SELKIRK MOUNTAINS GRIZZLY BEAR RECOVERY AREA 2017 RESEARCH AND MONITORING PROGRESS REPORT

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ABSTRACT

The U.S. Fish and Wildlife Service (USFWS) has been leading a grizzly bear monitoring and research program in the Selkirk Mountains Ecosystem (SE) since 2012. Key research and funding cooperators include Idaho Department of Fish and Game (IDFG), the Panhandle National Forest (USFS), Idaho Department of Lands, the Kalispel Tribe, the Kootenai Tribe of Idaho, and Washington Department of Fish and Wildlife. The British Columbia (BC) effort was led by Michael Proctor with key funding provided by BC Habitat Conservation Trust Fund and BC Fish and Wildlife Compensation Fund.

Numbers of females with cubs in the SE varied from 1–6 per year and averaged 3.0 per year from 2012–17. Seven of 10 U.S. bear management units and the BC unit had sightings of females with young during 2012–17. Human-caused mortality averaged 1.8 bears per year (1.0 males and 0.8 females per year). Five females (all BC) and 6 males (two US and four BC) died due to human caused mortality during 2012–2017. Sex and age class and cause of mortality are as follows: four adult females (three under investigation and one management removal), three adult males (management removal, defense of life, and mistaken identity), one subadult female (management removal), and three subadult males (management removal, one mistaken identity, one train collision).

Eighty-one instances of known and probable grizzly bear mortality were detected inside or within 16 km of the U.S. SE and the BC South Selkirk grizzly bear population unit during 1980–2017. This was the period of active research. Sixty-seven were human caused, 9 were natural mortality, and 5 were unknown cause. Fifty-two occurred in BC, 21 in Idaho, and 8 in Washington.

Remote cameras and corrals were deployed at 121 sites and checked for pictures and hair collection 183 times during 2017. Grizzly bears were detected by cameras at 30 sites. Genetic DNA results are not yet complete from collected hair at sites in 2017. Because of the lag time in lab analysis, we will report 2017 genetic results in the 2018 report. Females with cubs were detected at 8 corral sites (Blue-Grass Bear Management Unit [BMU], State Land BMU, and Myrtle BMU). In addition, we set up cameras at some rub sites and opportunistically along roadways and trails presumed to be on grizzly bear travel routes. This extended effort documented presence of a female grizzly bear with young in Ruby Creek and Trapper Creek, a female with cubs in Smith Creek (Long-Smith BMU), and several other single individuals. Additionally, 321 bear rub locations have been identified and installed since 2013. Hair samples were also collected from all captured individuals.

Fifty-six grizzly bears were trapped and radio collared for research purposes from 2007to 2017, the most recent period of active bear research in BC (2007–2016) and the U.S. (2012–2017). Sixteen of these occurred in the U.S. and 40 occurred in British Columbia. Home ranges were calculated and maps were displayed. Den entrance and exit dates were summarized.

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INTRODUCTION

Grizzly bear (*Ursus arctos*) populations south of Canada are currently listed as Threatened under the terms of the 1973 Endangered Species Act (16 U.S.C. 1531-1543). In 1993 a revised Recovery Plan for grizzly bears was adopted to aid the recovery of this species within ecosystems that they or their habitat occupy (USFWS 1993). Seven areas were identified in the Recovery Plan, one of which was the Selkirk Mountains Grizzly Bear Recovery Zone (SE) of northern Idaho, northeast Washington, and southeast British Columbia (BC) (Fig. 1). The recovery area includes the South Selkirks BC grizzly bear population unit and encompasses approximately 5,070 km^2.

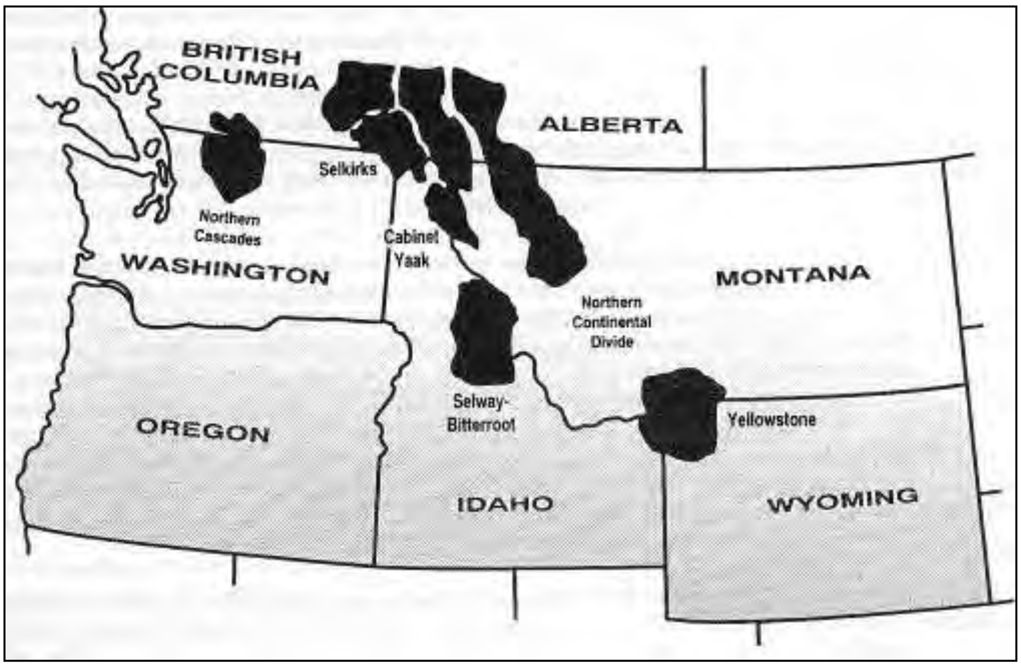

Figure 1. Grizzly bear recovery areas in the U.S., southern British Columbia, and Alberta, Canada.

Surveys of sightings, sign, and mortality have been documented by Layser (1978) and Zager (1983). Idaho Department of Fish and Game (IDFG) captured and monitored a radio collared sample of grizzly bears in the SE from 1983 until 2002 to determine distribution, home ranges, cause specific mortality, reproductive rates, and population trend (Almack 1985, Wakkinen and Johnson 2004, Wakkinen and Kasworm 2004). This effort was suspended in 2003 due to funding constraints and management decisions. In cooperation with IDFG and the Panhandle National Forest (USFS) this effort was reinitiated during 2012 with personnel from the U.S. Fish and Wildlife Service (USFWS). During 2013, the program was expanded with funding from IDFG, USFS, several sources in BC, and USFWS. This cooperative research and monitoring effort was further expanded to involve Idaho Department of Lands, the Kalispel Tribe, the Kootenai Tribe of Idaho, and Washington Department of Fish and Wildlife in 2014. USFWS began a trapping and monitoring effort to collect and update known-fate population vital rates of radio-collared grizzly bears within the SE. In 2013–17, we also collected camera and hair samples at DNA hair corral, camera, and rub post locations, adding to similar efforts conducted by IDFG and USFS personnel.

OBJECTIVES

1. Document grizzly bear distribution in the SE.
2. Describe and monitor the grizzly bear population in terms of reproductive success, age structure, mortality causes, population trend, and population estimates and monitor the targets for recovery as described in the grizzly bear recovery plan (USFWS 1993).
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 permeability of the Kootenai River valley between the SE and adjacent grizzly bear populations.
4. Determine the relationship between human activity and grizzly bear habitat use through the identification of areas used more or less than expected in relation to ongoing timber management activities, open and closed roads, and human residences.
5. Identify mortality sources and management techniques to limit human-caused mortality of grizzly bears.

STUDY AREA

The SE encompasses 5,700 km^2 of the Selkirk Mountains of northeastern Washington, northern Idaho, and southern British Columbia (BC). (Figure 2). Approximately 53% lies in the U.S. with the remainder in BC. Land ownership in BC is approximately 65% crown (public) land and 35% private. Land ownership in the U.S. portion is about 80% federal, 15% state, and 5% private.

Elevation on the study area ranges from 540 to 2,375 m. Weather patterns are characterized as Pacific maritime-continental climate, with long winters and short summers. Most of the precipitation falls during winter as snow, with a second peak in spring rainfall.

SE vegetation is dominated by various forested types. Dominant tree species include subalpine fir (*Abies lasiocarpa*), Englemann spruce (*Picea engelmannii*), western red cedar (*Thuja plicata*), and western hemlock (*Tsuga heterophylla*). Major shrub species include alder (*Alnus* spp.), fool's huckleberry (*Menziesia ferruginea*), mountain ash (*Sorbus scopulina*), and

Figure 1 Selkirk Mountains grizzly bear recovery area.

huckleberry (*Vaccinium* spp.).

Historically, wildfire was the primary disturbance factor in the SE. The 1967 Trapper Peak (6,000 ha) and Sundance (9,000 ha) fires produced large seral huckleberry shrubfields. Timber management and recreation are currently the principal land uses.

METHODS

Grizzly Bear Observations

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

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

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

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

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

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

Capture and Marking

Capture and handling of bears followed an approved Animal Use Protocol through the University of Montana, Missoula, MT (061-14CSCFC111714). Capture of black bears and grizzly bears was performed under Idaho and Washington state collection permits (ID 140226 and WA 14-082a) and a federal permit (TE704930-0). Bears were captured with leg-hold snares following the techniques described by Johnson and Pelton (1980) and Jonkel (1993). Snares were manufactured in house following the Aldrich Snare Co. (Clallam Bay, WA) design and consist of 6.5 mm braided steel aircraft cable. All bears were immobilized with Telazol (tiletamine hydrochloride and zolazepam hydrochloride), a mixture of Ketaset (ketamine hydrochloride) and Rompun (xylazine hydrochloride), or a combination of Telazol and Rompun. Yohimbine and Atipamezole were the primary antagonists for Rompun. Drugs were administered intramuscularly with a syringe mounted on a pole (jab-stick), homemade blowgun, modified air pistol, or cartridge powered dart gun. Immobilized bears were measured, weighed, and a first premolar tooth was extracted for age determination (Stoneberg and Jonkel 1966). Blood, tissue and/or hair samples were taken from most bears for genetic and food use studies. Immobilized bears were given oxygen at a rate of 2–3 liters per minute. Recovering bears were dosed with Atropine and Diazepam.

All grizzly bears were fitted with radio collars or ear tag transmitters when captured. Some bears were collared with Global Positioning System (GPS) radio collars. Collars were manufactured by Telonics (Mesa, AZ). To prevent permanent attachment, a canvas spacer was placed in the collars so that they would drop off in 1–3 years (Hellgren et al. 1988).

Trapping efforts were typically conducted from May through August. Trap sites were usually located within 500 m of an open road to allow vehicle access. In a few instances trap sites were accessed behind restricted roads within the administrative motorized access provisions of the land management agency. Further, some remote trap sites were accessed with pack livestock. Traps were checked daily or in some cases twice daily. Bait consisted primarily of road-killed ungulates and a liquid lure composed of fish and livestock blood.

Hair Sampling for DNA Analysis

Genetic information from hair-snagging with remote-camera photo verification allows us to document the number of individual grizzly bears occupying the study area and understand the level of relatedness within this population and between this and adjacent populations. Project objectives include: observations of females with young, sex ratio of sampled bears, and relatedness as well as genetic diversity measures of captured bears and source population and assessment of movement or gene flow in and out of the population.

Sampling occurred from May–September in the SE following standard hair snagging techniques with barbed wire hair corrals (Woods *et al.* 1999). Sampling sites were established based on location of previous sightings, sign, habitat quality, and radio telemetry from bears. Sites were baited with 2 liters of a blood and fish mixture to attract bears across a barbwire perimeter placed to snag hair. Sites were deployed for 2–3 weeks prior to hair collection. Hair sampling also occurred at sites where personnel observed bear hair and “rubbing” on a tree, artificial sign post, or similar object. When observed, personnel formally established these sites by attaching barbed wire at the spot of rubbing and designating the location with a unique site number. Crews then subsequently revisited these locations to collect bear hair. Hair was collected and labeled to indicate: number and color of hairs collected, site location, date, and barb number. Samples collected 1) as part of this formal hair sampling effort, 2) from captured and handled bears, and 3) opportunistically (i.e., not from established sampling sites, such as tree staubs along trail, within identified daybeds, etc.) were sent to Wildlife Genetics International Laboratory in Nelson, British Columbia for DNA extraction and genotyping. Only samples from known grizzly bears or that outwardly appeared to be grizzly bear were sent to the lab. Hairs visually identified as black bear hair by technicians on our project or at the Laboratory were not processed and hairs processed and determined to be black bear were not genotyped. Dr. Michael Proctor (Birchdale Ecological Consulting) is a cooperator on this project and assisted with genetic interpretations.

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 not in dens. Global Positioning System (GPS) collars were programmed to attempt locations every 1–2 hours depending on configuration, and data were stored within the collar and then downloaded to a lap top computer in an aircraft (Telonics Inc., Mesa AZ). Beginning in 2016, we have been using iridium collars on select males to enable remote download. All collars were equipped with a release mechanism to allow them to drop off and be retrieved in October prior to denning. Weekly aircraft radio monitoring was conducted to check for mortality signals and approximate location. Life home ranges (minimum convex polygons; Hayne 1959) were calculated for grizzly bears during the study period. We generated home range polygons using ArcGIS.

Isotope Analysis

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

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

Berry Production

Quantitative comparisons of annual fluctuations and site-specific influences on fruit production of huckleberry were made using methods similar to those established in Glacier National Park (Kendall 1986). Transect line origins were marked by a painted tree or by surveyors' ribbon. A specific azimuth was followed from the origin through homogenous habitat. At 0.5 m intervals, a 0.04 m^2 frame (2 x 2 decimeter) was placed on the ground or held over shrubs and all fruits and pedicels within the perimeter of the frame were counted. If no portion of a plant was intercepted, the frame was advanced at 0.5 meter intervals and empty frames were counted. Fifty frames containing the desired species were counted on each transect. Timbered shrub fields and mixed shrub cutting units were the primary sampling areas to examine the influence of timber harvesting on berry production within a variety of aspects and elevations. Berry phenology, berry size, and plant condition were recorded. Monitoring goals identified annual trend of berry production and did not include documenting forest succession.

Temperature and relative humidity data recorders (LogTag®, Auckland, New Zealand) were placed at berry monitoring sites. These devices record conditions at 90 minute intervals and will be retrieved, downloaded, and replaced at annual intervals. We used a berries/plot calculation as an index of berry productivity. Transects were treated as the independent observation unit. For each year observed, mean numbers of berries/plant (berries/plot) were used as our transect productivity indices.

RESULTS AND DISCUSSION

Grizzly Bear Observations, Mortality, and Recovery Plan Criteria

Eighty-one reported sightings rated 4 or 5 (most credible) during 2017 (Table 1). Sightings occurred in all Bear Management Units (BMUs) except Kalispel-Granite and Lakeshore. Five known mortalities occurred during 2017 (Table 2).

Recovery Target 1: 6 females with cubs over a running 6-year average both inside the recovery zone and within a 10 mile area immediately surrounding the recovery zone.

Cubs are offspring in the first 12 months of life and yearlings are offspring in their second 12 months. The recovery plan (USFWS 1993) indicates that female with cub sightings within 10 miles of the recovery zone count toward recovery goals. Twelve credible sightings of a female with cubs occurred during 2017 in Blue-Grass, Long-Smith, Myrtle, State Lands, Pack River, and BC BMUs or Bears Outside Recovery Zone (BORZ) units (Tables 2, 3, 4, 5 and Fig. 4). There appeared to be 6 unduplicated females with cubs in the recovery area during 2017. Fourteen credible sightings of a female with yearlings or 2-year-olds occurred in Blue-Grass, LeClerc, Long-Smith, State Lands, Sullivan-Hughes, Pack River, and BC BMUs in 2017. Unduplicated sightings of females with cubs (including Canada) varied from 1–6 per year and averaged 3.0 per year from 2012–17 (Tables 3, 4). Recovery plan targets require a running 6 year average of 6.0 females with cubs per year and therefore this target has not been met.

Recovery Criteria 2: 7 of 10 BMU's occupied by females with young from a running 6-year sum of verified evidence.

Seven of 10 BMUs in the U.S. portion of the recovery zone and the BC BMU had sightings of females with young (cubs, yearlings, or 2-year-olds) during 2012–17 (Fig. 4 and Table 5). Occupied U.S. BMUs were: Blue-Grass, LeClerc, Long-Smith, Myrtle, Salmo-Priest, State Lands, and Sullivan-Hughes BMUs. Recovery plan criteria indicate the need for 7 of 10 U.S. BMUs to be occupied.

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

Eighty-one instances of grizzly bear mortality were detected inside or within 16 km of the U.S. portion of the SE and within the boundary of the BC South Selkirk grizzly bear population unit during 1980–2017 (Table 2, Fig. 3). Five known mortalities occurred during 2017. A female with 2 cubs were removed from the Creston, BC landfill in a management action, an adult male was killed in a defense of life incident in Porthill Creek in BC and an adult male was killed in a case of mistaken identity by a black bear hunter in McCormick Creek, ID.

Eleven known or probable human caused mortalities of grizzly bears occurred in or within 10 miles of the SE in the U.S. or in the South Selkirk GBPU during 2012–17, including 5 females (all BC) and 6 males (Myrtle and BC BMUs) (Table 1). These mortalities included four adult females (three under investigation and one management removal), three adult males (management removal, defense of life, and mistaken identity), one subadult female (management removal), and three subadult males (management removal, one mistaken identity, one train collision). We estimated minimum population size by dividing observed females with cubs (13), minus any human-caused adult female mortality (1) from 2015–17, by 0.6 (sightability correction factor as specified in the recovery plan) then dividing by 0.333 (adult female proportion of population as specified in the recovery plan) (Tables 3, 4) (USFWS 1993). This resulted in a minimum population of 61 individuals. The recovery plan states; "any attempt to use this parameter to indicate trends or precise population size would be an invalid use of these data". Applying the 4% mortality limit to the minimum calculated population resulted in a total mortality limit of 2.4 bears per year. The female limit is 0.7 females per year (30% of 1.6). Average annual human caused mortality for 2012–17 was 1.8 bears/year and 0.8 females/year. These mortality levels for total bears were less than the calculated limits and female mortality exceeded the calculated limit during 2012–17. The recovery plan established a goal of zero human-caused mortality for this recovery zone due to the initial low number of bears; however it also stated "In reality, this goal may not be realized because human bear conflicts are likely to occur at some level within the ecosystem." All tables and calculations are updated when new information becomes available.

Table 1. Credible grizzly bear sightings, credible female with young sightings, and known human caused mortality by Selkirk Mountain bear management unit (BMU) or area, 2017.

BMU OR AREA	2017 Credible[1] Grizzly Bear Sightings	2017 Sightings of Females with Cubs (Total)	2017 Sightings of Females with Cubs (Unduplicated[2])	2017 Sightings of Females with Yearlings or 2-year-olds (Total)	2017 Sightings of Females with Yearlings or 2 year-olds (Unduplicated[2])	2017 Human Caused Mortality
Ball-Trout	1	0	0	0	0	0
Blue Grass	31	2	1	6	1	0
Kalsipel-Granite	0	0	0	0	0	0
Lakeshore	0	0	0	0	0	0
LeClerc	7	0	0	1	1	0
Long-Smith	16	1	0	3	1	0
Myrtle	4	1	0	0	0	1
Salmo-Priest	1	0	0	0	0	0
State Idaho	7	4	2	1	0	0
Sullivan-Hughes	2	0	0	1	1	0
Pack River	9	3	2	1	1	0
Priest River	1	0	0	0	0	0
BC	2	1	1	1	0	4
TOTAL	81	12	6	14	5	5

[1]Credible sightings are those rated 4 or 5 on a 5 point scale (see methods).
[2]Sightings may duplicate the same animal in different locations. Only the first sighting of a duplicated female with cubs is counted toward total females (Table 3), however subsequent sighting contribute toward occupancy (Table 5).

Table 2. Known and probable grizzly bear mortality in the Selkirk Mountains recovery area, 1980–2016.

Mortality Date	Tag Number	Sex	Age	Mortality Cause	Location	<500m from open road	Owner[1]
11-May-80	None	F	5.0	Human, Hunting	Barrett Creek, BC	Unk	BC
2-May-82	None	M	AD	Human, Poaching	Priest River, ID	Yes	USFS
Sept 1982	None	U	Unk	Human, Undetermined	LeClerc Creek, WA	Yes	USFS
1-Jul-85	949	M	4.5	Human, Undetermined	NF Granite Creek, WA	Yes	USFS
Autumn, 1985	867-85a	U	Cub	Natural	Cow Creek, ID	Unk	USFS
1-Sep-86	898	F	1.5	Human, Undetermined	Grass Creek, ID	Unk	USFS
10-Sep-86	None	M	7.0	Human, Management	Curtis Lake, BC	Yes	BC
June 1987	1005	M	10.5	Human, Poaching	Wall Mtn, BC	Unk	BC
8-Sep-87	962	M	7.5	Human, Poaching	Trapper Creek, ID	No	IDL
30-May-88	None	M	5.0	Human, Hunting	Monk Creek, BC	Unk	BC
Sept 1988	1050	M	1.5	Natural	Porcupine Creek, BC	No	BC
Sept 1988	1085	F	3.5	Human, Mistaken Identity	Cow Creek, ID	No	USFS
14-Aug-89	1044	F	20+	Natural	Laib Creek, BC	No	Private
22-Sep-89	None	M	2.0	Human, Management	49 Mile Creek, BC	Yes	Private
22-Sep-89	None	U	Unk	Human, Management	49 Mile Creek, BC	Yes	Private
6-Aug-90	None	M	Unk	Human, Management	Ymir Area, BC	Yes	Private
16-Sep-90	1042	F	3.5	Human, poaching	Maryland Creek, BC	Yes	BC
1-Aug-91	1076	F	20+	Natural	Next Creek, BC	No	BC
23-Apr-91	867-92a	U	1.5	Natural	Trapper Creek, ID	Unk	IDL
11-Apr-92	None	M	Unk	Unknown	Atbara, BC	Yes	BC
22-May-92	None	M	4.0	Human, Hunting	Cottonwood, BC	Unk	BC
July 1992	None	M	Unk	Human, Management	Lost Creek, BC	Yes	BC
7-Sep-92	1090	M	5.5	Unknown	Laib Creek, BC	Yes	BC

Mortality Date	Tag Number	Sex	Age	Mortality Cause	Location	<500m from open road	Owner[1]
25-Sep-92	1015	F	12.5	Human, Self Defense	Monk Creek, BC	No	BC
2-Jun-93	None	M	4.0	Human, Management	Lost Creek, BC	Yes	BC
5-Jun-93	None	M	4.0	Human, Hunting	Elmo Creek, BC	Unk	BC
2-Nov-93	867	F	15.5	Human, Poaching	Willow Creek, WA	No	USFS
2-Nov-93	867-93a	U	0.5	Human, Poaching	Willow Creek, WA	No	USFS
2-Nov-93	867-93b	U	0.5	Human, Poaching	Willow Creek, WA	No	USFS
23-May-94	None	M	12.0	Human, Hunting	Wall Mountain, BC	Unk	BC
10-May-95	None	F	1.5	Human, Undetermined	Boundary Creek, ID	Yes	USFS
31-Oct-95	1100	M	2.5	Human, Mistaken Identity	Granite Pass, WA	Yes	USFS
Autumn, 1995	None	M	AD	Human, Mistaken Identity	Mill Creek, WA[2]	Yes	USFS
Autumn, 1996	1027-96b	U	Cub	Natural	Cedar Creek, ID	Unk	USFS
10-Oct-1996	1022	M	2.5	Human, Management	Boswell, BC	Yes	Private
Sept 1997	None	M	1.5	Human, Management	Salmo, BC	Yes	Private
29-May-98	1023	M	4.5	Human, Hunting	Findlay Creek, BC[2]	Yes	BC
Aug 1998	None	M	3.5	Human, Undetermined	Usk, WA	Yes	Private
Oct 1999	1032	M	18.0	Human, Management	Procter, BC	Yes	Private
Oct 1999	9810	M	10.0	Human, Undetermined	Smith Creek, ID	Unk	USFS
Autumn 2000	None	U	Unk	Unknown	Hughes Meadows, ID	Yes	USFS
29-Aug-01	7	F	13.0	Natural	Porcupine Creek, BC	Yes	BC
25-Oct-01	None	F	2.0	Human, Management	49 Mile Creek, BC	Yes	Private
Oct 2001	None	M	Unk	Human, Management	Cottonwood Creek, BC	Yes	Private
12-May-02	17	M	6.0	Human, Management	Nelway, BC	Yes	Private
15-Sep-02	None	F	10+	Human, Management	Blewett, BC	Yes	Private
15-Sep-02	None	U	0.5	Human, Management	Blewett, BC	Yes	Private
15-Sep-02	None	U	0.5	Human, Management	Blewett, BC	Yes	Private
15-Sep-02	None	U	0.5	Human, Management	Blewett, BC	Yes	Private
4-Oct-02	19	M	3.5	Human, Undetermined	Lamb Creek, ID	Yes	USFS
May 2003	None	U	1.5	Human, Mistaken Identity	Smith Creek, ID	Yes	Private
2-Sep-03	None	F	AD	Human, Management	Blewett, BC	Yes	Private
23-Sep-03	None	F	5.0	Human, Management	Blewett, BC	Yes	Private
23-Sep-03	None	F	0.5	Human, Management	Blewett, BC	Yes	Private
3-Oct-03	30	F	2.5	Human, Management	Erie Creek, BC	Yes	Private
May 2004	None	M	AD	Human, Undetermined	Hughes Meadows, ID	Yes	USFS
Autumn 2004	32	M	7.0	Human, Undetermined	Bismark Meadows, ID	Unk	Private
Spring 2005	None	U	Unk	Human, Undetermined	E F Priest River, ID	Unk	IDL
10-May-2005	31	M	6	Human, Hunting	Russell Creek, BC[2]	Yes	BC
May 2006	None	M	AD	Human, Management	Procter, BC	Yes	Private
23-Oct-06	None	F	1.0	Human, Management	Blewett Ski Hill, BC	Yes	Private
23-Oct-06	None	M	1.0	Human, Management	Blewett Ski Hill, BC	Yes	Private
1-Aug-07	29	F	AD	Vehicle Collision	Kootenay Pass, BC	Yes	BC
1-Oct-07	1000	F	AD	Human, Mistaken Identity	Pass Creek Pass, WA	Yes	USFS
4-Oct-07	5393	M	SA	Human, Management	Priest River, ID	Yes	Private
29-Sep-08	119	M	13.0	Human, Management	Salmo, BC	Yes	Private
18-Aug-10	8005	F	5	Vehicle Collision	Summit Creek, BC	Yes	BC
5-May-11	None	M	2.5	Human, Management	Porthill, ID	Yes	Private
25-May-11	0012	M	2.5	Human, Management	Nelson, BC	Yes	Private
25-May-11	None	M	2.5	Human, Management	Nelson, BC	Yes	Private
28-Aug-2011	002	M	20	Human, Management	Kootenay River, BC	Yes	Private
7-Oct-12	None	M	3.0	Human, Mistaken Identity	Beaverdale Creek, BC	Yes	BC
16-Oct-12	170	F	6.0	Human, Under investigation	Salmo River, BC	Yes	Private
6-Jun-14	12006	F	5.0	Human, Under investigation	Boundary Creek, BC	Yes	BC
27-Sep-14	None	F	AD?	Human, Under investigation	Ootishenia Creek, BC	Unk	BC
Summer 2014	3023a	U	Cub	Natural	Malcolm Creek, ID	Unk	USFS
Summer 2014	3023a	U	Cub	Natural	Malcolm Creek, ID	Unk	USFS
7-May-15	None	M	AD	Vehicle Collision	Summit Creek, BC	Yes	BC
11-Oct-2015	1001	M	4	Human, Undetermined	Grouse Creek, ID[2]	Yes	Private

Mortality Date	Tag Number	Sex	Age	Mortality Cause	Location	<500m from open road	Owner[1]
27-Aug-16	None	M	2.5?	Train Collision	Deep Creek, ID	Yes	Private
25-Jun-17	226	F	10	Human, Management	Kootenay River, BC	Yes	BC
25-Jun-17	None	M	0.5	Human, Management	Kootenay River, BC	Yes	BC
25-Jun-17	None	F	0.5	Human, Management	Kootenay River, BC	Yes	BC
1-Sep-17	922	M	5	Human, Self Defense	Porthill Creek, BC	Yes	BC
4-Oct-17	None	M	AD	Human, Mistaken Identity	McCormick Creek, ID	No	IUSFS

[1]BC – British Columbia Crown Lands, IDL – Idaho Department of Lands, and USFS – U.S. Forest Service.
[2]More than 10 miles outside recovery zone in the U.S.

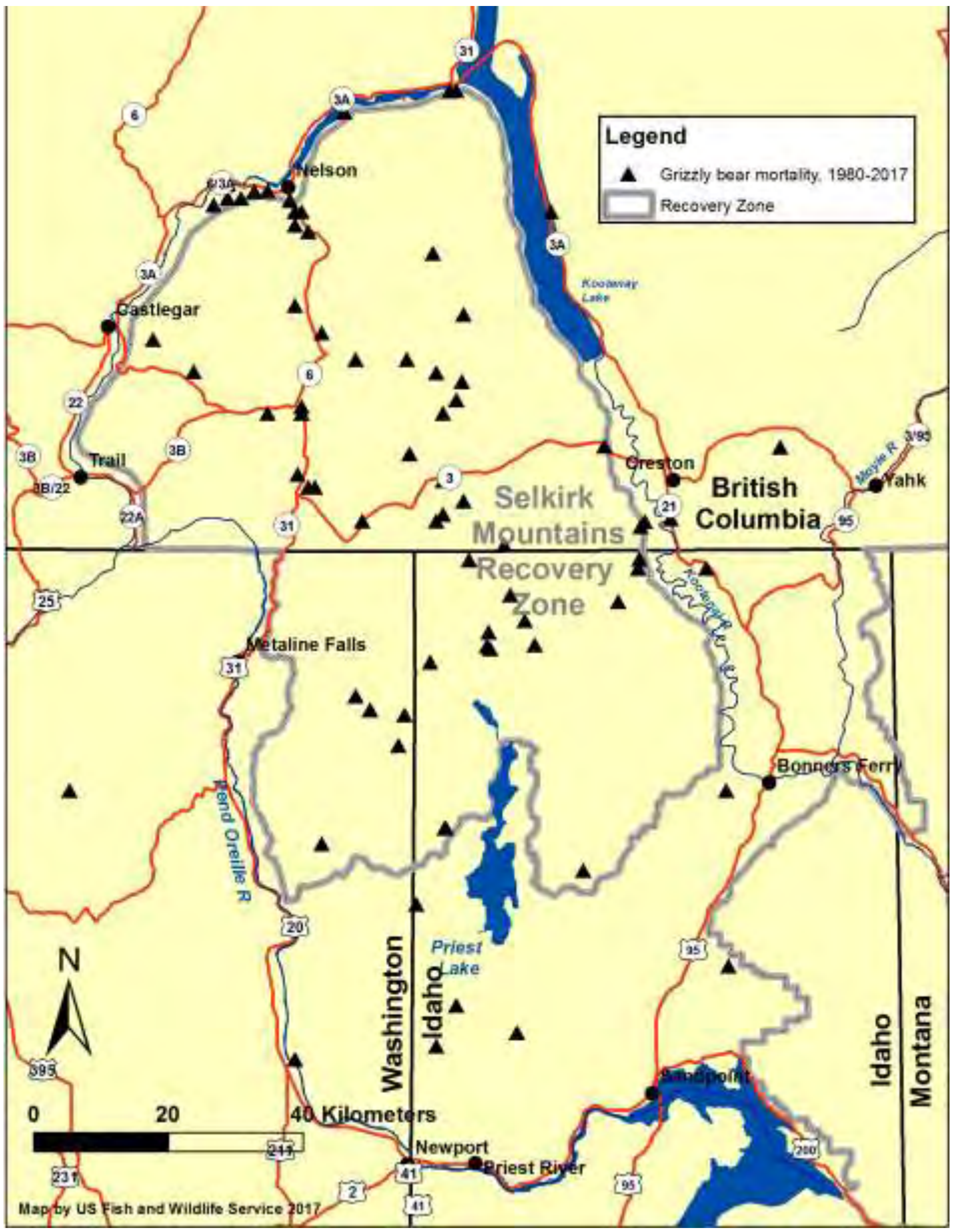

Figure 3. Grizzly bear known or probable mortalities from all causes (1980–2017) in the Selkirk Mountains recovery area.

Table 3. Status of the Selkirk Mountains recovery zone during 2012–2017 in relation to the demographic recovery targets from the grizzly bear recovery plan (USFWS 1993).

Recovery Criteria	Target	2017
Females w/cubs (6-yr avg)	6	3.0 (18/6)
Human Caused Mortality limit [1] (4% of minimum population estimate)	2.4	1.8 (6 yr avg)
Female Human Caused mortality limit [1] (30% of total mortality)	0.7	0.8 (6 yr avg)
Distribution of females w/young in the most recent 6 years [2]	7 of 10 BMUs	7 of 10 BMUs

[1] Includes both U.S. and B.C. mortalities.
[2] Includes only U.S. BMUs. B.C. BMUs are not yet drawn.

Table 4. Annual Selkirk Mountains recovery zone grizzly bear unduplicated counts of females with cubs (FWC's) and known human-caused mortality, 1988–2017. The grizzly bear recovery plan (USFWS 1993) states that the goal for human caused mortality shall be zero.

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	0	0	1	2				
1989	4	0	0	2				
1990	1	0	1	2				
1991	1	0	0	0				
1992	1	1	1	3				
1993	1	1	2	5	0.0	0.0	0.8	0.3
1994	1	0	0	1	0.2	0.1	0.2	0.0
1995	1	0	1	3	0.2	0.1	0.5	0.2
1996	1	0	0	0	0.4	0.1	0.5	0.2
1997	1	0	0	1	0.6	0.2	0.7	0.2
1998	1	0	0	1	0.6	0.2	0.8	0.2
1999	1	0	0	2	0.6	0.2	1.2	0.2
2000	2	0	0	0	0.8	0.2	1.2	0.2
2001	2	0	1	2	1.0	0.3	1.0	0.2
2002	0	1	3	6	0.6	0.2	2.0	0.7
2003	1	2	4	5	0.0	0.0	2.7	1.3
2004	1	0	0	2	-0.2	-0.1	2.8	1.3
2005	1	0	0	1	0.2	0.1	2.7	1.3
2006	0	0	1	3	0.4	0.1	3.2	1.5
2007	0	2	2	3	-0.2	-0.1	3.3	1.7
2008	0	0	0	1	-0.4	-0.1	2.5	1.2
2009	0	0	0	0	-0.4	-0.1	1.7	0.5
2010	0	1	1	1	-0.2	-0.1	1.5	0.7
2011	0	0	0	4	-0.2	-0.1	2.0	0.7
2012	1	1	1	2	-0.2	-0.1	1.8	0.7
2013	1	0	0	0	0.2	0.1	1.3	0.3
2014	3	2	2	2	0.4	0.1	1.5	0.7
2015	4	0	0	1	1.2	0.4	1.7	0.7
2016	3	0	0	1	1.6	0.5	1.7	0.5
2017	6	1	2	5	2.4	0.7	1.8	0.8

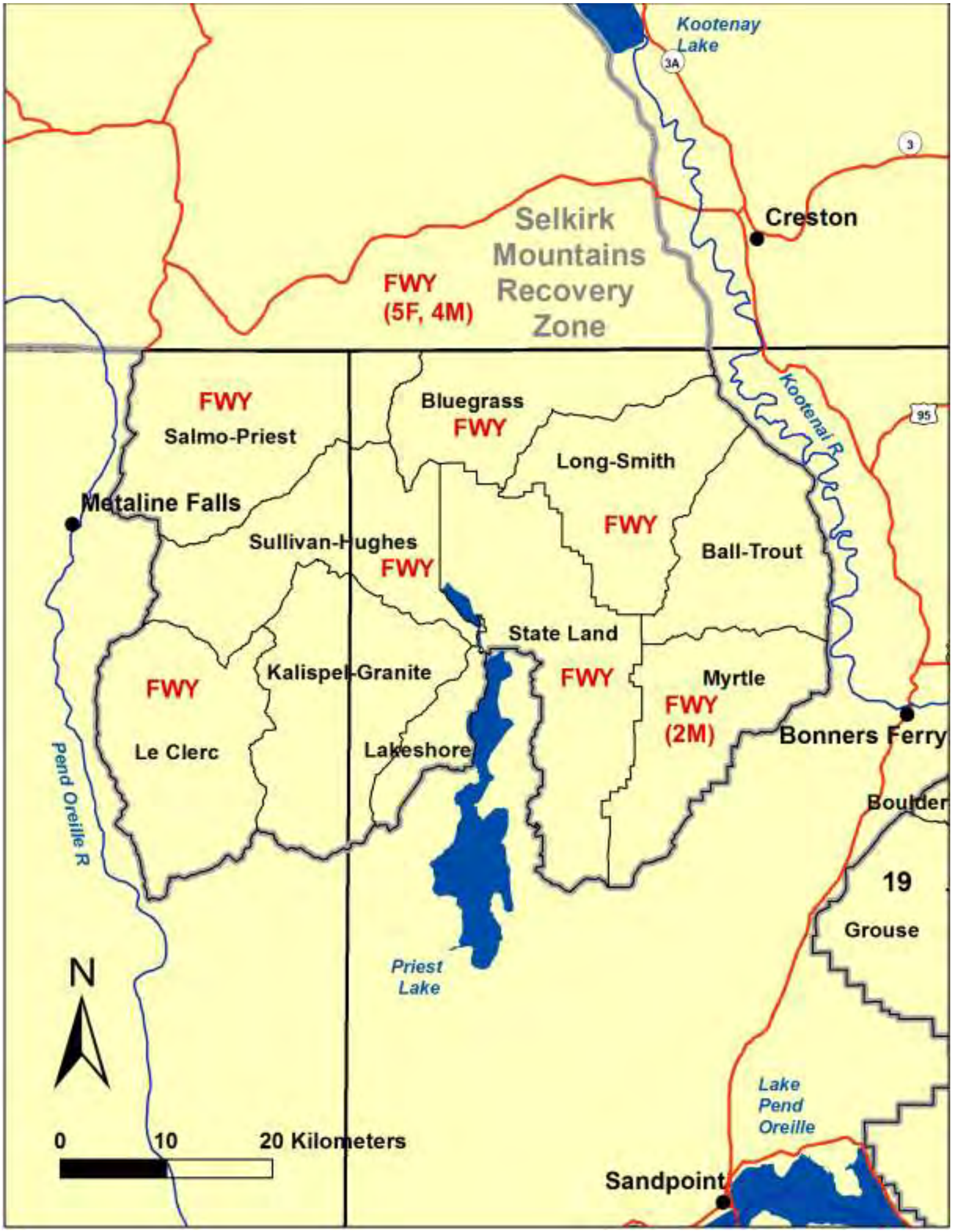

Figure 4. Female with young occupancy and known or probable mortality within Bear Management Units (BMUs) in the Selkirk Mountains recovery zone 2012–2017. FWC indicates occupancy of a BMU by a female with cubs, FWY indicates occupancy of a female with young, and sex of any mortality is in parentheses.

Table 5. Occupancy of bear management units by grizzly bear females with young in the Selkirk Mountains recovery zone 1996–2016.

YEAR	Ball-Trout	Blue Grass	Kalispell-Granite	Lakeshore	LeClerc	Long-Smith	Myrtle	Salmo-Priest	State Idaho	Sullivan-Hughes	BC
1996	Yes	Yes	No	No	No	Yes	Yes	No	No	No	No
1997	Yes	Yes	No	No	No	Yes	Yes	No	Yes	No	No
1998	Yes	Yes	No	No	No	Yes	No	Yes	Yes	No	No
1999	No	Yes	No	No	No	Yes	No	Yes	Yes	No	No
2000	No	No	No	No	No	No	No	No	No	No	No
2001	No	Yes	Yes	No	No	Yes	Yes	No	Yes	No	No
2002	No	Yes	Yes	No	No	Yes	Yes	No	Yes	No	No
2003	No	Yes	Yes	No	No	Yes	No	No	Yes	No	No
2004	No	Yes	Yes	No	No	Yes	No	No	Yes	No	No
2005	No	Yes	Yes	No	No	Yes	No	No	Yes	No	No
2006	No	No	Yes	No	No	Yes	Yes	No	No	Yes	No
2007	No	No	Yes	No	No	Yes	Yes	No	No	Yes	No
2008	No	No	Yes	No	No	Yes	Yes	No	No	Yes	No
2009	No	No	No	No	No	No	No	No	No	No	No
2010	No	No	No	No	No	No	No	No	No	No	No
2011	No	Yes	No	No	No	Yes	No	No	No	No	No
2012	No	Yes	No	No	No	Yes	No	No	Yes	No	No
2013	No	Yes	No	No	No	Yes	No	No	Yes	No	No
2014	No	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
2015	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No	Yes
2016	No	Yes	No	No	Yes	Yes	No	No	Yes	Yes	Yes
2017	No	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes

Hair Collection, Remote Camera, and Genetics

Remote cameras and corrals were deployed at 121 sites and were checked for pictures and hair collection 183 times during 2017 (Table 6). Grizzly bears were detected by cameras at 30 sites. Genetic DNA results are not yet complete from collected hair at sites in 2017. Because of the lag time in lab analysis, we will report 2017 genetic results in the 2018 report. Cameras detected females with cubs at 8 corral sites (Blue-Grass Bear Management Unit [BMU], State Land BMU, and Myrtle BMU). In addition, we set up cameras at some rub sites and opportunistically along roadways and trails presumed to be on grizzly bear travel routes. This extended effort documented presence of a female grizzly bear with young in Ruby Cr. and Trapper Cr., a female with cubs in Smith Cr. (Long-Smith BMU), and several other single individuals. Hair samples were collected from sign posts, bridges, and rub trees, as observed opportunistically by study personnel. Additionally, 321 bear rub locations have been identified and installed since 2013. Interagency personnel checked 292 of these rub sites a total of 1071 times during 2017.

In total from corral, rub, or opportune methods, 1923 samples were collected in the Selkirks in 2017. All hair samples were visually examined by study personnel to screen out hair that appeared to be black bear and the remaining 529 samples collected in 2017 were sent to Wildlife Genetics International for analysis. Again, lab analysis for 2017 samples has not yet been completed.

In 2016, thirty-seven rub sites (22% of checked) yielded grizzly bear hair in 2016. This extended rub effort identified 13 individual grizzly bears. Combined, corral and rub efforts identified 25 individual grizzly bears in 2016. Four bears were identified from opportunistic hair collections (i.e., collections along trails, at trapsites, on cattle fencing or tree staubs). Both research captured bears were also genotyped. One photographed adult female was not detected genetically (226). One radiocollared bear was monitored in 2016 but not detected genetically or from photos (3017). In total, all combined efforts identified a minimum 30 individual grizzly bears (18 male, 12 female) alive and within the U.S. portion of the Selkirk grizzly bear population in 2016. New genotypes from these individuals were added to the grizzly bear genetic database from the South Selkirk Mountains that contains 161 individuals, 1983–2016.

Table 6. Grizzly bear hair snagging corrals and success in the Selkirk Mountains study area, 2013–2017. DNA genetic results not yet complete for 2017 samples.

Year	Number of sites	Sites with grizzly bear pictures(%)	Sites with grizzly bear hair(%)	Individual grizzly bear genotypes	Locations with grizzly bear pictures or hair	Comments
2013	29	4(14)	0	0	Apache Ridge, Italian Peak, Sema Meadows, Plowboy Ridge	
2014	47	12(26)	11(23)	4	Apache Ridge, Italian Peak, Joe Lake, Cow Cr., Boundary Cr., Trapper Cr., Grass Cr., Burton Ridge, Soldier Cr., Saddle Pass, Caribou Pass	Female with cubs at Burton Ridge, Boundary Cr., and Italian Peak
2015	189	31(16)	24(13)	20	Ruby Ridge, Joe Cr., Hellroaring Cr., Joe Lake, Boundary Cr., Hughes Meadows, Malcom Cr., Jungle Cr., Bog Cr., Grass Cr., Horton Cr., Burton Ridge, Italian Cr., Smith Cr.	Female with cubs at Jungle Cr., Boundary Cr., and Grass Cr.
2016	182	17(9)	11(6)	14	Fall Cr., Beaver Cr., Hellroaring Cr., Boundary Cr., Jeru Cr., Cow Cr., Smith Cr., Pearson Cr., Grass Cr., Trapper Cr., High Rock Cr., Highland Cr.	Female with young at Beaver Cr. Female with cubs at Boundary Cr. and Grass Cr.
2017	121	30(25)	--	--	Boundary Cr., Burton Cr., Cow Cr., Fall Cr., Gold Cr., Jeru Cr., Molybdenite Cr., Joe Cr., Grass Cr., Pearson Cr., Ruby Cr., SF Granite Cr., Smith Cr., Bugle Cr., Branch Cr., Roman Nose Cr., Trapper Cr., Trout Cr., WB LeClerc Cr.	Female with young at Boundary Cr., Molybdenite Cr., and Cow Cr. Female with cubs at Boundary Cr., Branch Cr., Bugle Cr., Cow Cr., Fall Cr., Jeru Cr., Roman Nose Cr., Ruby Cr., and Trapper Cr.
Total	568	94	36	31 [2]		

[1]Percent success out of total number of sites deployed within the year

[2]Some individuals captured multiple times among years.

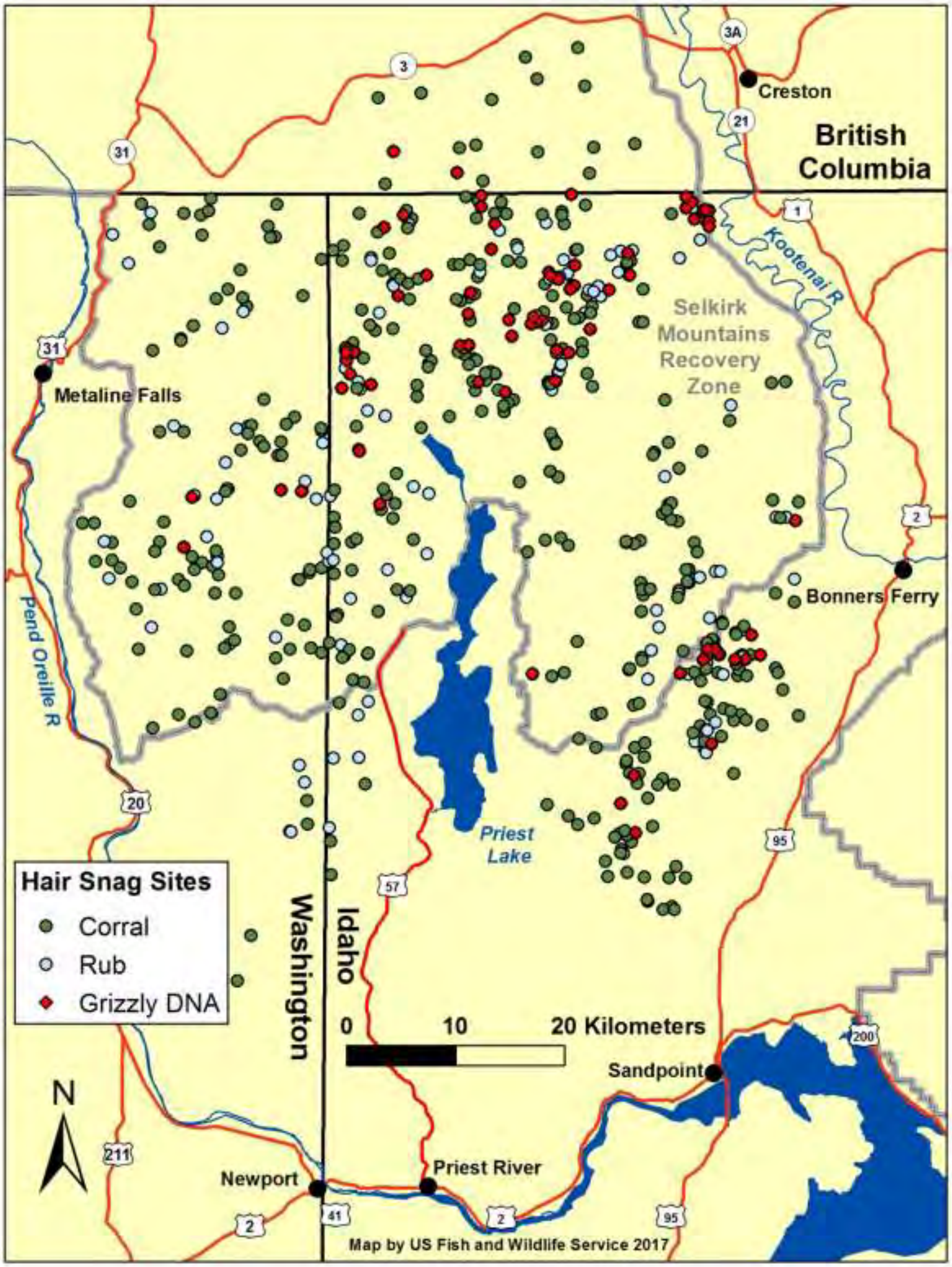

Figure 5. Location of hair snag corral and rub sampling sites in the Selkirk Mountains, 2007–16. "Grizzly DNA" represents a site where collected hair was genetically identified as grizzly bear.

Movements and Gene Flow

The SE population was previously identified as having low genetic diversity as determined by heterozygosity calculations (*H*=0.54, Proctor et al. 2012). This 2007 level was among the lowest of all interior North American grizzly bear populations. Low heterozygosity was believed to be the result of a small remnant population that has grown by reproduction with little emigration and gene flow from adjacent populations. Capture, telemetry, and genetic data were analyzed to evaluate movement and subsequent reproduction resulting in gene flow into and out of the SE. Twenty-seven grizzly bears were identified as immigrants, emigrants, or were the offspring of immigrants to the SE (Appendix Table T1). While movement and gene flow out of the SE may benefit other populations, gene flow into the SE is most beneficial to genetic health. Eight individuals (6 males and 1 female) are known to have moved into the SE from adjacent populations; however two males and one female were killed or removed (Figure 6). Known gene flow has been identified through reproduction by one immigrant (one male) resulting in 6 offspring in the SE. Additional analysis of changes in heterozygosity and other genetic measures is planned.

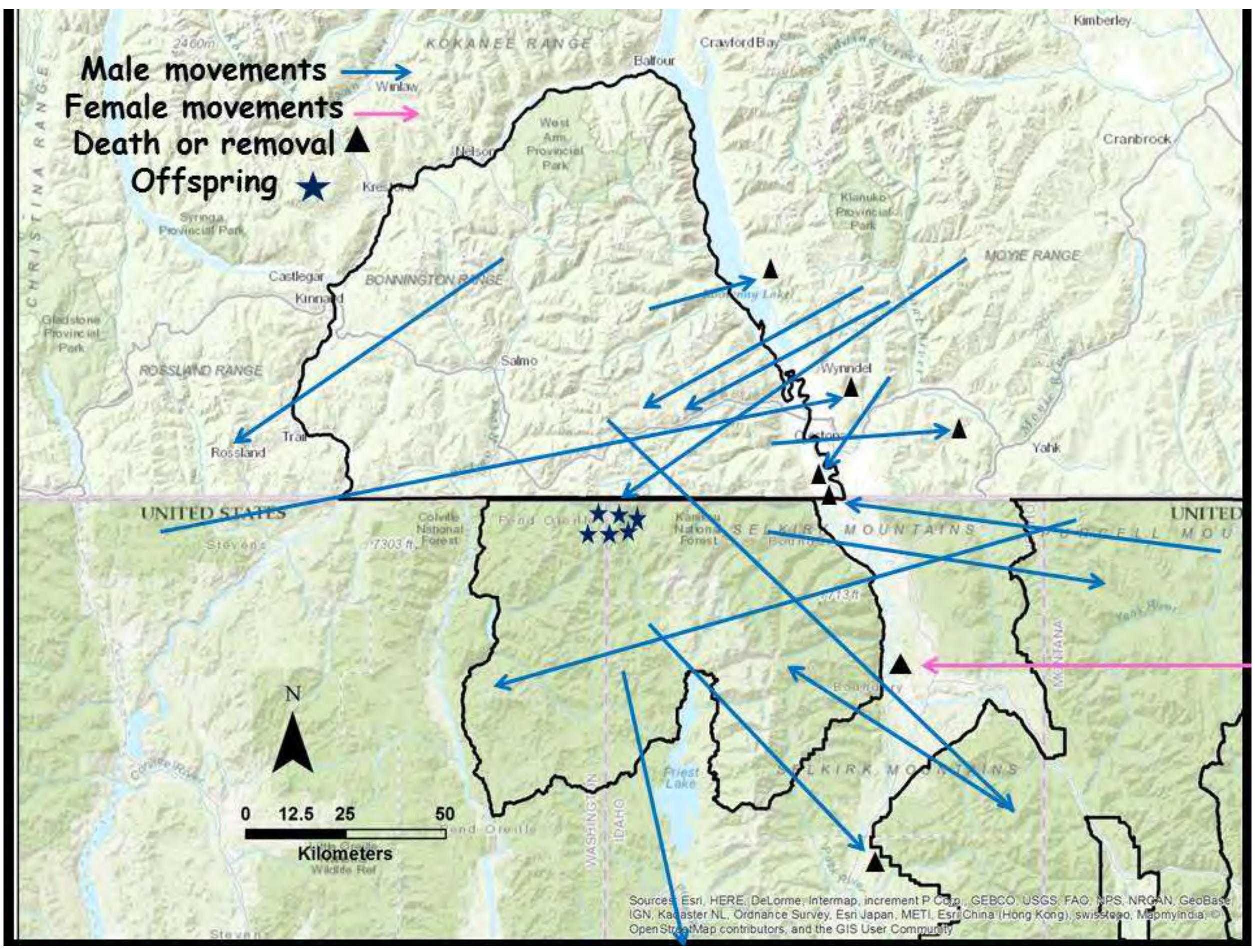

Figure 6. Known immigration, emigration, and gene flow in the Selkirk Mountains, 2000–17.

Known Grizzly Bear Mortality

Five known grizzly bear mortalities occurred during 2017 when a female grizzly bear with two cubs were removed from the Creston, BC landfill, an adult male was involved in a defense of life, and another adult male was the mistakenly killed by a black bear hunter in Idaho. Eighty-one instances of known and probable grizzly bear mortality were detected inside or within 16 km of the U.S. SE and the BC South Selkirk grizzly bear population unit during 1980–2017 (Tables 2 and 7, Fig. 6). Sixty-seven were human caused, 9 were natural mortality, and 5 were unknown cause. Fifty-two occurred in BC, 21 in Idaho, and 8 in Washington.

Seventy-three individuals were of known sex and age (Table 7). Fifteen were adult females, 18 adult males, 5 subadult females, 15 subadult males, 8 yearlings, and 12 cubs. Mortality causes (frequency) were management removal (33), unknown but human-caused (9), natural (9), poaching (7), mistaken identity (6), BC legal hunting (5), unknown (5), vehicle/train collision (4), and defense of life (3). Fifteen mortalities occurred in spring (April 1 to May 31), 20 in summer (June 1 to August 31), 42 in autumn (September 1 to November 30), and 4 on unknown dates.

Calculation of sex and age specific survival rates, reproductive rates, and a population trend is expected in the 2018 annual report.

Table 7. Cause, timing, and location of known or probable grizzly bear mortality in or within 16 km of the Selkirk Mountains recovery zone (with South Selkirk Population Unit), 1980–2017.

	Mortality cause									
Age / sex / season / ownership	Defense of life	Legal Hunt	Management removal	Mistaken identity	Natural	Poaching	Vehicle/Train Collision	Unknown, human	Unknown	Total
BC Adult female	1	1	5		3		2	1		13
US Adult female				1		1				2
BC Subadult female			2			1		1		4
US Subadult female				1						1
BC Adult male	1	2	6			1	1	1		12
US Adult male				1		2		3		6
BC Subadult male		2	5	1						8
US Subadult male	1		2	1			1	2		7
BC Yearling			3		1					4
US Yearling				1	1				2	4
BC Cub			6							6
US Cub					4	2				6
BC Unknown			4						1	5
US Unknown								1	2	3
Total	3	5	33	6	9	7	4	9	5	81
Season[1]										
Spring		4	5	1		1	1	1	2	15
Summer		1	7		6	1	3	2		20
Autumn	3		21	5	2	5		4	2	42
Unknown					1			2	1	4
Ownership										
BC Private			28		1			1		30
BC Public	2	5	3	1	3	2	3	2	1	22
US Private			2	1			1	2		6
US Public	1			4	5	5		4	4	23

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

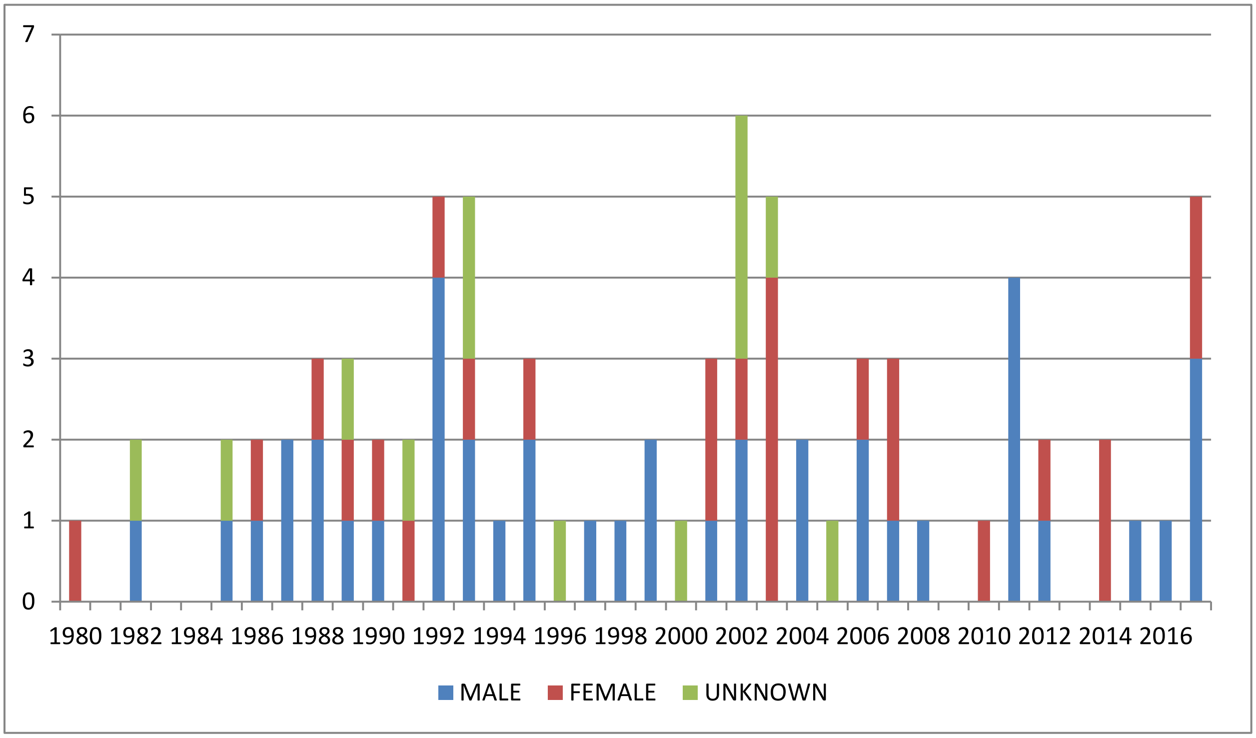

Figure 7. Known grizzly bear annual mortality from all causes in Selkirk Mountains recovery zone (including Canada), 1980–2017.

Capture and Marking

Nine grizzly bears (5 females and 4 males) were captured during research trapping in 2017 (seven in the U.S. and two in BC). Two sibling 2-year-old female bears were captured for management purposes after having gotten garbage. They were originally captured in the Creston Valley and relocated to the Yahk River. Two weeks later they were recaptured in the U.S. It was decided to separate the bears with one relocated to BC and the other was released in the U.S. Fifty-three grizzly bears were captured during 1420 trap-nights in BC and the U.S. during 2007–17 (Table 8, 9). Fifty-three individual black bears have been captured during these efforts (Appendix Table T2).

Rates of grizzly bear capture were higher in BC than the U.S. Thirty-seven individual grizzly bears have been captured in BC at a rate of 1 new individual every 16 trap-nights. Rates of capture of grizzly bears in the U.S. were 1 new individual every 53 trap-nights. Rates of capture for black bears were similar in BC and the U.S. at 1 new individual every 25 to 28 trap-nights. Black bear data are provided for comparison purposes.

Table 8. Capture effort and success for grizzly bears and black bears within the Selkirk Mountains study areas, 2007–2017.

Area / Year(s)	Trap-nights	Grizzly Bear Captures	Black Bear Captures	Trap-nights / Grizzly Bear	Trap-nights / Black Bear
Selkirks, US, 2012–17					
ID Total Captures	628	17	22	37	29
WA Total Captures	213	1	8	213	27
US Individual bears[1]	841	16	30	53	28
Selkirks, BC, 2007-17					
Total Captures	579	42	28	14	21
BC Individual bears[1]	579	37	23	16	25

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

Table 9. Grizzly bear capture information from the Selkirk Mountain study area, 2007–2017. Multiple captures of a single bear during a given year are not included.

Bear	Capture Date	Sex	Age (Est.)	Mass kg	Location	Capture Type
119	4/21/07	M	19	205	Duck Lake, BC	Research
138	5/20/08	F	2	100	Corn Cr., BC	Research
144	6/16/08	M	12	(205)	Next Cr., BC	Research
150	6/21/08	F	7	71	Elmo Cr., BC	Research
151	6/23/08	F	20	82	Cultus Cr., BC	Research
155	6/27/08	M	11	(170)	Next Cr., BC	Research
149	6/12/09	M	10	216	Wildhorse Cr., BC	Research
161	6/15/09	F	18	82	Wildhorse Cr., BC	Research
163	6/16/09	F	7	(102)	Wildhorse Cr., BC	Research
8005	6/16/09	F	4	(90)	Salmo River, BC	Management, pig feed
165	6/19/09	F	14	(80)	Apex Cr., BC	Research
169	6/23/09	F	20	(80)	Wildhorse Cr., BC	Research
171	6/25/09	F	14	91	Seaman Cr,, BC	Research
177	6/22/10	F	9	84	Hidden Cr., BC	Research
183	6/29/10	F	11	102	Sheep Cr., BC	Research
17	9/17/10	M	3	100	Nelson Golf Course, BC	Management, non-target capture
154	9/18/10	M	(4)	(91)	Summit Cr., BC	Research
7	9/25/10	F	13	132	Nelson Golf Course, BC	Management, grease bin
152	5/26/11	M	10	148	Cottonwood Cr., BC	Research
149	5/31/11	M	12	(205)	Cottonwood Cr., BC	Research
2	8/19/11	M	26	178	Creston Valley, BC	Research
174	5/25/12	M	6	84	Cottonwood Cr., BC	Research
166	5/30/12	M	3	56	Cottonwood Cr., BC	Research
170	6/5/12	F	6	130	Salmo River, BC	Management, cat food
183	6/8/12	F	11	--	Lost Cr., BC	Research
156	8/17/12	M	2	125	Creston Valley, BC	Management, fruit trees
12003	8/15/12	F	8	111	Trapper Cr., ID	Research
12008	8/26/12	F	15	114	Trapper Cr. ID	Research
12006	8/29/12	F	2	60	Trapper Cr. ID	Research
221	8/29/12	M	6	149	Creston Valley, BC	Research
226	6/6/13	F	6	115	Creston Valley, BC	Management, frequenting dump
13017	7/22/13	F	2	58	Trapper Cr., ID	Research
13021	7/30/13	F	3	76	Bugle Cr., ID	Research
13023	7/30/13	F	9	94	Trapper Cr., ID	Research
12016	8/23/13	F	10	104	Grass Cr., ID	Research
232	5/17/14	M	5	130	Apex Cr., BC	Research
174	5/22/14	M	8	116	Apex Cr., BC	Research
234	5/23/14	M	7	75	Ymir Cr., BC	Research

240	5/26/14	M	22	>245	Cottonwood Cr., BC	Research
150	6/14/14	F	14	70	Hidden Cr., BC	Research
248	6/19/14	M	4	93	Apex Cr., BC	Research
250	6/21/14	M	7	123	Wildhorse Cr., BC	Research
14327	6/21/14	M	7	195	Jackson Cr., ID	Research
227	6/24/14	M	8	112	Hidden Cr., BC	Research
229	6/26/14	F	4	72	Apex Cr., BC	Research
4250	10/6/14	F	(6)	(145)	Creston Valley, BC	Research
1019	5/30/15	F	3	221	Creston Valley, BC	Research
1020	6/7/15	F	6	144	Cultus Cr., BC	Research
150	6/13/15	F	14	182	Next Cr., BC	Research
1001	6/20/15	M	6	215	Trapper Cr., ID	Research
247	5/29/16	M	3	79	Creston Valley, BC	Research
1019	5/29/16	F	3	115	Creston Valley, BC	Research
1021	5/31/16	M	11	242	Creston Valley, BC	Research
1024	6/1/16	M	(2)	74	Creston Valley, BC	Research
1002	6/29/16	M	8	166	Willow Cr., WA	Research
4-070	8/6/16	F	(10)	(182)	Creston Valley, BC	Research
1003	8/14/16	F	6	128	Boundary Cr., ID	Research
4-011	8/15/16	F	>5	(68)	Kootenay R., BC	Management; fruit trees
4-002	8/15/16	F	(0.5)	(34)	Kootenay R., BC	Management; captured with mother 4-011
4-004	8/15/16	F	(0.5)	(34)	Kootenay R., BC	Management; captured with mother 4-011
1006	5/26/17	M	(1)	46	Boundary Cr., ID	Research
1028	6/5/17	F	(2)	58	Corn Cr., BC	Management; garbage
1026	6/5/17	F	(2)	60	Corn Cr., BC	Management; garbage
1030	6/10/17	F	(4)	110	Kootenay R., BC	Research
1031	6/14/17	F	(1)	40	Kootenay R., BC	Research
1007	6/19/17	M	(15)	170	Cow Cr., ID	Research
1008	6/21/17	M	(2)	86	Boundary Cr., ID	Research
1009	6/21/17	M	(5)	151	Cow Cr., ID	Research
1010	6/25/17	F	(12)	123	Cow Cr., ID	Research
12008	7/23/17	F	20	113	Trapper Cr., ID	Research
12003	7/24/17	F	13	97	Bugle Cr., ID	Research

Grizzly Bear Monitoring and Home Ranges

Eleven grizzly bears were monitored by GPS radio collars during portions of 2017 in the Selkirk Mountains study area. Monitoring included four females (all adults) and seven males (4 adults and 3 subadults).

Specific and general locations were obtained on collared bears, but only aerial, specific locations and GPS collar locations were used to calculate home ranges. Convex polygon life ranges were computed for bears monitored during 2007–2017 (Table 10, Appendix, Figs. A1-A47). Bears with multiannual home range estimates and sample sizes in excess of 50 locations were used to calculate basic statistics. Adult male life range averaged 1,172 km^2 (95% CI ± 456, n = 19) using the minimum convex polygon. Adult female life range averaged 435 km^2 (95% CI ± 210, n = 20) using the minimum convex polygon estimator.

Home ranges of collared grizzly bears overlap extensively on a yearly and lifetime basis. However, bears typically utilize the same space at different times. Male home ranges overlap several females to increase breeding potential, but males and females consort only during the brief period of courtship and breeding. Adult male bears, whose home ranges overlap, seldom use the same habitat at the same time to avoid conflict.

Table 10. Home range sizes of grizzly bears in the Selkirk Mountains of northern Idaho and southern British Columbia, 2006–2017.

Bear	Sex	Age (Est)	Years	Collar Type	Number of fixes	100% Convex polygon (km²)	Area of use
103	M	3-4	2006-07	GPS	4,872	6,545	Kootenai, & Pend Oreille River, BC, ID, & WA
119	M	19-20	2008-09	GPS	2,115	1,830	Selkirk Mtns., BC
138	F	2-3	2008-09	GPS	3,232	750	Kootenay River, BC
144	M	9	2008	GPS	1,648	883	Selkirk Mtns., BC
7005	M	4	2008	GPS	229	1,144	Selkirk Mtns., BC
150	F	6-14	2008-09, 2014-16	GPS	5,919	1,354	Selkirk Mtns., BC
155	M	11-13	2008-10	GPS	2,175	1,479	Selkirk Mtns., BC
161	F	6-7	2009-10	GPS	2,008	126	Selkirk Mtns., BC
163	F	6-7	2009-10	GPS	4,144	271	Selkirk Mtns., BC
165	F	15-16	2009-10	GPS	416	169	Selkirk Mtns., BC
171	F	15-16	2009-10	GPS	2,740	227	Selkirk Mtns., BC
8005	F	4-5	2009-10	GPS	1,649	4,511	Selkirk Mtns., BC
177	F	9	2010	GPS	486	72	Selkirk Mtns., BC
154	M	4	2010	GPS	396	178	Selkirk Mtns., BC
183	F	9-12	2010, 12-13	GPS	616	362	Selkirk Mtns., BC
7	F	9	2010	GPS	35	75	Selkirk Mtns., BC
17	M	3	2010	GPS	255	106	Selkirk Mtns., BC
152	M	6-7	2011-12	GPS	1,189	340	Selkirk Mtns., BC
149	M	11	2011	GPS	737	2,114	Selkirk Mtns., BC
12003	F	5-7,13	2012-13,17	GPS	1570	426	Selkirk Mtns, ID
12006	F	2-4	2012-14	GPS	626	532	Selkirk Mtns, ID
12008	F	15-17,20	2012-14,17	GPS	1,892	706	Selkirk Mtns, ID
221	M	6-7	2012-13	GPS	47	140	Selkirk Mtns., BC
174	M	4-6	2012-14	GPS	972	621	Selkirk Mtns., BC
12016	F	10-13	2013-16	GPS	742	216	Selkirk Mtns, ID
13017	F	2-5	2013-16	GPS	1,707	859	Selkirk Mtns, ID
13021	F	3-5	2013-15	GPS	1,187	1,801	Selkirk Mtns, ID
13023	F	9-11	2013-15	GPS	1,109	472	Selkirk Mtns, ID
226	F	6-9	2013-16	GPS	2,578	482	Selkirk Mtns, Creston Valley, BC
229	F	3-5	2014-16	GPS	489	71	Selkirk Mtns, BC
232	M	5	2014	GPS	1,354	353	Selkirk Mtns, BC
234	M	7-9	2014-16	GPS	3,560	446	Selkirk Mtns, BC
248	M	4-6	2014-16	GPS	4,418	2,321	Selkirk Mtns, BC
250	M	7-8	2014-15	GPS	3,224	829	Selkirk Mtns, BC
4250	F	(6-7)	2014	GPS	1,722	395	Selkirk Mtns, BC
227	M	8-9	2014-15	GPS	2,227	771	Selkirk Mtns, BC
14327	M	(6-8)	2014-16	GPS	785	2,580	Selkirk Mtns, BC, ID&WA
807	M	4-7	2014-17	GPS	2,568	3,319	Selkirk Mtns, ID&Yaak River, MT
1001	M	(4)	2015	GPS	1,352	1,357	Selkirk Mtns, BC
1019	F	(3-4)	2015-16	GPS	894	187	Selkirk Mtns, Creston Valley
1020	F	5-6	2015-16	GPS	3,366	196	Selkirk Mtns, BC
1002	M	(10)	2016	GPS	1,017	830	Selkirk Mtns, ID&WA
1003	F	(6)	2016	GPS	1,257	122	Selkirk Mtns, ID& Creston Valley BC
1024	M	(2)	2016	GPS	594	80	Selkirk Mtns, Creston Valley, BC
4011	F	(10-11)	2016-17	GPS	2729	312	Selkirk Mtns, BC
4070	F	(10)	2016	GPS	600	60	Selkirk Mtns, Creston Valley, BC

Bear	Sex	Age (Est)	Years	Collar Type	Number of fixes	100% Convex polygon (km²)	Area of use
247	M	(2)	2016	GPS	601	129	Selkirk Mtns, Creston Valley, BC
1021	M	(11)	2016	GPS	139	945	Selkirk Mtns, Creston Valley, BC
922[2]	M	4-5	2016-17	GPS	938	2,148	Kootenai Rr., ID Yaak Rr, MT
1006	M	(1)	2017	GPS	1553	393	Selkirk Mtns, ID&BC
1007	M	(15)	2017	GPS	118	74	Selkirk Mtns, ID&BC
1008	M	(3)	2017	GPS	152	52	Selkirk Mtns, ID& Creston Valley BC
1009	M	(5)	2017	GPS	180	216	Selkirk Mtns, ID&BC
1010	F	(12)	2017	GPS	43	61	Selkirk Mtns, ID
23	M	(3)	2017	GPS	427	114	Selkirk Mtns, BC

Grizzly Bear Denning Chronology

We used VHF and GPS location data from radio-collared grizzly bears during 1998–2017 to summarize den entry and exit dates by month and week. Den entry dates (n = 72) ranged from the first week of October to the first week of December. Sixty-one (92%) entries occurred between the 2nd week of October and the 4th week of November (Fig. 8). SE grizzly bears (median entry during 1st week of November) entered dens 1 and 3 weeks earlier than bears in the Cabinet Mountains and Yaak River drainage (Kasworm et al. 2018), respectively (median entry during 2nd week of November for Cabinet bears and 4th week of November for Yaak bears). Males enter dens one week later than females (Fig. 8). By December 1, 96% of monitored Selkirk grizzly bears had entered winter dens. By this same date, only 62% of Cabinet and Yaak grizzly bears had entered dens.

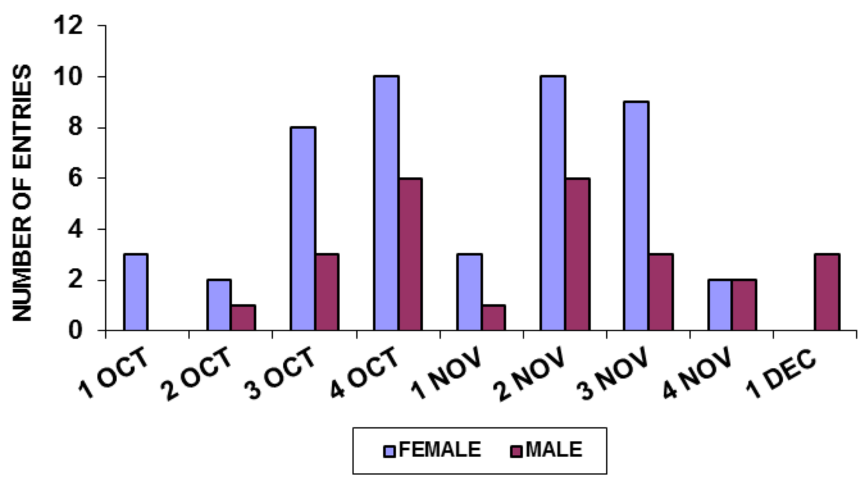

Figure 8. Month and week of den entry for male and female radio-collared grizzly bears in the Selkirk Ecosystem, 1998–2017.

We have far fewer den exit dates for Selkirk radio-collared grizzly bears (n = 21), and nearly all emergence data is from female grizzly bears. Exit dates for female Selkirk grizzly bears ranged from the third week of March to the second week of May (median of 4th week in April) (Fig. 9). Exit dates for females are similar to those of females in the Cabinet Mountains and Yaak drainage (Kasworm et al. 2018). In general, Cabinet and Yaak female grizzly bears exit dens only one week earlier than female bears in the SE.

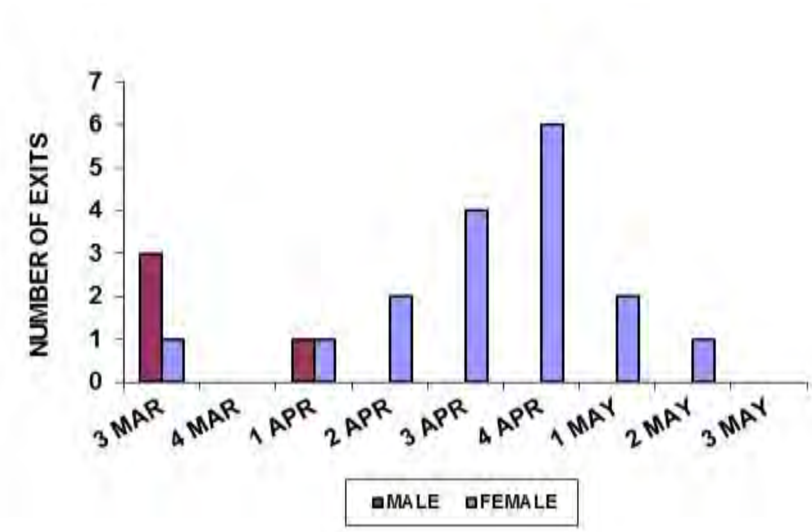

Figure 9. Month and week of den exit for male and female radio-collared grizzly bears in the Selkirk Ecosystem, 2013-2017.

Inter-ecosystem Isotope Analysis

To date, we have obtained carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotope ratios from 237 grizzly bear hair and blood samples between 1984 and 2015 across the Cabinet-Yaak and Selkirk ecosystems. Across the Selkirk and Cabinet-Yaak ecosystems, adult males consume slightly more animal matter (22%) than adult females (14%) and subadults (13%). Adult females in the Yaak River consume higher proportions of animal matter (22%) than do adult females in the Cabinets (10%) and the Selkirks (6%).

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

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

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

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

By analyzing different hair types that initiate growth at different times of the year, we have observed increases in proportion of animal matter in bear diets as they transition from summer months (diet estimated from guard hairs) to fall months (diet from underfur).). Previous studies have emphasized the importance of splitting these hair types due to temporal differences in growing period (Jones et al. 2006). We currently have 45 bear capture events with paired guard hair and underfur samples collected at capture. In all cases, grizzly bears have either 1) the same dietary meat proportion in summer vs. fall or 2) have higher amounts of meat in their fall diet. On average, grizzly bears' meat consumption nearly doubles from summer to fall (10.7%summer to 17.6% fall). Fall shifts toward meat use were not isolated to a specific sex-age class. Larger shifts include: an adult male (4327) shifting from 31% meat in summer to 82% meat in fall, an adult female (mortality on 5/18/2012) consuming 14% in spring time, then 38% in the fall, and a subadult female grizzly (675) with a summer diet consisting of 6% meat and fall diet of 16% meat. We suspect that wounding loss and gut piles from hunted ungulates contribute to observed increases in meat use by grizzly bears in fall months.

Berry Production

Huckleberries are an important summer and early-fall food for SE grizzly bears, as they are high in sugar content and effective in contributing to necessary fat gains for winter denning and reproduction. In an effort to index year-to-year production of huckleberries, we established and evaluated one huckleberry transect in the Selkirk Mountains in 2014. In 2015, we established and evaluated four additional transects in the Selkirks. Surveys were repeated on these five sites in 2016 and 2017 (Fig. 10). In 2017, Selkirk transect counts were higher than previous years, at 3.3 berries per frame (range = 2.9–3.7; 95% CI = 0.346) (Table 11). In comparison, huckleberry indices in the Cabinet-Yaak Ecosystem were slightly lower in 2017, at 2.8 berries per plot (n = 15 transects; range = 1.4–4.3; Table 11) but still well above long-term averages for the Cabinet-Yaak Ecosystem (1989–2017) (Kasworm et al. 2018).

Table 11. Berry production indices (berries per plot) at transect locations within the Selkirk Mountains study area, 2014–17. At bottom, yearly mean indices and 95% confidence intervals (CI), with comparison to Cabinet-Yaak transects.

	Berries per plot			
Huckleberry transect	2014	2015	2016	2017
Cow Creek	2.2	1.0	1.0	2.9
Caribou Creek	–	1.8	2.4	3.1
East Ruby Creek	–	2.2	3.0	3.7
Pass Creek Pass	–	2.0	1.3	3.6
Bunchgrass Meadows	–	1.5	2.0	2.9
Selkirk Annual Mean (CI)	2.2 (–)	1.7 (0.45)	1.9 (0.79)	3.3 (0.35)
Cabinet-Yaak Annual Mean (CI)	3.4 (1.09)	1.3 (0.33)	1.8 (0.33)	2.8 (0.49)

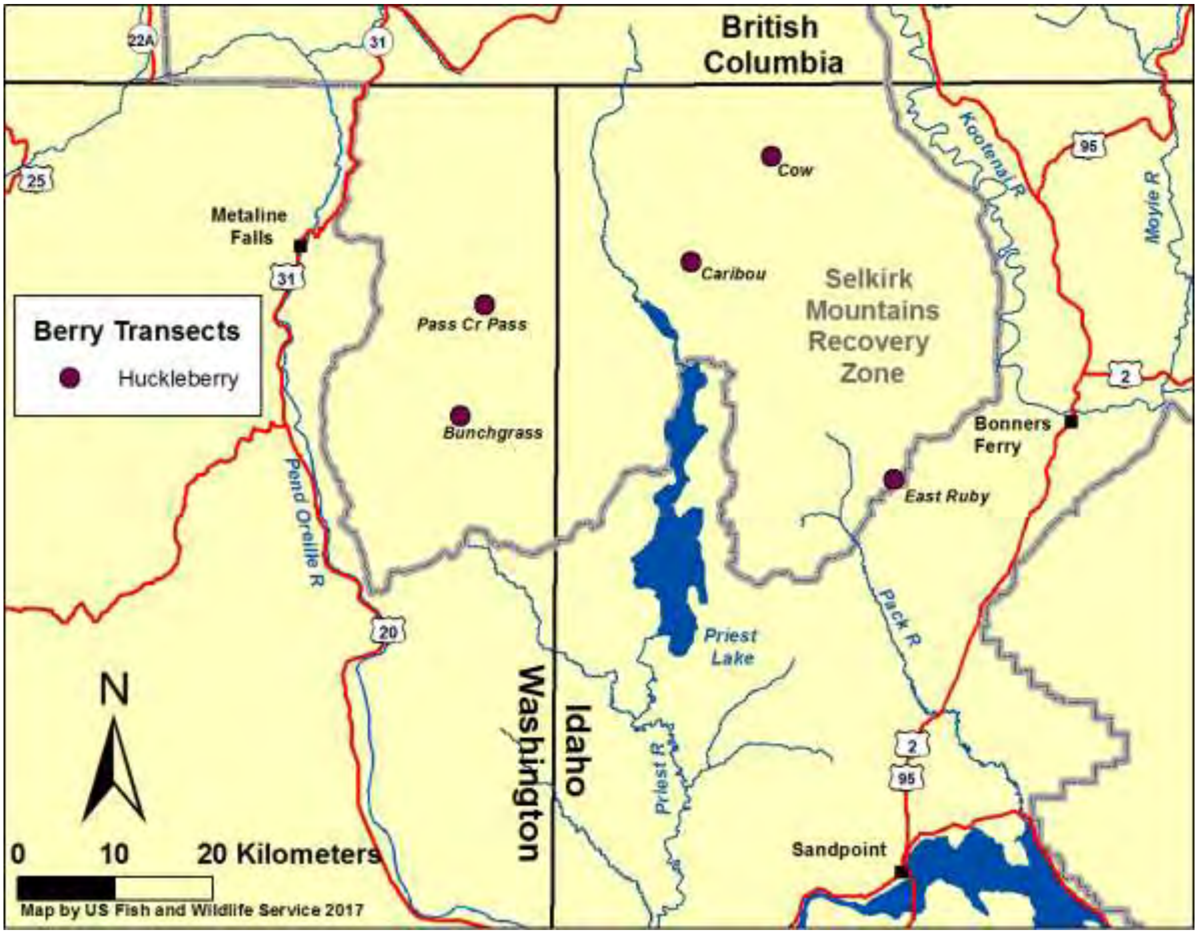

Figure 10. Locations of huckleberry transects surveyed within the Selkirk Mountain study area, 2014–17.

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APPENDIX

Table T1. Movement and gene flow to or from the Selkirk Mountains recovery area.

Area Start / Finish[1]	Action	Bear ID	Sex	Age	Year	Basis	Comments
NCDE / SSelk	Movement	None	F	2	2000	Telemetry, capture	Captured and relocated several times in NCDE. Recaptured north of Bonners Ferry, ID and relocated back to NCDE.
NPur / SSelk	Movement	SCptHM	M	19	2008	Telemetry, Genetics	Born in NPur but traveled to SSelk and captured. Genetics determine parents in NPur
SPur / SSelK	Movement	YHydeM	M	3	2006-07	Telemetry	Captured in SPur Yaak 2006. Bear traveled to SSelk 2006, denned then lost collar 2007.
KG/NPur	Movement	Wilf(156)	M	4	2012	Capture, Genetics	Traveled from Kettle Granby in WA to N Purcells. Management removal 2012
SSelk / Bitt	Movement	B90307M	M	?	2007	Genetic assignment	Killed in Bitterroot September 2007. Genetic analysis indicates origin in Sselk
SSelk / CABSR / SSelk	Movement	928442	M	5	2012	Genetics	Father SSelk S9058aM, Mother SSelk SBettyF, Hair snagged USGS 2012 in CABSR and again in Sselk 2015
SSelk / NPur	Movement	S1022M	M	1	1994, 1996	Telemetry, Mortality	Captured in SSelk 1994, Management removal 1996 Boswell, BC NPur.
SSelk / SPur	Movement	S31M	M	6	2004-05	Telemetry, Mortality	Father SSelk SS3KM, Mother SSelk S1MF, Collared 2003 West of Creston. Hunter kill 2005 east of Creston in SPur
NPur / SSelk	Movement	PBobM	M	26	2011	Telemetry, Mortality	Collared in NPurs, but recaptured later in SSelk and Management removal 2011
SSelk / KG	Movement	ApexS248M	M	4	2014-15	Telemetry	Radio collared and traveled west to KG from SSelk 2015
SSelk / Cabsr	Movement	S1001M	M	6	2015	Telemetry, Mortality	Travel east from SSelk to Cabsr. Mortality 2015

SPur / SSelK	Movement	Y11048M	M	4	2017	Telemetry, Mortality	Travel west from SPur to Sselk. Mortality 2017
SPur / SSelK	Movement	YGB807M	M	5	2015-17	Telemetry	Travel west from SPur to Sselk.
NPur / SSelk	Movement	S14151M	M	Unk	2014	Genetics	Parents both NPur, Father NPur PKiddM, Mother NPur PKellyF
NPur / SSelk	Gene flow	SFoccacia170F	F	6	2012	Genetics	Father NPur SCptHM , Mother SSelk SCulveF
NPur / SSelk	Gene flow	S92231M	M	Unk	2016	Genetics	Father NPur SCptHM , Mother SSelk JillS226F
NPur / SSelk	Gene flow	S25793M	M	Unk	2016	Genetics	Father NPur SCptHM , Mother SSelk S1029F
NPur / SSelk	Gene flow	S21285M	M	Unk	2016	Genetics	Father NPur SCptHM , Mother SSelk S11675F
NPur / SSelk	Gene flow	S21690M	M	Unk	2016	Genetics	Father NPur SCptHM , Mother SSelk SMaya4208F
NPur / SSelk	Gene flow	S21698M	M	Unk	2016	Genetics	Father NPur SCptHM , Mother SSelk SMaya4208F
SSelk / KG	Movement	9305a	?	Unk	Unk	Genetics	Father SKirkM, Mother SSelk S10991F, Origin of father probably SSelk
SSelk / KG	Movement	JC12-23	M?	Unk	2012	Genetics, Mortality	Father Sunk1M, Mother S10739F Both Selkirks Male offspring JC12-23 in KG
SSelk / SPur	Movement	16749	M	Unk	2015	Genetics	Father C134B2V2, Mother JillS226F Both Selkirks. Male offspring 16749 in SPur

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

Table T2. Black bears captured by study personnel in the Selkirk Ecosystem, 2007–17.

Bear	Tag Color	Capture Date	Sex	Age (Est.)	Mass kg (Est)	Location	Capture Type
116	BLACK	4/24/2007	M	13	(125)	Corn Cr., BC	Research
118	BLACK	4/26/2007	M	3	(57)	Corn Cr., BC	Research
120	BLACK	4/28/2007	M	UNK	163	Corn Cr., BC	Research
120	BLACK	4/30/2008	M	UNK	(136)	Corn Cr., BC	Research
118	BLACK	4/30/2008	M	(4)	(73)	Duck Lake, BC	Research
136	BLACK	5/17/2008	M	(6)	(79)	Leach Cr., BC	Research
146	BLACK	6/17/2008	M	UNK	(59)	Cultus Cr., BC	Research
148	BLACK	6/20/2008	M	UNK	76	Laib Cr., BC	Research
142	BLACK	6/21/2008	M	UNK	(68)	Cultus Cr., BC	Research
153	BLACK	6/24/2008	M	UNK	67	Elmo Cr., BC	Research
143	BLACK	5/17/2009	M	20	(109)	Corn Cr., BC	Research
145	BLACK	5/24/2009	UNK	UNK	(79)	Corn Cr., BC	Research
143	BLACK	5/27/2009	M	20	(109)	Dodge Cr., ID	Research
401	GREEN	6/22/2011	F	5	56	Fall Cr., ID	Research
403	GREEN	6/26/2011	F	9	79	Fall Cr., ID	Research
405	GREEN	6/29/2011	M	4	58	Fall Cr., ID	Research
407	GREEN	7/13/2011	M	2	47	Dodge Cr., ID	Research
409	GREEN	7/15/2011	M	3	54	Trail Cr., ID	Research
411	GREEN	7/18/2011	M	2	52	Fall Cr., ID	Research
417	GREEN	7/21/2011	M	UNK	37	Fall Cr., ID	Research
8006	GREEN	8/18/2011	F	2	41	Roman Nose Cr., ID	Research
155	GREEN	9/19/2011	F	8	(73)	Dodge Cr., ID	Research

Bear	Tag Color	Capture Date	Sex	Age (Est.)	Mass kg (Est)	Location	Capture Type
165	GREEN	9/25/2011	M	11	139	SF Dodge Cr., ID	Research
160	BLACK	5/26/2012	M	4	(68)	Blewett Cr., BC	Research
2001	GREEN	5/29/2012	M	11	95	Fedar Cr., ID	Research
162	BLACK	5/29/2012	M	3	60	Blewett Cr., BC	Research
2005	GREEN	8/23/2012	M	3	61	Abandon Cr., ID	Research
3016	GREEN	7/21/2013	M	10	74	Hughes Meadows, ID	Research
3019	GREEN	7/22/2013	M	4	49	Upper Priest Rv., ID	Research
3020	GREEN	7/29/2013	M	3	49	Bugle Cr., ID	Research
3013	GREEN	8/20/2013	F	16	75	Silver Cr., ID	Research
238	BLACK	5/25/2014	M	9	58	Porcupine Cr., BC	Research
236	BLACK	5/25/2014	M	8	90	Clearwater Cr., BC	Research
236	BLACK	6/12/2014	M	6	93	Apex Cr., BC	Research
4326	GREEN	6/13/2014	M	6	61	Jackson Cr., ID	Research
246	BLACK	6/17/2014	M	8	102	Wildhorse Cr., BC	Research
244	BLACK	6/17/2014	M	15	76	Wildhorse Cr., BC	Research
392	RED	6/28/2014	M	(4)	72	Hemlock Cr., WA	Research
388	RED	7/19/2014	M	(6)	96	LeClerc Cr., WA	Research
389	RED	7/25/2014	F	(9)	57	Le Clerc Cr., WA	Research
391	RED	7/26/2014	M	(5)	63	Jungle Cr., WA	Research
390	RED	7/26/2014	F	(4)	61	Sema Meadows, WA	Research
4330	GREEN	8/22/2014	M	8	103	Trapper Cr., ID	Research
4331	GREEN	8/24/2014	F	(8)	(79)	Bugle Cr., ID	Research
4332	GREEN	8/26/2014	M	16	105	Trapper Cr., ID	Research
4333	GREEN	8/28/2014	M	3	53	Trapper Cr., ID	Research
4305	GREEN	6/24/2015	F	6	47	Lime Cr., ID	Research
4306	GREEN	7/18/2015	M	(12)	113	Bugle Cr.,ID	Research
4307	GREEN	8/23/2015	M	(7)	(125)	Grass Cr., ID	Research
601	RED	5/27/2016	M	7	88	SF Granite, WA	Research
602	RED	6/9/2016	M	6	74	NF Harvey, WA	Research
603	RED	6/27/2016	M	6	74	Willow Cr., WA	Research
---	---	8/23/2016	---	(1)	(18)	Boundary Cr., ID	Research culvert, not tagged
4308	GREEN	7/17/2017	M	(3)	62	Bugle Cr., ID	Research
4309	GREEN	7/19/2017	M	(3)	52	Trapper Cr., ID	Research
4310	GREEN	7/19/2017	M	(8)	65	Bugle Cr., ID	Research
4329	GREEN	7/21/2017	M	(4)	63	Trapper Cr., ID	Research
4334	GREEN	7/23/2017	M	(3)	(68)	Trapper Cr., ID	Research
4335	GREEN	8/1/2017	M	(6)	96	Trapper Cr., ID	Research
4336	GREEN	8/24/2017	M	(3)	61	Caribou Cr., ID	Research

APPENDIX 2. Grizzly Bear Home Ranges

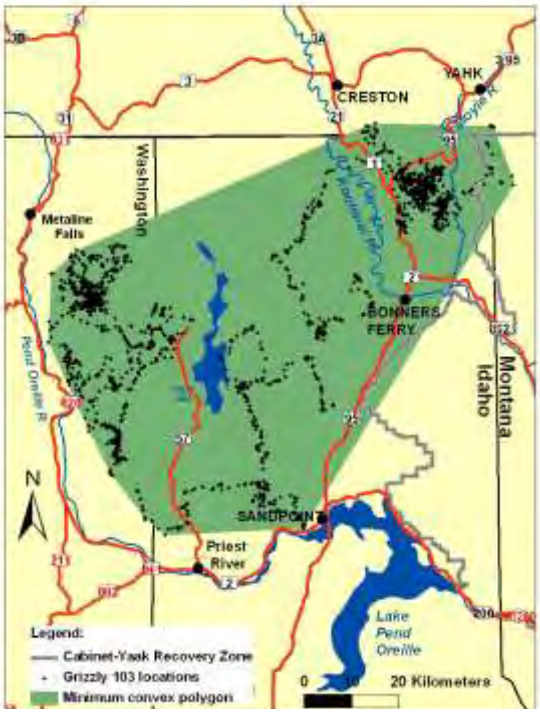

Figure A1. Radio locations and minimum convex (shaded) life range of male grizzly bear 103 in the Yaak River and Selkirk Mountains, 2006-07.

Figure A2. Radio locations and minimum convex (shaded) life range of male grizzly bear 119 in the Selkirk Mountains, 2008-09.

Figure A3. Radio locations and minimum convex (shaded) life range of female grizzly bear 138 in the Selkirk Mountains, 2008-09.

Figure A4. Radio locations and minimum convex (shaded) life range of male grizzly bear 144 in the Selkirk Mountains, 2008.

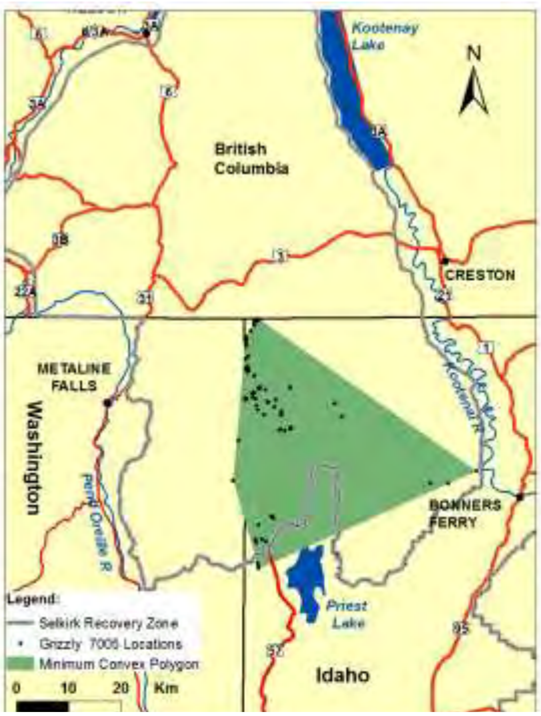

Figure A5. Radio locations and minimum convex (shaded) life range of management male grizzly bear 7005 in the Selkirk Mountains, 2008.

Figure A6. Radio locations and minimum convex (shaded) life range of female grizzly bear 150 in the Selkirk Mountains, 2008-09, 2014-16.

Figure A7. Radio locations and minimum convex (shaded) life range of male grizzly bear 155 in the Selkirk Mountains, 2008-10.

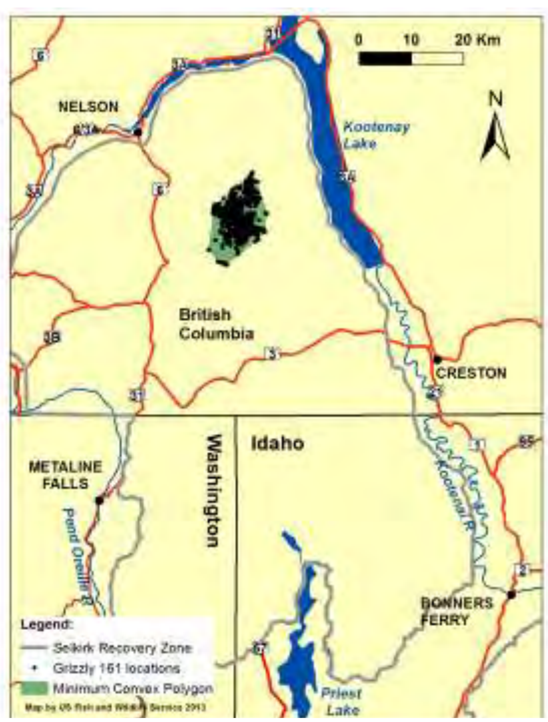

Figure A8. Radio locations and minimum convex (shaded) life range of female grizzly bear 161 in the Selkirk Mountains, 2009-10.

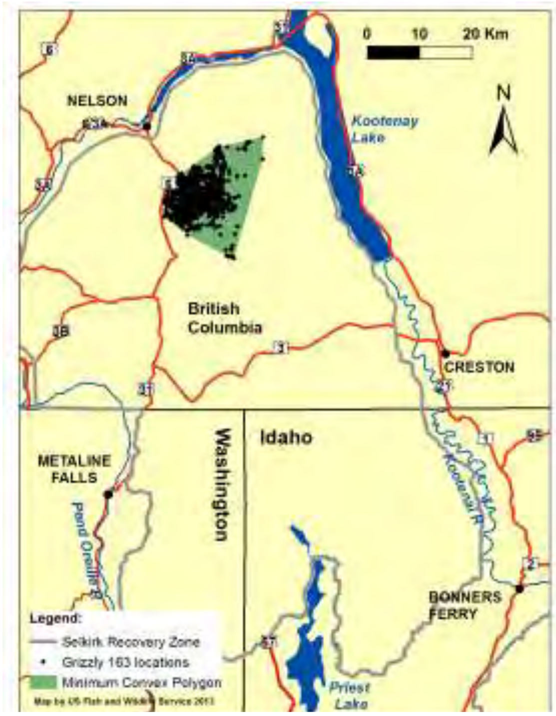

Figure A9. Radio locations and minimum convex (shaded) life range of female grizzly bear 163 in the Selkirk Mountains, 2009-10.

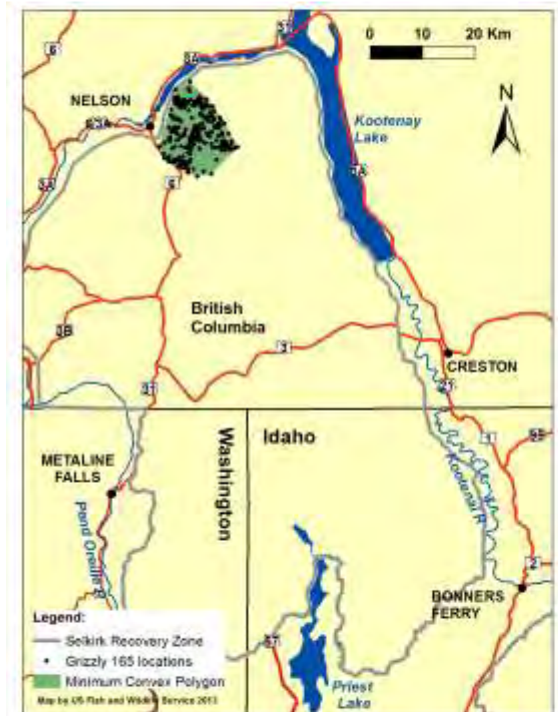

Figure A10. Radio locations and minimum convex (shaded) life range of female grizzly bear 165 in the Selkirk Mountains, 2009-10.

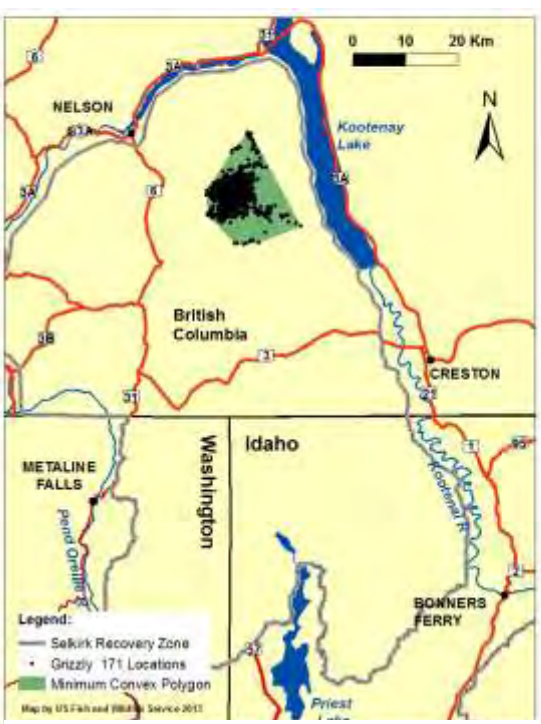

Figure A11. Radio locations and minimum convex (shaded) life range of female grizzly bear 171 in the Selkirk Mountains, 2009-10.

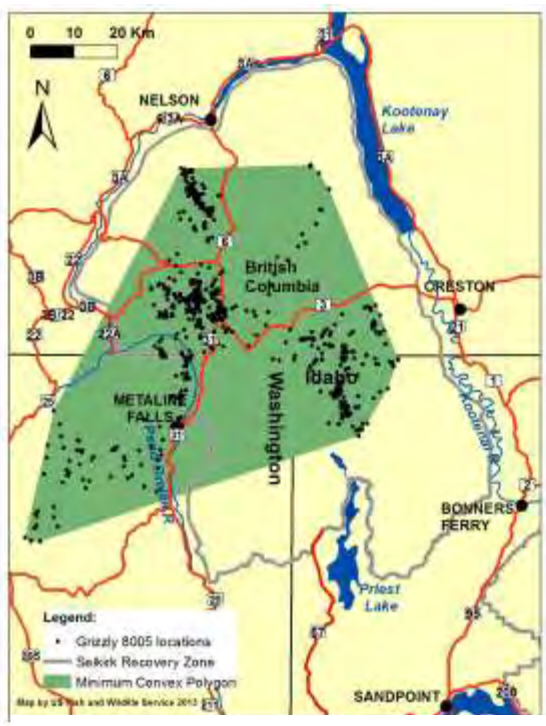

Figure A12. Radio locations and minimum convex (shaded) life range of female grizzly bear 8005 in the Selkirk Mountains, 2009-10.

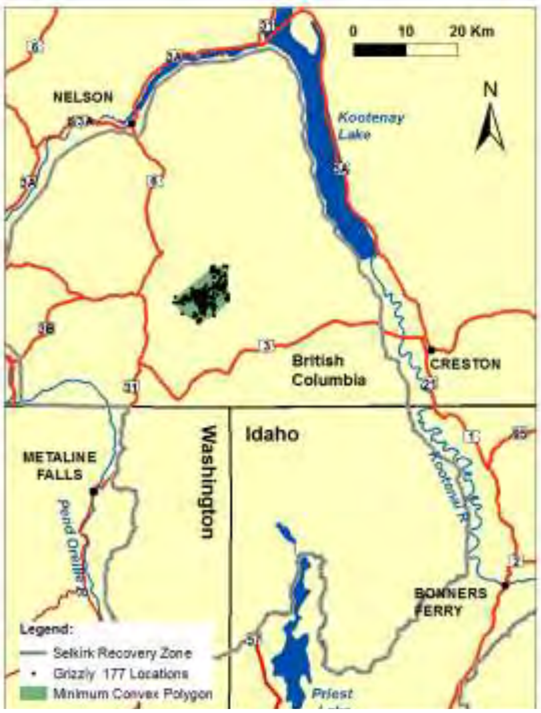

Figure A13. Radio locations and minimum convex (shaded) life range of female grizzly bear 177 in the Selkirk Mountains, 2010.

Figure A14. Radio locations and minimum convex (shaded) life range of male grizzly bear 154 in the Selkirk Mountains, 2010.

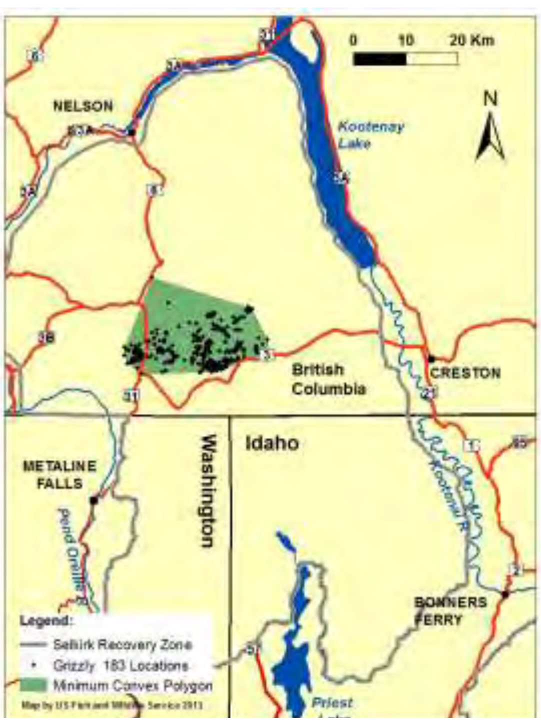

Figure A15. Radio locations and minimum convex (shaded) life range of female grizzly bear 183 in the Selkirk Mountains, 2010 and 2012-13.

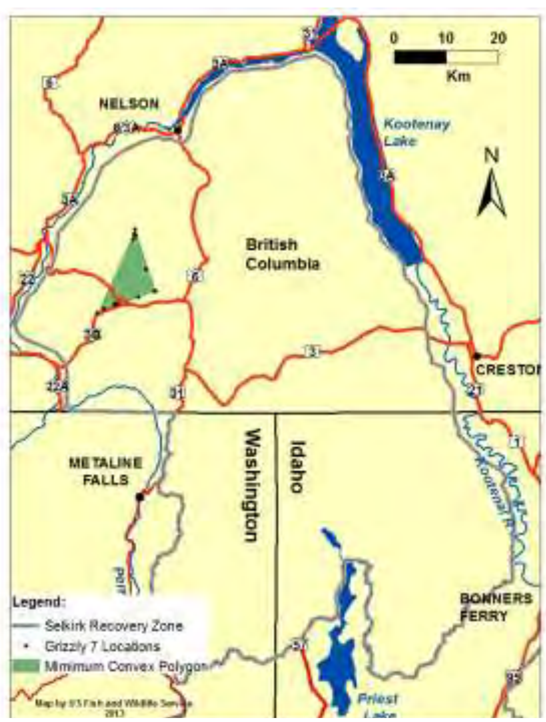

Figure A16. Radio locations and minimum convex (shaded) life range of management female grizzly bear 7 in the Selkirk Mountains, 2010.

Figure A17. Radio locations and minimum convex (shaded) life range of management male grizzly bear 17 in the Selkirk Mountains, 2010.

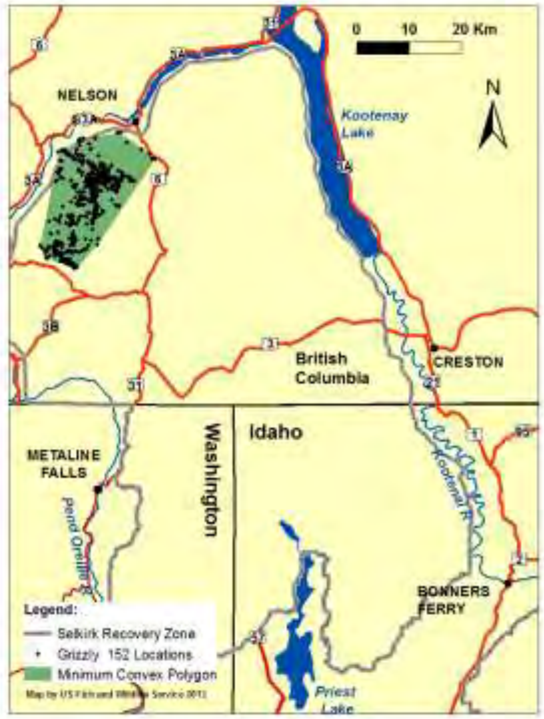

Figure A18. Radio locations and minimum convex (shaded) life range of male grizzly bear 152 in the Selkirk Mountains, 2011-12.

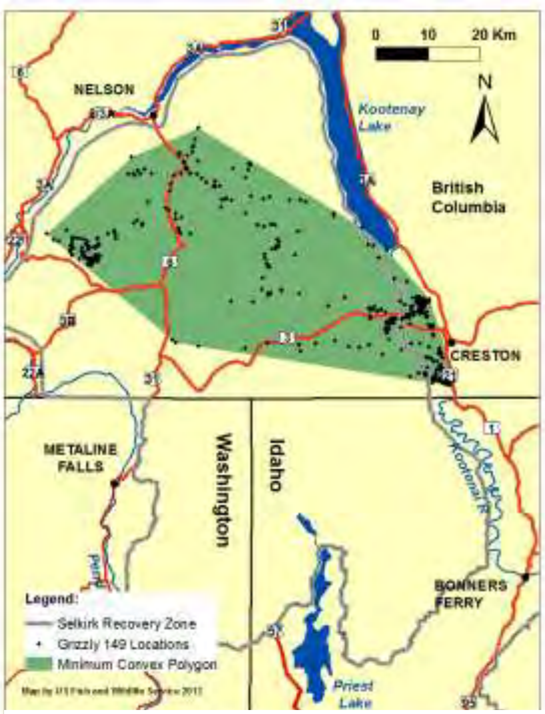

Figure A19. Radio locations and minimum convex (shaded) life range of male grizzly bear 149 in the Selkirk Mountains, 2011.

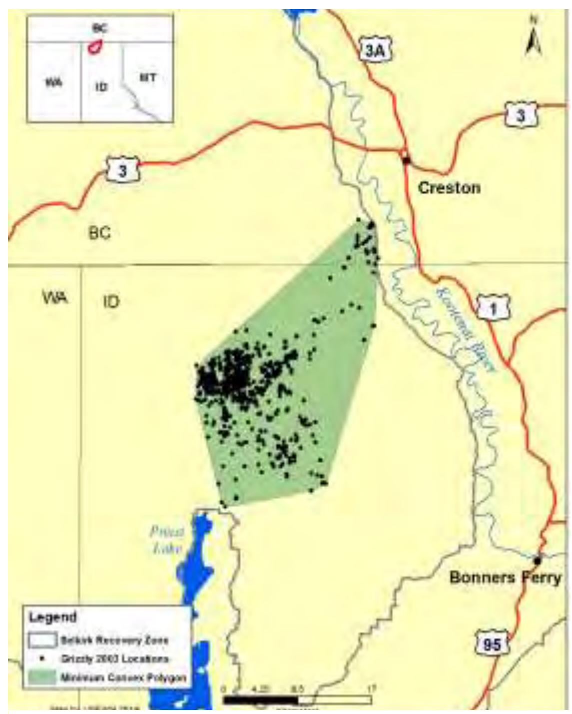

Figure A20. Radio locations and minimum convex (shaded) life range of female grizzly bear 12003 in the Selkirk Mountains, 2012-14, 2017.

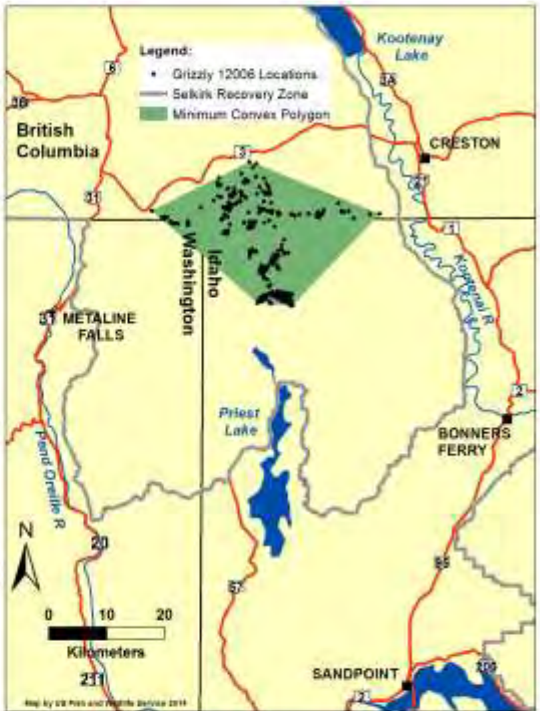

Figure A21. Radio locations and minimum convex (shaded) life range of female grizzly bear 12006 in the Selkirk Mountains, 2012-14.

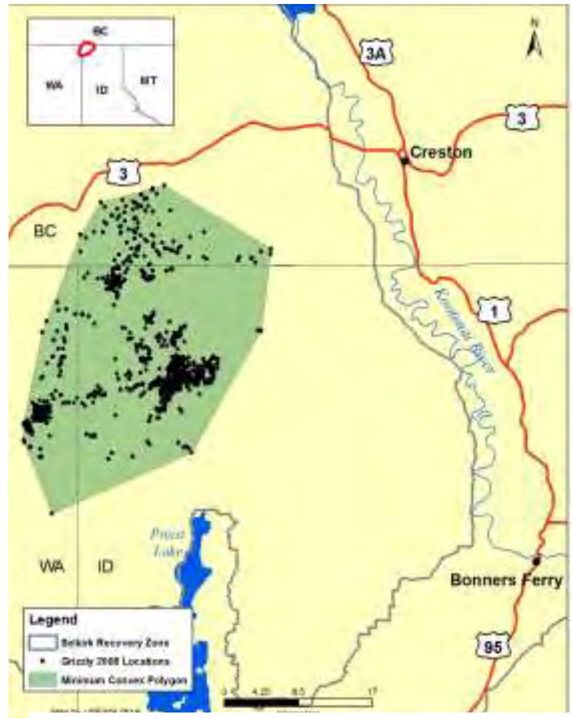

Figure A22. Radio locations and minimum convex (shaded) life range of female grizzly bear 12008 in the Selkirk Mountains, 2012-14, 2017.

Figure A23. Radio locations and minimum convex (shaded) life range of male grizzly bear 221 in the Selkirk Mountains, 2012-13.

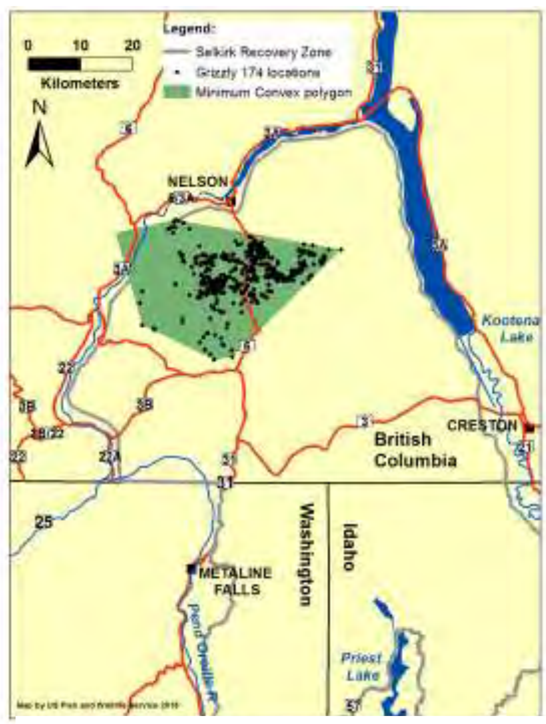

Figure A24. Radio locations and minimum convex (shaded) life range of male grizzly bear 174 in the Selkirk Mountains, 2012-13, 2015.

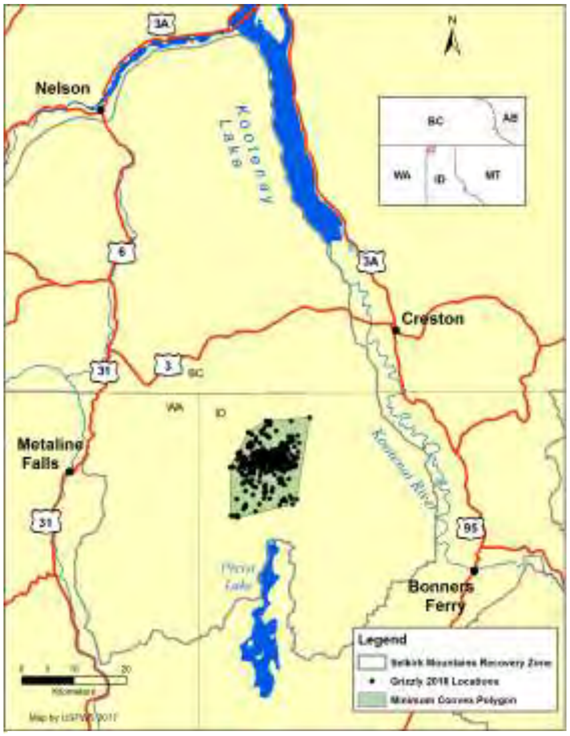

Figure A25. Radio locations and minimum convex (shaded) life range of female grizzly bear 12016 in the Selkirk Mountains, 2013-16.

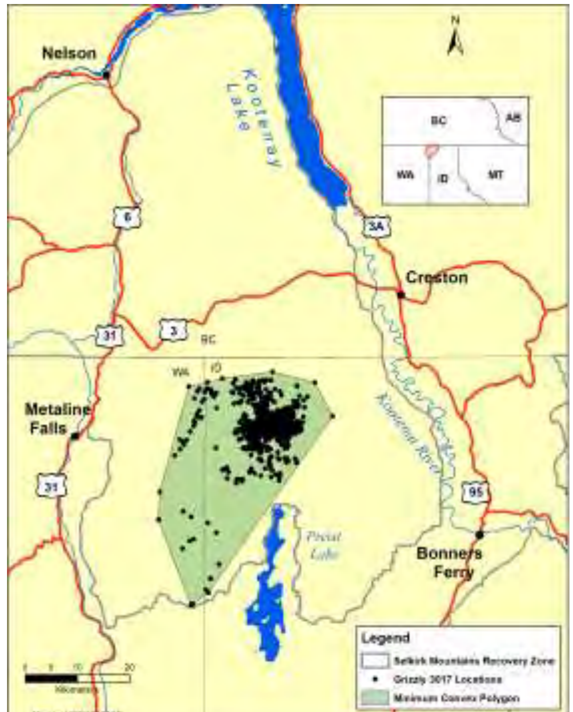

Figure A26. Radio locations and minimum convex (shaded) life range of female grizzly bear 13017 in the Selkirk Mountains, 2013-16.

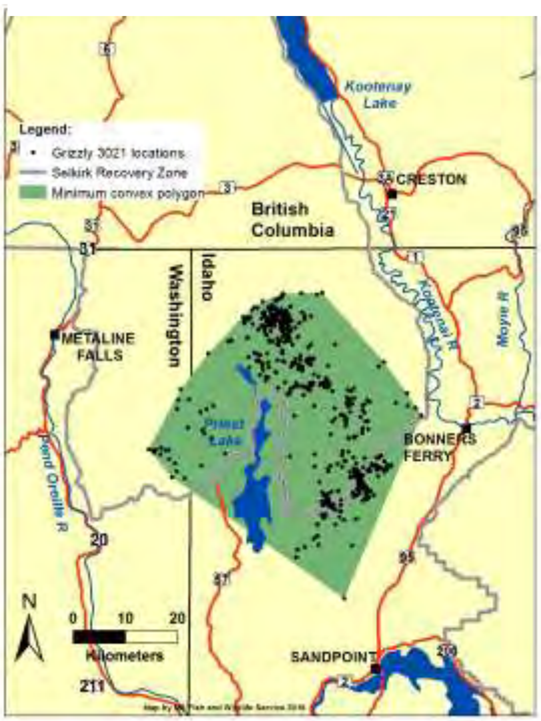

Figure A27. Radio locations and minimum convex (shaded) life range of female grizzly bear 13021 in the Selkirk Mountains, 2013-15.

Figure A28. Radio locations and minimum convex (shaded) life range of female grizzly bear 13023 in the Selkirk Mountains, 2013-15.

Figure A29. Radio locations and minimum convex (shaded) life range of female grizzly bear 226 in the Selkirk Mountains, 2013-16.

Figure A30. Radio locations and minimum convex (shaded) life range of female grizzly bear 229 in the Selkirk Mountains, 2014-16.

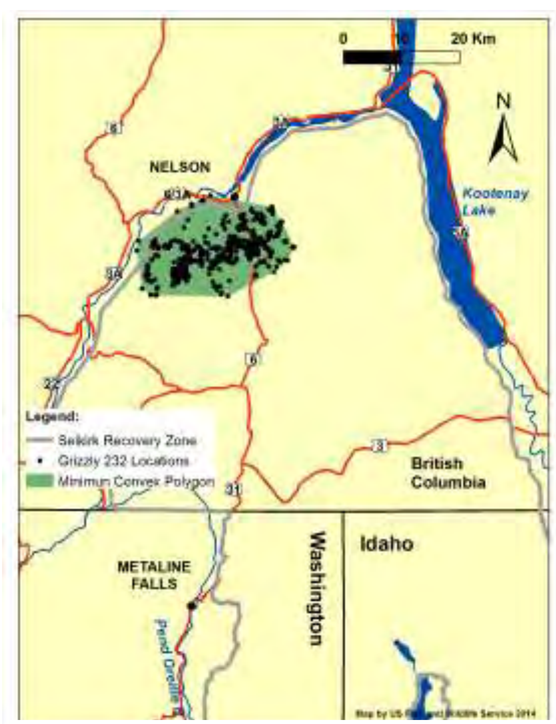

Figure A31. Radio locations and minimum convex (shaded) life range of male grizzly bear 232 in the Selkirk Mountains, 2014.

Figure A32. Radio locations and minimum convex (shaded) life range of male grizzly bear 234 in the Selkirk Mountains, 2014-16.

Figure A33. Radio locations and minimum convex (shaded) life range of male grizzly bear 248 in the Selkirk Mountains, 2014-16.

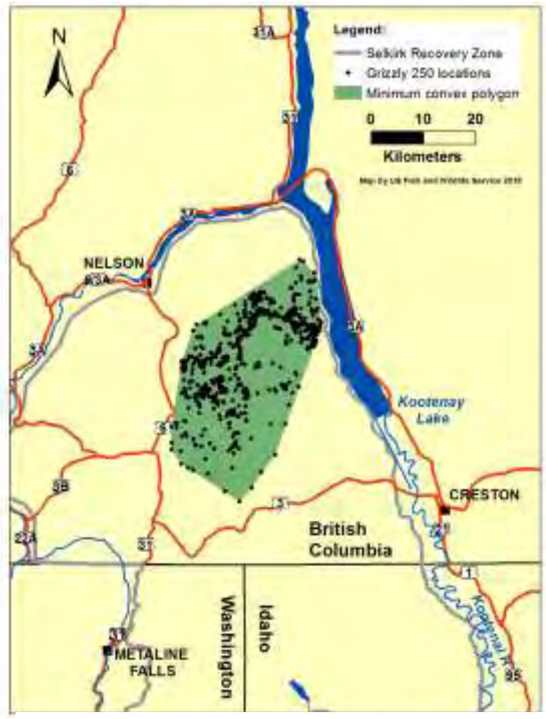

Figure A34. Radio locations and minimum convex (shaded) life range of male grizzly bear 250 in the Selkirk Mountains, 2014-15.

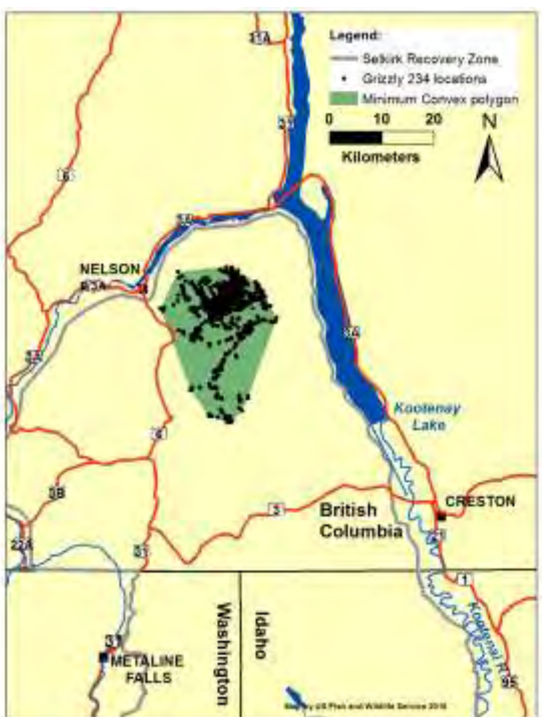

Figure A35. Radio locations and minimum convex (shaded) life range of male grizzly bear 4250 in the Selkirk Mountains, 2014-15.

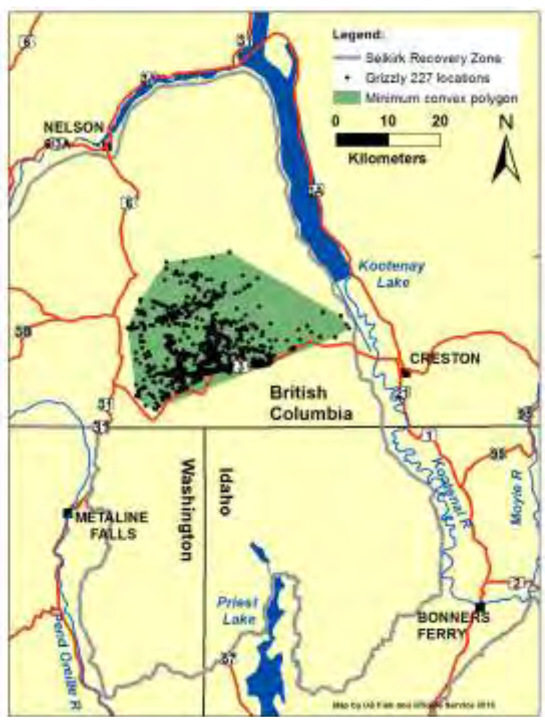

Figure A36. Radio locations and minimum convex (shaded) life range of male grizzly bear 227 in the Selkirk Mountains, 2014-15.

Figure A37. Radio locations and minimum convex (shaded) life range of male grizzly bear 4327 in the Selkirk Mountains, 2014-16.

Figure A38. Radio locations and minimum convex (shaded) life range of male grizzly bear 807 in the Yaak River and Selkirk Mountains, 2014-17.

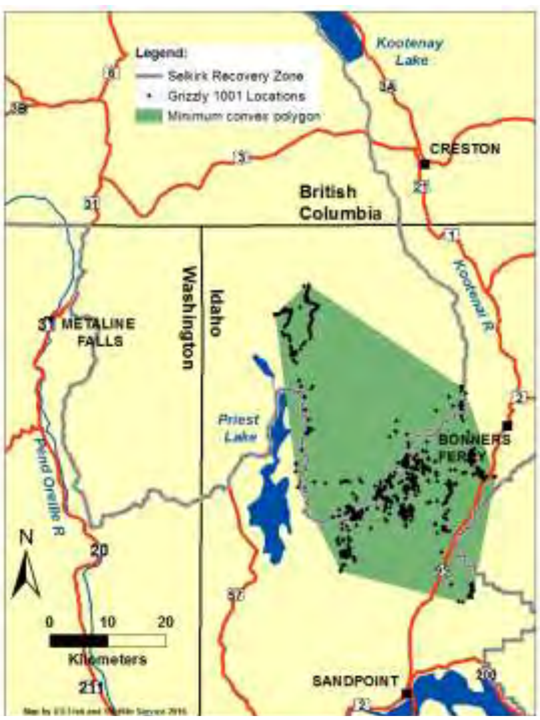

Figure A39. Radio locations and minimum convex (shaded) life range of male grizzly bear 1001 in the Selkirk and Cabinet Mountains, 2015-16.

Figure A40. Radio locations and minimum convex (shaded) life range of female grizzly bear 1019 in the Selkirk Mountains, 2015-17.

Figure A37. Radio locations and minimum convex (shaded) life range of female grizzly bear 1020 in the Selkirk Mountains, 2014-17.

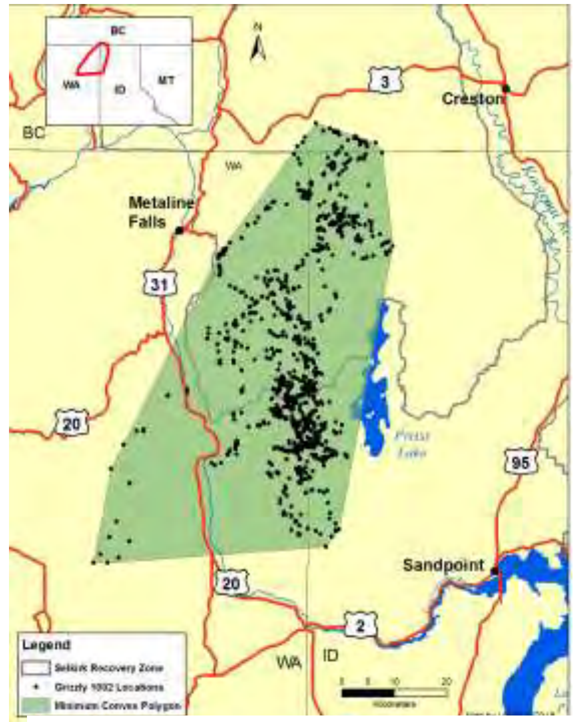

Figure A38. Radio locations and minimum convex (shaded) life range of male grizzly bear 1002 in the Selkirk Mountains, 2016-17.

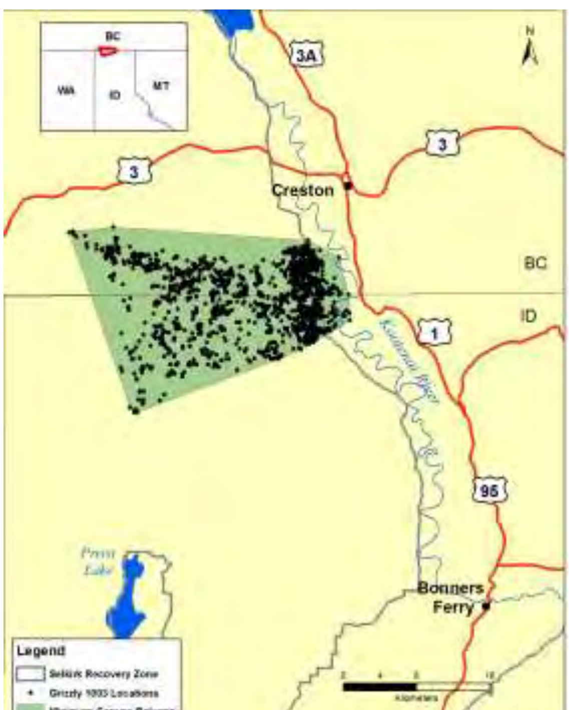

Figure A39. Radio locations and minimum convex (shaded) life range of female grizzly bear 1003 in the Selkirk Mountains, 20165-17.

Figure A40. Radio locations and minimum convex (shaded) life range of male grizzly bear 1024 in the Selkirk Mountains, 2016.

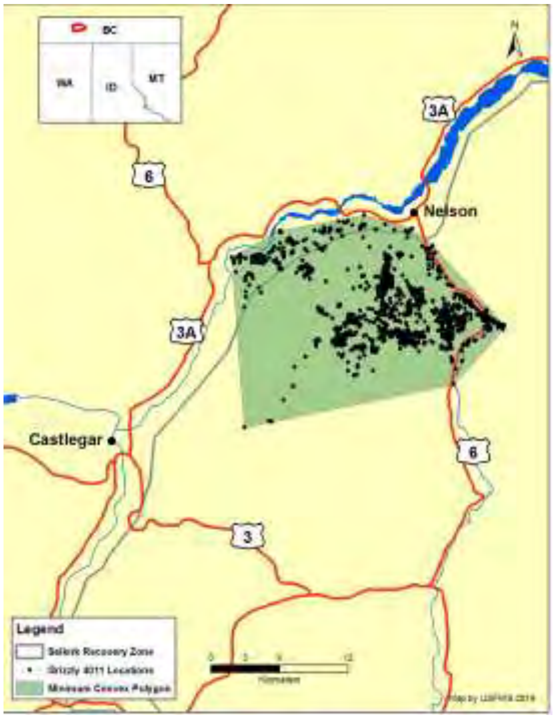

Figure A41. Radio locations and minimum convex (shaded) life range of male grizzly bear 4011 in the Selkirk Mountains, 2016-17.

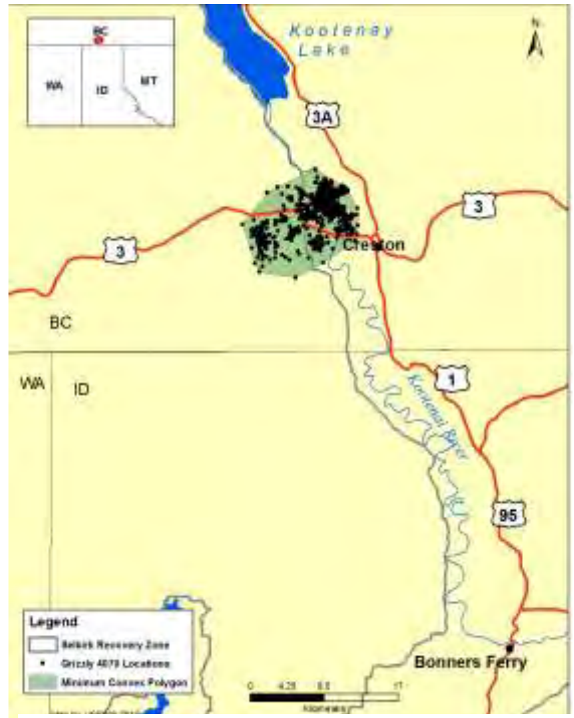

Figure A42. Radio locations and minimum convex (shaded) life range of female grizzly bear 4070 in the Selkirk Mountains, 2016-17.

Figure A43. Radio locations and minimum convex (shaded) life range of male grizzly bear 247 in the Selkirk Mountains, 2016.

Figure A44. Radio locations and minimum convex (shaded) life range of male grizzly bear 1021 in the Selkirk Mountains, 2016.

Figure A45. Radio locations and minimum convex (shaded) life range of management male grizzly bear 922 in the Yaak River and Selkirk Mountains,

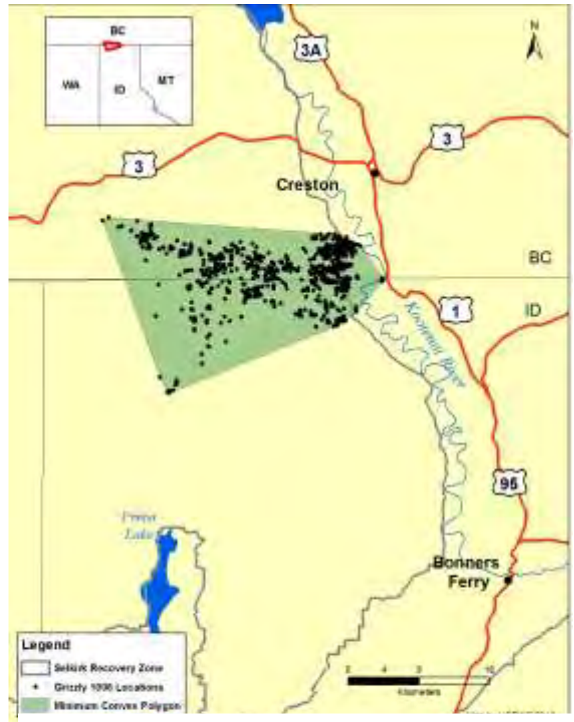

Figure A46. Radio locations and minimum convex (shaded) life range of male grizzly bear 1006 in the Selkirk Mountains, 2017.

Figure A47. Radio locations and minimum convex (shaded) life range of male grizzly bear 1007 in the Selkirk Mountains, 2017.

Figure A44. Radio locations and minimum convex (shaded) life range of male grizzly bear 1008 in the Selkirk Mountains, 2017.

Figure A45. Radio locations and minimum convex (shaded) life range of male grizzly bear 1009 in the Selkirk Mountains, 2017.

Figure A46. Radio locations and minimum convex (shaded) life range of female grizzly bear 1010 in the Selkirk Mountains, 2017.

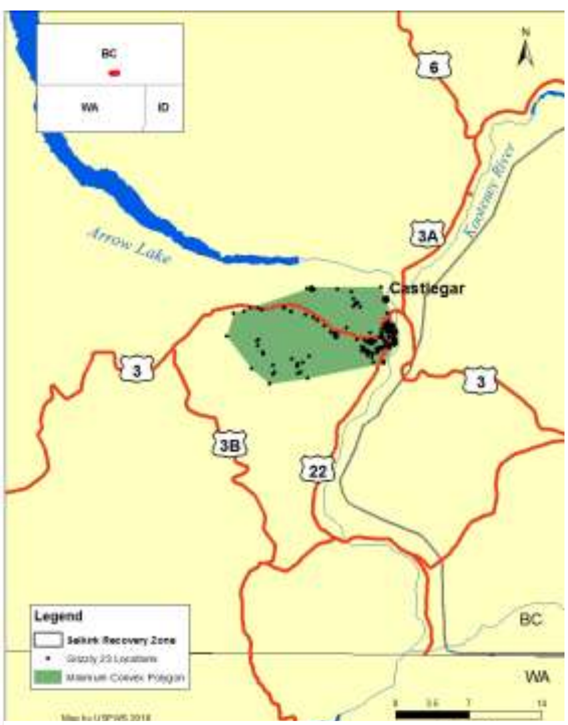

Figure A47. Radio locations and minimum convex (shaded) life range of male grizzly bear 23 in the Selkirk Mountains, 2017.