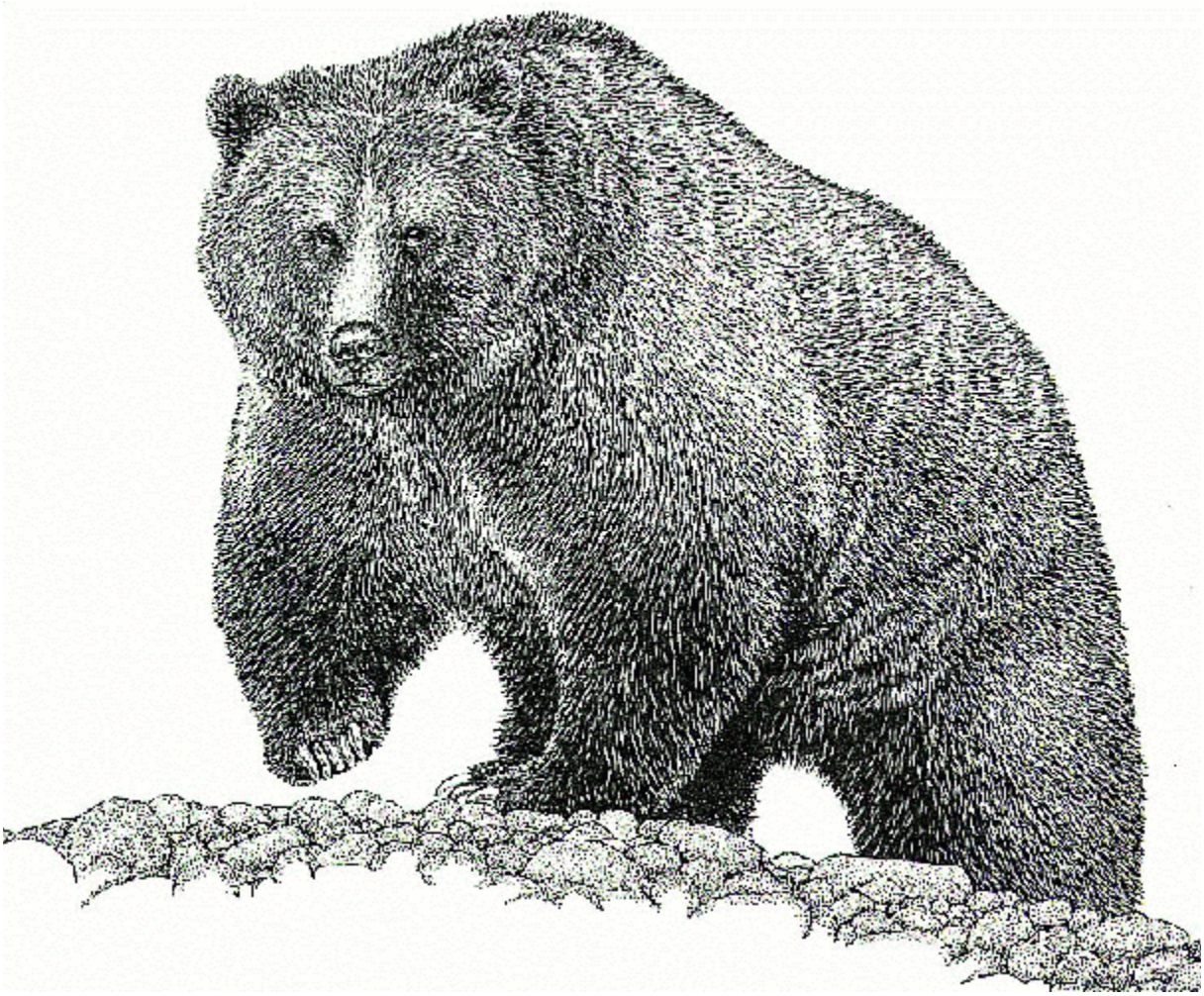
CABINET-YAAK GRIZZLY BEAR RECOVERY AREA 2005 RESEARCH AND MONITORING PROGRESS REPORT



PREPARED BY
WAYNE F. KASWORM, HARRY CARRILES, THOMAS G. RADANDT, AND CHRISTOPHER SERVHEEN
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UNITED STATES FISH AND WILDLIFE SERVICE
GRIZZLY BEAR RECOVERY COORDINATOR'S OFFICE
UNIVERSITY OF MONTANA, MAIN HALL ROOM 309
MISSOULA, MONTANA 59812
(406) 243-4903

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Abstract:

Numbers of females with cubs in the Cabinet-Yaak recovery zone varied from 0-4 per year and averaged 1.8 per year from 2000-05. Eleven known human caused mortalities of grizzly bears have occurred in the recovery zone or within 10 miles since 2000. Human caused mortality averaged 1.8 total bears per year and 1.5 females per year during 2000-05. Human caused mortalities during 2000-05 were 1 adult female (train collision), an adult female with 3 cubs (poaching), 4 subadult females (3 illegal under investigation, a black bear mistaken identity, and a train collision), and a subadult male (black bear mistaken identity). Since 2000 there have been 2 known natural mortalities (a yearling female, and 1 cub). Twelve of 22 bear management units had sightings of females with young during 2000-05.

Grizzly bear research in the Cabinet Mountains indicated that only a small population remained as of 1988. Furthermore, it was believed that this population would not persist unless intensive management steps were taken. An effort to test population augmentation techniques began in 1990. Four subadult female bears with no history of conflicts with humans were captured in southeast British Columbia and moved to the Cabinet Mountains for release during 1990-94. Three of four transplanted bears remained within the target area for at least one year. One bear left the target area, but was recaptured and returned to the target area. One bear died the year following release while accompanied by a cub. None of the transplanted bears were wearing a functional radio collar by the end of 1995. An adult female was moved from the North Fork of the Flathead River to the West Cabinet Mountains in 2005. Several sightings of individual grizzly bears and females with young have occurred since 1995. Hair snag sampling and DNA analysis during 2002-05 identified one of the transplanted bears. The animal was a 2 year-old female when released in 1993. Additional analysis will attempt to identify any offspring from this bear among the other identified individuals.

Thirty individual grizzly bears and 329 black bears were captured from 1986-05 in the Yaak River drainage. Mean trap nights per individual grizzly bear captured was 233 and mean trap nights per individual black bear captured was 21. Seven grizzly bears and 272 black bears were captured from 1983-05 in the Cabinet Mountains. Mean trap nights per individual grizzly bear captured were 878 and mean trap nights per individual black bear captured were 23. One grizzly bear and 5 black bears were captured in the Salish Mountains during 63 trap nights of effort in 2003, and 6 grizzly bears and 26 black bears were captured in British Columbia north of highway 3 during 159 nights of trapping effort in 2004 and 2005. Annual and life range adaptive kernel and minimum convex polygon grizzly bear home ranges are reported. Grizzly bear use of elevation, aspect and vegetation type was analyzed for seasonal trends. Berry count transects indicated less than average production during 1998-2004 for all species. Huckleberry production was average in 2005, but buffaloberry and serviceberry were below average.

A minimum population estimate of 30-40 bears was made for the Cabinet-Yaak recovery zone in 2005 based on current and previous captures and sightings of unique individuals. Mortality causes, timing, and locations were analyzed for 1983-05. Estimates of cause specific mortality rates, reproductive rates, and population trend from 1983-02 (Wakkinen and Kasworm 2004) were updated with new information.

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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 in which specific measures to aid recovery were identified (USFWS 1993). Seven areas were identified in the Recovery Plan as ecosystems in which grizzly bears or their habitat was thought to occur (Fig. 1). One area identified was the Cabinet-Yaak Grizzly Bear recovery zone (CYGBRZ) of extreme northwestern Montana and northeast Idaho. This area lies directly south of Canada and encompasses approximately 6800 km^2. The Kootenai River bisects the area with the Cabinet Mountains portion to the south and the Yaak River portion to the north. The degree of grizzly bear movement between the two portions is unknown but thought to be minimal. The U.S. Fish and Wildlife Service issued a 12-month finding of warranted for endangered status but precluded by other listing actions on February 12, 1993 (58 FR 8250-8251).

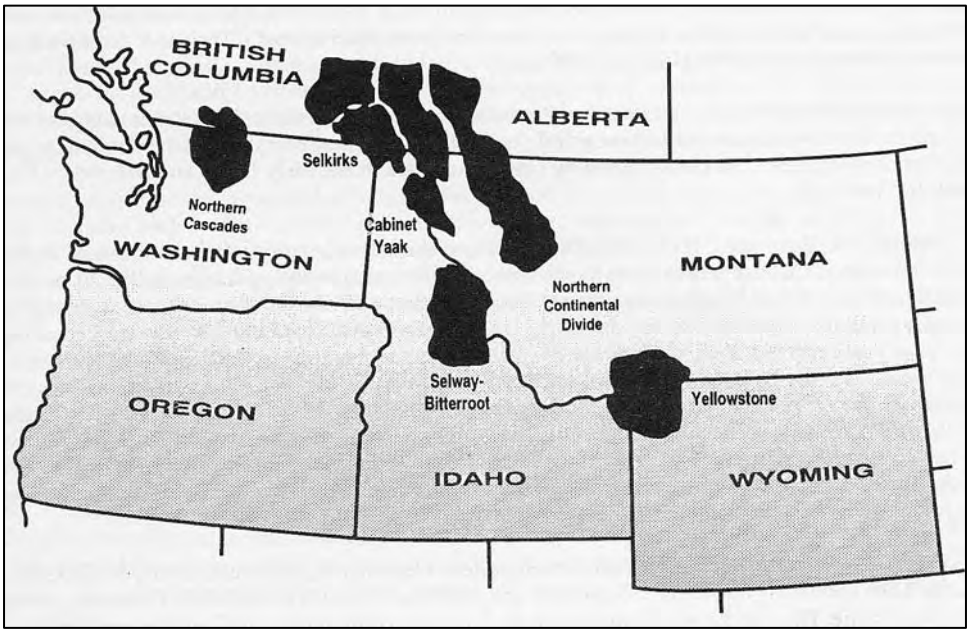


Figure 1. Grizzly bear recovery areas in the U.S., southern British Columbia, and Alberta, Canada.

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

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

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

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

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

OBJECTIVES

A. Cabinet Mountains Population Augmentation:

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

B. Recovery Zone Research and Monitoring:

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

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

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

STUDY AREA

The CYGBRZ (48° N, 116° W) encompasses approximately 6,800 km^2 of northwest Montana and northern Idaho (Fig. 2). The Cabinet Mountains are about 58% of the CYGBRZ and lie south of the Kootenai River, while the Yaak River borders Canadian grizzly populations to the north. Two 12 km wide corridors link the Yaak with 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. is the main corporation holding a significant amount of land in the area. Individual ownership exists primarily along major rivers, and there are numerous patented mining claims along the Cabinet Mountains Wilderness boundary. The Cabinet Mountains Wilderness encompasses 381 km^2 of higher elevations of the study area in the Cabinet Mountains. Libby, Troy, Thompson Falls, Noxon, and Trout Creek are the primary communities adjacent to the East Cabinet Mountains.

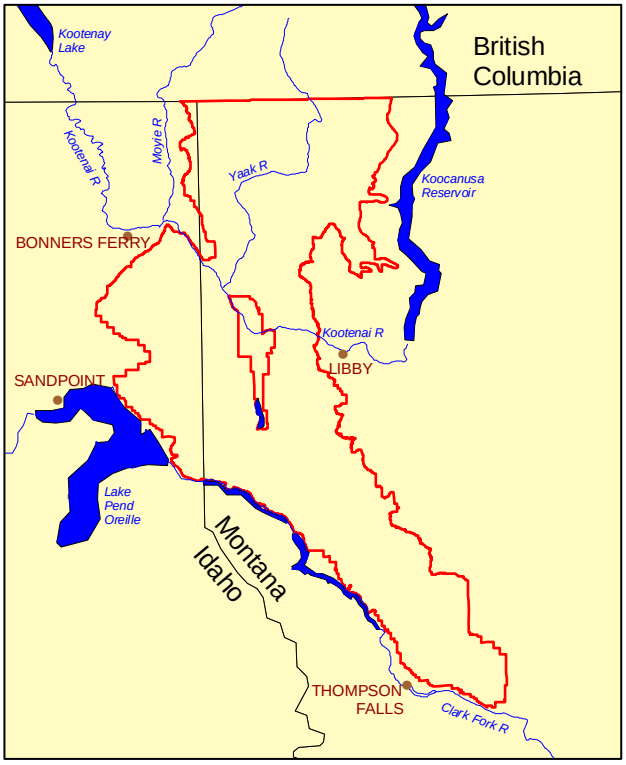


Figure 2. Cabinet-Yaak recovery zone.

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

fires. Effective fire suppression has reduced wildfires as a natural force creating or maintaining berry-producing shrubfields.

The Yaak River drainage lies in the extreme northwestern corner of Montana, northeastern Idaho, and southern British Columbia and is bounded on the east and south by Lake 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. Climate is dominated by Pacific Maritime weather patterns that produce 100-150 cm of annual precipitation, which occurs primarily as snow. 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 western 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.

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

Cabinet Mountains population augmentation trapping was conducted in the upper North Fork of the Flathead River drainage and the Wigwam River drainage in British Columbia, approximately 10-40 km north of the U.S. border during 1990-1994. During 1992 trapping was conducted south of the international border in the North Fork of the Flathead River. Subalpine fir was the indicated climax species throughout most of the area, with lodgepole pine the most prevalent. Recent wildfires in upper elevations have had more influence on habitat than in the CYGBRZ. An outbreak of pine bark beetles resulted in logging large areas at lower elevations during the 1980's. Large portions of upper elevations had been logged earlier in response to a spruce bark beetle (*Dendroctonus obesus*) epidemic. Although open road density was high, very little public use was observed. Grizzly bears are considered an important game animal in this portion of British Columbia and are hunted under a system of limited entry.

METHODS

Grizzly Bear Observations

All grizzly bear observations and reports of sign (tracks, digs, etc.) by study personnel and the public were recorded. Grizzly bear sighting forms were sent to a variety of field personnel from different agencies to maximize the number of reports received. Sightings of grizzly bears were rated 1-5 with 5 being the best quality and 1 being the poorest. General definitions of these categories are presented below, but it was difficult to describe all circumstances under which sightings were reported. Only sightings receiving ratings of 4 or 5

are used in reports. Sightings that rate 1 or 2 may not be recorded in the database in all instances.

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

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

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

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

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

Capture and Marking

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

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

Trapping efforts were typically conducted from May through September. In 1986-87, snares were placed in areas where black bear captures were maximized on a defined study area of 214 km^2 (Thier 1990). Snares were placed over a broader area during 1989-94 to maximize grizzly bear captures. Trap sites were usually located within 200 m of an open road

to allow vehicle access. Beginning in 1995, an effort was made to capture and re-collar known 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. 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 and 2005. Both studies were designed to examine bear population connectivity across river valleys with highways, railways, and human habitation. The highway 2 study utilized black bears as surrogates for grizzly bears because of the small number of grizzly bears in the valley. The Highway 3 effort in British Columbia collared grizzly bears. Much of the trapping effort in the Yaak and Cabinet Mountains areas involved the use of horses on backcountry trails and closed logging roads. Traps were checked daily. Bait consisted primarily of road-killed ungulates.

Trapping for population augmentation was conducted in the North Fork of the Flathead River in British Columbia during 1990-94. Only unmarked female grizzly bears < 6 years old (or prior to first reproduction) and > 35 kg were deemed suitable for transplant. All other captured grizzly bears were released with some collared to aid an ongoing bear study in British Columbia. Capture efforts for bears transplanted in 2005 occurred primarily in the North Fork of the Flathead River in the U.S.

Hair Sampling for DNA Analysis

This project seeks evidence of grizzly bears in the Cabinet Mountains using DNA to understand what happened to the 4 bears transplanted into this area almost 10 years ago. The program will utilize genetic information from a hair-snagging and remote camera program to attempt to identify transplanted bears or their offspring living in the Cabinet Mountains. This project will provide a minimum estimate of the number of bears inhabiting the area, sex ratio of captured bears, and relatedness and genetic diversity measures of captured bears. Capture-recapture estimates of the population would not be appropriate because expected sample sizes from the Cabinet Mountains population ($N \leq 15$) would not likely provide population estimates with reasonable precision. Capture-recapture estimates would require at least 4 sessions of sampling the entire area and funds available are not sufficient to implement this approach

Sampling occurred from June-August of 2002-05 in the Cabinet-Yaak recovery zone south of the Kootenai River in Idaho and Montana (Woods *et al.* 1999). During 2002 (n=27), 2004 (n=14) and 2005 (n=15) sampling sites were established based on the location of previous sightings, sign, and radio telemetry from bears in the Cabinet Mountains. A 5 km x 5 km grid (25 km^2) was used to distribute sample sites across the area in 2003. 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 in place for 2 weeks prior to hair collection. One third of the sites were sampled during each of the months of June, July, and August. Sample sites were stratified by elevation with lowest elevation sites sampled in June and highest elevation sites sampled in August. Remote cameras were used at some sites. Hair was collected and labeled to indicate: the number and color of hairs collected, site location, date, and barb number. These data aided sorting hair to minimize lab costs.

Radio Monitoring

Attempts were made to obtain aerial radiolocations on all instrumented grizzly bears at least once each week during the 7-8 month period in which they were active. GPS collars

obtained a location every hour and collars were retrieved in October. Transplanted bears were monitored daily following release for at least the first two weeks and usually three times per week following. In addition, efforts were made to obtain as many ground locations as possible on all bears, usually by triangulating from a vehicle. Annual and composite home ranges (minimum convex polygons; Hayne 1945, adaptive kernel; Worton 1989) were calculated for all grizzly bears for the entire study period. A computer program (CALHOME; U.S. Forest Service and California Fish and Game) was used to determine home range sizes.

Testing of GPS radio collars was conducted in the Yaak study area during 2003. The effects of dense vegetation and timber canopy on signal acquisition rates were evaluated with radio collars placed at several sites and at different heights (Appendix 1).

In 2004 and 2005, 7 and 3 black bears respectively were fitted with GPS radio collars to study movements across the Kootenai River Valley and Highway 2. Three and 5 grizzly bears were collared during 2004 and 2005 respectively with GPS collars to study movements across the Moyie River Valley and Highway 3 in British Columbia. Collars attempted to record hourly locations and location data were stored within the collar. Collars were equipped with a release mechanism to allow collars to be retrieved in October prior to denning. Weekly aircraft radio monitoring was conducted to check for mortality signals and approximate location.

Berry Transects

Quantitative comparisons of annual fluctuations and site-specific influences on fruit production of huckleberry and buffaloberry were made using methods similar to those established in Glacier National Park (Kendall 1986). Transect line origins were marked by a painted tree or by flagging with surveyors' ribbon. A specific azimuth was followed from the origin through homogenous habitat. At 1 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. Two habitat components were sampled (Timbered Shrubfields and Mixed Shrub/Cutting Units), primarily to examine the influence of timber harvesting on berry production on a variety of aspects and elevations. Notes on berry phenology, berry size, and plant condition were recorded. Nineteen huckleberry and 5 buffaloberry transects were sampled from 1990-99, however, only 18 huckleberry transects were sampled in 2000. Two new transects were added in 2001 and one was added in 2002. Two transects were added in 2004 and in 2005 seven transects were dropped, for a total of 16. One buffaloberry transect was dropped in 2005. Berry production at several sites appears to be affected by plant succession and shading or crowding by conifers or other shrub species. Several sites were dropped or relocated in 2005 to better display annual fluctuations in berry production.

Serviceberry productivity was estimated by counting berries on 5 marked plants in 1990. In 1991 the number of marked plants sampled was increased to 10 at each site. Five serviceberry sites were sampled from 1990-96, and one site was added in 1997, and another was added in 2005. In 2001, three new plots were established to document berry production of mountain ash (*Sorbus scopulina*). Ten plants were permanently marked at each site, similar to the serviceberry plots.

Survival Calculation

Survival rates for all age classes except cubs were calculated by use of the Kaplan-Meier procedure as modified for staggered entry of animals (Pollock et al. 1989, Wakkinen and

Kasworm 2004). Assumptions of this method include the following: marked individuals were representative of the population, individuals had independent probabilities of survival, capture and radio collaring did not affect future survival, censoring mechanisms were random, a time origin could be defined, and newly collared animals had the same survival function as previously collared animals. Censoring was defined as radio-collared animals lost due to radio failure, radio loss, or emigration of the animal from the study area. Kaplan-Meier estimates may differ slightly from Booter survival estimates used in the trend calculation.

Our time origin for each bear began at the time of capture. If a bear changed age classification when it was radio-collared, (i.e., subadult to adult), the change in status occurred on the first of February, which was assigned the birth date of all bears. Weeks were used as the interval 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 23 years of the study. Mortality dates were established based on radio telemetry, collar retrieval, and mortality site inspection. Radio failure dates were estimated using the date of the last radiolocation when the animal was known to be alive.

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

Bears captured and relocated to the Cabinet Mountains as a test of population augmentation (Kasworm et al. 1998) and seven bears that were captured as part of a preemptive move to avoid nuisance activity were included in the analyzed sample. None of these animals had any prior history of nuisance activity.

Reproduction

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

Population Growth Rate

We used the software program Booter 1.0 (© F. Hovey, Simon Fraser University, Burnaby, B.C.) to estimate the finite rate of increase (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:

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

where S_a, S_s, S_y, and S_c are adult female, subadult female, yearling, and cub survival rates, respectively, a = age of first parturition, m = rate of reproduction, and w = maximum age.

Booter internally calculates annual survival rates with a seasonal hazard function estimated from censored telemetry information collected through all years of monitoring for use in its calculation of λ. This calculation may result in point estimates and confidence intervals slightly different from those produced by Kaplan-Meier techniques. (See differences between Tables 14 and 15). The 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). These intervals defined seasons when survival rates were assumed constant and corresponded with spring and autumn hunting seasons and the denning season.

Booter provides the option of using paired or unpaired reproductive data to calculate a reproductive rate (m). If paired data is selected, only those bears with both a known litter size and interbirth interval are used. With our data this method appeared to bias the results because the paired sample documented shorter interbirth intervals, thereby artificially inflating the true population reproductive rate (using this option: m = 0.378). We selected the option of using unpaired data with sample size restricted to the number of females. This allows the use of bears from which accurate counts of cubs were not obtained but interval was known, or instances where litter size was known but radio failure or death limited knowledge of intervals. To calculate reproductive rates, the following formula was used (from Booter 1.0):

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

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

RESULTS AND DISCUSSION

Grizzly Bear Observations and Recovery Plan Criteria

Grizzly bear observations and mortality from public and agency sightings or records were appended to a database. The file includes over 1,000 credible sightings, tracks, scats, digs, and hair dating from 1960 (Fig. 3) and 112 mortalities dating from 1949 (Table 1, Fig. 3). These databases include information from the U.S. and Canada.

Fifty grizzly bear sightings were reported to this study that rated 4 or 5 (most credible) on a 5 point scale for credibility during 2005. Twenty-four of these sightings occurred in the Yaak portion of the recovery zone and 16 sightings occurred in the Cabinet Mountains portion of the recovery zone. Eight sightings came from east of Koocanusa Reservoir and two came from British Columbia. Forty credible sighting reports of grizzly bears received by this study were distributed among Bear Management Units (BMUs) 3, 4, 5, 6, 10, 11, 12, 13, 14, 15, 16, 17, and 20 (Table 2 and Fig. 3).

Cubs are offspring in the first 12 months of life and yearlings are offspring in their second 12 months of life. One credible sighting of a female with cubs occurred during 2005 in BMU 5 (Tables 2, 3, 4, 5, Fig. 4). Eight credible sightings of a female with yearlings or 2-year-olds collectively occurred in BMUs 5, 6, and 17. Unduplicated sightings of females with cubs (excluding Canada) varied from 1-4 per year and averaged 1.8 per year from 2000-05 (Tables 3, 4). Recovery plan criteria indicate the need for an average of 6.0 females with cubs per year (USFWS 1993).

Twelve of 22 BMUs in the recovery zone had sightings of females with young (cubs, yearlings, or 2-year-olds) during 2000-05 (Figs. 4, 5, Table 6). Occupied BMUs were: 2, 5, 6, 11, 12, 13, 14, 15, 16, 17, 18, and 21. Recovery plan criteria indicate the need for 18 of 22 BMUs to be occupied. Sightings of females with young in BMUs 2, 5, 6, 18, and 21 were indicative of recent reproduction in the Cabinet Mountains.

Eleven known human caused mortalities of grizzly bears have occurred in or within 10 miles of the CYGBRZ in the U.S. during 2000-05 (Table 1, Appendix Table 2). Three bears are known to have died by human causes during 2005. Mortalities in Canada should not be counted toward recovery goals (USFWS 1993). These include 9 females and 2 males. Human caused mortalities during 2000-05 were 1 adult female (train collision), an adult female with 3 cubs (illegal), 5 subadult females (3 illegal under investigation, a black bear mistaken identity, and a train collision) and 1 subadult male (black bear mistaken identity). Within the same area, a cub and a female yearling were known to have died of assumed natural causes during 2000-05. Population levels were calculated by dividing observed females with cubs (4) minus any human-caused adult female mortality (0) from 2003-05 by 0.6 (sightability) then dividing by 0.284 (adult female proportion of population) as specified in the recovery plan (Tables 3, 4) (USFWS 1993). This resulted in a minimum population of 23 individuals. The recovery plan states; “any attempt to use this parameter to indicate trends or precise population size would be an invalid use of these data”. Applying the mortality limit of 4% to the minimum calculated population resulted in a total mortality limit of 0.9 bears per year. The female limit is 0.3 females per year (30% of 0.7). Average annual human caused mortality for 2000-05 was 1.8 grizzly bears and 1.5 females. None of the calculated goals for mortality were met during 2000-05. It should be noted that the recovery plan established a goal of zero human-caused mortality for this recovery zone.

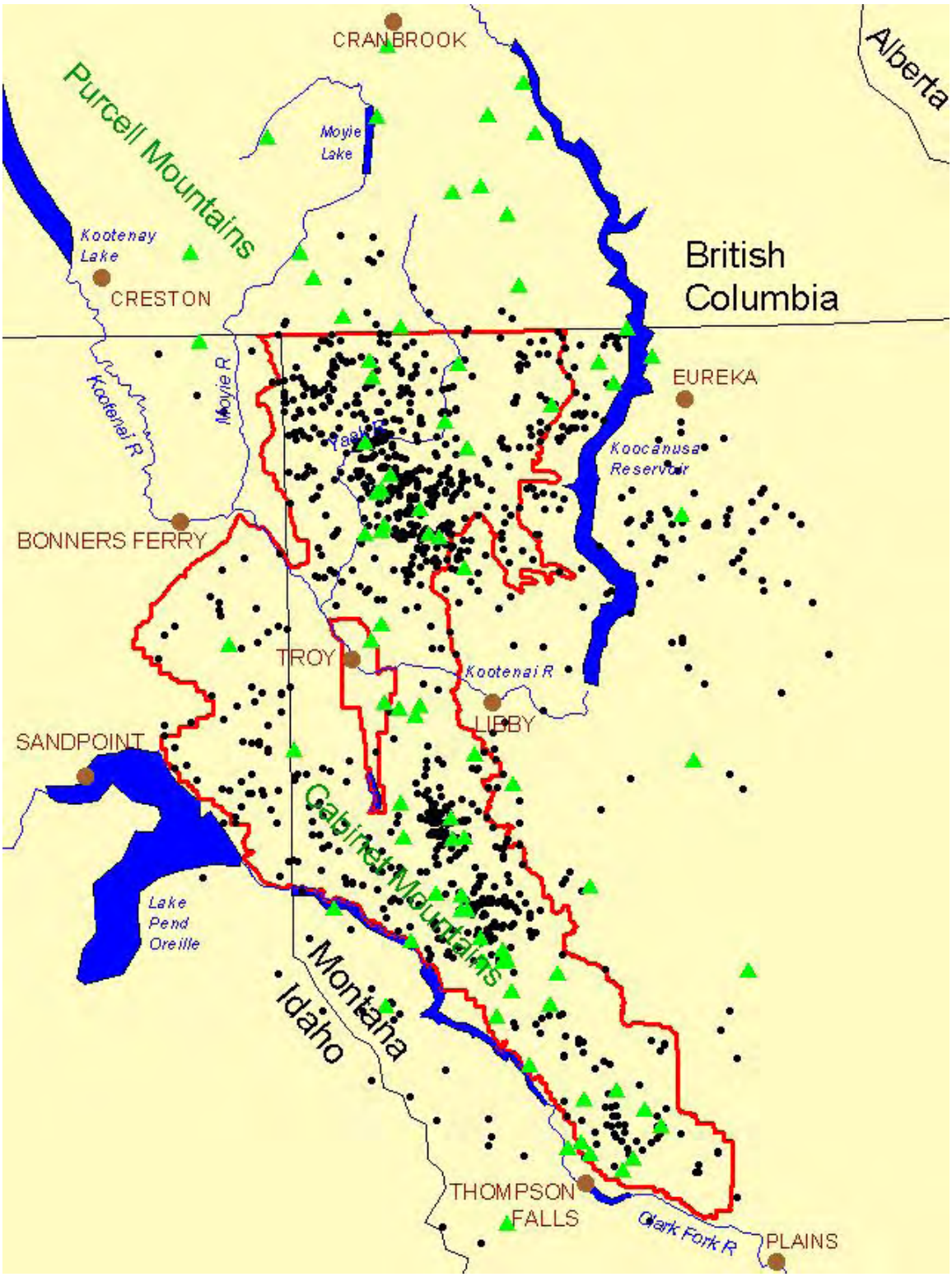


Figure 3. Grizzly bear observations (1959-2005, circles) and mortality (1949-2005, triangles) in the Cabinet-Yaak recovery area.

Table 1. Known grizzly bear mortality in or near the Cabinet-Yaak recovery zone and the Yahk grizzly bear population unit in British Columbia, 1949-05.

YEAR	LOCATION	TOTAL	SEX / AGE	MORTALITY CAUSE
1949	COPPER CR, MT	1	ADULT FEMALE	HUMAN, HUNTER KILL
1950	SQUAW CR, MT	1	SUBADULT	UNKNOWN
1951	PETE CR, MT	1	ADULT MALE	HUMAN, MANAGEMENT REMOVAL
1951	PAPOOSE CR, MT	2	SUBADULTS	UNKNOWN
1951	GOAT CR, MT	1	SUBADULT MALE	UNKNOWN
1952	FELIX CR, MT	6	2 ADULT FEMALES, 4 YEARLINGS	HUMAN, MANAGEMENT REMOVAL
1953	OBRIEN CR, MT	1	SUBADULT MALE	HUMAN, HUNTER KILL
1953	KENELTY MT, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1953	20-ODD MT, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1953	BURNT CR, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1953	17-MILE CR, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1954	N F BULL R, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1954	S F BULL R, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1954	CEDAR LK, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1954	CEDAR LK, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1954	TAYLOR PK, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1954	SILVERBUTTE CR, MT	1	UNKNOWN	HUMAN, HUNTER KILL
1954	SILVERBOW CR, MT	1	ADULT FEMALE	HUMAN, HUNTER KILL
1955	WOLF CR, MT	1	ADULT MALE	HUMAN, MANAGEMENT REMOVAL
1955	MT HEADLEY, MT	1	SUBADULT	HUMAN, MANAGEMENT REMOVAL
1955	BAREE LK, MT	1	ADULT MALE	UNKNOWN
1955	BAREE LK, MT	1	ADULT FEMALE	UNKNOWN
1955	BEAR CR, MT	1	SUBADULT MALE	HUMAN, HUNTER KILL
1958	SQUAW CR, MT	1	ADULT FEMALE	HUMAN, MANAGEMENT REMOVAL
1959	E F ROCK CR, MT	2	ADULT FEMALE, 1 CUB	HUMAN, HUNTER KILL
1959	W F THOMPSON R, MT	4	ADULT FEMALE, 3 CUBS	UNKNOWN
1959	CLIFF CR, MT	1	UNKNOWN	UNKNOWN
1960	PROSPECT CR, MT	2	ADULT FEMALE, 1 CUB	UNKNOWN
1964	GRAVES CR, MT	2	SUBADULTS	UNKNOWN
1964	WANLESS LK, MT	3	SUBADULTS (ADULT WOUNDED)	UNKNOWN
1965	SNOWSHOE CR, MT	2	SUBADULTS	UNKNOWN
1965	PINKHAM CR, MT	1	UNKNOWN	UNKNOWN
1967	SOPHIE LK, MT	1	UNKNOWN	UNKNOWN
1968	BEAR CR, MT	1	ADULT FEMALE	HUMAN, ILLEGAL KILL
1968	GRANITE CR, MT	1	SUBADULT MALE	HUMAN, MANAGEMENT REMOVAL
1969	PRISCILLA PK, MT	1	ADULT FEMALE	UNKNOWN
1970	THOMPSON R, MT	1	UNKNOWN	UNKNOWN
1970	CAMERON CR, MT	1	SUBADULT MALE	UNKNOWN
1970	SQUAW CR, MT	2	ADULT FEMALE, SUBADULT FEMALE	HUMAN, MANAGEMENT REMOVAL
1971	MURR CR, MT	1	ADULT FEMALE	UNKNOWN
1972	ROCK CR, MT	1	SUBADULT	HUMAN, MISTAKEN IDENTITY (Black Bear)
1974	SWAMP CR, MT	1	ADULT MALE	HUMAN, HUNTER KILL
1977	RABBIT CR, MT	1	ADULT MALE	HUMAN, DEFENSE OF LIFE BY HUNTER
1978	MOYIE LAKE, BC	1	SUBADULT MALE	HUMAN, MANAGEMENT
1982	GROUSE, ID	1	ADULT MALE	HUMAN, ILLEGAL KILL
1984	HARVEY CR, ID	1	UNKNOWN	HUMAN, MISTAKEN IDENTITY (Black Bear)
1985	LYONS CR, MT	1	ADULT MALE	HUMAN, DEFENSE OF LIFE BY HUNTER
1986	BURNT CR, MT	1	CUB	UNKNOWN (NATURAL)
1987	FLATTAIL CR, MT	1	FEMALE CUB	HUMAN, MISTAKEN IDENTITY (Elk)
1988	LEWISBY CR, BC	1	ADULT MALE	HUMAN, HUNTER KILL (BC)
1988	N F 17-MILE CR, MT	1	ADULT FEMALE	HUMAN, DEFENSE OF LIFE BY HUNTER
1989	BURNT CR, MT	1	SUBADULT FEMALE	HUMAN, RESEARCH TRAP (Predation)
1990	POVERTY CR, MT	1	SUBADULT MALE	HUMAN, ILLEGAL
1992	TRAIL CR, MT	1	ADULT FEMALE	UNKNOWN
1993	LIBBY CR, MT	2	ADULT FEMALE AND CUB	UNKNOWN (NATURAL)
1994	JIM CR, BC	1	SUBADULT MALE	HUMAN, MANAGEMENT
1994	SOUTHWEST CRANBROOK, BC	3	2 FEMALES AND 1 MALE	HUMAN, MANAGEMENT
1995	RYAN CR, BC	1	ADULT MALE	HUMAN, MANAGEMENT REMOVAL
1996	DODGE CR, MT	1	SUBADULT MALE	HUMAN, UNDER INVESTIGATION
1996	GOLD CR, BC	1	ADULT MALE	HUMAN, UNDER INVESTIGATION

YEAR	LOCATION	TOTAL	SEX / AGE	MORTALITY CAUSE
1997?	LIBBY CR, MT	1	ADULT MALE	HUMAN, ILLEGAL
1997	PLUMBOB CR, BC	1	MALE	HUMAN, MANAGEMENT
1997	WARDNER, BC	1	ADULT FEMALE	HUMAN, MANAGEMENT
1997	MAYOOK, CR,BC	1	SUBADULT MALE	HUMAN, ILLEGAL KILL
1999	17 MILE CR, MT	3	ADULT FEMALE, 2 CUBS	NATURAL MORTALITY (Predation)
1999	W FK YAHK R, BC	1	SUBADULT FEMALE	HUMAN, DEFENSE OF LIFE BY HUNTER
1999	E FK YAAK R, MT	1	ADULT MALE	HUMAN, MANAGEMENT REMOVAL
2000	HAWKINS CR, BC	2	2 CUBS	UNKNOWN (NATURAL)
2000	FOWLER CR, MT	1	1 CUB	UNKNOWN (NATURAL)
2000	PETE CR, MT	1	SUBADULT FEMALE	HUMAN, UNDER INVESTIGATION
2001	COLD CR, BC	2	2 CUBS	UNKNOWN (NATURAL)
2001	SPREAD CR, MT	1	SUBADULT FEMALE	HUMAN, MISTAKEN IDENTITY (Black Bear)
2001	ELK CR, MT	1	ADULT FEMALE	HUMAN, TRAIN COLLISION
2002	MARTEN CR, MT	1	SUBADULT FEMALE	NATURAL
2002	PORCUPINE CR, MT	1	SUBADULT FEMALE	HUMAN, UNDER INVESTIGATION (Illegal)
2002	YAAK R, MT	4	ADULT FEMALE, 3 CUBS	HUMAN, ILLEGAL
2002	BLOOM CR, BC	1	UNKNOWN	HUMAN, BLACK BEAR HOUND HUNTERS
2002	KOOTENAY R, BC	1	FEMALE	HUMAN, DEFENSE OF LIFE
2004	WEST FORT STEELE, BC	1	MALE	HUMAN, DEFENSE OF LIFE AT DUMP
2004	JIM CR, BC	1	ADULT MALE	HUMAN, MISTAKEN IDENTITY
2004	NEWGATE,BC	1	ADULT FEMALE	HUMAN, MANAGEMENT REMOVAL
2005	RUSSELL CR, BC	1	ADULT MALE	HUMAN, HUNTER KILL (BC)
2005	GOVERNMENT CR, MT	1	SUBADULT FEMALE	HUMAN, TRAIN COLLISION
2005	PIPE CR, MT	1	SUBADULT FEMALE	HUMAN, ILLEGAL
2005	YAAK R, MT	1	SUBADULT MALE	HUMAN, ILLEGAL

Table 2. Credible grizzly bear sightings, credible female with young sightings, and known human caused mortality by bear management unit (BMU) or area, 2005.

BMU or Area	2005 Credible Grizzly Bear Sightings	2005 Female with Cub sightings (Unduplicated)	2005 Sightings of Females with Yearlings or 2-year-olds[2]	2005 Human Caused Mortality
3	1	0	0	0
4	1	0	0	1
5	6	1	2	0
6	5	0	4	0
10	4	0	0	0
11	4	0	0	1
12	3	0	0	0
13	1	0	0	0
14	1	0	0	0
15	5	0	0	0
16	1	0	0	1
17	2	0	2	0
20	1	0	0	0
British Columbia[1]	2	0	1	0
Cabinet Face[1]	2	0	0	0
Tobacco[1]	8	0	2	0
West Kootenai[1]	3	0	0	0
2005 TOTAL	50	1	11	3

[1] Areas are outside of Cabinet-Yaak recovery zone.
[2] Sightings may duplicate the same animal in different locations

Table 3. Annual Cabinet-Yaak recovery zone (excluding Canada) grizzly bear minimum unduplicated counts of females with cubs and known human-caused mortality, 1988-2005.

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

[1] Presently grizzly bear numbers are so small in this ecosystem that the mortality goal shall be zero known human-caused mortalities.

Table 4. Status of the Cabinet-Yaak recovery zone during 2000-2005 in relation to the demographic recovery targets from the grizzly bear recovery plan (USFWS 1993).

Recovery Criteria	Target	2000-2005
Females w/cubs (6-yr avg)	6.0	1.8 (11/6)
Human Caused Mortality limit (4% of minimum estimate)	0.9	1.8 (6 yr avg)
Female Human Caused mortality limit (30% of total mortality)	0.3	1.5 (6 yr avg)
Distribution of females w/young	18 of 22	12 of 22

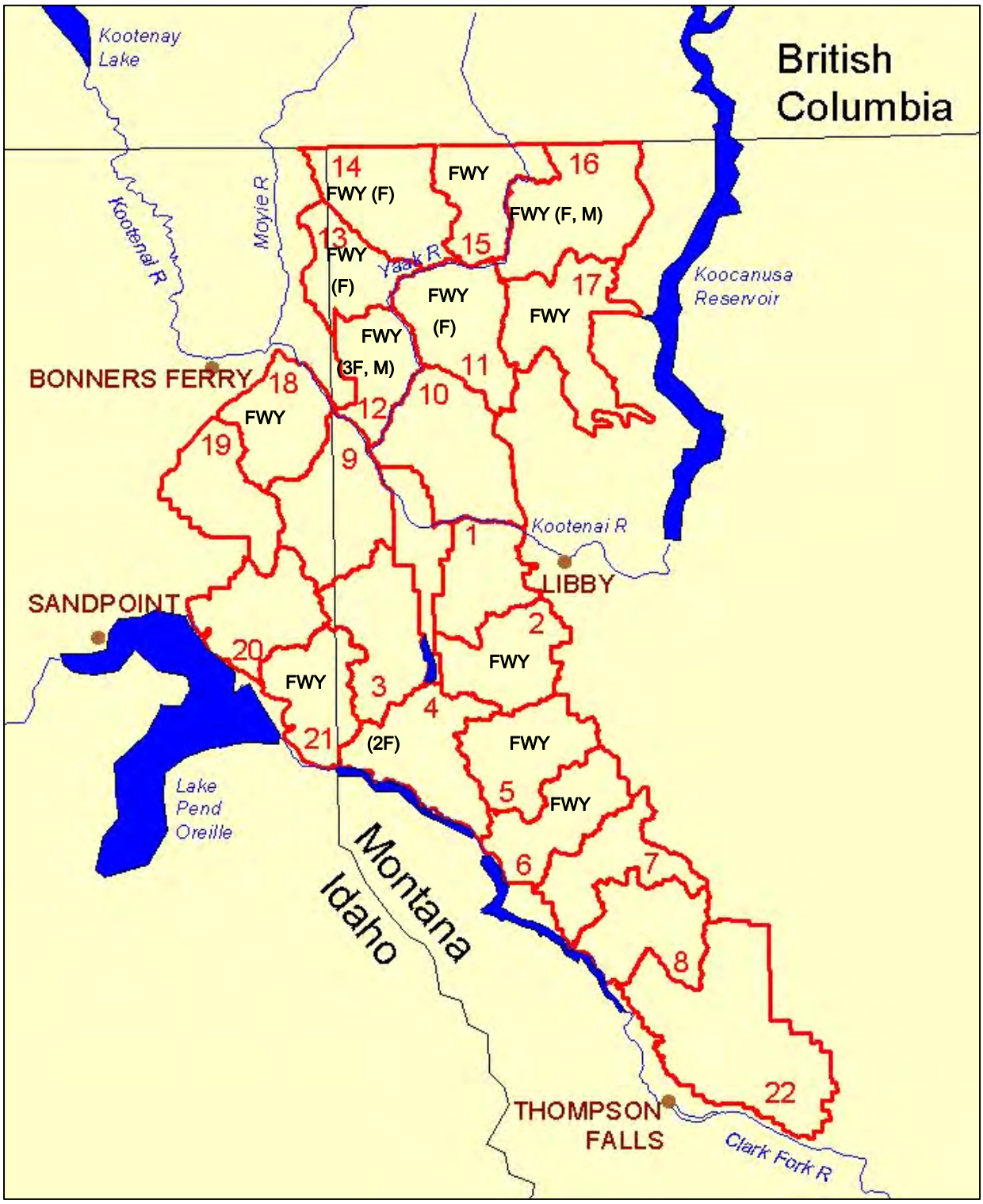


Figure 4. Female with young occupancy and mortality by Bear Management Units (BMUs) within the Cabinet-Yaak recovery zone 2000-2005. (FWY indicates occupancy of a female with young and the sex of any mortality is indicated within parentheses).

Table 5. Credible observations of females with young in or within 10 miles of the Cabinet-Yaak recovery zone, 1988-2005. Observations from Canada shown in parentheses.

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

Table 6. Occupancy of bear management units by grizzly bear females with young in the Cabinet-Yaak recovery zone 1988-2005.

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

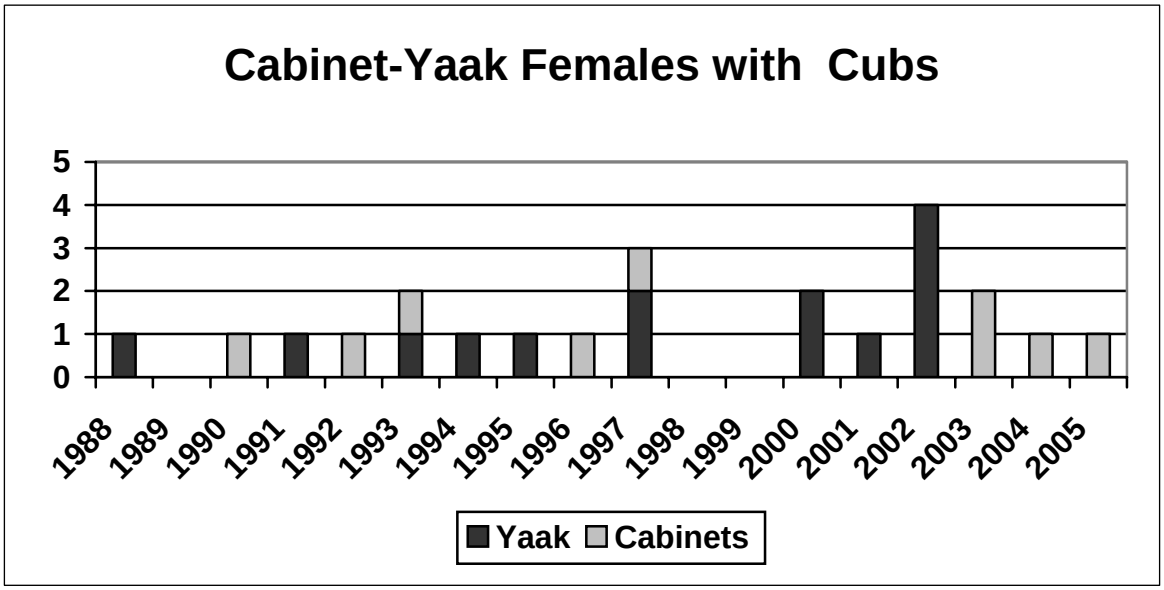


Figure 5. Credible observations of females with cubs in or within 10 miles of the Cabinet-Yaak recovery zone (excluding Canada), 1988-05.

Trapping

Cabinet Mountains Research and Population Augmentation

Research trapping was conducted in the Cabinet Mountains portion of the CYGBRZ from 1983-87. Six captures of 3 individual grizzly bears and 281 captures of 184 individual black bears were made during 4,758 trap-nights (Tables 7, 8). A trap night was defined as one site with one or more snares set for one night. Rates of capture by individual were 1 grizzly bear/1,586 trap-nights and 1 black bear/26 trap-nights.

From 1990-94 four female grizzly bears were captured in the Flathead River Valley of British Columbia and released in the Cabinet Mountains to augment the existing population. Twenty-two different grizzly bears were captured during 840 trap-nights, to obtain the 4 subadult females transplanted. Capture rates were 1 grizzly bear/38 trap-nights, and 1 suitable subadult female/210 trap-nights. Seventy-four black bears were captured with a capture rate of 1/11 trap-nights. One transplanted bears and her cub died of unknown causes a year after release (Kasworm et al. 1998). The remaining three bears were monitored until their collars fell off. A short history of these bears follows later in this report. The program was designed to determine if transplanted bears would remain in the target area and ultimately contribute to the population through reproduction. Three of four transplanted bears remained within the target area for more than one year. Though one of the transplanted bears produced a cub, the animal had likely bred prior to translocation and did not satisfy our criteria for reproduction with native males.

In 1995 an effort was begun to recapture these bears in order to determine success of the transplant program. A total of 1392 trap nights were expended during 1995-2005 (Table 7). 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.

Only one grizzly bear (2005) has been captured in the Cabinet Mountains north of the Clark Fork River since 1986. Three yearling grizzly bears (1 female and 2 males) were captured in May 2002 south of the Clark Fork River near human habitation. These siblings weighed 50-65 pounds and were fitted with ear tag transmitters. The yearlings were preemptively moved away from humans. There were no indications that these bears had received human foods, but the agencies were concerned that they may become conditioned to human foods if they remained in that area. The yearling female died of natural causes in June 2002. A grizzly bear that apparently died in 2001 was found along the railroad tracks in May 2002 and was presumed to be their mother. Another female grizzly bear was transplanted from the Flathead River drainage in the U.S. to the West Cabinet Mountains during October of 2005.

Yaak River Research

Trapping was conducted in the Yaak portion of the CYGBRZ during 1986 and 1987 as part of a black bear graduate research study (Thier 1990), and from 1989-05 by the U.S. Fish and Wildlife Service. Sixty four captures of 30 individual grizzly bears and 404 captures of 329 individual black bears were made during 7,002 trap nights during 1986-05 (Tables 7,8). A trap night was defined as one site with one or more snares set for one night.

Trapping effort was concentrated in home ranges of known bears during 1995-2005 to recapture adult females with known life histories. Much of the effort involved using horses in areas inaccessible to vehicles, such as backcountry trails and closed roads. This strategy limited the area that was sampled during trapping and probably decreased chances of catching new bears, especially females.

Salish Mountains Research

Trapping occurred in the Salish Mountains, south of Eureka, Montana, in 2003. An adult female grizzly bear (5 years old), and 5 black bears were captured during 63 trap nights of effort (Tables 7, 8).

Linkage Area Research, Kootenai River Valley, Montana

Eight black bears were captured in 2004 to determine bear crossing patterns of the Kootenai River valley near the junction of Highway 2 and 92. Seven of these bears were fitted with GPS radio collars that store location data and detach in early October. Capture success was 1 black bear / 35 trap-nights (283 trap-nights). These captures were distributed north (2 females and 2 males) and south of the Kootenai River (1 female and 2 males). Three black bears were captured and collared in 2005. All three bears (2 females and 1 male) were captured north of the river. Capture success was 1 black bear / 136 trap-nights (408 trap-nights).

Linkage Area Research, Moyie River Valley, British Columbia

Three grizzly bears and 19 black bears were captured in the Moyie River valley near Highway 3 in BC during 208 trap nights (1 grizzly bear / 69 trap nights) in 2004. Grizzly bears (2 females and 1 male) were fitted with GPS radio collars that store location data and later detach. All 3 bears were captured north of Highway 3. Six grizzly bears and 18 black bears were captured during 174 trap nights of effort (1 grizzly bear / 29 trap nights) in 2005. Three grizzly bears (1 female and 2 males) were captured north of Highway 3, and 3 males were captured south of Highway 3. Five bears were collared, however the female was too small.

Table 7. Capture effort and success for grizzly bears and black bears in the Yaak, Cabinet Mountains, Salish Mountains, and North of Highway 3, British Columbia, study areas.

Area / Year	Trap Nights	Grizzly Bear Captures	Black Bear Captures	Trap Nights / Grizzly Bear	Trap Nights / Black Bear
Cabinet Mtns.					
1983	365	1	44	365	8
1984	1461	1	88	1461	17
1985	1333	3	64	444	21
1986	1531	1	81	1531	19
1987	68	0	4	0	17
1995	331	0	29	0	11
1996	63	0	20	0	3
1997	129	0	9	0	14
1999	14	0	1	0	14
2001	10	0	2	0	5
2002	398	3	35	133	11
2003	17	0	3	0	6
2004	152	0	3	0	51
2005	272	1	4	272	68
1983-05 Total					
Captures	6144	10	383	614	16
Individuals[1]	6144	7	272	878	23
Salish Mtns.					
2003	63	1	5	63	13
Yaak River, S Hwy 3					
1986	759	4	29	190	26
1987	549	7	6	78	92
1989	646	3	48	215	14
1990	508	3	26	169	20
1991	507	1	38	507	13
1992	205	2	16	103	13
1993	216	2	19	108	11
1994	82	3	4	27	21
1995	505	5	47	101	11
1996	223	8	9	28	25
1997	569	7	48	81	12
1998	71	5	3	14	24
1999	129	3	10	43	13
2000	169	1	15	169	11
2001	116	1	5	116	23
2002	509	2	29	255	18
2003	568	3	26	189	22
2004	318	0	12	0	27
2005	353	4	14	88	25
1986-05 Total					
Captures	7002	64	404	109	17
Individuals[1]	7002	30	329	233	21
N Hwy 3, BC					
2004	103	3	14	34	7
2005	56	3	12	19	5

[1]Individual new bears captured during the indicated time.

Table 8. Grizzly bear capture information from the Cabinet-Yaak 1983-05. Multiple captures of a single bear during a given year are not included.

Bear	Capture Date	Sex	Age (Est.)	Weight kg (Est.)	Location
678	6/29/83	F	28	86	Bear Cr.
680	6/19/84	M	11	(181)	Libby Cr.
680	5/12/85	M	12	(181)	Bear Cr.
678	6/01/85	F	30	79	Cherry Cr.
14	6/19/85	M	27	(159)	Cherry Cr.
101	4/30/86	M	(8)	(171)	N Fk 17Mile Cr.
678	5/21/86	F	31	65	Cherry Cr.
106	5/23/86	F	8	92	Otis Cr.
128	5/10/87	M	4	(114)	Lang Cr.
129	5/20/87	F	1	32	Pheasant Cr.
106	6/20/87	F	9	(91)	Grizzly Cr.
134	6/24/87	M	8	(181)	Otis Cr.
129	7/06/89	F	3	(80)	Grizzly Cr.
192	10/14/89	M	1	90	Large Cr.
193	10/14/89	M	1	79	Large Cr.
193	6/03/90	M	2	77	Burnt Cr.
206	6/03/90	F	2	70	Burnt Cr.
106	9/25/90	F	12	(136)	Burnt Cr.
206	5/24/91	F	3	77	Burnt Cr.
244	6/17/92	M	6	140	Yaak R.
106	9/04/92	F	14	144	Burnt Cr.
34	6/26/93	F	(15)	158	Spread Cr.
206	10/06/93	F	5	(159)	Pete Cr.
505	9/14/94	F	Cub	45	Jungle Cr.
302	10/07/94	M	1	95	Cool Cr.
303	10/07/94	F	1	113	Cool Cr.
106	9/20/95	F	17	(169)	Cool Cr.
353	9/20/95	F	Cub	43	Cool Cr.
354	9/20/95	F	Cub	47	Cool Cr.
302	9/24/95	M	2	113	Cool Cr.
342	5/22/96	M	4	(146)	Zulu Cr.
363	5/27/96	M	4	(158)	Zulu Cr.
303	5/27/96	F	3	(113)	Zulu Cr.
355	9/12/96	M	(6)	(203)	Rampike Cr.
358	9/22/96	M	8	(225)	Pete Cr.
353	9/23/96	F	1	83	Cool Cr.
354	9/23/96	F	1	88	Cool Cr.
384	6/12/97	M	7	(248)	Zulu Cr.
128	6/15/97	M	14	(270)	Cool Cr.
386	6/20/97	M	5	(180)	Zulu Cr.
363	6/26/97	M	5	(180)	Cool Cr.
538	9/25/97	F	6	(135)	Rampike Cr.
354	9/27/97	F	2	99	Burnt Cr.
354	8/20/98	F	3	(90)	Cool Cr.
106	8/29/98	F	20	(146)	Burnt Cr.
363	8/30/98	M	6	(203)	Burnt Cr.
342	9/17/98	M	6	(203)	Clay Cr.
303	9/21/98	F	5	(113)	Clay Cr.
592	8/17/99	F	2	(91)	Pete Cr.
596	8/23/99	F	2	(91)	French Cr.
538	7/16/00	F	9	(171)	Moyie River, BC
552	7/16/01	F	1	(36)	Copeland Cr.
577	5/22/02	F	1	23	Elk Cr.

Bear	Capture Date	Sex	Age (Est.)	Weight kg (Est.)	Location
578	5/22/02	M	1	23	Elk Cr.
579	5/22/02	M	1	30	Elk Cr.
353	6/15/02	F	7	(136)	Burnt Cr.
651	9/25/02	M	(8)	(227)	Spread Cr.
787	5/17/03	M	(2)	71	Deer Cr. ID
342	5/23/03	M	11	(227)	Burnt Cr.
648	8/18/03	F	(5)	(159)	McGuire Cr., Salish Mtns.
244	9/25/03	M	17	(205)	N Fk Hellroaring Cr.
576	10/21/04	M	(3)	(114)	Young Cr.
675	10/22/04	F	(3)	100	Young Cr.
677	5/13/05	M	(4)	105	Canuck Cr., BC
576	6/17/05	M	(4)	133	Teepee Cr., BC
17	6/18/05	M	(4)	175	Norge Pass, BC
292	7/6/05	F	4	(114)	Mission Cr., ID
694	7/15/05	F	(2)	73	Kelsey Cr.
770	9/20/05	M	(12)	(250)	Chippewa Cr.
M1	10/4/05	M	(2)	(80)	Pipe Cr.
668	10/11/05	M	(4)	120	Yaak R.

Hair Sampling for DNA Analysis

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

During 2003, 184 sites were sampled on about 4,300 km^2 in the Cabinet Mountains portion of the recovery zone (Fig. 6). Approximately 900 hair samples were collected. Cameras were placed at 12 sites during August. At one site a picture of a grizzly bear was obtained, but none of the hair samples appeared to be grizzly bear. Three sites planned for sampling could not be utilized because of a lack of access across private land or ongoing forest fires.

During 2004, 14 hair snag sites were operated during late July and early August in the Cabinet Mountains (Fig. 6). All sites were equipped with remote cameras. A site in the East Fork of the Bull River produced hair that was visually identified as grizzly bear, but the camera malfunctioned. At a site in Rock Creek, pictures of a grizzly bear and hair were obtained. No other sites produced hair or pictures that appeared to be grizzly bear. Due to funding constraints, only 14 hair samples from these 2 sites were analyzed by the laboratory.

During 2005, 17 hair snag sites were operated during July and August in the Cabinet Mountains (Fig. 6). All sites were equipped with remote cameras. A site in the East Fork of the Bull River produced hair that was visually identified as grizzly bear, and the camera provided a picture of a grizzly bear mother and cub. At a site in Libby Creek, pictures of a grizzly bear and hair were obtained. No other sites produced hair or pictures that appeared to be grizzly bear. Due to funding constraints, only the 9 hair samples from these 2 sites were analyzed by the laboratory.

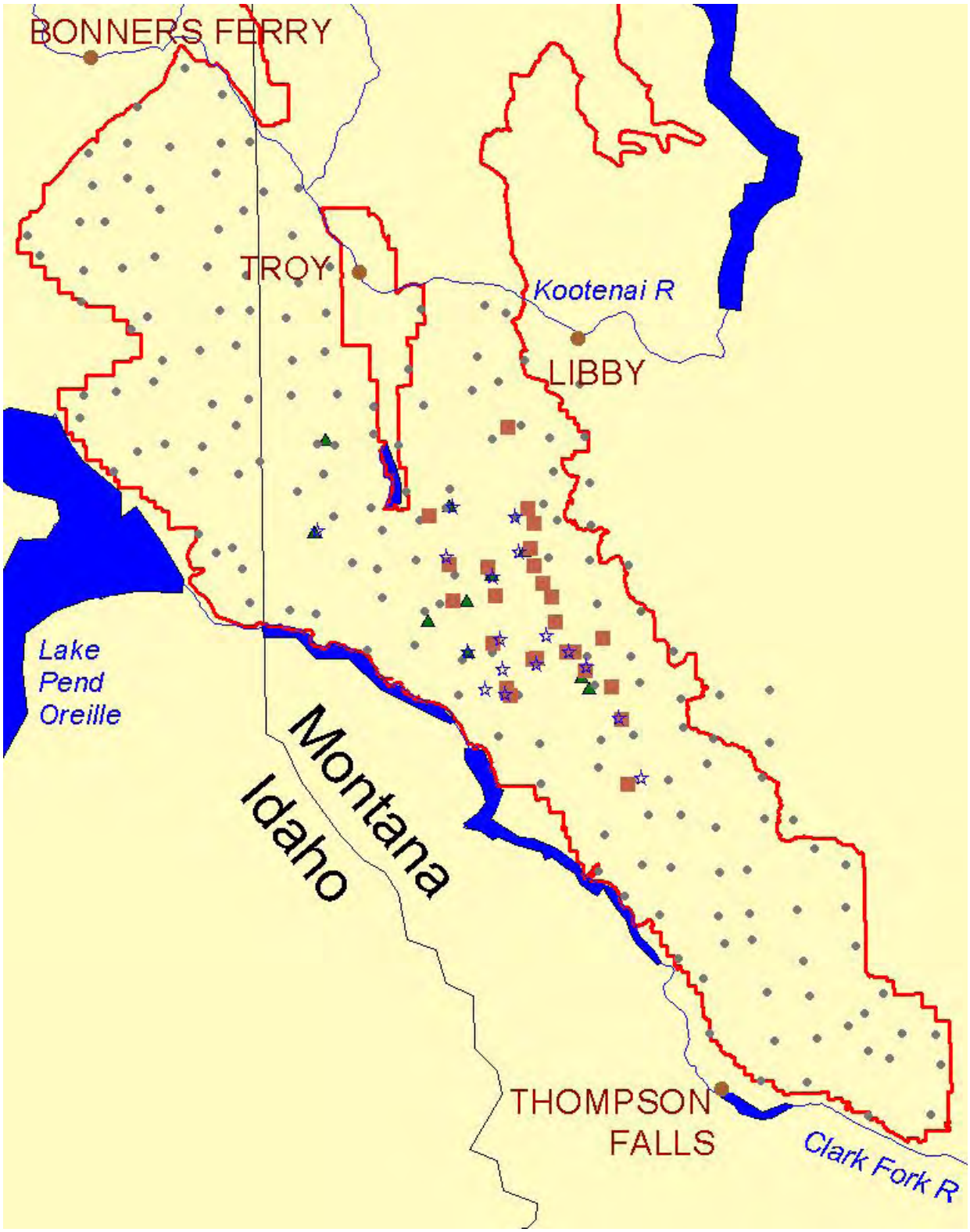


Figure 6. Location of hair snag sample sites in the Cabinet Mountains, 2002-05 (square = 2002, circle = 2003, triangle = 2004 and star = 2005).

Samples collected as a part of this effort and other hair samples collected in the Cabinet Mountains in previous years that were either from known grizzly bears or samples that outwardly appeared to be grizzly bear sent to the Wildlife Genetics International Laboratory in Nelson, British Columbia for DNA extraction and genotyping. Hairs visually identified as black bear hair by technicians at the Laboratory were not processed and hairs processed and determined to be black bear were not genotyped. Dr. Michael Proctor is a 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).

Twenty-nine samples of hair were identified as grizzly bear by the Laboratory. These samples originated from 6 different individual grizzly bears further identified as 4 females and 2 males. All grizzly bear samples were collected at sites in the East Fork of the Bull River, Rock Creek, and the West Fisher River. Laboratory genotypes indicate that the samples in the East Fork of the Bull River were from grizzly bear 286 that was released in the Cabinet Mountains as part of population augmentation in 1993. This animal was 2 years old at the time of her release and would have been 13 years-old when the hair sample was obtained during 2004. No other grizzly bear samples were collected at that site. Further analysis of these samples will occur to examine parent-offspring relationships.

In 1993, claws from a grizzly bear were discovered in Baree Creek of the Cabinet Mountains. Analysis of the DNA from these claws matched DNA from bear 678 originally captured in the Cabinet Mountains in 1983 at the age of 28 years-old. In 2001, portions of a bear were discovered near Heron, Montana after being struck and killed by a train. Analysis of DNA from the remains indicated that this bear was a female, but genotyping was insufficient to determine if the 3 yearlings captured in the same area in 2002 were related to this female.

Monitoring

Grizzly Bear

Seven grizzly bears were monitored for portions of 2004 (three adult males, two subadult males, an adult female, and a subadult female). Males 244 and 342 were monitored for the entire year, but a den location was not obtained for 342. Bear 244 denned in Seventeen Mile Creek. Subadult male 787 was captured during May of 2003 in Deer Creek, Idaho, during a management action involving a county-operated dumpster site. He was released in the Big Creek drainage on 18 May 2003 and monitored mostly in the Big Creek drainage until November of 2003 when he returned to Skin Creek to den. He emerged in May 2004 and was monitored again largely in the Big Creek drainage until he lost his collar in September 2004. Six grizzly bears were monitored for portions of 2005. Bear 694 was captured and collared on 15 July 2005 and monitored until 9 October when she was found shot and had to be euthanized. Bear 770 was captured in September and monitored until he denned in Cable Creek in the fall. Bear A1 was captured on 30 September 2005 in Spruce Creek in the North Fork of the Flathead River Valley and moved to the West Cabinet Mountains near Spar Lake. She was monitored until she denned in Goat Creek. Bear M1 was captured on 4 October 2005 in Pipe Creek and released in the Northwest Peaks area. Only one location was obtained in 2005 after his release.

Five-year-old female 648 was captured on 18 August 2003 in the Salish Mountains, and her signal was monitored until 13 November. Her den location was not determined until early spring of 2004 in Williams Creek, east of Highway 93 in the Whitefish Range. She emerged with one cub in May and denned in December in Deep Creek with the cub. She emerged with the

yearling in the spring of 2005 and denned in Williams Creek in the fall.

Subadult siblings, male 576 and female 675 were captured on 21 and 22 October 2004 respectively in Young Creek. They were captured as part of a management action at a residence involving unsecured garbage. Both bears were relocated and released separately at Spread Creek and Hawkins Creek, and monitored until the male denned in Spruce Creek during December of 2004. The female could not be located during December monitoring flights, but she was located in May 2005 and monitored until she denned in Manson Creek, BC in the fall. Bear 576 was recaptured on 17 June 2005 in Teepee Creek, BC and fitted with a GPS collar.

Three grizzly bears (2 females and 1 male) were monitored by GPS radio collars in conjunction with the Highway 3 linkage project in BC in 2004. Collars automatically detached during October and were retrieved to download stored location data. Neither of the adult females crossed the highway. The male appears to have crossed highway 3 on several occasions between Yahk and Creston, BC before he lost his collar in September. Five male grizzly bears were collared in BC in 2005, including bear 576 described above. Monitoring information from these animals will be reported in a later report.

Black Bear

Ten black bears were monitored during June-October of 2004-05. Sample animals were distributed north (4 females and 3 males) and south of the river valley (1 female and 2 males). Collars released during October and were retrieved to download location information. One collar from the north side of the valley malfunctioned and was not retrieved. None of the six bears monitored during 2004-05, crossed the Kootenai River. Two of the 7 bears on the north side of the Kootenai River crossed Highway 2. This study will be continued during 2006.

Monitoring Summary of Each Adult Female Grizzly Bear

Cabinet Mountains Native Adult Female Bears

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

Cabinet Mountains Transplanted Bears

Bear 218--This animal was captured in the North Fork of the Flathead River in British Columbia on 21 July 1990 as a 5-year-old and released near the west edge of the Cabinet Mountains Wilderness in Lost Girl Creek the following day. Bear 218 weighed 71 kg when captured. She was monitored for remainder of 1990 and denned in the upper reaches of Big Cherry Creek at

an elevation of about 2100 m. Contact with bear 218 was lost in August of 1991 when the canvas spacer on her collar separated. On 2 July 1992, she was observed crossing a road in the Midas Creek area. Although she was of potential reproductive age, she was not observed with cubs. She has not been observed since and her fate at this time is unknown.

Bear 258--This animal was captured in the North Fork of the Flathead in British Columbia on 21 July 1992 as a 6-year-old and released near the west edge of the Cabinet Mountains Wilderness in Lost Girl Creek the following day. Bear 258 weighed 70 kg at capture. She was monitored from release through denning in the East Fork of Rock Creek during early November of 1992. She emerged from her den between 12 and 19 May. Small tracks were later observed in the snow from the air, indicating young accompanied her. The presence of one cub was confirmed on 17 June when she and a cub were observed on a radio monitoring flight. Bear 258 was seven years old in 1993 and had apparently bred in British Columbia prior to being moved the previous year (Table 9). Bear 258 traveled fairly extensively in 1993 (considering the age of her cub) and utilized upper elevations in the East Fork of Rock Creek, Swamp Creek, Libby Creek, and East Fork of the Bull River. In mid-July her movements ceased near the vicinity of Libby Lakes (in upper Libby Creek drainage) and it was assumed she had cast her collar. An examination of the site was made on 22 July. Bear 258 was found dead, lying on her stomach in a daybed she had made in a small patch of trees at 2000 m elevation on an otherwise open slope. It was estimated she had been dead for 8-10 days. There was no evidence of a traumatic death at the site, nor was there any evidence of her cub. The carcass was removed the following day via helicopter and sent to the Montana Department of Fish, Wildlife and Parks Wildlife Laboratory in Bozeman for analysis. Laboratory personnel were unable to determine a cause of death, though several factors such as parasites, physical trauma, physical abnormalities, fast acting poisons, and starvation were ruled out.

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

Bear 311--This 3-year-old female was captured on 12 July 1994 in the North Fork of the Flathead River. She weighed 75 kg and was released at the Lost Girl site on 13 July. She remained near the release site for 4 days before moving east about 15 km to an area near Horse Mountain. She fed on huckleberries in that area until 24 July when she began moving west. On 25 July she lost her radio collar in the vicinity of Standard Lake. Bear 311 was sighted again on 7 September in the East Fork of Rock Creek. There were no additional sightings reported after that date. On 2 October 1995 this bear was captured at Lydia Creek approximately 80 km northeast of her last known sighting in the Cabinet Mountains. She was

moved back to the Cabinet Mountains and released in Lost Girl Creek with a new radio collar. She was monitored for approximately one month, after which the signal was lost.

Bear A1—This adult female (approximately 7-8 years old) was captured at Spruce Creek in the North Fork of the Flathead River on 30 Sept. 2005 by Montana Dept of Fish, Wildlife and Parks personnel. She was released near Spar Lake in the West Cabinet Mountains and was monitored within an 8 km radius of the release site until late November when she moved north to within 3 km of the Kootenai River along the Idaho-Montana border before denning in Goat Creek in mid December.

Yaak Drainage Adult Female Bears

Grizzly 106--An adult female bear was captured on 23 May 1986 in the Yaak River near the confluence with Pheasant Creek. Two 5-month-old cubs accompanied the 8-year-old female, although the cubs were not captured. She weighed 92 kg and her body condition was judged to be good. She was recaptured in 1986, 1987, 1990, 1992, 1995, and 1998. She was accompanied by only 1 cub when captured in the fall of 1986. A sibling cub apparently died in early July. Bear 106 produced 3 cubs in 1988 (bears 192, 193, and 206). These cubs remained with her until the spring of 1990. She was recaptured in the fall of 1990 and her collar was replaced. In 1991, bear 106 was accompanied by 2 cubs, from which she separated during June of 1992 during the breeding season. She was observed consorting with male bear 128 during 1992. She was recaptured on 4 September and weighed 144 kg. Bear 106 produced two cubs again in 1993. Those cubs remained with her until June of 1994 when she was observed in the company of an unmarked adult male and at a later time, grizzly 244. She lost her collar during July of 1994. Bears 302 and 303 were believed to be her 1993 offspring. On 20 September 1995 she was recaptured and collared. Two female cubs (bears 353 and 354) were captured with her. These two cubs remained with her until 1997. She was captured and re-collared on 29 August 1998. She was alone and was not lactating at the time of capture. She was monitored until June 1999 at which time the radio signal came from the same location on two consecutive flights. Upon examination of the site, bear 106 was found dead along with two cubs of unknown sex. Evidence at the site indicated that she had likely been killed by an adult male grizzly bear while defending an elk carcass and/or her cubs (Table 9).

Grizzly 206--Female 206 was the offspring of bear 106 and had 2 litter mates (Bears 192 and 193). Sibling grizzly bears 206 and 192 were captured on 3 June 1990 in Burnt Creek. She was in good condition and weighed 70 kg. Bear 206 was monitored throughout 1991 and 1992. During 1992 she was observed consorting with male bear 128 during breeding season. Bear 206 was 4 years-old at that time. She did not emerge with cubs in 1993 and was seen consorting with at least 2 male grizzly bears during breeding season. She was recaptured in October 1993 and was in excellent condition weighing in excess of 150 kg. Since separating from her mother bear 206 has centered her home range in the West Fork of the Yaak River and Pete Creek. She lost her radio collar at the den during April of 1994. On 14 September 1994 a female cub (505) was captured in Jungle Creek. Bear 206, and another cub were present at the trap site. In 1997 a female believed to be bear 206 was sighted with two cubs (Table 9).

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

due to her large neck, the collar dropped off within a week.

Grizzly 538--This female bear was captured on 25 September 1997 in Rampike Creek. A single cub was with her at the trap site but was not captured. She was estimated to be 6 years old and weighed approximately 135 kg. She separated from the yearling in May of 1998 and was observed with male bear 358 (Table 9). She did not produce cubs in spring 1999, possibly due to the very poor berry crop in 1998. She was seen with an adult male in June of 1999. In late May of 2000 she emerged from the den with two cubs, however, both cubs were not seen with her after June 2000 and were presumed dead. She was captured on 16 July 2000 in the Moyie River drainage in British Columbia. She emerged from her den with 2 cubs in May of 2001, but they were not seen with her after June 2001 and are also presumed to be dead. In May of 2002 she emerged from her den with 2 cubs, which survived to den with her in the fall. Her collar ceased transmitting during the denning period of 2002-2003.

Grizzly 303--This female is the offspring of bear 106. She was captured on 27 May 1996 in Zulu Creek and recaptured on 21 September 1998 in Clay Creek. Her home range is centered around the South Fork of the Yaak River. As a 5 year old she was seen with an adult male during breeding season in 1998. She did not have cubs in the spring of 1999, but was seen with an adult male during breeding season. In May 2000 she emerged from the den with two cubs (Table 9), however, after June 2000 one of the cubs was no longer observed with her and was presumed dead. The remaining cub survived and entered the den with her mother in November 2000. She emerged from the den in April 2001, with her yearling. She was monitored until July 2001 when her collar ceased transmitting.

Grizzly 353–This female is the offspring of bear 106. She was captured on 20 September 1995 as a yearling, and on 23 September 1996 as a 2 year old. She wore a transmitter from 1995-97. On 15 June 2002 she was recaptured. She was seen with 3 cubs shortly after capture (Table 9). She was killed in November of 2002 and the remains of 1 cub were also found. The other 2 cubs are assumed to be dead.

Salish Mountains Adult Female Bears

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

Table 9. Captured grizzly bear reproductive information from the Cabinet-Yaak 1983-05.

Bear	Year	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 of unknown sex and fate
106	1993	2	2	♂ #302 dead in 1996, ♀ #303
106	1995	2	4	♀ #353 dead in 2002, ♀ #354
106	1999	2	-	♀ #106 and 2 cubs dead in 1999
206	1994	2	3	♀ #505
206	1997	2	-	suspected offspring ♀ #596 dead in 1999, ♀ #592 dead in 2000
258	1993	1	-	♀ #258 and cub dead in 1993
538	1997	1?	2 (5)[2]	1 cub separated from 538 in 1998
538	2000	2	1	2 cubs dead in 2000
538	2001	2	1	2 cubs dead in 2001
538	2002	2	-	2 cubs of unknown sex and fate
303	2000	2	-	1 cub dead in 2000, ♀ #552
353	2002	3	-	♀ #353 dead in 2002, 3 cubs (1 female) assumed dead in 2002

[1]Number of years from birth to subsequent birth.
[2]Number of years from birth to surviving litter of cubs.

Grizzly Bear Home Ranges

Specific and general locations were obtained on collared bears, but only aerial, specific locations were used to calculate home ranges. The convex polygon and 95% and 100% adaptive kernel estimators for life ranges were computed for bears monitored during 1983-2005 (Table 10 and Figs. 7-41).

Four subadult female grizzly bears were transplanted to the Cabinet Mountains during 1990-94. Life range 95% adaptive kernel estimators averaged 367 km^2 (95% CI ± 164).

Native CYGBRZ adult male life range averaged 1,252 km^2 (95% CI ± 512) using the 95% adaptive kernel estimator (*n* = 11, bears 14, 680, 101, 128, 134, 244, 342, 358, 363, 386, and 651). Native adult female life range averaged 574 km^2 (95% CI ± 443) using the 95% adaptive kernel estimator (*n* = 6, bears 678, 106, 206, 303, 353 and 538). Bears 770 and A1 are not included in this discussion due to the small number of locations obtained for them in 2005. The average annual 95% kernel estimator for bear 106 was 231 km^2 (95% CI ± 77) during the 1986-99 period. Her home range was smallest during 1986, 1988, 1991, 1993, and 1995 when she had cubs. The mean annual home range of native adult female bear 678 in the Cabinet Mountains from 1983-88 was 403 km^2 (95% CI ± 239). The 2003-2005 range for female bear 648, in the Salish Mountains, was 819 km^2 (95% adaptive kernel).

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

lived within her mother's old range, before her death.

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

Eleven of twenty-seven bears (41 percent) captured south of the international boundary in the Yaak study area of northwest Montana and northern Idaho were monitored crossing into Canada between 1987 and 2004. Five of these animals were adult males that spent portions of spring breeding season in Canada during various years between 1987 and 1999 (128,134, 355, 358, and 386). One of these males (358) was observed courting an adult female (538) whose home range occurs largely in Canada, but was initially captured in the United States. Another adult female (206) whose home range occurs largely in the United States was observed in association with 2 different unmarked adult males in Canada and subsequently produced a litter of cubs. Furthermore, 2 adult males (134 and 128) originally captured in the United States were monitored up to 20 miles north of the border and north of the Moyie River in the Purcell Mountains during breeding season of 1987 and 1992.

Table 10. Home range sizes of native and transplanted grizzly bears in the Cabinet-Yaak recovery zone, and the Salish Mountains, 1983-05.

Bear	Year	Age (Est.)	Radio Locations	100% Convex Polygon (km^2)	95% Adaptive Kernel (km^2)	100% Adaptive Kernel (km^2)
678 ♀	1983-1989	28-34	173	658	579	1,204
680 ♂	1984-1985	11-12	75	1,947	2,217	3,967
14 ♂	1985	27	23	589	778	2,023
218[1] ♀	1990-1991	5-6	95	541	503	1038
258[1] ♀	1992-1993	6-7	54	400	345	645
286[1] ♀	1993-1994	2-3	82	266	365	624
311[1] ♀	1994-1995	3-4	17	680	568	1,385
101 ♂	1986	8	38	787	575	1,227
106 ♀	1986-1999	8-20	379	852	394	1,424
128 ♂	1987-1997	4-14	204	2,895	2,566	5,825
128 ♂	Subadult	4	21	394	642	871
128 ♂	Adult	5-14	183	2,895	2,647	5,853
129 ♀	1987-1989	1-3	42	60	68	89
134 ♂	1987-1988	8-9	20	594	1,078	1,459
192 ♂	1990	2	10	574	1,067	77
193 ♂	1990	2	34	642	1,013	1,327
206 ♀	1990-1995	2-7	208	1,332	1,357	2,341
206 ♀	Subadult	2-4	136	1,288	1,416	2,218
206 ♀	Adult	5-7	72	549	637	935
244 ♂	1992-2004	6-18	156	1,406	912	2,424
302 ♂	1994-1996	1-3	60	514	290	531
303 ♀	1994-2001	1-8	237	337	336	618
303 ♀	Subadult	1-4	110	193	238	279
303 ♀	Adult	5-8	127	295	293	522
342 ♂	1996-2004	4-12	134	1,653	1,303	2,980
342 ♂	Subadult	4	26	711	785	1,229
342 ♂	Adult	5-12	108	867	1,058	1,392
354 ♀	1997-1999	2-4	69	536	451	908
355 ♂	1996	(6)	5	N/A	N/A	N/A
358 ♂	1996-1998	8-10	55	1,442	1,379	2,534
363 ♂	1996-1999	4-7	120	538	586	874
363 ♂	Subadult	4	40	384	369	704
363 ♂	Adult	5-7	81	525	643	732
386 ♂	1997-1998	5-6	29	1,895	2,153	3,313
538 ♀	1997-2002	6-11	230	835	630	1,941
592 ♀	1999-2000	2-3	59	471	520	739
596 ♀	1999	2	10	283	382	382
552 ♀	2001	1	6	N/A	N/A	N/A
353 ♀	2002	7	37	119	146	321
577 ♀	2002	1	11	2	4	9
578 ♂	2002	1	3	N/A	N/A	N/A
579 ♂	2002	1	10	5	11	16
651 ♂	2002-2003	(8-9)	12	69	226	255
787 ♂	2003-2004	(2-3)	84	1,863	1,139	2,653
576 ♂	2004	(3)	7	N/A	N/A	N/A
675 ♀	2004-2005	(3-4)	24	424	413	1,048
694 ♀	2005	(2-3)	11	89	202	231
770 ♂	2005	(12)	6	N/A	N/A	N/A
A1[1] ♀	2005	(7)	7	N/A	N/A	N/A
Salish Mountains						
648 ♀	2003-2005	(5-7)	83	939	819	1,628

[1] Bear transplanted to Cabinet Mountains from British Columbia.

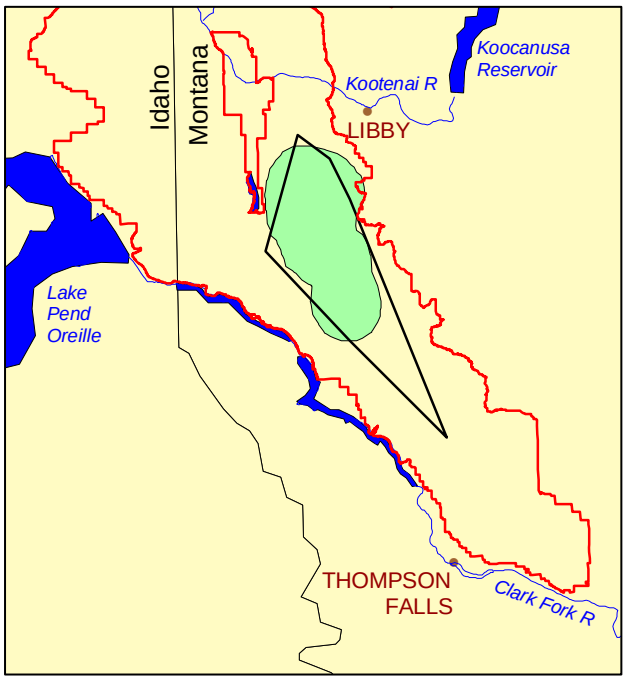


Figure 7. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 678 in the Cabinet-Yaak recovery zone, 1983-89.

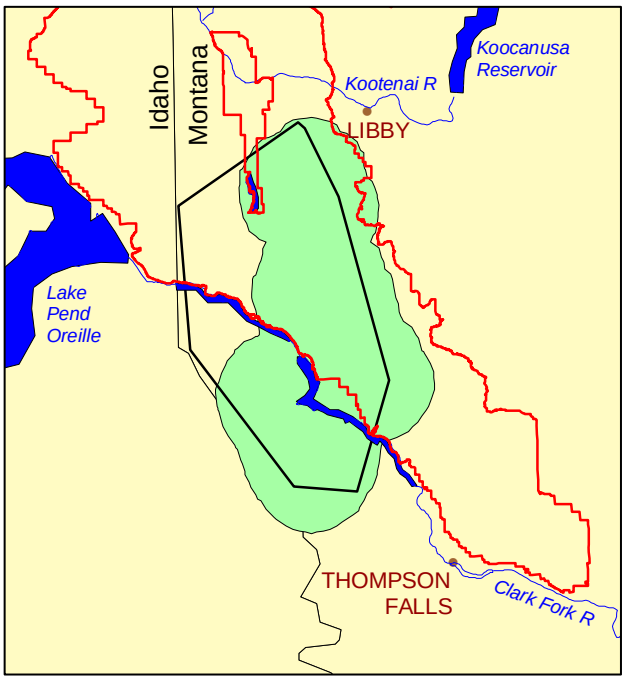


Figure 8. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 680 in the Cabinet-Yaak recovery zone, 1984-85.

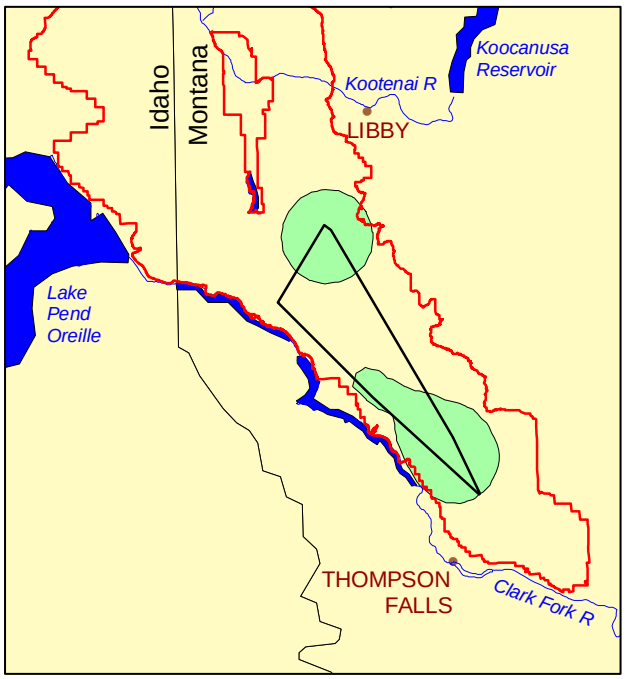


Figure 9. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 14 in the Cabinet-Yaak recovery zone, 1985.

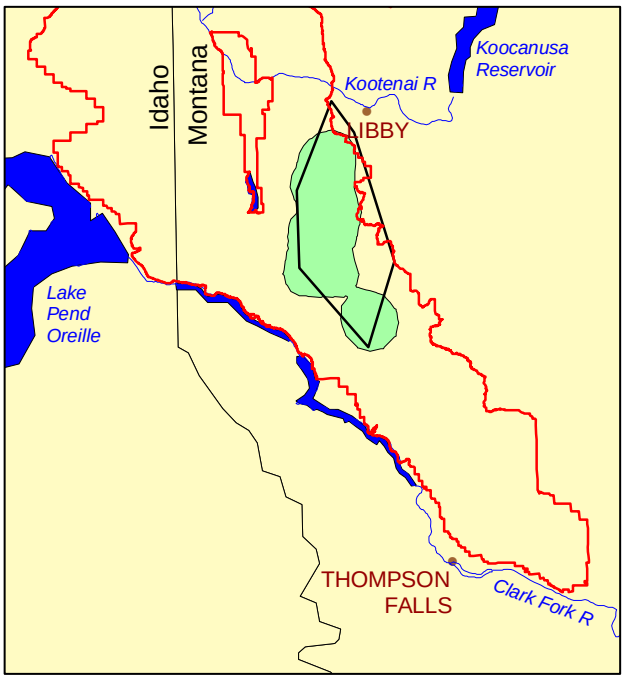


Figure 10. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 218 (augmentation female) in the Cabinet-Yaak recovery zone, 1990-91.

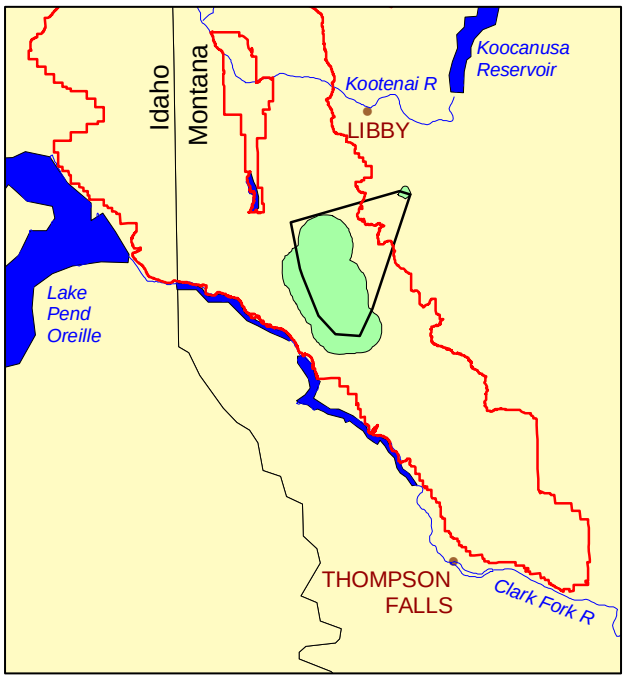


Figure 11. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 258 (augmentation female) in the Cabinet-Yaak recovery zone, 1992-93.

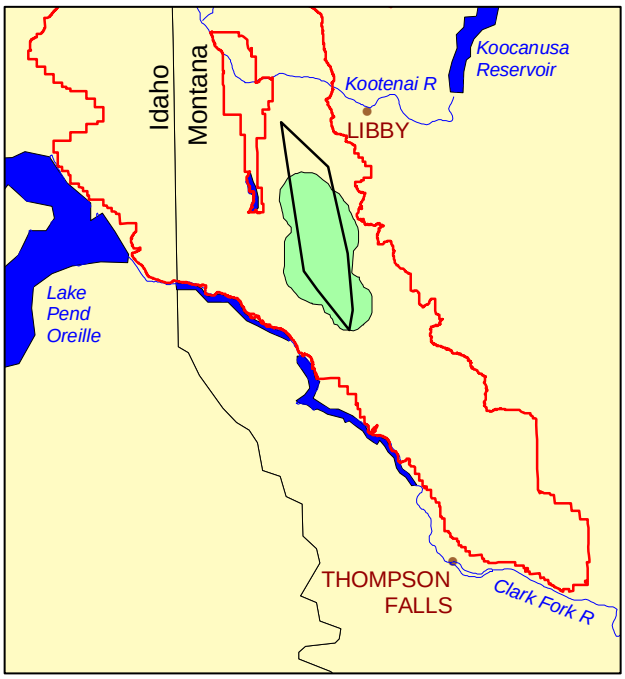


Figure 12. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 286 (augmentation female) in the Cabinet-Yaak recovery zone, 1993-94.

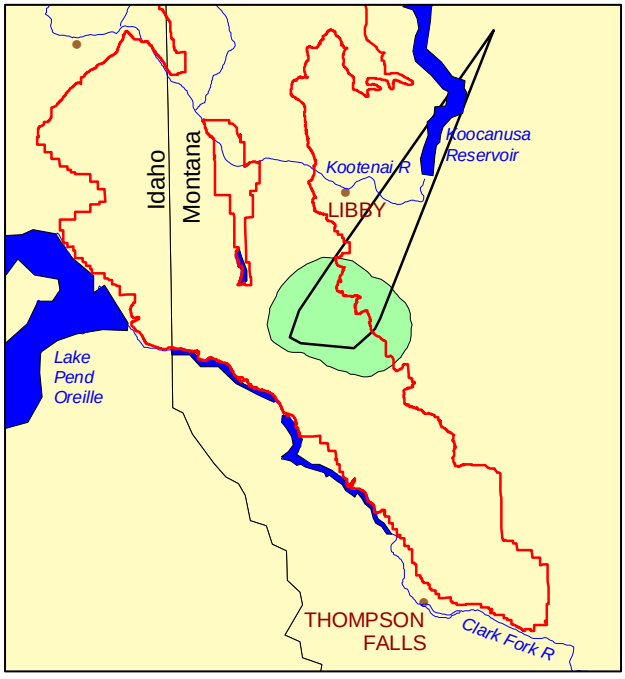


Figure 13. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 311 (augmentation female) in the Cabinet-Yaak recovery zone, 1990-91.

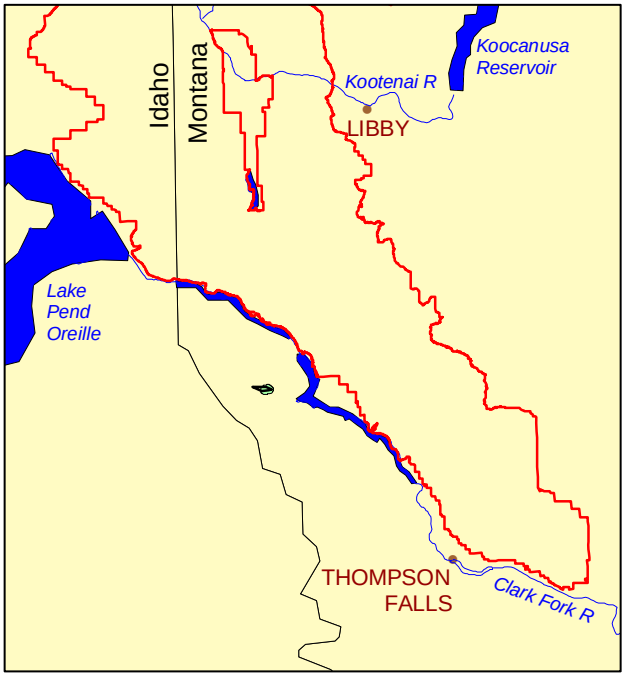


Figure 14. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 577 in the Cabinet-Yaak recovery zone, 1990-91.

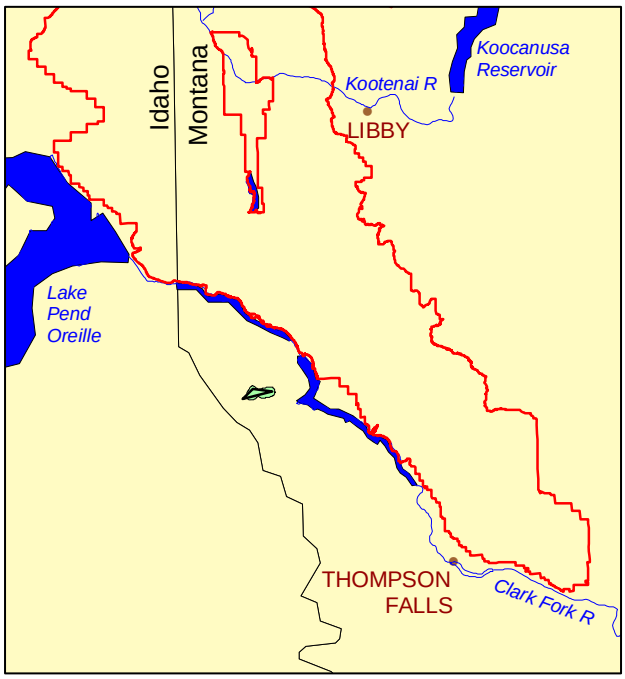


Figure 15. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 579 in the Cabinet-Yaak recovery zone, 2002.

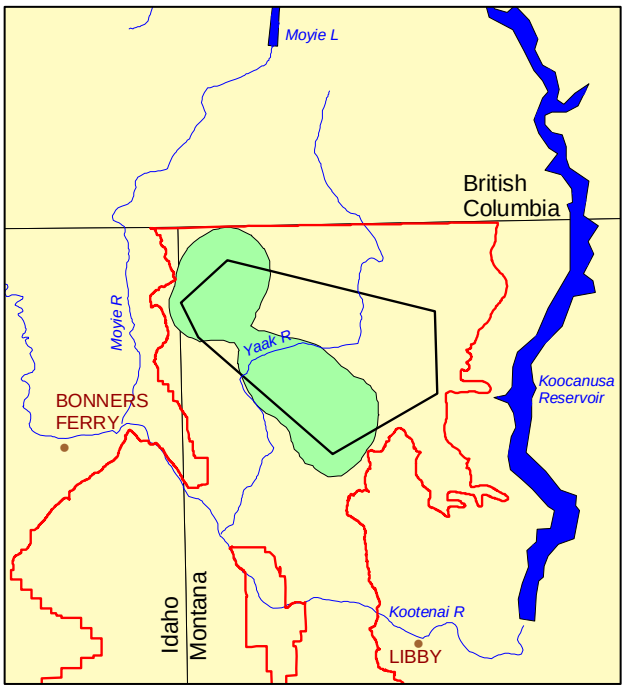


Figure 16. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 101 in the Cabinet-Yaak recovery zone, 1986-87.

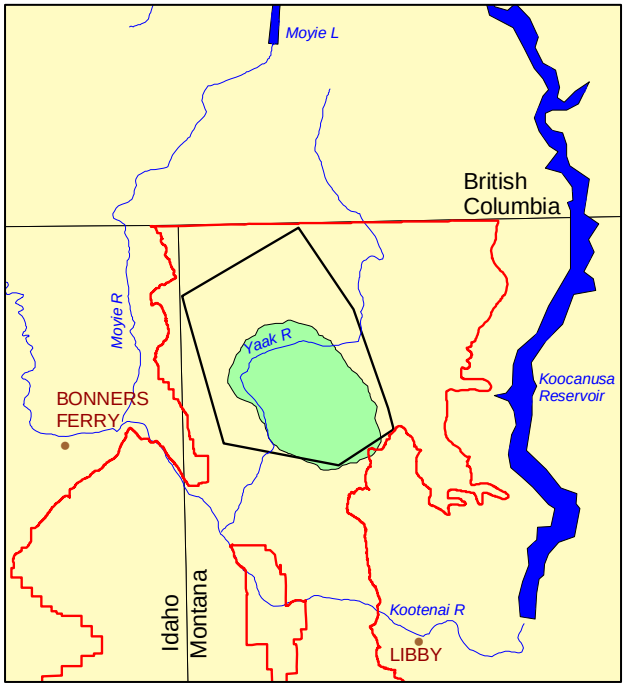


Figure 17. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 106 in the Cabinet-Yaak recovery zone, 1986-99.

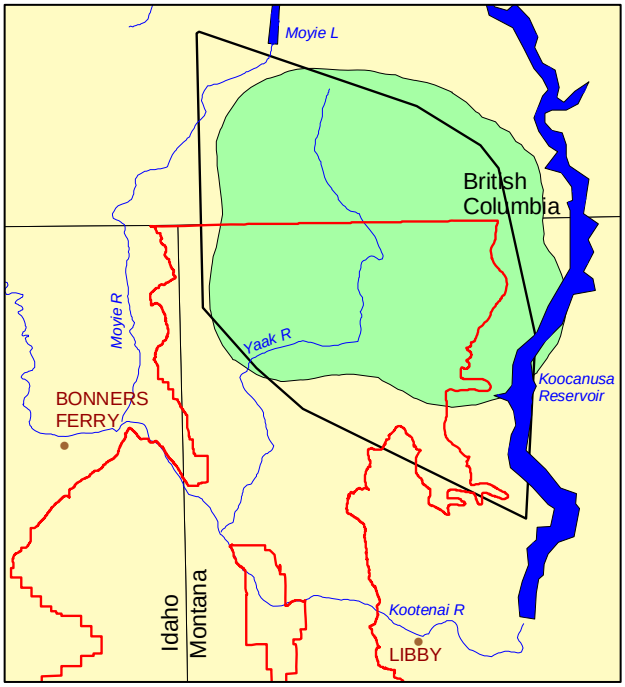


Figure 18. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 128 in the Cabinet-Yaak recovery zone, 1987-92.

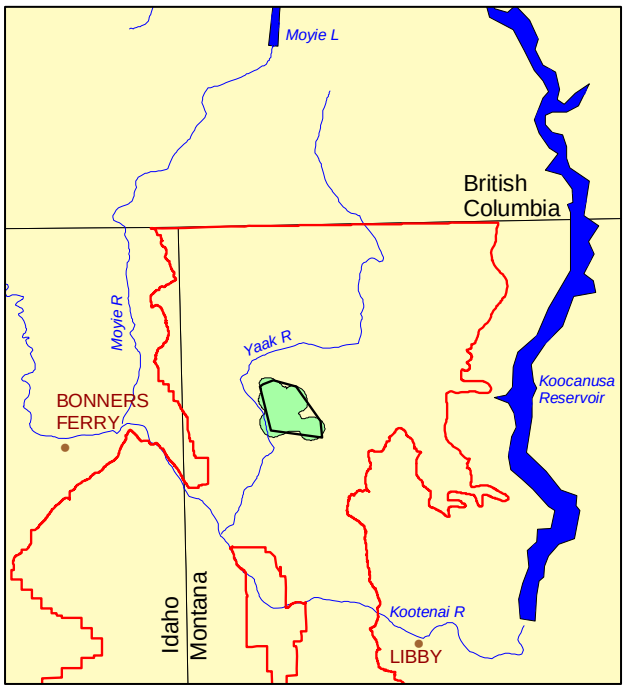


Figure 19. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 129 in the Cabinet-Yaak recovery zone, 1987-89.

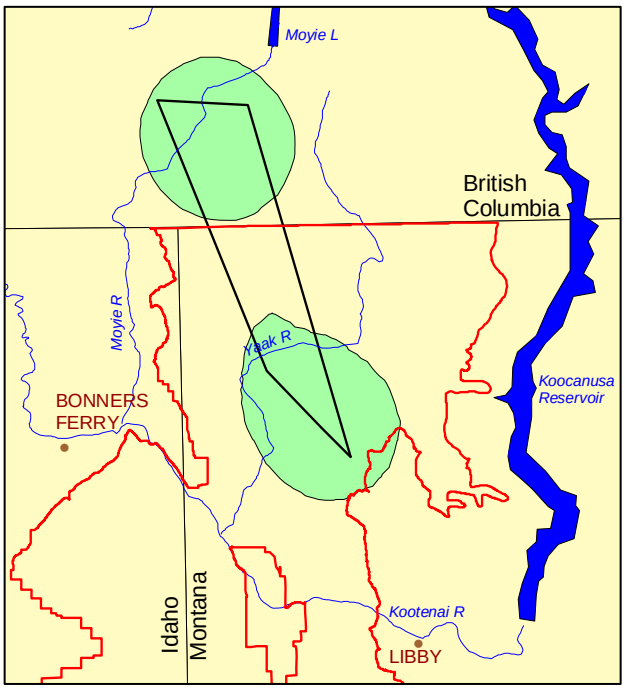


Figure 20. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 134 in the Cabinet-Yaak recovery zone, 1987-98.

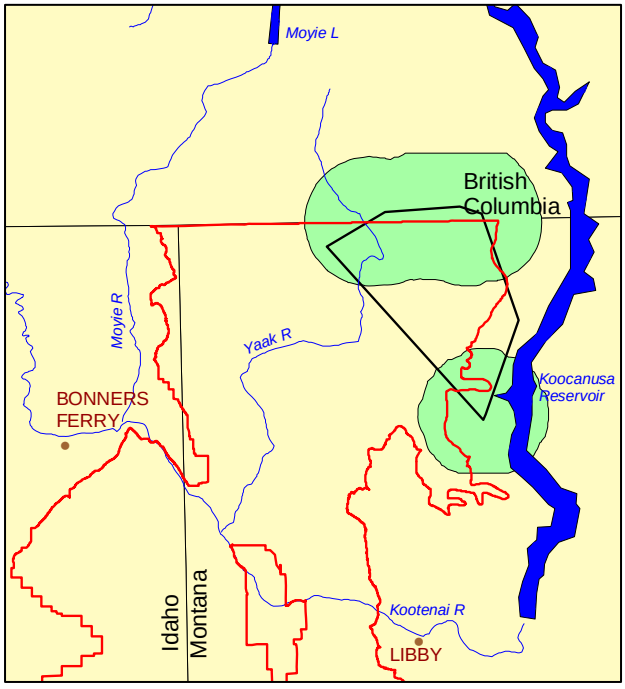


Figure 21. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 192 in the Cabinet-Yaak recovery zone, 1990.

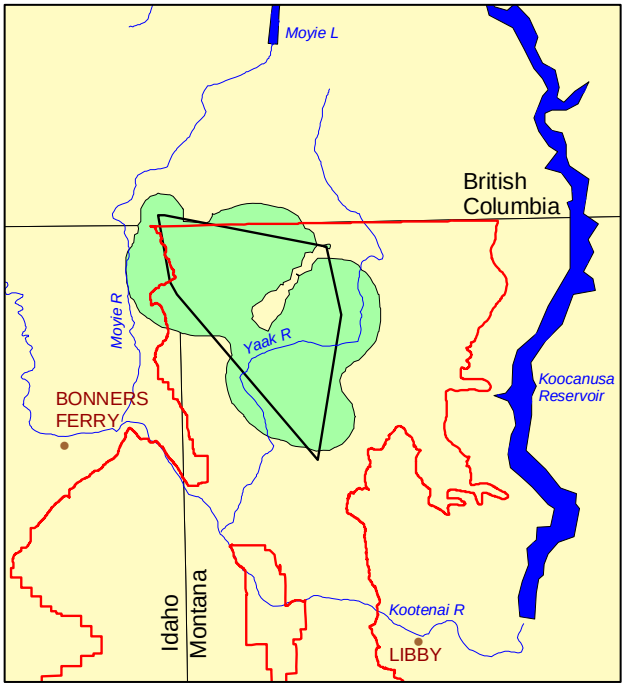


Figure 22. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 193 in the Cabinet-Yaak recovery zone, 1990.

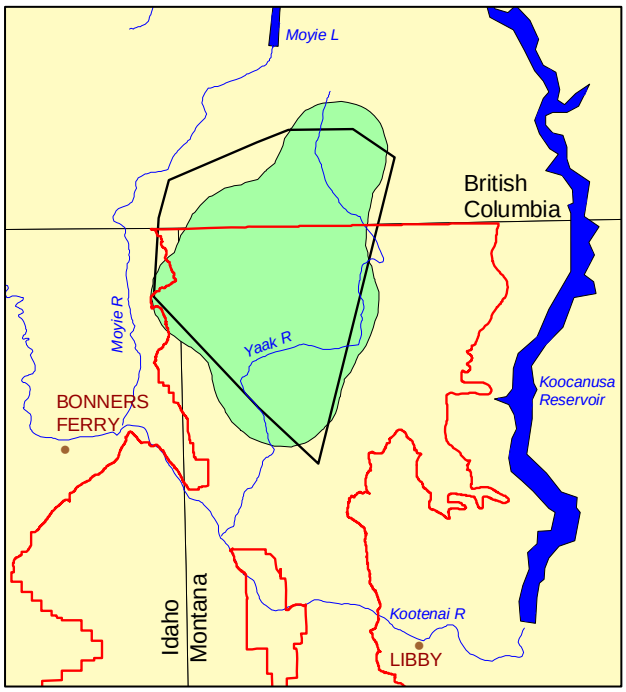


Figure 23. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 206 in the Cabinet-Yaak recovery zone, 1991-94.

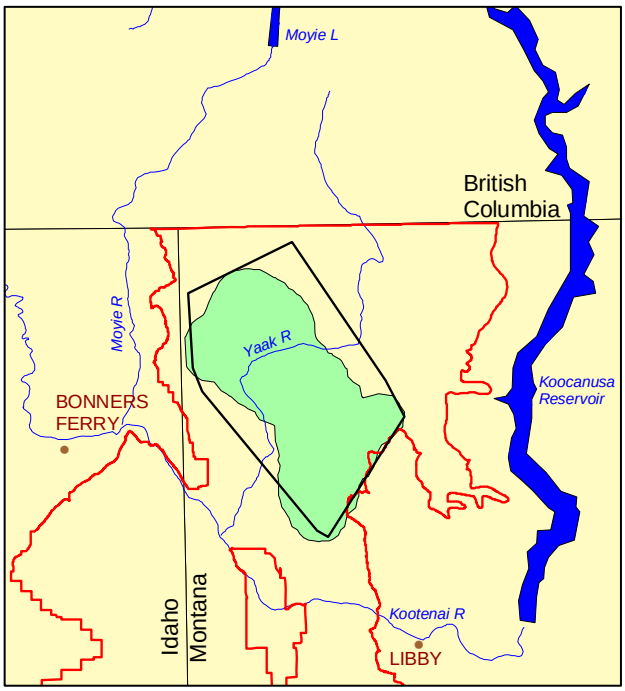


Figure 24. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 244 in the Cabinet-Yaak recovery zone, 1992-03.

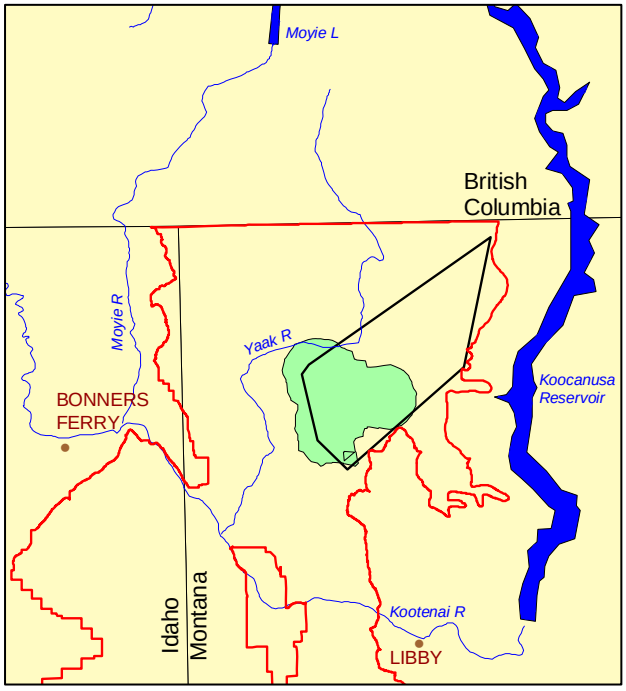


Figure 25. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 302 in the Cabinet-Yaak recovery zone, 1994-96.

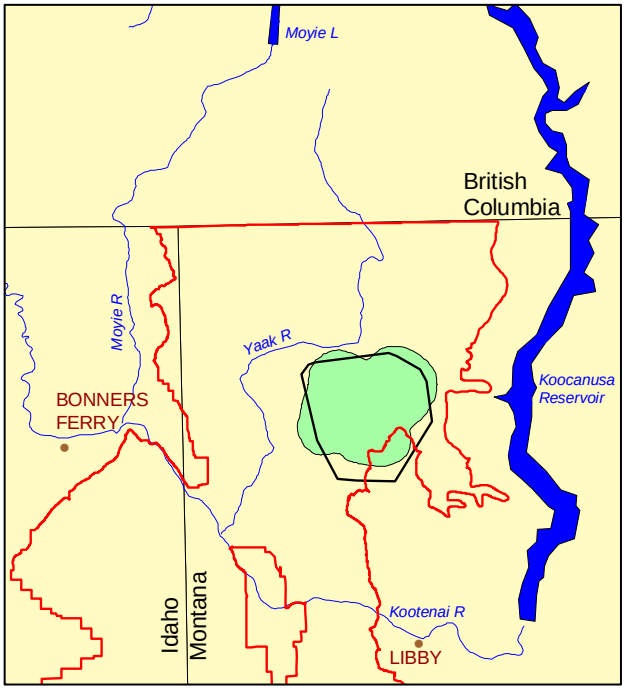


Figure 26. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 303 in the Cabinet-Yaak recovery zone, 1994-01.

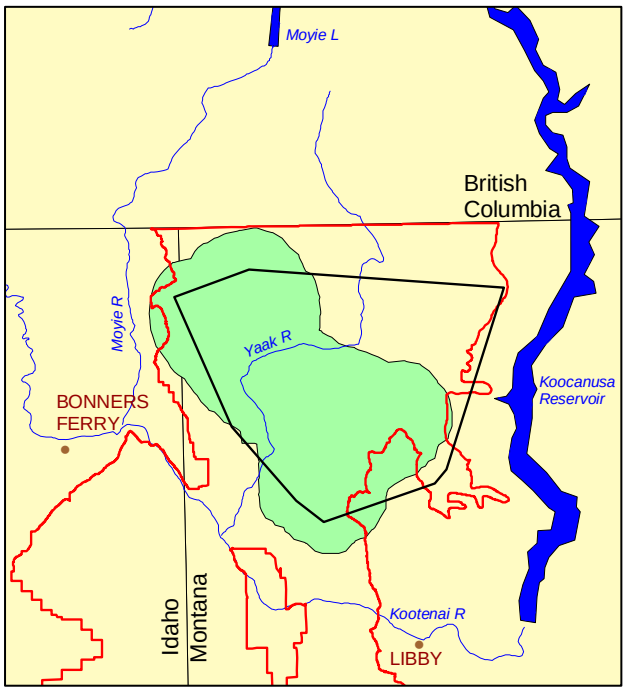


Figure 27. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 342 in the Cabinet-Yaak recovery zone, 1996-03.

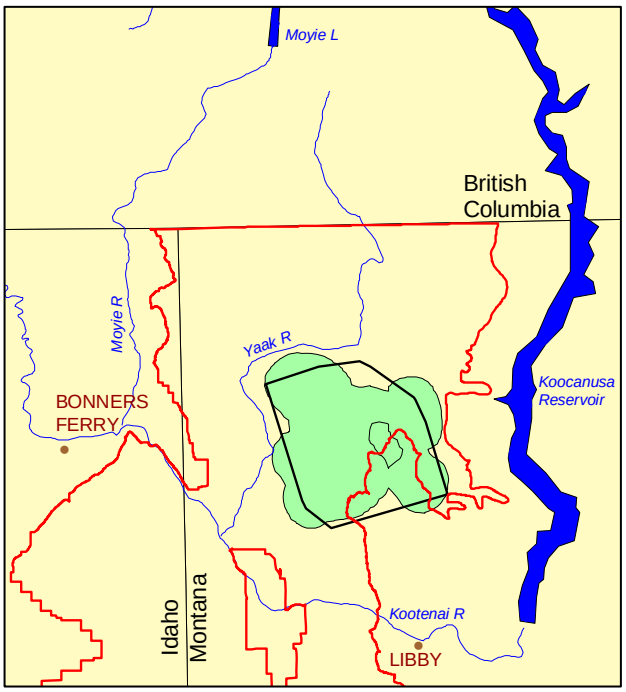


Figure 28. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 363 in the Cabinet-Yaak recovery zone, 1996-99.

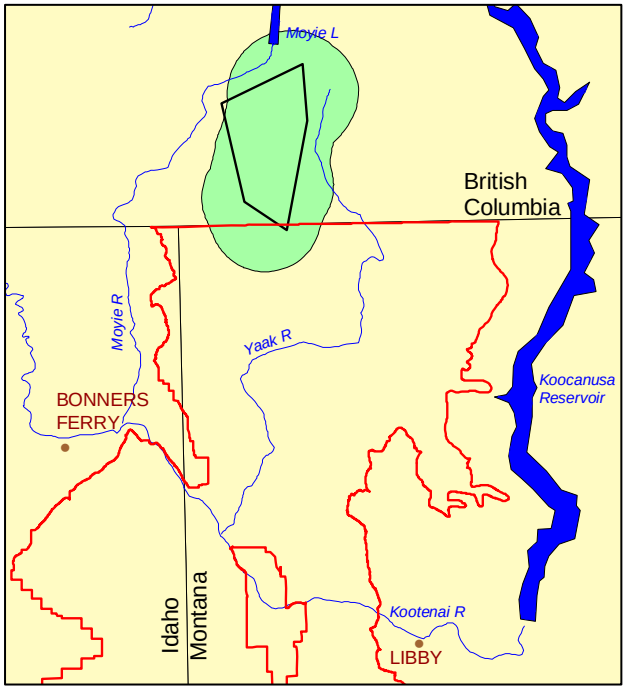


Figure 29. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 355 in the Cabinet-Yaak recovery zone, 1996.

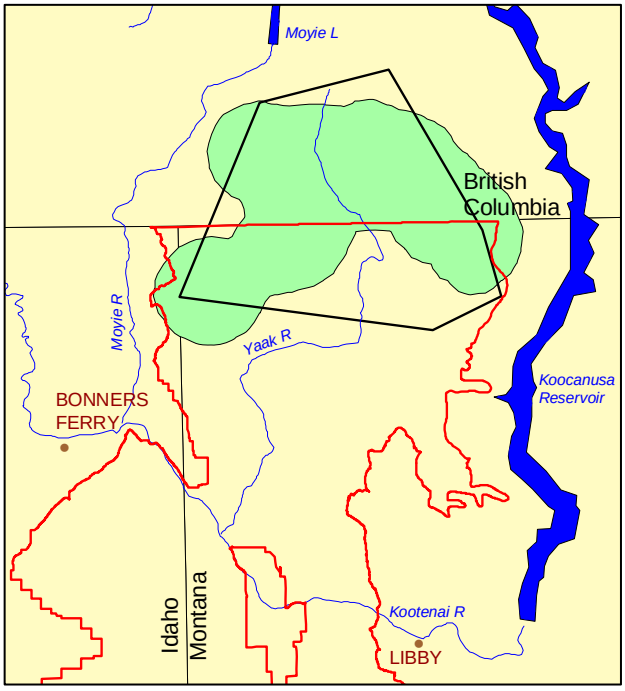


Figure 30. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 358 in the Cabinet-Yaak recovery zone, 1996-98.

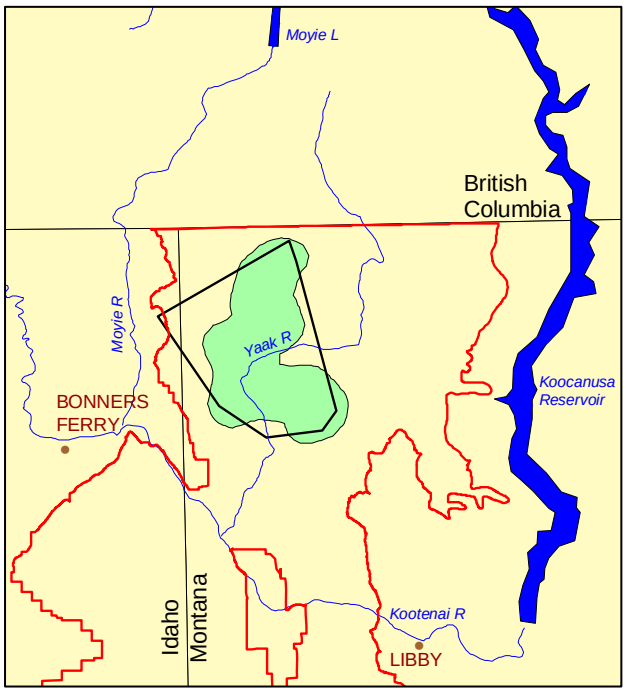


Figure 31. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 354 in the Cabinet-Yaak recovery zone, 1997-99.

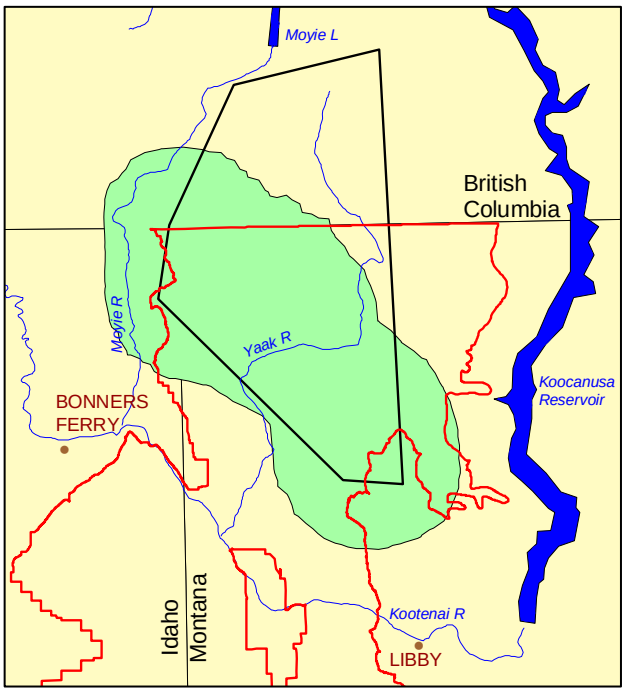


Figure 32. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 386 in the Cabinet-Yaak recovery zone, 1997-98.

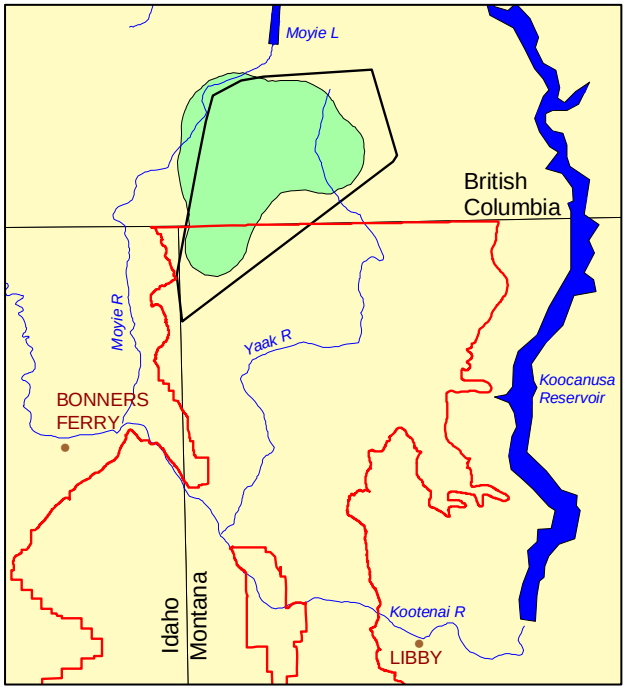


Figure 33. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 538 in the Cabinet-Yaak recovery zone, 1997-02.

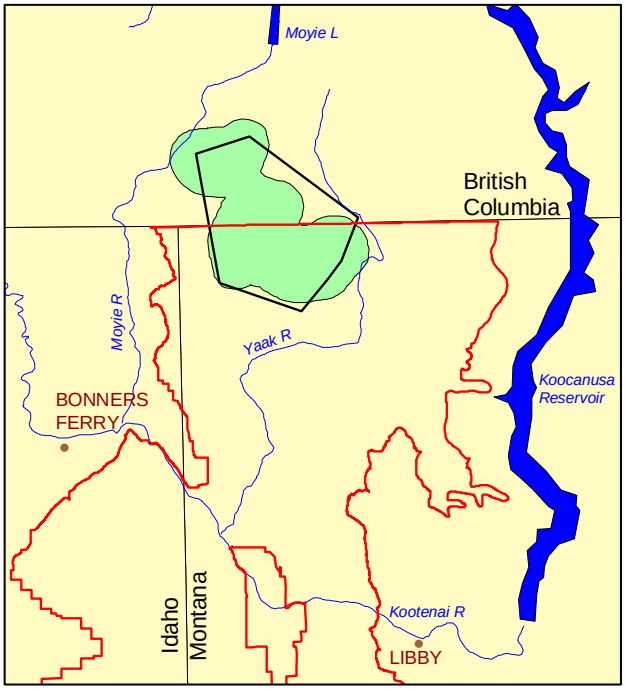


Figure 34. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 592 in the Cabinet-Yaak recovery zone, 1999-00.

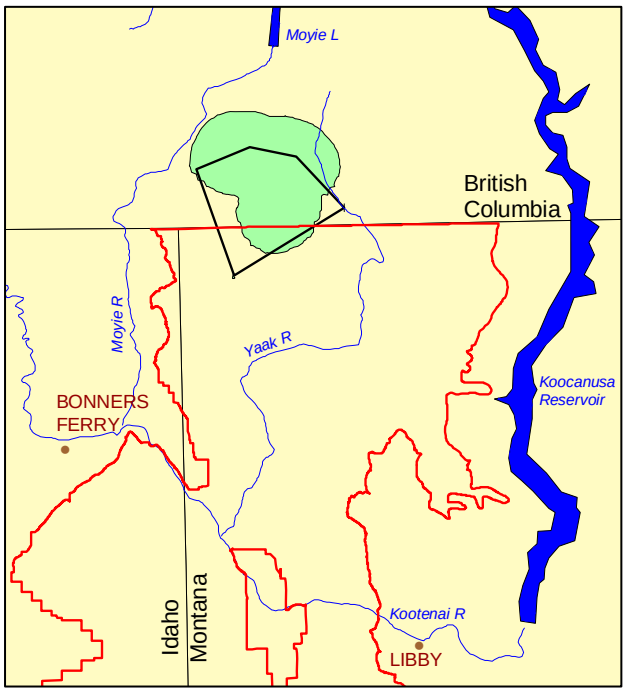


Figure 35. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 596 in the Cabinet-Yaak recovery zone, 1999.

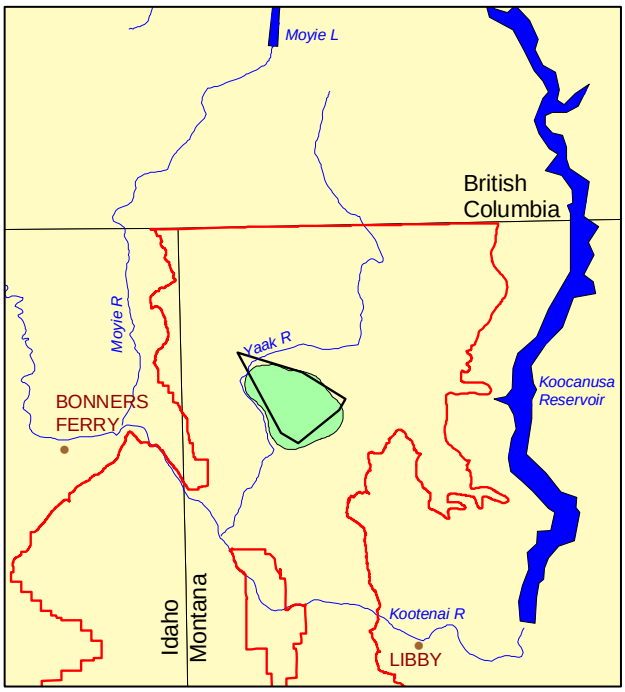


Figure 36. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 353 in the Cabinet-Yaak recovery zone, 2002.

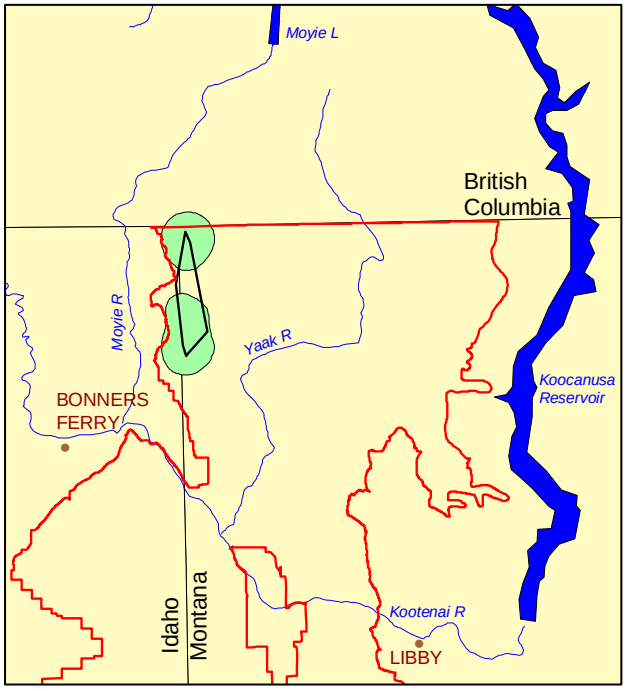


Figure 37. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 651 in the Cabinet-Yaak recovery zone, 2002.

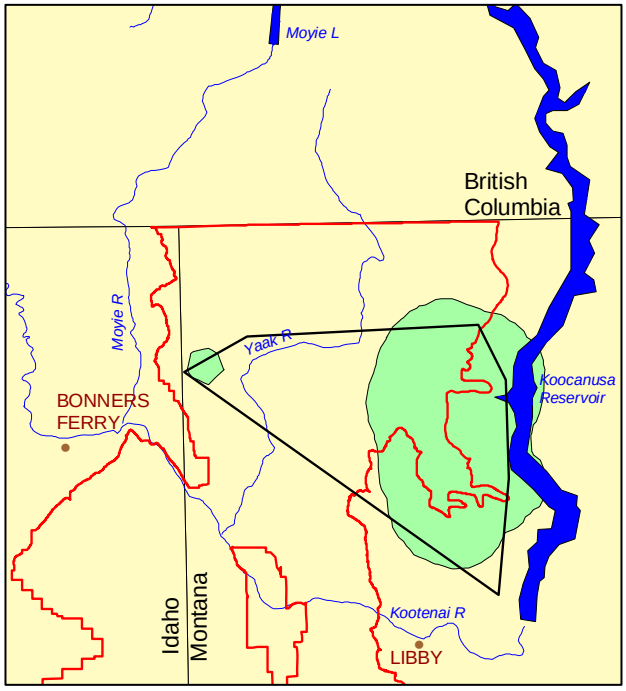


Figure 38. Minimum convex and 95% adaptive kernel (shaded) life ranges of male grizzly bear 787 in the Cabinet-Yaak recovery zone, 2003.

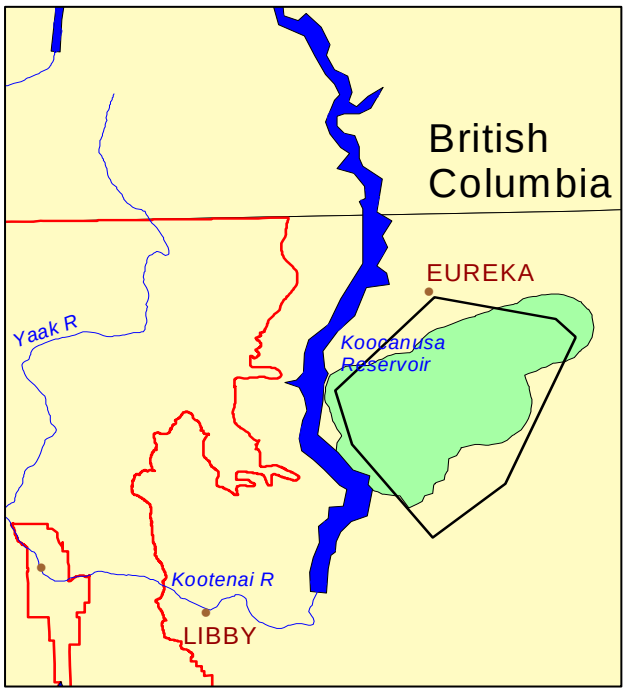


Figure 39. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 648 in the Salish Mountains, 2003-05.

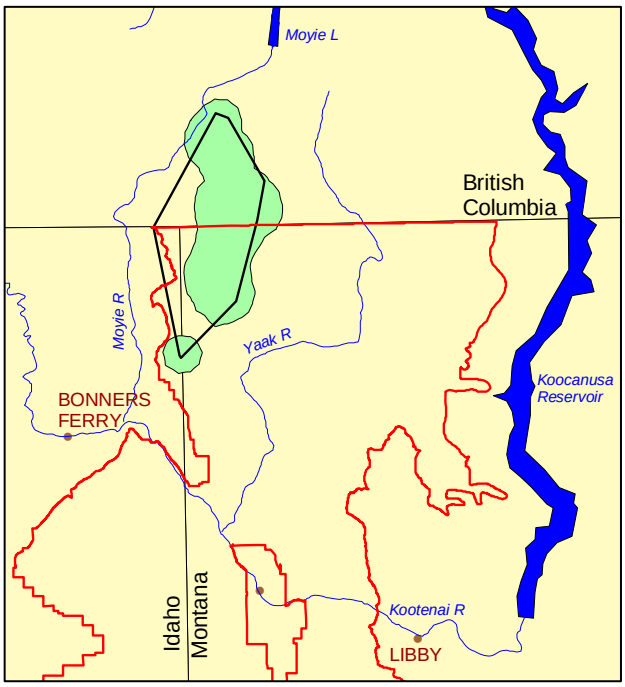


Figure 40. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 675 in the Cabinet-Yaak recovery zone, 2004-05.

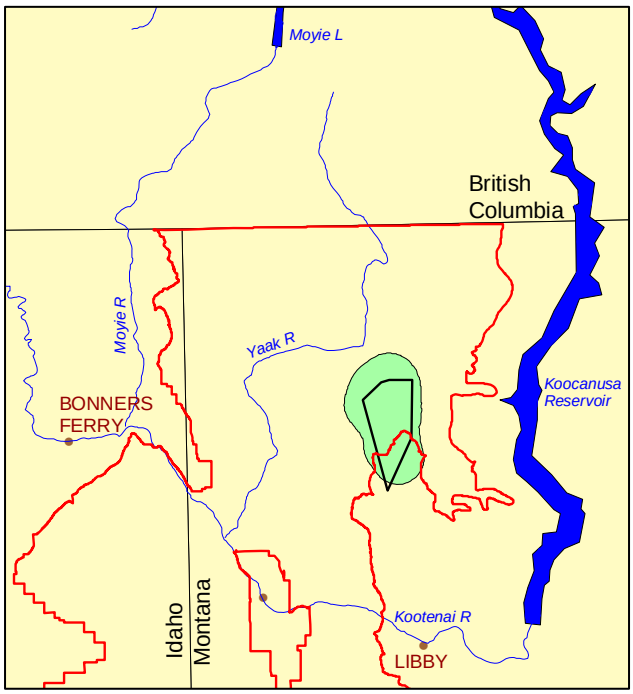


Figure 41. Minimum convex and 95% adaptive kernel (shaded) life ranges of female grizzly bear 694 in the Cabinet-Yaak recovery zone, 2005.

Grizzly Bear Denning Chronology

Den entry and exit dates were summarized by week during 1983-05. Fifty-four den exit dates were available for summarization. Dates ranged from the third week of March to the third week of May (Figure 40). Forty-three exit dates occurred from the first through fourth weeks of April. Grizzly bears in the Cabinet Mountains generally exited dens at least one week later than bears in the Yaak river drainage. Males generally exited dens earlier than females. Females with cubs appear to exit dens later than other females.

Sixty-three den entry dates ranged from the third week of October to the last week of December. Thirty-eight of these dates ranged from the third week of November through the second week of December (Figure 41). Grizzly bears in the Cabinet Mountains generally entered dens at least 2 to 3 weeks earlier than bears in the Yaak river drainage. Males generally entered dens later than females.

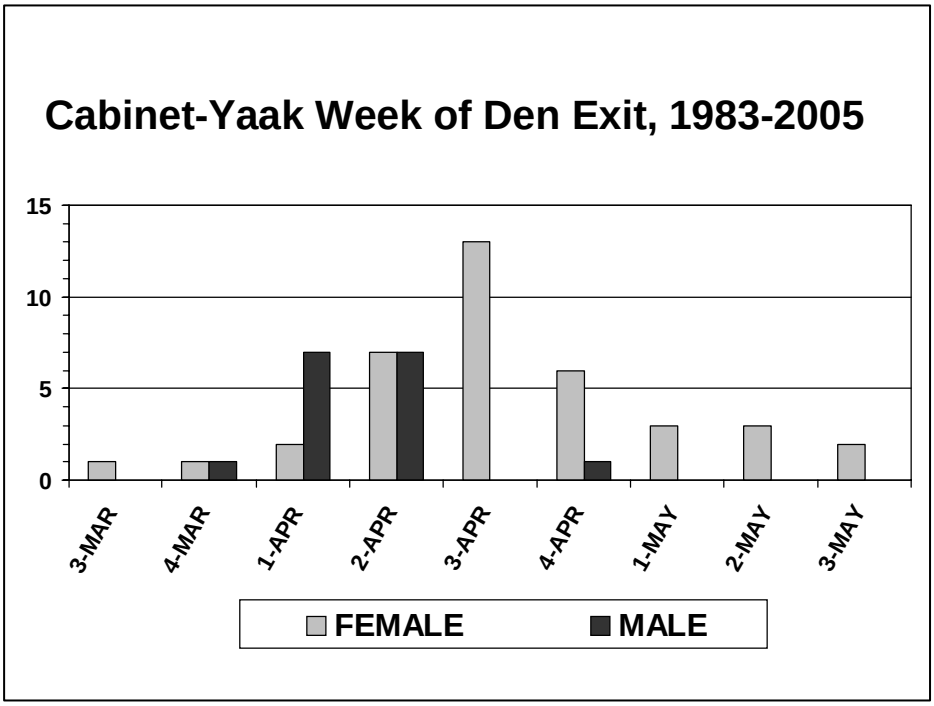


Figure 40. Week of den exit for radio collared grizzly bears in the Cabinet-Yaak recovery zone 1983-2005.

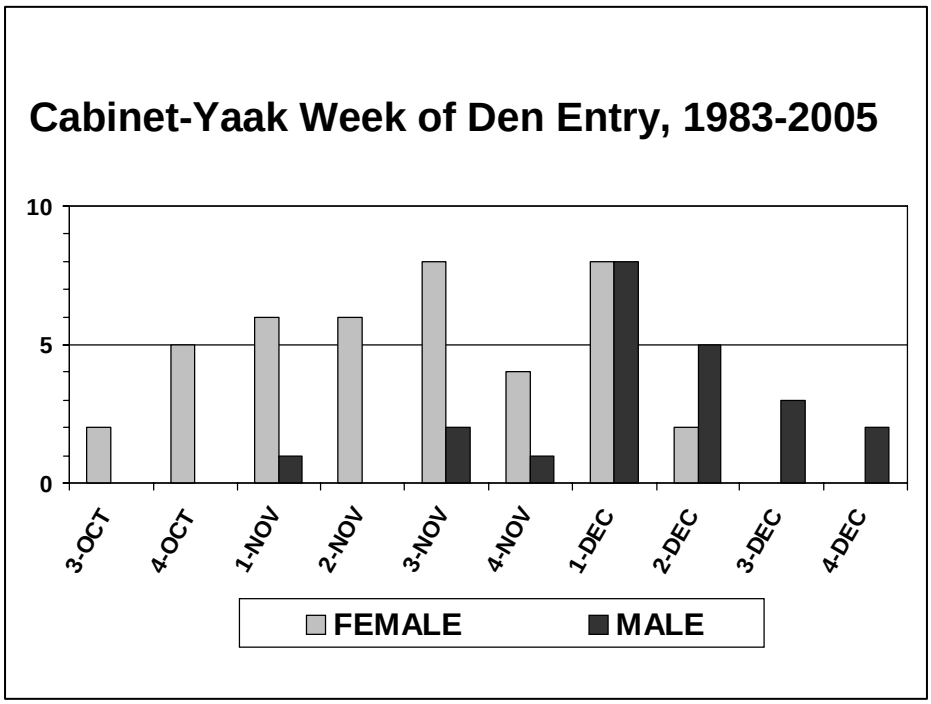
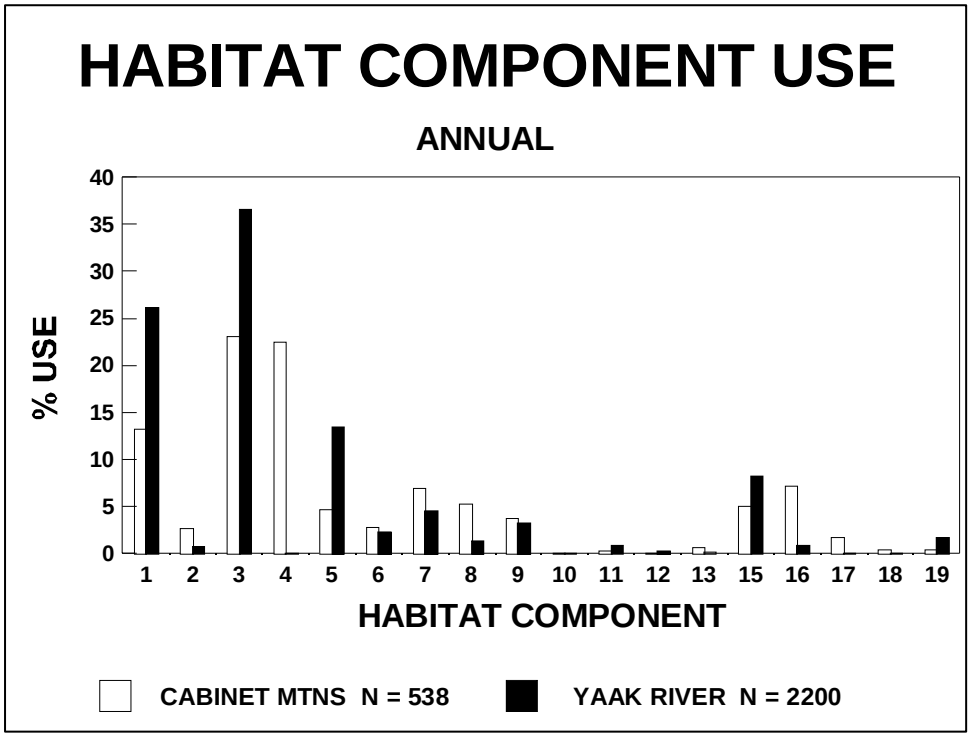


Figure 41. Week of den entry for radio collared grizzly bears in the Cabinet-Yaak recovery zone 1983-2005.

Grizzly Bear Use of Habitat Components

Grizzly bear use of habitat components was summarized on a seasonal basis. Spring was defined as den exit through 15 June, summer was 16 June through 15 September, and autumn was 16 September through den entry. Radiolocation sample sizes for the Cabinet Mountains were: 106 in spring, 314 in summer, and 106 in autumn. Radiolocation sample sizes for the Yaak River were: 458 in spring, 1003 in summer, and 688 in autumn. Den site sample sizes were 12 in the Cabinet Mountains and 51 in the Yaak River.

Radio collared grizzly bears in the Cabinet Mountains and Yaak River made greatest annual use of closed timber, timbered shrubfields, mixed shrub snowchutes, mixed shrub/cutting units, alder shrubfields, huckleberry shrubfields, and graminoid and beargrass sidehill parks (Fig. 42). Primary differences in annual use of habitat components include greater use of mixed shrub snowchutes, alder shrubfields, huckleberry shrubfields, and beargrass sidehill parks in the Cabinet Mountains and greater use of closed timber, timbered shrubfields, mixed shrub/cutting units, and graminoid sidehill parks in the Yaak River. A brief description of all 19 habitat components is provided in Appendix 3.



Habitat Components

1. Closed Timber
2. Open Timber
3. Timbered Shrubfield
4. Mixed Shrub/Snowchute
5. Mixed Shrub/Cutting Unit
6. Mixed Shrub/Burn
7. Alder Shrub
8. Huckleberry Shrub
9. Riparian Streambottom
10. Marsh
11. Wet Meadow
12. Dry Meadow
13. Drainage Forbfield
14. Snowchute
15. Graminoid Sidehill Park
16. Beargrass Sidehill Park
17. Slabrock
18. Talus/Rock/Scree
19. Timbered Grass

Figure 42. Annual habitat component use in the Cabinet Mountains and Yaak River, 1983-2005.

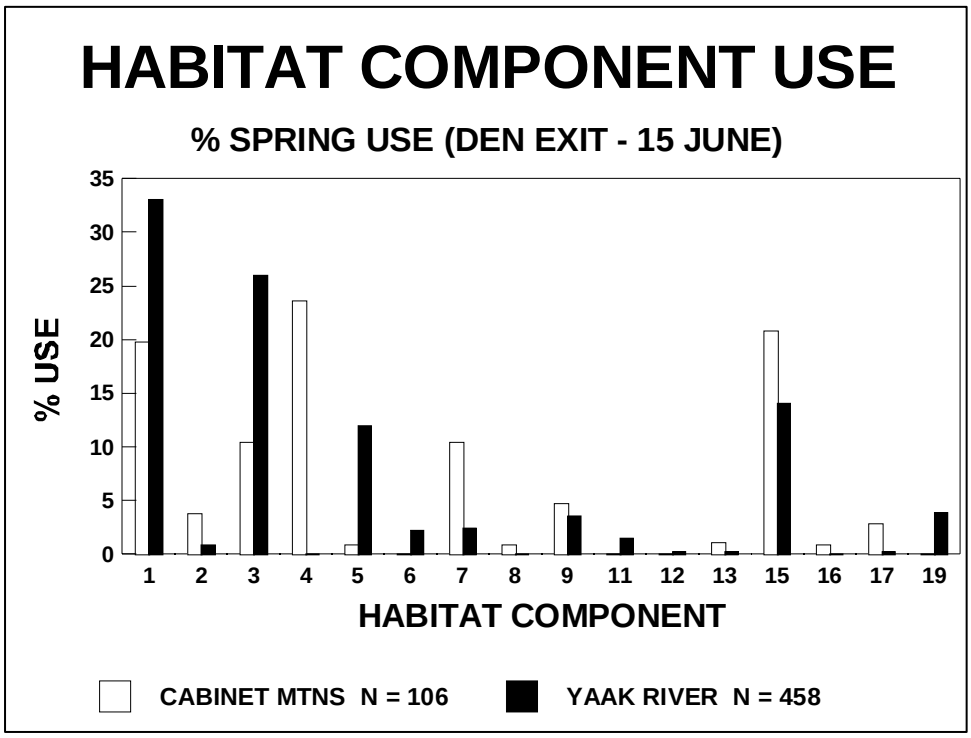
Spring use of habitat components by radio collared grizzly bears in the Cabinet Mountains and the Yaak River drainage was dominated by closed timber, timbered shrubfields, mixed shrub snowchutes, mixed shrub cutting units, alder shrubfields, and graminoid sidehill parks (Fig. 43). Notable differences between the two study areas include heavier use of snowchutes, alder, and graminoid parks in the Cabinet Mountains and heavier use of closed timber, timbered shrubfields, and cutting units in the Yaak River. Food habits indicate that bears are utilizing grasses, sedges, succulent forbs, and the corms of glacier lily and biscuitroot at this time of the year (Kasworm and Thier 1993). Snowchutes, cutting units, alder, and graminoid parks provide many of these items at this time.

Summer use of habitat components by radio collared grizzly bears in the Cabinet Mountains and the Yaak River drainage was dominated by closed timber, timbered shrubfields, mixed shrub snowchutes, mixed shrub cutting units, mixed shrub burns, alder shrubfields, huckleberry shrubfields, graminoid sidehill parks, and beargrass sidehill parks (Fig. 44). Differences between the two study areas include heavier use of snowchutes, huckleberry shrubfields, and beargrass parks in the Cabinet Mountains and heavier use of closed timber, timbered shrubfields, cutting units, and graminoid parks in the Yaak River. Food habits indicate heavy use of succulent forbs, insects, and berries (mostly huckleberries) (Kasworm and Thier 1993).

Autumn use of habitat components by radio collared grizzly bears in the Cabinet Mountains and the Yaak River drainage was dominated by closed timber, timbered shrubfields, mixed shrub snowchutes, mixed shrub cutting units, mixed shrub burns, alder shrubfields, huckleberry shrubfields, graminoid sidehill parks, and beargrass sidehill parks (Fig. 45). Differences between the two study areas include heavier use of snowchutes, huckleberry shrubfields, and beargrass parks in the Cabinet Mountains and heavier use of closed timber, timbered shrubfields, cutting units, and graminoid parks in the Yaak River. Autumn bear diets reverted back to grasses and sedges during late rains and subsequent green-up. Berries can still be important at this time of year when huckleberries are still available at higher elevations or mountain ash berries which persist on plants beyond first snowfall. Bears also utilize carrion and gut piles from hunter harvested or wounded deer and elk.

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

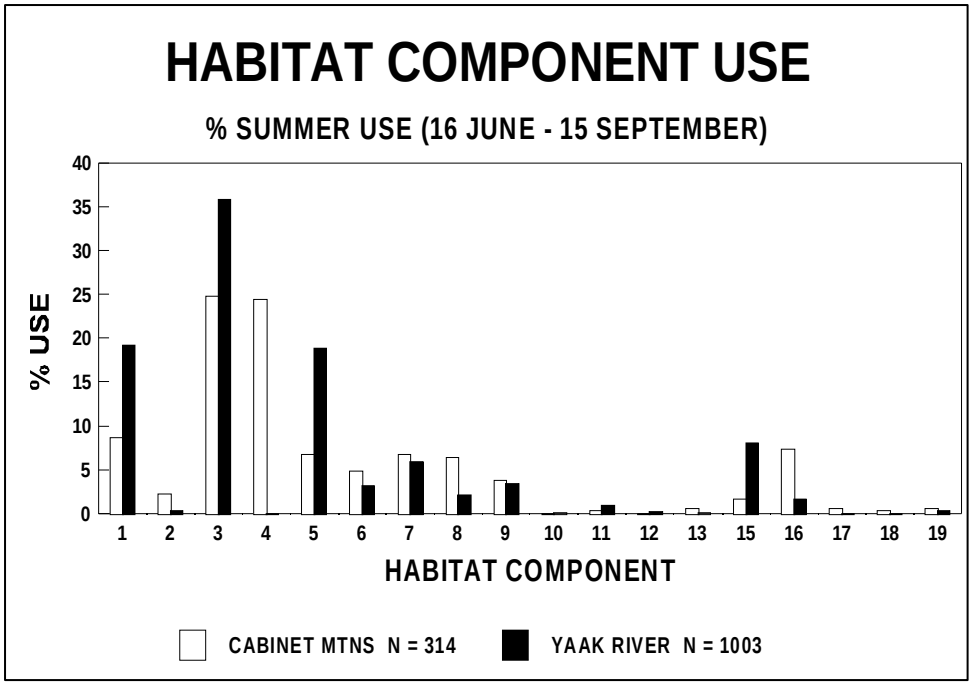
Den use of habitat components by radio collared grizzly bears in the Cabinet Mountains and the Yaak River drainage was dominated by closed timber, timbered shrubfields, graminoid sidehill parks, and beargrass sidehill parks (Fig. 46). Differences between the two study areas include heavier use of beargrass parks in the Cabinet Mountains and heavier use of closed timber, timbered shrubfields, and graminoid parks in the Yaak River.



Habitat Components

1. Closed Timber
2. Open Timber
3. Timbered Shrubfield
4. Mixed Shrub/Snowchute
5. Mixed Shrub/Cutting Unit
6. Mixed Shrub/Burn
7. Alder Shrub
8. Huckleberry Shrub
9. Riparian Streambottom
10. Marsh
11. Wet Meadow
12. Dry Meadow
13. Drainage Forbfield
14. Snowchute
15. Graminoid Sidehill Park
16. Beargrass Sidehill Park
17. Slabrock
18. Talus/Rock/Scree
19. Timbered Grass

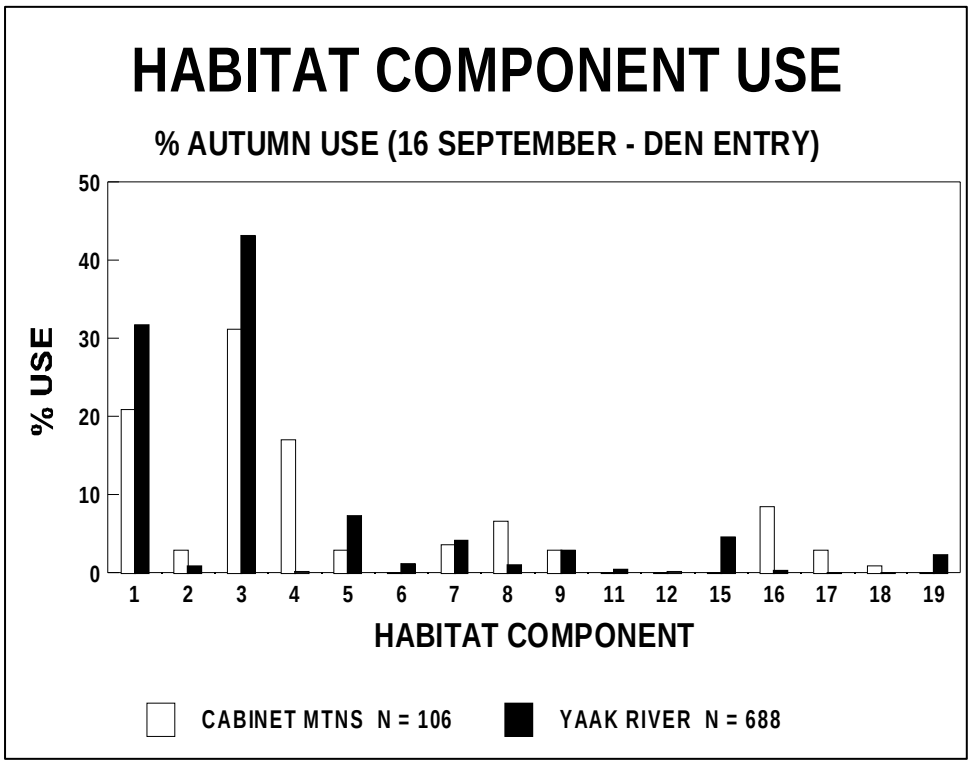
Figure 43. Spring habitat component use in the Cabinet Mountains and Yaak River, 1983-2005.



Habitat Components

1. Closed Timber
2. Open Timber
3. Timbered Shrubfield
4. Mixed Shrub/Snowchute
5. Mixed Shrub/Cutting Unit
6. Mixed Shrub/Burn
7. Alder Shrub
8. Huckleberry Shrub
9. Riparian Streambottom
10. Marsh
11. Wet Meadow
12. Dry Meadow
13. Drainage Forbfield
14. Snowchute
15. Graminoid Sidehill Park
16. Beargrass Sidehill Park
17. Slabrock
18. Talus/Rock/Scree
19. Timbered Grass

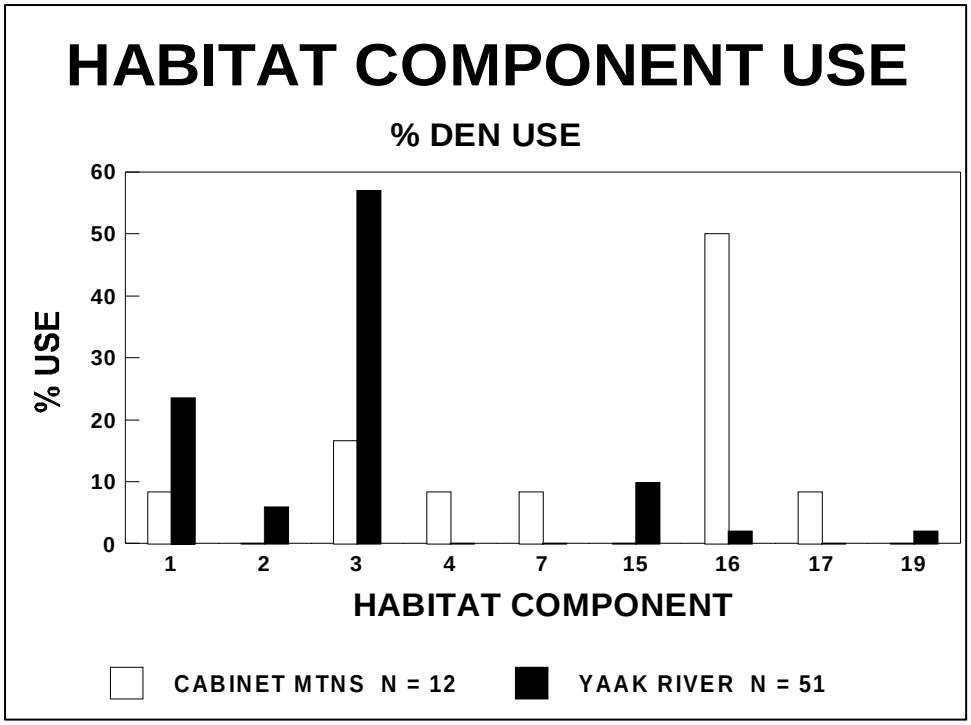
Figure 44. Summer habitat component use in the Cabinet Mountains and Yaak River, 1983-2005.



Habitat Components

1. Closed Timber
2. Open Timber
3. Timbered Shrubfield
4. Mixed Shrub/Snowchute
5. Mixed Shrub/Cutting Unit
6. Mixed Shrub/Burn
7. Alder Shrub
8. Huckleberry Shrub
9. Riparian Streambottom
10. Marsh
11. Wet Meadow
12. Dry Meadow
13. Drainage Forbfield
14. Snowchute
15. Graminoid Sidehill Park
16. Beargrass Sidehill Park
17. Slabrock
18. Talus/Rock/Scree
19. Timbered Grass

Figure 45. Autumn habitat component use in the Cabinet Mountains and Yaak River, 1983-2005.



Habitat Components

1. Closed Timber
2. Open Timber
3. Timbered Shrubfield
4. Mixed Shrub/Snowchute
5. Mixed Shrub/Cutting Unit
6. Mixed Shrub/Burn
7. Alder Shrub
8. Huckleberry Shrub
9. Riparian Streambottom
10. Marsh
11. Wet Meadow
12. Dry Meadow
13. Drainage Forbfield
14. Snowchute
15. Graminoid Sidehill Park
16. Beargrass Sidehill Park
17. Slabrock
18. Talus/Rock/Scree
19. Timbered Grass

Figure 46. Den habitat component use in the Cabinet Mountains and Yaak River, 1983-2005

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. 47). Annual mean elevation used by grizzly bears in the Cabinets Mountains was 1,596 meters compared to 1,489 meters for the Yaak River. Monthly mean elevation followed similar patterns with Cabinet Mountain grizzly bears utilizing higher elevations during most months except November. Sample size in the Cabinet Mountains during November was small, but bears were generally forced into lower elevations by snowfall prior to den entry and may have been responding to increased amount of carrion in the form of gut piles and wounded animals from hunters. Mean den elevation in the Cabinet Mountains was 1,891 meters and 1,698 meters in the Yaak River.

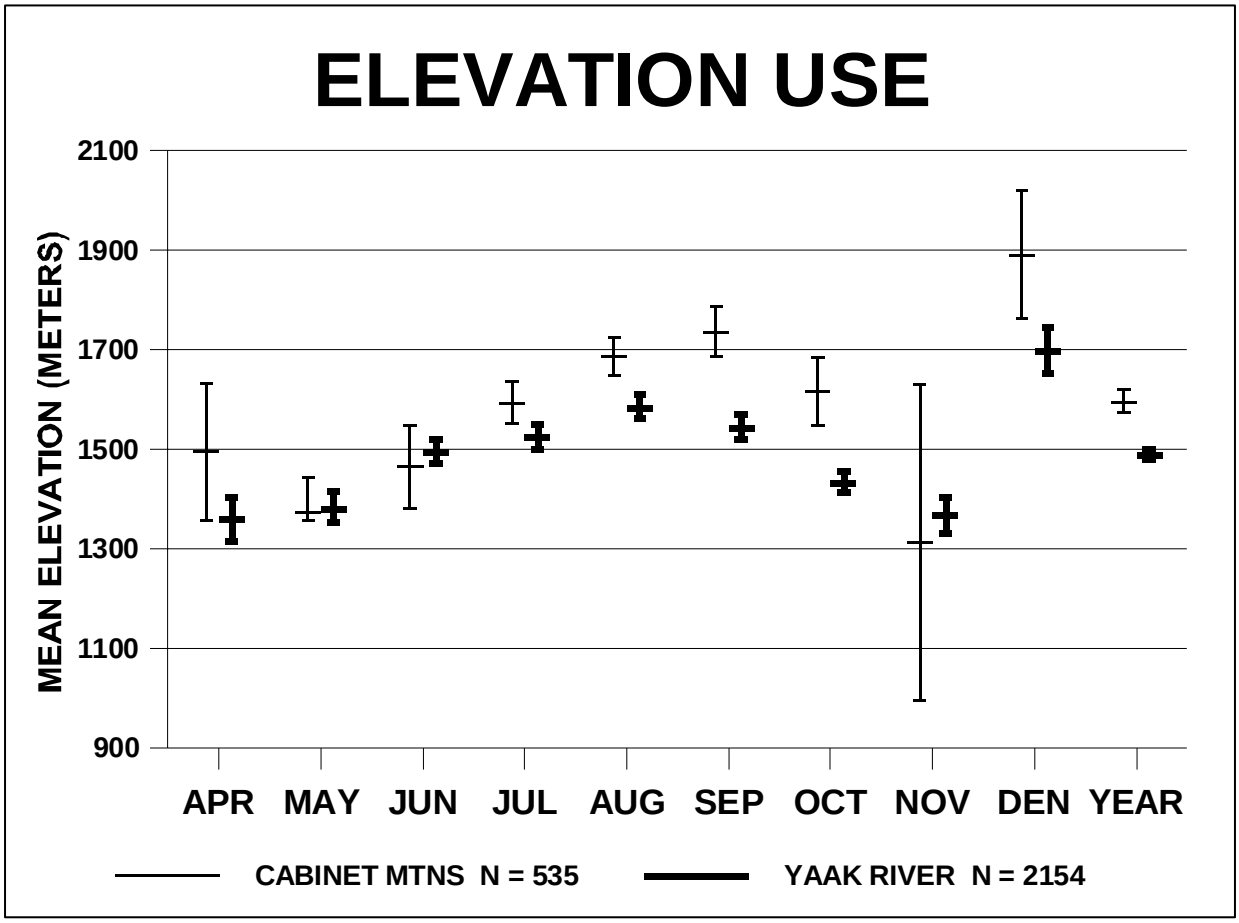


Figure 47. Mean elevation and 95% confidence intervals of radiolocations in the Cabinet Mountains and the Yaak River, 1983-2005.

Grizzly Bear Use by Aspect

Use of aspect by grizzly bears varied between the Cabinet Mountains and Yaak River study areas, particularly during early spring (Figs. 48-49). South aspects received greatest use by grizzly bears in the Cabinet Mountains during April and May. However, grizzly bears in the Yaak area showed more balanced use of all aspects during that time. Generally grizzly bears in the Cabinet Mountains made greater use of southerly slopes during all months than grizzly bears in the Yaak River. South aspects were most heavily used by grizzly bears in the Cabinet Mountains for den sites, but used least in the Yaak River. Elevation, slope, and the resultant vegetation in addition to snow melt likely interacted to produce the observed patterns of use.

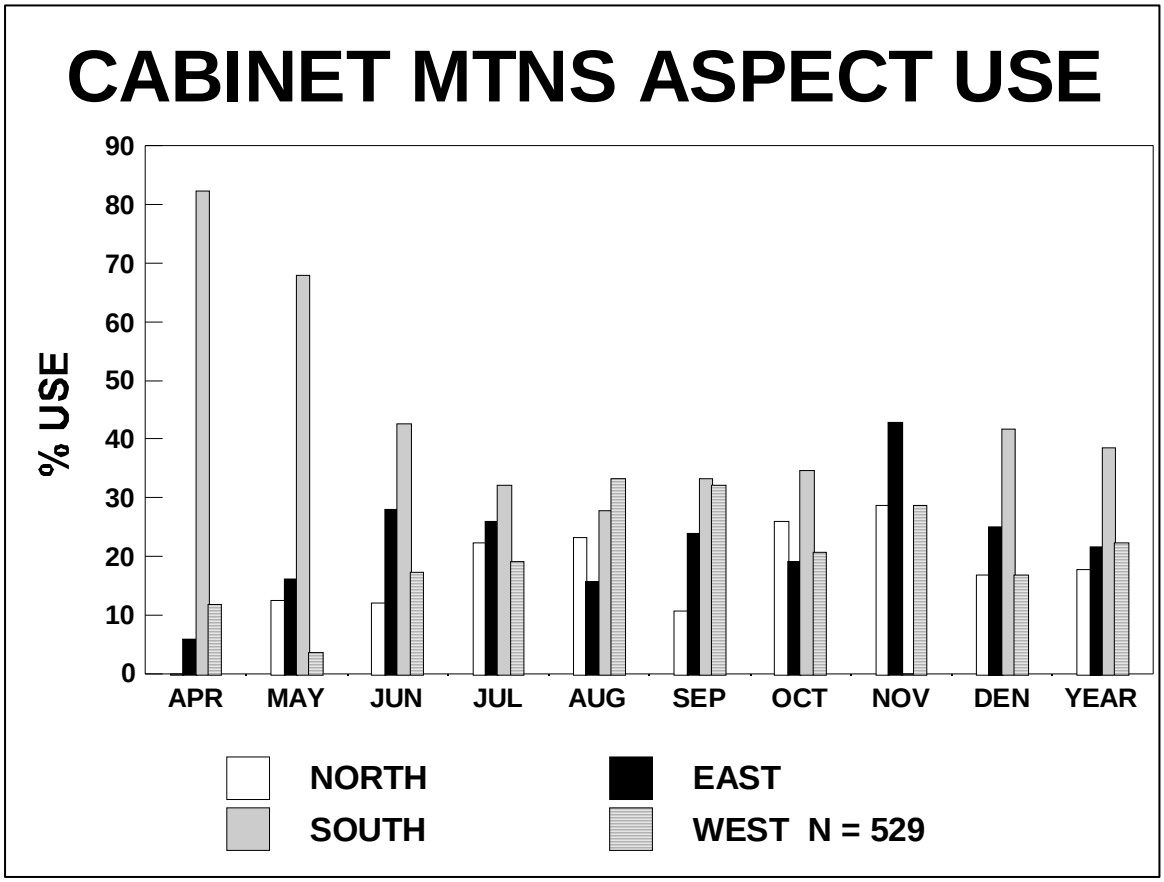


Figure 48. Aspect of radiolocations in the Cabinet Mountains, 1983-2005.

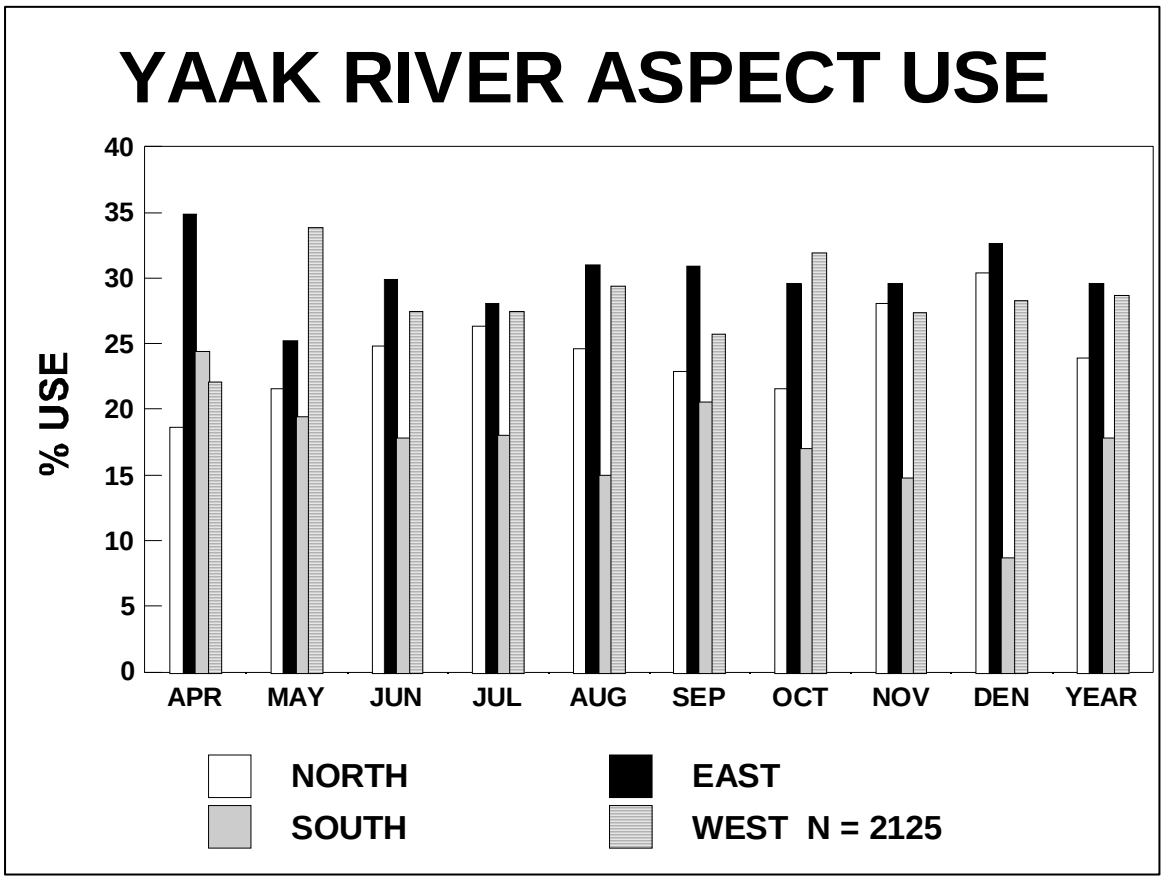


Figure 49. Aspect of radiolocations in the Yaak River, 1986-2005.

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 carrion from winterkills. Spring use of habitat in both study areas (April and May) indicated use of low elevation sites. Cabinet Mountains radio locations indicated most use below 1,600 m with primary use of southerly facing snowchutes, alder shrubfields, grassy sidehill parks, and closed timber. Yaak River radiolocations indicated most use below 1,400 m with primary use of closed timber, timbered shrubfields, cutting units, and grassy sidehill parks on virtually all aspects. This may be due to the lower elevation of the Yaak River area, which allows the snow to melt, and vegetation to green-up earlier than the Cabinet Mountains.

Berry Production Monitoring

Huckleberry

Eleven huckleberry transects were evaluated during 1989, 19 transects were evaluated during 1990-99, 18 in 2000, 20 in 2001 ,21 in 2002-03, 23 in 2004 and 16 in 2005. Mean berry count per plot for all transects combined was 1.5 (95% CI ± 0.1) during the study period. Mean annual berry counts during 1989-2005 ranged from 0.5-3.1 (Fig. 50). Low berry counts occurred in 1992, 1998 and 2003. High berry counts occurred in 1989, 1990, 1991, and 1996.

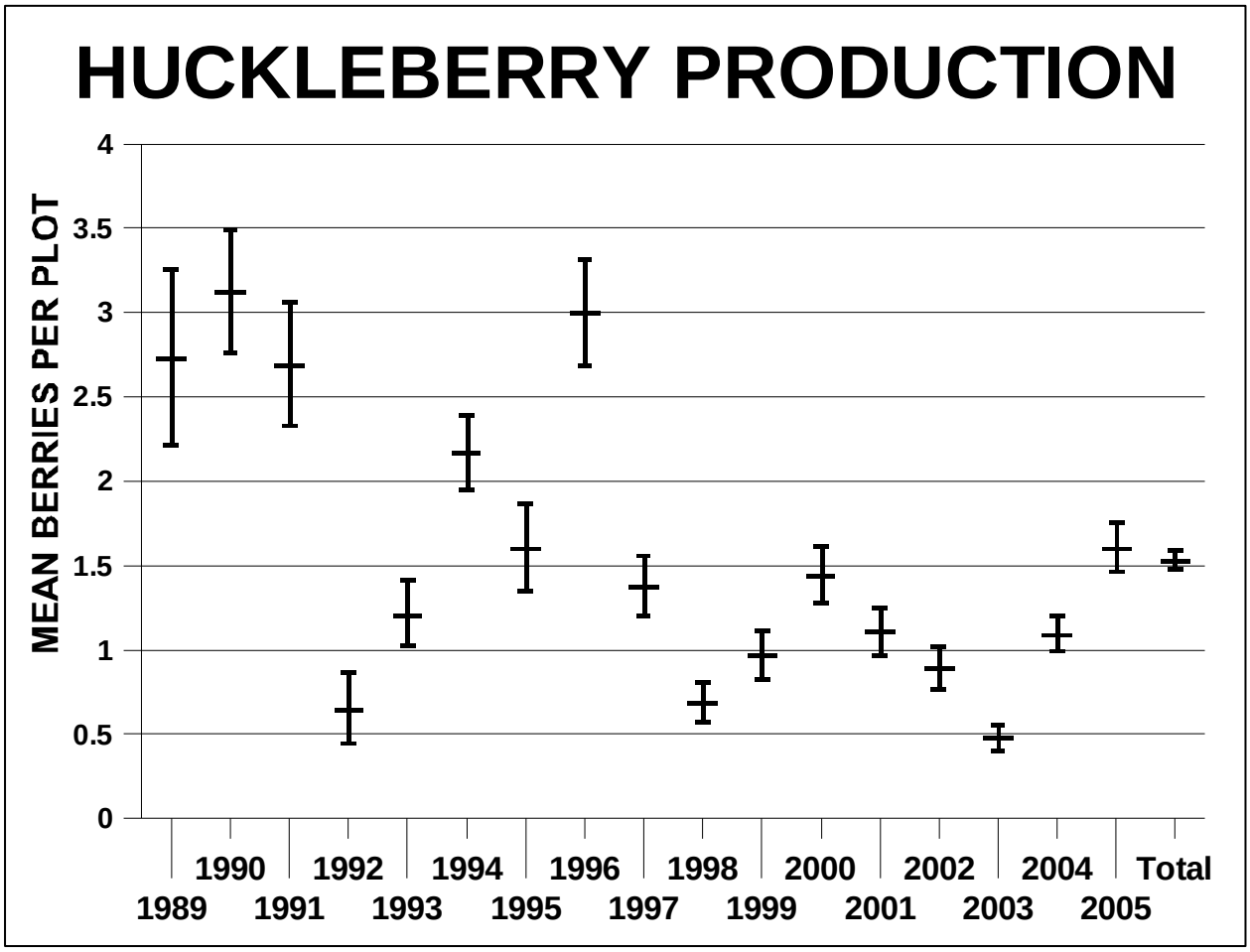


Figure 50. Mean berries per plot and 95% confidence intervals for huckleberry transects in the Yaak River, 1989-2005.

Buffaloberry

Five buffaloberry transects were evaluated during 1990-04, and 4 during 2005. Mean berry counts per plot from all transects was 1.5 (95% CI ± 0.22) during the study period. Mean berry counts ranged from 0.3 to 3.3 berries per plot from 1990 to 2005 (Fig. 51), with low counts occurring in 1992, 1995, 1998, 1999, 2000, 2003 and 2005. High counts occurred in 1990, 1991, 1996 and 2002.

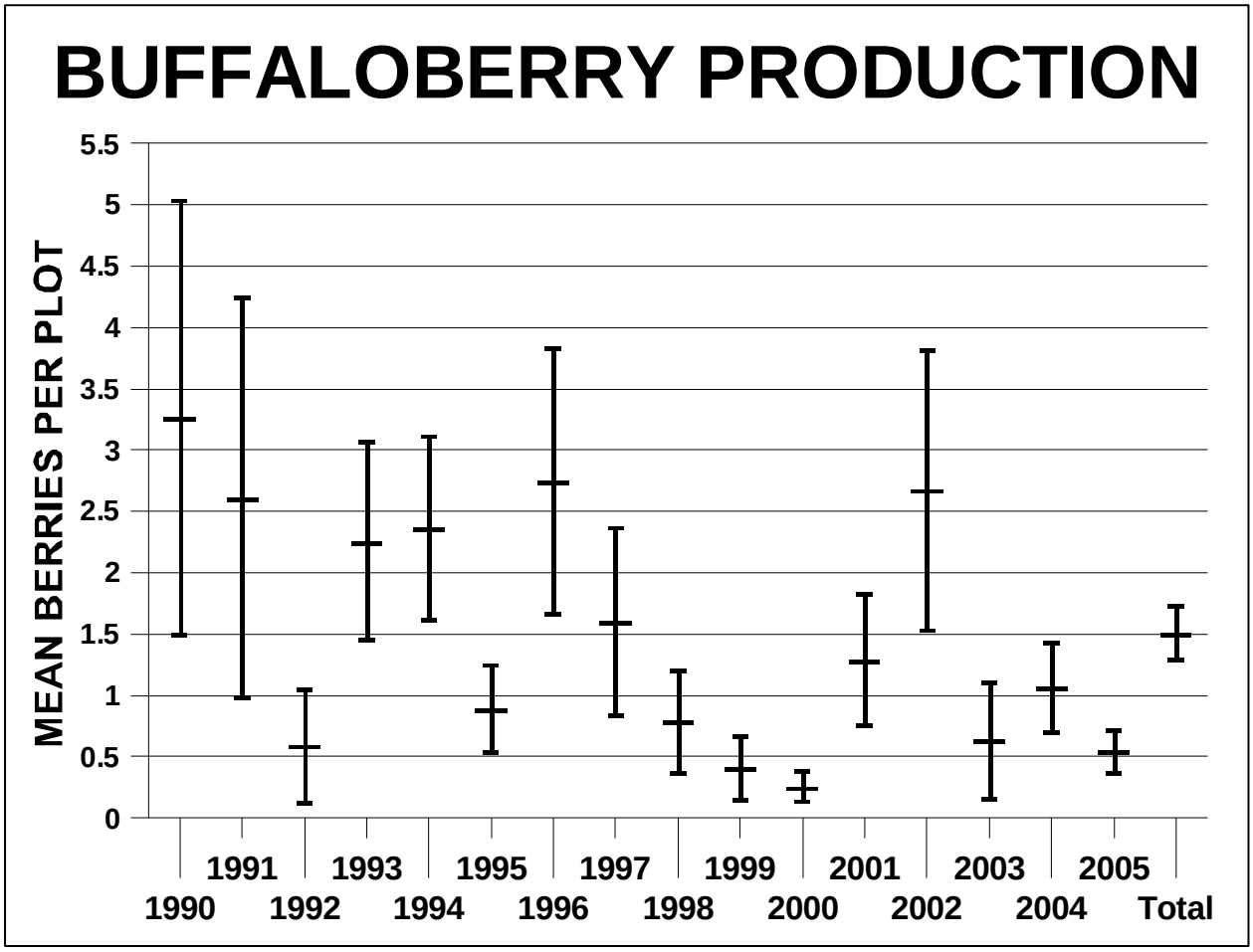


Figure 51. Mean berries per plot and 95% confidence intervals for buffaloberry transects in the Yaak River, 1989-2005.

Serviceberry

Five sites were evaluated for serviceberry production during 1990-96. One more site was added in 1997 and again in 2005. Mean berry count per plant was 131 (95% CI ±19) during the study. Mean berry counts per plant varied from 12 to 355 during the years 1990 to 2004 (Fig. 52). Low counts occurred during 1992, 1994, 1998, 1999, 2002, 2004 and 2005. High counts occurred during 1990 and 1995.

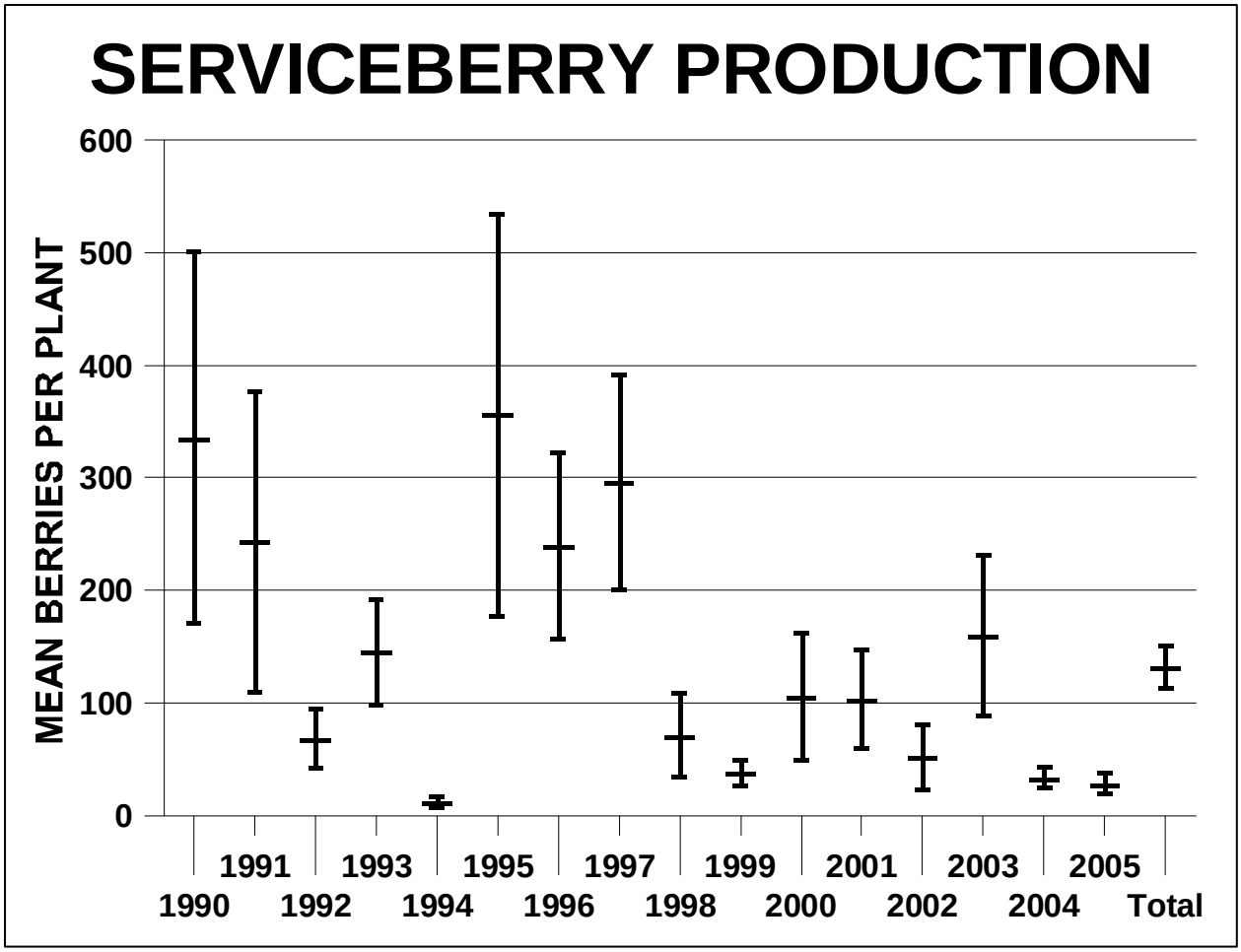


Figure 52. Mean berries per plot and 95% confidence intervals for serviceberry transects in the Yaak River, 1989-2005.

Mountain Ash

Three sites were evaluated for mountain ash production in 2001-05. Total mean berry counts for each year were 392, 147, 66, 141 and 226 respectively, with the lowest elevation site producing the most berries. The mean berry count for five years combined was 194 (95% CI ± 41).

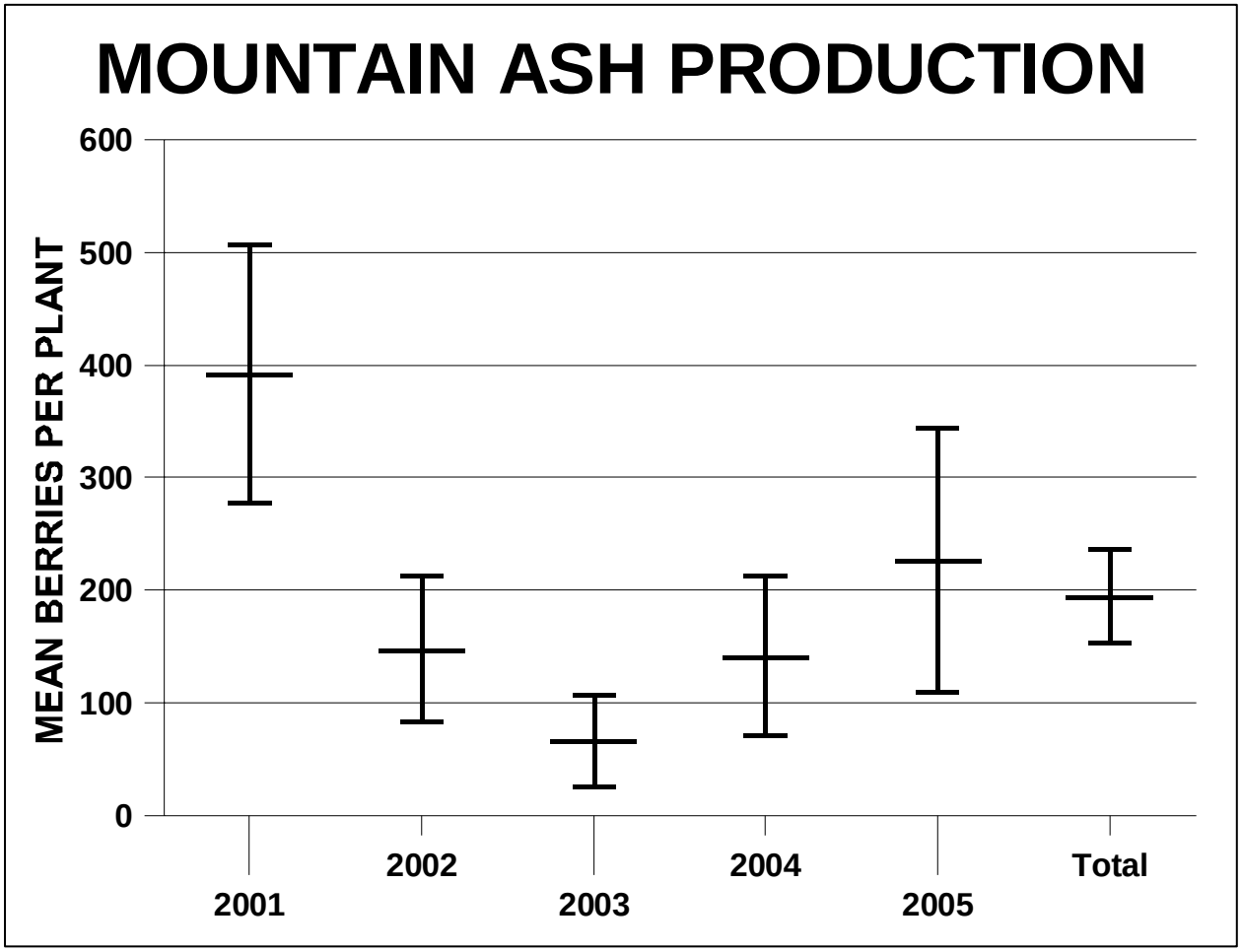


Figure 52. Mean berries per plot and 95% confidence intervals for mountain ash transects in the Yaak River, 2001-2005.

Low berry counts were recorded for huckleberry, buffaloberry, and serviceberry in 1992 and 1998. Buffaloberry and serviceberry counts were low in 1999 and 2005. The lowest berry count recorded for huckleberry during the study occurred in 2003. Low counts were also recorded for serviceberry in 1994 and 2004, and for buffaloberry in 1995, 2000 and 2003. High berry counts for all three species occurred in 1990. All transects will continue to be evaluated each year during the study. Timing of sampling will be adjusted for peak berry ripening.

Grizzly Bear Population Size

Observations and captures of grizzly bears by study personnel in the Yaak study area were examined to evaluate minimum population size for 1989-2004. Individuals not radio collared were separated by size, age, location, coloration, genetic information, or reproductive status. Some sightings believed to be the same individuals may actually consist of separate additional individuals. Additional new information may change individual status or relationships. Less capture activity occurred during 1998-2001 because trapping personnel were not available during June and forest fires or hot, dry conditions eliminated trapping activity during August and September. This has reduced the marked sample and ability to discern new individuals.

Fifty-four individuals were identified with 33 bears radio collared and 21 unmarked individuals from 1989-2005 (Table 11). Twenty-two of these animals are known or suspected to have died during 1989-05. Human causes were linked to 14 of these mortalities. The remaining 8 are believed to have died of natural causes during 1999-2001. Seven of these 8 mortalities involved cubs. The increase in natural mortality beginning in 1999 may be linked to poor food production during 1998-2000. Huckleberry production during these years was about half the 11-year average. Huckleberries are the major source of late summer food that enables bears to accumulate sufficient fat to survive the denning period and females to produce and nurture cubs. Poor nutrition often causes females to not produce cubs in the following year. Poor food production may also cause females to travel further for food, which may expose cubs to greater risk of mortality from predators or accidental deaths. Four of 7 cub mortalities have come from one female bear that lost litters of 2 cubs each during 2000 and 2001. Another mortality incident involved a female with 2 cubs that appear to have been killed by another bear in 1999. The effect of this cub mortality may be greatest in succeeding years when some of these animals might have been recruited to the reproductive segment of the population.

Similar observations, captures, and photographic information from the Cabinet Mountains was collected and summarized for 2001-2005 (Table 12). Few observations limit use of this information prior to 2001. The data set is not comparable to the Yaak area data because of less effort expended in trapping and monitoring collared individuals. However, 16 different bears were identified by this technique during 2001-2005, with 3 of these known to be dead.

Total animals identified during 1989-2005 (54 bears) less known mortality (22 bears) would suggest a population of at least 32 animals. It is unlikely that all identified animals have survived the entire period. Using only animals identified during 1998-2005 (41) less known mortality (18) suggests a population of at least 23. This estimate is conservative because study personnel observations alone would not likely sample all bears in the area, some sightings classified as the same animal may represent different animals, and the study has received several credible public reports of additional bears not included in this analysis. Since 1989 there have been credible sightings of bears in all 8 BMUs that make up the Yaak portion of the recovery area, with sightings of females with young in 6 BMUs. About half of the credible observations of females with young in these BMUs did not appear to come from marked bears. The actual number of unmarked females represented is unknown. A minimum population estimate of 20-30 grizzly bears for the Yaak portion of the recovery zone appears reasonable.

The Cabinet Mountains population was estimated to be 15 bears or fewer in 1988 (Kasworm and Manley 1988). There is insufficient data to dramatically improve that estimate, but since 1988 the population was augmented with 5 females, credible sightings of individual bears have occurred in all 14 BMUs from the Cabinet Mountains, with sightings of females with young in 7 BMUs since the completion of transplants. Based on these data, we conservatively estimate the minimum population of the CYGBRZ at 30-40 grizzly bears.

Table 11. Grizzly bears captured or observed by study personnel in the Yaak study, 1989-05.

Bear	Sex	Years Radioed or Observed	Comments
106	F	1989-1999	Radio collared 1986-99. Mortality 1999.
129	F	1989	Radio collared 1986-89. Mortality 1989.
128	M	1989-92, 1997	Radio collared 1989-92 and 1997.
192	M	1988-1990	Offspring of 106. Radio collared 1989-90.
193	M	1988-1990	Offspring of 106. Radio collared 1989-90. Possible mortality 1990.
206	F	1988-95, 1997	Offspring of 106. Radio collared 1990-95. Observed 1997.
?	F	1990	Female consort of bear 128 in W. F. Yaak 1990.
?	M	1990, 1994, 1996, 1999	Large, unmarked black male bear with 106 1990 & 1994, with 303 1996 & 1999.
?	?	1991-92	Offspring of 106.
?	?	1991-92	Offspring of 106.
244	M	1992-94, 2003-04	Radio collared 1992-94 & 2003-04.
302	M	1993-96	Offspring of 106. Radio collared 1994-96. Mortality 1996.
303	F	1993-96, 1998-01, 2003	Offspring of 106. Radio collared 1994-96, 1998-01. Possibly observed 2003.
34	F	1993	Transplanted to Bloom Creek by BC 1993, captured in US 1993.
355	M	1993, 1996	Possible 1993 consort of 206. Radio collared 1996. Mortality 1996.
358	M	1993, 1996-98	Possible 1993 consort of 206. Radio collared 1996-98. Mortality 1999.
505	F	1994-95, 1998	Offspring 206. Radio collared 1994-95. Observed 1998.
?	?	1994-95, 1998	Offspring 206, sibling of bear 505. Observed 1994-95, 1998.
?	F	1994, 1998	Unmarked female consort of 244, possibly unmarked female consort of 363.
353	F	1995-1999, 2002	Offspring 106. Radio collared 1995-97 & 2002. Observed 1998-99. Mortality 2002.
354	F	1995-99	Offspring bear 106. Radio collared 1995-99.
?	?	1995	Bear seen twice near 303 (similar or smaller size).
342	M	1996-99, 2003-04	Radio collared 1996-99 & 2003-04.
363	M	1996-99	Radio collared 1996-99.
592	F	1998, 1999-00	Offspring of 206. Radio collared 1999. Mortality 2000.
596	F	1997, 1999	Offspring of 206. Radio collared 1999. Mortality 1999.
386	M	1997-98, 2000-01	Radio collared 1997-98. Possibly consort of 538 in 2000 , 2001
384	M	1997	Radio collared 1997.
538	F	1997-02	Radio collared 1997-02.
?	?	1997-98	Offspring bear 538. Possibly unmarked subadult observed in 2001.
?	?	1999	Offspring bear 106. Mortality 1999.
?	?	1999	Offspring bear 106. Mortality 1999.
?	?	2000	Offspring bear 538. Mortality 2000.
?	?	2000	Offspring bear 538. Mortality 2000.
?	?	2000	Offspring bear 303. Mortality 2000.
552	F	2000,2001	Offspring bear 303.
?	?	2001	Offspring bear 538. Mortality 2001.
?	?	2001	Offspring bear 538. Mortality 2001.
?	F	2001	Unmarked yearling female killed by mistaken identity, 2001
?	F	2002	Offspring bear 353. Mortality 2002.
?	?	2002	Offspring bear 353. Assumed mortality 2002.
?	?	2002	Offspring bear 353. Assumed mortality 2002.
?	?	2002	Offspring bear 538.
?	?	2002	Offspring bear 538.
651	M	2002	Radio collared 2002.
787	M	2003-04	Radio collared 2003-04.
576	M	2004-05	Radio collared 2004. GPS collar 2005.
675	F	2004-05	Radio collared 2004-05
677	M	2005	Radio collared 2005.
17	M	2005	Radio collared 2005.
292	F	2005	Radio collared 2005.
694	F	2005	Radio collared 2005. Mortality 2005.
M1	M	2005	Radio collared 2005.
668	M	2005	Radio collared 2005. Mortality 2005.

Table 12. Grizzly bears captured, photographed, or observed by study personnel in the Cabinet Mountains, 2001-05.

Bear	Sex	Years Radioed or Observed	Comments
?	?	2001-03	Unmarked adult observed in 2001, 2002, and 2003.
?	?	2001-2003	Unmarked subadult observed and photographed in 2001, 2002, and 2003.
?	F	2001	Train collision mortality 2001.
577	F	2002	Mortality 2002. Sibling 578 and 579.
578	M	2002	Sibling 577 and 579.
579	M	2002	Sibling 577 and 578.
?	?	2002	Unmarked adult photographed in 2002.
?	F	2002	Adult female with 3 young photographed in 2002.
?	?	2002	One of 3 young photographed in 2002.
?	?	2002	One of 3 young photographed in 2002.
?	?	2002	One of 3 young photographed in 2002.
?	?	2004	At least 1 cub photographed with adult female.
?	?	2005	At least 1 cub photographed with adult female.
770	M	2005	Adult male collared.
A1	F	2005	Augmentation bear released in the W. Cabinets. Radio collared 2005.
?	F	2005	Train collision mortality 2005.

Grizzly Bear Mortality and Population Trend Estimate

This segment of the report updates information on survival rates, cause-specific mortality and population trend following the methods used in a peer reviewed journal paper (Wakkinen and Kasworm 2004). Comparisons of these estimates of trend with previous estimates from this recovery zone must consider changes in methods suggested by peer review used in Wakkinen and Kasworm (2004). These survival and reproductive estimates super cede all previous calculations and are based on the most current information.

Cabinet-Yaak Total Known Mortality

Forty instances of grizzly bear mortality were detected inside or within 16 km of the Cabinet-Yaak recovery zone (including Canada) during 1982-2005 (Appendix Table 2, Table 13, Fig. 53). This summary included radio collared bears regardless of where they died. Seven adult females, 7 adult males, 6 female subadults, 3 male subadults, 2 female yearlings, and 2 female cubs were included in the known sex and age individuals. Mortality cause frequency in descending order was natural (12), poaching (7), mistaken identity (5), unknown but human-caused (5), defense (3), management removal (3), train collision (2), hunting (1), research (1), and unknown (1). Four mortalities were known to have occurred during spring, 13 during summer, 20 during autumn, and 3 unknown. All 12 natural mortalities occurred during summer. One poaching mortality occurred during spring, 5 occurred during autumn, and one was unknown. One unknown but human-caused mortality occurred during spring and 4 occurred during autumn. One mistaken-identity mortality occurred during spring, 3 occurred in autumn, and 1 was unknown. All defense of life, management removals, and train collisions occurred during autumn. The hunting mortality occurred during spring and the research death occurred during summer. The public reported 20 of 40 (50%) total mortality incidents and 19 of 27 (70%) human-caused mortalities to management authorities. Other mortality was discovered by agency personnel or with the aid of radio telemetry. Seven of 11 (64%) human caused mortalities occurring on the National Forests were within 500m of an open road. Sixteen

instances of known mortality occurred during the 17-year period from 1983-1998, however 24 instances of known mortality occurred during 1999-2005. Twelve of the 16 (75%) mortalities occurring during 1983-1998 were human-caused and 15 of 24 (63%) mortalities during 1999-2005 were human-caused. Rates of human-caused mortality were 0.71 mortalities per year from 1983-1998 and 2.14 mortalities per year from 1999-2005.

Table 13. Causes and timing of known grizzly bear mortalities in or within 10 miles of the Cabinet-Yaak recovery zone (including Canada) and all radio collared bears, 1983-2005.

	Mortality cause										
Age / sex / season	Defense of life	Hunting	Management removal	Mistaken identity	Natural	Poaching	Research	Train Collision	Unknown, human	Unknown	Total
Adult female	1		1		2	1		1		1	7
Subadult female	1						1	1	3		6
Adult male	1	1	2			2			1		7
Subadult male				1		1			1		3
Yearling				1	1						2
Cub				1	9	3					13
Unknown				2							2
Total	3	1	3	5	12	7	1	2	5	1	40
Season											
Spring[1]		1		1		1			1		4
Summer[2]					12		1				13
Autumn[3]	3		3	3		5		2	4		20
Unknown				1		1				1	3

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

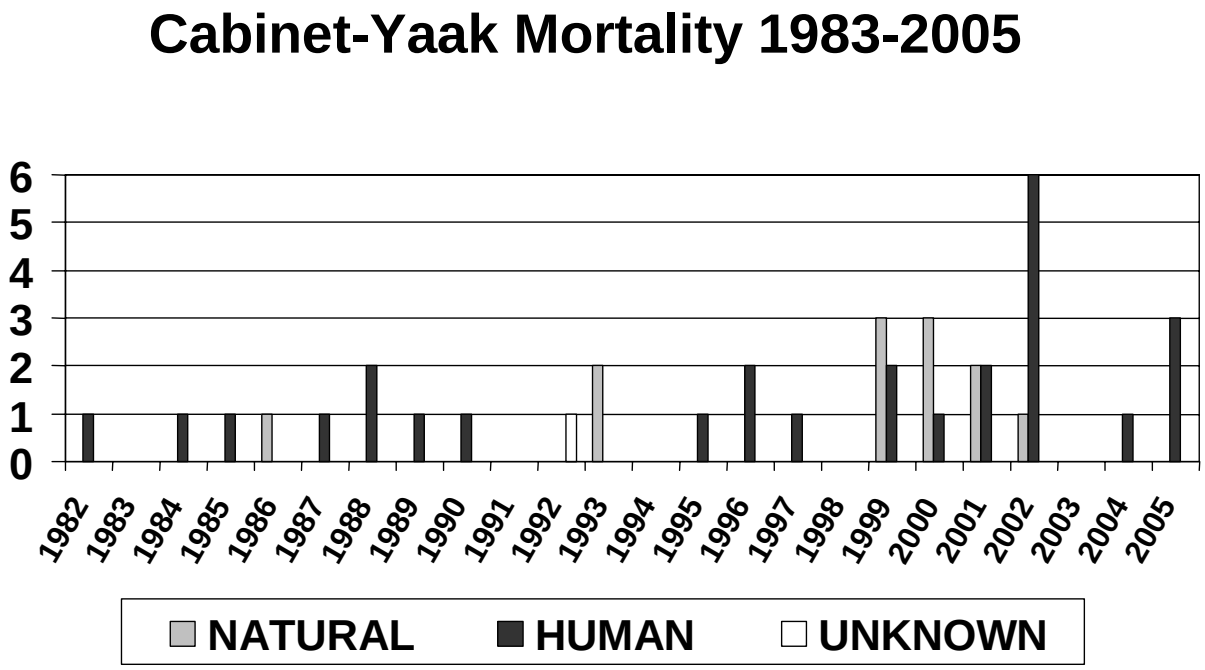


Figure 53. Grizzly bear annual mortality in or within 10 miles of the Cabinet-Yaak recovery zone (including Canada) and all radio collared bears by cause, 1982-2005.

Cabinet-Yaak Survival and Cause-Specific Mortality

Survival and cause-specific mortality rates were calculated for 6 sex and age classes of bears (Table 14). Adult female survival was 0.899 (95% CI 0.796-1.000) with 1 instance of poaching and 2 instances of natural mortality among 10 radio-collared bears monitored for 28.9 years. The poaching mortality occurred during autumn and both natural mortalities occurred during summer. Adult male survival was 0.871 (95% CI 0.740-1.000) with 1 hunting mortality, 1 defense of life, and 1 unknown but human-caused mortality among 15 radio collared bears monitored for 22.6 years. The hunting mortality occurred during spring in an area 35 km northwest of the recovery zone in British Columbia. The defense of life and the unknown but human-caused mortality occurred during autumn. Subadult female survival was 0.752 (95% CI 0.562-0.942) among 13 bears monitored for 14.7 years. The research mortality occurred in summer when a bear captured in a foot snare was killed by another grizzly bear. A defense of life and 2 unknown but human-caused mortalities occurred during autumn. Nine subadult males were monitored for 6.0 years and produced a survival rate of 0.667 (95% CI 0.329-1.0). There was 1 spring unknown but human-caused mortality and a mistaken identity during autumn. Yearling survival was 0.875 (95% CI 0.661-1.089) among 17 bears monitored for 9.5 years. One bear died during summer from natural causes. Twelve of 31 cubs died resulting in a survival rate of 0.571 (95% CI 0.393-0.750). Three cubs died by poaching during autumn and 9 cubs were believed to have died of natural causes with 2 during spring and 7 during summer.

Table 14. Survival and cause-specific mortality rates of grizzly bear sex and age classes based on censored telemetry data in the Cabinet–Yaak recovery zone, 1983–2005.

	Demographic parameters and mortality rates					
Parameter	Adult female	Adult male	Subadult female	Subadult male	Yearling	Cub
Individuals / bear-years	10 / 28.9	15 / 22.6	13 / 14.7	9 / 6.0	17 / 9.5	28 / 28[a]
Survival[b] (95% CI)	0.899 (0.796–1.0)	0.871 (0.740-1.0)	0.752 (0.562–0.942)	0.667 (0.329-1.0)	0.875 (0.661–1.0)	0.571 (0.393–0.750)
Mortality cause						
Hunting	0	0.050	0	0	0	0
Natural	0.071	0	0	0	0.125	0.321
Defense of life	0	0.040	0.054	0	0	0
Mistaken ID	0	0	0	0.167	0	0
Poaching	0.030	0	0	0	0	0.107
Research	0	0	0.091	0	0	0
Unknown	0	0.040	0.104	0.167	0	0

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

Cabinet-Yaak Reproduction

Fourteen litters comprised of 29 cubs were observed through monitoring radio-collared bears, for a mean litter size of 2.07 (95% C.I. 1.80-2.35). Three radio-collared adult female bears provided 7 complete interbirth intervals. Mean interbirth interval was 3.0 years (95% C.I. 1.9-4.1). Two successive instances of a female losing a complete litter of cubs prior to breeding season and producing another litter the following year were observed. Sex ratio of bears captured as cubs or yearlings was 8 females and 5 males. Estimated reproductive rate was 0.287 female cubs/year/adult female (95% C.I. 0.192-0.464). Age of first parturition was 6.6 years (95% CI; 5.9-7.3, n=5).

Cabinet-Yaak Population Trend

The estimated finite rate of increase (λ) for 1983-2005 was 0.929 (95% CI = 0.801-1.025) based on the estimated demographic variables (Table 15). Adult female survival (44.5%) and subadult female survival (42.8%) accounted for most of the uncertainty in λ, with reproductive rate (6.6%), yearling survival (3.0%), cub survival (2.9%), and age at first parturition (0.3 %) contributing much smaller amounts. The sample sizes available to us to calculate population trend are small and small samples sizes yield wide confidence intervals around any calculated trend estimate (λ). The probability that the population was declining is 91.4%.

Table 15. Estimated annual survival rates, age at first parturition, reproductive rates, and population trend of grizzly bears in the Cabinet–Yaak recovery zone, 1983–2005.

Parameter	Sample size	Estimate (95% CI)	SE	Variance (%)[a]
Adult female survival[b] (S_a)	10 / 28.8[c]	0.896 (0.734–1.0)	0.065	44.5
Subadult female survival[b] (S_s)	13 / 14.7[c]	0.766 (0.539–0.947)	0.104	42.8
Yearling survival[b] (S_y)	17/9.2[c]	0.851 (0.535–1.0)	0.140	3.0
Cub survival[b] (S_c)[d]	28/28	0.571 (0.393–0.750)	0.093	2.9
Age first parturition (a)	5	6.6 (6.2–7.0)	0.221	0.3
Reproductive rate (m)[e]	3/6[f]	0.287 (0.192–0.464)	0.071	6.6
Maximum age (w)	Fixed	27		
Lambda (λ)	5000 bootstrap runs	0.929 (0.801–1.025)	0.057	

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

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Appendix 1. GPS Collar Fix Success in the Purcell Mountains

Tabitha Graves, College of Forestry and Conservation, UH 309, University of Montana, Missoula, MT 59812, tgraves@forestry.umt.edu

Thomas G. Radandt, U.S. Fish and Wildlife Service, UH 309, University of Montana, Missoula, MT 59812, Thomas_radandt@fws.gov

Introduction

The purpose of this study was to determine how well GPS collars would work in the wet, highly vegetated Purcell Mountains within the Cabinet Yaak Recovery Zone (USFWS 1993). No previous studies have addressed GPS collar success in this ecosystem. Recent studies have indicated that the position of the animal may influence fix success, so we explored the effects of collar height on fix success as well.

Study Area

The Yaak River lies in the extreme northwestern corner of Montana, northeastern Idaho, and southern British Columbia. The study area 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 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. Climate is dominated by Pacific Maritime weather patterns that produce 100-150 cm of annual precipitation, which occurs primarily as snow. 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 (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*) are common at lower elevations on south and western 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. Understory and non-forested habitats include graminoid parks consisting primarily of fescue (*Festuca* spp.) and bluebunch wheatgrass (*Agropyron spicatum*), which occur at moderate to high elevations. Riparian shrubfields of red-osier dogwood (*Cornus stolonifera*) and hawthorn (*Crataegus douglasii*) are prevalent along major drainages. Buffaloberry (*Shepherdia canadensis*) is common under stands of open lodgepole pine while serviceberry (*Amelanchier alnifolia*) and chokecherry (*Prunus virginiana*) prevail on drier, rockier sites. Huckleberry shrubfields are often found under open timber canopies adjacent to graminoid parks, in old burns, in cutting units, and intermixed with beargrass (*Xerophyllum tenax*) (Kasworm et al 2002).

Methods

We placed GPS collars at 14 sites in stands encompassing the range of forest types, size classes, tree densities, and topographic features. We placed collars approximately 26" above the ground on a tripod to represent standing bears and 0-10" above the ground around logs to represent bears lying down or sleeping. Collar height was measured as the distance between the ground and the antenna. We tested the collars at the standing bear height for all 14 sites and at the sleeping bear height for 6 of those sites, for a total of 20 tests. Collars attempted to identify locations once per hour and were left for 16-47 hours (mean = 24.4 hours) during each test. We recorded the collar height, major drainage, weather, aspect, slope, maximum, minimum, and average angle to the horizon, the two most dominant existing tree types and understory types, the habitat component class, coverage class for understory and overstory, the topographic location, tree sizeclass and tree density class. UTM coordinates were recorded with a Garmin GPS unit.

We calculated the percent of successful fixes for each test. We compared fix success between categorical variables and calculated correlations with percent of available fixes for all continuous variables. We examined scatterplots of variables with correlations greater than 0.5 and based on these examined relevant interactions.

We conducted analysis of variance (ANOVA) for the variables with the highest correlations and relevant interaction terms.

Results

Overall fix success was high (78.7%), indicating that GPS collars will collect locations in the Yaak. For categorical variable comparisons, many categories only had one or two tests, and thus results must be considered to be trends rather than final results. Fix success was higher in the bear standing position, in flat areas, and where there were no trees (Table 1).

Only collar height (Pearson's $r=0.77$, $p<0.001$) and tree sizeclass (Pearson's $r=-0.63$, $p=0.003$) had highly explanatory, significant levels of correlation. Scatterplots indicated a potential interaction between collar height and tree sizeclass (Figures 1-2), so we included an interaction term in the ANOVA. The ANOVA indicated that all three terms, collar height, tree sizeclass, and the interaction of the two contributed significantly to the explanation of percent fix success (Table 2).

Discussion

Fix success for collar tests is generally high (e.g. Dussault et al. 2001, 100%). Fix success here (78.7%) was higher than collar tests in the Badger- Two Medicine study area (Graves and Waller In press, 73.7%) and is within the range of collar tests conducted in Alberta (Frair et al. 2004; 67.6 - 99.7%). Fix success for collars on free-ranging bears tends to be lower than during collar tests. Given the lower fix success we have seen with lower collar height it is highly probable that decreased fix success on free ranging bears is primarily due to the changes in collar position when bears lie down. This is also supported by recent studies of the effect of collar position on GPS success (D'Eon and Delparte in review). Recent analysis of collars on bears in the Badger Two Medicine area (Graves and Waller in press) indicates that fix success is lowest on free ranging bears when there is little movement and suggests that larger, heavier bears have lower fix success. Overall there is little to indicate that fix success in the Yaak will be less than in other areas.

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Table 1. Fix success by categorical variables.

Collar position	N	Mean	Median	SD	Minimum	Maximum
Standing	14	93.83	95.74	6.89	80.77	100
Sleeping	6	47.44	42.05	42.93	0	100

Topography	N	Mean	Median	SD	Minimum	Maximum
Bench or flat	2	100.00	100.00	0.00	100.00	100.00
Lower slope	6	92.43	95.74	12.13	68.09	100.00
Stream bottom	5	71.56	84.00	33.23	13.04	96.00
Mid-slope	4	70.74	91.48	47.44	0.00	100.00
Ridge	3	67.65	86.96	45.21	16.00	100.00

Dominant tree	N	Mean	Median	SD	Minimum	Maximum
None	1	100.00	100.00		100.00	100.00
Alnten	1	100.00	100.00		100.00	100.00
Pinmon	1	100.00	100.00		100.00	100.00
Tshmer	2	97.92	97.92	2.95	95.83	100.00
Tsuhet	1	96.00	96.00		96.00	96.00
Pincon	1	95.65	95.65		95.65	95.65
Piceng	3	88.98	87.50	5.87	84.00	95.45
Abegra	1	84.00	84.00		84.00	84.00
Larocc	3	66.67	100.00	57.74	0.00	100.00
Thupli	6	59.98	74.43	36.30	13.04	95.00

Habitat class	N	Mean	Median	SD	Minimum	Maximum
Dry meadow	1	100.00	100.00		100.00	100.00
Alder shrub	1	100.00	100.00		100.00	100.00
Timbered shrubfield	2	97.92	97.92	2.95	95.83	100.00
Riparian streambottom	2	90.00	90.00	8.49	84.00	96.00
Open timber	6	74.34	91.25	38.13	0.00	100.00
Closed timber	8	72.05	85.48	36.22	13.04	100.00

Table 2. ANOVA results

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	17278.31	3	5759.44	57.76	0.000
Intercept	9716.75	1	9716.75	97.44	0.000
Collar height	161.70	1	161.70	1.62	0.221
Tree sizeclass	5678.81	1	5678.81	56.95	0.000
Height * sizeclass	3181.43	1	3181.43	31.90	0.000
Error	1595.53	16	99.72		
Total	146600.39	20			
Corrected Total	18873.84	19			
R Squared = 0.915 (Adjusted R Squared = 0.900)					

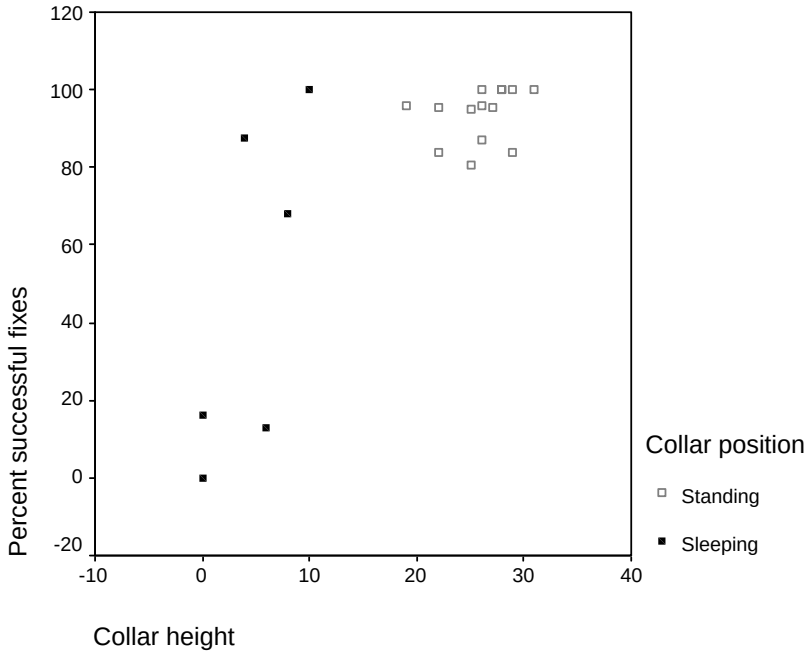

Figure 1. Percent of successful fixes by collar height.

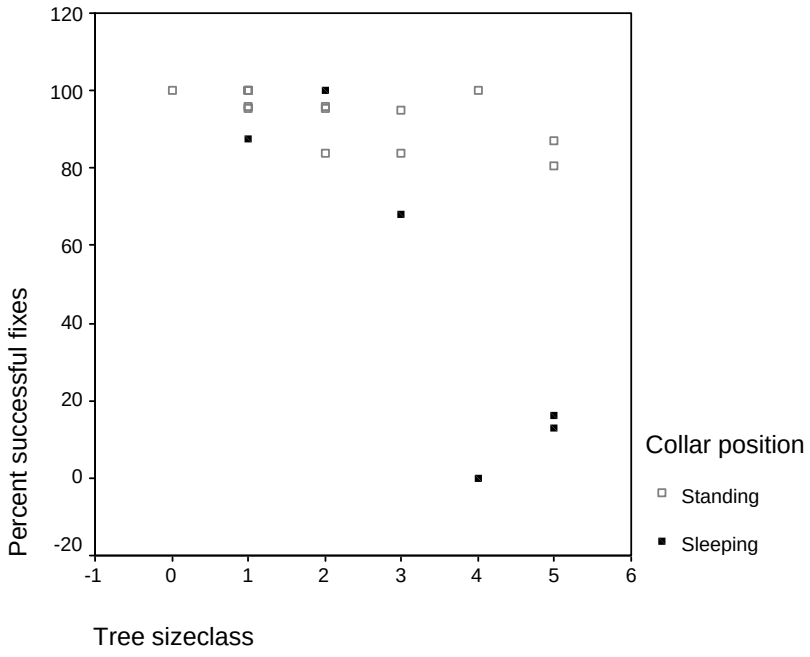

Figure 2. Percent of successful fixes by tree sizeclass. Sizeclass 1 = <5", 2 = 5-9", 3 = 9-15", 4 = 15-24", and 5 = 24-36".

Appendix Table 2. Grizzly bear mortality information for the Cabinet-Yaak recovery zone and radio collared bear mortalities in British Columbia, 1982-2005.

Mortality Date	Tag #	Sex	Age	Mortality Cause	Location	<500 m from Open Road	Public Reported	Owner
October, 1982	None	M	AD	Human, Poaching	Grouse Creek, ID	No	Yes	USFS
October, 1984	None	Unk	Unk	Human, Mistaken Identity	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	Flattail Creek, MT	No	Yes	USFS
5/29/1988	134	M	AD	Human, Hunting	Moyie River, BC[1]	Yes	Yes	BC
10/31/1988	None	F	AD	Human, Self Defense	Seventeen Mile Creek, MT	No	Yes	USFS
7/6/1989	129	F	3.5	Human, Research	Burnt Creek, MT	Yes	No	USFS
1990	192	M	2.5	Human, Poaching	Poverty Creek, MT	Yes	Yes	USFS
1992	678	F	37	Unknown	Trail Creek, MT	No	Yes	USFS
7/22/1993	258	F	7.5	Natural	Libby Creek, MT	No	No	USFS
7/22/1993	258-cub	Unk	Cub	Natural	Libby Creek, MT	No	No	USFS
10/4/1995	None	M	AD	Human, Management	Ryan Creek, BC[1]	Yes	Yes	BC, PRIV
5/6/1996	302	M	3.5	Human, Under Investigation	Dodge Creek, MT	Yes	No	USFS
October, 1996	355	M	AD	Human, Under Investigation	Gold Creek, BC[1]	Yes	No	BC
May, 1997?	None	M	AD	Human, Poaching	Libby Creek, MT	Unk	Yes	PRIV
6/4/1999	106	F	21	Natural, Conspecific	Seventeen Mile Creek, MT	No	No	USFS
6/4/1999	106-cub	Unk	Cub	Natural, Conspecific	Seventeen Mile Creek, MT	No	No	USFS
6/4/1999	106-cub	Unk	Cub	Natural, Conspecific	Seventeen Mile Creek, MT	No	No	USFS
10/12/1999	596	F	2.5	Human, Self Defense	Hart Creek, BC[1]	Yes	Yes	BC
11/15/1999	358	M	15	Human, Management	Yaak River, MT	Yes	No	PRIV
6/1/2000	538-cub	Unk	Cub	Natural	Hawkins Creek, BC	Unk	No	BC
6/1/2000	538-cub	Unk	Cub	Natural	Hawkins Creek, BC	Unk	No	BC
7/1/2000	303-cub	Unk	Cub	Natural	Fowler Creek, MT	Unk	No	USFS
11/15/2000	592	F	3	Human, Under Investigation	Pete Creek MT	Yes	No	USFS
5/5/2001	None	F	1.5	Human, Mistaken Identity	Spread Creek, MT	Yes	Yes	USFS
6/18/2001	538-cub	Unk	Cub	Natural	Cold Creek, BC	Unk	No	BC
6/18/2001	538-cub	Unk	Cub	Natural	Cold Creek, BC	Unk	No	BC
October, 2001	None	F	AD	Human, Train collision	Elk Creek, MT	Yes	Yes	MRL
2002	None	Unk	Unk	Human, Mistaken Identity	Bloom Creek, BC[1]	Yes	Yes	BC
7/1/2002	577	F	1.5	Natural	Marten Creek, MT	Yes	No	USFS
10/28/2002	None	F	4	Human, Under Investigation	Porcupine Creek, MT	Yes	Yes	USFS
11/18/2002	353/584	F	7	Human, Poaching	Yaak River, MT	Yes	Yes	PRIV
11/18/2002	None	F	Cub	Human, Poaching	Yaak River, MT	Yes	Yes	PRIV
11/18/2002	None	Unk	Cub	Human, Poaching	Yaak River, MT	Yes	No	PRIV
11/18/2002	None	Unk	Cub	Human, Poaching	Yaak River, MT	Yes	No	PRIV
10/15/2004	None	F	AD	Human, Management	Linklater Creek, BC[1]	Yes	Yes	BC, PRIV
10/9/2005	None	F	3-4	Human, Train collision	Government Creek, MT	Yes	Yes	MRL
10/9/2005	694	F	2-3	Human, Poaching	Pipe Creek, MT	Yes	No	PRIV
10/19/2005	668	M	4	Human, Mistaken Identity	Yaak River, MT	Yes	Yes	PRIV

[1]The recovery plan (USFWS 1993) specifies that human-caused mortality or female with young sightings from Canada will not be counted toward recovery goals in this recovery zone.

Appendix 3. Description of Habitat Components.

1. Closed Timber - Timber stands with tree cover greater than 60%, and a variable but often sparse understory.

2. Open Timber - Timbered sites with tree canopy cover of from 30 to 60%, and a sparse grass - forb understory. Commonly found on dry exposures, limiting undergrowth to a few rhizomatous species.

3. Timbered Shrubfield - Open timbered sites with tree cover of 30 to 60%, and a shrub dominated understory. Except for more xeric aspects, the shrub layer is well developed, and the forb layer is characteristically sparse due to limited light penetration.

4. Mixed Shrub/Snowchute - Shrub dominated communities resulting from, and often maintained by sudden snowslides on steep timbered drainages. They exist as narrow, linear openings in the forest canopy, or as extensive, broad chutes covering an entire slope.

5. Mixed Shrub/Cutting Unit - Open sites which have been harvested and are currently dominated by shrubs. Structure and composition is variable depending on harvest method, site treatment, habitat type, topographic position and time since harvest.

6. Mixed Shrub/Burn - Open sites, dominated by shrubs, which have developed following fire. Structure and composition is dependent on fire intensity, habitat type, topographic position and time since burn.

7. Alder Shrub - Tall shrub community dominated by alder (*Alnus sinuata*), almost to the exclusion of all other shrub species, with a herbaceous understory. Component can develop as a result of disturbance, but is often restricted to mesic sites.

8. Huckleberry Shrub - Seral shrubfields dominated by *Vaccinium* species. This open, low structured shrubfield is created and at times maintained by fire. Timber harvest and snowslides may have the same developmental effect.

9. Riparian Stream bottom - Stream bottom habitat is identified by riparian plant associations, which reflect the influence of increased soil moisture. Considerable variation in vegetation composition and structure exist, with some site being open and some timbered. The development and extent of riparian habitat is dependent on timber canopy and stream channel gradient.

10. Marsh - Open sedge dominated communities that are perennially moist, often containing standing water. Can exist as either unbroken monotypic communities or as infringing zones around open shallow lakes and ponds.

11. Wet Meadow - Mesic graminoid dominated communities along flat low elevation watersheds, and in slightly concave depressions at high elevations. Floristic composition varies between and within open meadows depending on slight differences in soil moisture.

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

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

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

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

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

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

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

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