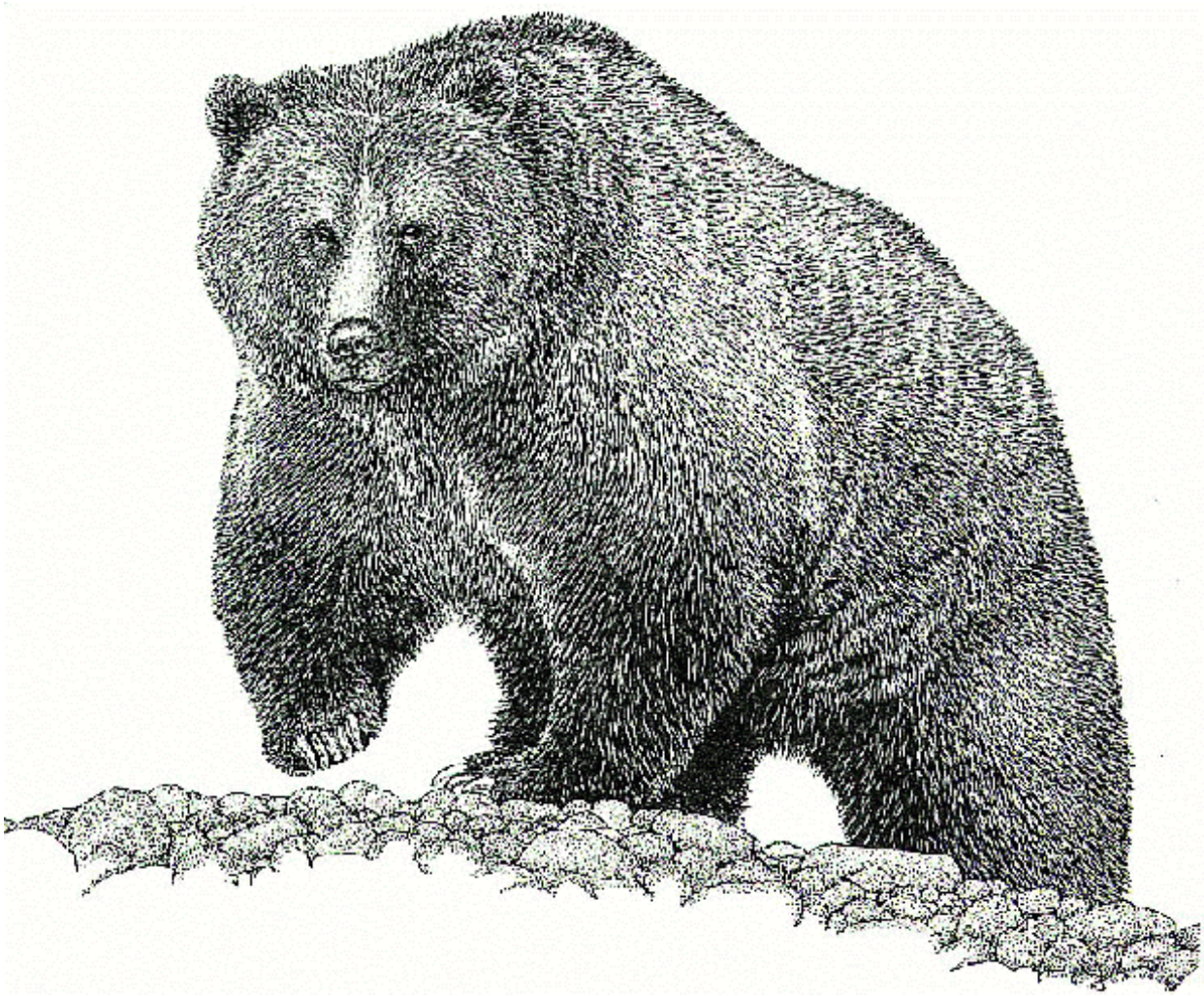
CABINET-YAAK GRIZZLY BEAR RECOVERY AREA 2018 RESEARCH AND MONITORING PROGRESS REPORT



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ABSTRACT

Ten grizzly bears were monitored with radio collars during portions of 2018. Research monitoring included four females (three adults and one subadult) and four males (one adult and three subadults) in the Cabinet-Yaak Ecosystem (CYE). One subadult male bear from the Cabinet Mountains was part of the augmentation program. One subadult male bear was collared for conflict management purposes. Grizzly bear monitoring and research has been ongoing in the Cabinet Mountains since 1988 and in the Yaak River since 1986. Sixty-nine resident bears were captured and monitored through telemetry in the two areas from 1986–2018. 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 for release in the Cabinet Mountains 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 2000–04 identified one of the original transplanted bears. The animal was a 2-year-old female when released in 1993. Genetic analysis conducted in 2005 identified at least three first generation offspring and two second generation offspring from this individual. The success of the augmentation test program prompted additional augmentation in cooperation with Montana Fish, Wildlife, and Parks (MFWP). Nine female bears and seven male bears were moved from the Flathead River to the Cabinet Mountains during 2005–18. Three of these individuals died during their first year from human related causes. Two were illegally shot and one was struck by a train. Five bears left the target area for the augmentation effort.

Numbers of females with cubs in the CYE varied from 2–5 per year and averaged 3.0 per year from 2013–18. Eleven of 22 bear management units (BMUs) had sightings of females with young. Human caused mortality averaged 1.3 bears per year (0.3 females and 1.0 males) from 2013–18. Eight grizzly bears (2 females and 6 males) died due to known or probable human causes during 2013–2018, including 1 adult female (under investigation), 1 adult male (self-defense), 4 subadult males (1 self-defense, 2 human under investigation, and 1 poaching), and 2 cubs (believed to be a male and a female, under investigation).

Using all methods of detection (capture, collared individuals, rub tree DNA, corral DNA, opportune DNA sampling, photos, credible observations), we detected a minimum 54 individual grizzly bears alive and within the CYE grizzly bear population at some point during 2017. Twenty-five bears were detected in the Cabinets (12 male, 8 female, 2 unknown sex). Twenty-nine bears were detected in the Yaak (14 male, 13 female, 2 unknown sex).

Sex- and age-specific survival and reproductive rates yielded an estimated finite rate of increase (λ) of 1.012 (95% C.I. 0.934–1.078) for 1983–2018 using Booter software with the unpaired litter size and birth interval option. Finite rate of population change was an annual 1.2% for 1983–2018. The probability that the population was stable or increasing was 62%.

Berry counts indicated average production for huckleberry, serviceberry, and mountain ash and less than average production for buffaloberry during 2018.

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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 (CYE) 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 CYE, 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 was believed to be minimal but several movements by males into the Cabinet Mountains from the Yaak River and the Selkirk Mountains have occurred since 2012.

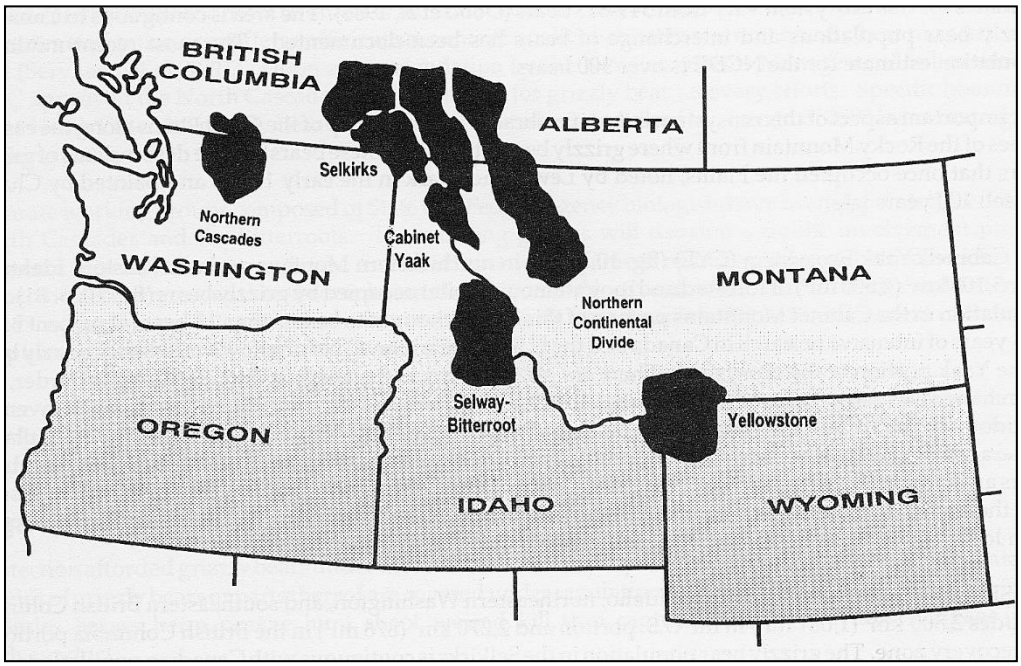


Figure 1. Grizzly bear recovery areas in the U.S., southern British Columbia, and Alberta, Canada.

Research on resident 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 CYE. 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 CYE. 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 grizzly bears using the area, the U.S. Forest Service and (MFWP) cooperated with the U.S. Fish and Wildlife Service (USFWS) initiating a long term study. Field work began in June of 1989.

A population viability analysis recommended four areas of emphasis in future management for recovery of this population (Proctor *et al*. 2004). Those recommendations included: reducing human caused mortality, implementing population augmentation in the Cabinet Mountains, enhancing population interchange by improving internal and external population linkage, and motorized access management on public lands to reduce mortality risk and habitat displacement. Recovery efforts have and will continue to emphasize these recommendations.

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 CYE.
2. Describe and monitor the grizzly bear population in terms of reproductive success, age structure, mortality causes, population trend, and population estimates and report this information through the grizzly bear recovery plan monitoring process.

3. Determine habitat use and movement patterns of grizzly bears. Determine habitat preference by season and assess the relationship between human-altered habitats 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 CYE (48º N, 116º W) encompasses approximately 6,800 km^2 of northwest Montana and northern Idaho (Fig. 2). The Cabinet Mountains constitute about 58% of the CYE 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 border. Prior to 2012 we were unable to document any grizzly bear movement between these areas or grizzly bear use within these linkage zones; however, since that time we have documented at least four instances where bears have been radio tracked moving from the Selkirk Mountains or the Yaak River in the Cabinet Mountains. 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

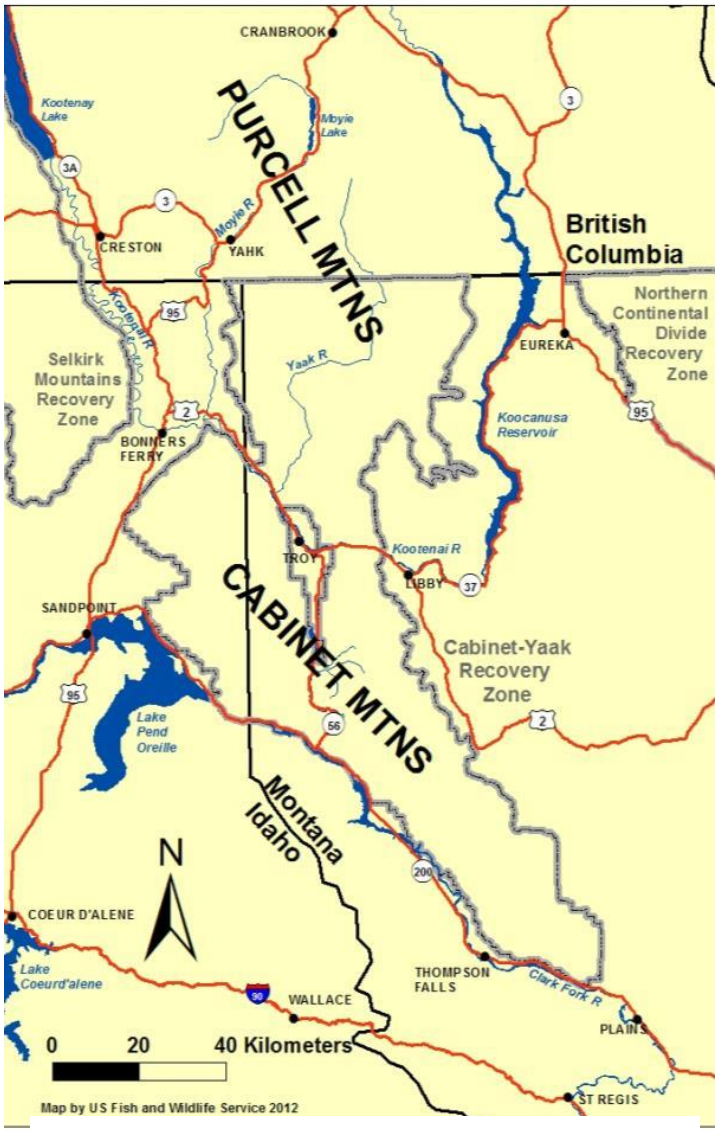


Figure 2. Cabinet-Yaak grizzly bear recovery zone.

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.

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 Panhandle 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. Buffaloberry (*Shepherdia canadensis*) is common under stands of open lodgepole pine while serviceberry (*Amelanchier alnifolia*) and chokecherry (*Prunus virginiana*) prevail on drier, rockier sites. Huckleberry 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 CYE. 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. Trapping was also conducted south of the international border in the North Fork of the Flathead River in 1992. Since 2005, augmentation trapping has occurred south of the international border in the Flathead River drainage.

METHODS

This annual report is cumulative and represents almost all data collected since the inception of this monitoring program since 1983. New information collected or made available to this study was incorporated into summaries and may change previous results.

Grizzly Bear Observations and Mortality

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 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 for use in reports. Sightings that rate 1 or 2 may not 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 someone other than the observer.

Reported grizzly bear mortality includes all bears known to have died within the U.S. and within 16 km of the international border in Canada. Many bears collared in the U.S. have home ranges that extend into Canada. Mortality occurring in this area within Canada can affect calculations for U.S. populations. All radio collared bear mortality was reported regardless of location in the U.S. or Canada.

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 the unknown proportion of management bears in the population and known 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 as: {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.

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 unreported mortality correction were >2 years-old and died from human related causes.

Cabinet Mountains augmentation individuals were counted as mortalities when removed from the Northern Continental Divide Ecosystem and are not counted again as mortalities in the CYE if they die during their first year (Appendix Table T2). Mortalities in Canada are not counted toward recovery goals (USFWS 1993) even though bears initially marked within the CYE have died in Canada. Bears originating in Canada that die in the US are counted.

Reproduction

Reproduction data was gathered through observations of radio-collared females with offspring and genetics data analyzed for maternity relationships. 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 and maternity relationships in genetics data from known age individuals.

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:

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

where S_i is survival of age class i, k is the number of seasons, D_{ij} is the number of recorded deaths for age class i in season j, T_{ij} is the number of days observed by radio telemetry, and L_j is the length of season j in days. Cub survival rates were estimated by 1 - (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 $r = \log_e \lambda$ (Caughley 1977).

Bears captured and relocated to the Cabinet Mountains as part of population augmentation were not included in the population trend calculation (Appendix Table T1). None of these animals had any prior history of nuisance activity. Bears captured initially as objects of

conflict captures were not included. Several native bears that were captured as part of a preemptive move to avoid nuisance activity were included. Currently collared bears that became management bears while wearing a collar were included.

Capture and Marking

Capture and handling of bears followed an approved Animal Use Protocol through the University of Montana, Missoula, MT (061-14CSCFC111714). Capture of black bears and grizzly bears was performed under state permits 2018-058 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. Bears were immobilized with either Telazol (tiletamine hydrochloride and zolazepam hydrochloride), a mixture of Ketaset (ketamine hydrochloride) and Rompun (xylazine hydrochloride), a mixture of Telazol and Dexmedetomidine, or a combination of Telazol and Rompun. Yohimbine and Atipamezole were the primary antagonists for Rompun and Dexmedetomidine. 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.

All grizzly bears (including management bears captured at conflict sites) 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 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 CYE 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. Other captured grizzly bears were released with some collared to aid an ongoing BC bear study. Capture efforts for bears transplanted in 2005–18 occurred primarily in the North Fork and South Fork of the Flathead River in the US by MFWP. No suitable bears were captured in 1992 or 2007.

Hair Sampling for DNA Analysis

This project originally sought evidence of grizzly bears in the Cabinet Mountains using DNA to understand the fates of four bears transplanted during 1990–94. The program used genetic information from hair-snagging with remote-camera photo verification to identify transplanted bears or their offspring living in the Cabinet Mountains. Since then, sampling has expanded into the Yaak drainage and project objectives now include: observations of females with young, sex ratio of captured bears, relatedness as well as genetic diversity measures of captured bears, and evidence of interpopulation movements of individuals.

Sampling occurred from May–October of 2002–18 in the CYE 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 and Yaak drainage. 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. Solid black hairs were judged to be from black bears and not analyzed further. Samples collected as a part of this effort and other hair samples collected 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 (Birchdale Ecological Consulting) 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 a US Geological Survey (USGS) study to estimate CYE grizzly bear population size (Kendall *et al*. 2015). USGS was concerned that our sample sites might influence capture success at their sites.

The USGS study established and sampled 1,373 rub trees across the CYE during 2012. The study made preliminary data available regarding the success of this effort by providing us 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 2013–18. 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 1–2 hours. Collar releases were programmed to drop in early October for retrieval. Expected collar life varied from 1–3 field seasons over the course of the study depending upon model of collar and programming. 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 ArcMap 10.

Grizzly and black bears were collared with GPS collars during 2004–10 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. 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 2008–2012, 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, and radio location of instrumented bear) as from grizzly bears. Food habits analysis was completed by William Callaghan (Florence, MT) and Kevin Frey (Bozeman, MT). Samples were rinsed with hot and cold water 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 buffaloberry were made using methods similar to those established in Glacier National Park (Kendall 1986). Transect line origins were marked by a painted tree or by surveyors' ribbon. A specific azimuth was followed from the origin through homogenous habitat. At 0.5 m intervals, a 0.04 m^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 2018. Buffaloberry sampling began in 1990 at 5 sites. Due to the dioecious (separate male and female plants) nature of buffaloberry all frame count transects were dropped in 2007 in favor of marking 10 plants per site and counting the berries on marked plants. Two sites were sampled in 2018. Serviceberry productivity was estimated by counting berries on 10 marked plants at 5 sample sites beginning in 1990. Five sites were sampled in 2018. 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 2018.

Temperature and relative humidity data recorders (LogTag®, Auckland, New Zealand) 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 average (annual 95% confidence interval falls above study-wide mean), average (confidence interval encompasses the study-wide mean), or below average (confidence interval falls below study-wide mean).

RESULTS AND DISCUSSION

Research and monitoring with telemetry and full time personnel were present since 1983 and therefore this date represents the most intense period of data collection. All tables and calculations are updated when new information becomes available. For instance, genetic analysis determined the sex of a previously unknown mortality (2012) and a bear originally identified as a probable mortality (2003) was removed when genetic evidence later indicated that the bear survived that incident.

Grizzly Bear Observations and Recovery Plan Targets

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 1,900 credible sightings, tracks, scats, digs, hair, and trail camera photographs dating from 1960 (Fig. 3) and 120 mortalities dating from 1949 (Table 1, Appendix Table 2, Fig. 3). Credible sightings were those rating 4 or 5 on the 5-point scale (see page 9). Seventy-two instances of grizzly bear mortality were detected inside or within 16 km of the CYE (including Canada) during 1982–2018 (Table 1). Eighty-three credible sightings were reported to this study that rated 4 or 5 (most credible) during 2018. Fifty-two of these sightings occurred in the Yaak portion of the CYE and 31 sightings occurred in the Cabinet Mountains portion of the CYE (Table 2 and Fig. 3).

<u>Recovery Target 1: 6 females with cubs over a running 6-year average both inside the recovery zone and within a 10-mile area immediately surrounding the recovery zone</u>.
Seventeen credible sightings of a female with cubs occurred during 2018 in Bear Management Units (BMUs) 5, 12, 13, and 14 (Tables 2, 3, 4, 5, Fig. 4 and 5). There appeared to be 5 unduplicated females with cubs in the recovery area or within 10 miles during 2018. Two

credible sightings of a female with yearlings or 2-year-olds occurred in BMU 6 and another credible sighting occurred south of the Clark Fork River. Unduplicated sightings of females with cubs (excluding Canada) varied from 2–5 per year and averaged 3.0 per year from 2013–18 (Tables 3, 4).

Recovery Target 2: 18 of 22 BMU's occupied by females with young from a running 6-year sum of verified evidence.

Eleven of 22 BMUs in the recovery zone had sightings of females with young (cubs, yearlings, or 2-year-olds) during 2013–18 (Figs. 4, 5, Table 6). Occupied BMUs were: 2, 5, 6, 8, 11, 12, 13, 14, 15, 16, and 17.

Recovery Target 3: The running 6-year average of known, human-caused mortality should not exceed 4 percent of the population estimate based on the most recent 3-year sum of females with cubs. No more than 30 percent shall be females. These mortality limits cannot be exceeded during any 2 consecutive years for recovery to be achieved. .

Four known or probable human caused mortalities occurred during 2018. Eight known or probable human caused mortalities of grizzly bears have occurred in or within 10 miles of the CYE in the U.S. during 2013–18 (Table 1), including 2 females (Deer Ridge) and 6 males (BMUs 12, 13, 19, 22, West Kootenai and Deer Ridge units). These mortalities included one adult female (human caused, under investigation), 1 adult male (self-defense), 4 subadult males (self-defense, poaching, and two human caused under investigation), and 1 male and 1 female cub (human caused, under investigation). We estimated minimum population size by dividing observed females with cubs during 2016–18 (11) minus any human-caused adult female mortality (1) by 0.6 (sightability correction factor as specified in the recovery plan) 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 59 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 2.3 bears per year. The female limit is 0.7 females per year (30% of 2.3). Average annual human caused mortality for 2013–18 was 1.3 bears/year and 0.3 females/year. These mortality levels for total bears and female mortality were less than the calculated limit during 2013–18. The recovery plan established a goal of zero human-caused mortality for this recovery zone due to the initial low number of bears, however it also stated "In reality, this goal may not be realized because human bear conflicts are likely to occur at some level within the ecosystem." Therefore, even if the goal of zero mortality is not met, it is important to evaluate the targets to determine if we are making progress towards recovery. During the 2013–18 reporting period we are meeting all mortality targets and moving closer to recovery. All tables and calculations were updated as new information becomes available.

Table 1. Known and probable grizzly bear mortality in or within 16 km of the Cabinet-Yaak grizzly bear recovery zone (including Canada). Includes all radio collared bears regardless of location, 1982–2018.

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

Mortality Date	Tag #	Sex	Age	Mortality Cause	Location	Open Road <500 m	Public Reported	Owner[1]
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, Undetermined	Dodge Creek, MT	Yes	No	USFS
October, 1996[1]	355	M	AD	Human, Undetermined	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, Undetermined	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
9/6/2001	128	M	18	Human, Undetermined	Swamp Creek, MT[3]	Yes	No	PRIV
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, Undetermined	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
10/15/2004[1]	None	F	AD	Human, Management	Newgate, BC	Yes	Yes	PRIV
2005?	363	M	14	Human, Undetermined	Curley Creek, MT	Yes	Yes	PRIV
10/9/2005	694	F	2	Human, Undetermined	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	?	M	3	Human, Under Investigation	Fishtrap Creek, MT	Yes	Yes	PCT
10/20/2008[2]	790	F	3	Human, Poaching	Clark Fork River. MT	Yes	Yes	PRIV
10/20/2008[2]	635	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
6/25/2010	675-cub	Unk	Cub	Natural	American Creek, MT	Unk	No	USFS
7/7/2010	303-cub	Unk	Cub	Natural	Bearfite 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	M	Cub	Human, Under Investigation	Mission Creek, ID	Yes	Yes	USFS
October 2012[1]	5381	M	8	Human, Management	Duck Creek, BC	Yes	Yes	PRIV

Mortality Date	Tag #	Sex	Age	Mortality Cause	Location	Open Road <500 m	Public Reported	Owner[1]
10/26/2014	79575279	M	6	Human, Self defense	Little Thompson River, MT	Yes	Yes	PRIV
5/15/2015[1]	552-ygl	Unk	1	Natural	Linklater Creek, BC	Unk	No	BC
5/23/2015[2]	921	F	3	Natural	NF Ross Creek, MT	No	No	USFS
5/24/2015	None	M	4?	Human, Poaching	Yaak River, MT	Yes	Yes	USFS
8/12/2015	818	M	2	Human, Self Defense	Moyie River, ID	Yes	Yes	PRIV
9/30/2015[2]	924	M	2	Human, Mistaken Identity	Beaver Creek, ID[3]	Yes	Yes	PRIV
10/11/2015	1001	M	6	Human, Under Investigation	Grouse Creek, ID	Yes	No	PRIV
9/1/2017[1]	922	M	5	Human, Self defense	Porthill Creek, BC[3]	Yes	Yes	BC
4/16/2018	821	M	4	Unknown probable	Pine Creek, MT	Yes	Yes	PRIV
5/21/2018	9077	M	3	Human, Under Investigation	Bristow Creek, MT	Yes	No	USFS
9/5/2018	810	F	15	Human, Under Investigation	Spruce Creek, ID	Yes	No	USFS
9/5/2018	None	Unk	Cub	Human, Under Investigation probable	Spruce Creek, ID	Yes	No	USFS
9/5/2018	None	Unk	Cub	Human, Under Investigation probable	Spruce Creek, ID	Yes	No	USFS

[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 the CYGBRZ. BC – British Columbia, MRL – Montana Rail Link, PRIV – Individual Private, PCT – Plum Creek Timber Company, 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, 2018.

BMU OR AREA	2018 Credible[1] Grizzly Bear Sightings	2018 Sightings of Females with Cubs (Total)	2018 Sightings of Females with Cubs (Unduplicated[2])	2018 Sightings of Females with Yearlings or 2-year-olds (Total)	2018 Sightings of Females with Yearlings or 2 year-olds (Unduplicated[2])	2018 Human Caused Mortality
1	1	0	0	0	0	0
2	5	0	0	0	0	0
3	2	0	0	0	0	0
4	0	0	0	0	0	0
5	7	1	1	0	0	0
6	9	0	0	2	1	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	1	0	0	0	0	0
10	3	0	0	0	0	0
11	4	0	0	0	0	0
12	3	1	1	0	0	0
13	18	10	1	0	0	0
14	6	4	1	0	0	0
15	2	0	0	0	0	0
16	6	0	0	0	0	0
17	1	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	4	0	0	0	0	0
Deer Ridge	2	1	1	0	0	3
Fisher[4]	1	0	0	0	0	0
South Clark Fork[4]	1	0	0	1	1	0
West Kootenai	7	0	0	0	0	1
2018 TOTAL	83	17	5	3	2	4

[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.

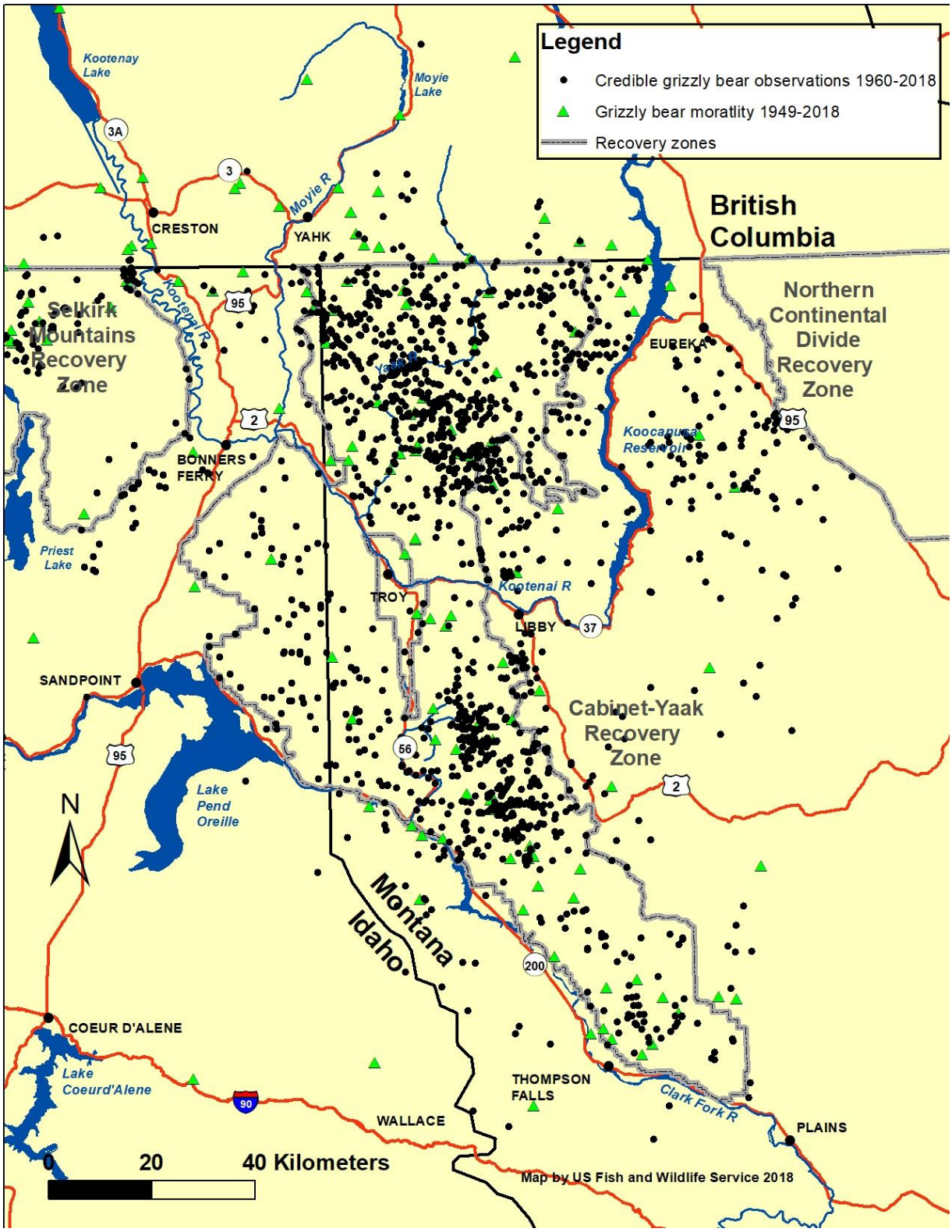


Figure 3. Grizzly bear observations (1959–2018) and known or probable mortalities from all causes (1949–2018) in and around the Cabinet-Yaak recovery area.

Table 3. Status of the Cabinet-Yaak recovery zone during 2013–2018 in relation to the demographic recovery targets from the grizzly bear recovery plan (USFWS 1993).

Recovery Criteria	Target	2013–2018
Females w/cubs (6-yr avg)	6	3.0 (18/6)
Human Caused Mortality limit (4% of minimum estimate)[1]	2.3	1.3 (6 yr avg)
Female Human Caused mortality limit (30% of total mortality)[1]	0.7	0.3 (6 yr avg)
Distribution of females w/young	18 of 22	11 of 22

[1] The grizzly bear recovery plan states "Because of low estimated population and uncertainty in estimates, the current human-caused mortality goal to facilitate recovery of the population is zero. In reality, this goal may not be realized because human bear conflicts are likely to occur at some level within the ecosystem".

Table 4. Annual Cabinet-Yaak recovery zone (excluding Canada) grizzly bear unduplicated counts of females with cubs (FWC's) and known human-caused mortality, 1988–2018.

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	0.0		
1989	0	0	1	1	0.0	0.0		
1990	1	0	0	1	0.0	0.0		
1991	1	0	0	0	0.0	0.0		
1992	1	0	0	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	0.0
1996	1	0	0	1	0.7	0.2	0.2	0.0
1997	3	0	0	1	1.2	0.4	0.3	0.0
1998	0	0	0	0	0.9	0.3	0.3	0.0
1999	0	0	0	1	0.7	0.2	0.5	0.0
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	4	1.2	0.4	1.5	1.2
2003	2	0	0	0	1.2	0.4	1.3	1.2
2004	1	0	0	0	1.4	0.4	1.3	1.2
2005	1	0	2	4	0.9	0.3	1.8	1.5
2006	1	0	0	0	0.7	0.2	1.7	1.3
2007	4	1	1	1	1.2	0.4	1.5	1.2
2008	3	0	0	1	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	1.6	0.5	1.7	0.5
2013	2	0	0	0	1.2	0.4	1.5	0.3
2014	3	0	0	1	1.6	0.5	1.5	0.3
2015	2	0	0	3	1.6	0.5	1.8	0.2
2016	3	0	0	0	1.9	0.6	1.7	0.2
2017	3	0	0	0	1.9	0.6	1.0	0.2
2018	5	1	2	4	2.3	0.7	1.3	0.3

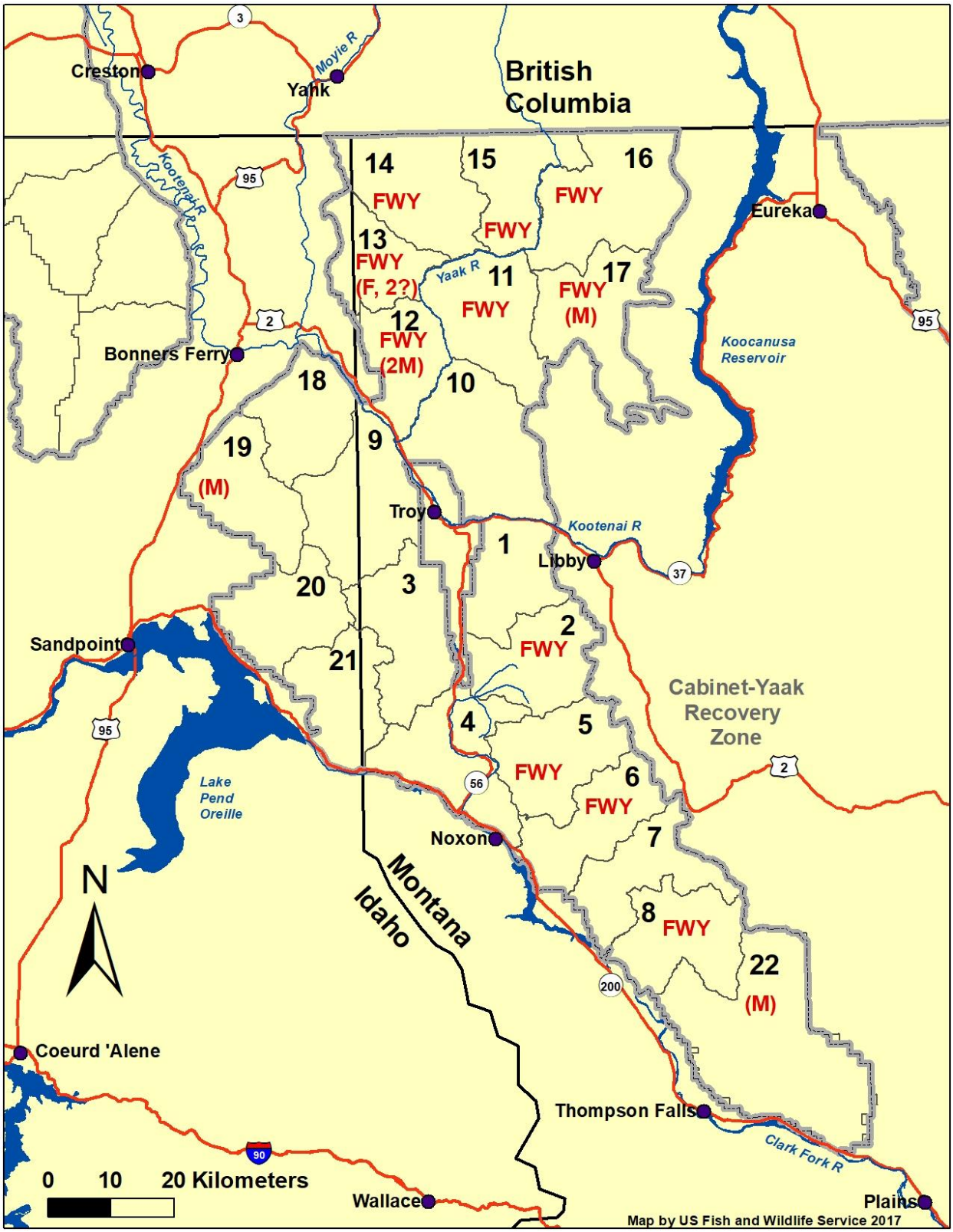


Figure 4. Female with young occupancy and known or probable mortality within Bear Management Units (BMUs) in the Cabinet-Yaak recovery zone 2013–2018. (FWC indicates occupancy of a female with cubs, FWY is occupancy of a female with young and sex of any mortality is in parentheses).

Table 5. Credible observations of females with young in or within 10 miles of the Cabinet-Yaak recovery zone, 1988–2018. Canadian credible observations shown in parentheses.

Year	Total credible[1] sightings females with young	Unduplicated females with cubs	Unduplicated females with yearlings or 2-year-olds	Unduplicated adult females without young	Minimum probable adult females
1990	9	1	2	0	3
1991	4	1	1	1	2
1992	8	1	5	1	6
1993	6	2	1	0	3
1994	5	1	2	0	3
1995	8	1	2	0	3
1996	5	1	1	0	2
1997	14 (1)	3	4	0	7
1998	6 (1)	0	2 (1)	2	2 (1)
1999	2	0	2	3	2
2000	6 (1)	2 (1)	1	0	3 (1)
2001	5 (2)	1 (1)	3	0	4 (1)
2002	10 (1)	4 (1)	1	0	5 (1)
2003	11	2	4	0	6
2004	11	1	4	0	5
2005	10 (1)	1	4 (1)	1	5 (1)
2006	7 (1)	2 (1)	2	1	4 (1)
2007	17	4	2	2	6
2008	7 (1)	3 (1)	3	1	6 (1)
2009	5 (0)	2 (0)	2 (0)	1	4 (0)
2010	14 (0)	4 (0)	2 (0)	1	6 (0)
2011	4 (0)	1 (0)	1 (0)	1	2 (0)
2012	12 (0)	3 (0)	3 (0)	0	6 (0)
2013	9 (0)	2 (0)	5 (0)	0	7 (0)
2014	20 (1)	3 (0)	3 (0)	1	7 (0)
2015	19 (1)	2 (0)	5 (0)	2	9 (0)
2016	11 (0)	3 (0)	3 (0)	2	8 (0)
2017	8 (0)	3 (0)	3 (0)	2	8 (0)
2018	20 (0)	5 (0)	2 (0)	1	8 (8)

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

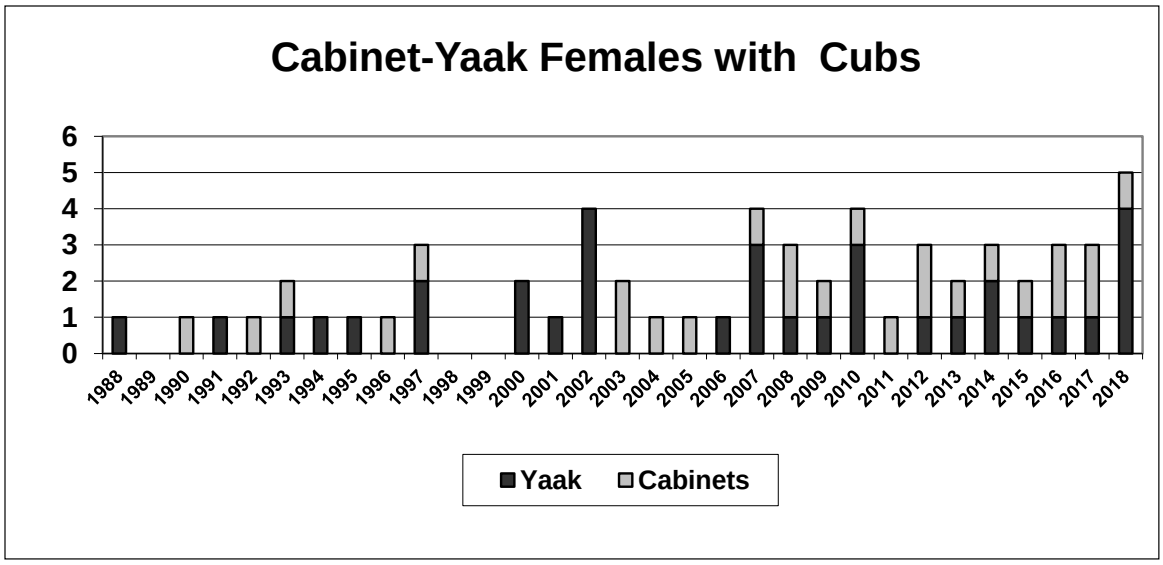


Figure 5. Credible observations of females with cubs in or within 10 miles of the Cabinet-Yaak recovery zone (excluding Canada), 1988–2018. Credible sightings are those rated 4 or 5 on a 5 point scale.

Table 6. Occupancy of bear management units by grizzly bear females with young in the Cabinet-Yaak recovery zone 1990–2018.

	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 - NW PEAK	15 - GARVER	16 - E FORK YAAK	17 - BIG CREEK	18 - BOULDER	19 - GROUSE	20 - N 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	Y	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
2014	N	N	N	N	Y	Y	N	N	N	N	N	N	Y	Y	Y	Y	Y	N	N	N	N	N
2015	N	N	N	N	Y	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	N	N	N	N	N
2016	N	N	N	N	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y	N	N	N	N	N
2017	N	N	N	N	Y	Y	N	N	N	N	N	N	N	N	N	Y	Y	N	N	N	N	N
2018	N	N	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N	N

Cabinet Mountains Population Augmentation

From 1990–94 four female grizzly bears were captured in the Flathead River of British Columbia and released in the Cabinet Mountains (Table 7). Twenty-two different grizzly bears were captured during 840 trap-nights to obtain the 4 subadult females. Capture rates were 1 grizzly bear/38 trap-nights and 1 suitable subadult female/210 trap-nights. One transplanted bear and her cub died of unknown causes one year after release. The remaining three bears were monitored until collars dropped. 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 in the target area for more than one year. One of the transplanted bears produced a cub, but had likely bred prior to translocation and did not satisfy our criteria for reproduction with resident males.

In 2005 the augmentation program was reinitiated through capture by MFWP personnel and monitoring by this project. During 2005–18, 9 female and 7 male grizzly bears were released in the Cabinet Mountains (Table 7). A 2-year-old male was released in the West Cabinet Mountains on July 21, 2018. The bear remained in the West Cabinet Mountains until August when it moved south of the Clark Fork River. The bear was photographed at a black

bear bait site on private property in late August. Landowner concerns prompted Idaho Fish and Game to capture the bear and it was released in the East Cabinet Mountains near the Wilderness. The bear returned to the area south of the Clark Fork River but did not revisit the bait site and spent most of September and October in Montana where black bear baiting is not allowed. The bear moved north of the Clark Fork River in November and denned in the West Cabinet Mountains.

Of 20 bears released through 2018, 6 are known to have left the target area (one was recaptured and brought back and one returned a year after leaving), three were killed within 4 months of release, and one was killed 16 years after release. One animal was known to have produced at least 10 first generation offspring, 16 second generation offspring, and one third generation offspring. Another female was known to have produced three offspring and a male was also known to have produced one offspring.

Table 7. Sex, age, capture date, capture location, release location, and fate of augmentation grizzly bears moved to the Cabinet Mountains, 1990–2018.

Bear	Sex	Age	Capture date	Capture Location	Cabinet Mtns Release Location	Fate
218	F	5	7/21/1990	NF Flathead R, BC	EF Bull River	Den Cabinet Mtns 1990, Lost collar Aug. 1991, observed July 1992.
258	F	6	7/21/1992	NF Flathead R, BC	EF Bull River	Den Cabinet Mtns 1992 Produced 1 cub 1993, Natural mortality July 1993.
286	F	2	7/14/1993	NF Flathead R, BC	EF Bull River	Den Cabinet Mtns 1993–95 Lost collar at den Apr. 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 Oct. 1995 south of Eureka, MT, released EF Bull River, Signal lost Nov. 1995.
A1	F	7-8	9/30/2005	NF Flathead R, MT	Spar Lake	Den West Cabinet Mtns 2005–06, Lost collar Sept. 2007.
782	F	2	8/17/2006	SF Flathead R, MT	Spar Lake	Den West Cabinet Mtns 2006–07, Lost collar Aug. 2008.
635	F	4	7/23/2008	Stillwater R, MT	EF Bull River	Killed by train near Heron, MT Oct. 2008.
790	F	3	8/7/2008	Swan R, MT	EF Bull River	Illegally killed near Noxon, MT Oct. 2008.
715	F	10	9/17/2009	NF Flathead R, MT	Spar Lake	Den West Cabinet Mtns 2009–10, returned to NF Flathead R, May 2010. Lost collar June 2010.
713	M	5	7/18/2010	NF Flathead R, MT	Spar Lake	Den Cabinet Mtns 2010, Lost collar Sept. 2011.
714	F	4	7/24/2010	NF Flathead R, MT	Silverbutte Cr	Returned to NF Flathead July 2010. Lost collar Oct. 2013.
725	F	2	7/25/2011	MF Flathead R, MT	Spar Lake	Moved to Glacier National Park, Sept. 2011 den, returned to Cabinet Mtns Aug. 2012 and den, moved to Glacier National Park and returned to Cabinet Mtns, lost collar Oct. 2013
723	M	2	8/18/2011	Whitefish R, MT	Spar Lake	Den Cabinet Mtns 2011. Lost collar June 2012.
918	M	2	7/6/2012	Whitefish R, MT	EF Bull River	Den Cabinet Mtns 2012–-13. Lost collar Oct. 2014.
919	M	4	7/30/2013	NF Flathead R, MT	Spar Lake	Den Cabinet Mtns 2013. Lost collar Aug. 2014.
920	F	2	6/18/2014	NF Flathead R, MT	Spar Lake	Den Cabinet Mtns 2014–15.
921	F	2	6/18/2014	NF Flathead R, MT	Spar Lake	Den West Cabinet Mtns 2014. Died of unknown cause May 2015.
924	M	2	7/25/2015	SF Flathead R, MT	Spar Lake	Mistaken identity mortality Sept. 2015
926	M	3	7/25/2016	SF Flathead R, MT	Spar Lake	Den Cabinet Mtns 2016. Lost collar July 2017
927	M	2	7/20/2018	NF Flathead R, MT	Spar Lake	Den West Cabinet Mtns 2018

Cabinet-Yaak Hair Sampling and DNA Analysis

Hair snag sampling occurred at barb wire corrals baited with a scent lure during 2000–2018 (Table 8 and Fig. 6). Sampling occurred from May–October but varied within years. Sites were selected based on prior grizzly bear telemetry, sightings, and access. Remote cameras supplemented hair snagging at most sites and were useful in identifying family groups and approximate ages of sampled bears. In 2002, study personnel assisted an MFWP black bear population estimate effort that sampled 285 sites in the Yaak River portion of the CYE. During 2003, 184 sites on a 5 km^2 grid were sampled on 4,300 km^2 in the Cabinet Mountains portion of the CYE. In 2009, 98 sites were sampled south of the Clark Fork River. Other years had much lower numbers of sampled sites. Collectively, USFWS and USGS crews have sampled 1,941 corral traps from 2000–2018 (Table 8 and Fig. 6). Through 2017, six percent of site visits provided hair from at least 62 grizzly bears. Genetic analysis from 2018 field collected samples is not yet complete; we will report on these results in the 2019 report.

Table 8. Hair snagging corrals and success in the Cabinet-Yaak study area, 2000–2018. DNA genetic results not yet complete for 2018 samples.

Year	Number of corral sessions[1]	Sessions with grizzly bear DNA(%[2])	Sessions with grizzly bear photos or DNA(%[2])	Individual grizzly bear genotypes	Locations with grizzly bear pictures or hair	Comments
2000	1	0	0	0		
2001	3	0	0	0		
2002	319	9 (3)	10 (3)	9	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 (1)	1	WF Rock Cr., W Fisher Cr.	
2004	14	2 (14)	2 (14)	3	EF Bull R., EF Rock Cr.	
2005	17	1 (6)	2 (12)	1	EF Bull R., Libby Cr.	
2006	19	3 (16)	3 (16)	3	Cub Cr., Silverbutte Cr., Bear Cr., EF Rock Cr.	
2007	36	4 (11)	5 (14)	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 (5)	1 (5)	1	EF Bull R.	
2009	125	2 (2)	4 (3)	4	Bear Cr., Libby Cr., NF Callahan Cr., W Fisher Cr.	Female with young Bear Cr.
2010	27	3 (11)	4 (15)	5	EF Rock Cr., W Fisher Cr., Cub Cr., Drift Cr.	Female with young EF Rock Cr.
2011	72	9 (13)	12 (17)	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	854	48 (6)	48 (6)	29	Beaver Cr. (USFWS); myriad others from USGS population estimate efforts (Kendall et al. 2016)	USFWS effort genotyped and photo'd 1 GB from 64 corrals
2013	5	2 (40)	2 (40)	2	W. Fisher Cr.EF Rock Cr.	Female with young W Fisher Cr.
2014	41	3 (7)	8 (7)	4	Boyd Cr., Miller Cr., Libby Cr., Midge Cr., Faro Cr., Spread Cr.	Female with young Faro Cr.
2015	72	5 (7)	12 (17)	7	Pete Cr., Hellroaring Cr., Boulder Cr. (Cabinets), NF EF Bull Cr., Libby Cr., Rock Cr., Bear Cr.	Female with young Hellroaring Cr.; Female with cubs Bear Cr. and Libby Cr.
2016	39	6 (15)	9 (23)	10	Spruce Cr. (Yaak), Hellroaring Cr., Windy Cr., WF Yaak Cr., Papoose Cr., NF EF Bull Cr., Libby Cr.	Female with young Hellroaring Cr., NF EF Bull Cr.; Female with cub Windy Cr.
2017	92	18 (20)	18 (20)	18	Snowshoe Cr., SF Callahan Cr., Spruce Lakes, Rock Cr., Libby Cr., Poorman Cr., Cherry Cr., Bear Cr., EF Bull Cr., Hellroaring Cr., WF Yaak R., Lake Cr., Baree Cr.	Female with cubs Rock Cr., Female with young Bear Cr., Female with young EF Bull R.

Year	Number of corral sessions[1]	Sessions with grizzly bear DNA(%[2])	Sessions with grizzly bear photos or DNA(%[2])	Individual grizzly bear genotypes	Locations with grizzly bear pictures or hair	Comments
2018	55	--	16 (29)[3]	--	Bear Cr., Deer Cr., Drift Cr., EF Yaak R,, Garver Cr., Hellroaring Cr., Libby Cr., Midas Cr., Pete Cr., Rock Cr., Snowshoe Cr., W Fisher Cr., Whitetail Cr,	Female with cubs Hellroaring Cr., Pete Cr., and Bear Cr. Female with young W Fisher Cr.
Total	1996	117 (6)	153 (8)	62[4]		

[1]Some corral sites were deployed for multiple sessions per year. A "session" is typically 3-4 weeks long and defined as the interval between site set-up and revisits to collect samples and photos.
[2]Percent success at all corral sessions
[3]Sites with photos only. Awaiting 2018 genetic results.
[4]Some individuals captured multiple times among years.

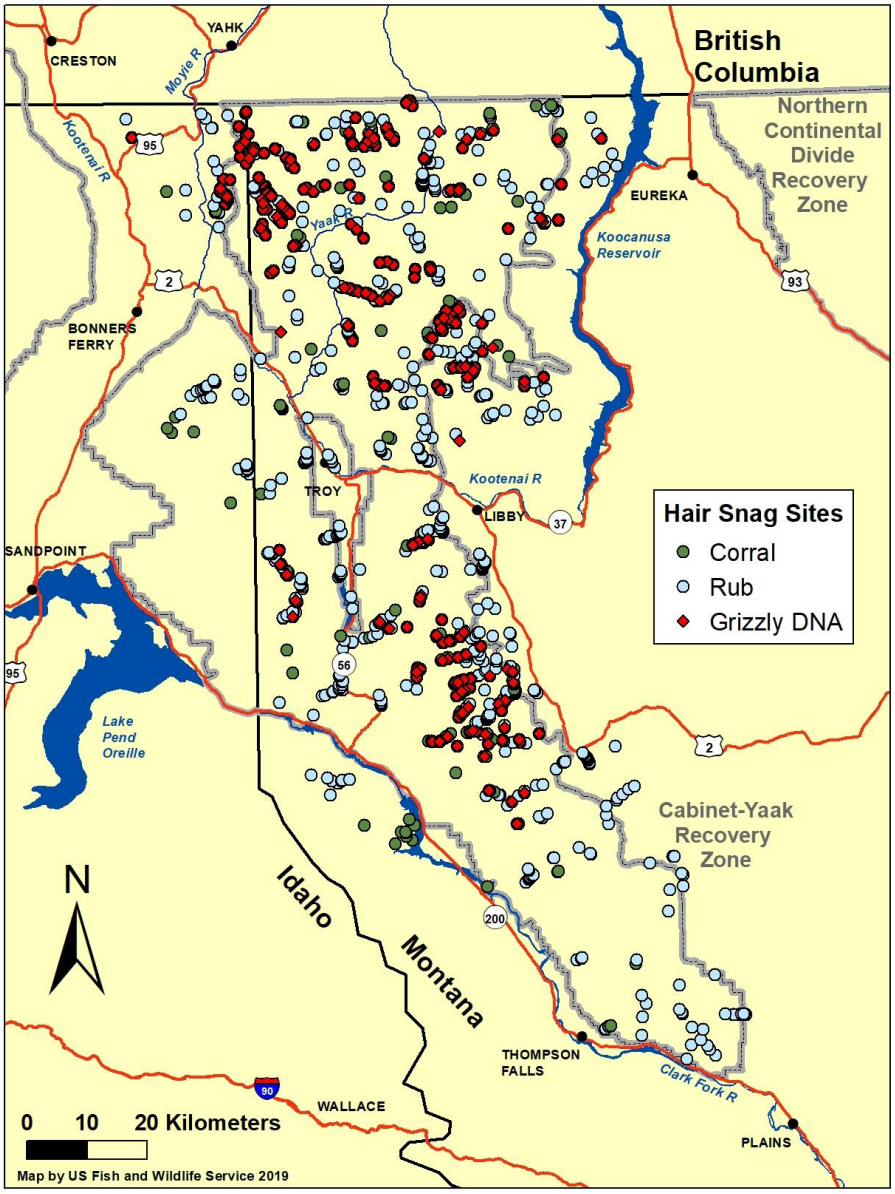


Figure 6. Location of hair snag sample sites in the Cabinet-Yaak Ecosystem study area, 2013–18. Sites with grizzly bear DNA are identified (2013–17).

In 2018, we collected 2267 samples from 2513 visits to 782 individual rub trees (Table 9). Samples were evaluated during cataloging and 1,791 were judged to be black bears (based on solid black coloration), leaving 476 to be sent to Wildlife Genetics International Laboratory in Nelson, British Columbia for DNA extraction and genotyping. Lab analysis on 2018 samples is still in progress, and we will report on results in the 2019 report. Since 2013, we have genetically identified 64 individual grizzly bears (38 males, 26 females) from 11,929 samples collected via rub effort.

Table 9. Grizzly bear hair rubs and success in the Cabinet-Yaak study area, 2012–2018.

Year	Number of rubs checked	Number of samples collected (%GB[1])	Number of samples sent to Lab (%GB[1])	Number of rubs with grizzly DNA	Individual grizzly bear genotypes	Males	Females
2012[2]	1376	8356 (2)	4639 (3)	85	33	19	14
2013	488	1038 (6)	480 (12)	33	17	9	8
2014	583	1894 (7)	708 (19)	50	24	14	10
2015	693	2258 (6)	617 (22)	76	30	20	10
2016	780	3781 (5)	1049 (19)	90	29	18	11
2017	836	2958 (13)	676 (55)	148	38	24	14
2018	782	2267 (--)	476 (--)	--	--	--	--
Total[3]	1592[4]	20285 (5)	8169 (13)	275[4]	72[5]	45[5]	27[5]

[1] Percentage of samples yielding a grizzly bear DNA genotype.

[2] 2012 results from USGS population estimation study (Kendall et al. 2016). 2013-18 efforts are from USFWS coordinated efforts.

[3]Totals are through 2017. 2018 genetic results from the lab are not yet complete.

[4] Unique rub locations. Some rub locations visited multiple times among years.

[5]Some individuals captured multiple times among years.

Grizzly Bear Genetic Sample Summary

We provide data from and prior to 2017 as 2018 sample results have not been completed by the laboratory. Using all methods (capture, collared individuals, rub tree DNA, corral DNA, opportune DNA sampling, photos, credible observations), we detected a minimum 54 individual grizzly bears alive and in the CYE grizzly bear population at some point during 2017. Twenty-five bears were detected in the Cabinets (12 male, 8 female, 2 unknown sex). Twenty-nine bears were detected in the Yaak (14 male, 13 female, 2 unknown sex).

Captures, genotypes from hair or tissue, and observations of grizzly bears by study personnel in the CYE study area were summarized during 1986–2017. 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.

One hundred seventy-six individuals were identified within the CYE study area with 164 bears captured or genotyped and 20 unmarked individuals observed during 1986–2017. Sixty-eight of these animals are known or suspected to have died. Human causes were linked to 48 of these mortalities. Nineteen were believed to have died of natural causes. Thirteen of these 19 mortalities involved cubs. Four mortalities were from unknown causes. Twelve bears were known to have emigrated from the population. Three were augmentation bears returning to their area of capture, one was an augmentation bear that moved south out of the recovery area and was killed, three went north of BC Highway 3 where one was killed, three bears went east of the recovery area where two are known dead, and two went west to the Selkirk Mountains. All bears known to have left the population are either augmentation bears or male individuals.

We determined parent-offspring relationships of Yaak grizzly bears using sample genotypes from 1986–2017. A majority of our detected sample in the Yaak descends from female grizzly bear 106 (Figure 7). She produced five known litters, and her matrilines tie to 43 known 1st, 2nd, and 3rd generation offspring. Since 1986, we have genetically detected 38 female grizzly bears in the US Yaak and BC Yahk, 27 (71%) of which are direct maternal descendants of bear 106. Since 2014, all female bears detected in the Yaak are her maternal descendants. In 2015–17, we detected 1 daughter, 7 granddaughters, and 4 great-granddaughters of 106.

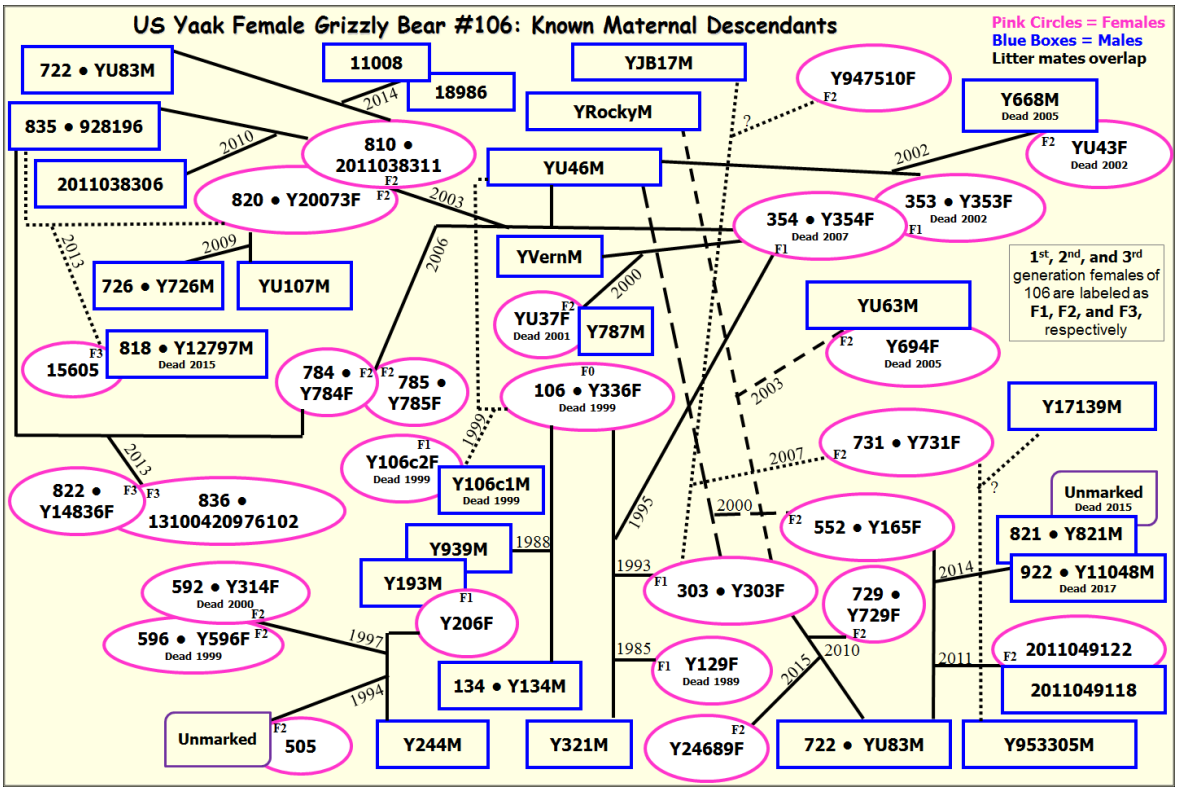


Figure 7. Most likely pedigree displaying matrilineal ancestry of female grizzly bear 106 in the Yaak River, 1986–2016. Squares indicate males and circles represent females. Lines indicate a parent-offspring relationship. F0 is the initial generation, F1 the first generation, F2 the second generation, and F3 the third generation. Numbers along lines indicate when the descendant litter was produced.

Claws from a grizzly bear were discovered in Baree Creek of the Cabinet Mountains, in 1993. 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 three bears captured in the Cabinet Mountains from 1983–1988 were a triad with bear 680 being the offspring of bears 678 and 14.

The Cabinet Mountains population was estimated to be 15 bears or fewer in 1988 on the basis of independent tracks, sightings, and expert opinion (Kasworm and Manley 1988). However, lack of resident bears identified since 1989 suggests the population was well below 15 individuals. Genetic samples from the Cabinet Mountains (1983–2017) were determined to originate from 67 different grizzly bears. Three of these were from captures during 1983–1988, 19 were from augmentation bears during 1990–2017 (1 augmentation bear 218 genetically

unmarked), and 45 from captures, mortalities, or hair snagging during 1997–2017.

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 as a 2-year-old (Kasworm *et al*. 2007). She was 13 years old when the first hair sample was obtained during 2004. Pedigree analysis indicates she has produced at least 10 first generation offspring, 16 second generation offspring, and 1 third generation offspring. Six of those first generation offspring were females, and all 6 are known to have reproduced (Fig. 8). Bear 286 was killed in a self-defense incident with a hunter in November of 2009. Only 10 genotyped bears not known to be augmentation bears or their offspring have been identified in the Cabinet Mountains since 1990 and four are known to be dead. Of these 10 bears, two are adult males that bred with 286 to contribute to the first generation. Four are a family group (adult female with 3 cubs) identified south of the Clark Fork River in 2002. One bear was a subadult male captured near Thompson Falls in 2011 in an incident involving livestock depredation. Another was a male migrant from the Selkirk Mountains identified in 2012, who is now known to have moved back to the Selkirks. Another was an adult male killed by self-defense in the Little Thompson River during 2014. This bear was known to have originated in the Northern Continental Divide Population to the northeast and moved into the CYE during 2014. The remaining bear is an adult male born in 2009 in the Yaak whose range included the Cabinets and the Yaak in 2016. The augmentation effort appears to be the primary reason grizzly bears remain and were increasing in the Cabinet Mountains.

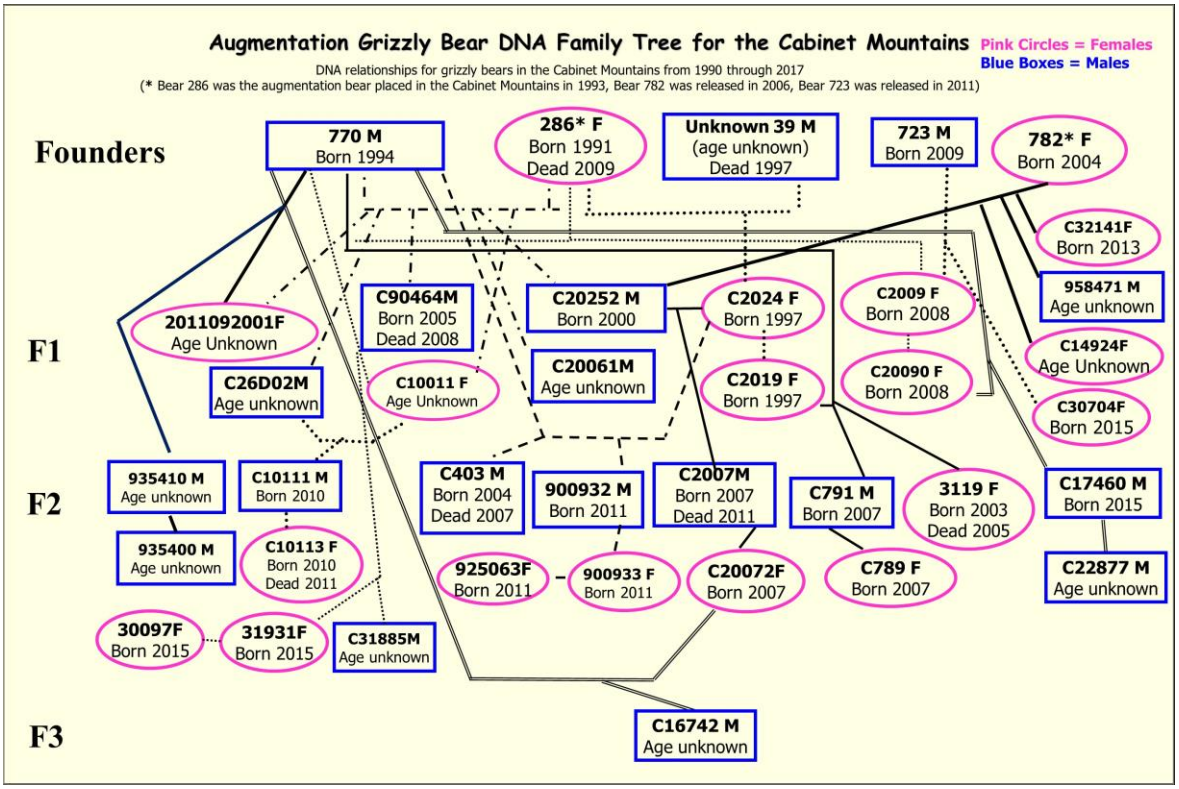


Figure 8. Most likely pedigree resulting from translocated female grizzly bears 286 and 782 in the Cabinet Mountains, 1993–2017. Squares indicate males and circles represent females. Lines indicate a parent-offspring relationship. F0 is the initial generation, F1 is the first generation of offspring for translocated females 286 or 782 and male 723, F2 is the second generation and F3 is the third generation.

Grizzly Bear Movements and Gene Flow Within and Between Recovery Areas

Population linkage is a goal of the recovery plan for the CYE (USFWS 1993). The population goal of approximately 100 animals requires genetic connectivity to maintain genetic health over time. While movement data from telemetry or genetic methods may be a precursor of linkage, gene flow in the form of reproduction by immigrant individuals is the best measure of connectivity.

Capture, telemetry, and genetic data were analyzed to evaluate movement and subsequent reproduction resulting in gene flow into and out of the CYE. Thirty-six grizzly bears were identified as immigrants, emigrants, or were the offspring of immigrants to the CYE (Appendix Table T4). While movement and gene flow out of the CYE may benefit other populations, gene flow into the CYE is most beneficial to genetic health. Fourteen individuals (11 males and 3 females) are known to have moved into the CYE from adjacent populations; however eight of these were killed or removed (Figure 9). Most of these immigrants originated in the North Purcells or South Selkirks with only three originating in the NCDE. Of those three, two are known dead. Gene flow has been identified through reproduction by three immigrants (two males and one female) resulting in 4 offspring in the CYE. All three immigrants producing gene flow originated in the North Purcells.

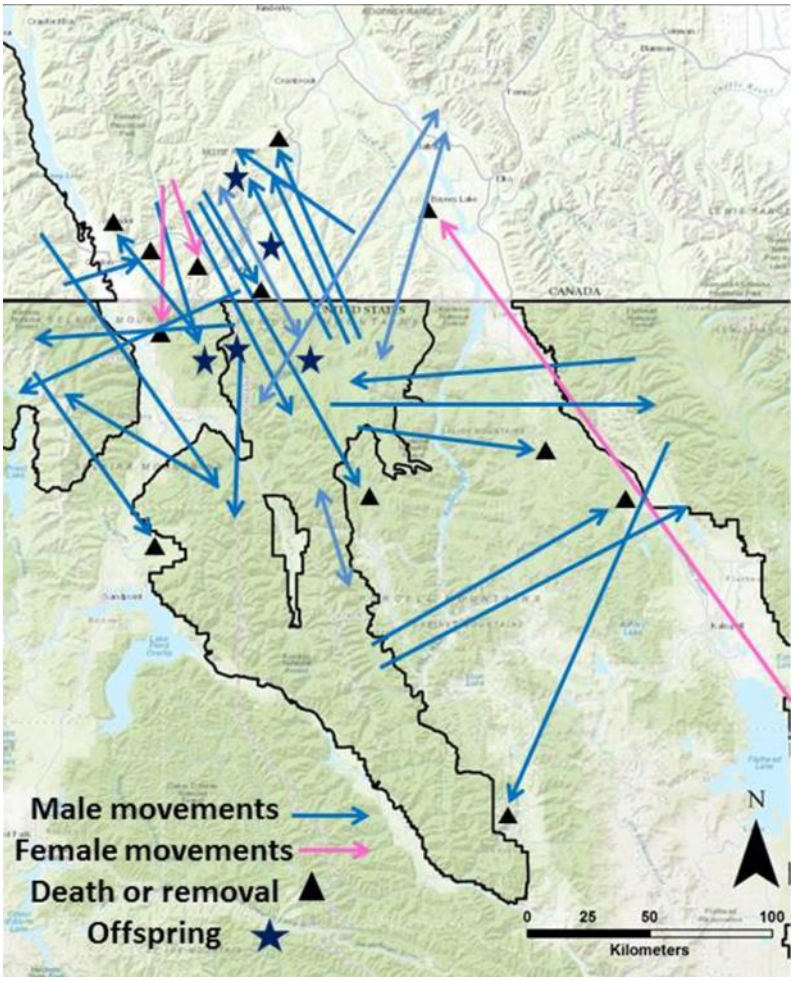


Figure 9. Known immigration or emigration events (blue and pink lines) and gene flow (black stars) in the Cabinet-Yaak, 1988–2018

Known Grizzly Bear Mortality

There were five instances of known or probable grizzly bear mortality in or within 16 km of the CYE (including BC) during 2018 (2 subadult males, 1 adult female, 2 cubs-of-the-year). Four were known human-caused (1 subadult male, 1 adult female and her 2 cubs) and one was probable and of unknown cause (subadult male). Sixty instances of known and probable grizzly bear mortality from all causes were detected inside or near the CYE (excluding Canada) during 1982–2018 (Tables 1 and 10, Fig. 9). Forty-four were human caused, 13 were natural mortality, and 3 were unknown cause. There were 18 instances of known grizzly bear mortality in Canada within 16 km of the CYE in the Yahk and South Purcell population units from 1982–2018 (Tables 1 and 10, Fig. 10). Thirteen were human-caused and 5 were natural mortalities.

Table 10. Cause, timing, and location of known and probable grizzly bear mortality in or within 16 km of the Cabinet-Yaak recovery zone (including Canada), 1982–2018. Radio collared bears included regardless of mortality location.

	Mortality cause											
Country/ age / sex / season / ownership	Defense of life	Legal Hunt	Hound hunting	Management removal	Mistaken identity	Natural	Poaching	Trap predation	Vehicle collision	Unknown, human	Unknown	Total
U.S.												
Age / sex												
Adult female	3					2	1		1	2	1	10
Subadult female						1	1	1	2	3		8
Adult male	2			1	1		2			4		10
Subadult male	2				4		2			4	1	13
Yearling					1	1					1	3
Cub					1	9	2			3		15
Unknown					1							1
Total	7			1	8	13	8	1	3	16	3	60
Season[1]												
Spring					1	1	1			4	1	8
Summer	1				1	12	1	1				16
Autumn	6			1	6		5		3	11		32
Unknown							1			1	2	4
Ownership												
US Private	3			1	2		5		3	5	1	20
US Public	4				6	13	3	1		11	2	40
Canada												
Adult female				2								2
Subadult female	1							1				2
Adult male	1	1		2	1					1		6
Subadult male				1						1		2
Yearling						1						1
Cub						4						4
Unknown			1									1
Total	2	1	1	5	1	5		1		2		18
Season[1]												
Spring		1		1		1		1				4
Summer			1	1		4						6
Autumn	2			3	1					2		8
Unknown												
Ownership												
BC Private				4								4
BC Public	2	1	1	1	1	5		1		2		14

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

Seventy-two percent (18 of 25) of known human-caused mortalities occurring on the US National Forests were <500m of an open road and 28% were >500m from an open road (7 of 25). Twenty-eight percent (7 of 25) of known human-caused mortalities occurring on National Forests were located within core habitat (area greater than 500m from an open or gated road).

Mortality rates were examined by breaking the data into periods of increase (1982–98, 2007–18) and decrease (1999–2006) in population trend. From 1982–98, 16 instances of known mortality occurred in the U.S. and Canada, with 12 (75%) of these mortalities being human-caused (Table 1). The annual rate of known human-caused mortality was 0.71 mortalities per year. Twenty-seven instances of known mortality occurred during 1999–2006 with 18 (67%) of these mortalities human-caused. Annual rate of known human-caused mortality was 2.25 per year. Thirty-five instances of known mortality occurred from 2007–18 with 27 (77%) of these mortalities human-caused. Annual rate of known human-caused mortality was 2.25 per year. Though the rate of known human caused mortality was similar 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. The rate of known female mortality was 0.29 and human caused female mortality was 0.18 during 1982–98. Total known female mortality rate decreased from 1.88 during 1999–2006 to 0.67 during 2007–18 and known human-caused female mortality rate decreased from 1.38 to 0.50. This decline of female mortality is largely responsible for the improving population trend from 2007–18 (Pages 37–42). Effort to detect mortality were probably lowest during 1982–98 because of fewer collared bears and less personnel presence in the Yaak portion of the recovery zone. Comparisons involving the two most recent time periods represent more similar amounts of effort to detect mortality.

The increase in total known mortality beginning in 1999 may be linked to poor food production during 1998–2004 (Fig. 10). Huckleberry production during these years was about half the long term average. 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 may not allow females to produce cubs in the following year and cause females to travel further for food, exposing young to greater risk of mortality from conflicts with humans, predators, or accidental deaths. One female bear 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.

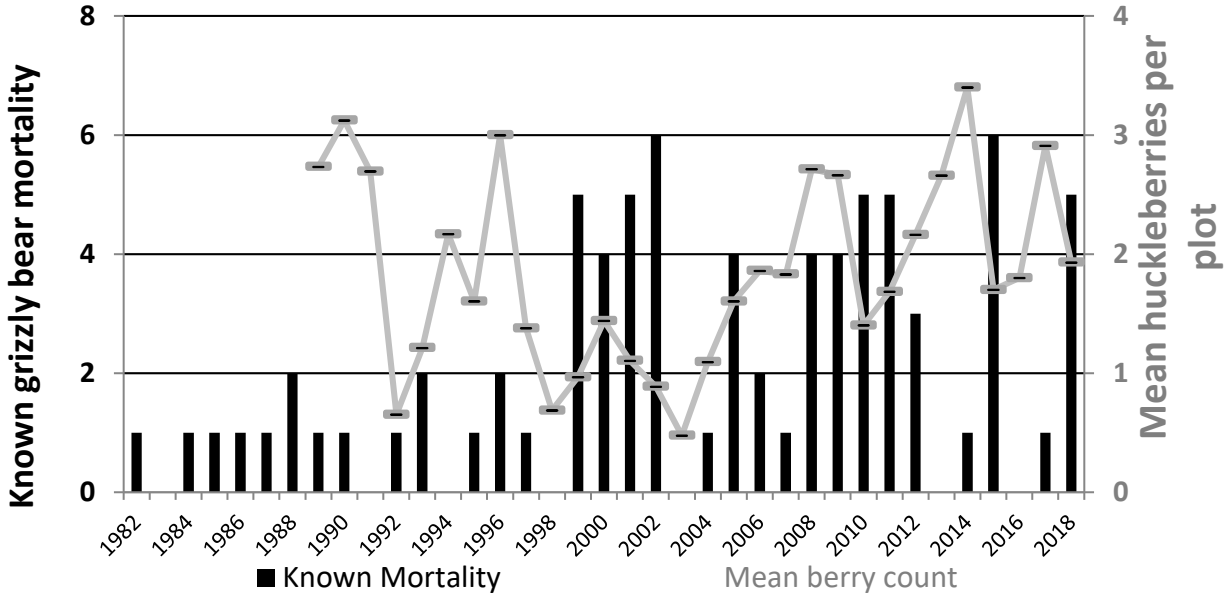


Figure 10. Known grizzly bear annual mortality from all causes in or within 16 km of the Cabinet-Yaak recovery zone (including Canada) and all radio-collared bears by cause, 1982–2018 and huckleberry production counts, 1989–2018.

Use of known human-caused mortality counts probably under-estimates total human-caused mortality. Numerous mortalities identified by this study were reported only because animals wore a radio-collar at 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). Correction factors were not applied to natural mortality, management removals, mortality of radio-collared bears or bears that died of unknown causes (Table 11). All radioed bears used to develop the unreported mortality correction were >2 years-old and died from human related causes. Twenty-three radio-collared bears died from human causes during 1982–2018. Ten of these were reported by the public (53%) and 9 were unreported (47%). The Bayesian statistical analysis described by Cherry *et al*. (2002) was used to calculate unreported mortality in 3 year running periods in the Yellowstone ecosystem, but samples sizes in the CYE are much smaller, so we grouped data based on the cumulative population trend (ʎ, Fig. 11). The unreported estimate added 22 mortalities to the 77 known mortalities from 1982–2018. The unreported estimate includes bears killed in BC which are not counted in recovery criteria (USFWS 1993).

Table 11. Annual human-caused grizzly bear mortality in or within 16 km of the Cabinet-Yaak recovery zone (including Canada) and estimates of unreported mortality, 1982–2018 (including all radio-collared bears regardless of mortality location).

Years	Population trend	Natural	Management or research	Radio monitored	Unknown cause	Public reported	Unreported estimate	Total
1982-1998	Improving	3	2	4	1	6	5	21
1999-2006	Declining	9	4	7	0	7	6	33
2007-2018	Improving	5	2	12	2	13	11	45
Total		17	8	23	3	26	22	99

Grizzly Bear Mortality, Reproduction, Population Trend, and Population Estimate

This report segment updates information on survival rates, cause-specific mortality, and population trend following the methods used in Wakkinen and Kasworm (2004).

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 1983–2018 (Table 12). We calculated survival and mortality rates for augmentation and management bears separately (see below).

Table 12. 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, 1983–2018.

	Demographic parameters and mortality rates					
Parameter	Adult female	Adult male	Subadult female	Subadult male	Yearling	Cub
Individuals / bear-years	16 / 47.4	26 / 35.9	20 / 24.5	21 /16.7	33 / 16.3	42 / 42[a]
Survival[b] (95% CI)	0.937 (0.869–1.0)	0.891 (0.794-0.989)	0.844 (0.705–0.983)	0.822 (0.641-01.0)	0.889 (0.744–1.0)	0.619 (0.476–0.762)
Mortality rate by cause						
Legal Hunt Canada	0	0.031	0	0	0	0
Natural	0.021	0	0	0	0.111	0.286
Defense of life	0	0.028	0.037	0.042	0	0
Mistaken ID	0	0	0	0.059	0	0
Poaching	0.020	0	0	0	0	0.048
Trap predation	0	0	0.046	0	0	0
Unknown human	0.022	0.050	0.074	0.077	0	0.048

[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 resident non-management radio-collared grizzly bears ≥2 years old were summarized by cause and location of death (Table 13). 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 three time periods. The three periods (1983–1998, 1999-2006, and 2007–2018) correspond to a period of population increase followed by a period of decline followed by a period of increase in long term population trend (λ). Grizzly bear survival of all sex and age classes decreased from 0.899 during 1983–1998 to 0.792 during 1999–2006 and then rose to 0.930. Some of this decrease in the 1999–2006 period could be attributed to an increase in natural mortality probably related to poor berry production during 1998–2004. Mortality on private lands in the U.S. increased during this period, suggesting that bears were searching more widely for foods to replace the low berry crop. Several mortalities occurring during 1999–2006 were associated with sanitation issues on private lands. Declines in mortality rate on private lands beginning in 2007 correspond to and may be the result of the initiation of the MFWP bear management specialist position. Several deaths of management bears occurred on private lands, but were not included in this calculation due to capture biases (traps were set only once a conflict occurred and removed after capture). Point estimates for human caused mortality occurring on public lands in the U.S. and British Columbia decreased from 1983–1998 to 1999–2006 and again from 1999–2006 to 2007–2018. This apparent decrease in mortality rates on public lands from 1983–1998 to 1999–2006 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 13. Survival and cause-specific mortality 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, 1983–2018.

Parameter	1983–1998	1999–2006	2007–2018
Individuals / bear-years	23 / 48.9	21 / 20.3	42 / 55.3
Survival[b] (95% CI)	0.899 (0.819–0.979)	0.792 (0.634–0.950)	0.930 (0.861–0.999)
Mortality rate by location and cause			
Public / natural	0	0.059	0
U.S. public / human	0.061	0.036	0.036
U.S. private / human	0	0.075	0.034
B.C. public / human	0.040	0.038	0
B.C. private / human	0	0	0

Augmentation Grizzly Bear Survival and Cause-Specific Mortality

Kaplan-Meier survival rates were calculated for 20 augmentation grizzly bears from 1990–2018. Bears that left the area were censored. Thirteen female and seven male bears ranged in age from 2–10, but were pooled for calculation because of small sample size. Survival for augmentation bears was 0.786 (95% CI=0.631–0.942, n=20) with a natural mortality (female), a poaching (female), a mistaken identity (male), a train collision (female), and an unknown cause (female) among 20 radio-collared bears monitored for 21.3 bear-years. The natural mortality occurred during spring, the unknown mortality occurred during summer, and the poaching, mistaken identity, and train mortality occurred during autumn. The female that died of unknown cause produced a cub before her death, and it is assumed the cub died.

Management Grizzly Bear Survival and Cause-Specific Mortality

Kaplan-Meier survival rates were calculated for 15 management grizzly bears captured at conflict sites from 2003–18. Thirteen bears were males and two were females aged 2–18 but were pooled for this calculation because of small sample size. Survival rate was 0.614 (95% CI=0.377–0.850, n=15) with an instance of mistaken identity, a defense of life, and two unknown but human-caused mortality among 15 radio-collared bears monitored for 7.8 bear-years. One mortality occurred during spring and three occurred during autumn. All mortality involved males.

Grizzly Bear Reproduction

Reproductive parameters originated from all bears monitored from 1983–2018. Mean age of first parturition among native grizzly bears was 6.33 years (95% CI=6.1–6.9, n=12, Table 16). Three 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. Eight other first ages of reproduction were established through genetic parentage analysis and known age of offspring. Twenty-seven litters comprised of 57 cubs were observed through both monitoring radio-collared bears and known genetic parentage analysis paired with remote camera observation, for a mean litter size of 2.11 (95% CI=1.92–2.30, n=27, Table 14). Twenty-two reproductive intervals were determined through both monitoring radio-collared bears and known genetic parentage analysis paired with remote camera observation (Table 15). Mean inter-birth interval was calculated as 2.91 years (95% CI=2.48–3.34, n=22). 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 0.361 female cubs/year/adult female (95% CI=0.286–0.467, n=12 adult females, Table 16). In all calculations the sex ratio of cubs born was assumed to be 1:1. Reproductive rates do not include augmentation bears.

Table 14. Grizzly bear reproductive data from the Cabinet-Yaak 1983–2018.

Bear	Year	Age at first reproduction	Cubs	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 1 male other 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	6	2	3	♀ 505
206	1997		2		♀ 596 dead in 1999, ♀ 592 dead in 2000
538	1997	6	1	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	7	2	3	1 cub dead in 2000, ♀ 552
303	2003			4	At least 2 cubs
303	2007			3	
303	2010		3		1 cub dead in 2010
303	2013				Observed with courting male in May 2014
303	2016				1 yearling observed in 2016
354	2000	5		3	Genetic data indicated reproduction of at least two cubs in 2000
354	2003			3	At least 2 cubs
354	2006				At least 2 cubs
353	2002	7	3		♀ 353 dead in 2002, 3 cubs (1 female) all assumed dead in 2002
772	2003	6		4	Genetic data indicated reproduction of at least one cub in 2003
772	2007		3		♀ 789, ♂ 791, Unknown sex dead in 2007
675	2009	7	2	1	2 cubs dead in 2009
675	2010		1		1 cub dead in 2010
552	2011		2	3	♀ 2011049122, ♂ 2011049118
552	2014		3		3 cubs, 2 males and one of unknown sex
784	2013	7			At least 2 cubs
810	2010	7		4	At least one cub
810	2014		2		2 cubs observed at camera site, August 2014
810	2018		2		2 cubs observed June 2018
820	2009	6		4	At least one cub
820	2013				At least 2 cubs
820	2018		2		2 cubs observed July 2018
831	2004	7		3	At least 1 cub
831	2007				At least 2 cubs
831	2011		3	4	At least 3 cubs
831	2017		2		Photo with 2 cubs July 2017
822	2018	5			Photo June 2018 with at least one cub

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

Population Trend

Approximately 95% of the survival data and 85% of the reproductive 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. However, only the Kootenai River divides the Cabinet Mountains from the Yaak River and the trend produced from this data would appear to be applicable to the entire population of native bears in

the absence of population augmentation. We have no data to suggest that mortality or reproductive rates are different between the Yaak River and the Cabinet Mountains. The Cabinet Mountains portion of the population was estimated to be <15 in 1988 (Kasworm and Manley 1988) and subsequent lack of identification of resident bears through genetic techniques would suggest the population was possibly 5–10. Population augmentation has added 20 bears into this population since 1990 and a mark recapture population estimate from 2012 indicated the population was 22–24 individuals (Kendall *et al*. 2016). These data indicate the Cabinet Mountains population has increased by 2–4 times since 1988, but this increase is largely a product of the augmentation effort with reproduction from that segment.

The estimated finite rate of increase (λ) for 1983–2018 using Booter software with the unpaired litter size and birth interval data option was 1.012 (95% CI=0.934–1.078, Table 15). Finite rate of change over the same period was an annual 1.2% (Caughley 1977). Subadult female survival and adult female survival accounted for most of the uncertainty in λ, 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 yielded wide confidence intervals around our estimate of trend (i.e., λ). The probability that the population was stable or increasing was 62%. Utilizing the entire survival and reproductive data set from 1983–2018 is partially the product of small sample sizes but also produces the effect of smoothing the data over time and results in a more conservative estimate of population trend.

Finite rates of increase calculated for the period 1983–1998 (λ = 1.067) suggested an increasing population (Wakkinen and Kasworm 2004). Lack mortality in specific sex-age classes limited calculations for many time periods other than those shown here (Fig. 11). Annual survival rates for adult and subadult females were 0.948 and 0.901 respectively, during 1983–1998, and then declined to 0.926 and 0.740 for the period of 1983–2006, respectively. Cumulative lambda calculations reached the lowest point in 2006 (Fig. 10). Human-caused mortality has accounted for much of this decline in annual survival rates and population trend. During 2018, adult female survival and subadult female survival had increased to 0.938 and 0.845 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 15. 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, 1983–2018.

Parameter	Sample size	Estimate (95% CI)	SE	Variance (%)[a]
Adult female survival[b] (S_a)	16 / 47.1[c]	0.938 (0.853–1.0)	0.036	33.7
Subadult female survival[b] (S_s)	20 / 24.8[c]	0.845 (0.692–0.963)	0.072	50.3
Yearling survival[b] (S_y)	33 / 16.2[c]	0.884 (0.723–1.0)	0.076	2.9
Cub survival[b] (S_c)[d]	42/42	0.619 (0.476–0.762)	0.074	5.5
Age first parturition (*a*)	12	6.2 (5.7–6.6)	0.227	0.8
Maximum age (*w*)	Fixed	27		
Unpaired Reproductive rate (*m*)[e]	12/21/25[f]	0.361 (0.286–0.467)	0.048	6.8
Unpaired Lambda (λ)	5000 bootstrap runs	1.012 (0.934–1.078)	0.037	

[a] Percent of lambda explained by each parameter
[b]Booter survival calculation which may differ from Kaplan-Meier estimates in Table 13.
[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 reproductive adult females / sample size for birth interval / sample size for litter size from Table 14.

Population Estimate

During 2012 the USGS used mark-recapture techniques to estimate the CYE grizzly bear population at 48–50 (95% CI = 44–62) (Kendall *et al*. 2016). Using the midpoint of this starting estimate (49), the calculated rate of increase (1.2%), results in a gain of 4 bears through 2018 to a population of 53. The augmentation program added 6 bears since 2012 but two of those are known dead. Based on this information, a population estimate of 55–60 bears would seem reasonable.

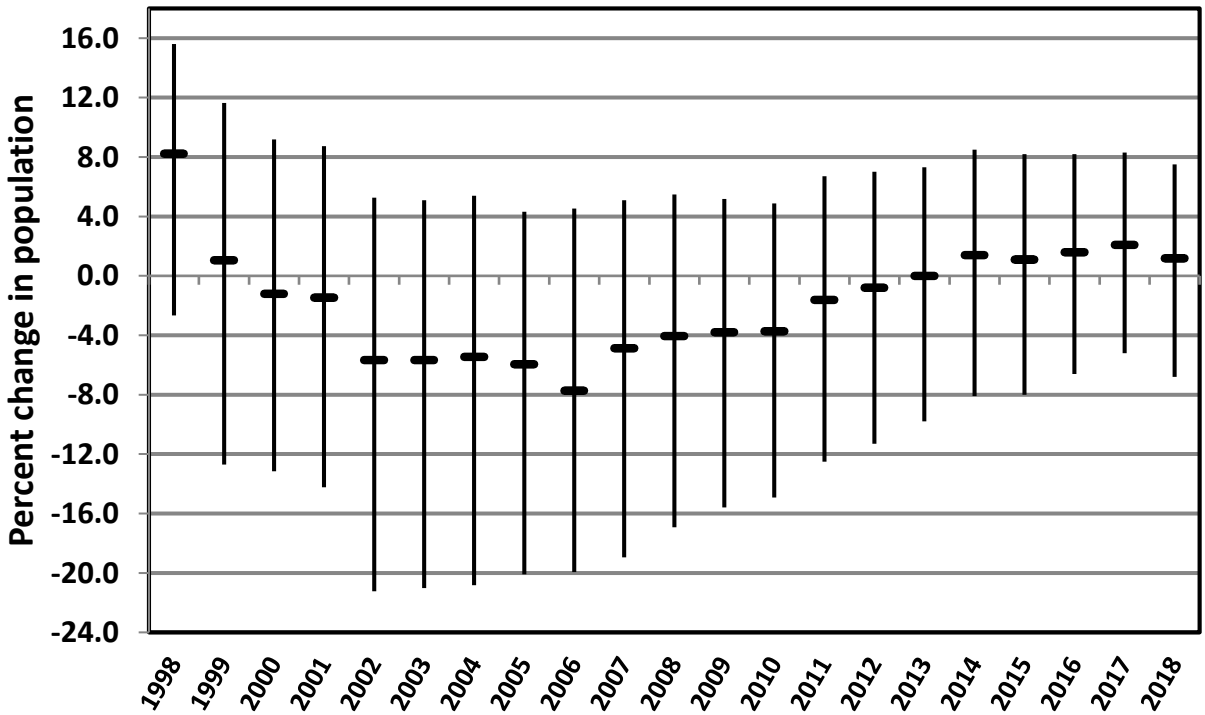


Figure 11. Point estimate and 95% confidence intervals for cumulative annual calculation of population rate of change for native grizzly bears in the Cabinet-Yaak recovery area, 1983–2018. Each entry represents the annual rate of change from 1983 to that date.

Capture and Marking

Only three grizzly bears were captured (1 adult male, 2 subadult males) during 2018. One capture occurred for research purposes and 2 were management captures. Ninety-three individual grizzly bears have been captured 138 times as part of this monitoring program since 1983 (Tables 16 and 17). One-hundred sixteen captures occurred for research purposes and 22 captures occurred for management purposes.

Cabinet Mountains

Research trapping was conducted in the Cabinet Mountains portion of the CYE from 1983–87. Three adult grizzly bears were captured during this effort (1 female and 2 males). No trapping occurred from 1988–1994 as effort was directed toward the Yaak River. 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 1983–2018, 7,598 research trap-nights were expended to capture 12 known individual grizzly bears and 315 individual black bears (Table 16 and 17, Fig. 12). Rates of capture by individual were 1 grizzly bear/633 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. One augmentation bear was 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, Purcell Mountains South of BC Highway 3

Trapping was conducted in the Yaak portion of the CYE during 1986–87 as part of a black bear graduate study (Thier 1990). Research trapping was continued from 1989–2018 by USFWS. One-hundred five captures of 58 individual grizzly bears and 535 captures of 451 individual black bears were made during 11,145 trap-nights during 1986–2018 (Tables 16 and 17, Fig. 12). Rates of capture by individual were 1 grizzly bear/192 trap-nights and 1 black bear/25 trap-nights. Trapping effort was concentrated in home ranges of known bears during 1995–2018 to recapture adult females with known life histories. Much of the effort involved using horses and bicycles 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 16, 17).

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 16 and Fig. 12). Trapping was conducted in cooperation with M. Proctor (Birchdale Ecological Consultants, Kaslo, BC) 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 16). Sixteen bears were collared (15 in Montana, 1 in Idaho). Eight bears (2 females and 6 males) were collared north of the 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. Effort centered on the McArthur Lake State

Wildlife Management Area. Nineteen black bears were captured during 413 trap-nights, or 22 trap-nights/capture (Table 16). 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.

Table 16. Research capture effort and success for grizzly bears and black bears within study areas, 1983–2018.

Area / Year(s)	Trap-nights	Grizzly Bear Captures	Black Bear Captures	Trap-nights / Grizzly Bear	Trap-nights / Black Bear
Cabinet Mountains,1983–18					
Total Captures	7598	15	433	507	18
Individuals[1]	7598	12	315	633	24
Salish Mountains, 2003[1]	63	1	5	63	13
Yaak River South Hwy 3, 1986–18					
Total Captures	11145	105	535	106	21
Individuals[1]	11145	58	451	192	25
Purcells N. Hwy 3, BC 2004–09					
Total Captures	390	10	37	39	11
Individuals[1]	390	9	32	43	12
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

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

Table 17. Grizzly bear capture information from the Cabinet-Yaak and Purcell populations, 1983–2018. Multiple captures of a single bear in a single 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
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	10/14/89	M	1	90	Large Cr., MT	Research
193	10/14/89	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

Bear	Capture Date	Sex	Age (Est.)	Mass kg (Est.)	Location	Capture Type
106	9/04/92	F	14	144	Burnt Cr., MT	Research
34	6/26/93	F	(15)	158	Spread Cr., MT	Research
206	10/06/93	F	5	(159)	Pete Cr., MT	Research
505	9/14/94	F	Cub	45	Jungle Cr., MT	Research
302	10/07/94	M	1	95	Cool Cr., MT	Research
303	10/07/94	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	11/15/99	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	10/21/04	M	2	(114)	Young Cr., MT	Management, garbage feeding
675	10/22/04	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

Bear	Capture Date	Sex	Age (Est.)	Mass kg (Est.)	Location	Capture Type
668	10/11/05	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
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	10/15/07	F	1	75	Pete Cr., MT	Research
675	5/23/09	F	7	89	Elmer 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	11/21/09	M	4	(273)	Kidd Cr., BC	Research
799	5/21/10	M	3	(102)	Rock Cr., MT	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
726	5/24/11	M	2	77	Meadow Cr., MT	Research
722	5/31/11	M	12	261	Otis Cr., MT	Research
729	6/18/11	F	1	33	Beulah Cr., MT	Research
724	7/13/11	M	2	159	Graves Cr., MT	Management, killed pigs
732	10/27/11	M	5	139	Otis Cr., MT	Management, killed chickens
729	6/26/12	F	2	(80)	Pipe Cr., MT	Research
737	9/19/12	M	6	(159)	Basin Cr., MT	Research
552	9/24/12	F	12	(136)	Basin Cr., MT	Research
826	6/28/13	M	(5)	(136)	Pipe Cr., MT	Research
303	7/23/13	F	20	132	Pipe Cr., MT	Research
831	6/21/14	F	14	81	Libby Cr., MT	Research
807	6/24/14	M	4	111	Canuck Cr., ID	Research
808	6/27/14	M	4	130	Spruce Cr., ID	Research
722	8/21/14	M	15	(182)	Hellroaring Cr., MT	Research
835	8/24/14	M	19	185	Hellroaring Cr., MT	Research
836	9/19/14	F	1	75	Hellroaring Cr., MT	Research
837	9/29/14	M	6	(227)	Hellroaring Cr., MT	Research
729	5/19/15	F	5	107	Cool Cr., MT	Research
839	6/19/15	M	4	78	Bear Cr., MT	Research
810	7/16/15	F	12	120	Hellroaring Cr., MT	Research
818	7/18/15	M	2	82	Meadow Cr., MT	Research
820	8/20/15	F	12	149	Hellroaring Cr., MT	Research
726	10/5/15	M	6	227	Libby Cr., MT	Management, beehives
836	7/18/16	F	3	87	Hellroaring Cr., MT	Research
822	8/15/16	F	3	92	Hellroaring Cr., MT	Research
824	8/18/16	M	(12)	197	Hellroaring Cr., MT	Research
9811	8/19/16	M	(2)	(91)	Hellroaring Cr., MT	Research
821	8/27/16	M	2	127	Hellroaring Cr., MT	Research
853	9/21/16	M	5	120	Boulder Cr., MT	Research
722	9/29/16	M	17	238	17 Mile Cr., MT	Management, pigs and chickens
922	10/10/16	M	2	130	Upper Yaak R., MT	Management, chicken feed
726	6/18/17	M	8	(195+)	Beulah Cr., MT	Research
1026	6/21/17	F	2	63	Upper Yaak R., MT	Management, habituated
1028	6/21/17	F	2	64	Upper Yaak R., MT	Management, habituated
861	6/25/17	M	2	55	Bear Cr., MT	Research
840	6/26/17	F	2	53	Cruien Cr., MT	Research
842	7/25/17	F	4	93	Fourth of July Cr., MT	Research

Bear	Capture Date	Sex	Age (Est.)	Mass kg (Est.)	Location	Capture Type
810	9/18/17	F	14	150	Hellroaring Cr., MT	Research
9077	4/30/18	M	(3)	112	Thompson R., MT	Management
927	9/5/18	M	(2)	92	Dry Cr., ID	Management, Black Bear Bait Station
722	9/23/18	M	19	238	Hellroaring Cr., MT	Research

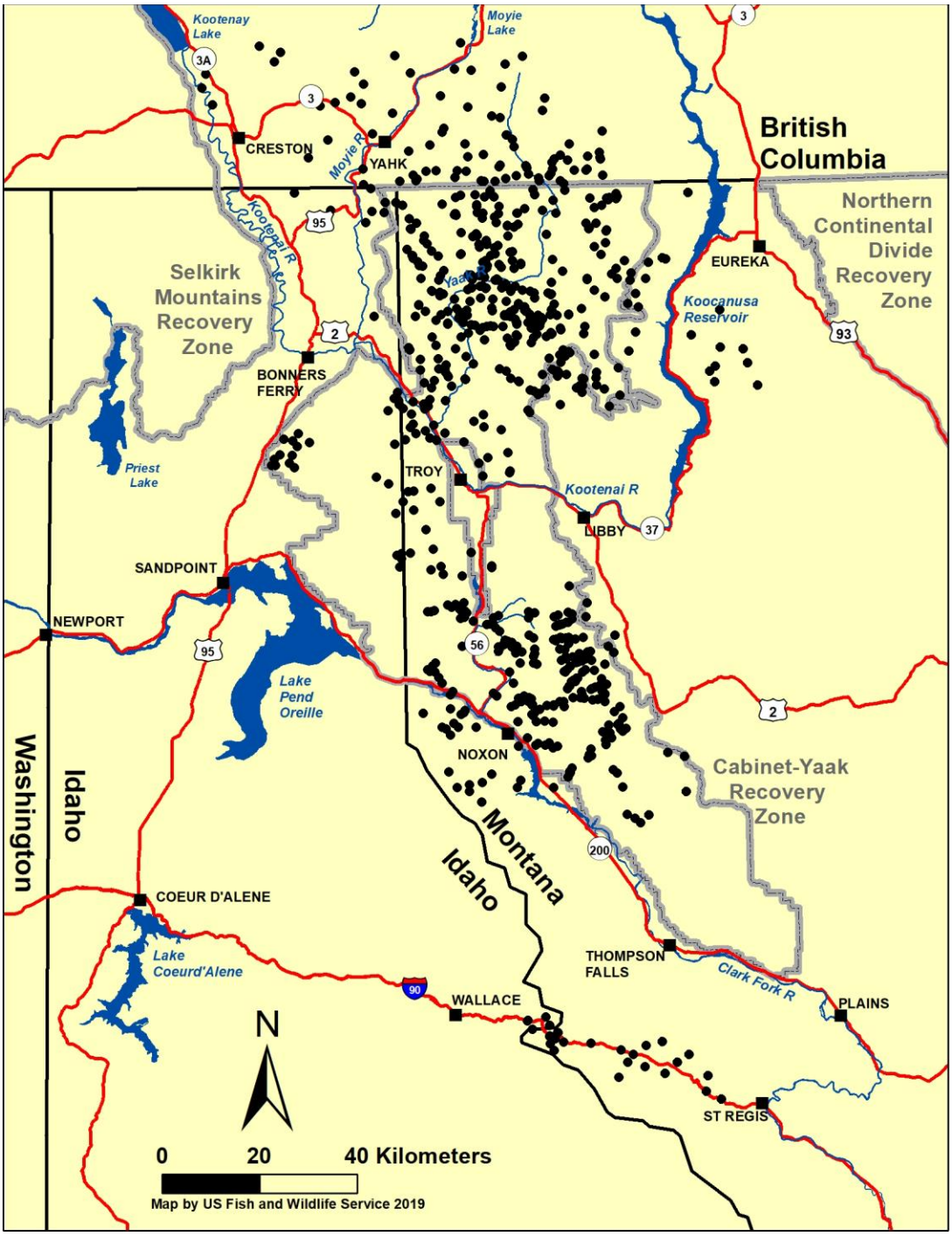


Figure 12. Trap site locations in the Cabinet-Yaak study areas 1983–2018.

Grizzly Bear Monitoring and Home Ranges

Ten grizzly bears were monitored with radio-collars during portions of 2018. Research monitoring included four females (three adults and one subadult) and four males (one adult and three subadults) in the CYE. One subadult male bear from the Cabinet Mountains was part of the augmentation program. One subadult male bear was collared for conflict management purposes.

Aerial telemetry locations and GPS collar locations were used to calculate home ranges. The convex polygon life ranges were computed for bears monitored during 1983–2018 (Table 18 and Appendix Figs. A1-A103). Resident, non-augmentation bears with life range estimates and sample sizes in excess of 50 locations were used to calculate basic statistics. Adult male life range averaged 1,948 km^2 (95% CI $\pm$ 416, n = 28) and adult female life range averaged 645 km^2 (95% CI $\pm$ 361, n = 17) using the minimum convex polygon estimator.

Young female bears typically utilize home ranges adjacent to or a part of their mother's home range. The minimum convex polygon estimator for bear 106 was 658 km^2 during her 1986–99 life time (Appendix Fig. 103). 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 (Appendix Fig. 104). Bear 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 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. Second-generation female offspring of 106 occupied habitats east and west of first-generation offspring (Appendix Fig.105). In recent years, third-generation females have established home ranges south of second-generation females (Appendix Fig. 106).

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 18. Home range sizes of native (independent or family groups) and transplanted grizzly bears in the Cabinet-Yaak recovery zone, Purcell Mountains and Salish Mountains 1983–2018.

Bear	Sex	Age (Est)	Years	Collar Type	Number of fixes	100% Convex polygon (km^2)	Area of use
678	F	28-34	1983-89	VHF	173	658	Cabinet Mtns, MT
680	M	11-12	1984-85	VHF	75	1,947	Cabinet Mtns, MT
14	M	27	1985	VHF	23	589	Cabinet Mtns, MT
101	M	8	1986	VHF	38	787	Yaak River, MT
106	F	8-20	1986-99	VHF	379	852	Yaak River, MT
128	M	4-14	1987-97	VHF	204	2,895	Yaak River, MT
129	F	1-3	1987-89	VHF	42	60	Yaak River, MT
134	M	8-9	1987-88	VHF	20	594	Yaak River, MT
192	M	2	1990	VHF	10	574	Yaak River, MT
193	M	2	1990	VHF	34	642	Yaak River, MT
206	F	2-7	1990-95	VHF	208	1,332	Yaak River, MT
218[1]	F	5-6	1990-91	VHF	95	541	Cabinet Mtns, MT
244	M	6-18	1992-04	VHF	158	1,406	Yaak River, MT
258[1]	F	6-7	1992-93	VHF	54	400	Cabinet Mtns, MT
286[1]	F	2-3	1993-94	VHF	82	266	Cabinet Mtns, MT
311[1]	F	3-4	1994-95	VHF	16	209	Cabinet Mtns, MT

Bear	Sex	Age (Est)	Years	Collar Type	Number of fixes	100% Convex polygon (km²)	Area of use
302	M	1-3	1994-96	VHF	60	514	Yaak River, MT
303	F	1-22	1994-01, 2011-16	GPS & VHF	12,177	605	Yaak River, MT
342	M	4-12	1996-04	VHF	134	1,653	Yaak River, MT
355	M	(6)	1996	VHF	5	N/A	Yaak River, MT & BC
358	M	8-10	1996-98	VHF	55	1,442	Yaak River, MT & BC
363	M	4-7	1996-99	VHF	120	538	Yaak River, MT
386	M	5-6	1997-98	VHF	29	1,895	Yaak River, MT
354	F	2-4	1997-99	VHF	70	537	Yaak River, MT
538	F	6-11	1997-02	VHF	232	835	Yaak River, MT & BC
592	F	2-3	1999-00	VHF	59	471	Yaak River, MT & BC
596	F	2	1999	VHF	10	283	Yaak River, MT & BC
552	F	1-15	2001, 2012-15	GPS & VHF	1,431	1,210	Yaak River, MT
577	F	1	2002	VHF	11	2	Cabinet Mtns, MT
578	M	1	2002	VHF	3	N/A	Cabinet Mtns, MT
579	M	1	2002	VHF	10	5	Cabinet Mtns, MT
353	F	7	2002	VHF	37	119	Yaak River, MT
651	M	7-11	2002-03,06	GPS & VHF	1,827	1,004	Yaak River, MT & BC
787[2]	M	3-4	2003-04	VHF	84	1,862	Yaak River, MT
648	F	5-7	2003-05	VHF	85	948	Salish Mtns, MT
576[2]	M	3-4	2005-06	GPS & VHF	2,290	1,320	Yaak River, MT & BC
675	F	2-8	2004-10	GPS & VHF	1,827	714	Yaak River, MT & BC
10	F	11	2004	GPS	1,977	176	Moyie River, BC
11	M	7	2004	GPS	894	1,453	Moyie River, BC
12	F	11	2004	GPS	1,612	333	Moyie River, BC
17	M	8	2005	GPS	1,903	3,074	Yaak River, MT & BC
677	M	6	2005	GPS	519	3,361	Yaak River, MT & BC
688	M	3-4	2005-06	GPS	3,421	1,544	Moyie & Goat River, BC
694	F	2	2005	VHF	11	89	Yaak River, MT
292	F	4	2005	GPS	7,062	253	Moyie & Goat River, BC & ID
770	M	11-12	2005-06	VHF	20	326	Cabinet Mtns, MT
2	M	(7-9)	2005-06	GPS	1,337	2,860	Moyie / Yahk, BC
A1[1]	F	(8-10)	2005-07	VHF	73	725	Cabinet Mtns, MT
782[1]	F	2-5	2006-08	GPS	1,126	1,932	Cabinet Mtns, MT
780	M	6-8	2006-08	VHF	56	1,374	Cabinet Mtns, MT
103	M	2-4	2006-07	GPS	4,872	6,545	Kootenai, & Pend Oreille River, BC, ID, & WA
5381	M	4-5	2006-07	GPS	11,491	1,949	Moyie & Goat River, BC & ID
130	F	26-27	2007-08	GPS	3,986	281	Goat River, BC
131	F	(5)	2007-08	GPS	3,270	276	Goat River, BC
784	F	1-3	2007-09	GPS	2,606	524	Yaak River, MT
785	F	1-2	2007-08	GPS	362	207	Yaak River, MT
772	F	10	2007	VHF	14	446	Cabinet Mtns, MT
635[1]	F	4	2008	GPS	285	451	Cabinet Mtns, MT
790[1]	F	3	2008	GPS	227	423	Cabinet Mtns, MT
715[1]	F	(10-11)	2009-10	GPS	437	6,666	Cabinet Mtns, MT
731	F	2-4	2009-11	GPS	1,652	852	Yaak River, MT
799	M	2-4	2010-11	GPS	1,422	805	Cabinet Mtns, MT
713[1]	M	5-6	2010-11	GPS & VHF	562	5,999	Cabinet Mtns, MT
714[1]	F	5-6	2010-12	GPS	1,684	2,389	Cabinet Mtns & Flathead, MT
737	M	4-7	2010-13	GPS & VHF	1,626	2,667	Yaak River, MT & BC
1374	M	2	2010	GPS	14	381	Yaak River, MT & BC
722[2]	M	12-18	2011-18	GPS	1,945	3,782	Yaak River, MT & BC

Bear	Sex	Age (Est)	Years	Collar Type	Number of fixes	100% Convex polygon (km²)	Area of use
723[1]	M	1-3	2011-12	GPS	430	1,063	Cabinet Mtns, MT
724[2]	M	1-3	2011-12	VHF	29	873	Cabinet Mtns, MT
725[1]	F	2-4	2011-13	GPS	3,194	3,314	Cabinet Mtns & Flathead, MT
726	M	2-3,6-8	2011-12,15-17	GPS	6,335	3,751	Kootenai & Yaak River, MT
729	F	1-7	2011-13, 15-17	GPS	17,356	560	Yaak River, MT
732[2]	M	5	2011	GPS	875	458	Yaak River, MT
918[1]	M	2-4	2012-14	GPS	1,192	587	Cabinet Mtns, MT
826	M	-5	2013	GPS	164	1,820	Yaak& Kootenai River, MT & BC
919[1]	M	4-5	2013-14	GPS	345	436	Cabinet Mtns, MT
808	M	4-5	2014-15	GPS	1,273	1,722	Yaak River, MT
831	F	14	2014	GPS	434	218	Cabinet Mtns, MT
835	M	19-21	2014-16	GPS	826	4,145	Yaak River, MT
836	F	1-4	2014--17	GPS	3,772	1,816	Yaak River, MT
837	M	6-8	2014-16	GPS	1,173	1,553	Yaak River, MT
920[1]	F	3-5	2014-16	GPS	5,108	913	Cabinet Mtns, MT
921[1]	F	2-3	2014-15	GPS	2,033	259	Cabinet Mtns, MT
810	F	12,14-15	2015,2017-18	GPS	3,150	413	Yaak River, MT
818	M	2	2015	GPS	461	225	Yaak River, MT
839	M	3-4	2015-16	GPS & VHF	2,595	6,819	Cabinet & Whitefish Mtns, MT
820	F	12-14	2015-18	GPS	2,537	295	Yaak River, MT
924[1]	M	2	2015	GPS	741	2,068	Cabinet Mtns, MT
1001	M	6	2015	GPS	1,352	1,357	Selkirk Mtns, BC
807	M	4-7	2014-17	GPS	2,568	3,319	Selkirk Mtns, ID&Yaak River, MT
821	M	2-3	2016-17	GPS	2,467	4,405	Yaak River, MT
822	F	3	2016	GPS	497	328	Yaak River, MT
824	M	(12-13)	2016-14	GPS	455	884	Yaak River, MT & BC
853	M	5-6	2016-17	GPS	938	736	Kootenay River, BC
9811	M	(2-4)	2016-18	GPS	3,135	1,210	Moyie River, MT,ID,BC
922[2]	M	4-5	2016-17	GPS	938	2,148	Kootenai Rr., ID Yaak Rr, MT
926[1]	M	4-5	2016-17	GPS	2,834	3,328	Cabinet Mtns, MT
840	F	2-3	2017-18	GPS	1,128	627	Pipe Cr., MT
842	F	4-5	2017-18	GPS	1,019	1,047	Yaak River, MT
861	M	2-3	2017-18	GPS	2,376	672	Cabinet Mtns, MT
1026[2]	F	2	2017	GPS	3,435	1,556	Creston Valley, BC Yaak Rr., MT
1028[2]	F	2	2017	GPS	1,639	708	Yaak Rr.,MT St. Mary's Rr. ,BC
927[1]	M	2	2018	GPS	617	496	Cabinet Mtns, MT, ID
9077[2]	M	(3)	2018	GPS	193	1,155	Cabinet Mtns, Yaak River, MT
1006	M	2-3	2017-18	GPS	1,921	8,092	Selkirk & Cabinet Mtns, Yaak River MT

[1]Augmentation bears.

[2]Management bears.

Grizzly Bear Denning Chronology

We summarized den entry and exit dates of radio-collared grizzly bears using primarily VHF and GPS location data (1983–2018). Radio-collars deployed since the late 2000s include an activity monitoring device (i.e., accelerometer), which allows an additional, more detailed assessment of den entrance and exit and activity during the denning period.

Den entry dates (n = 120) ranged from the third week of October to the last week of December. One hundred fourteen (95%) entries occurred between the 4th week of October and the 3rd week of December (Fig. 13). Grizzly bears in the Cabinet Mountains (median entry in 2nd

week of November) entered dens 2 weeks earlier than bears in the Yaak River drainage (median entry during 4th week of November). Males generally entered dens later than females. Female-offspring family groups tended to enter dens later than independent adult females (Fig. 14). By December 1, 37% of Cabinet and Yaak grizzly bears had not yet entered winter dens.

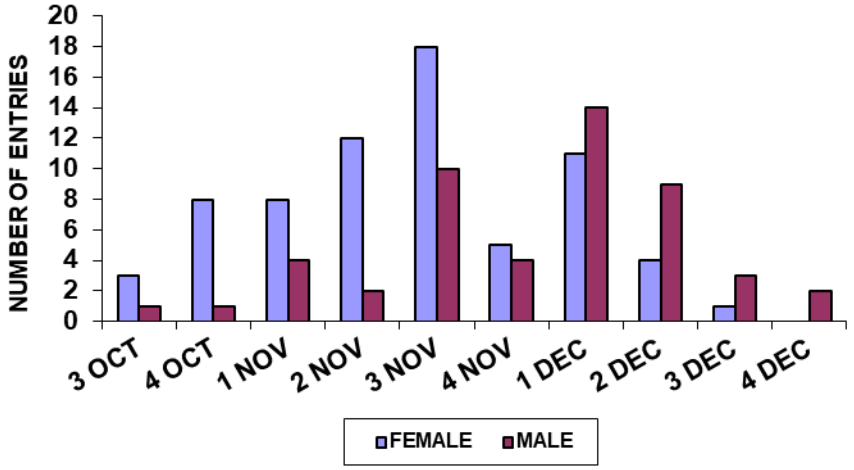


Figure 13. Month and week of den entry for male and female radio-collared grizzly bears in the Cabinet-Yaak grizzly bear recovery zone, 1983–2018.

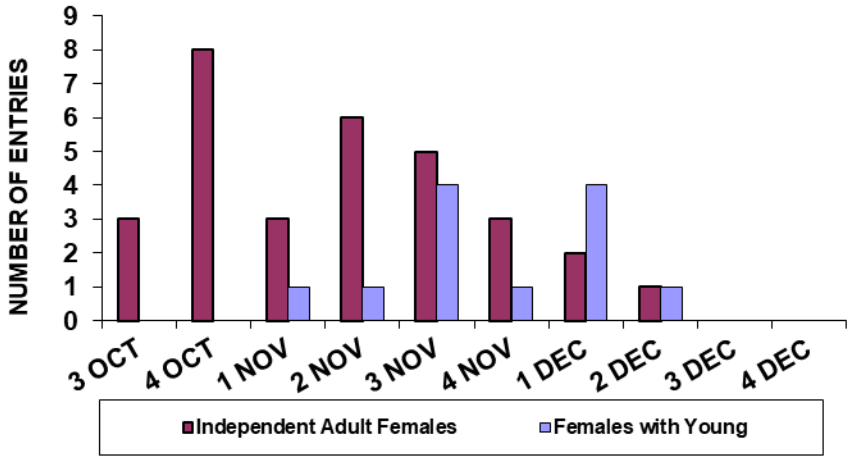


Figure 14. Month and week of den entry for adult female, radio-collared grizzly bears in the Cabinet-Yaak grizzly bear recovery zone, 1983–2018.

Den exit dates (*n* = 111) ranged from the first week of March to the third week of May (Fig. 15). One-hundred six (95%) exit dates occurred from the 2nd 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 tended to exit dens two weeks earlier than females. Seventy percent of den exits occurred during the month of April. By May 1, 14% of Cabinet and Yaak grizzly bears were still in dens, well over half of which were females with cubs-of-the-year. Females with cubs appear to exit dens later than other adult females (median

exit during 1st week of May; Fig. 16). All adult females with cubs remained at dens until at least April 15.

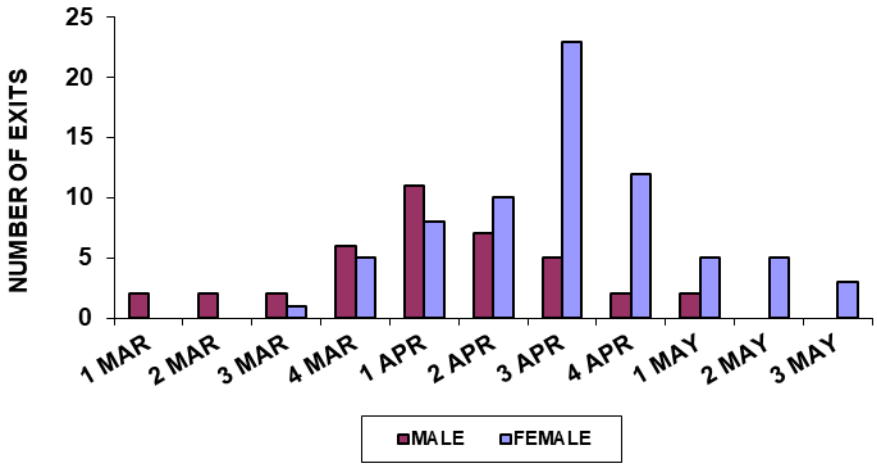


Figure 15. Month and week of den exit for male and female radio-collared grizzly bears in the Cabinet-Yaak grizzly bear recovery zone, 1983–2018.

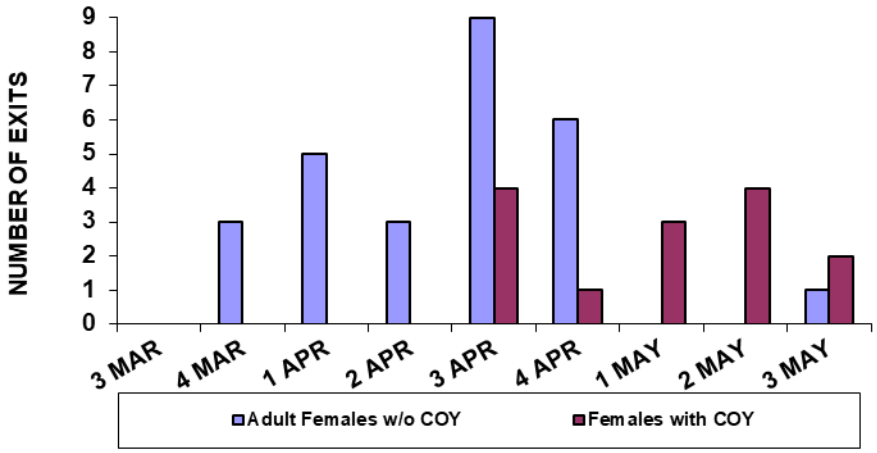


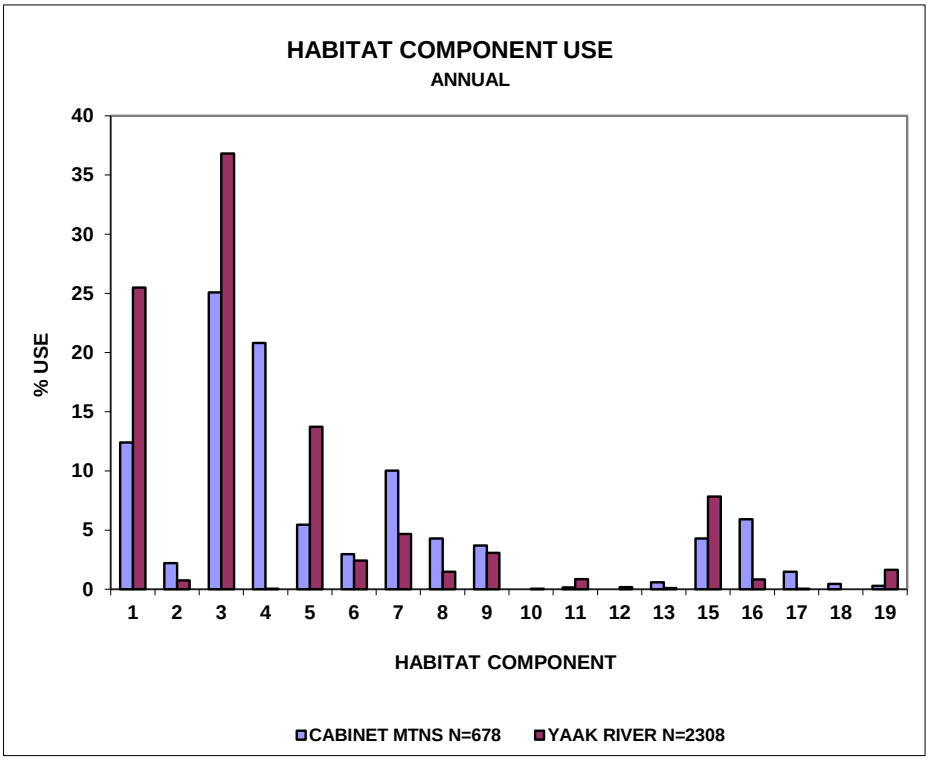
Figure 16. Month and week of den exit for adult female, radio-collared grizzly bears (with and without cubs-of-the year [COY]) in the Cabinet-Yaak grizzly bear recovery zone, 1983–2018.

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 radio location 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. 17). Primary differences between the Yaak River and the Cabinet Mountains 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 description of all 19 habitat components is in Appendix 5.



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

Spring use of habitat components by grizzly bears in the Cabinet Mountains and 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. 18). Notable differences between 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 corms of glacier lily and biscuitroot during spring (Kasworm and Thier 1993). Snow chutes, cutting units, alder, and graminoid parks provide these items.

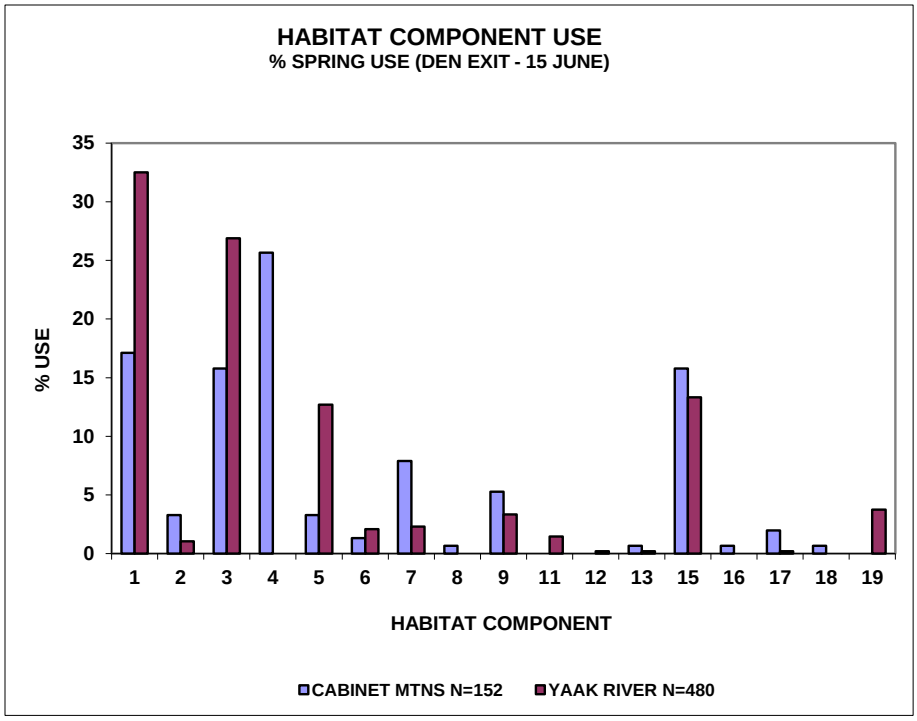
Summer use of habitat components by grizzly bears in the Cabinet Mountains and Yaak River drainage was dominated by closed timber, timbered shrub fields, mixed shrub snow chutes, mixed shrub cutting units, mixed shrub burns, alder shrub fields, huckleberry shrub fields, graminoid sidehill parks, and beargrass sidehill parks (Fig. 19). Differences between 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 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. 20). Differences between 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 when they are still available at higher elevations or mountain ash berries which persist on plants beyond first snowfall. Bears utilize carrion and gut piles from hunter harvested or wounded deer and elk.

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.

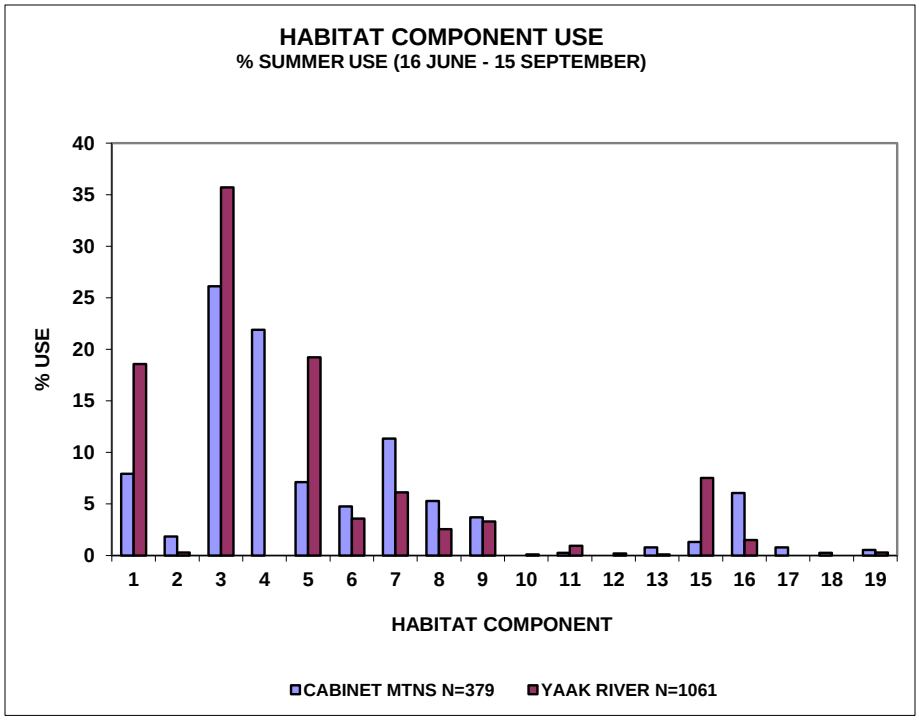
Den use of habitat components by grizzly bears in the Cabinet Mountains and Yaak River drainage was dominated by closed timber, timbered shrub fields, graminoid sidehill parks, and beargrass sidehill parks (Fig. 21). Differences between the two study areas include heavier use of beargrass parks in the 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

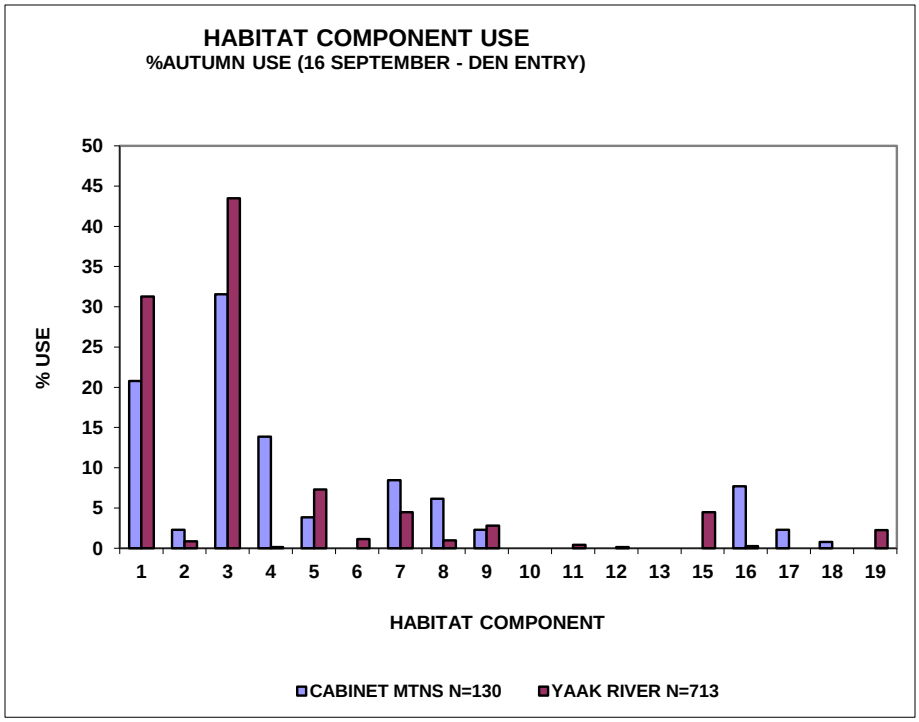
Figure 18. Spring habitat component use in the Cabinet Mountains and Yaak River, 1983-2009.



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

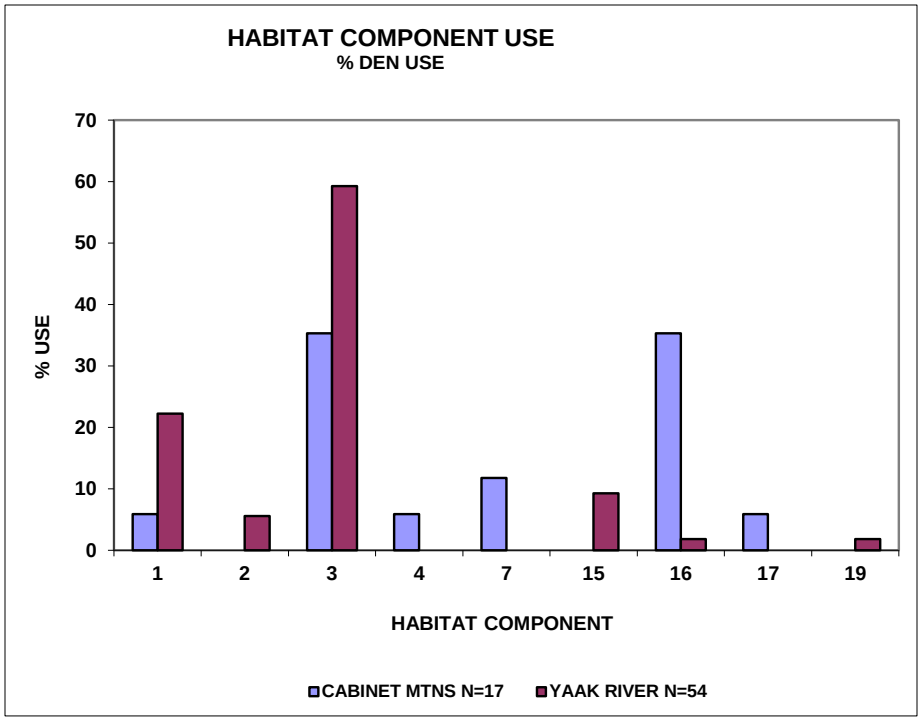
Figure 19. Summer habitat component use in the Cabinet Mountains and Yaak River, 1983-2009.



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

Grizzly Bear Use by Elevation

Differences in elevation between the Cabinet Mountains and the Yaak River study areas are reflected in the bear location data from both areas (Fig. 22). Annual mean elevation used by grizzly bears in the Cabinet Mountains was 1,575 m compared to 1,497 m 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 m and 1,698 m in the Yaak River.

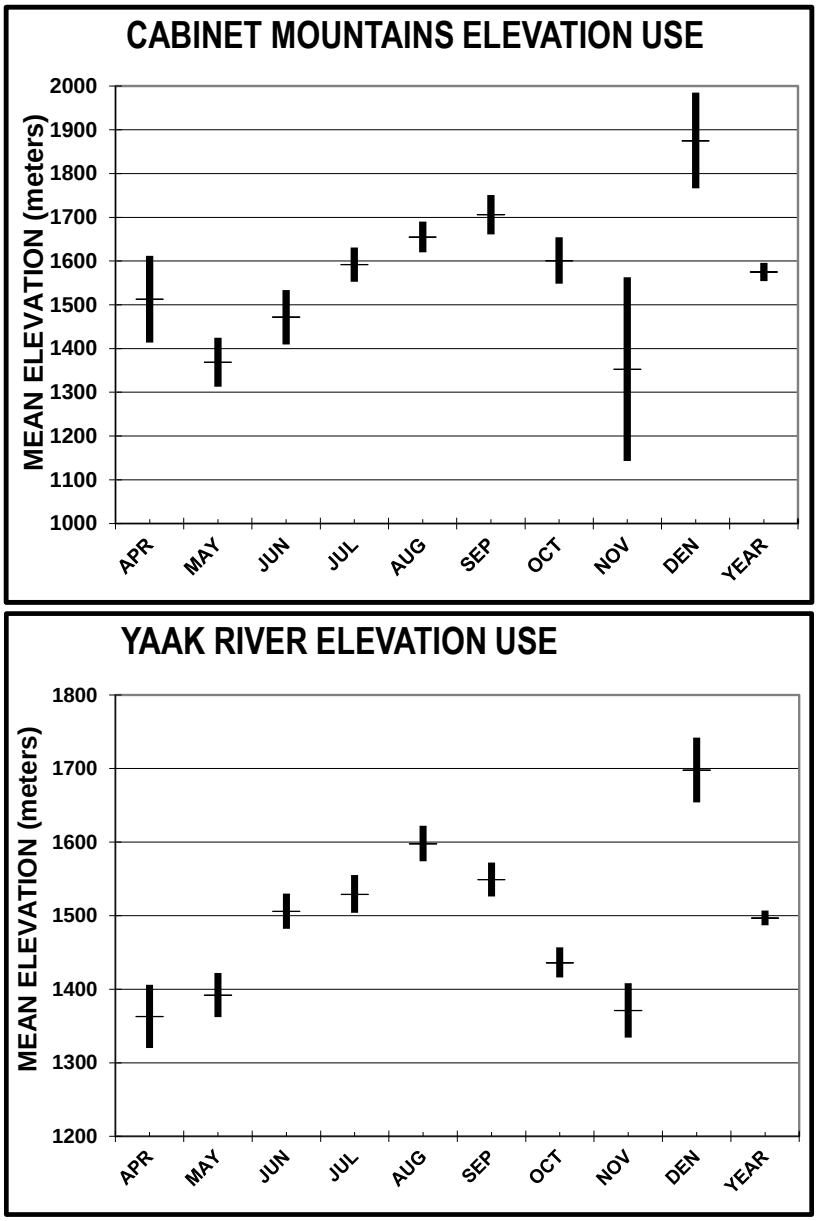
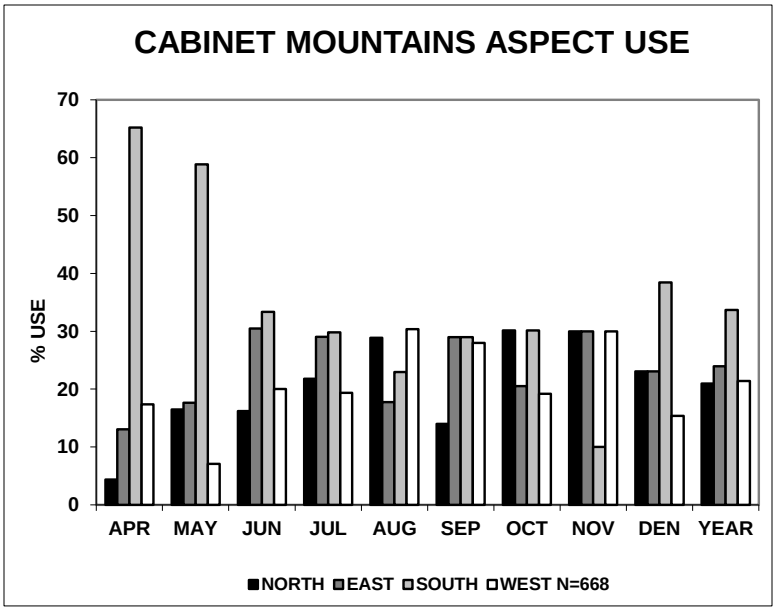


Figure 22. Mean elevation and 95% confidence intervals of radiolocations in the Cabinet Mountains and Yaak River, 1983–2009.

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 (Fig. 23). 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.



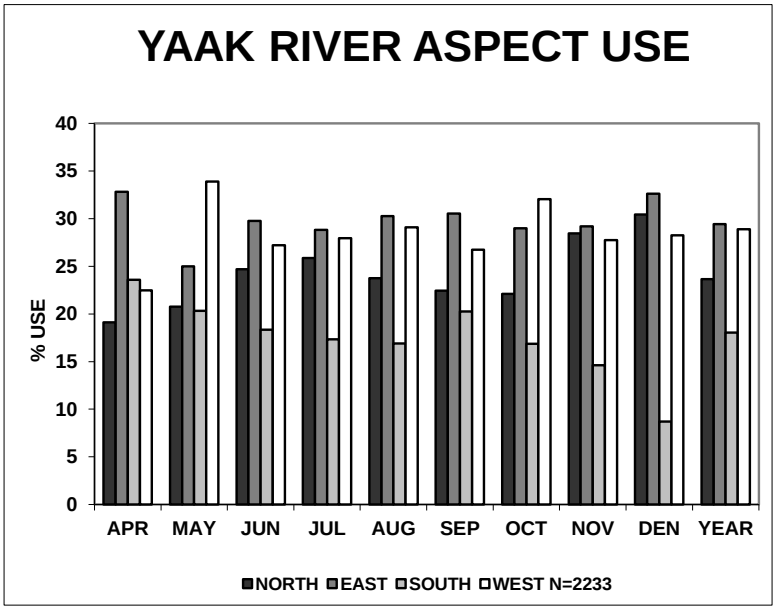


Figure 23. Aspect of radiolocations in the Cabinet Mountains and Yaak River, 1986-2009.

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. We have developed seasonal habitat Resource Selection Function maps that are undergoing testing for future use.

Inter-ecosystem Isotope Analysis

We are using isotope analysis to compare grizzly bear food use (plant vs. animal matter) between ecosystems, among sex-age classes, and across management status. Samples currently analyzed are only from grizzly bears of known sex and age. The majority of samples come from capture events; future analysis will include samples from known grizzly bears at hair rub and hair corral sites. To date, we have obtained carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotope ratios from 237 grizzly bear hair and blood samples between 1984 and 2015 from the CYE and Selkirk ecosystems. Across the Selkirk and CYE ecosystems, adult males consume slightly more animal matter (22%) than adult females (14%) and subadults (13%). Adult females in the Yaak River consume higher proportions of animal matter (22%) than do adult females in the Cabinets (10%) and the Selkirks (6%).

We estimate that 14% of the annual diet of Cabinet Mountain grizzly bears (n = 19 hair samples from non-management bears) is derived from animal matter. Adult males had slightly higher $\delta^{15}N$ stable isotope signatures (4.2‰) than adult females (3.1‰), indicating greater use of available animal matter (24% vs. 10% animal matter, respectively).

Yaak grizzly bear diets contained nearly 22% animal matter (n = 84 hair samples). Adult female use of animal matter varied widely; $\delta^{15}N$ and diet values ranged as low as 2.3‰ (~6% animal matter) to as high as 7.2‰ (~80% animal matter).

Sampled grizzly bears in the Selkirk ecosystem consumed less animal matter than Cabinet and Yaak bears (12%; n = 36 hair samples). Diets of non-management, adult female bears include only 7% animal matter. However, one adult female captured in a management incident in the Creston Valley fed on animal matter at a rate of 82%. We suspect bears such as her likely gain meat from bone piles or dead livestock at nearby dairy operations.

Across ecosystems, management bears had slightly higher proportions of meat (26%) in assimilated diets than research bears (17%). Management bears did not necessarily have higher $\delta^{13}C$ signatures as would indicate a more corn-based or anthropogenic food source (-23‰ for both research and management bears). In fact, highest $\delta^{13}C$ in our dataset came from a research female caught in Corn Creek of the Creston Valley, BC in 2008. By all indications, she likely fed extensively on corn from nearby fields without human conflict.

By analyzing different hair types that initiate growth at different times of the year, we have observed increases in proportion of animal matter in bear diets as they transition from summer months (diet estimated from guard hairs) to fall months (diet from underfur). Previous studies have emphasized the importance of splitting these hair types due to temporal differences in growing period (Jones *et al*. 2006). We currently have 45 bear capture events with paired guard hair and underfur samples collected at capture. In all cases, grizzly bears have either 1) the same dietary meat proportion in summer vs. fall or 2) have higher amounts of meat in their fall diet. On average, grizzly bears meat consumption nearly doubles from summer to fall (10.7% summer to 17.6% fall). Fall shifts toward meat use were not isolated to a specific sex-age class. Larger shifts include: an adult male (4327) shifting from 31% meat in

summer to 82% meat in fall, an adult female (mortality 5/18/2012) consuming 14% in spring time, then 38% in the fall, and a subadult female grizzly (675) with a summer diet consisting of 6% meat and fall diet of 16% meat. We suspect that wounding loss and gut piles from hunted ungulates contribute to observed increases in meat use by grizzly bears in fall months.

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. 24). 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 constitute 64% of total dry matter consumed annually by grizzly bears.

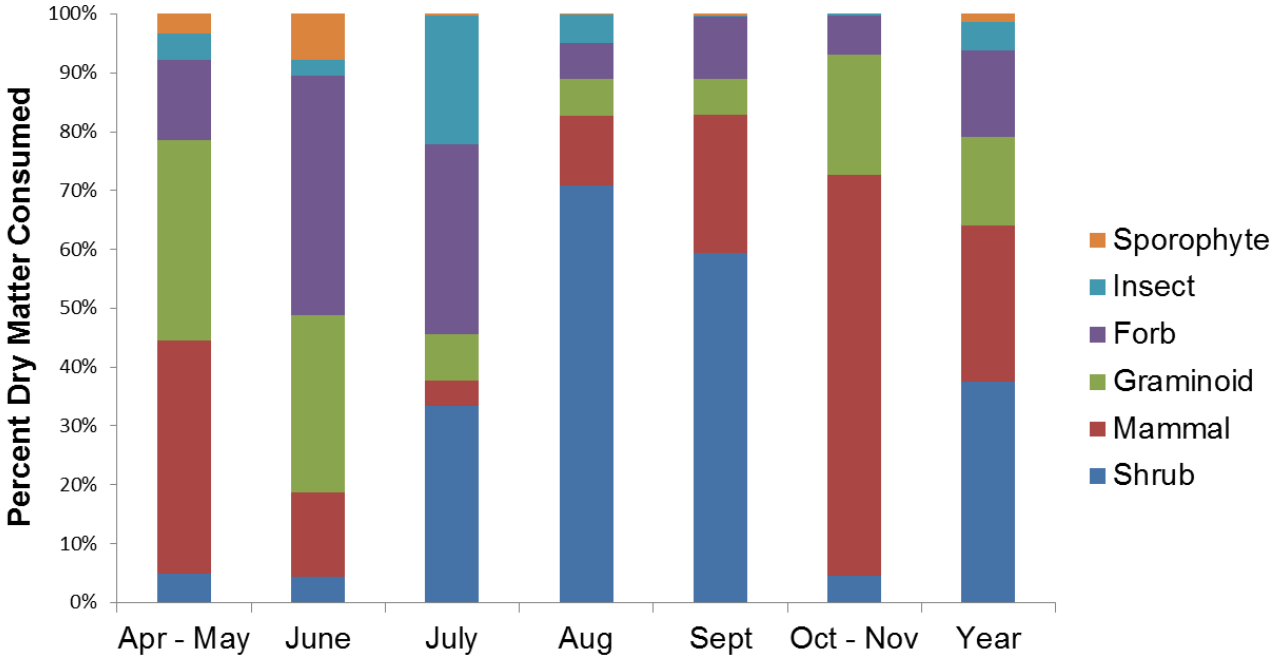


Figure 24. Monthly percent of total dry matter of foods consumed by grizzly bears in the Cabinet Mountains and Yaak River, 1981-1992.

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 (Fig. 25). 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%).

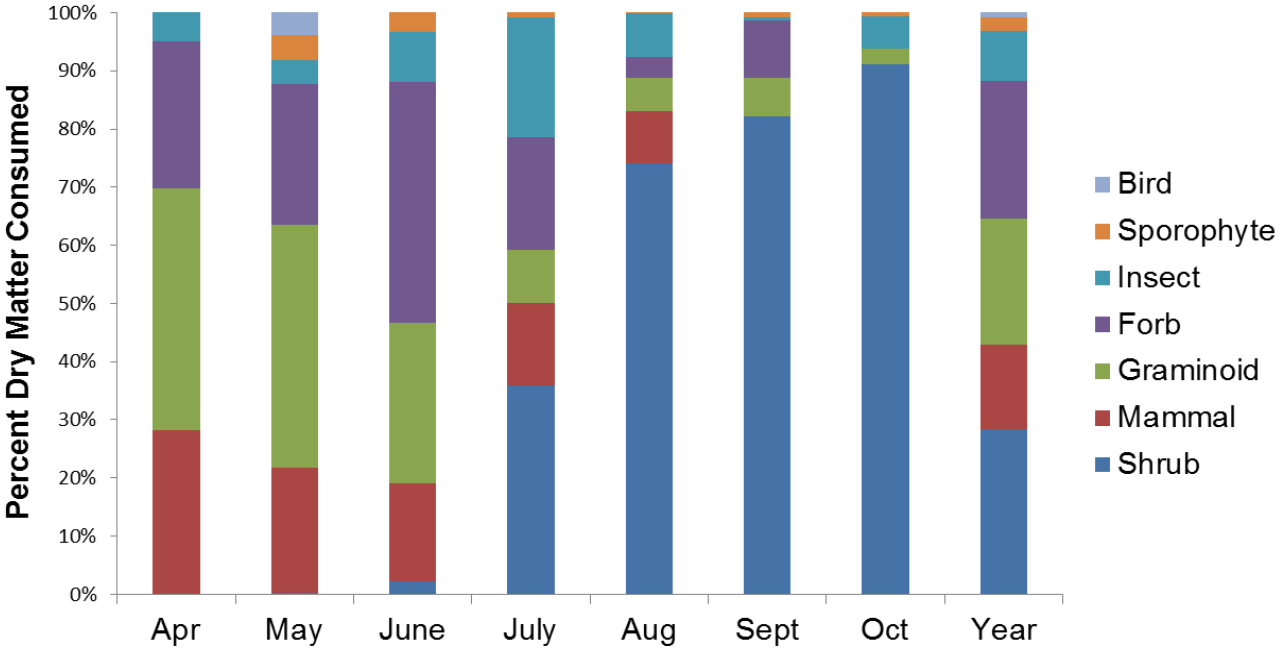


Figure 25. Monthly percent of total dry matter of foods consumed by black bears in the Cabinet Mountains and Yaak River, 1984-1992.

Berry Production

Because of its relatively far-ranging distribution in the CYE 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 CYE. 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, 2004, and 2015). Because of its

sparse distribution, buffalo berries appear to be the least-available berry food for grizzly bears in the CYE. Below-average production among all species surveyed occurred in 1992, 1998–2000, 2002, 2004, and 2015. The 2015 berry season marked the first time we have observed below average counts for all four berry species in one year. Sampling sites for these species of fruiting shrubs have been selected to be diverse in terms of geography, elevation, aspect, and overstory canopy (Fig. 26).

Fluctuations in berry production in the CYE may be influenced by climatic variables. Holden *et al*. (2012) found huckleberry production in the CYE 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 CYE grizzly bears.

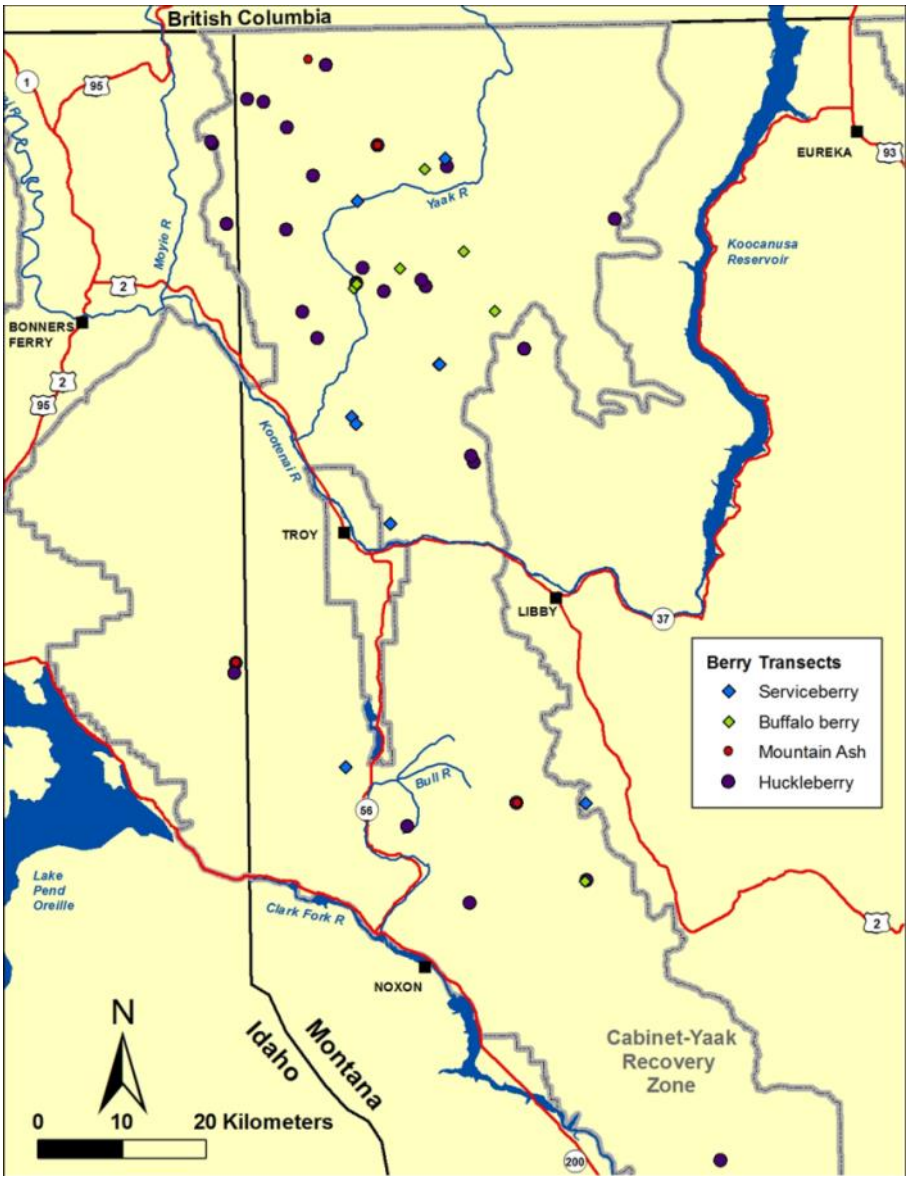


Figure 26. Locations of all serviceberry, buffaloberry, mountain ash, and huckleberry sampling sites within the CYE study area, 1989-2018. Some locations show multiple berry species sites in close proximity.

Huckleberry

We evaluated berry production at a median number of 18 (range = 11–23) huckleberry transects per year within the CYE study area from 1989–2018 (Fig. 27). During this study period, the mean number of berries per plot was 1.8 (95% CI ± 0.13). Mean annual berry counts between 1989 and 2018 ranged from 0.5–3.4. Statistically below-average berry counts occurred in 1992–93, 1997–99, 2001–04, 2010, and 2015. Above average counts occurred in 1990, 1996, 2008–09, 2012–14, and 2017. Highest mean annual counts occurred in 2014. Based upon these production indices at sampled sites, the 9-year period from 1997–2005 was a prolonged stretch of time without above average annual huckleberry production; more recent mean annual counts since 2006 average 102% higher than during the 1997-2005 period (2.2 berries per plot). Of interest is whether lower- and higher-than-average production had influence on population reproduction and survival.

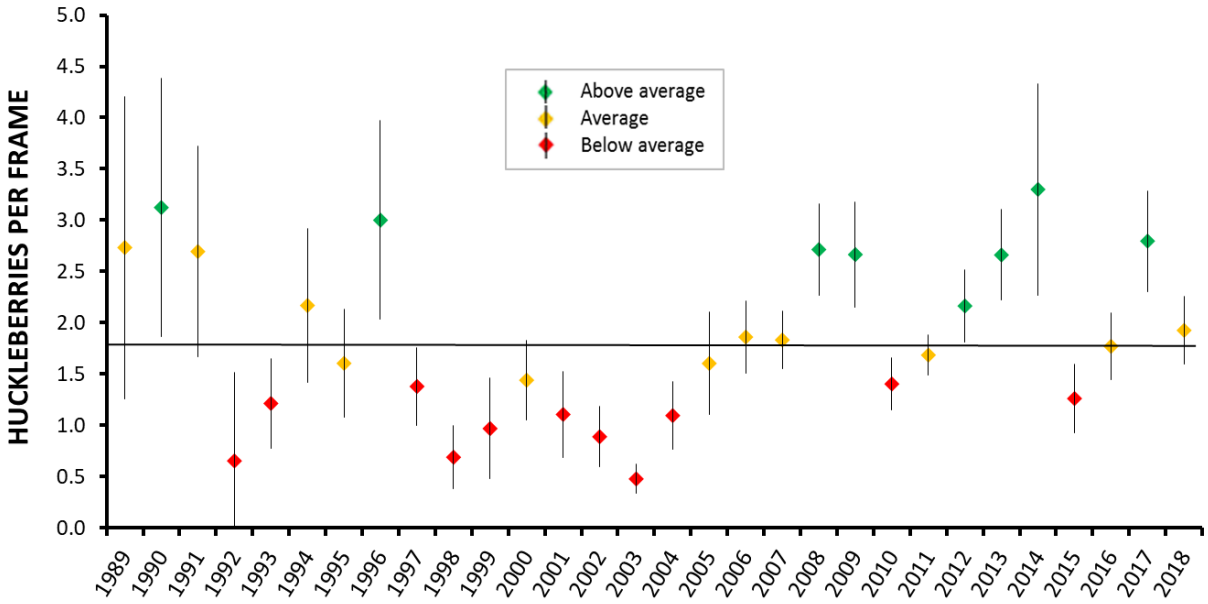


Figure 27. Mean berries per plant (± 95% confidence interval) for huckleberry transects in the Cabinet-Yaak, 1989–2018. Horizontal line indicates study-wide mean production, 1989–2018.

Serviceberry

We evaluated berry production at a median number of six (range = 5–7) serviceberry transects per year from 1990 to 2018 (Fig. 28). The overall mean berry count per plant was 107 (95% CI ± 23) during the study. Mean berry counts per plant ranged from 12 to 355 during the 25+ year index. Statistically below-average counts occurred during 1994, 1999, 2004–06, 2010, and 2012–17. Above average counts occurred only in 1997. Considering the entirety of the data, the past fifteen years have been particularly less productive (2004–18; 65 berries per plant) when compared to the first 14 (155 berries per plant from 1990–2003).

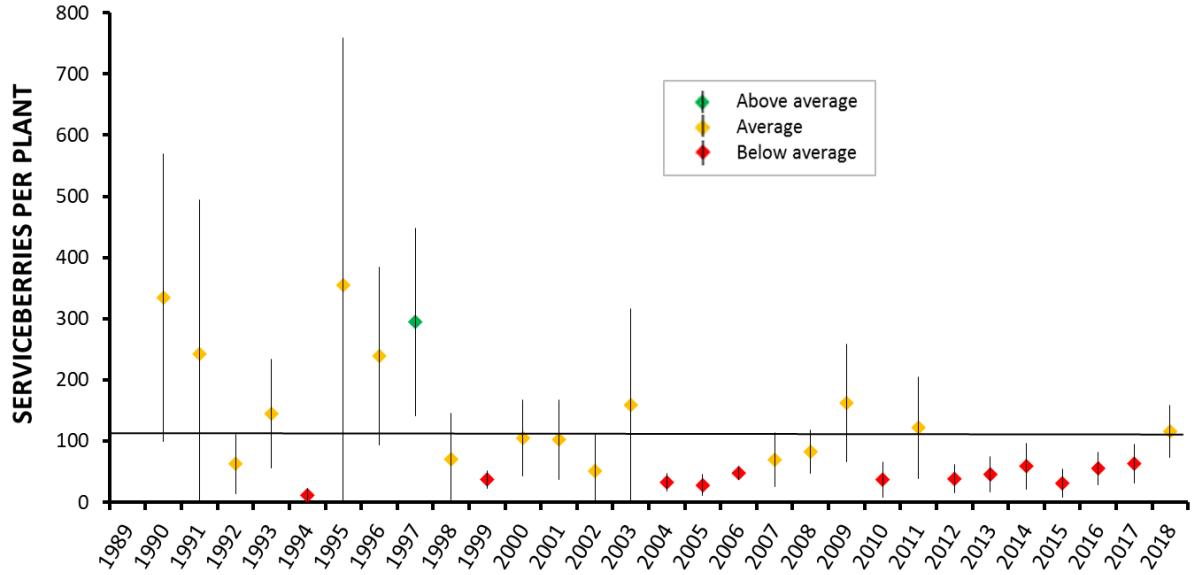


Figure 28. Mean berries per plant (± 95% confidence interval) for serviceberry transects in the Cabinet-Yaak, 1990–2018. Horizontal line indicates study-wide mean production, 1990–2018.

Mountain Ash

Three sites were evaluated for mountain ash production each year, from 2001 to 2018 (Fig. 29). Total mean berry count was 162 berries per plant (95% CI ± 53). Statistically below-average production occurred in 2003, 2006, 2010–11, 2013, and 2015. Above average production occurred only in 2008.

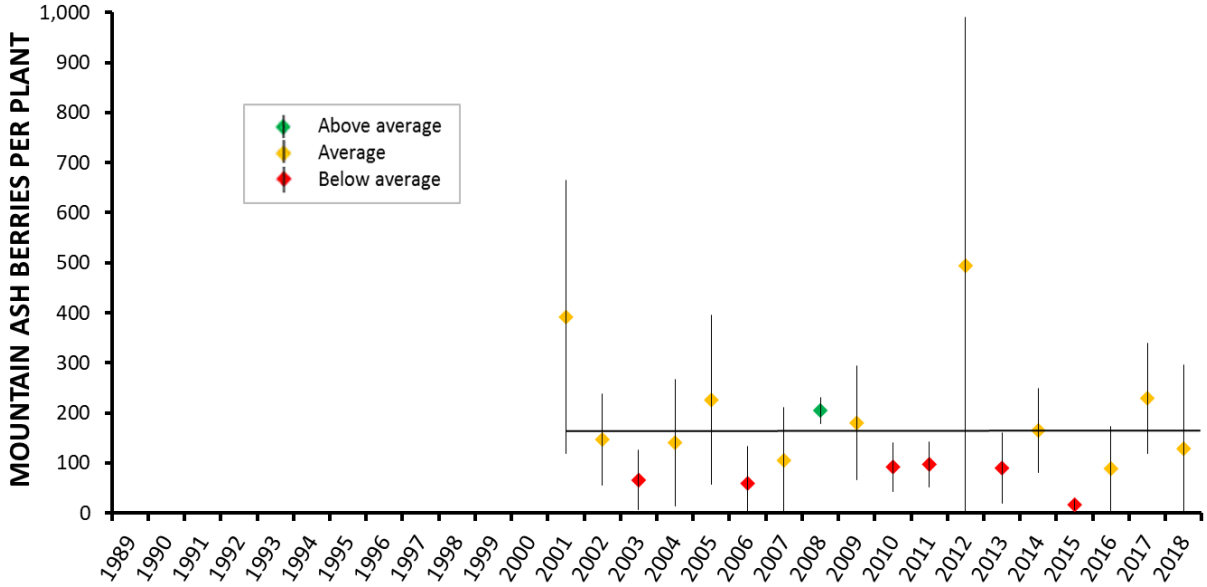


Figure 29. Mean berries per plant (± 95% confidence interval) for mountain ash transects in the Cabinet-Yaak, 2001–18. Horizontal line indicates study-wide mean production, 2001–18.

Buffaloberry

Five buffaloberry 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 2008–18. All told, a median of 4 sites were evaluated annually (range 1–5) between 1990 and 2018. Mean berry count per plant from all transects was 179 (95% CI ± 47) during the study period. Mean berry counts ranged between 15 to 627 berries per plant from 1990 to 2018 (Fig. 30), with statistically below-average counts in 1998–99, 2002–03, 2007, 2013, 2015–16, and 2018. Above-average counts occurred in 1990, 2010, and 2011.

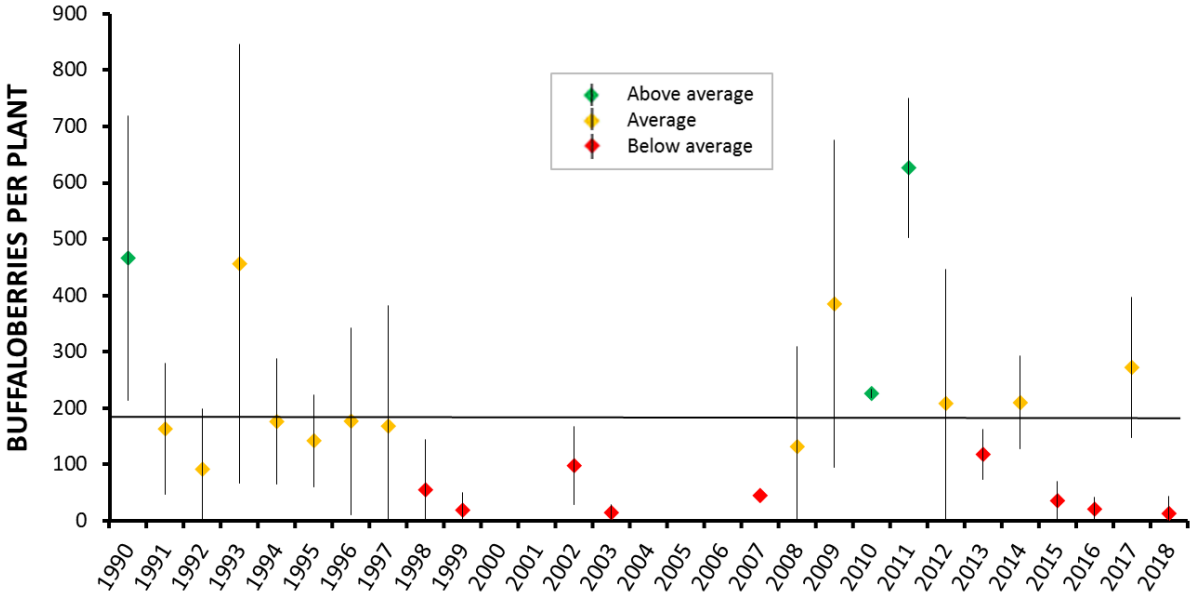


Figure 30. Mean berries per plant (± 95% confidence interval) for buffaloberry transects in the Cabinet-Yaak, 1990–2018. Horizontal line indicates study-wide mean production, 1990–2018.

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APPENDIX

Table T1. Mortality assignment of augmentation bears removed from one recovery area and released in another target recovery area.

#	Scenario	Where Mortality Credited and Year [1]	
		Source	**Target**
1	Bear stays in Target recovery area[2] past Year 1.	Mortality removal year	No mortality
2	Bear dies in Target recovery area[2] during Year 1.	Mortality removal year	No mortality
3	Bear dies in Target recovery area[2] after Year 1.	Mortality removal year	Mortality, Year 2 or later
4	Bear returns to Source area[2] and is alive in Year 1.	No mortality	No mortality
5	Bear returns to Source area[2] and is alive after Year 1.	No mortality	No mortality
6	Bear returns to Source area[2] and dies there after Year 1.	Mortality removal year only	No mortality
7	Bear dies outside both Target and Source areas[2] within Year 1.	Mortality removal year	No mortality
8	Bear dies outside both Target and Source areas[2] after Year 1.	Mortality removal year	No mortality
9	Collar failure/lost bear in Target area[2] within Year 1.	Mortality removal year	No mortality
10	Collar failure/lost bear in Target area[2] after Year 1.	Mortality removal year	No mortality

[1] Year 1 begins on the day the bear is released in the target area and ends after 365 days. One year was chosen to give the animal an opportunity to locate and use all seasonal habitats. This rule set may conditionally require a bookkeeping correction to remove the mortality in the source area in the year of removal.

[2] Target and Source areas include 10 mile buffer around Recovery Zones. Bears dying in Canada only count against mortality limits in the Selkirk Mountains, where the Recovery Plan defines a Recovery Zone that includes Canada. If an augmentation bear leaves the target recovery area and dies, it counts as source area mortality in the removal year but it does not count as target area mortality. If an augmentation bear leaves the target recovery area in year 2 or later it counts as source area mortality in year 1 and target area mortality in year 2 or later if the mortality was human caused. While this approach counts a bear as dead twice, the second mortality represents a human caused mortality issue outside of a bear learning a new area and should be counted in the target area. (Mortalities in Canada only count inside the Selkirk recovery zone inside Canada and the 10 mile buffer will not apply to that portion of the Selkirk recovery area in Canada. Areas adjacent to the Canadian Selkirks have more robust, contiguous populations, several of which are hunted and mortality should not be counted against the Selkirk recovery area. The 10 mile buffer was promoted inside the US because this area was believed to contain animals that spent a portion of their time outside the recovery area, but were believed to be part of that recovery area population.)

Table T2. Known historic grizzly bear mortality pre-dating project monitoring, in or near the Cabinet-Yaak recovery zone and the Yahk grizzly bear population unit in British Columbia, 1949–78.

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

Table T3. Movement and gene flow to or from the Cabinet-Yaak recovery area.

Area[1] Start / Finish	Action	Bear ID	Sex	Age	Year	Basis	Comments
Cabs / NCDE	Movement	C403M	M	2-3	2007	Telemetry, Genetics	Captured Marion, MT 2006 NCDE, traveled to Whitefish, relocated to Whitefish Range. Train kill 2007
NCDE / SPur	Movement	YGB737M	M	4	2010	Genetics	Captured and monitored 2010-15. Parentage in NCDE by USGS.
NCDE / SPur	Movement	43-44	F	3	2013	Capture, Mortality	Management bear relocated at least twice in NCDE. Traveld to SPur, shot after Killing chickens by landowner.
NPur / SPur	Movement	P9183M	M	Unk	2004-05	Genetics	DNA captured NPur and SPur.
NPur / SPur	Movement	PKiddM	M	7	2004	Telemetry	Radio collared June 2004, Travels from NPur to SPur, offspring in SPur.
NPur / SPur	Movement	YMarilF	F	4-5	2005-06	Telemetry, Genetic assignment	Radio collared July 2005 in SPur, Genetic assignment to the NPur. Management removal 2006.
NPur / SPur	Movement	Y732M	M	3	2011	Genetics	Born in NPur and Traveled to SPur. Mortality 2011.
NPur / SPur	Movement	10569F	F	6	2005, 2012	Genetics, Mortality	Father SPur YVernM, Mother NPur PIrishF, DNA capture NPur 2005, Mortality with cub SPur 2012
NPur / SPur	Gene flow	Y90479M	M	0.5	2012	Genetics, Mortality	Father Y576M Mother 10569F Mortality 2012
SPur / NCDE	Movement	N323M	M	Unk	1999	Genetics	Hair snagged 1999 in SPur. Hair snagged NCDE USGS 1998-2006. USGS assigned to SPur.
SPur / Salish	Movement	Y128M	M	18	2001	Mortality	Capture 1987. Monitored 1987-92 and 1997 SPur. Recaptured August 2001 in Salish, Mortality 2001.
SPur / NPur	Movement	Y128M	M	4-14	1987-92, 1997	Telemetry	Capture May 1987 SPur. Monitored 1987-92 and 1997. Monitored NPur and produced offspring.
SPur / NPur	Movement	YVernM	M	7-12	1997, 2002	Telemetry, Genetics	Radio collared SPur 1997. Hair snag NPur 2002.Sired offspring NPur and SPur.
SPur / NPur	Movement	YRockyM	M	8-12	2002-06	Telemetry	Captured and collared SPur 2002. Recapture 2006. Traveled NPur in 2006.
SPur / NPur	Movement	134	M	8-9	1987-88	Telemetry	Radio collar in SPur 1987. Hunter kill 1988 NPur
SPur / NPur	Movement	P9190M	M	4-5	2006-07	Telemetry	Radio collared June 2006 SPur. Traveled to NPur
SPur / NPur	Movement	PTerryM	M	3	2005	Telemetry, Genetics	Father SPS Y178M , Mother SPS Y538F Travel to NPur from SPur.
SPur / SSelK	Movement	YHydeM	M	3	2006-07	Telemetry	Captured in SPur Yaak 2006. Bear traveled to SSelk 2006-07
SSelk / Cabs / SSelk	Movement	928442	M	5	2012	Genetics	Father SSelk S9058aM, Mother SSelk SBettyF, Hair snagged USGS 2012 Cabs and in SSelk 2015
SSelk / SPur	Movement	S31M	M	6	2004-05	Telemetry, Mortality	Father SSelk SS3KM, Mother SSelk S1MF, Management capture 2003 and Relocated. Hunter kill 2005 SPur
SPur / Cabs / SPur	Movement	Y726M	M	6	2015-16	Telemetry	Travel from SPur to Cabs and back
SPur / SRock	Movement	922947	M	5	2013	Telemetry	Travel north from SPur across Kootenay in BC to SRock and return
SPur / SRock	Movement	928196	M	20	2015-16	Telemetry	Travel north from SPur across Kootenay in BC to SRock and return
SSelk / Cabs	Movement	S1001M	M	6	2015	Telemetry, Mortality	Travel from SSelk to Cabs. Mortality 2015
Cabs / NCDE	Movement	900932	M	4	2015-16	Telemetry	Travel east from Cabs to NCDE
SPur / NPur	Movement	958729	M	12	2016	Telemetry	Travel north from SPur to NPur

Area[1] Start / Finish	Action	Bear ID	Sex	Age	Year	Basis	Comments
SPur / SSelk	Movement	Y11048M	M	4	2017	Telemetry, Mortality	Travel west from SPur to SSelk. Mortality 2017
SPur / SSelk	Movement	YGB807M	M	5	2015-17	Telemetry	Travel west from SPur to SSelk.
SPur / Cabs	Movement	Y821M	M	3	2017	Telemetry	Travel from SPur to Cabs
NPur / SPur	Gene flow	YGB837M	M	6	2014	Genetics	Parents both NPur, Father NPur PKiddM, Mother NPur PIrishF
SPur / NPur	Gene flow	P9194F	F	Unk	2004-05	Genetics	Father SPur Y128M , Mother NPur P9127F, Origin of father probably NPur
NPur / SPur	Gene flow	Y787M	M	3	2003	Genetics	Father SPurYVernM, Mother SPur Y354F, Origin of father probably NPur
NPur / SPur	Gene flow	YU37F	F	1	2001	Genetics	Father SPurYVernM, Mother SPur Y354F, Origin of father probably NPur
SSelk / SPur	Movement	16749	M	Unk	2015	Genetics	Father C134B2V2, Mother JillS226F Both SSelk. Male offspring 16749 SPur
NCDE / Cabs	Movement	C90467M	M	6	2014	Genetics, Mortality	Management bear from NCDE traveled to Cabs, mortality 2014
NPur / SPur	Movement	P1374M	M	2	2010	Genetics, Mortality	Hair snag as cub in 2008 NPur? Management capture SPur 2010,relocated, Mortality 2010
NPur / SSelk / Cabs	Gene flow, Movement	S21285M	M	0.5-2	2016-18	Genetics, Telemetry	Father NPur SCptHM , Mother SSelk S11675F, S21285M moved to Cabs in 2018, then dropped collar
SPur / SRock	Movement	18986	M	4	2018	Genetics, Telemetry	Travel north from SPur across Kootenay in BC to SRock (BC mgmt. capture)
NPur / SPur	Movement	Y29761M	M	Unk	2017	Genetics	Father P9101M, Mother PMaeveF, both NPur. Male offspring Y29761M SPur

[1]Cabs – Cabinet Mountains, NCDE – Northern Continental Divide, NPur – Purcell Mountains north of Highway 3, SPur – Purcell Mountains south of Highway 3, SSelk – South Selkirk Mountains south of Nelson, BC

Appendix 4. Grizzly Bear Home Ranges

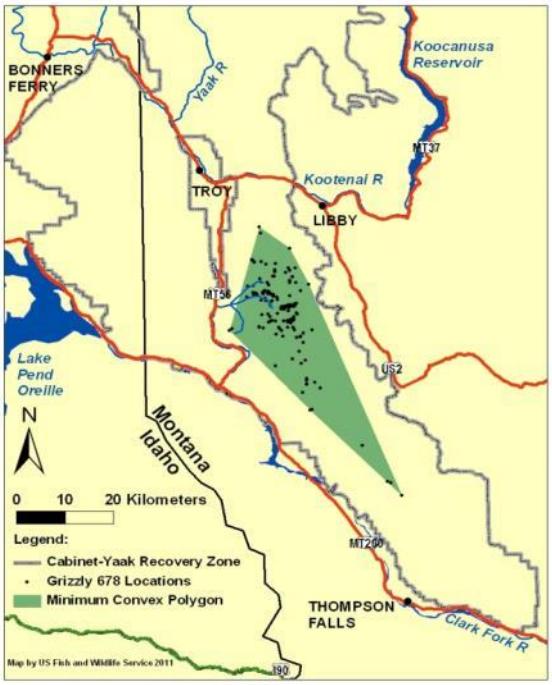

Figure A1. Radio locations and minimum convex (shaded) life range of female grizzly bear 678 in the Cabinet Mountains, 1983-89.

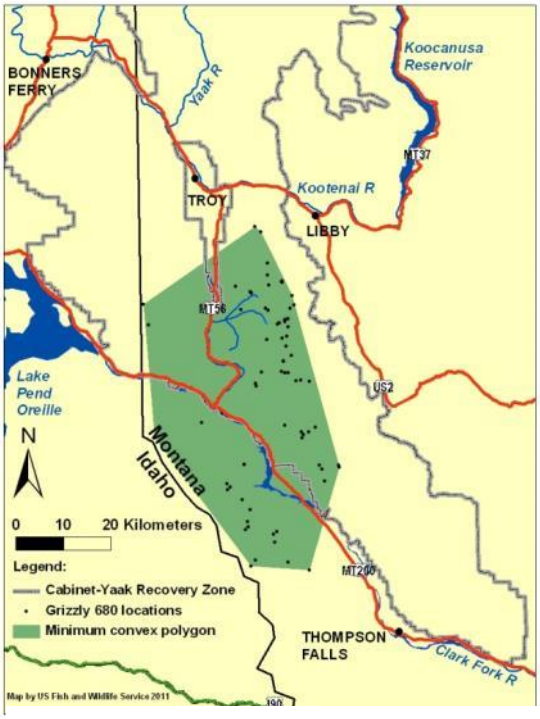

Figure A2. Radio locations and minimum convex (shaded) life range of male grizzly bear 680 in the Cabinet Mountains, 1984-85.

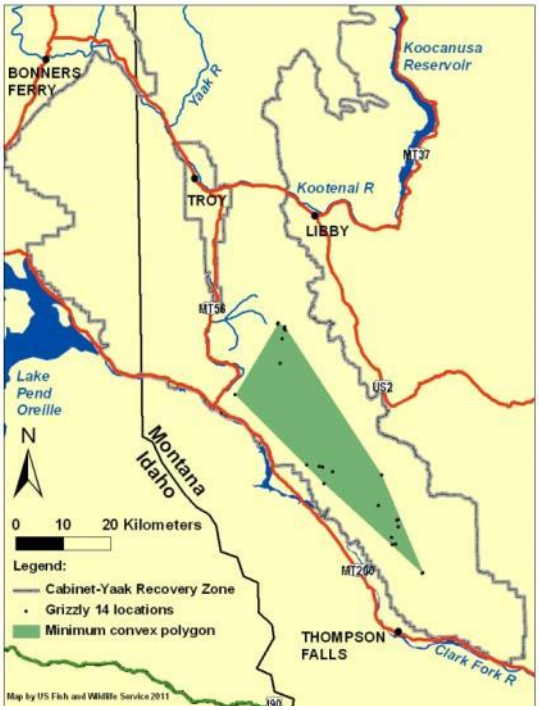

Figure A3. Radio locations and minimum convex (shaded) life range of male grizzly bear 14 in the Cabinet Mountains, 1985.

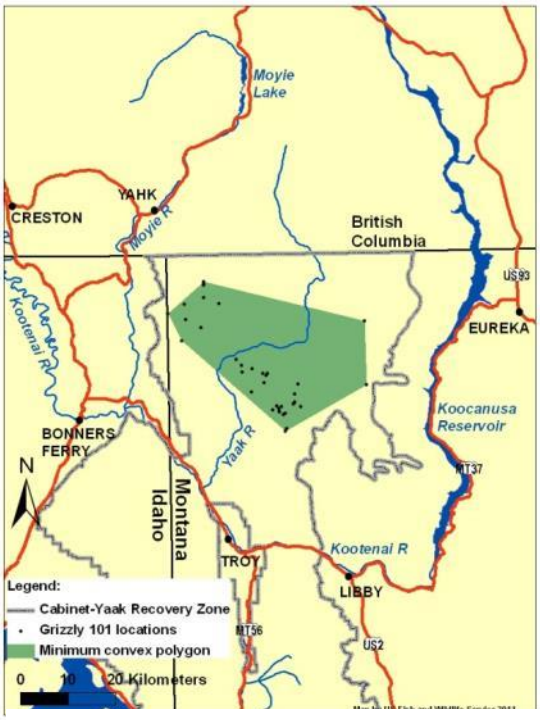

Figure A4. Radio locations and minimum convex (shaded) life range of male grizzly bear 101 in the Yaak River, 1986-87.

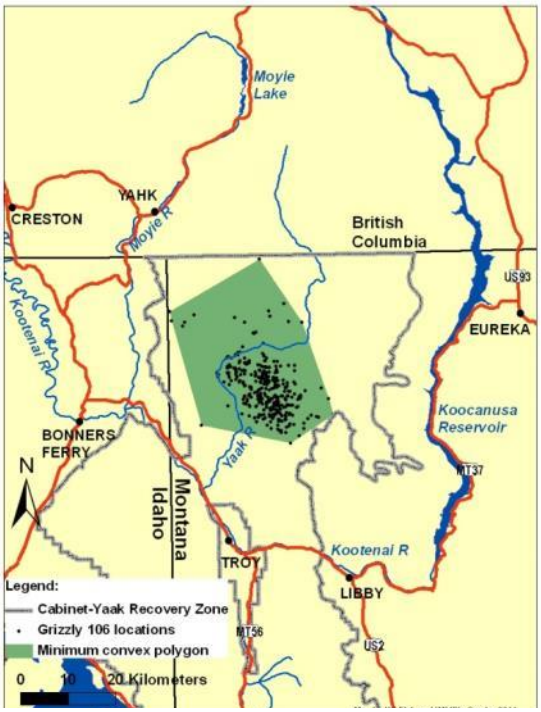

Figure A5. Radio locations and minimum convex (shaded) life range of female grizzly bear 106 in the Yaak River, 1986-99.

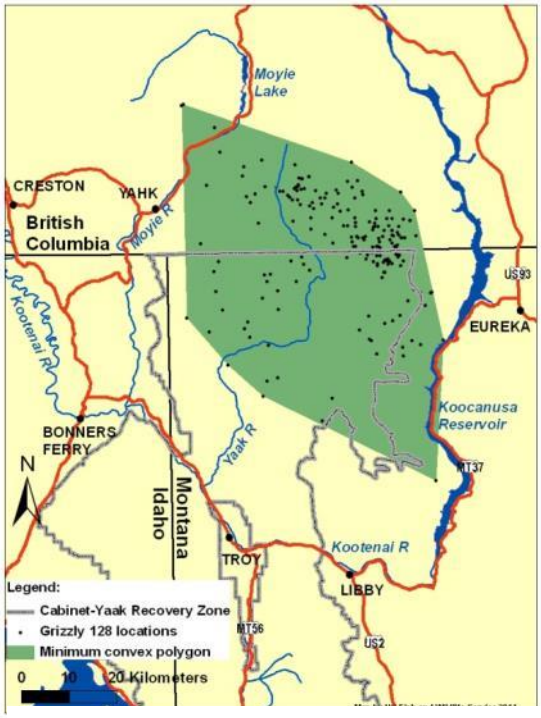

Figure A6. Radio locations and minimum convex (shaded) life range of male grizzly bear 128 in the Yaak River, 1987-97.

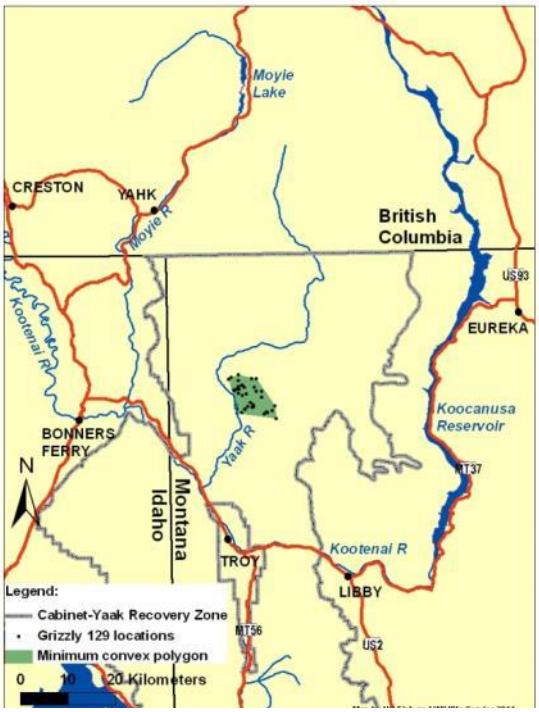

Figure A7. Radio locations and minimum convex (shaded) life range of female grizzly bear 129 in the Yaak River, 1987-89.

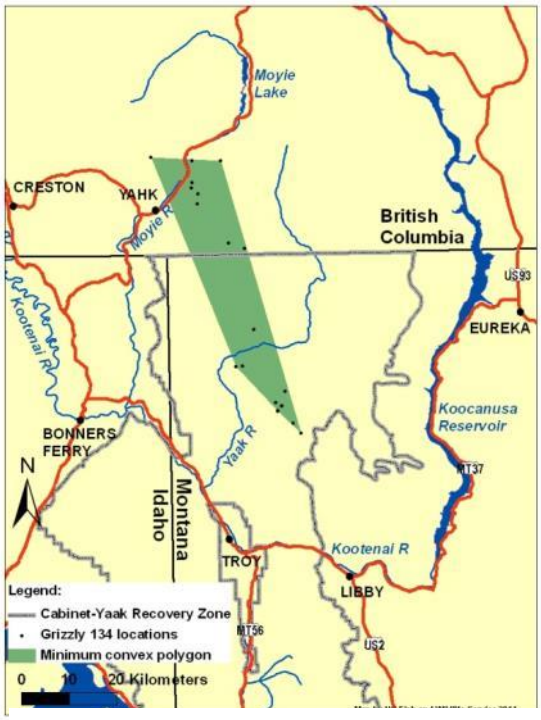

Figure A8. Radio locations and minimum convex (shaded) life range of male grizzly bear 134 in the Yaak River, 1987-88.

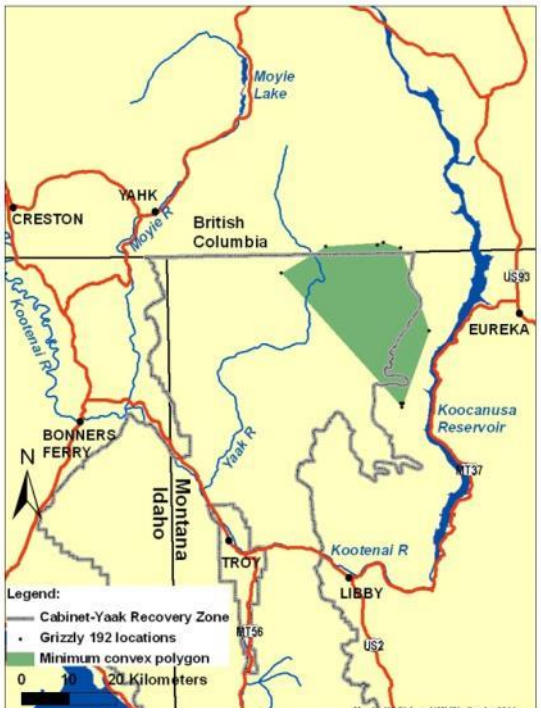

Figure A9. Radio locations and minimum convex (shaded) life range of male grizzly bear 192 in the Yaak River, 1990.

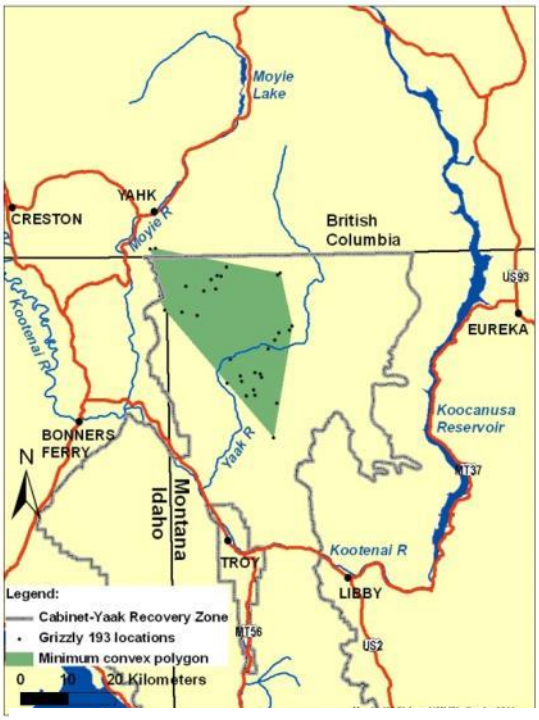

Figure A10. Radio locations and minimum convex (shaded) life range of male grizzly bear 193 in the Yaak River, 1990.

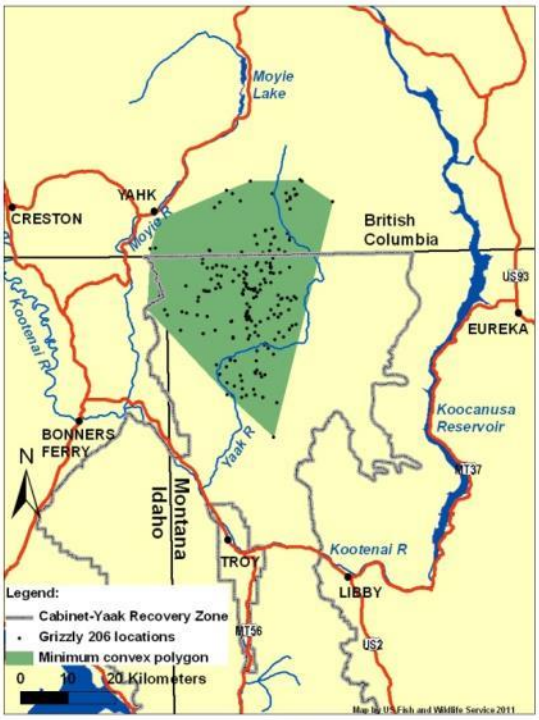

Figure A11. Radio locations and minimum convex (shaded) life range of female grizzly bear 206 in the Yaak River, 1991-94.

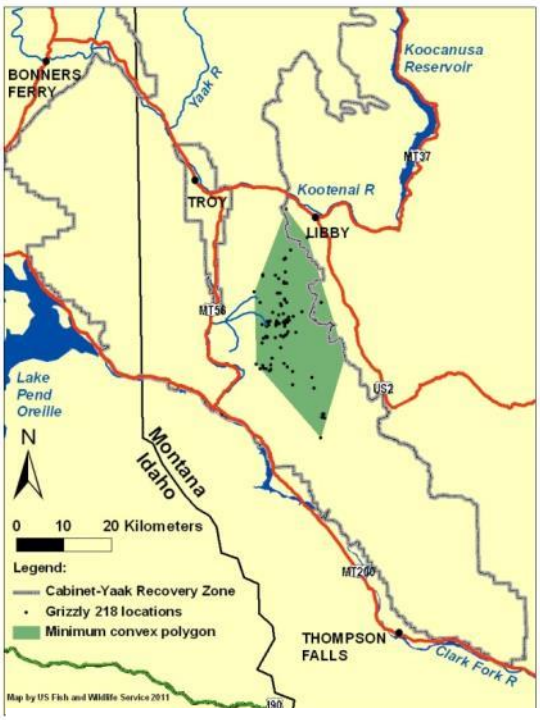

Figure A12. Radio locations and minimum convex (shaded) life range of female augmentation grizzly bear 218 in the Cabinet Mountains, 1990-91.

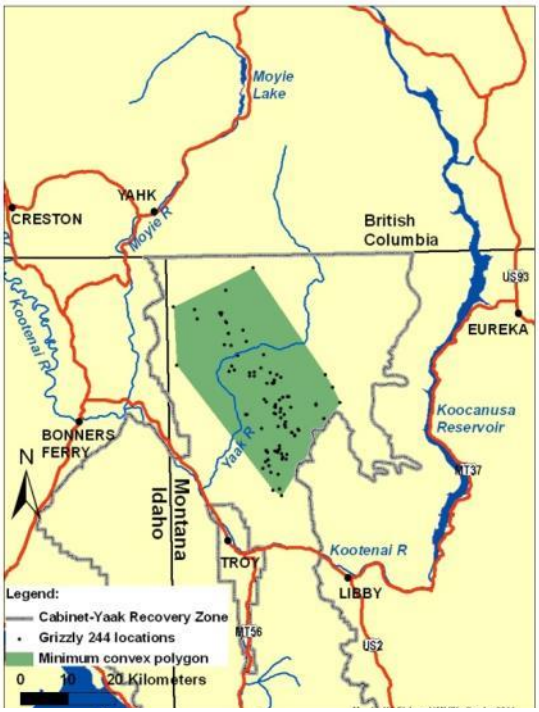

Figure A13. Radio locations and minimum convex (shaded) life range of male grizzly bear 244 in the Yaak River, 1992-03.

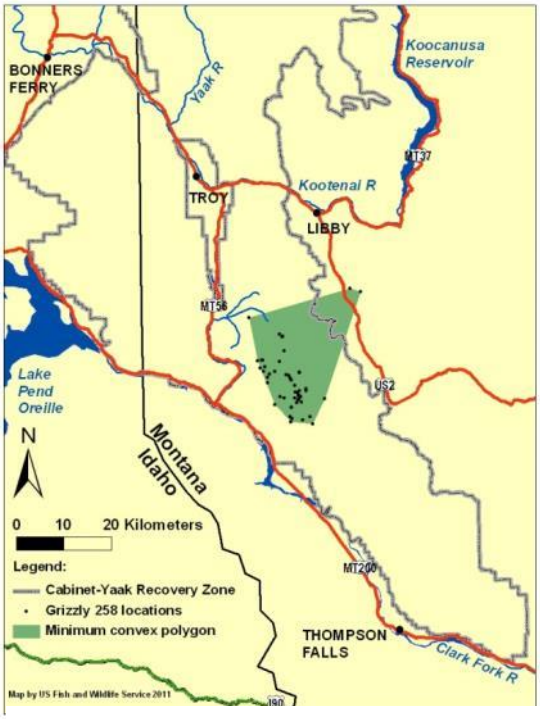

Figure A14. Radio locations and minimum convex (shaded) life range of female augmentation grizzly bear 258 in the Cabinet Mountains, 1992-93.

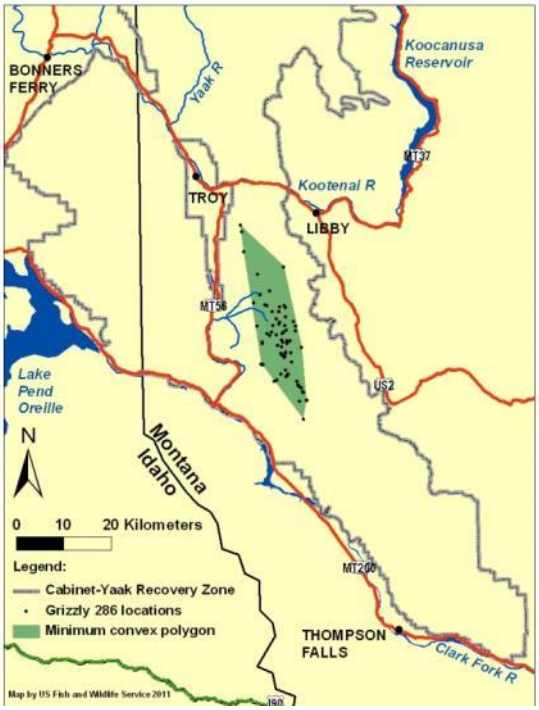

Figure A15. Radio locations and minimum convex (shaded) life range of female augmentation grizzly bear 286 in the Cabinet Mountains, 1993-95.

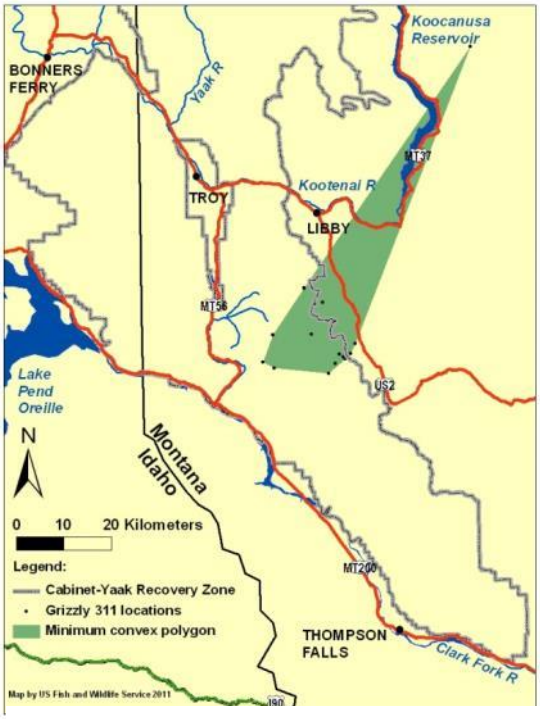

Figure A16. Radio locations and minimum convex (shaded) life range of female augmentation grizzly bear 311 in the Cabinet Mountains, 1994-95.

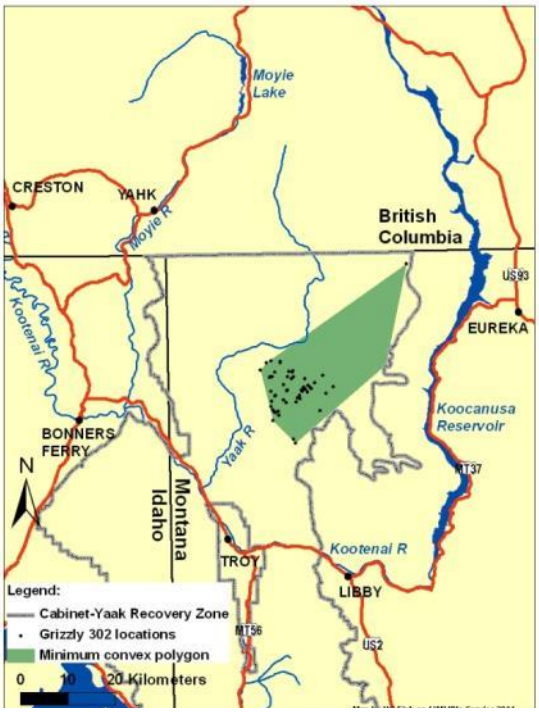

Figure A17. Radio locations and minimum convex (shaded) life range of male grizzly bear 302 in the Yaak River, 1994-96.

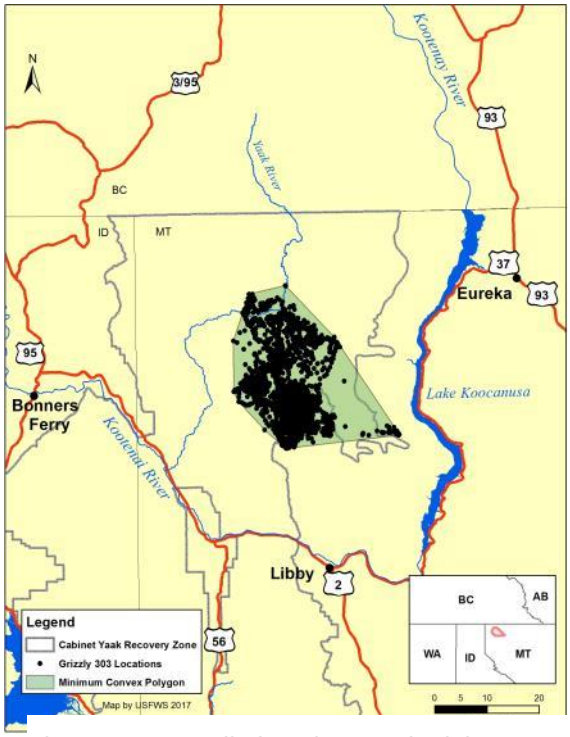

Figure A18. Radio locations and minimum convex (shaded) life range of female grizzly bear 303 in the Yaak River, 1994-01 and 2011-16.

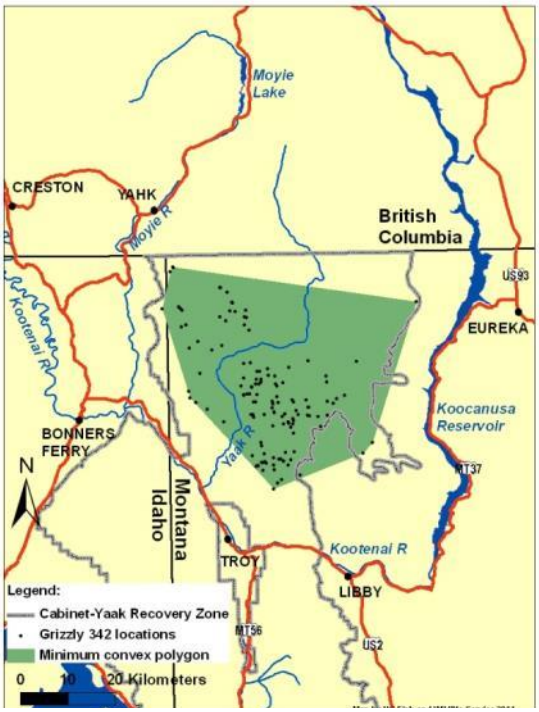

Figure A19. Radio locations and minimum convex (shaded) life range of male grizzly bear 342 in the Yaak River, 1995-01.

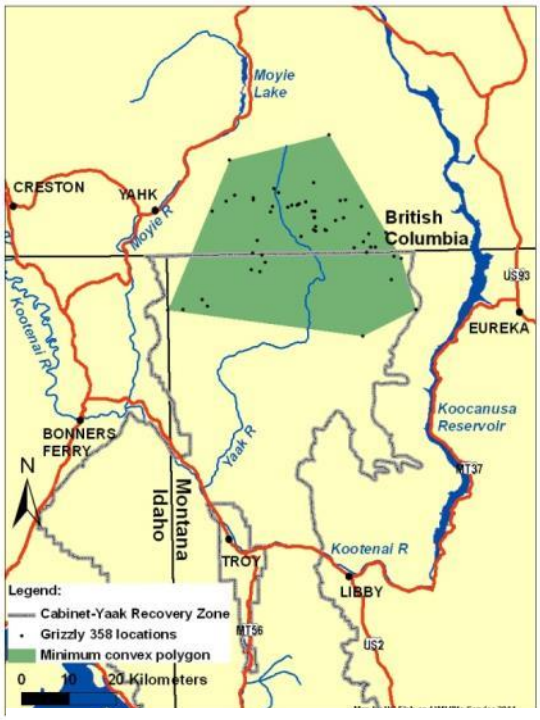

Figure A20. Radio locations and minimum convex (shaded) life range of male grizzly bear 358 in the Yaak River, 1996-98.

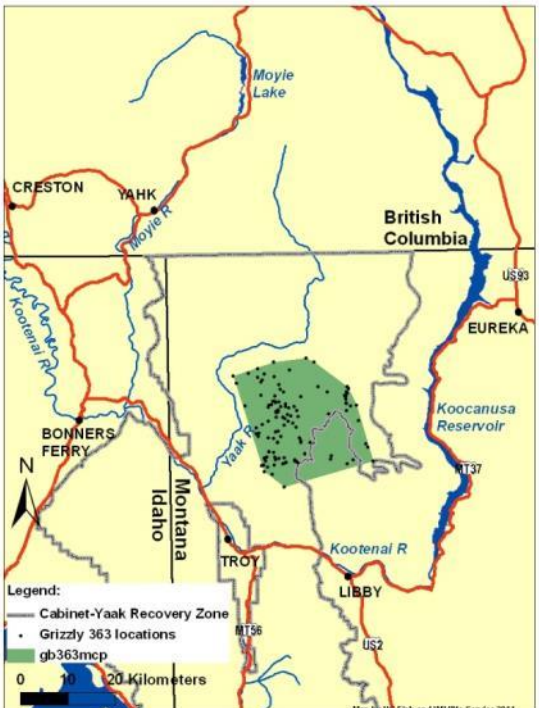

Figure A21. Radio locations and minimum convex (shaded) life range of male grizzly bear 363 in the Yaak River, 1996-99.

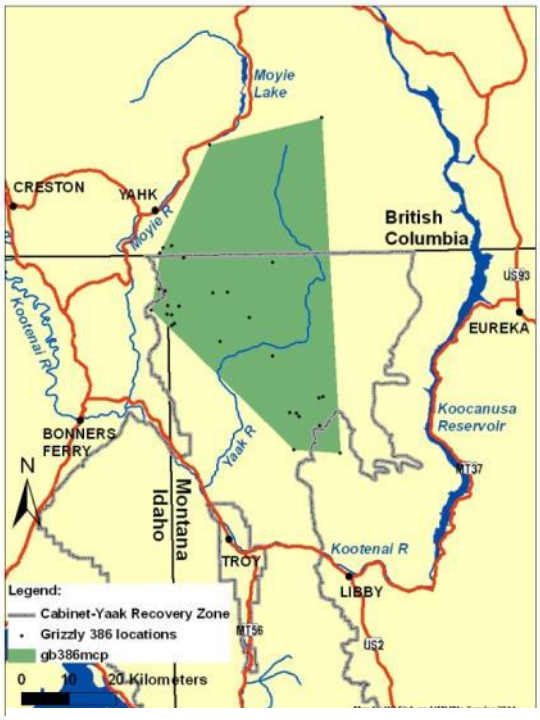

Figure A22. Radio locations and minimum convex (shaded) life range of male grizzly bear 386 in the Yaak River, 1997-99.

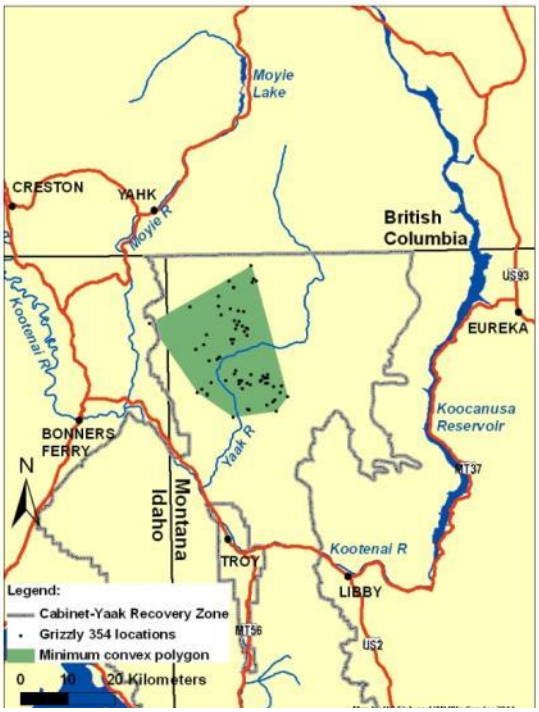

Figure A23. Radio locations and minimum convex (shaded) life range of female grizzly bear 354 in the Yaak River, 1997-99.

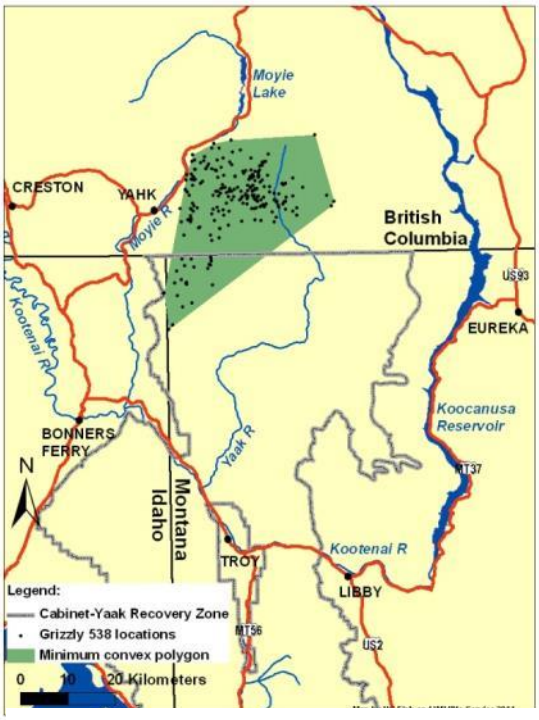

Figure A24. Radio locations and minimum convex (shaded) life range of female grizzly bear 538 in the Yaak River, 1997-02.

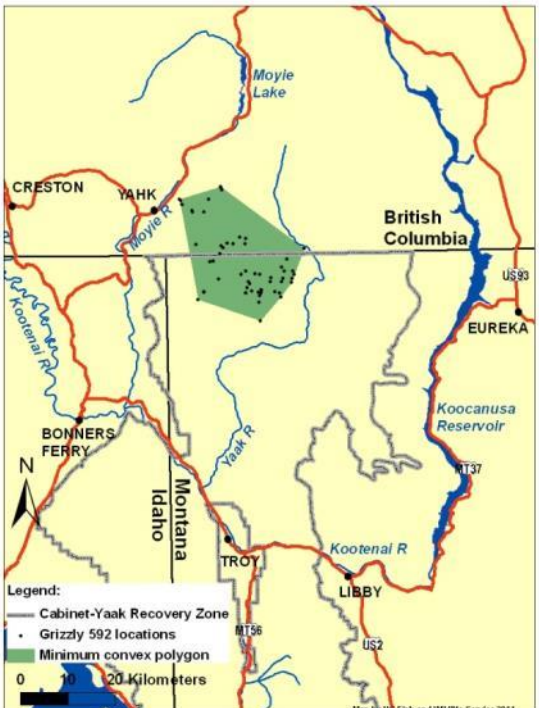

Figure A25. Radio locations and minimum convex (shaded) life range of female grizzly bear 592 in the Yaak River, 1999-00.

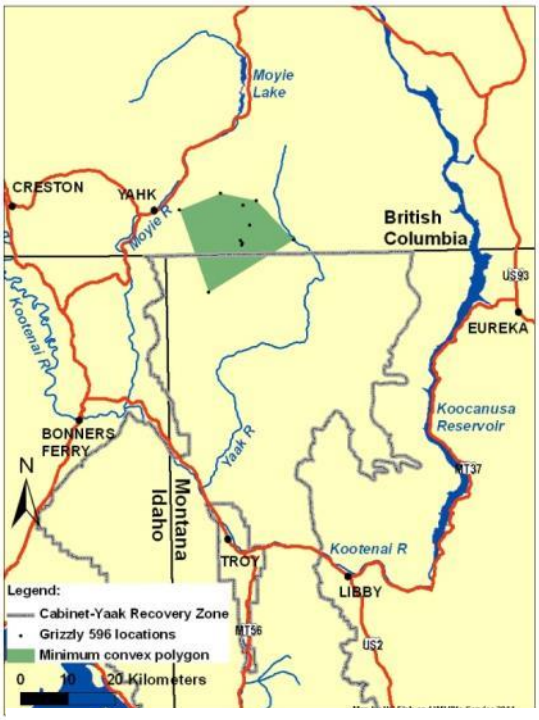

Figure A26. Radio locations and minimum convex (shaded) life range of female grizzly bear 596 in the Yaak River, 1999.

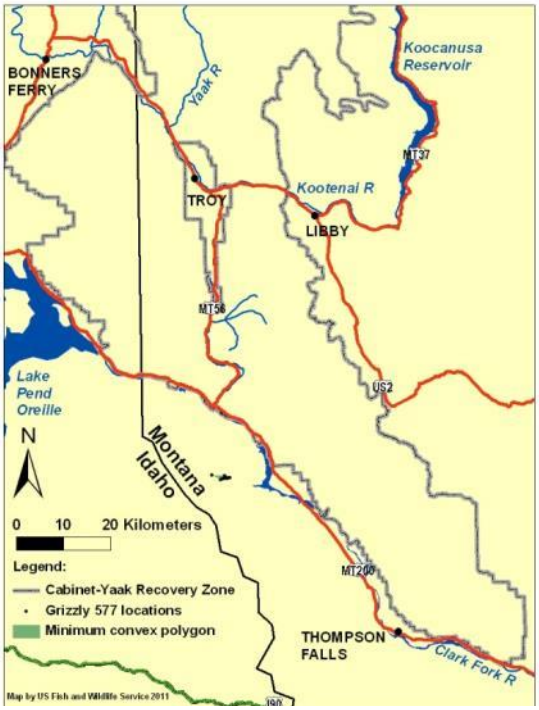

Figure A27. Radio locations and minimum convex (shaded) life range of female grizzly bear 577 in the Cabinet Mountains, 2002.

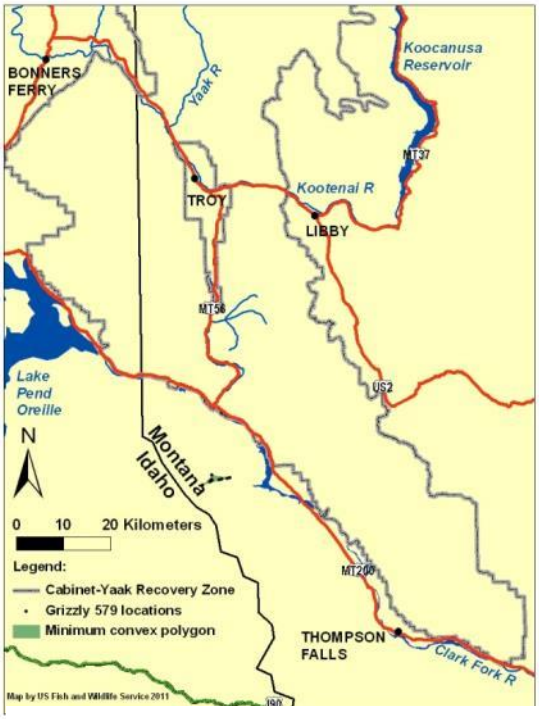

Figure A28. Radio locations and minimum convex (shaded) life range of male grizzly bear 579 in the Cabinet Mountains, 2002.

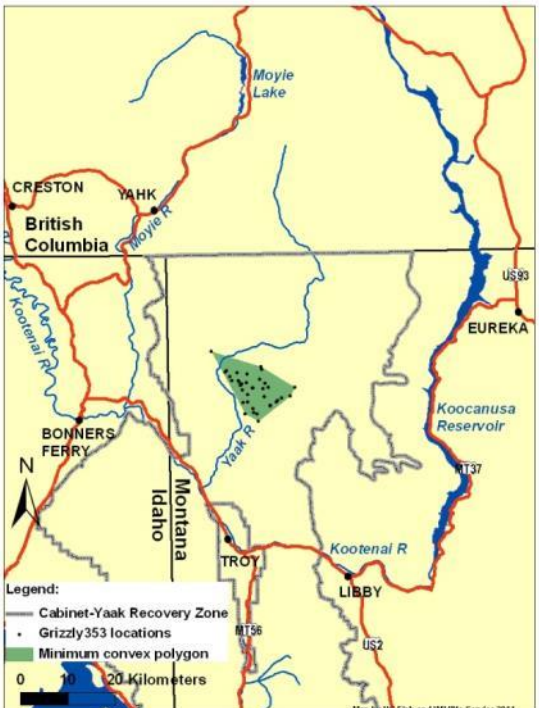

Figure A29. Radio locations and minimum convex (shaded) life range of female grizzly bear 353 in the Yaak River, 2002.

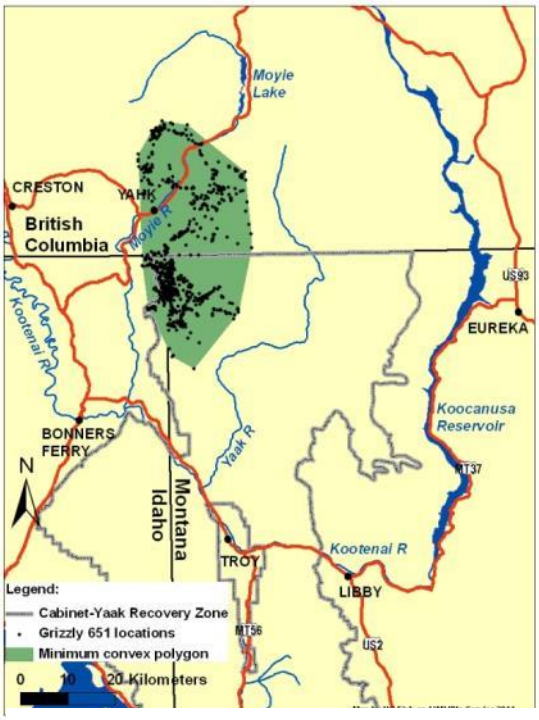

Figure A30. Radio locations and minimum convex (shaded) life range of male grizzly bear 651 in the Yaak River, 2002-06.

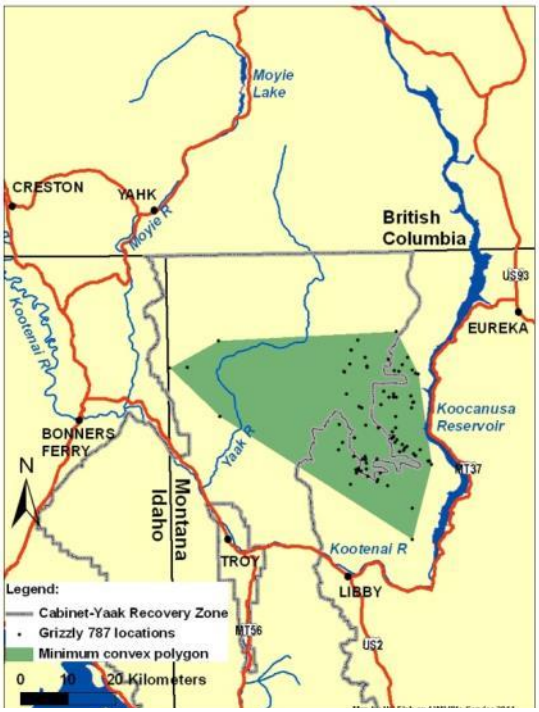

Figure A31. Radio locations and minimum convex (shaded) life range of male grizzly bear 787 in the Yaak River, 2003-04.

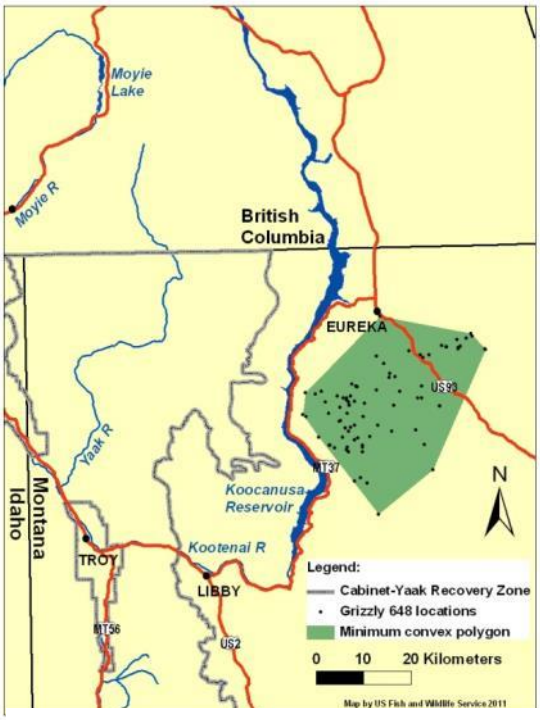

Figure A32. Radio locations and minimum convex (shaded) life range of female grizzly bear 648 in the Salish Mountains, 2003-05.

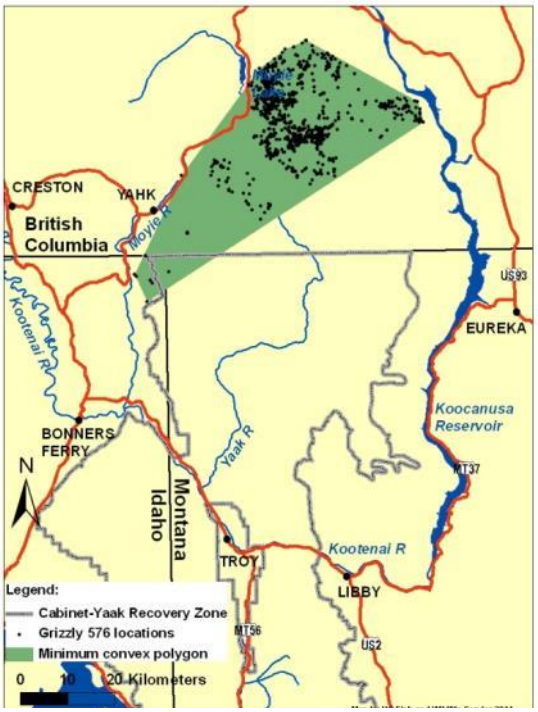

Figure A33. Radio locations and minimum convex (shaded) life range of male grizzly bear 576 in the Yaak River, 2004-06.

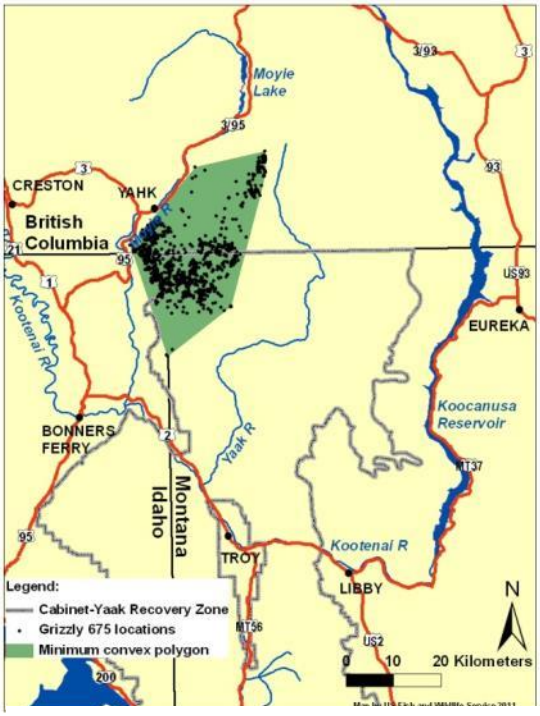

Figure A34. Radio locations and minimum convex (shaded) life range of female grizzly bear 675 in the Yaak River, 2004-10.

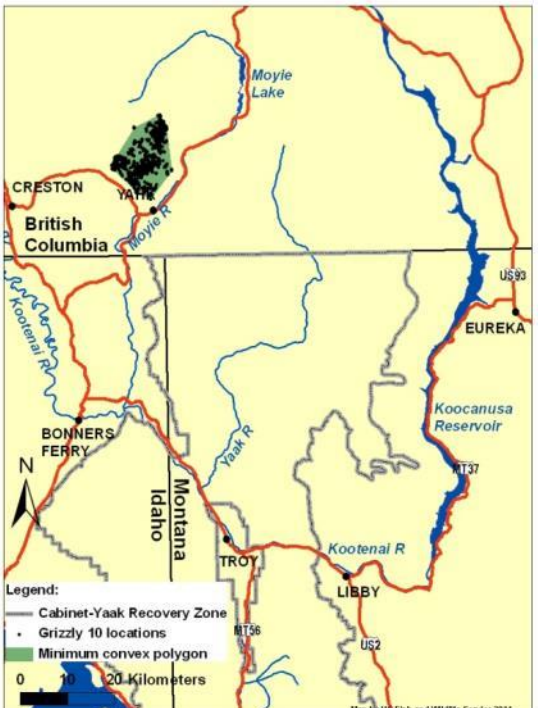

Figure A35. Radio locations and minimum convex (shaded) life range of female grizzly bear 10 in the Purcell Mountains, 2004.

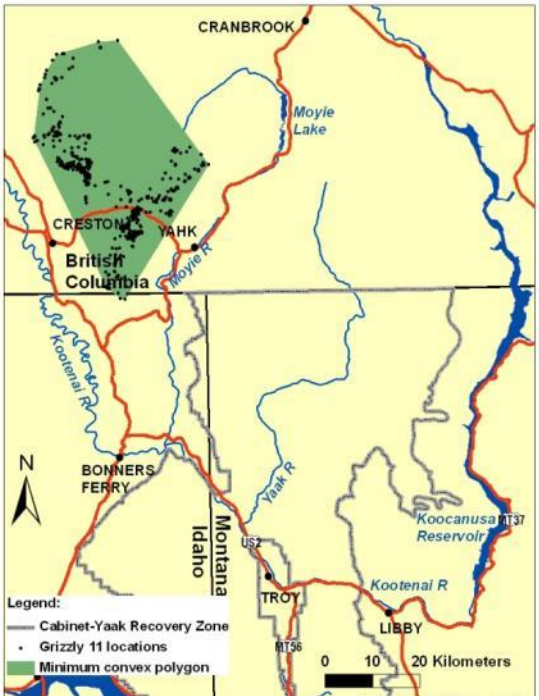

Figure A36. Radio locations and minimum convex (shaded) life range of male grizzly bear 11 in the Purcell Mountains, 2004.

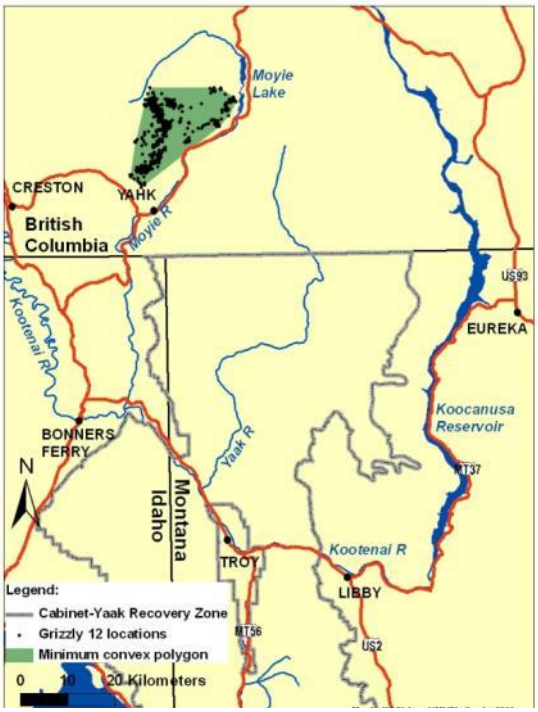

Figure A37. Radio locations and minimum convex (shaded) life range of female grizzly bear 12 in the Purcell Mountains, 2004.

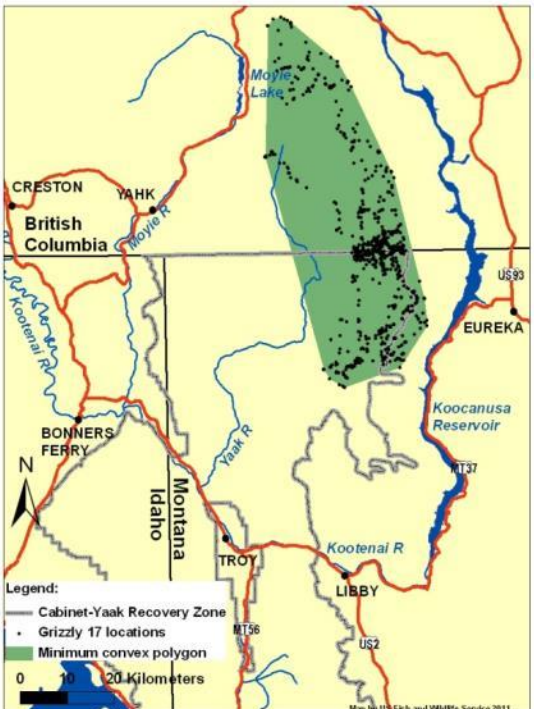

Figure A38. Radio locations and minimum convex (shaded) life range of male grizzly bear 17 in the Purcell Mountains, 2004.

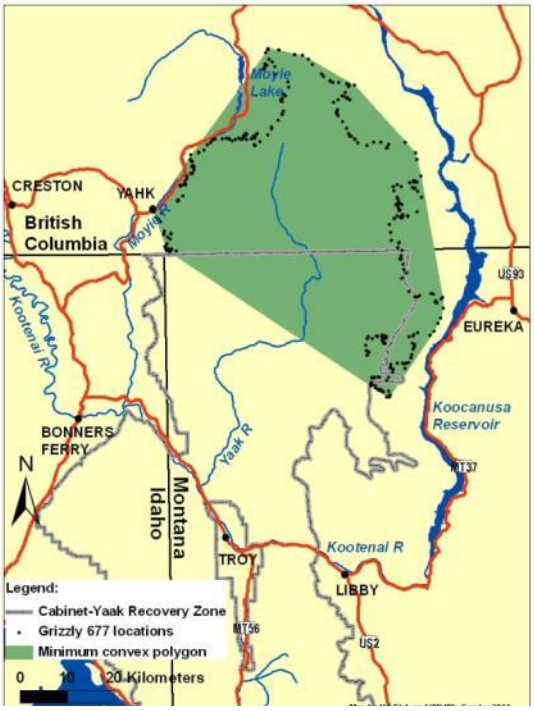

Figure A39. Radio locations and minimum convex (shaded) life range of male grizzly bear 677 in the Purcell Mountains, 2005.

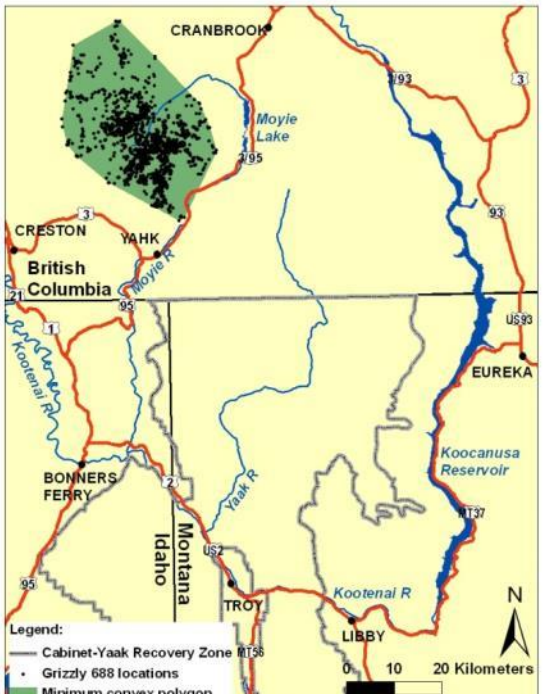

Figure A40. Radio locations and minimum convex (shaded) life range of male grizzly bear 688 in the Purcell Mountains, 2005-06.

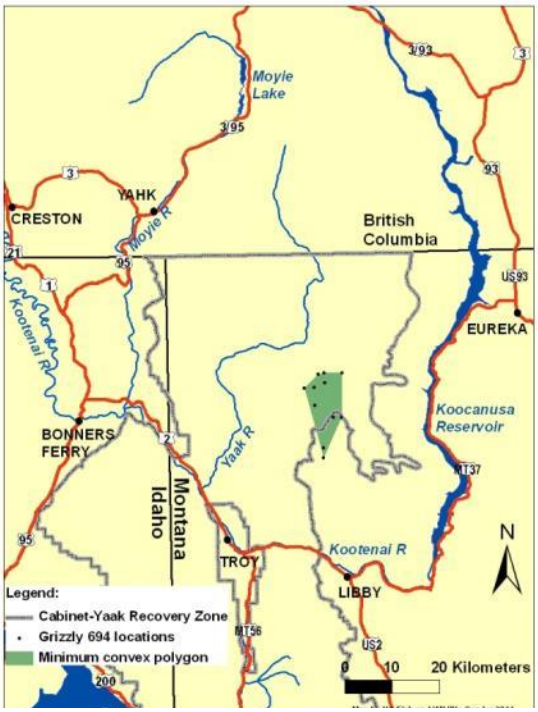

Figure A41. Radio locations and minimum convex (shaded) life range of female grizzly bear 694 in the Yaak River, 2005.

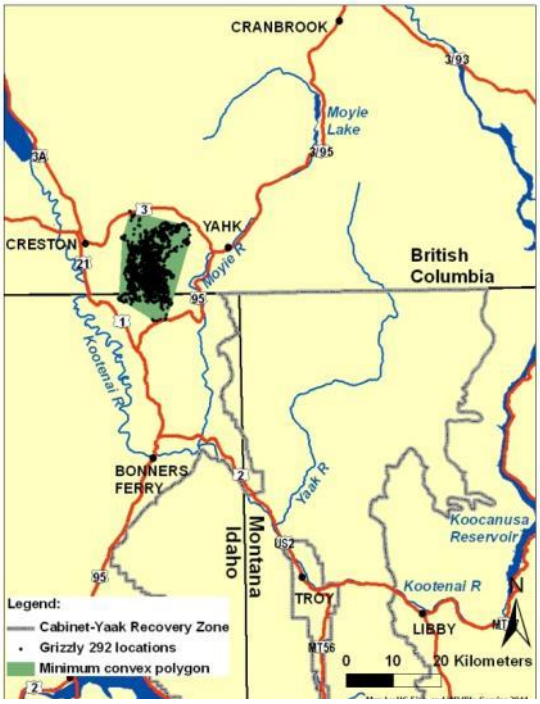

Figure A42. Radio locations and minimum convex (shaded) life range of female grizzly bear 292 in the Purcell Mountains, 2005.

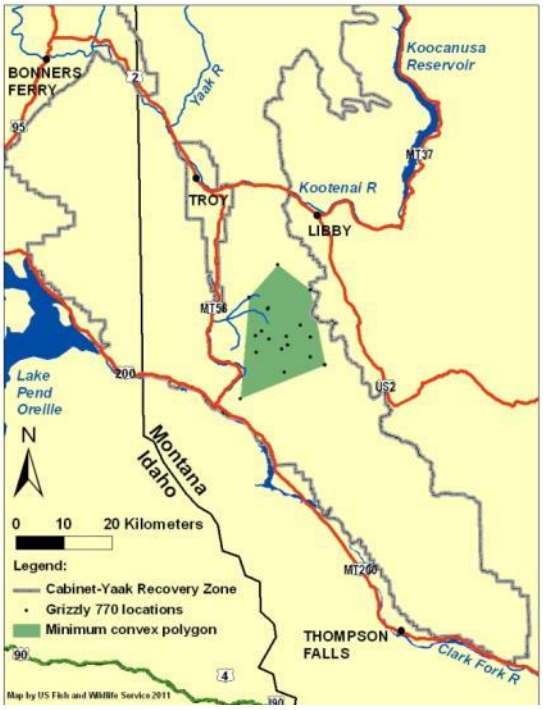

Figure A43. Radio locations and minimum convex (shaded) life range of male grizzly bear 770 in the Cabinet Mountains, 2005-06.

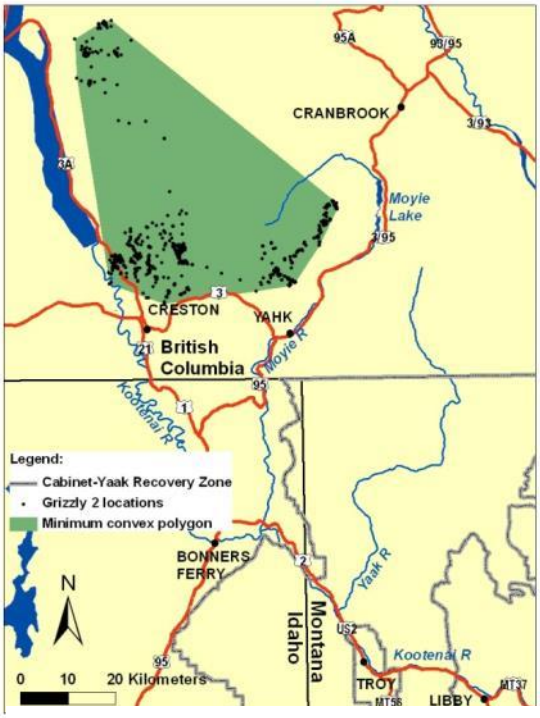

Figure A44. Radio locations and minimum convex (shaded) life ranges of male grizzly bear 2 in the Purcell Mountains, 2005.

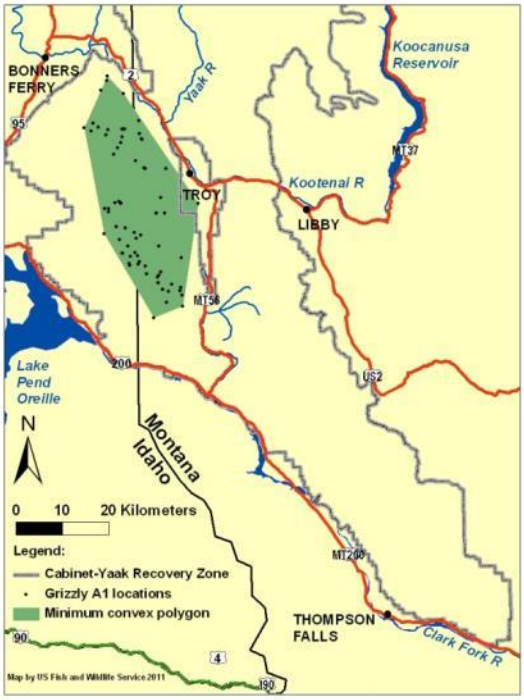

Figure A45. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear A1 in the Cabinet Mountains, 2005-07.

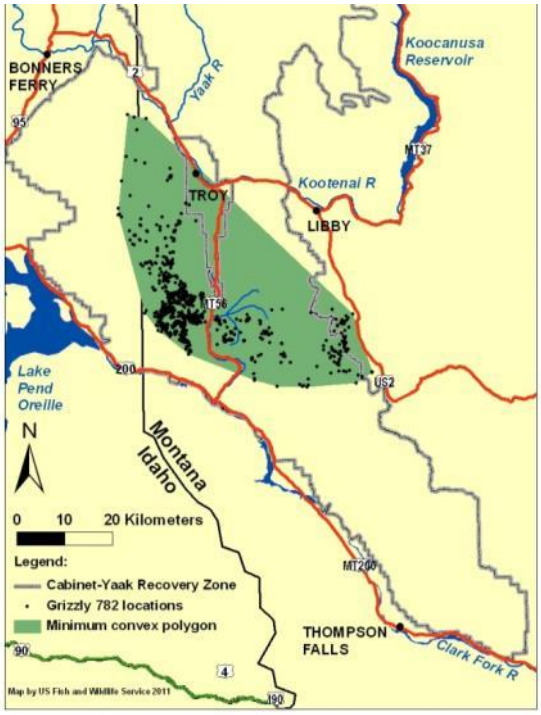

Figure A46. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 782 in the Cabinet Mountains, 2006-07.

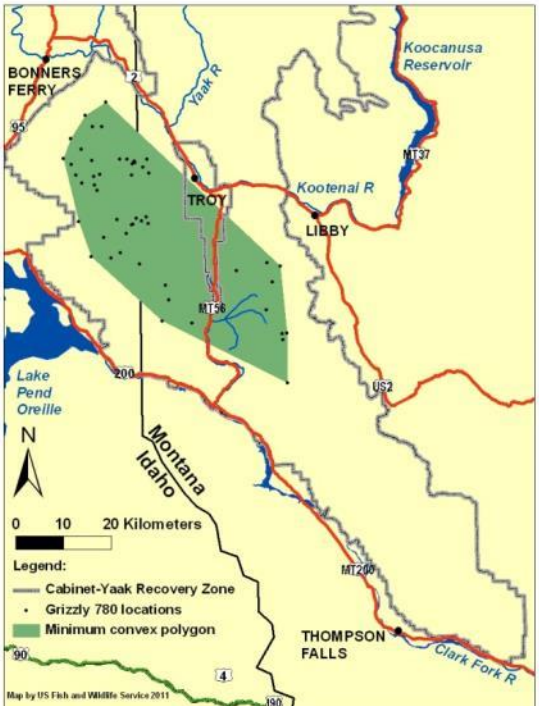

Figure A47. Radio locations and minimum convex (shaded) life range of male grizzly bear 780 in the Cabinet Mountains, 2006-08.

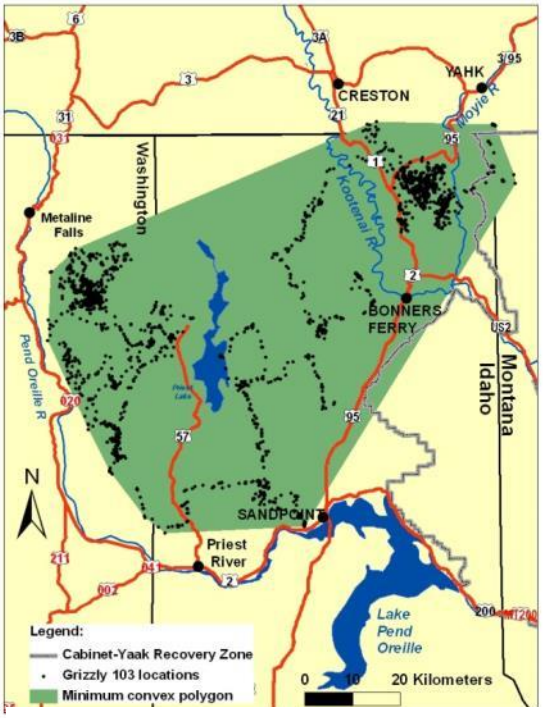

Figure A48. Radio locations and minimum convex (shaded) life range of male grizzly bear 103 in the Yaak River, 2006-07.

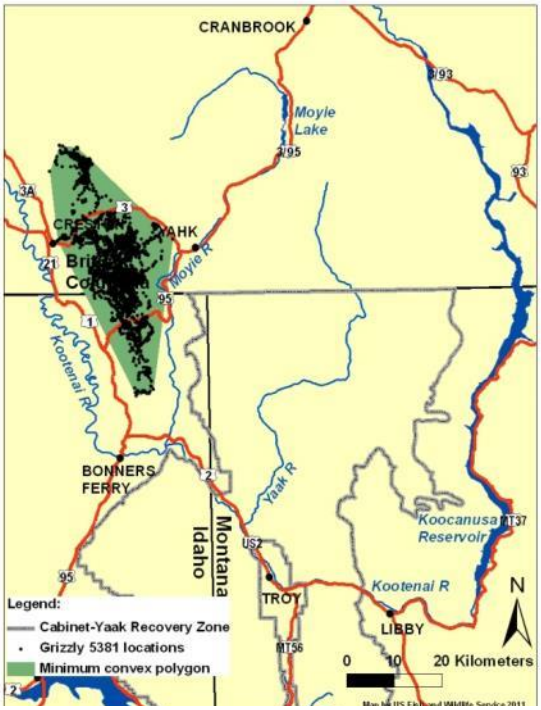

Figure A49. Radio locations and minimum convex (shaded) life range of male grizzly bear 5381 in the Purcell Mountains, 2006-07.

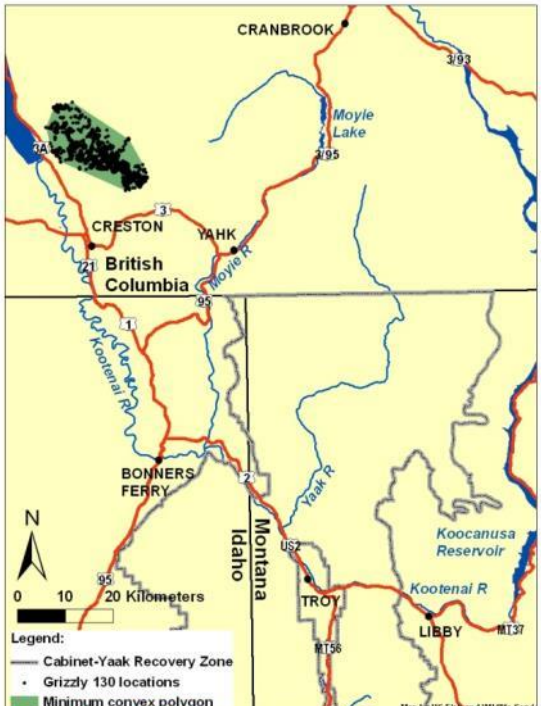

Figure A50. Radio locations and minimum convex (shaded) life range of female grizzly bear 130 in the Purcell Mountains, 2007-08.

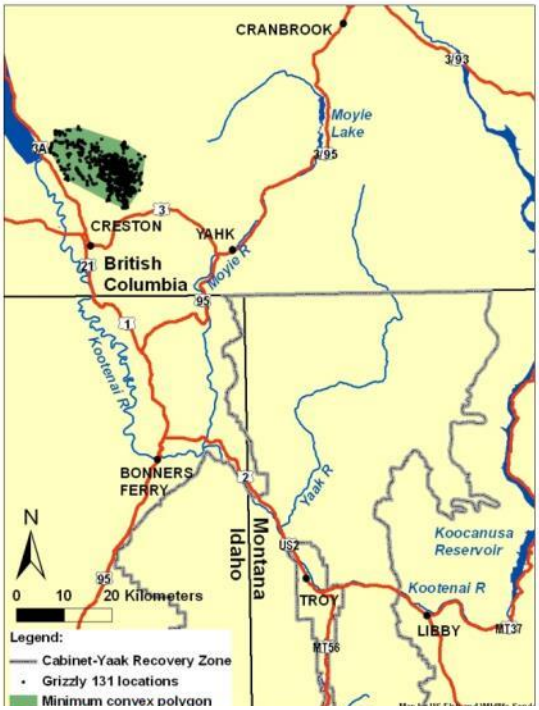

Figure A51. Radio locations and minimum convex (shaded) life range of female grizzly bear 131 in the Purcell Mountains, 2007-08.

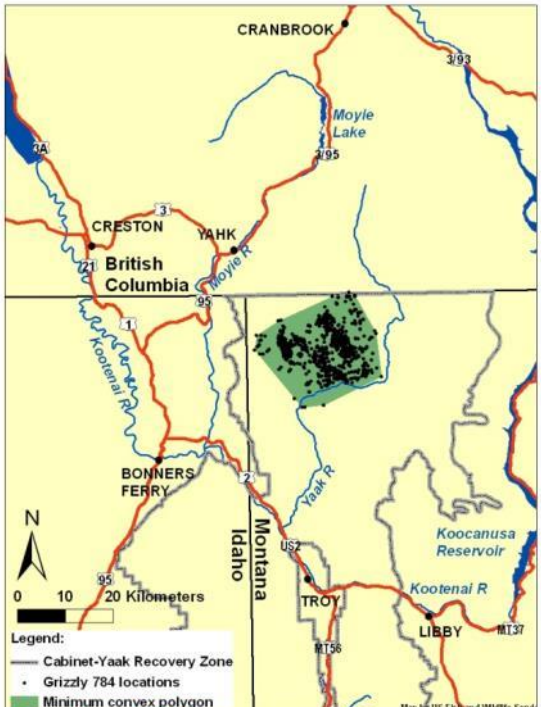

Figure A52. Radio locations and minimum convex (shaded) life range of female grizzly bear 784 in the Yaak River, 2007-09.

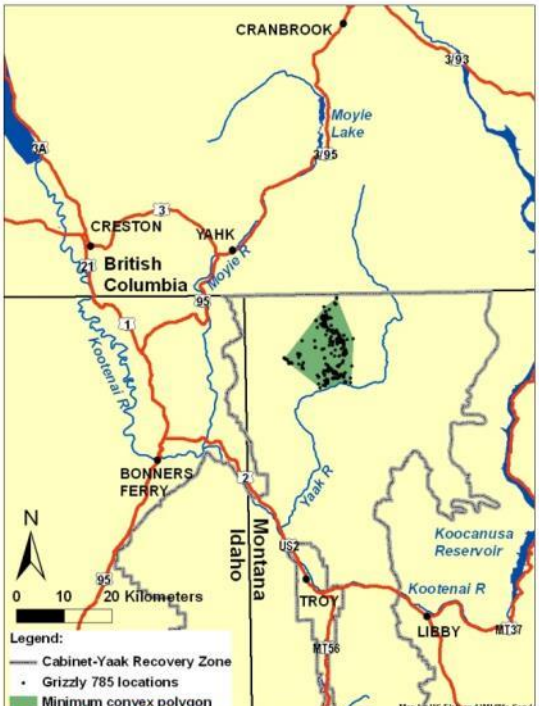

Figure A53. Radio locations and minimum convex (shaded) life range of female grizzly bear 785 in the Yaak River, 2007-08.

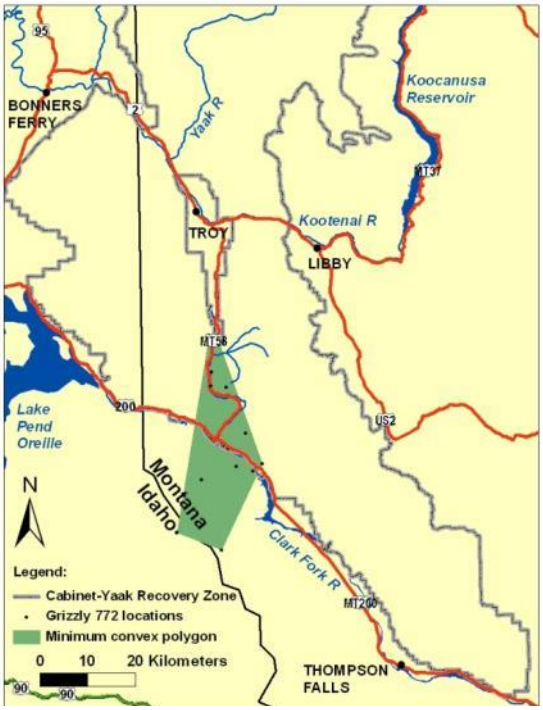

Figure A54. Radio locations and minimum convex (shaded) life range of female grizzly bear 772 in the Cabinet Mountains, 2007.

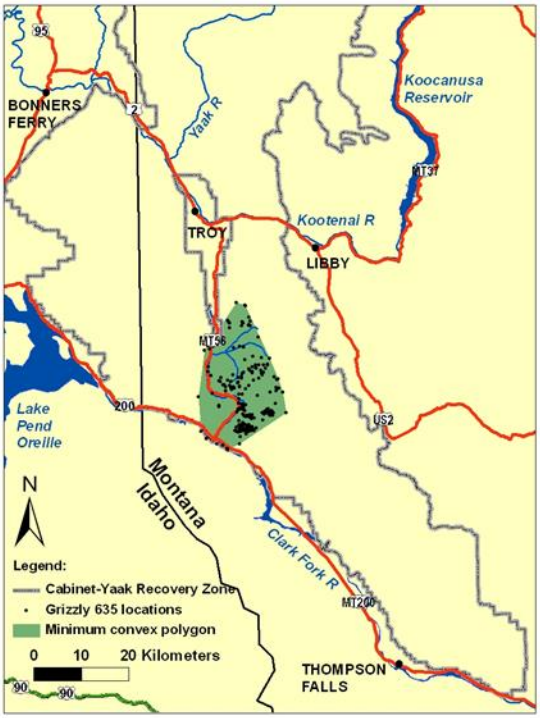

Figure A55. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 635 in the Cabinet Mountains, 2008.

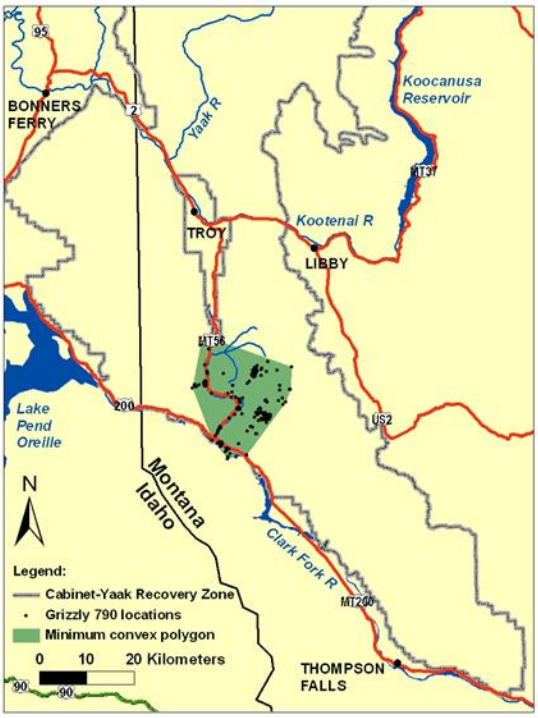

Figure A56. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 790 in the Cabinet Mountains, 2008.

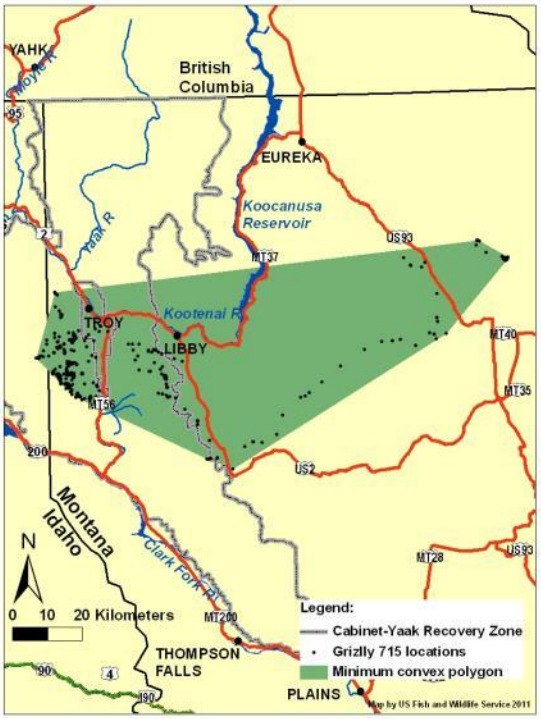

Figure A57. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 715 in the Cabinet Mountains, 2009-10.

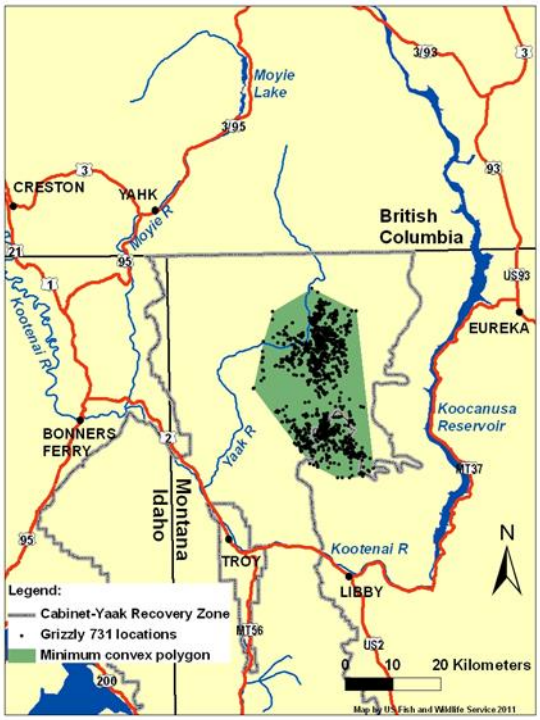

Figure A58. Radio locations and minimum convex (shaded) life range of female grizzly bear 731 in the Yaak River, 2009-11.

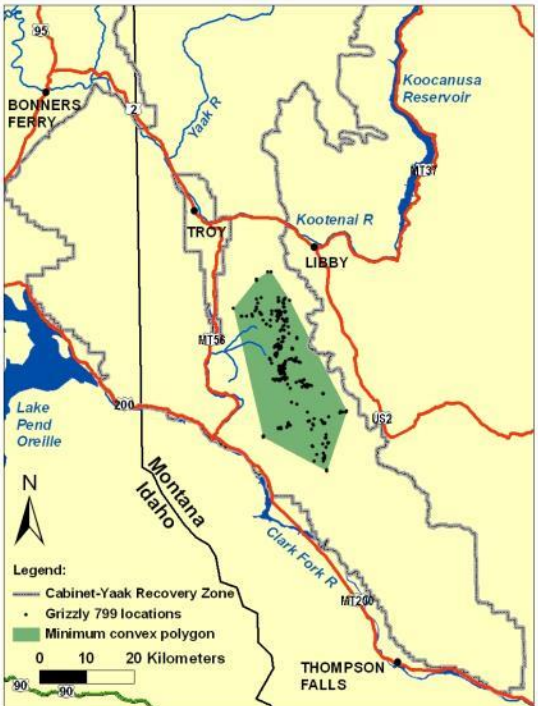

Figure A59. Radio locations and minimum convex (shaded) life range of male grizzly bear 799 in the Cabinet Mountains, 2009-10.

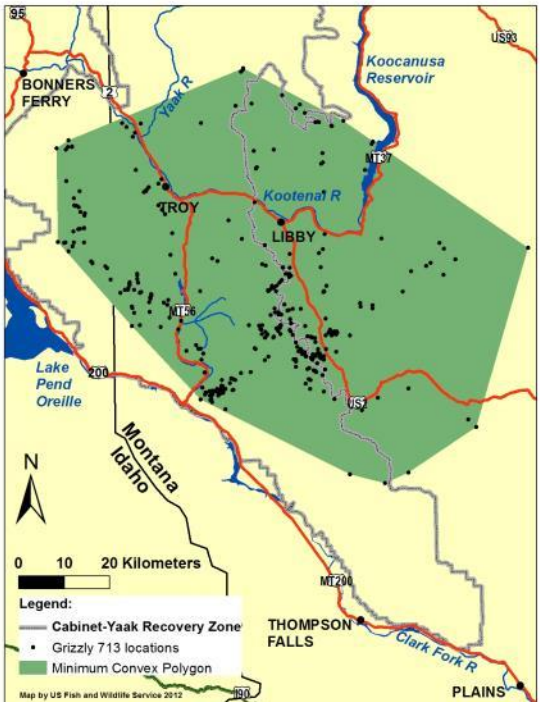

Figure A60. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 713 in the Cabinet Mountains, 2010-11.

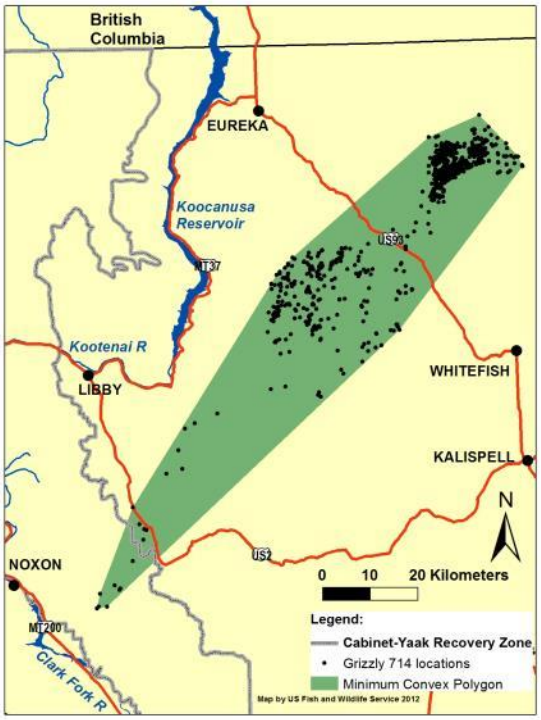

Figure A61. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 714 in the Cabinet Mountains, 2010-12.

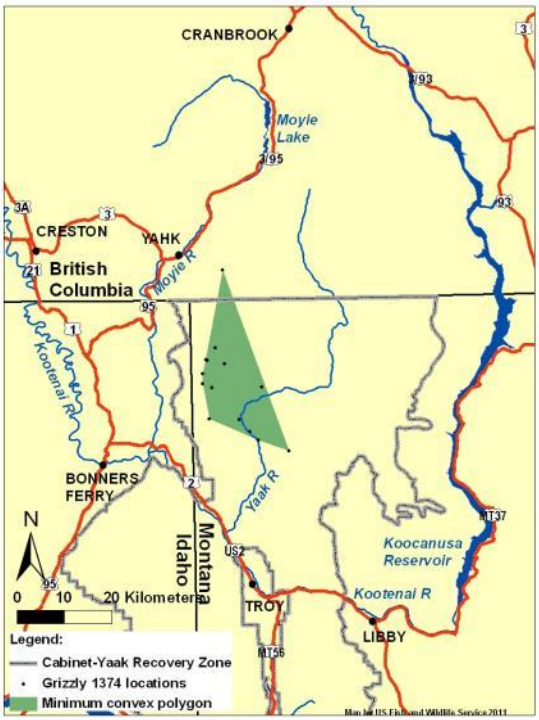

Figure A62. Radio locations and minimum convex (shaded) life range of male grizzly bear 1374 in the Yaak River, 2010.

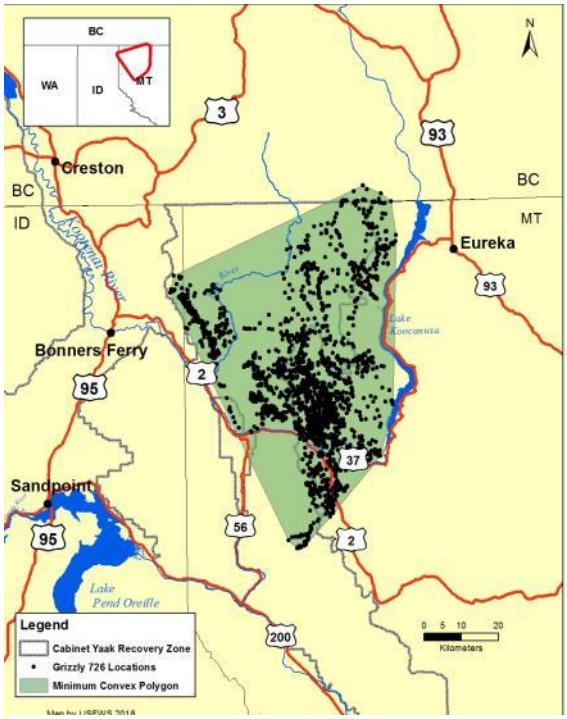

Figure A63 Radio locations and minimum convex (shaded) life range of male grizzly bear 726 in the Yaak River, 2011-12, 2015-17.

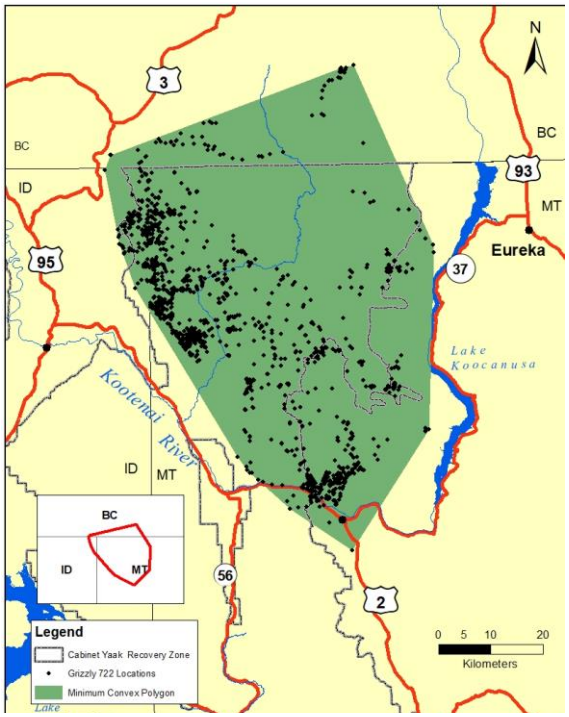

Figure A64. Radio locations and minimum convex (shaded) life range of male grizzly bear 722 in the Yaak River, 2011-12, 2014, 2016-18.

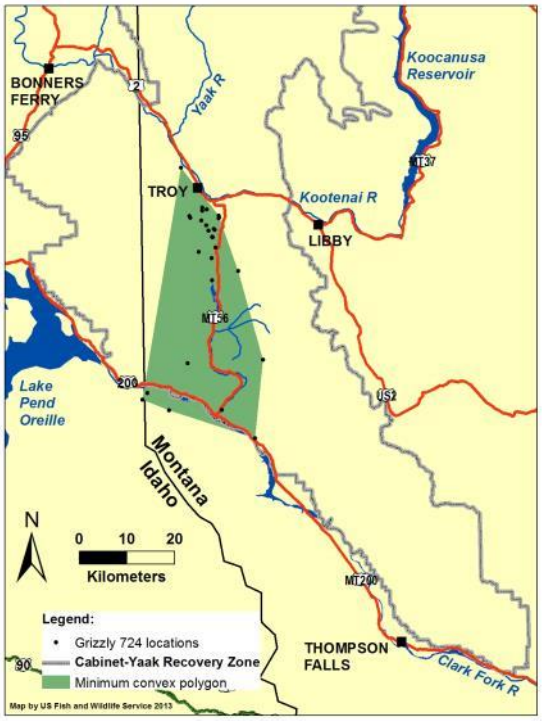

Figure A65. Radio locations and minimum convex (shaded) life range of management male grizzly bear 724 in the Cabinet Mountains, 2011-12.

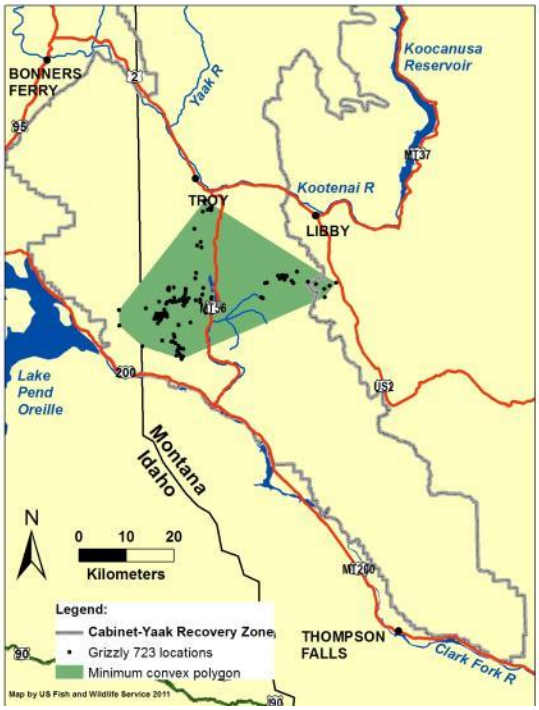

Figure A66. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 723 in the Cabinet Mountains, 2011-12.

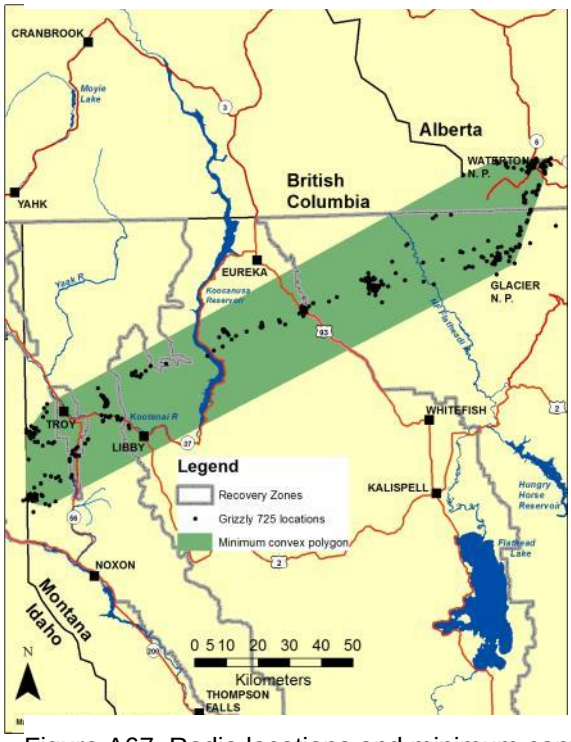

Figure A67. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 725 in the Cabinet Mountains, 2011-13.

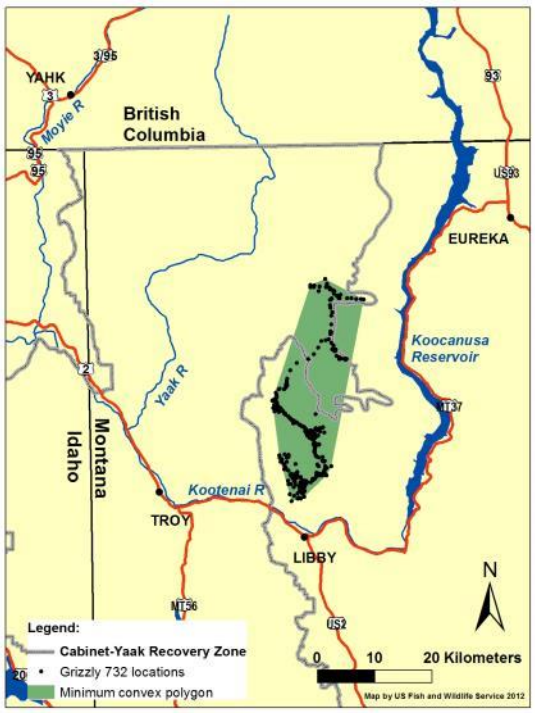

Figure A68. Radio locations and minimum convex (shaded) life range of management male grizzly bear 732 in the Yaak River, 2011.

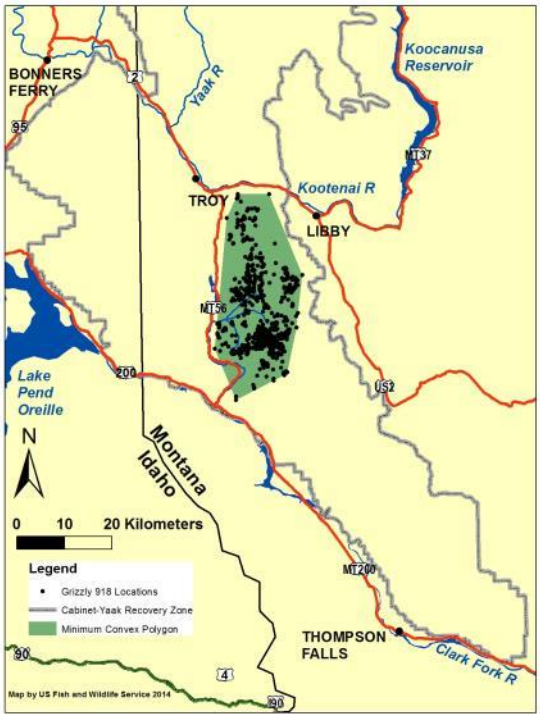

Figure A69. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 918 in the Cabinet Mountains, 2012-14.

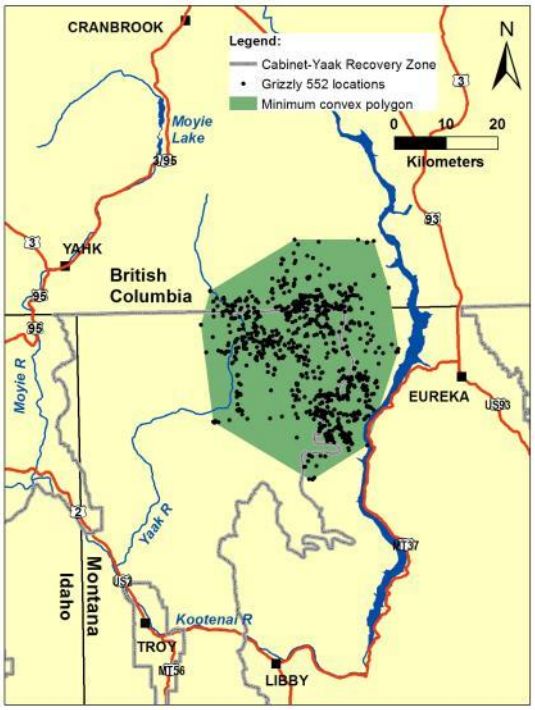

Figure A70. Radio locations and minimum convex (shaded) life range of female grizzly bear 552 in the Yaak River, 2012-15.

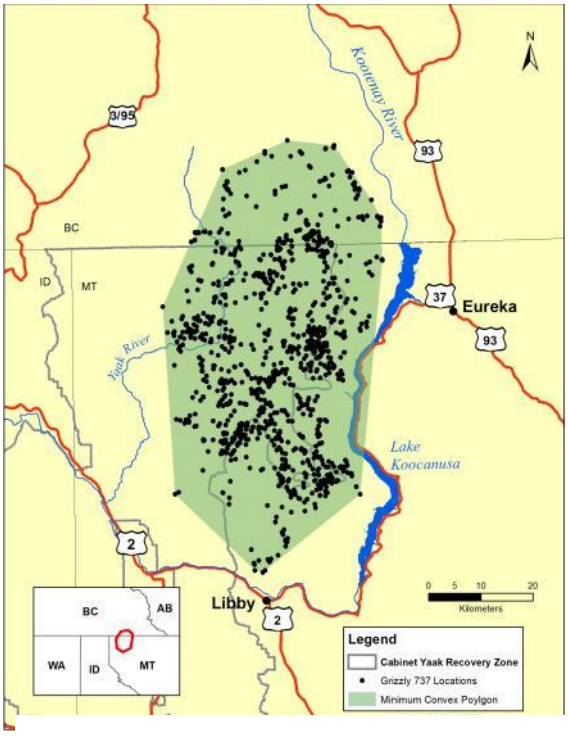

Figure A71. Radio locations and minimum convex (shaded) life range of male grizzly bear 737 in the Yaak River, 2010-13.

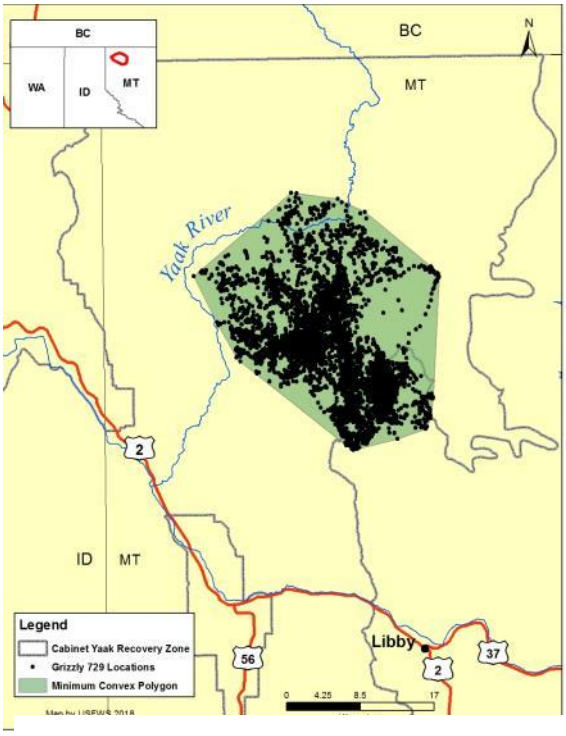

Figure A72. Radio locations and minimum convex (shaded) life range of female grizzly bear 729 in the Yaak River, 2013-17.

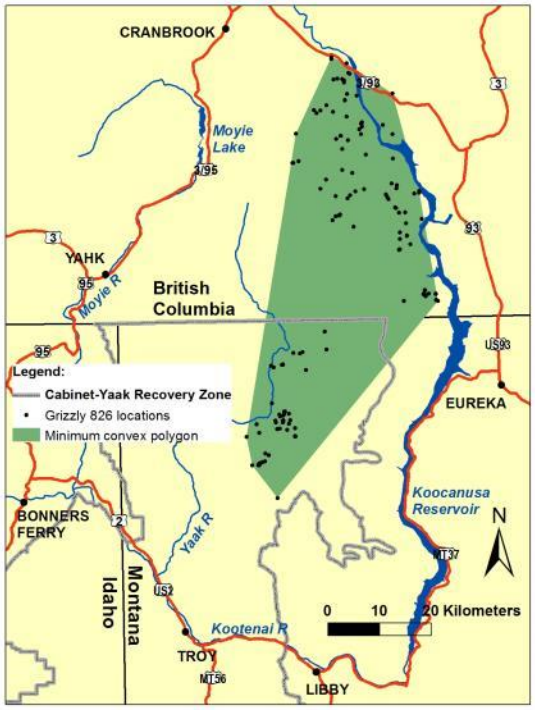

Figure A73. Radio locations and minimum convex (shaded) life range of male grizzly bear 826 in the Yaak River, 2013.

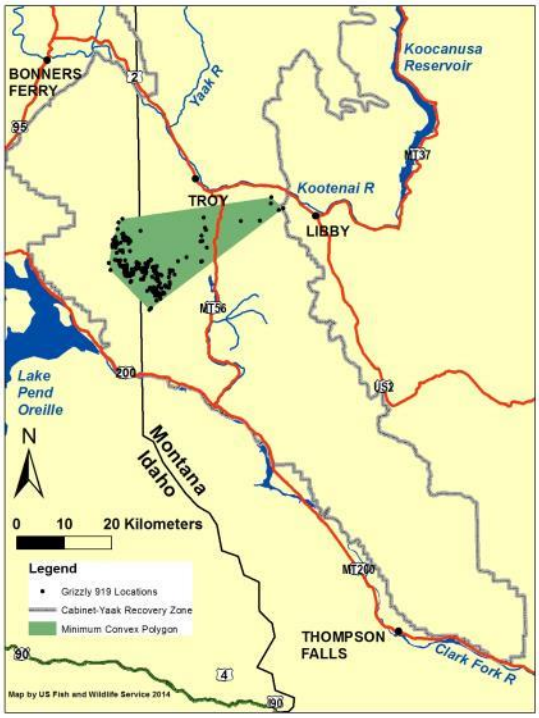

Figure A74. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 919 in the Cabinet Mountains, 2013-14.

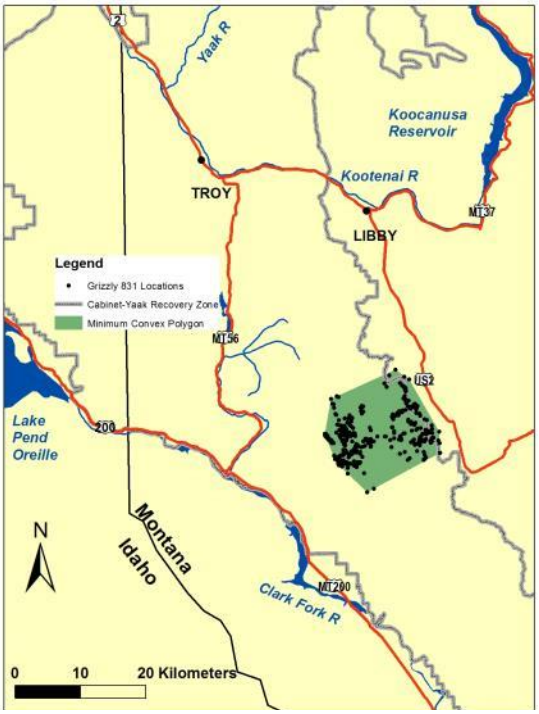

Figure A75. Radio locations and minimum convex (shaded) life range of female grizzly bear 831 in the Cabinet Mountains, 2014.

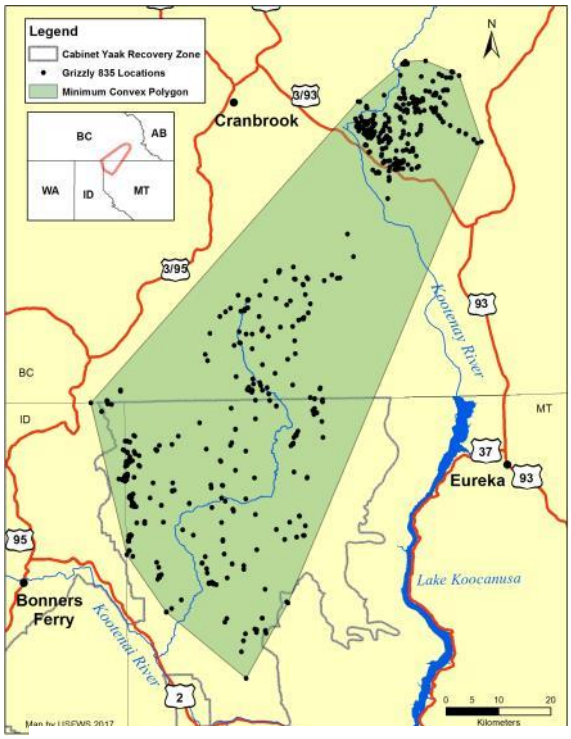

Figure A76. Radio locations and minimum convex (shaded) life range of male grizzly bear 835 in the Yaak River, 2014-16.

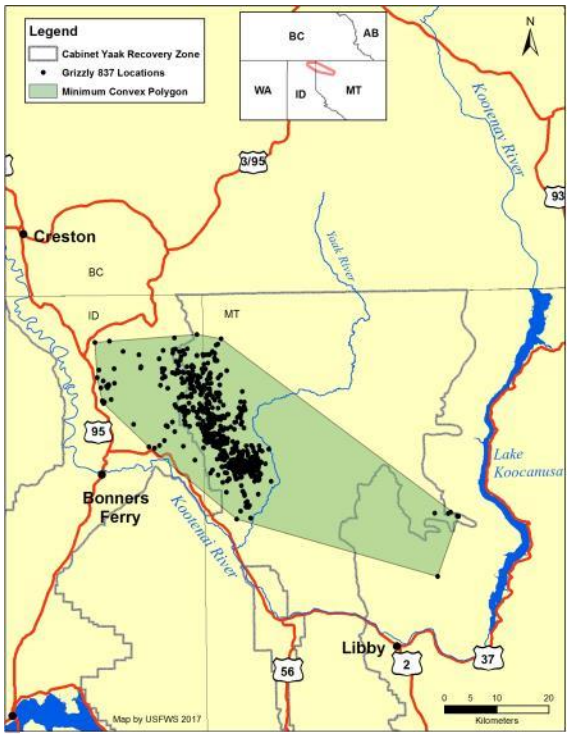

Figure A77. Radio locations and minimum convex (shaded) life range of male grizzly bear 837 in the Cabinet Mountains, 2014-16.

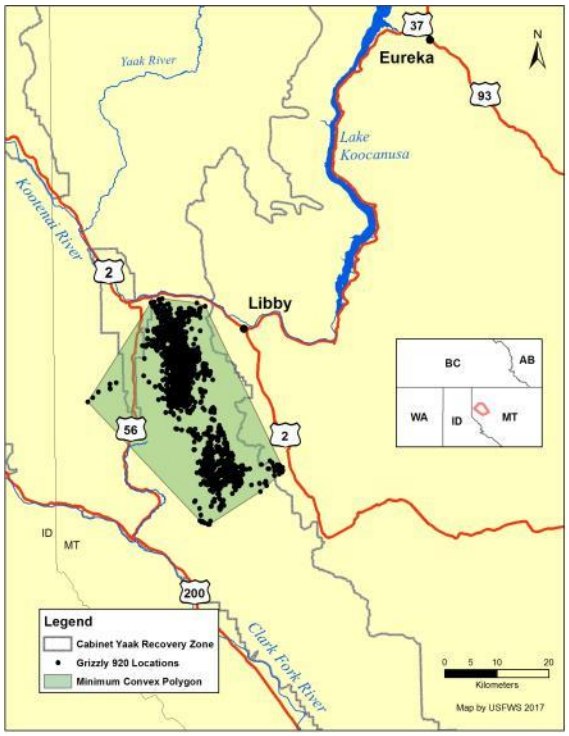

Figure A78. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 920 in the Cabinet Mountains, 2014-16.

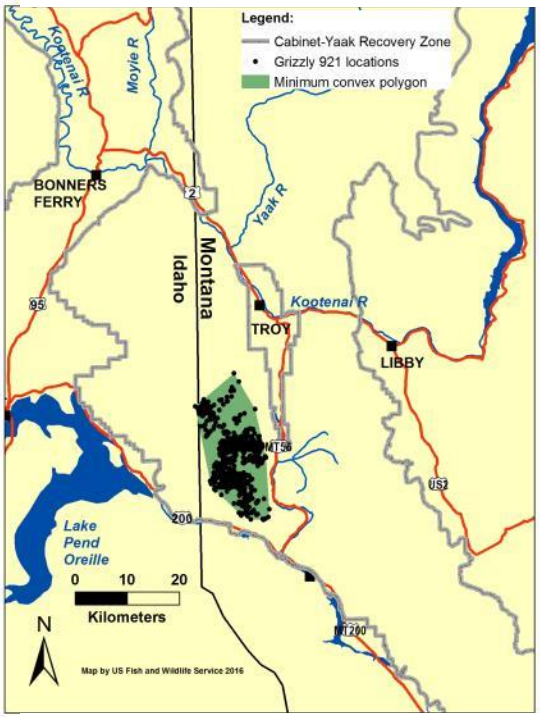

Figure A79. Radio locations and minimum convex (shaded) life range of augmentation female grizzly bear 921 in the Cabinet Mountains, 2014-15.

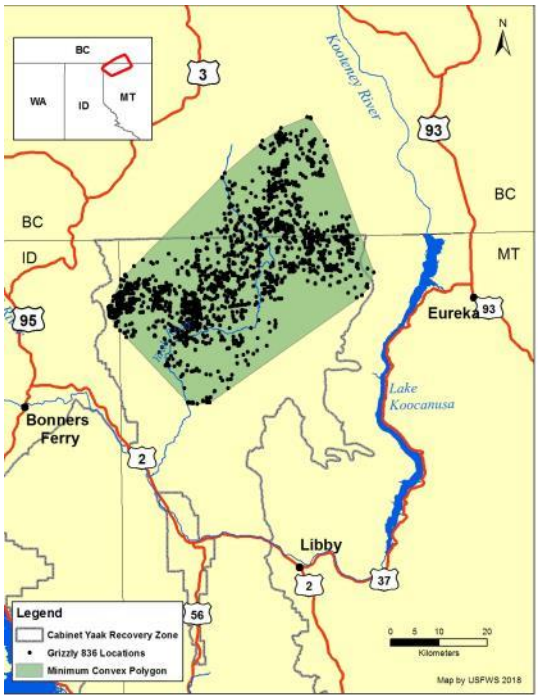

Figure A80. Radio locations and minimum convex (shaded) life range of female grizzly bear 836 in the Yaak River, 2014-17.

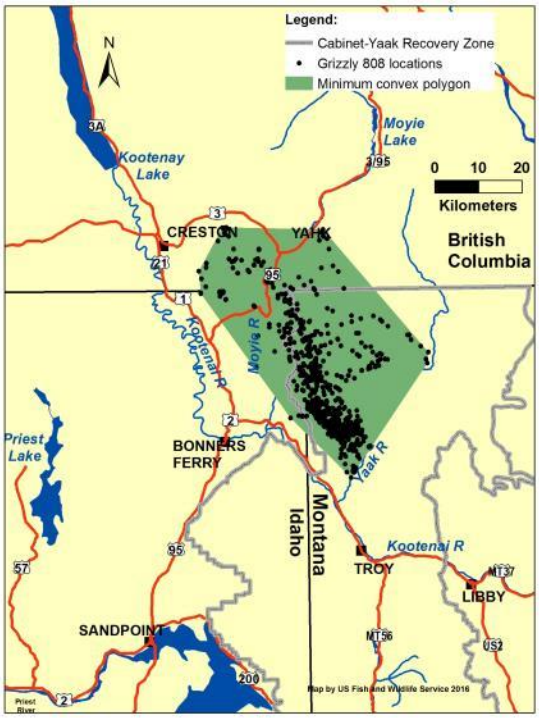

Figure A81. Radio locations and minimum convex (shaded) life range of male grizzly bear 808 in the Yaak River, 2014-15.

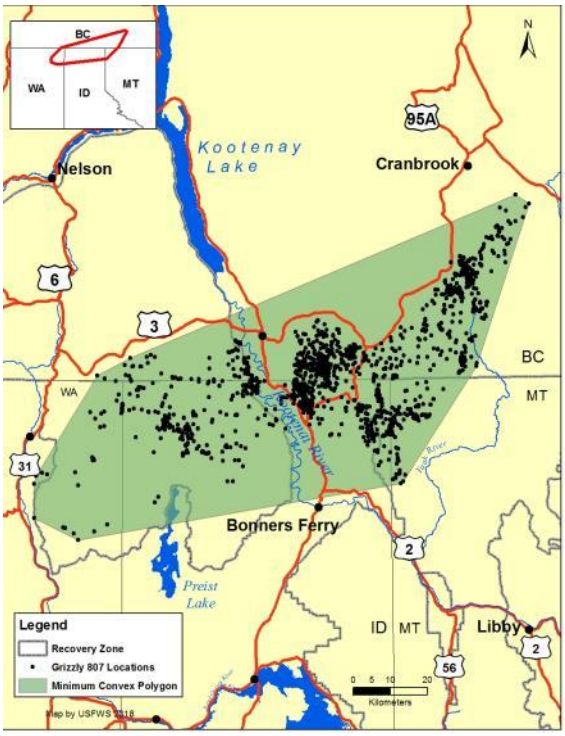

Figure A82. Radio locations and minimum convex (shaded) life range of male grizzly bear 807 in the Yaak River and Selkirk Mountains, 2014-17.

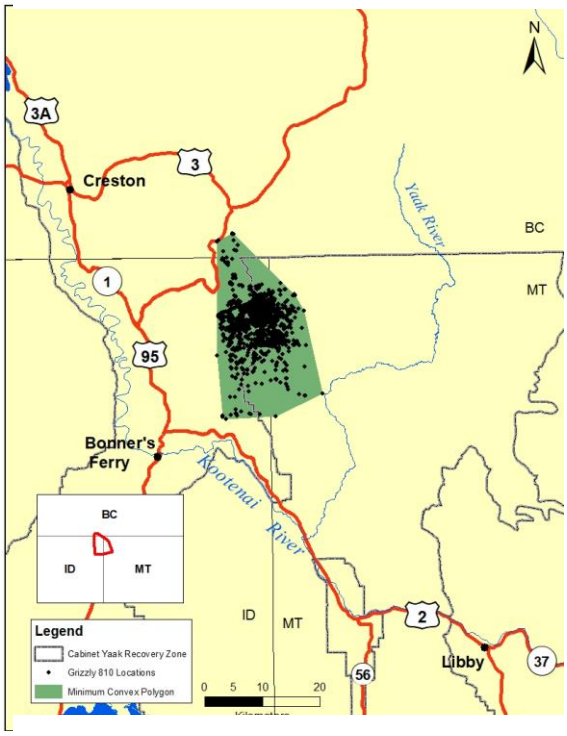

Figure A83. Radio locations and minimum convex (shaded) life range of female grizzly bear 810 in the Yaak River, 2015-18.

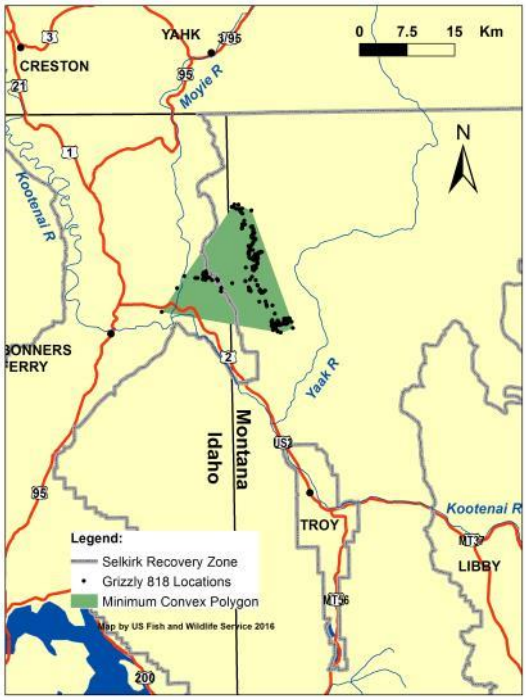

Figure A84. Radio locations and minimum convex (shaded) life range of male grizzly bear 818 in the Yaak River, 2015.

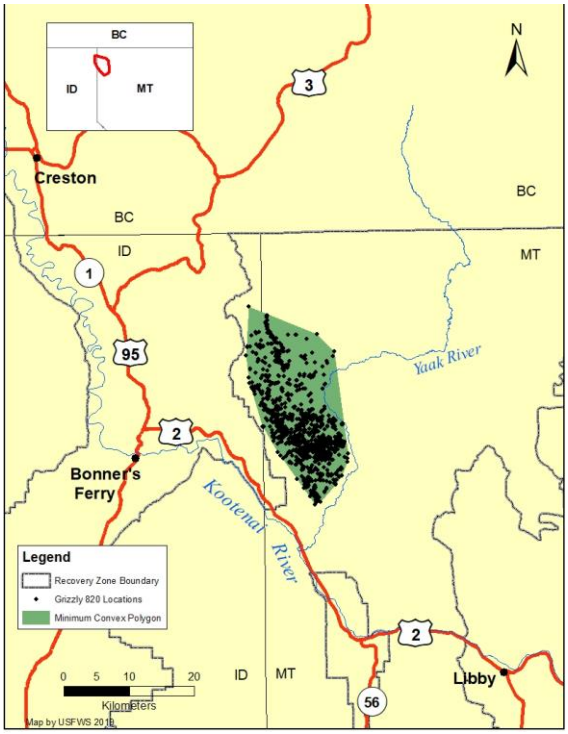

Figure A85. Radio locations and minimum convex (shaded) life range of female grizzly bear 820 in the Yaak River, 2015-18.

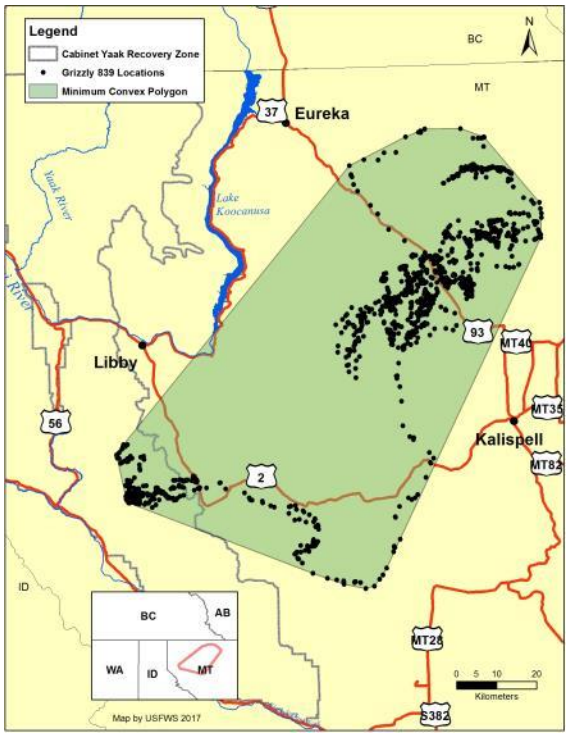

Figure A86. Radio locations and minimum convex (shaded) life range of male grizzly bear 839 in the Cabinet Mountains, 2015-16.

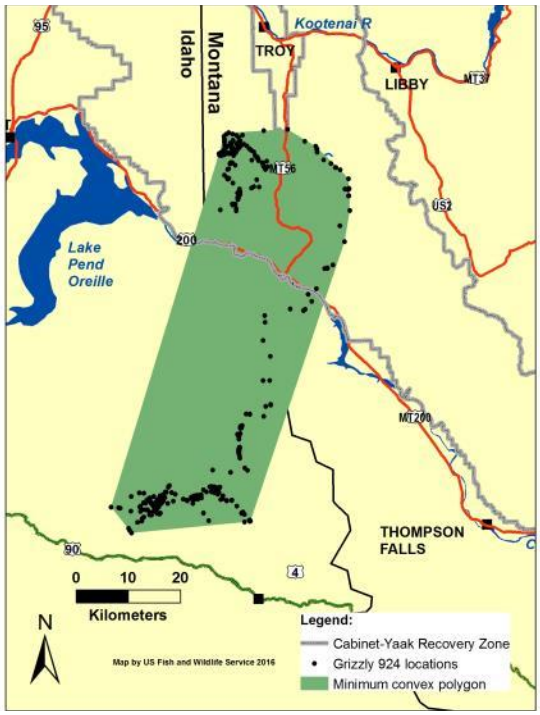

Figure A87. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 924 in the Cabinet Mountains, 2015.

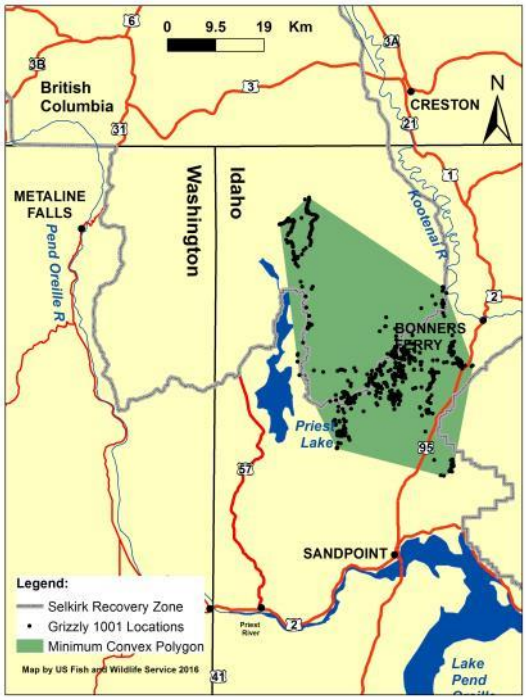

Figure A88. Radio locations and minimum convex (shaded) life range of male grizzly bear 1001 in the Selkirk and Cabinet Mountains, 2015.

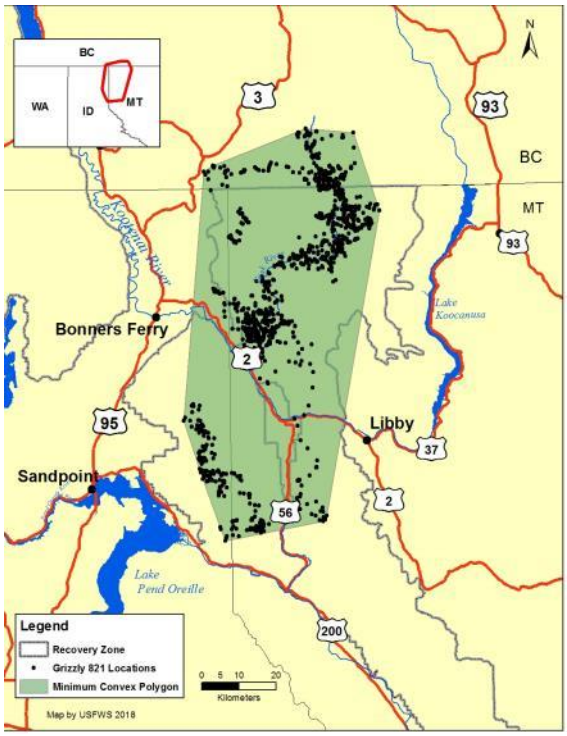

Figure A89. Radio locations and minimum convex (shaded) life range of male grizzly bear 821 in the Yaak River, 2016-17.

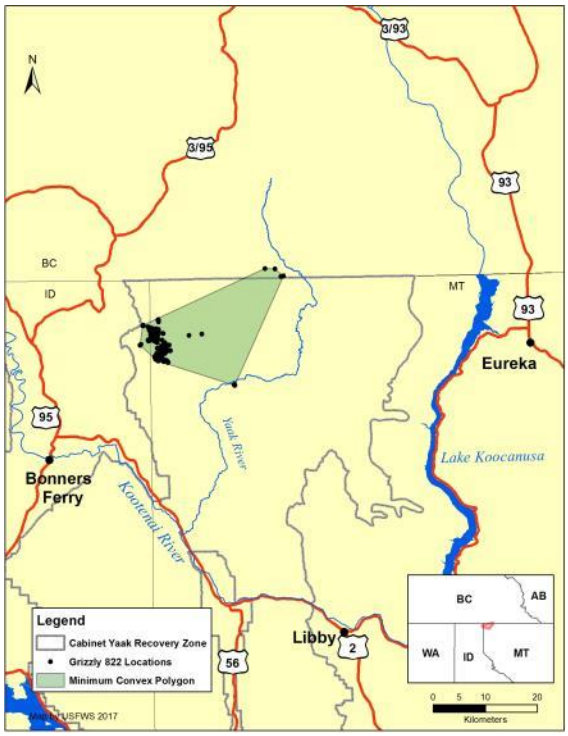

Figure A90. Radio locations and minimum convex (shaded) life range of male grizzly bear 822 in the Yaak River, 2016.

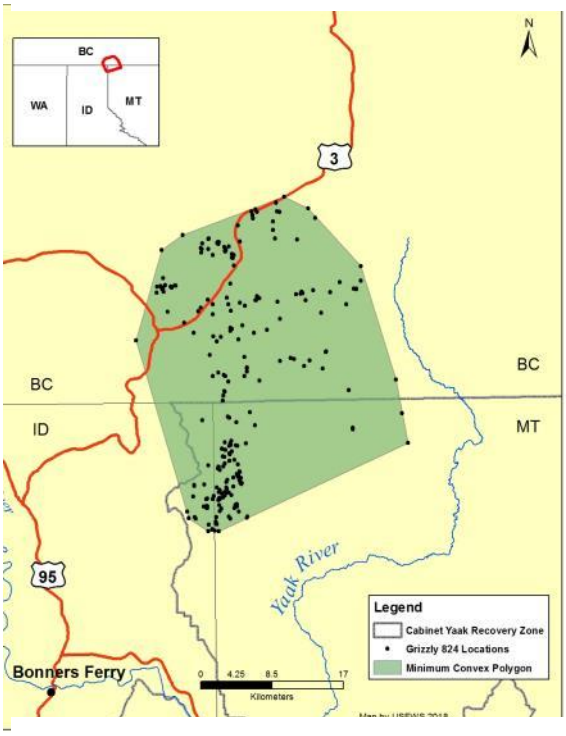

Figure A91. Radio locations and minimum convex (shaded) life range of male grizzly bear 824 in the Yaak River, 2016-17.

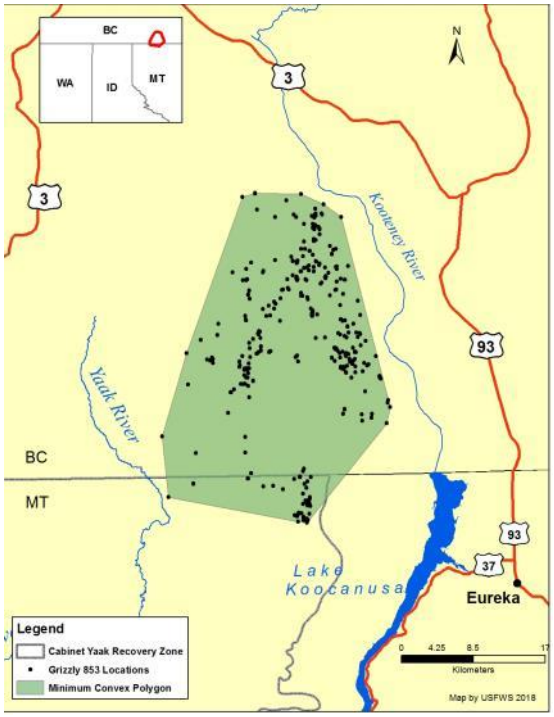

Figure A92. Radio locations and minimum convex (shaded) life range of male grizzly bear 853 in the Yaak River, 2016-17.

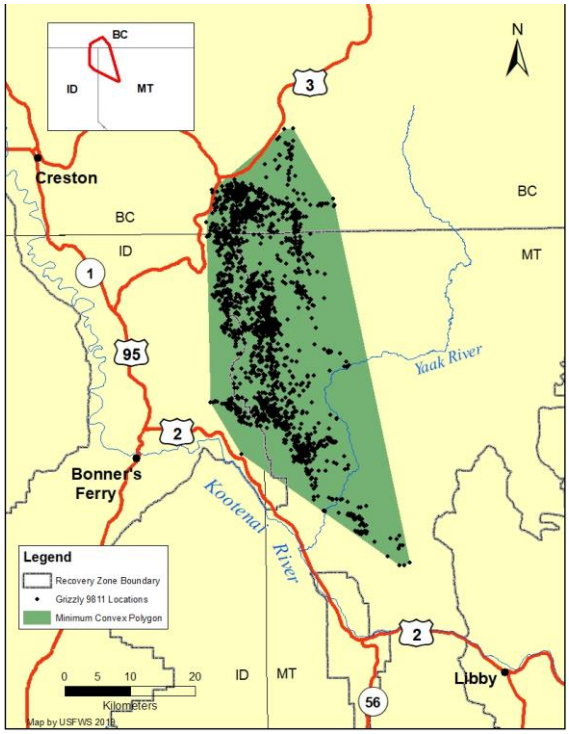

Figure A93. Radio locations and minimum convex (shaded) life range of male grizzly bear 9811 in the Yaak River, 2016-18.

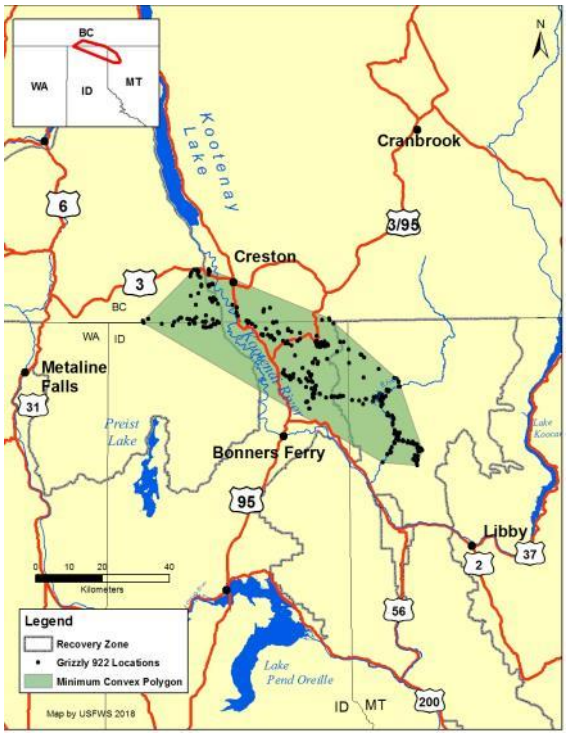

Figure A94. Radio locations and minimum convex (shaded) life range of male grizzly bear 922 in the Yaak River, 2016-17.

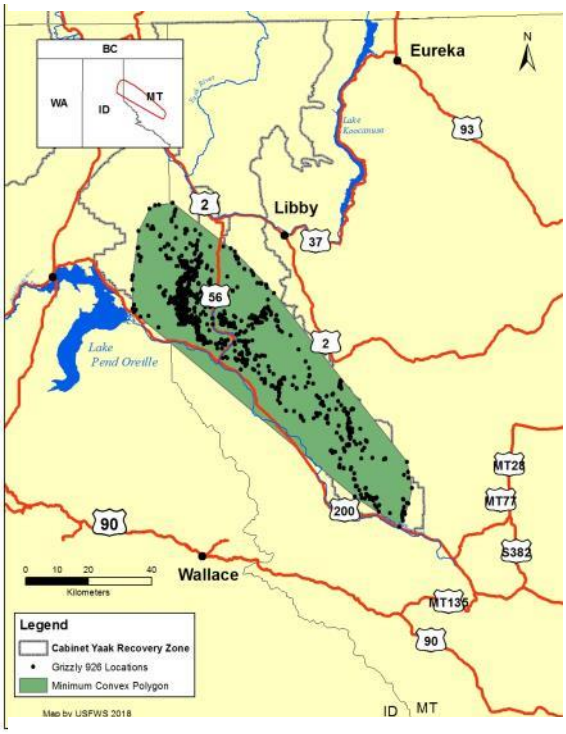

Figure A95. Radio locations and minimum convex (shaded) life range of augmentation male grizzly bear 926 in the Cabinet Mountains, 2016-17.

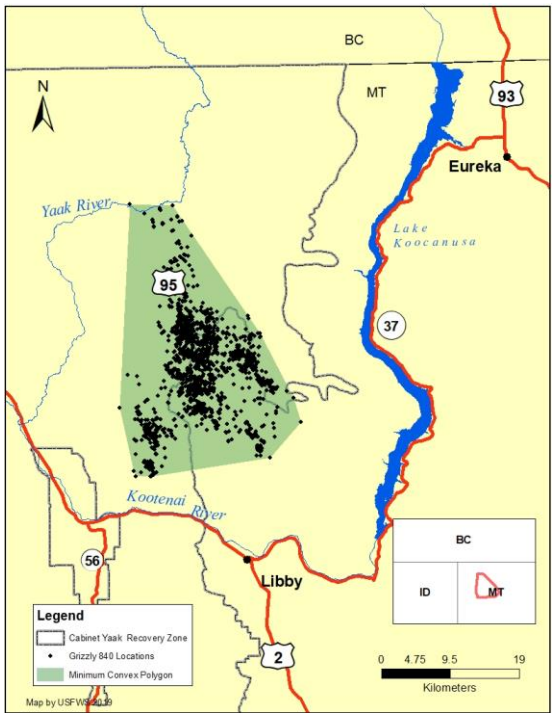

Figure A96. Radio locations and minimum convex (shaded) life range of female grizzly bear 840 in the Yaak River, 2016-18.

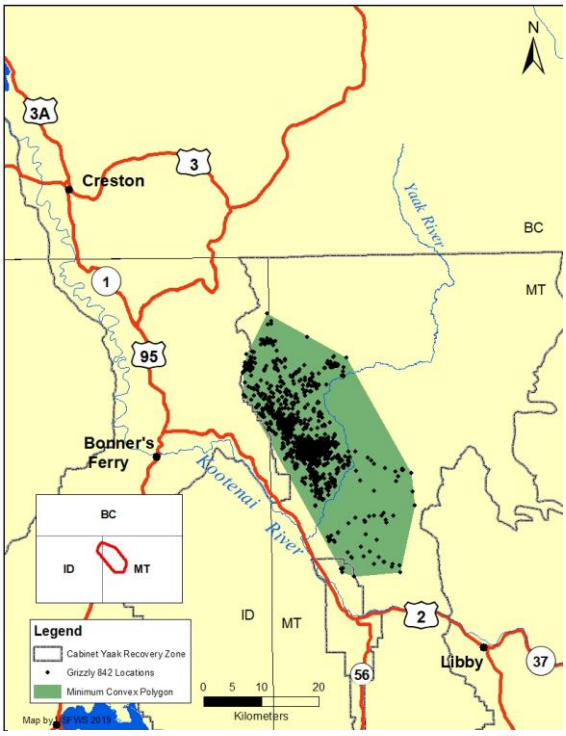

Figure A97. Radio locations and minimum convex (shaded) life range of female grizzly bear 842 in the Yaak River, 2017-18.

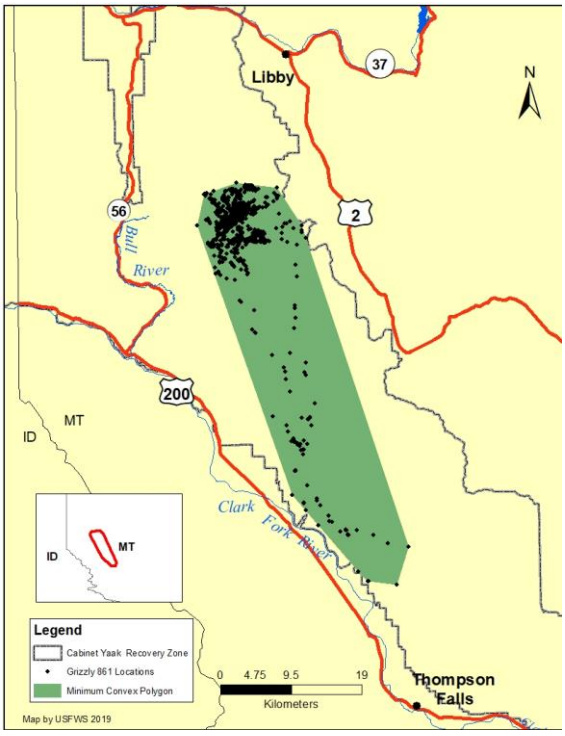

Figure A98. Radio locations and minimum convex (shaded) life range of male grizzly bear 861 in the Cabinet Mountains, 2017-18.

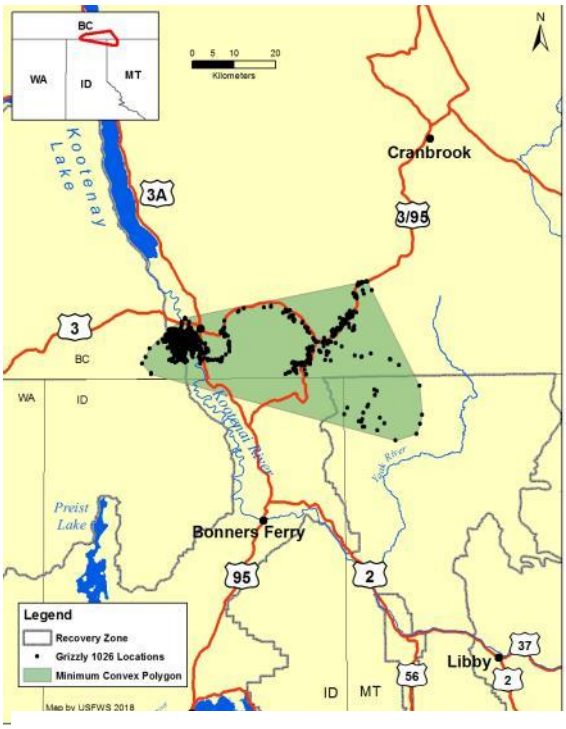

Figure A99. Radio locations and minimum convex (shaded) life range of management female grizzly bear 1026 in the Yaak River, 2017.

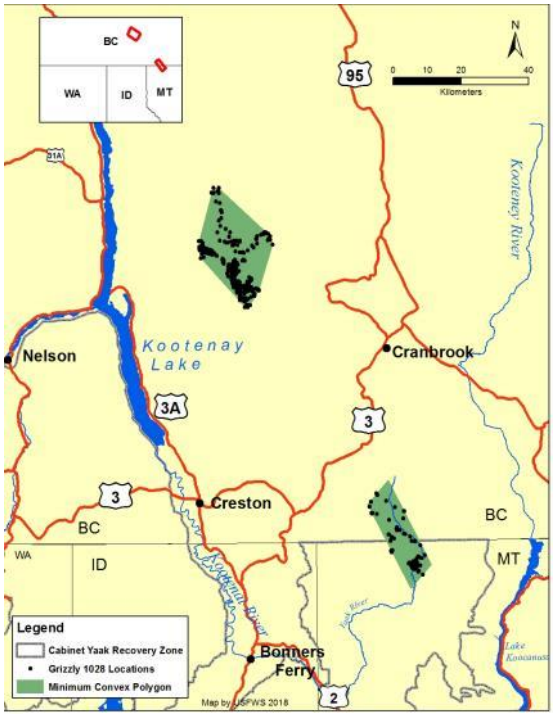

Figure A100. Radio locations and minimum convex (shaded) life range of management female grizzly bear 1028 in the Yaak River, 2017.

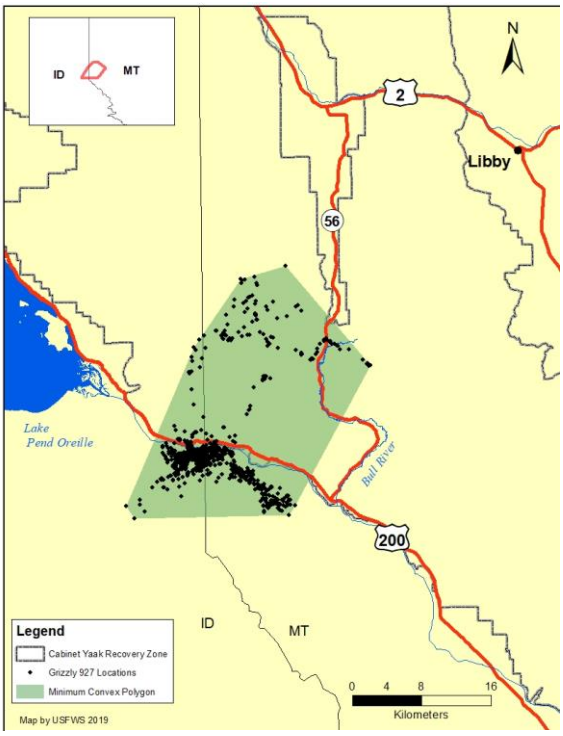

Figure A101. Radio locations and minimum convex (shaded) life range of augmentaiton male grizzly bear 927 in the Cabinet Mountains, 2018

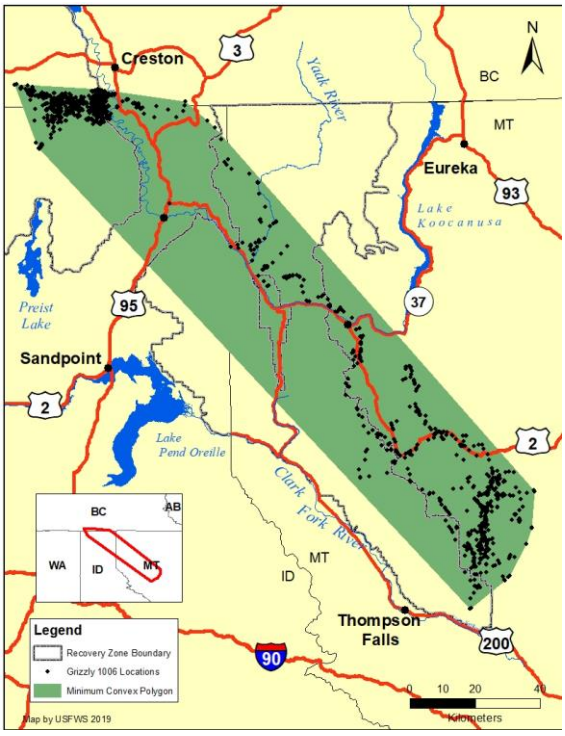

Figure A102. Radio locations and minimum convex (shaded) life range of male grizzly bear 1006 in the Selkirk, Purcell, and Cabinet Mountains, 2017-18.

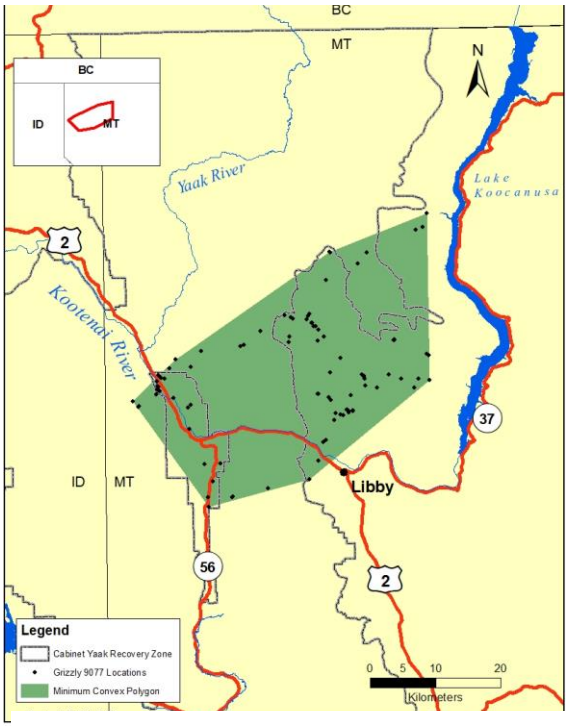

Figure A103. Radio locations and minimum convex (shaded) life range of management male grizzly bear 9077 in the Yaak River, 2018.

Table T4. 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. Found on dry exposures with a limited undergrowth of 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.