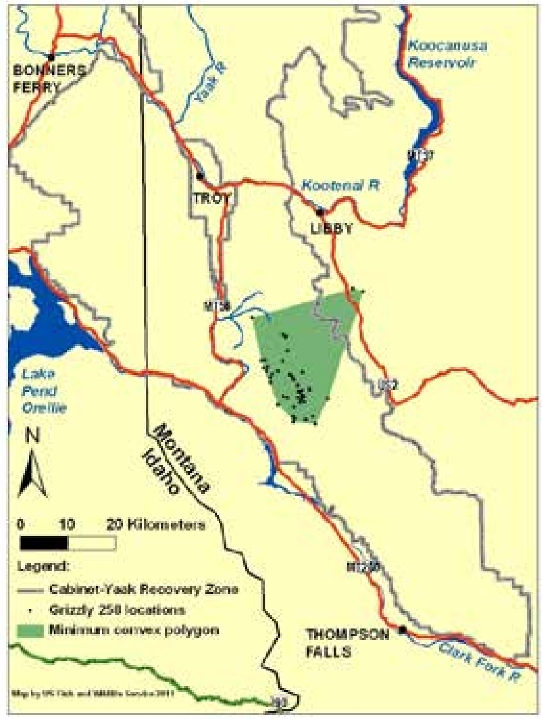


Figure 45. Radio locations and minimum convex (shaded) life range of female augmentation grizzly bear 258 in the Cabinet Mountains, 1992-93.

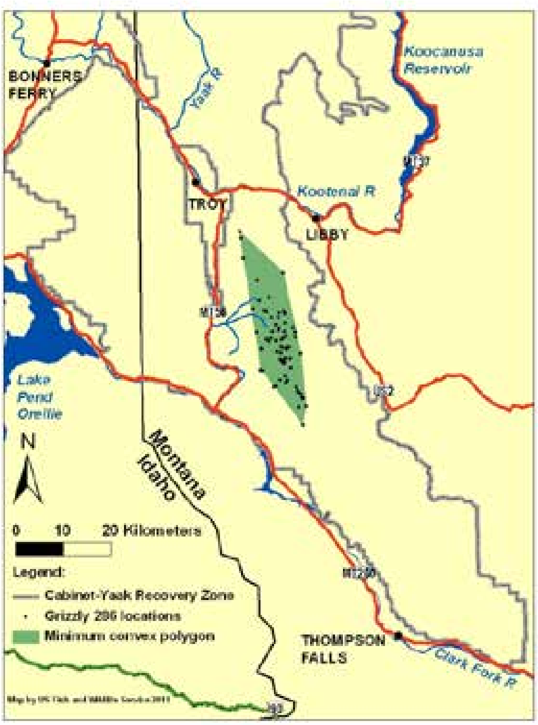


Figure 46. Radio locations and minimum convex (shaded) life range of female augmentation grizzly bear 286 in the Cabinet Mountains, 1993-95.

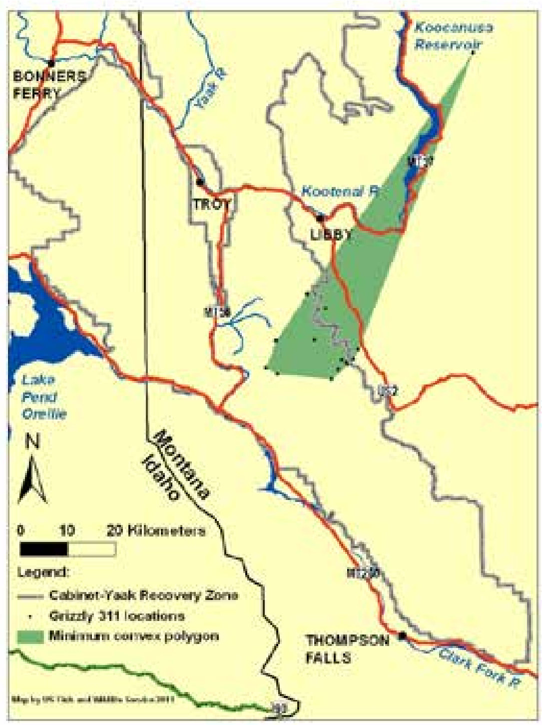


Figure 47. Radio locations and minimum convex (shaded) life range of female augmentation grizzly bear 311 in the Cabinet Mountains, 1994-95.

Figure 48. Radio locations and minimum convex (shaded) life range of male grizzly bear 302 in the Yaak River, 1994-96.

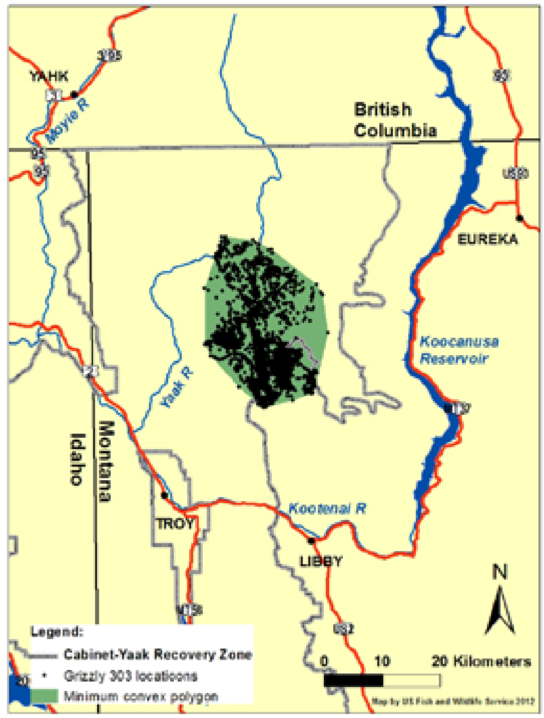


Figure 49. Radio locations and minimum convex (shaded) life range of female grizzly bear 303 in the Yaak River, 1994-01 and 2011-13.

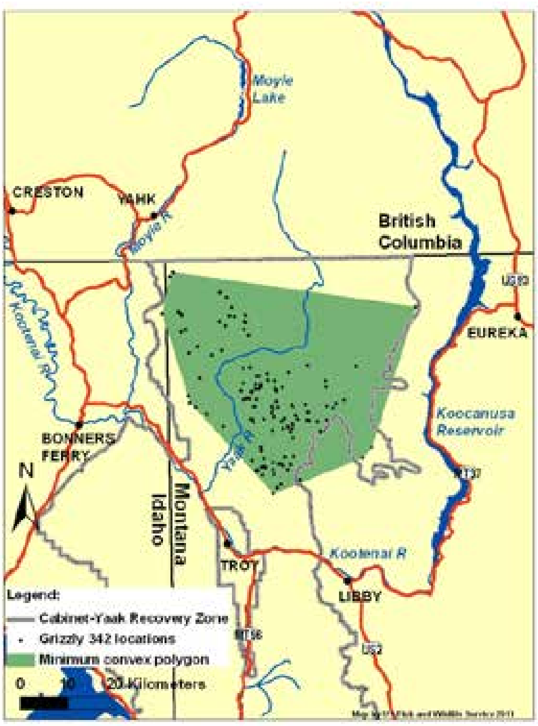


Figure 50. Radio locations and minimum convex (shaded) life range of male grizzly bear 342 in the Yaak River, 1995-01.

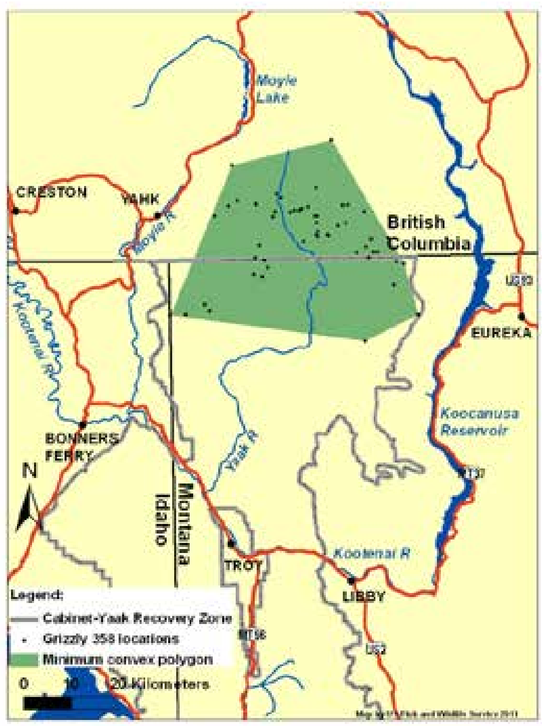


Figure 51. Radio locations and minimum convex (shaded) life range of male grizzly bear 358 in the Yaak River, 1996-98.

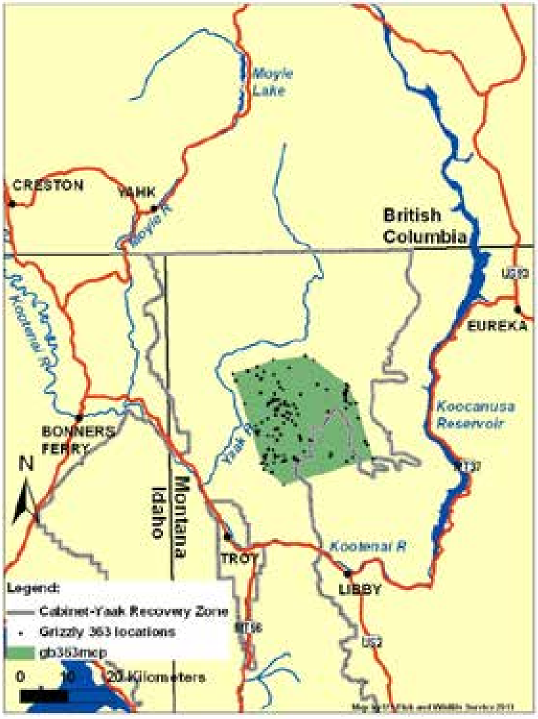


Figure 52. Radio locations and minimum convex (shaded) life range of male grizzly bear 363 in the Yaak River, 1996-99.

Figure 53. Radio locations and minimum convex (shaded) life range of male grizzly bear 386 in the Yaak River, 1997-99.

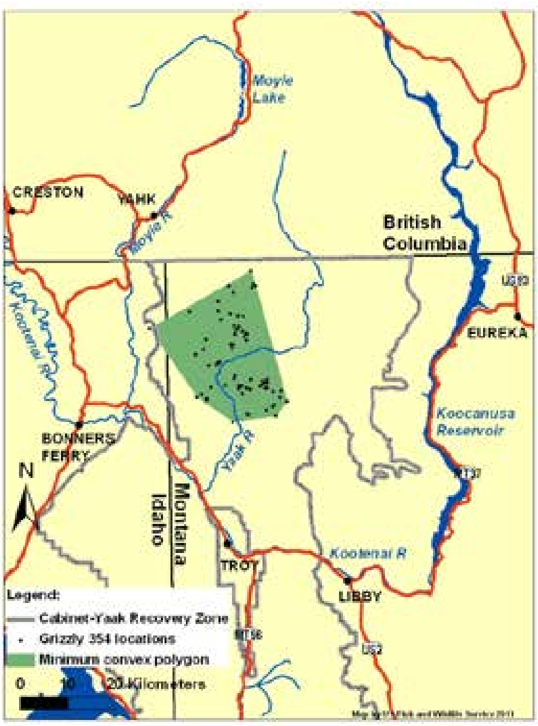


Figure 54. Radio locations and minimum convex (shaded) life range of female grizzly bear 354 in the Yaak River, 1997-99.

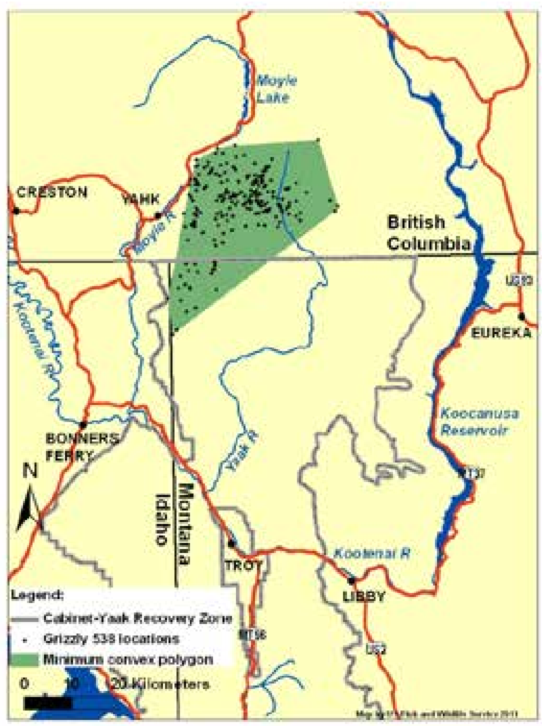


Figure 55. Radio locations and minimum convex (shaded) life range of female grizzly bear 538 in the Yaak River, 1997-02.

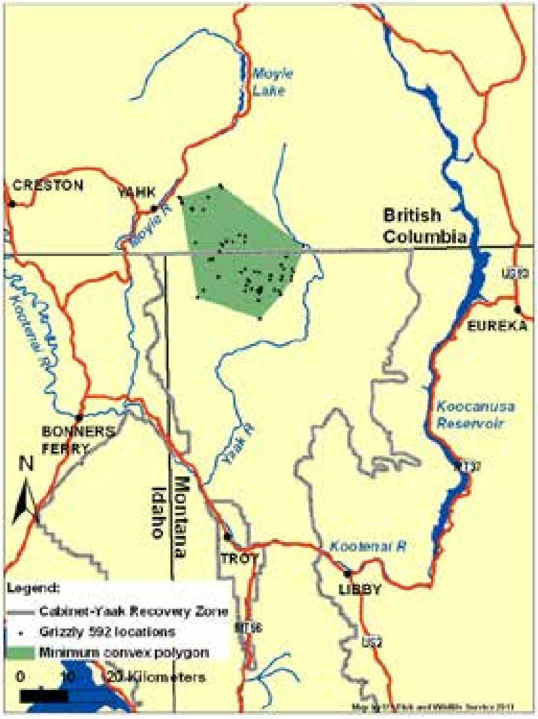


Figure 56. Radio locations and minimum convex (shaded) life range of female grizzly bear 592 in the Yaak River, 1999-00.

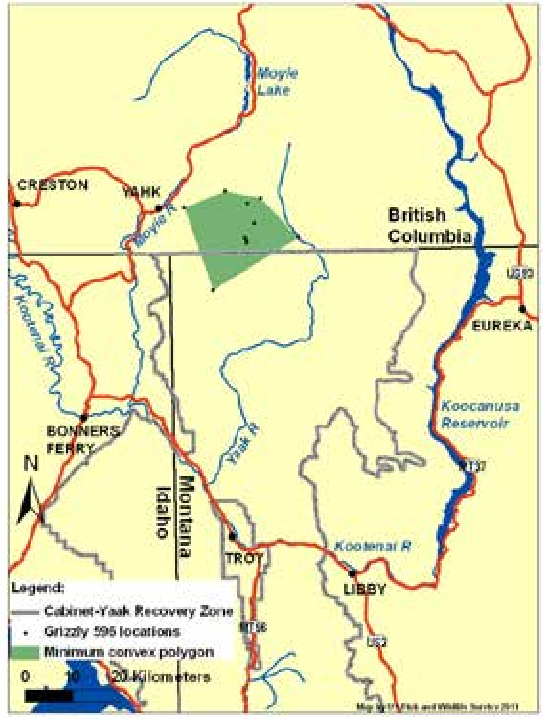


Figure 57. Radio locations and minimum convex (shaded) life range of female grizzly bear 596 in the Yaak River, 1999.

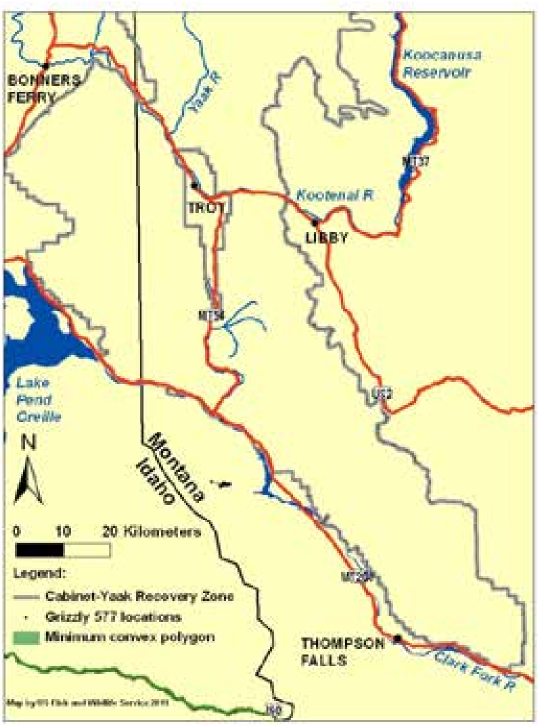


Figure 58. Radio locations and minimum convex (shaded) life range of female grizzly bear 577 in the Cabinet Mountains, 2002.

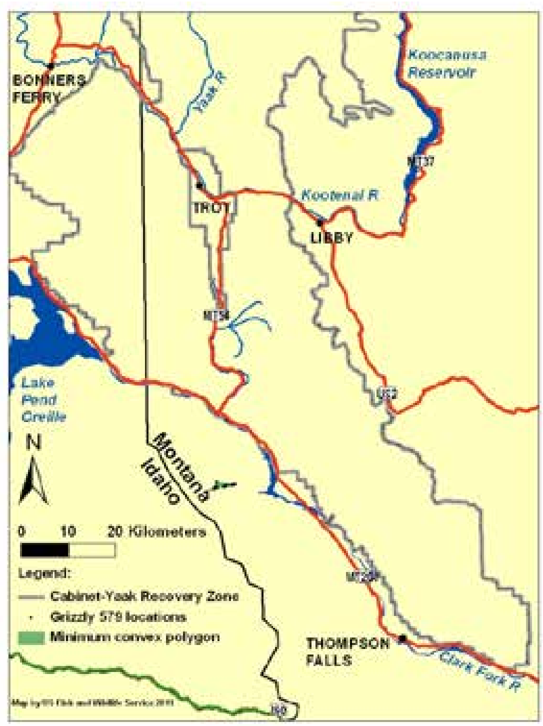


Figure 59. Radio locations and minimum convex (shaded) life range of male grizzly bear 579 in the Cabinet Mountains, 2002.

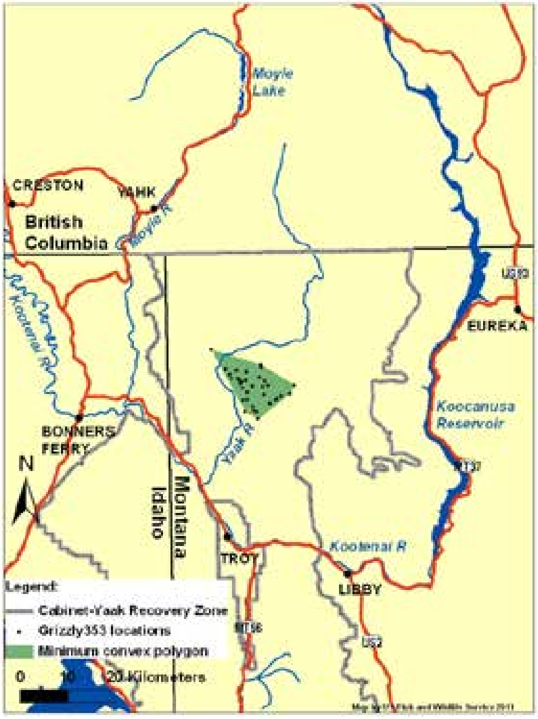


Figure 60. Radio locations and minimum convex (shaded) life range of female grizzly bear 353 in the Yaak River, 2002.

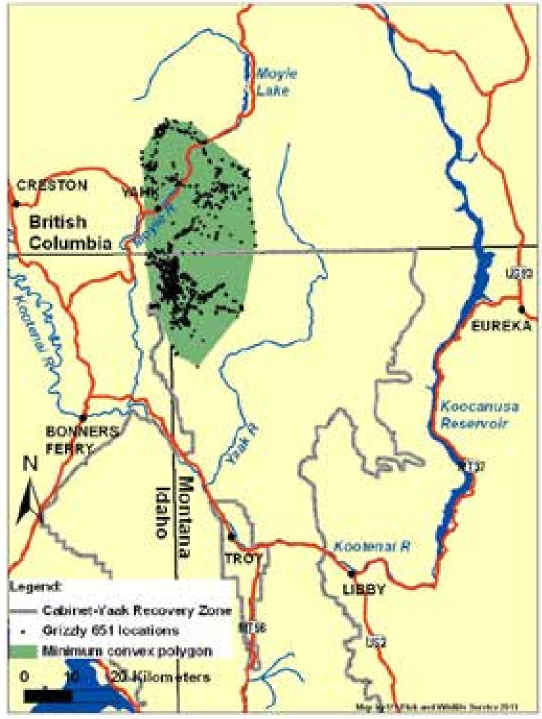


Figure 61. Radio locations and minimum convex (shaded) life range of male grizzly bear 651 in the Yaak River, 2002-06.

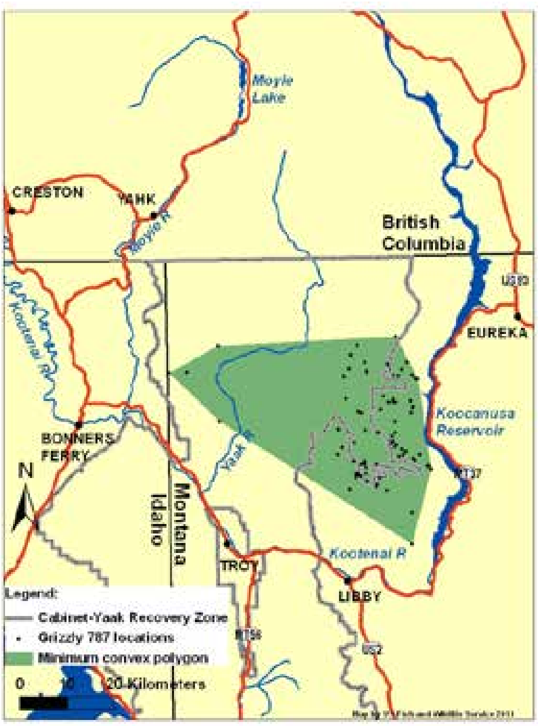


Figure 62. Radio locations and minimum convex (shaded) life range of male grizzly bear 787 in the Yaak River, 2003-04.

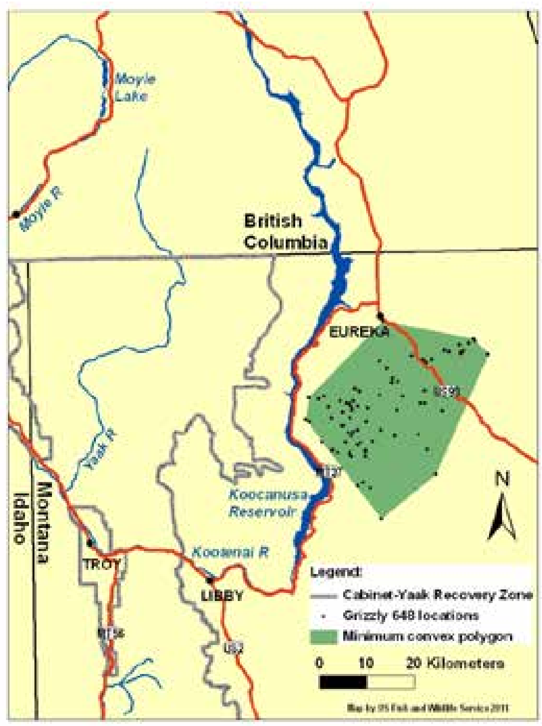


Figure 63. Radio locations and minimum convex (shaded) life range of female grizzly bear 648 in the Yaak River, 2003-05.

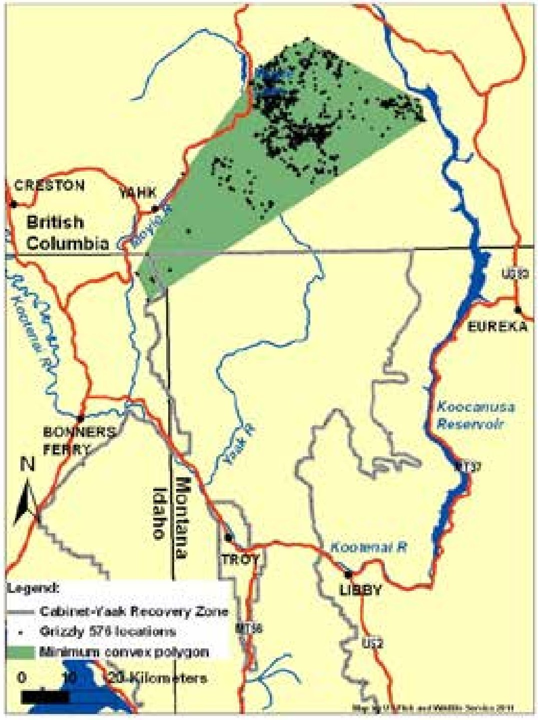


Figure 64. Radio locations and minimum convex (shaded) life range of male grizzly bear 576 in the Yaak River, 2004-06.

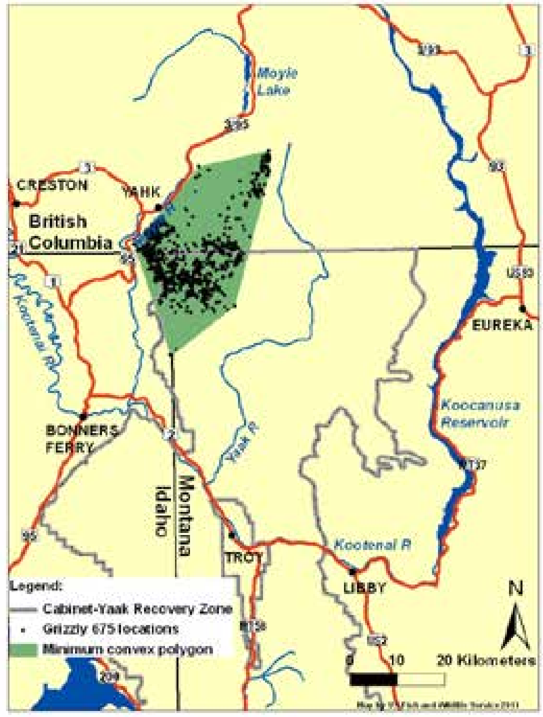


Figure 65. Radio locations and minimum convex (shaded) life range of female grizzly bear 675 in the Yaak River, 2004-10.

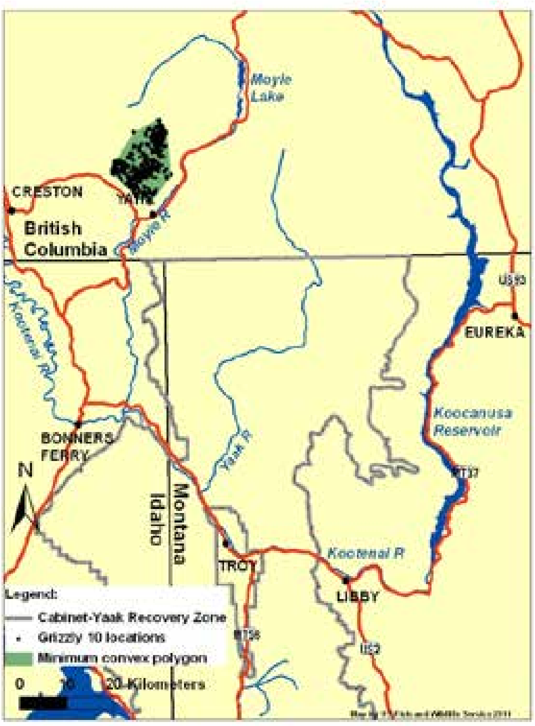


Figure 66. Radio locations and minimum convex (shaded) life range of female grizzly bear 10 in the Purcell Mountains, 2004.

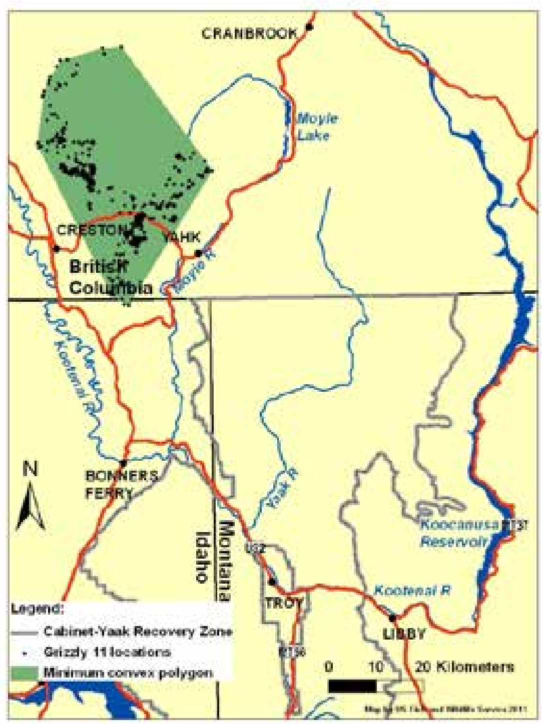


Figure 67. Radio locations and minimum convex (shaded) life range of male grizzly bear 11 in the Purcell Mountains, 2004.

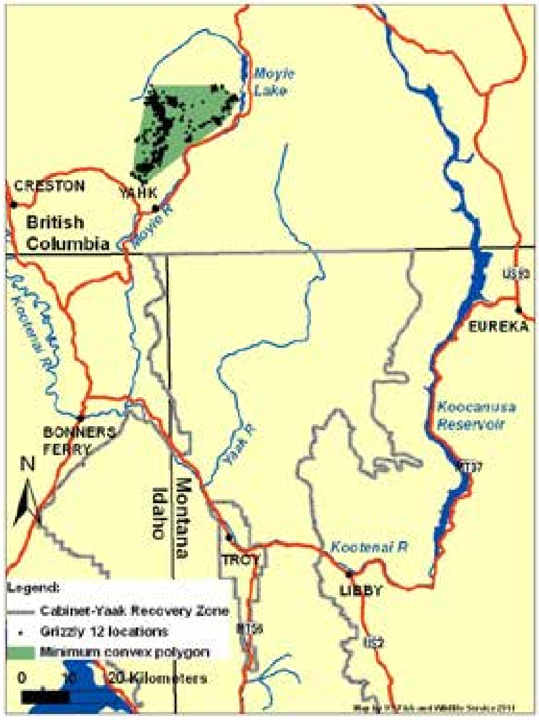


Figure 68. Radio locations and minimum convex (shaded) life range of female grizzly bear 12 in the Purcell Mountains, 2004.

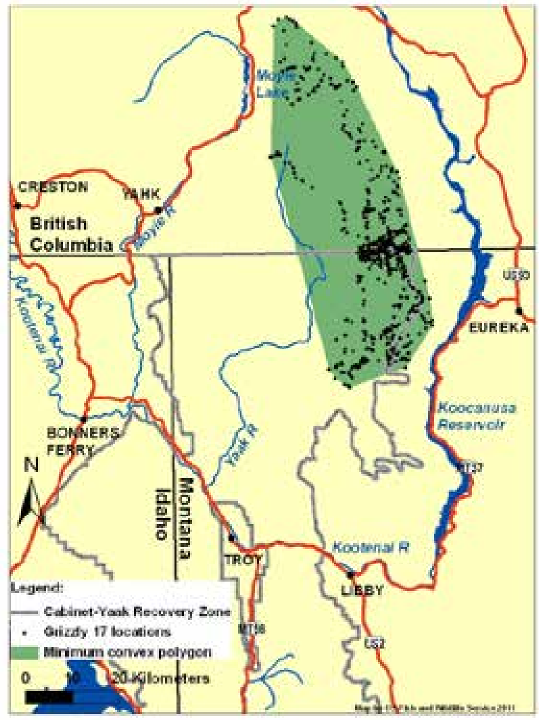


Figure 69. Radio locations and minimum convex (shaded) life range of male grizzly bear 17 in the Purcell Mountains, 2004.

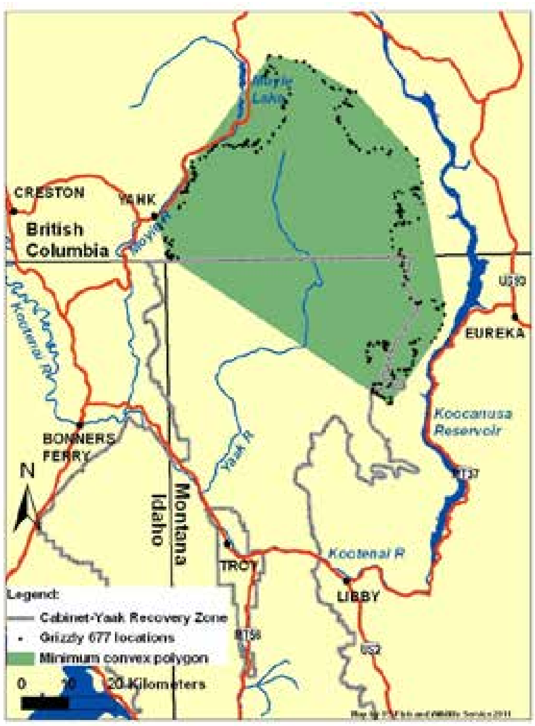


Figure 70. Radio locations and minimum convex (shaded) life range of male grizzly bear 677 in the Purcell Mountains, 2005.

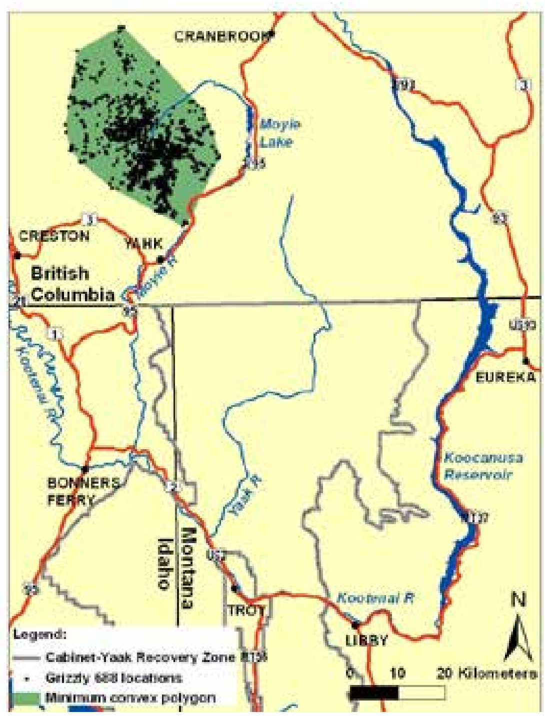


Figure 71. Radio locations and minimum convex (shaded) life range of male grizzly bear 688 in the Purcell Mountains, 2005-06.

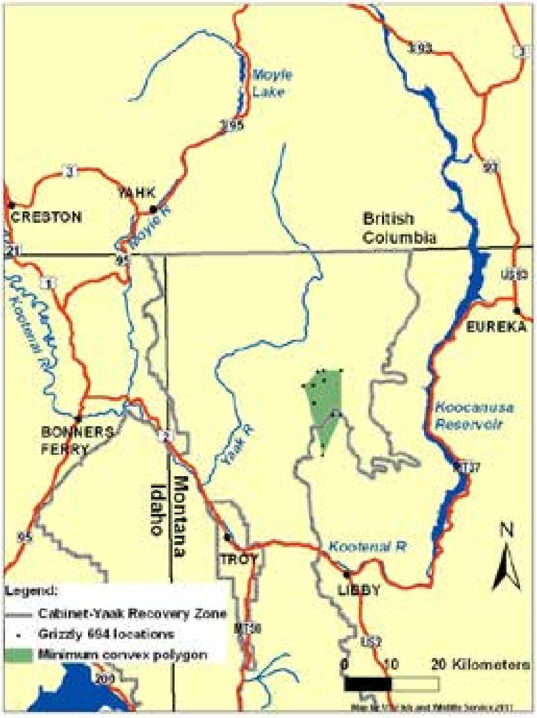


Figure 72. Radio locations and minimum convex (shaded) life range of female grizzly bear 694 in the Yaak River, 2005.

Figure 73. Radio locations and minimum convex (shaded) life range of female grizzly bear 292 in the Purcell Mountains, 2005.

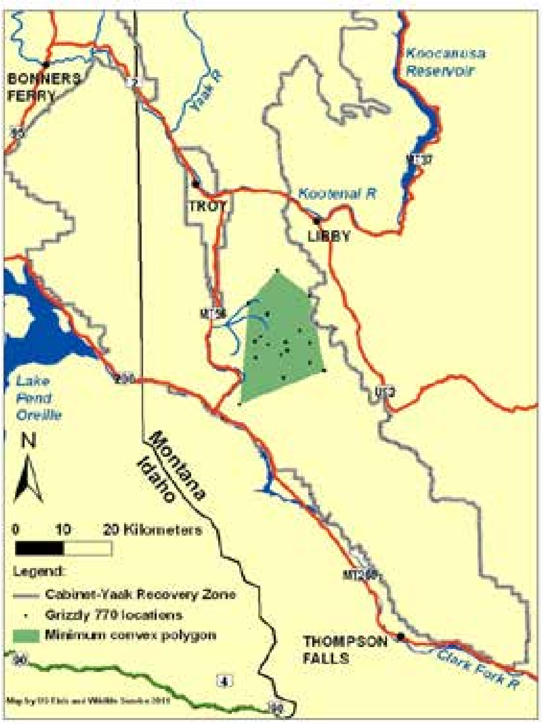


Figure 74. Radio locations and minimum convex (shaded) life range of male grizzly bear 770 in the Cabinet Mountains, 2005-06.

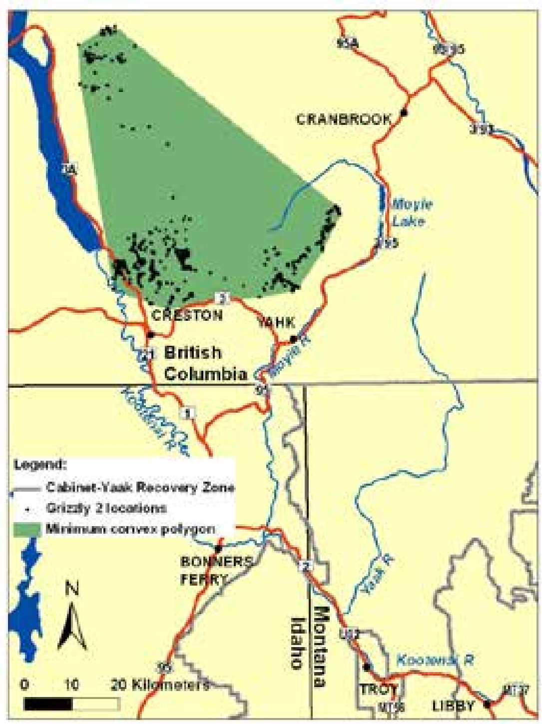


Figure 75. Radio locations and minimum convex (shaded) life ranges of male grizzly bear 2 in the Purcell Mountains, 2005.

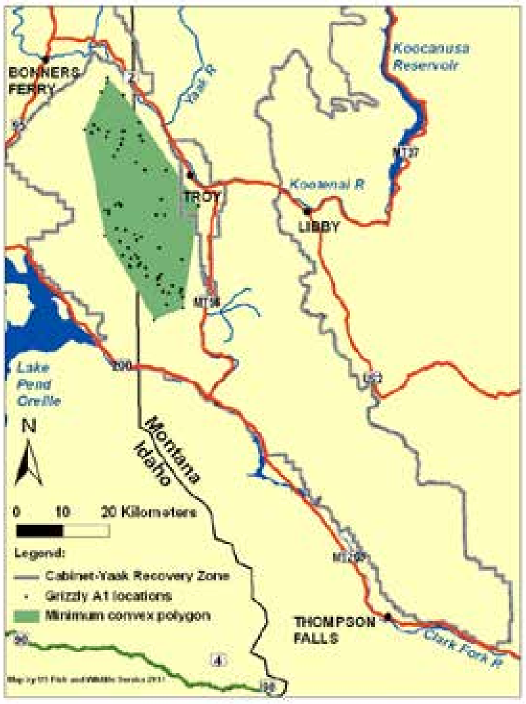


Figure 76. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear A1 in the Cabinet Mountains, 2005-07.

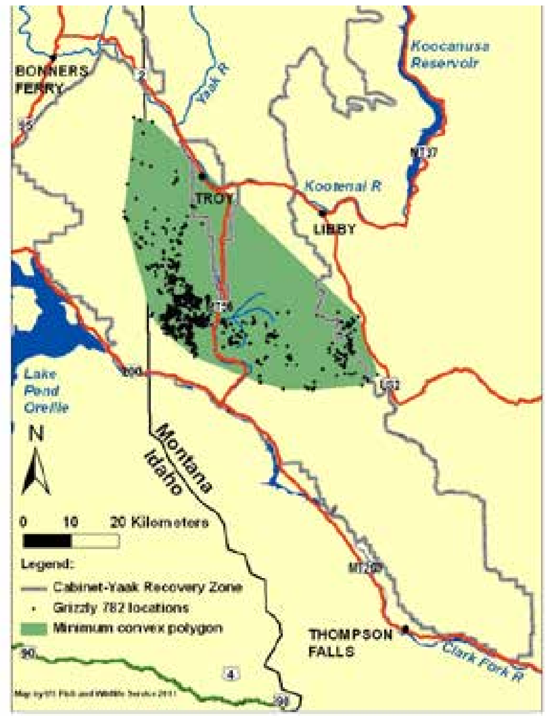


Figure 77. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 782 in the Cabinet Mountains, 2006-07.

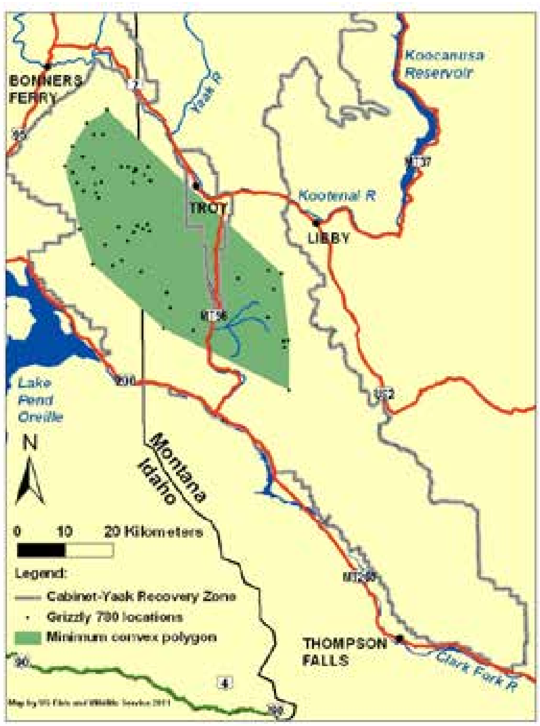


Figure 78. Radio locations and minimum convex (shaded) life range of male grizzly bear 780 in the Cabinet Mountains, 2006-08.

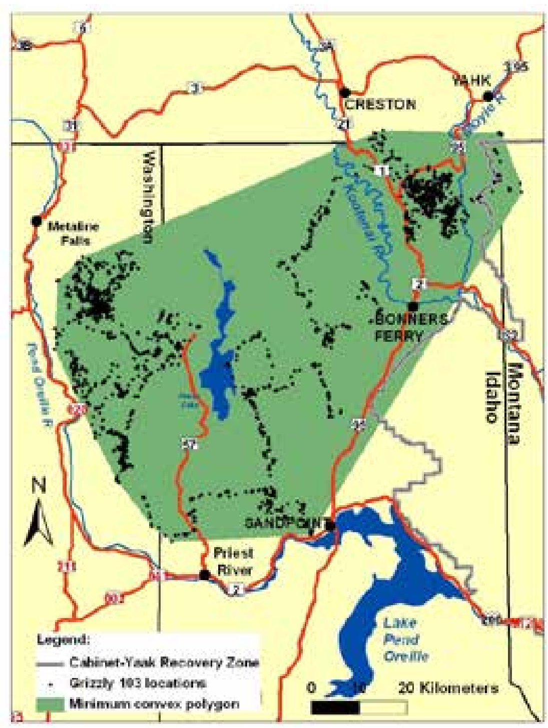


Figure 79. Radio locations and minimum convex (shaded) life range of male grizzly bear 103 in the Yaak River, 2006-07.

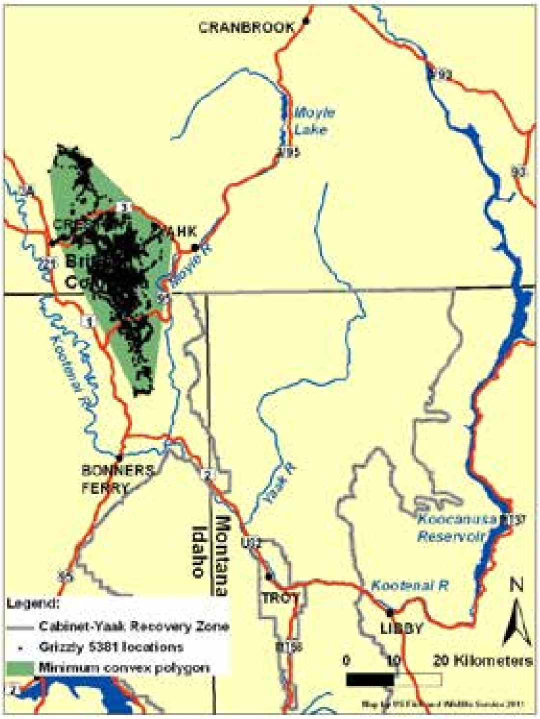


Figure 80. Radio locations and minimum convex (shaded) life range of male grizzly bear 5381 in the Purcell Mountains, 2006-07.

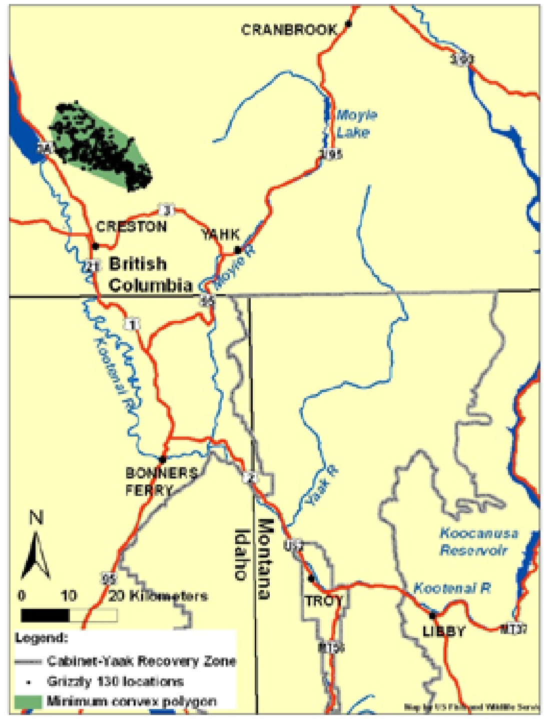


Figure 81. Radio locations and minimum convex (shaded) life range of female grizzly bear 130 in the Purcell Mountains, 2007-08.

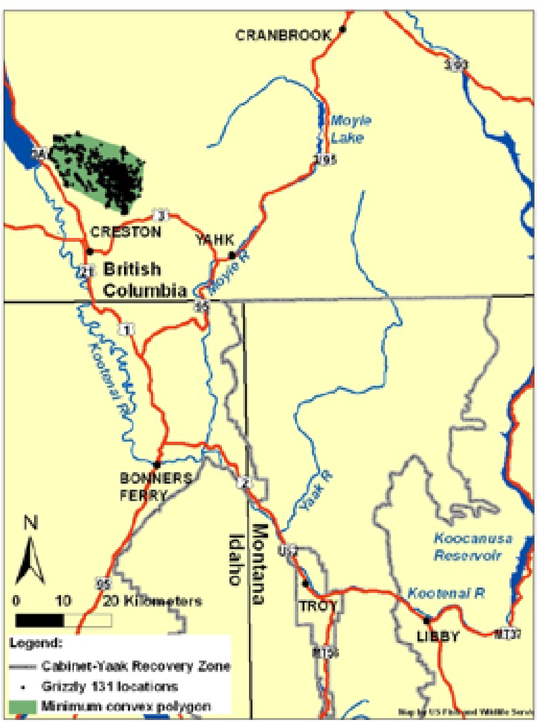


Figure 82. Radio locations and minimum convex (shaded) life range of female grizzly bear 131 in the Purcell Mountains, 2007-08.

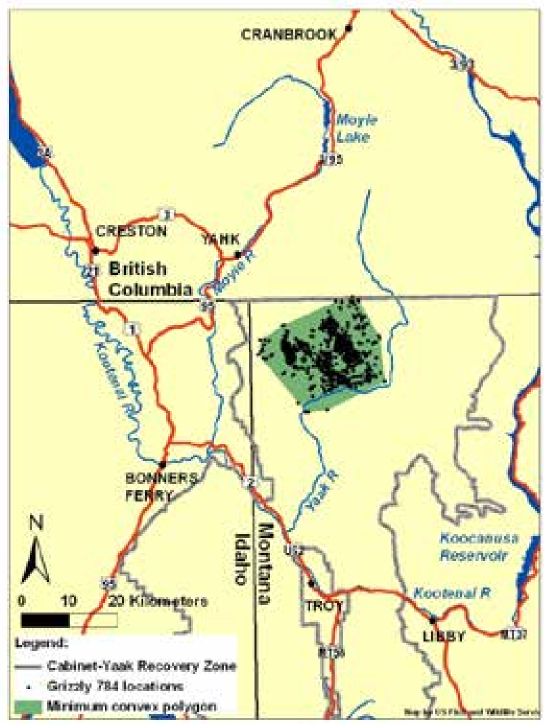


Figure 83. Radio locations and minimum convex (shaded) life range of female grizzly bear 784 in the Yaak River, 2007-09.

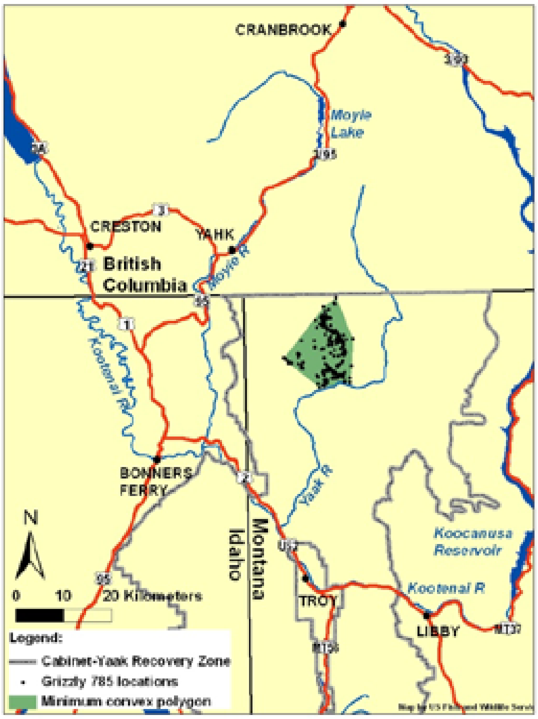


Figure 84. Radio locations and minimum convex (shaded) life range of female grizzly bear 785 in the Yaak River, 2007-08.

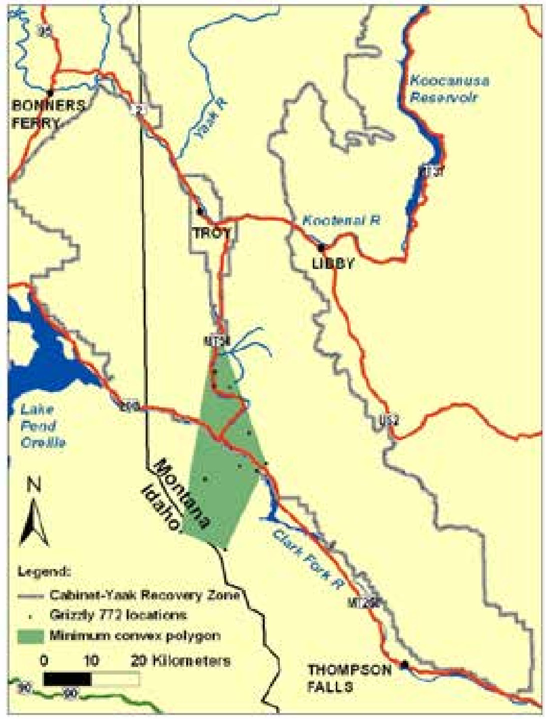


Figure 85. Radio locations and minimum convex (shaded) life range of female grizzly bear 772 in the Cabinet Mountains, 2007.

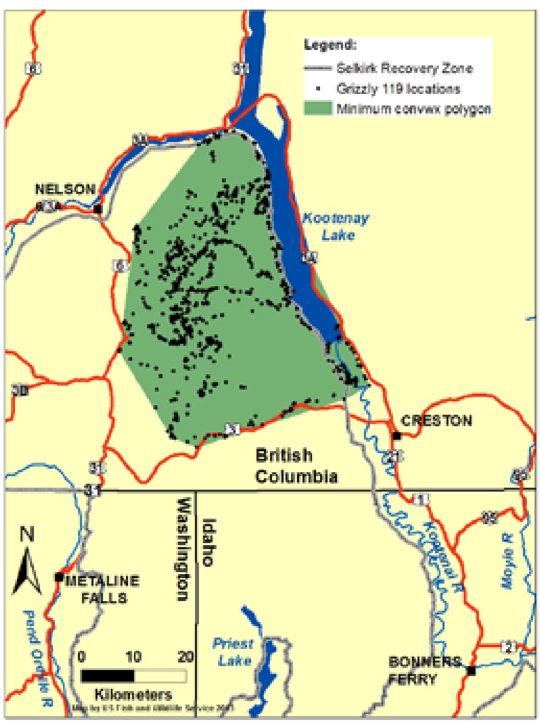


Figure 86. Radio locations and minimum convex (shaded) life range of male grizzly bear 119 in the Selkirk Mountains, 2008-09.

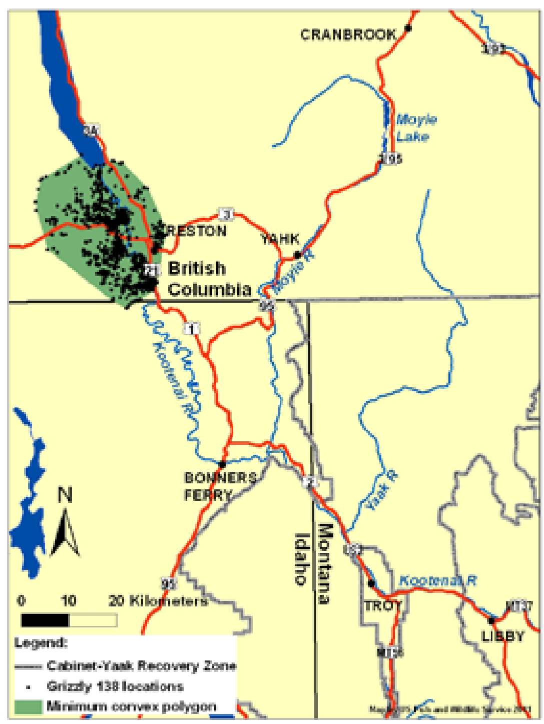


Figure 87. Radio locations and minimum convex (shaded) life range of female grizzly bear 138 in the Kootenay River Valley, 2008-09.

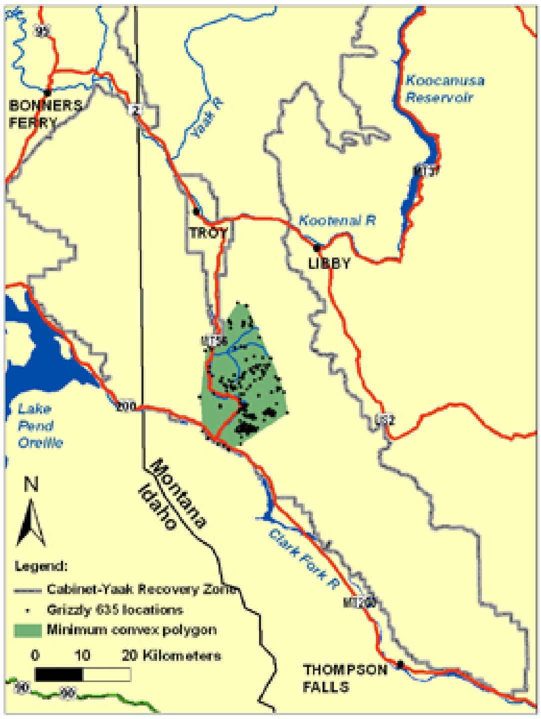


Figure 88. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 635 in the Cabinet Mountains, 2008.

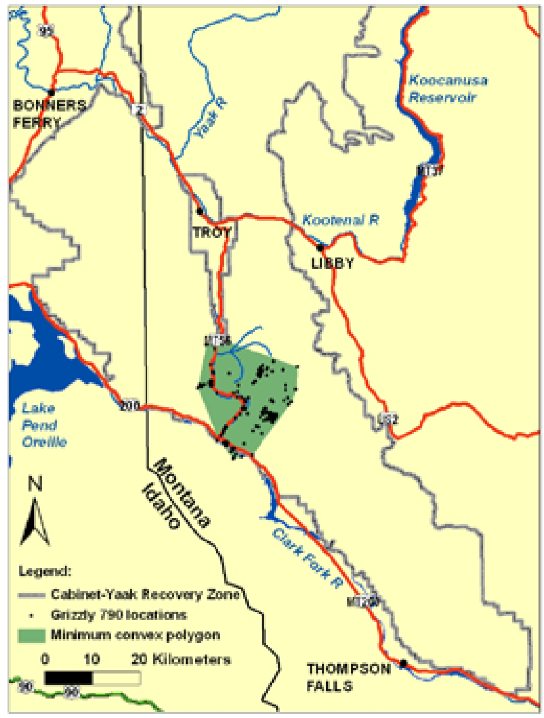


Figure 89. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 790 in the Cabinet Mountains, 2008.

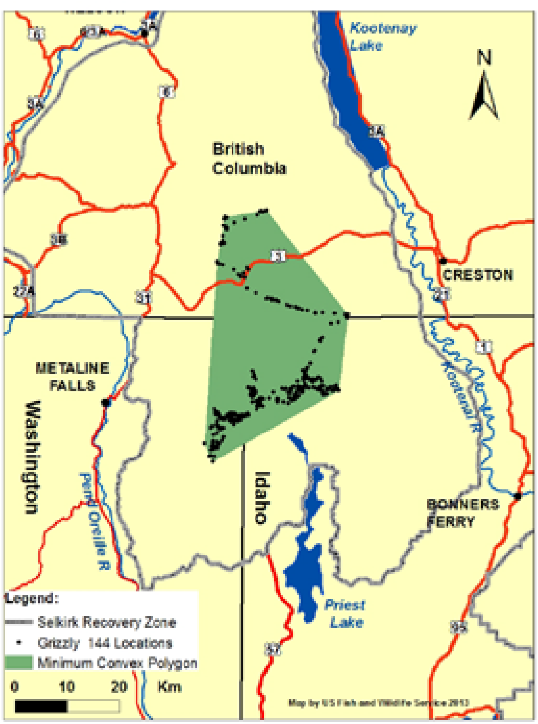


Figure 90. Radio locations and minimum convex (shaded) life range of male grizzly bear 144 in the Selkirk Mountains, 2008.

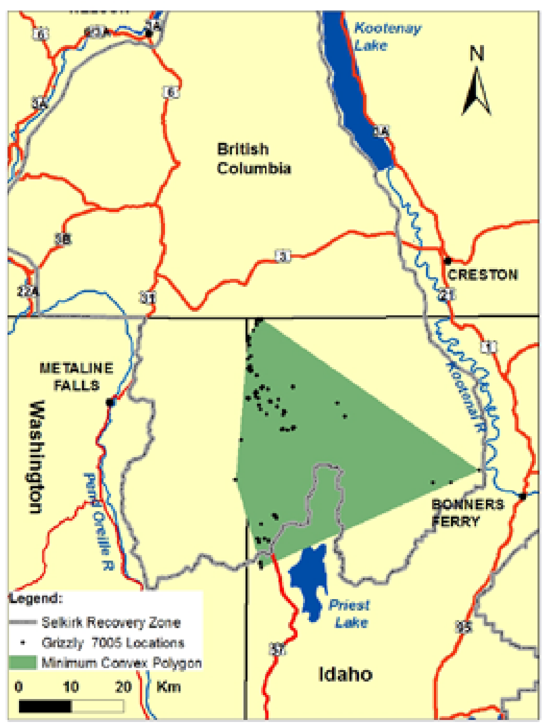


Figure 91. Radio locations and minimum convex (shaded) life range of management male grizzly bear 7005 in the Selkirk Mountains, 2008.

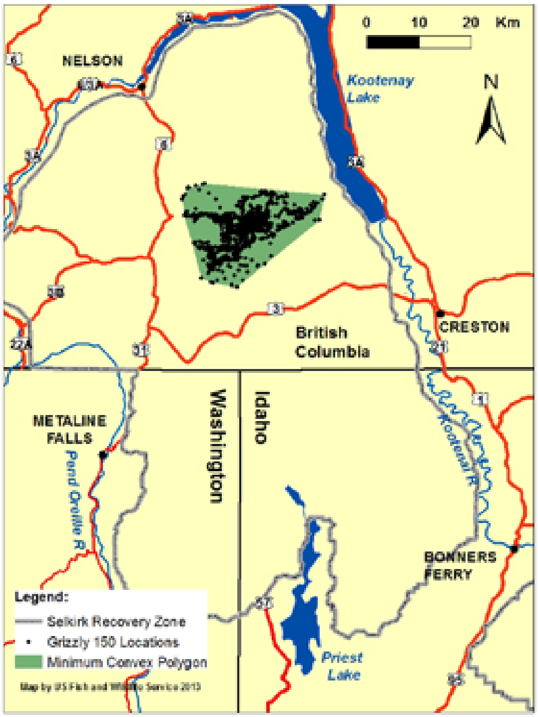


Figure 92. Radio locations and minimum convex (shaded) life range of female grizzly bear 150 in the Selkirk Mountains, 2008-09.

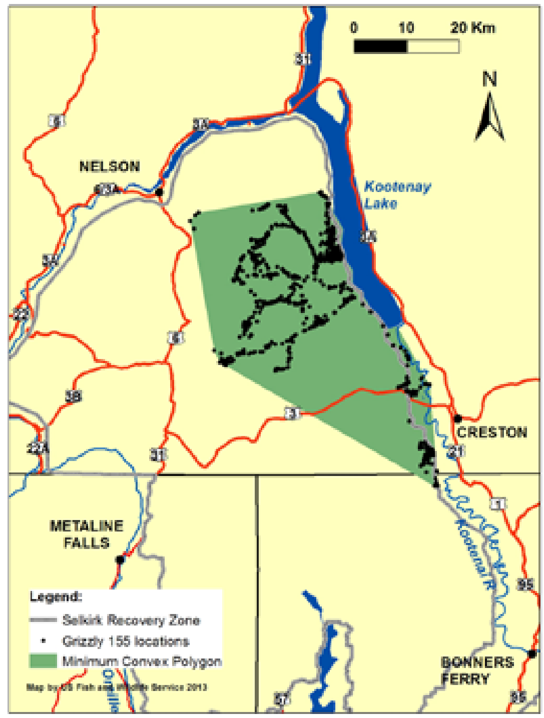


Figure 93. Radio locations and minimum convex (shaded) life range of male grizzly bear 155 in the Selkirk Mountains, 2008-10.

Figure 94. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 715 in the Cabinet Mountains, 2009-10.

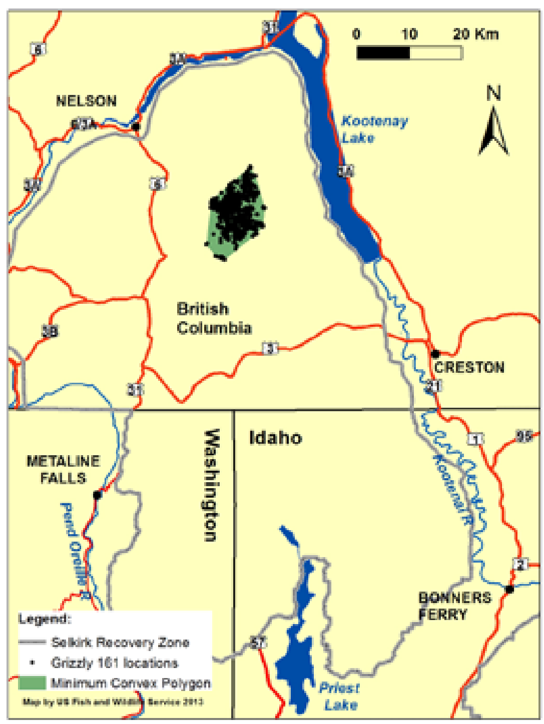


Figure 95. Radio locations and minimum convex (shaded) life range of female grizzly bear 161 in the Selkirk Mountains, 2009-10.

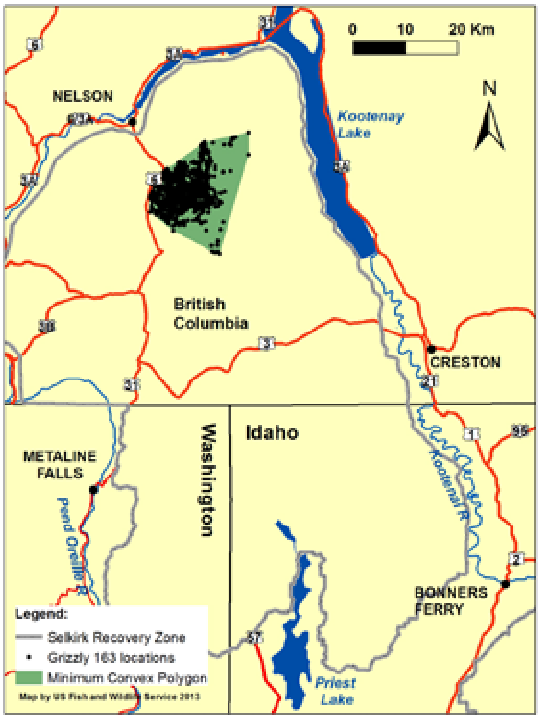


Figure 96. Radio locations and minimum convex (shaded) life range of female grizzly bear 163 in the Selkirk Mountains, 2009-10.

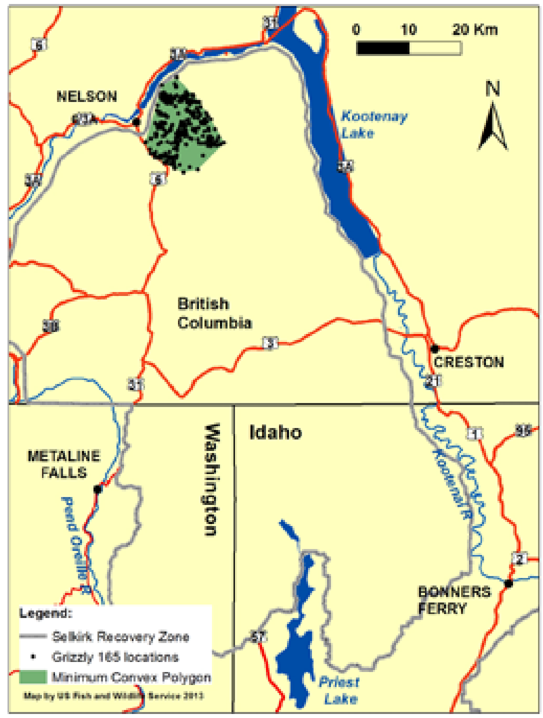


Figure 97. Radio locations and minimum convex (shaded) life range of female grizzly bear 165 in the Selkirk Mountains, 2009-10.

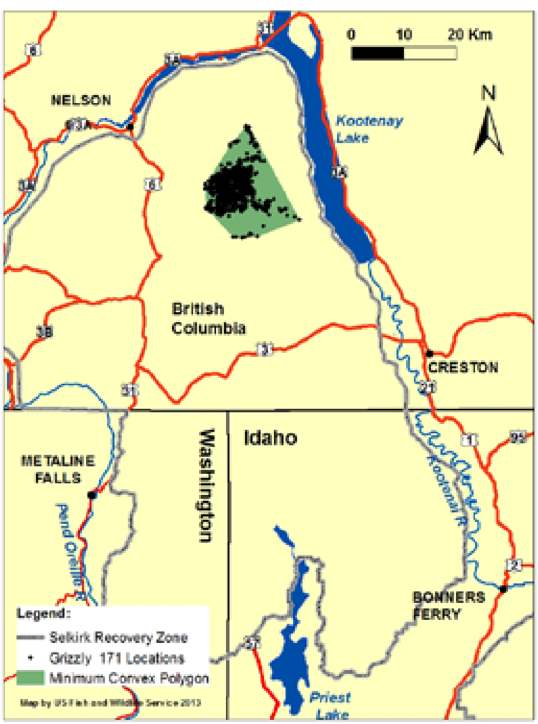


Figure 98. Radio locations and minimum convex (shaded) life range of female grizzly bear 171 in the Selkirk Mountains, 2009-10.

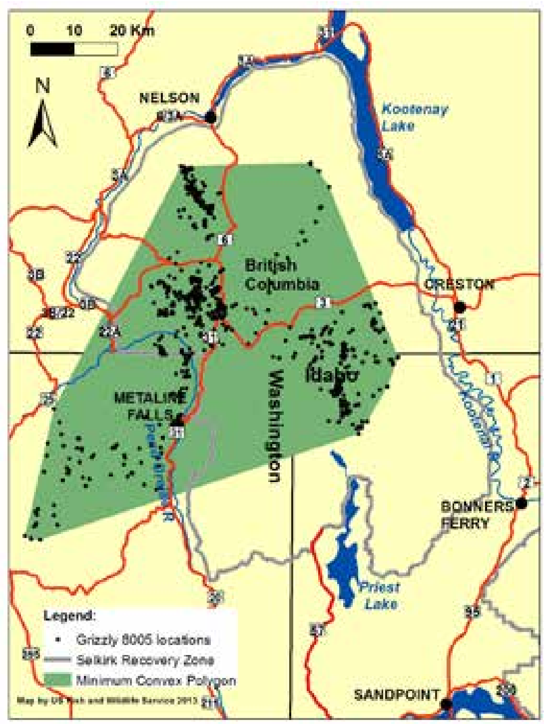


Figure 99. Radio locations and minimum convex (shaded) life range of female grizzly bear 8005 in the Selkirk Mountains, 2009-10.

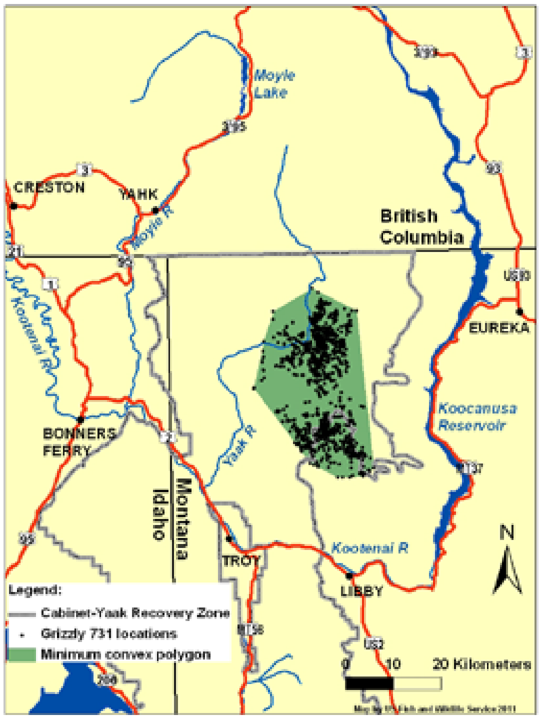


Figure 100. Radio locations and minimum convex (shaded) life range of female grizzly bear 731 in the Yaak River, 2009-11.

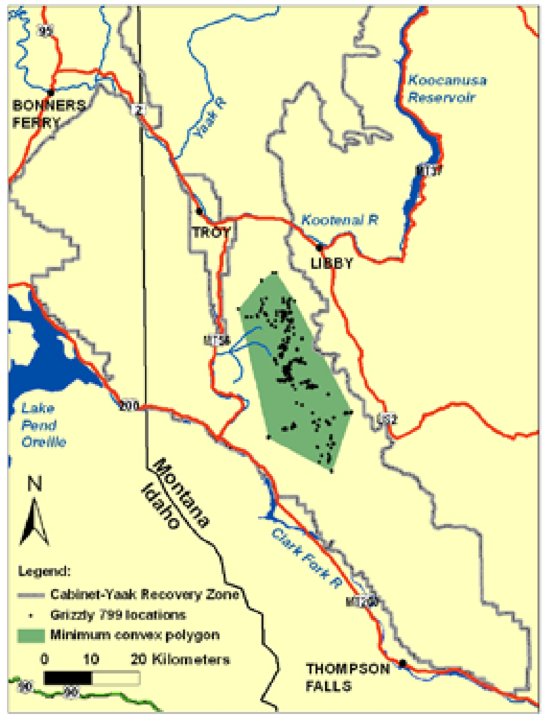


Figure 101. Radio locations and minimum convex (shaded) life range of male grizzly bear 799 in the Cabinet Mountains, 2009-10.

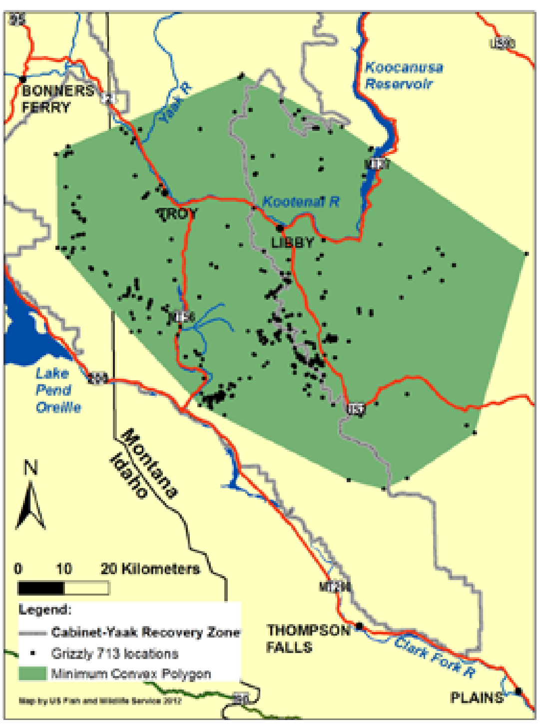


Figure 102. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 713 in the Cabinet Mountains, 2010-11.

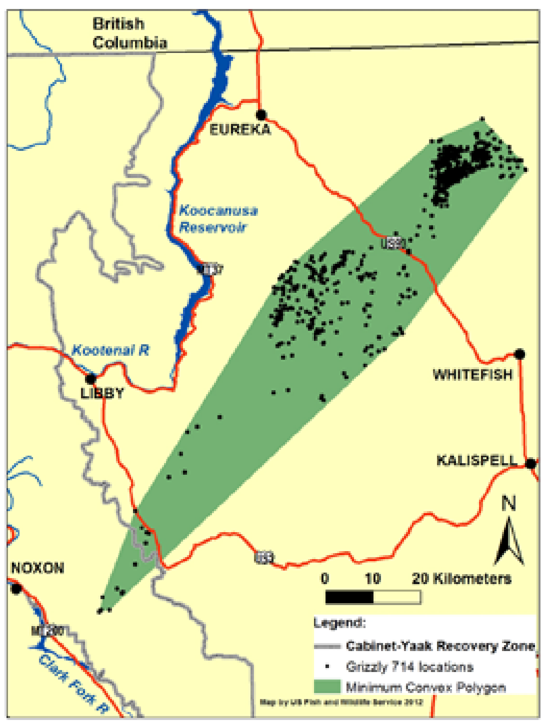


Figure 103. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 714 in the Cabinet Mountains, 2010-12.

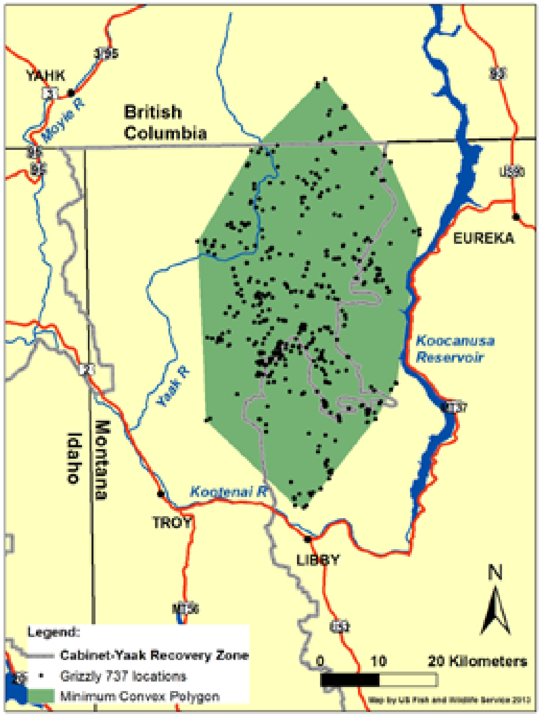


Figure 104. Radio locations and minimum convex (shaded) life range of male grizzly bear 737 in the Yaak River, 2010-12.

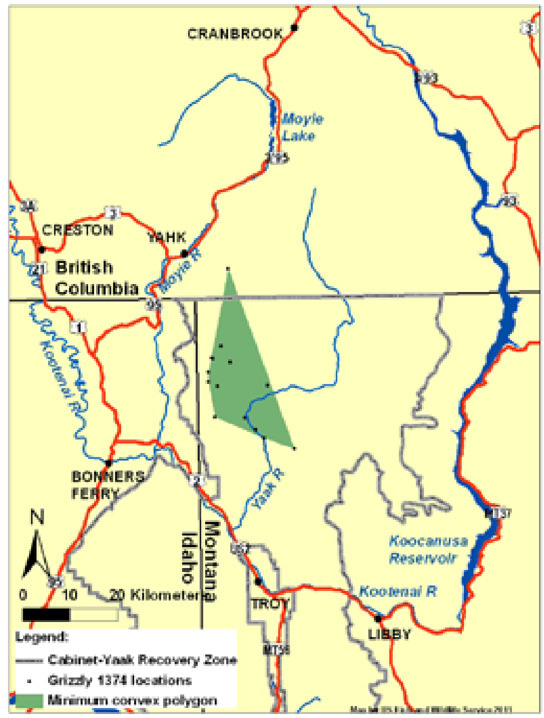


Figure 105. Radio locations and minimum convex (shaded) life range of male grizzly bear 1374 in the Yaak River, 2010.

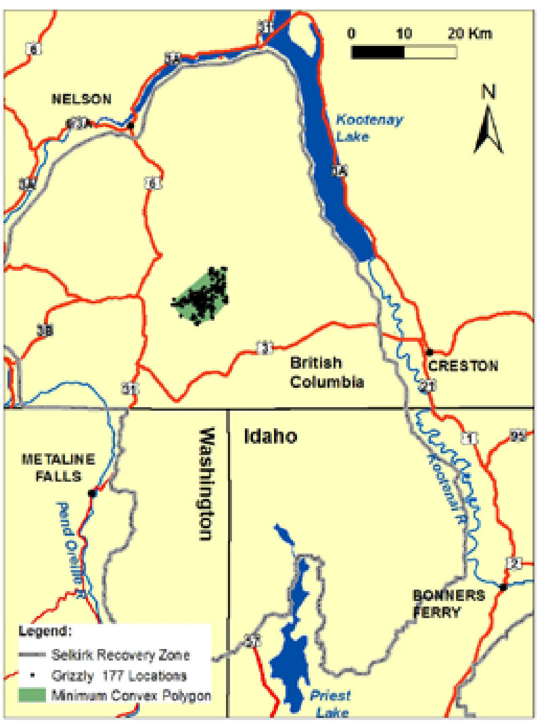


Figure 106. Radio locations and minimum convex (shaded) life range of female grizzly bear 177 in the Selkirk Mountains, 2010.

Figure 107. Radio locations and minimum convex (shaded) life range of male grizzly bear 154 in the Selkirk Mountains, 2010.

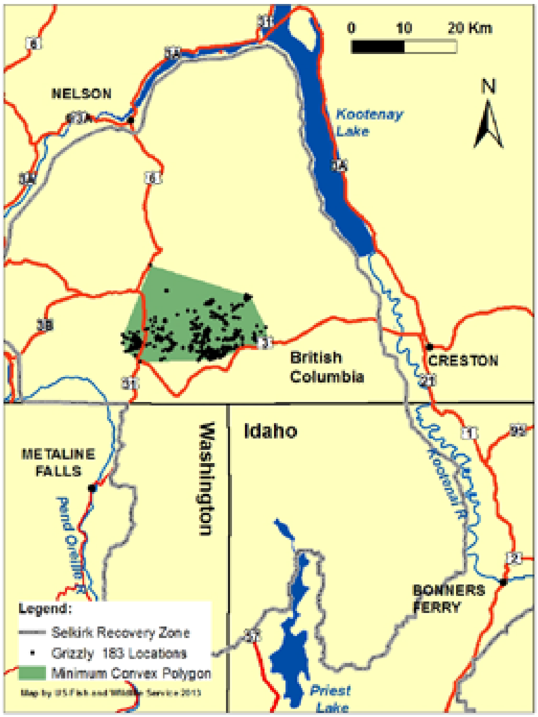


Figure 108. Radio locations and minimum convex (shaded) life range of female grizzly bear 183 in the Selkirk Mountains, 2010 and 2012-13.

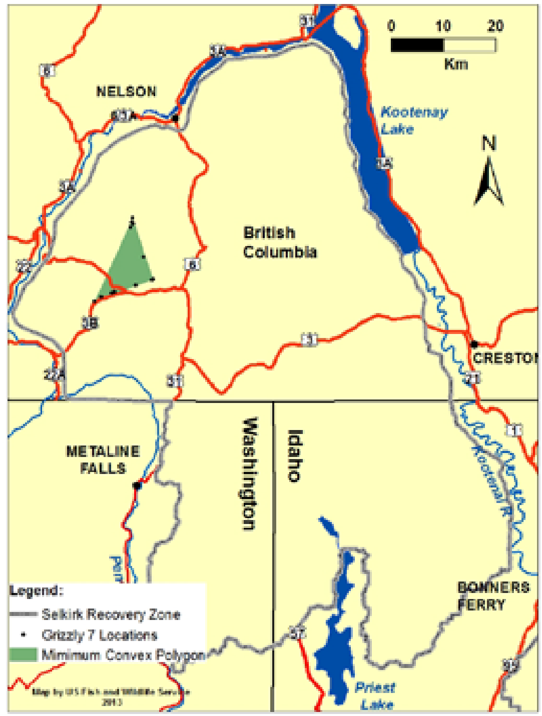


Figure 109. Radio locations and minimum convex (shaded) life range of management female grizzly bear 7 in the Selkirk Mountains, 2010.

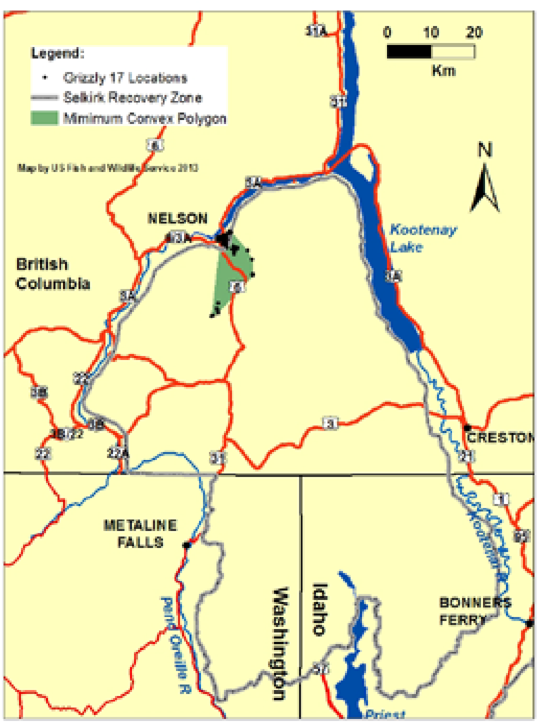


Figure 110. Radio locations and minimum convex (shaded) life range of management male grizzly bear 17 in the Selkirk Mountains, 2010.

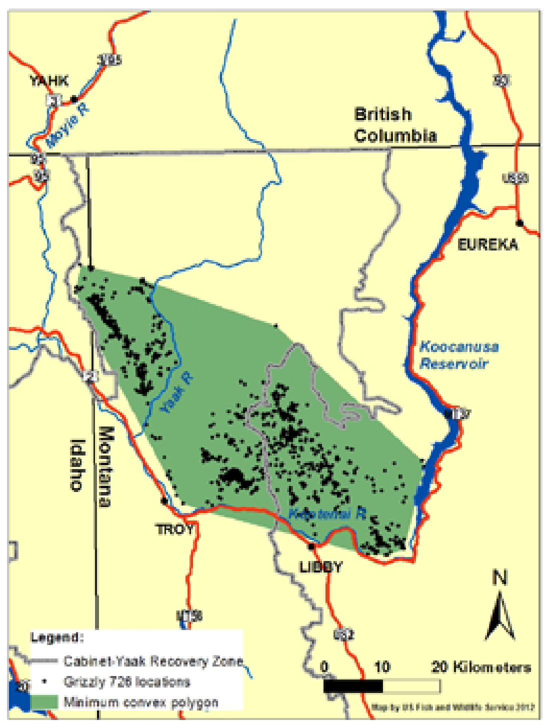


Figure 111. Radio locations and minimum convex (shaded) life range of male grizzly bear 726 in the Yaak River, 2011-12.

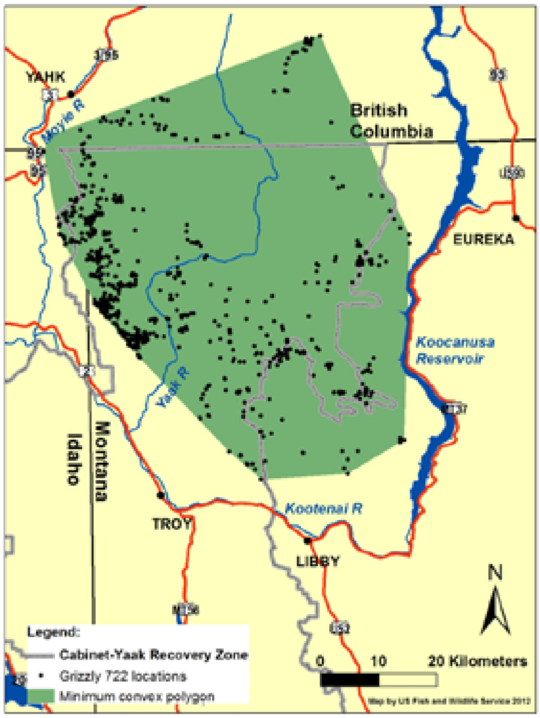


Figure 112. Radio locations and minimum convex (shaded) life range of male grizzly bear 722 in the Yaak River, 2011-12.

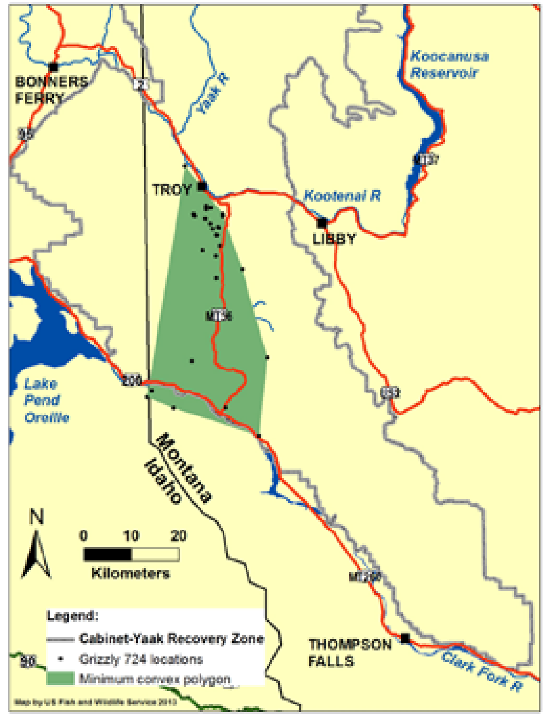


Figure 113. Radio locations and minimum convex (shaded) life range of management male grizzly bear 724 in the Cabinet Mountains, 2011-12.

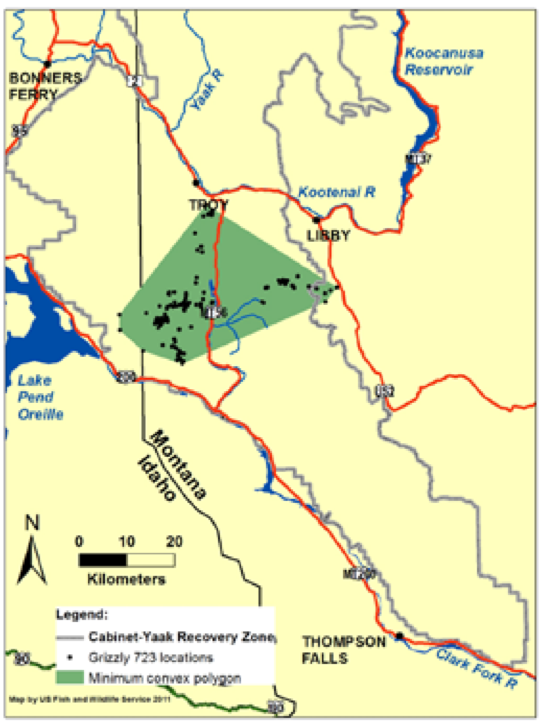


Figure 114. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 723 in the Cabinet Mountains, 2011-12.

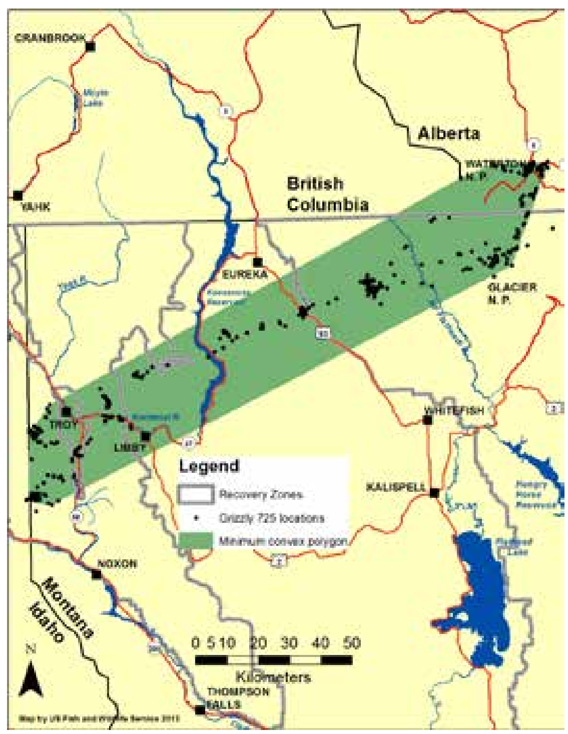


Figure 115. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 725 in the Cabinet Mountains, 2011-13.

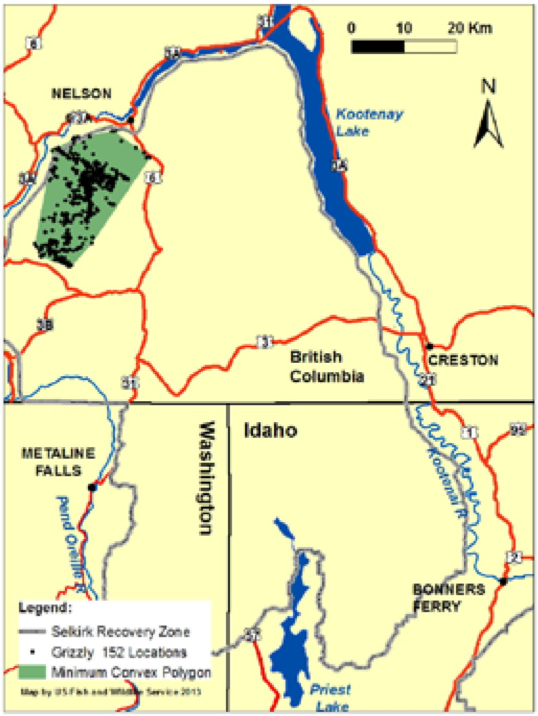


Figure 116. Radio locations and minimum convex (shaded) life range of male grizzly bear 152 in the Selkirk Mountains, 2011-12.

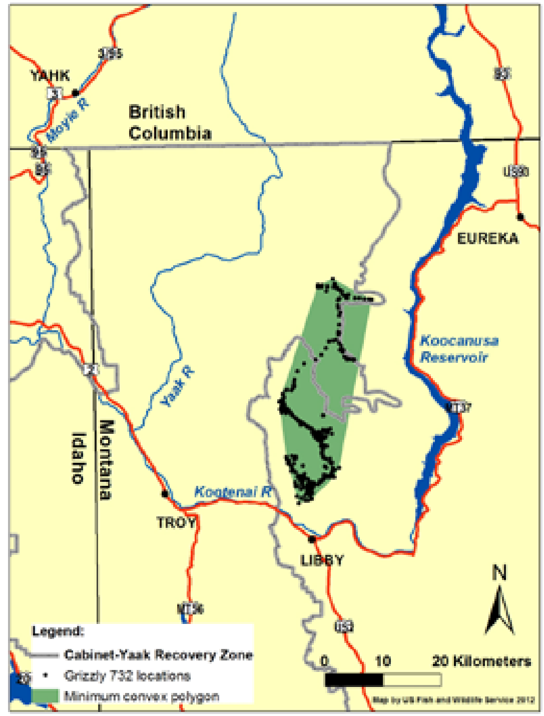


Figure 117. Radio locations and minimum convex (shaded) life range of management male grizzly bear 732 in the Yaak River, 2011.

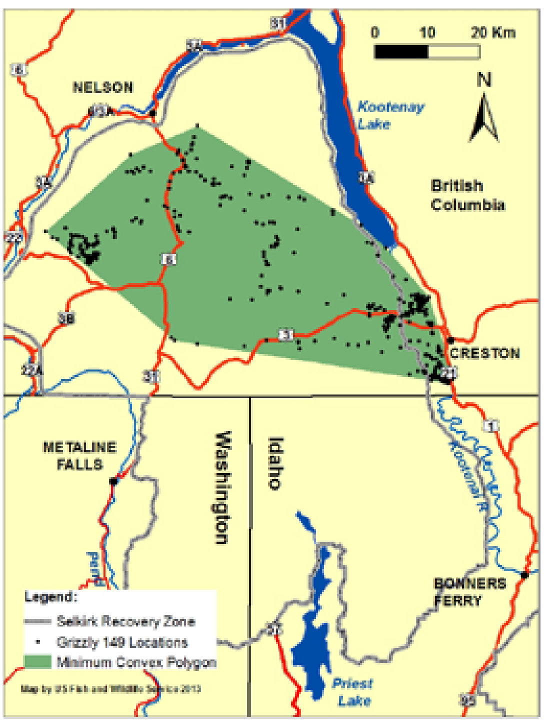


Figure 118. Radio locations and minimum convex (shaded) life range of male grizzly bear 149 in the Selkirk Mountains, 2011.

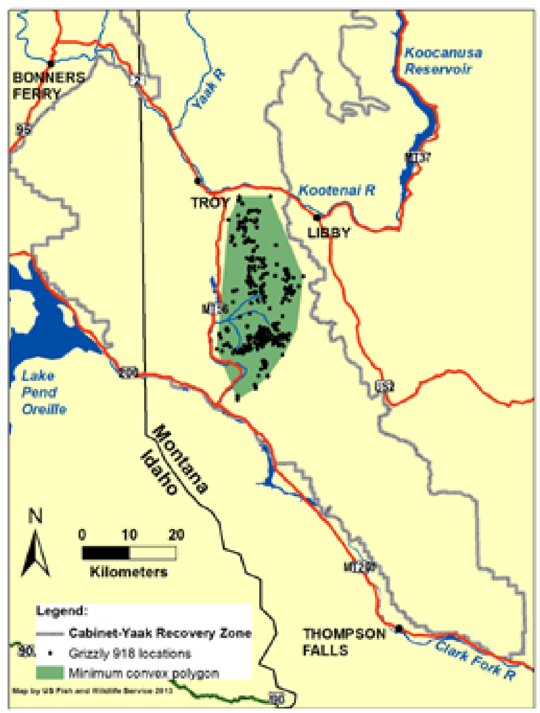


Figure 119. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 918 in the Cabinet Mountains, 2012-13.

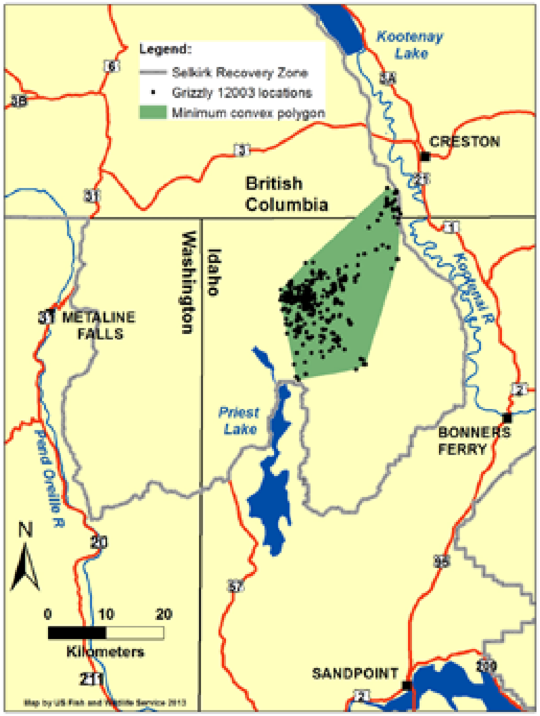


Figure 120. Radio locations and minimum convex (shaded) life range of female grizzly bear 12003 in the Selkirk Mountains, 2012-13.

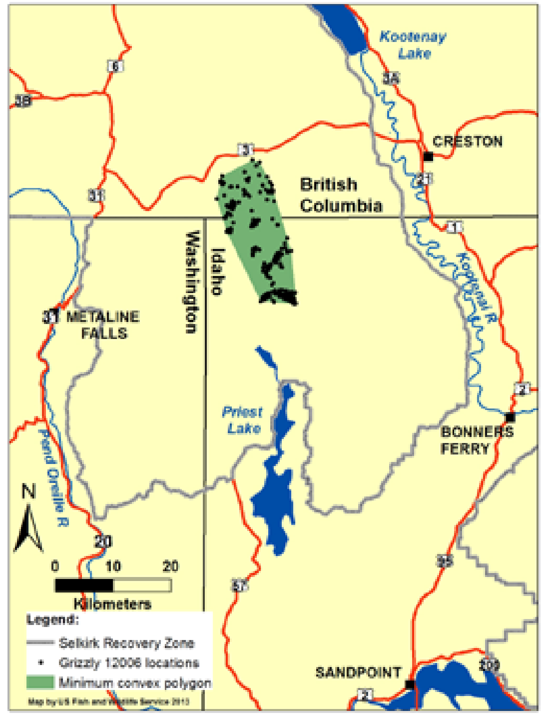


Figure 121. Radio locations and minimum convex (shaded) life range of female grizzly bear 12006 in the Selkirk Mountains, 2012-13.

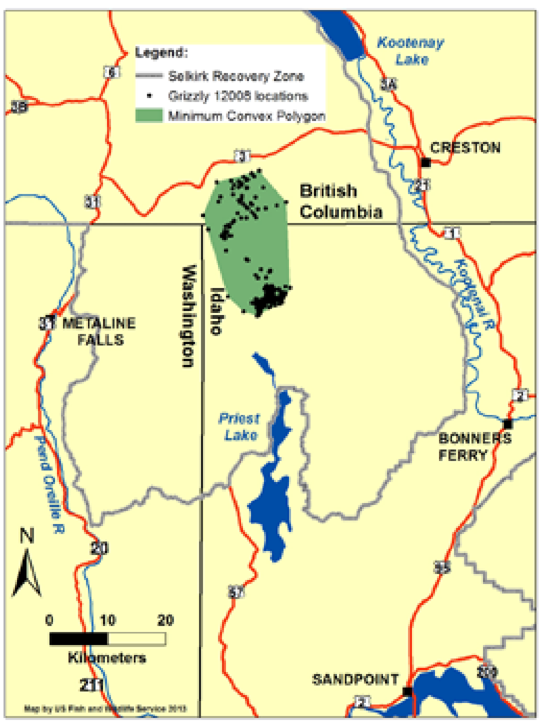


Figure 122. Radio locations and minimum convex (shaded) life range of female grizzly bear 12008 in the Selkirk Mountains, 2012-13.

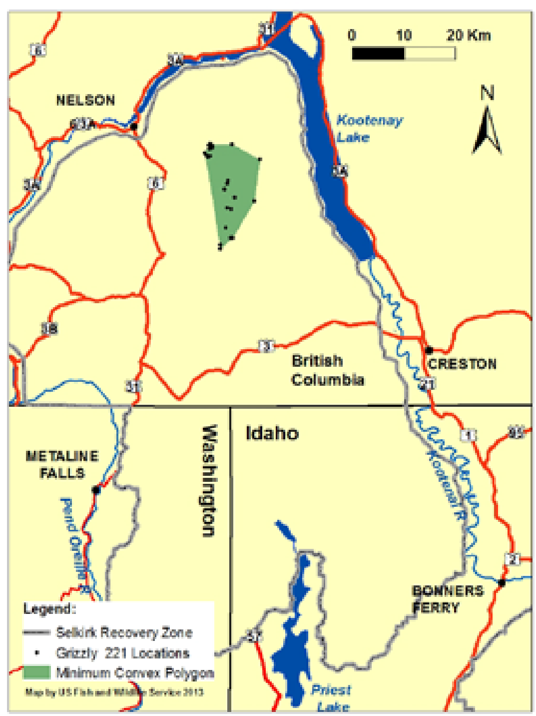


Figure 123. Radio locations and minimum convex (shaded) life range of male grizzly bear 221 in the Selkirk Mountains, 2012-13.

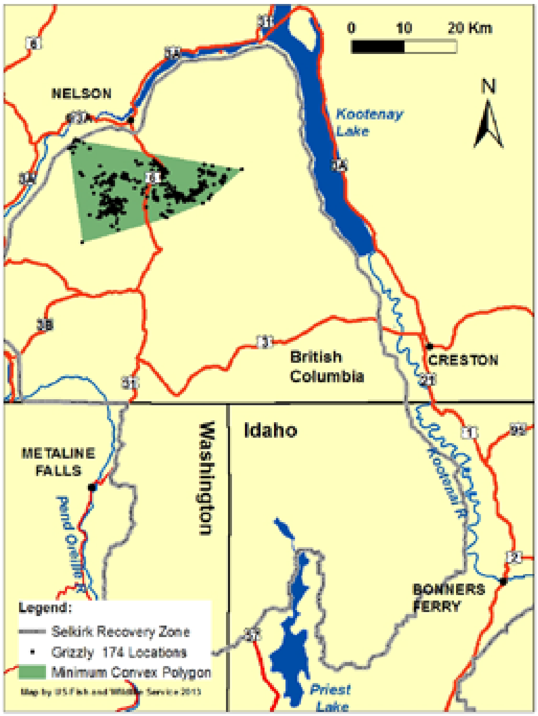


Figure 124. Radio locations and minimum convex (shaded) life range of male grizzly bear 174 in the Selkirk Mountains, 2012-13.

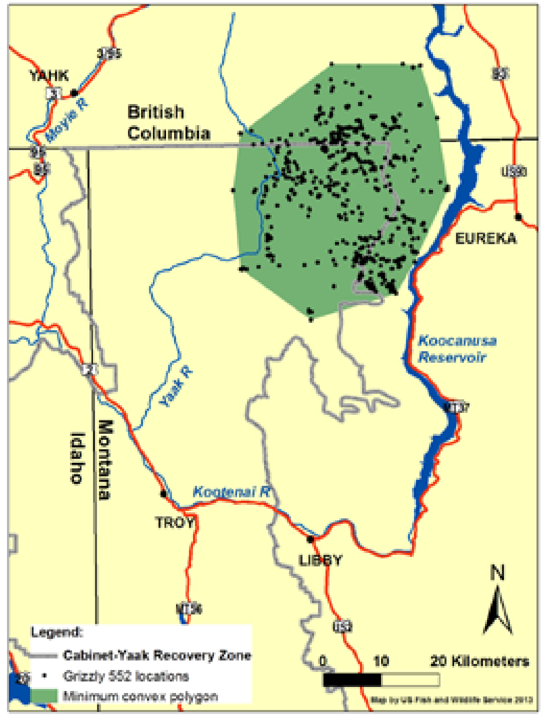


Figure 125. Radio locations and minimum convex (shaded) life range of female grizzly bear 552 in the Yaak River, 2012-13.

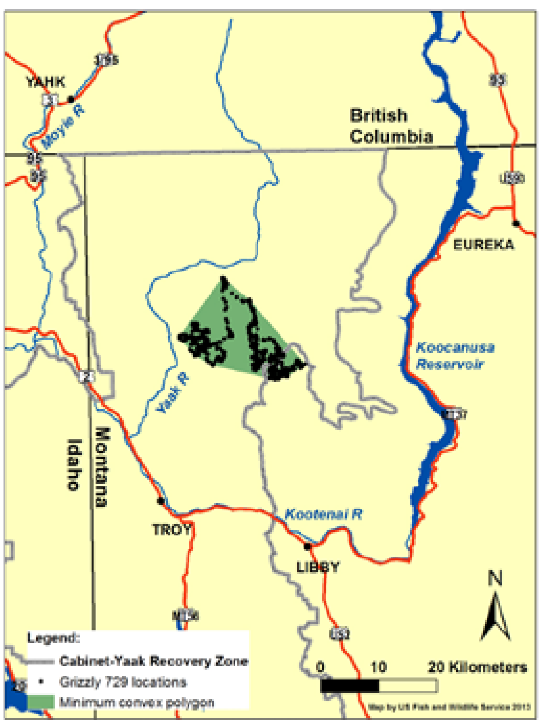


Figure 126. Radio locations and minimum convex (shaded) life range of female grizzly bear 729 in the Yaak River, 2013.

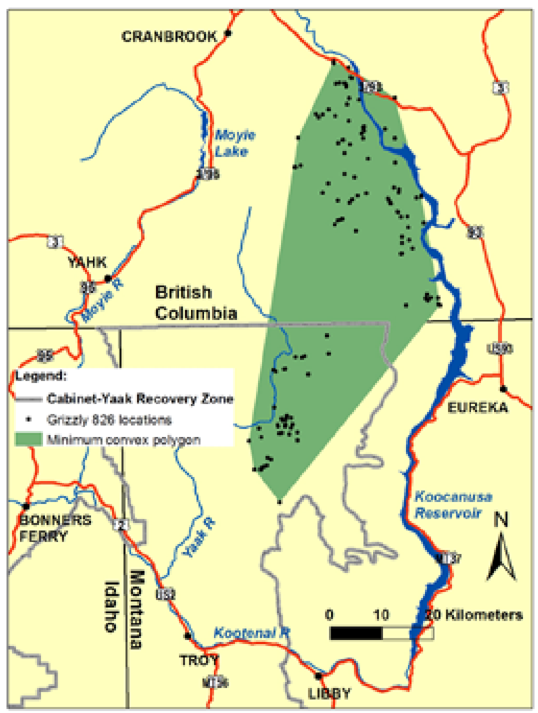


Figure 127. Radio locations and minimum convex (shaded) life range of male grizzly bear 826 in the Yaak River, 2013.

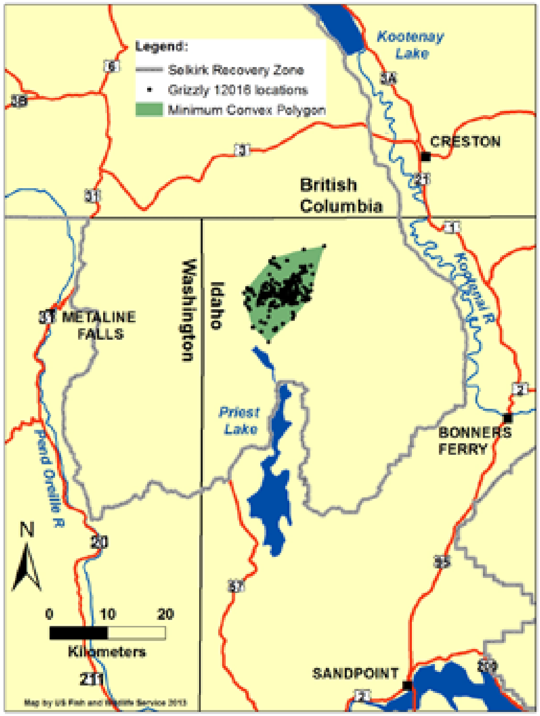


Figure 128. Radio locations and minimum convex (shaded) life range of female grizzly bear 12016 in the Selkirk Mountains, 2013.

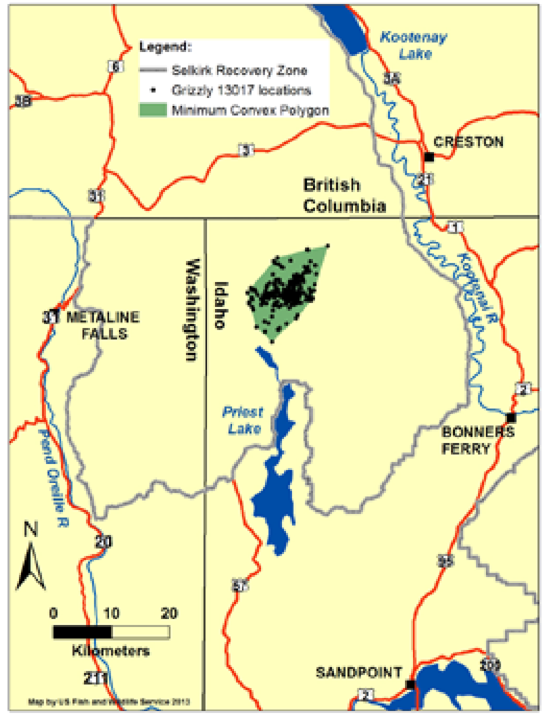


Figure 129. Radio locations and minimum convex (shaded) life range of female grizzly bear 13017 in the Selkirk Mountains, 2013.

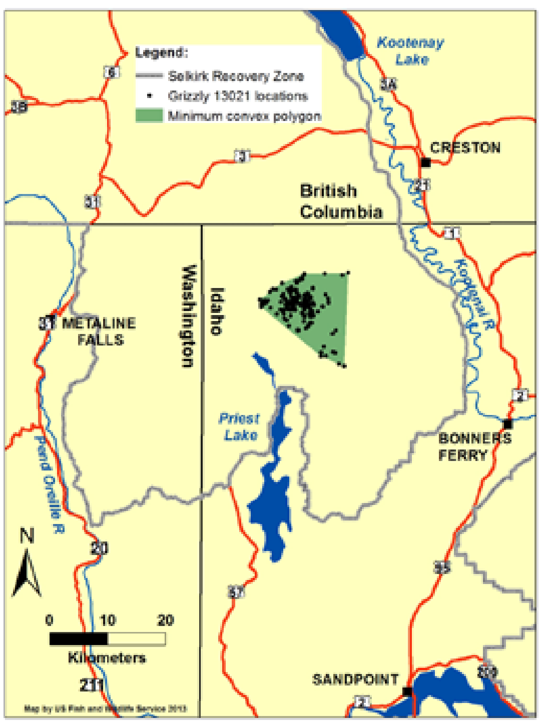


Figure 130. Radio locations and minimum convex (shaded) life range of female grizzly bear 13021 in the Selkirk Mountains, 2013.

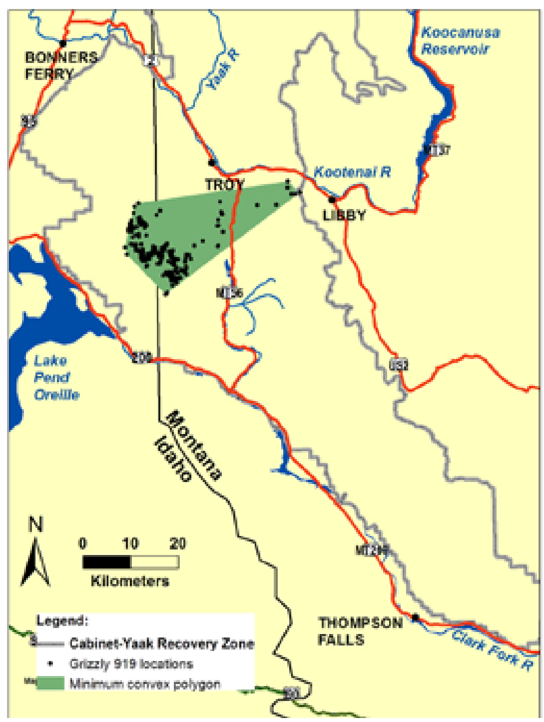


Figure 131. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 919 in the Cabinet Mountains, 2013.

Appendix 4. 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 30-60% and a sparse grass -forb understory. Commonly found on dry exposures, limiting undergrowth to a few rhizomatous species.

3. Timbered Shrub field - 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/Snow chute - Shrub dominated communities resulting from, and often maintained by sudden snow slides 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 shrub fields dominated by *Vaccinium* species. This open, low structured shrub field is created and at times maintained by fire. Timber harvest and snow slides 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, with some sites 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 Forb field - High elevation herbaceous fields with gradual to steep topography. Forb fields 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. Snow chute - Open, forb dominated snow chutes are the result of recent massive snow slides that remove both tree and shrub cover. Snow chutes 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. Slab rock - 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.