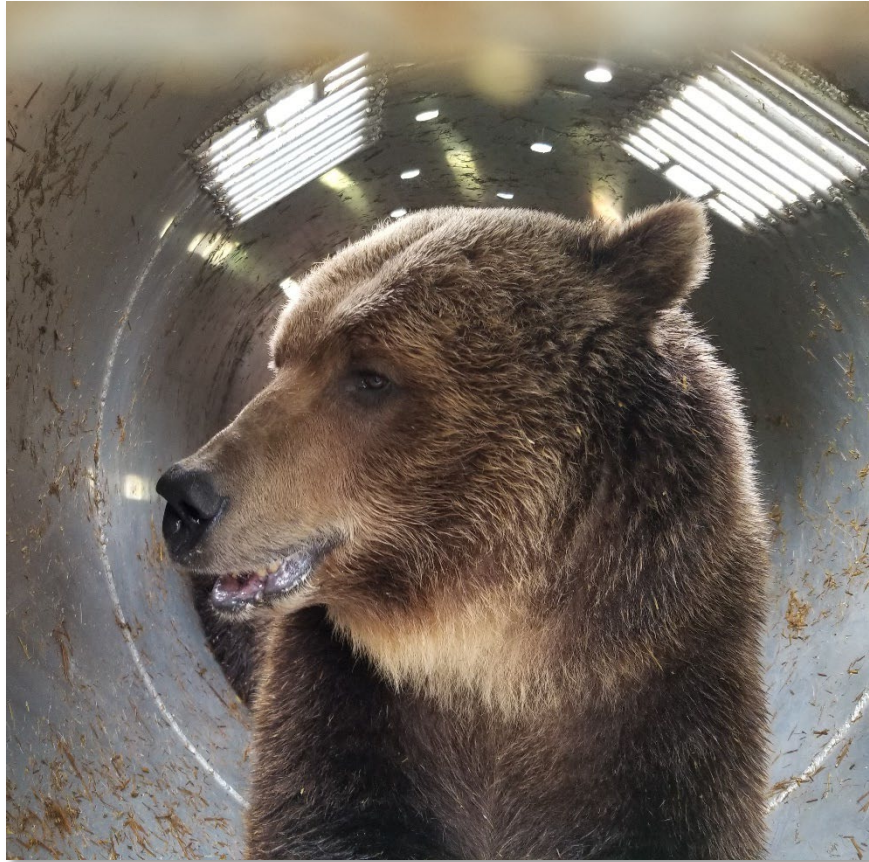


NORTHERN CONTINENTAL DIVIDE ECOSYSTEM
GRIZZLY BEAR POPULATION MONITORING TEAM
ANNUAL REPORT – 2020



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This annual report summarizes data collection efforts to date. It is not a peer-reviewed document, and data summaries and interpretations are subject to change.

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ABSTRACT

A program to monitor the population trend of grizzly bears in the Northern Continental Divide Ecosystem (NCDE) of Montana was initiated in 2004. The goal of this program is to estimate population trend by monitoring the survival and reproductive rates of radio-marked grizzly bears with the Demographic Monitoring Area (DMA). The DMA is composed of the Primary Conservation Area (PCA; equivalent to the Recovery Zone) and Zone 1 (a buffer area around the PCA). This report summarizes field accomplishments during 2020. We captured 20 grizzly bears (10F, 10M) for trend monitoring. An additional 50 bears (24F, 26M) were captured for management or other purposes. Including bears captured in previous years, we monitored 82 bears (56F, 26M) with radio-telemetry for research or management. We documented the deaths of 7 radio-marked bears (5F, 2M). Two deaths were among the research sample (2F) and 5 deaths were among bears captured for management (3F, 2M). We recorded the reproductive status of 34 adult females, including 12 with cubs, 9 with yearlings, 4 with 2-year-olds, 1 with a 3-year-old, and 8 with no offspring. We monitored survival of 3 cub litters (7 cubs) and 4 yearling litters (7 yearlings) and documented 3 presumed cub mortalities and 2 yearling mortalities. Including unmarked bears, we documented 37 known or probable mortalities of grizzly bears within the NCDE population. Management specialists in the NCDE preemptively responded to ≥ 35 situations where grizzly bears were near people and responded to ≥ 286 incidents of human-grizzly bear conflict. They took 46 action involving captured bears. We evaluated various demographic parameters relative to thresholds set forth in the 2019 Conservation Strategy. During the 6-year period of 2015–2020, all 23 Bear Management Units (BMUs) within the PCA and all 7 Occupancy Units (OUs) within Zone 1 were occupied by females with offspring, above the minimum thresholds of 21 BMUs and 6 OUs. During 2015–2020, we estimated an annual survival rate of 0.93 (± 0.01 SE) for independent females within the DMA, meeting the minimum threshold rate of 0.93. Within the DMA, we documented 11 and 12 mortalities of independent (≥ 2 years old) bears for females and males, respectively. From these, we estimated 12 total reported and unreported (TRU) mortalities for independent females and 14 TRU mortalities for independent males. During 2015–2020, the average of TRU mortalities for independent females within the DMA was 13, which fell below the maximum threshold of 24. The average for independent males was 21, which fell below the maximum threshold of 29. The estimated occupied range of the NCDE grizzly bear population during 2011–2020 encompassed 67,652 km², an increase of about

6% from the 2009-2018 estimate. Numerous other verified observations were also documented in connectivity areas between the NCDE and other grizzly bear ecosystems. Based on genotypes available through 2019, 2 natural movements of male bears from the NCDE to the Cabinet-Yaak Ecosystem (CYE) have been detected and were likely associated with natal dispersal. Capture and monitoring data indicated the 4 probable parents and 1 litter mate of these immigrants into the CYE resided in the northwest area of the NCDE. To date, there is no evidence of either of these 2 immigrants or any other undetected immigrant from the NCDE interbreeding with CYE bears. To date, we have not detected evidence of immigration into the NCDE from the Greater Yellowstone Ecosystem (GYE) or emigration from the NCDE into the GYE.

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1. INTRODUCTION AND STATEMENT OF NEED

The grizzly bear (*Ursus arctos horribilis*) was listed as threatened under the Endangered Species Act in 1975 for lack of information on its population status and habitat requirements. The NCDE has the largest population of grizzly bears in the lower 48 states; population size during 2004 was estimated to be 765 bears (Kendall et al. 2009). Managers and the public agree that information on both population size and trend is needed. Having these estimates will greatly improve our collective knowledge of grizzly bear ecology and provide more measurable and precise information with which to judge the status of the grizzly population in the NCDE. Therefore, in 2004 Montana Fish, Wildlife & Parks (MFWP), in cooperation with other state, federal, and tribal agencies, established a team to monitor the population trend of grizzly bears in the NCDE. The purpose of this long-term program is to monitor grizzly bear survival rates, reproductive rates, and population trend primarily by radio-monitoring grizzly bears, particularly females.

2. PROGRAM OBJECTIVES

The primary objective of this program is to monitor the population trend of grizzly bears in the NCDE using known-fate estimators of survival and documentation of reproductive rates of radio-transmitted grizzly bears. The ultimate responsibility of the monitoring team is to collect life history data on grizzly bears in western Montana and summarize findings in a comprehensive annual report. Major population monitoring categories will initially include:

- population trend,
- grizzly bear survival rates,
- grizzly bear reproductive rates,
- grizzly bear movements and habitat selection,
- grizzly bear distribution in western Montana,
- mortality levels in the NCDE, and
- levels of unreported mortality.

The 2019 Conservation Strategy detailed demographic monitoring protocols and management objectives developed by an interagency team to maintain and enhance a recovered grizzly bear population in the NCDE. It set forth 3 demographic objectives and associated thresholds. It also called for annual reporting of incidents of human-grizzly bear conflict and agency response. Although the Conservation Strategy is intended to take effect upon removal of the NCDE grizzly bear population from threatened status under the Endangered Species Act, the objectives and thresholds represent the most recent

monitoring methodologies, therefore we report on these objectives using field data obtained through 2020.

3. GEOGRAPHIC SCOPE OF THE MONITORING PROGRAM

Our trend monitoring program is focused within the Demographic Monitoring Area (DMA; Fig. 1), which encompasses the 23,119-km² Primary Conservation Area (PCA: equivalent to the Federal Recovery Zone) and the 19,460-km² Zone 1, which approximates a 10-mile buffer surrounding the PCA (USFWS 1993, NCDE Subcommittee 2019). The DMA includes Glacier National Park, parts of 4 National Forests (Flathead, Helena/Lewis and Clark, Kootenai, and Lolo); parts of the Blackfeet and Flathead Reservations; Bureau of Land Management lands; state lands, and private lands. The NCDE grizzly bear population is also contiguous with those in the Canadian provinces of British Columbia and Alberta, therefore occasional captures and monitoring occur north of the United States in Canada. Within the DMA, we designated 9 subunits for localized analyses, based on distinct land ownerships and grizzly bear population management authorities.

Although our focus for trend monitoring is the DMA, we also document presence and mortalities, respond to human-grizzly bear conflicts, and conduct limited research outside of the DMA. Notable areas include: Zone 2, an area of potential connectivity between the NCDE and the Greater Yellowstone Ecosystem (GYE); and Zone 3, an area occupied by grizzly bears which does not provide habitat linkage to other grizzly bear populations (NCDE Subcommittee 2019).

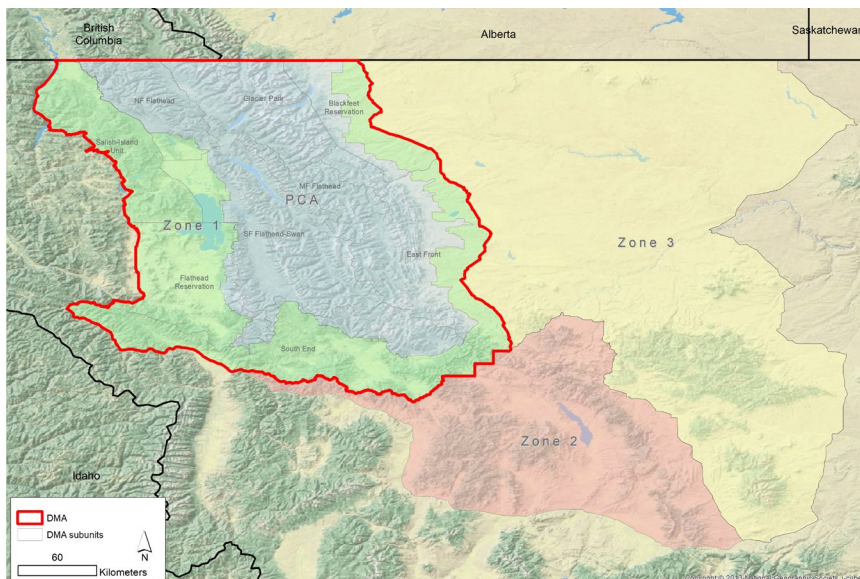


Figure 1. Zones of the NCDE. The Demographic Monitoring Area (DMA; red line), where population monitoring is conducted, consists of the Primary Conservation Area (PCA; blue) and Zone 1 (green). DMA subunits (gray lines) are used for localized population analyses. Zone 2 (pink) is the area of potential genetic connectivity between the NCDE and the Greater Yellowstone Ecosystem. Zone 3 (orange) is an area occupied by grizzly bears which is not likely to provide habitat linkage to other populations.

4. FIELD ACTIVITIES

Methods

We captured grizzly bears using leg-hold snares and culvert traps. We followed the handling and immobilization procedures found in the Montana Animal Care and Use Committee protocols for grizzly bears and black bears (Montana Fish, Wildlife and Parks 2004). We tagged all bears subcutaneously with passive transponder tags and pulled a premolar tooth for age determination (Stoneberg and Jonkel 1966). We radio-marked most females and a sample of males with radio-transmitters. Currently deployed transmitters include: Iridium neck-mounted GPS collars (TGW-4570-3; Telonics, Inc.); very high frequency (VHF) collars (Telonics, Inc., Mesa, AZ); and VHF ear-tag transmitters (Advanced Telemetry Systems, Inc., Isanti, MN). We captured research bears throughout the study area. We attempted to distribute our sample of research females roughly in proportion to relative grizzly bear density, based on the distribution of female bears detected at DNA hair traps in 2004 (Kendall et al. 2009). Grizzly bears were also captured and radio-marked for management and other purposes. Individual bears were classified as either research bears or other (non-research) bears using the terminology of Mace et al. (2012).

We monitored survival and reproduction using aerial telemetry flights conducted monthly and by remote downloads of GPS data. We attempted to investigate mortality signals within 2 weeks to ascertain whether the bear died or shed its collar. If a dead bear was found, we conducted preliminary necropsies in the field and collected relevant samples for laboratory analyses. In early spring, when bears were beginning to emerge from dens, we conducted observation flights for adult female bears to ascertain reproductive status, age of offspring, and litter size (if present). We continued to conduct telemetry flights throughout the active season, when possible, to document survival of dependent offspring.

We recorded known and probable mortalities of marked and unmarked grizzly bears inside and outside of the DMA. Known mortalities involved a carcass or parts which substantiate death; probable mortalities lacked a carcass but involve strong evidence that a bear died (e.g., blood loss).

During field activities, we opportunistically collected hair samples left by bears under various circumstances, such as bears that visited trap sites, bears that rubbed on natural and man-made objects, and bears that were present at sites of human-grizzly bear conflict. If the samples appeared adequate, we included them in DNA analyses for individual identification. These samples contributed to our sample of genotypes for population analyses and provided additional information about captured individuals, such as conflict history or continued presence in the population.

During 2020, we developed an ecosystem-wide management database for recording agency responses to grizzly bears or human-grizzly bear conflict and preventative measures taken.

Results

In 2020, we captured 70 individuals during 79 capture occasions (9 recaptures, Fig. 2). For this summary, we categorized individuals according to their first capture of the year. We captured 20 individuals for trend monitoring purposes within the DMA (Table 1), including 10 females and 10 males. Eight females and 1 male were fitted with radio-transmitters. In addition to research captures, bears were captured for management or other reasons. Management (conflict, non-target, and preemptive) captures included 23 females and 25 males, and 16 females and 16 males were fitted with radio-transmitters. Trapping for individuals to augment the population in the Cabinet-Yaak Ecosystem (CYE) included 1 male that was not translocated. One female was captured and radio-marked for research outside of the DMA.

Table 1. Number of individual grizzly bears captured and fitted with radio-transmitters in the NCDE, 2020.

Type ¹	Captured			Radio-marked		
	Female	Male	Total	Female	Male	Total
Trend research in DMA	10	10	20	8	1	9
Management ²	23	25	48	16	16	32
Augmentation	0	1	1	0	0	0
Research outside of DMA	1	0	1	1	0	1
Total	34	36	70	25	17	42

¹Bears with multiple captures in 2020 were placed in only one category according to their first capture of the year. ²Management captures included bears captured for conflict, non-target bears captured at conflict sites, bears captured preemptively to prevent conflict, and bears captured in other circumstances.

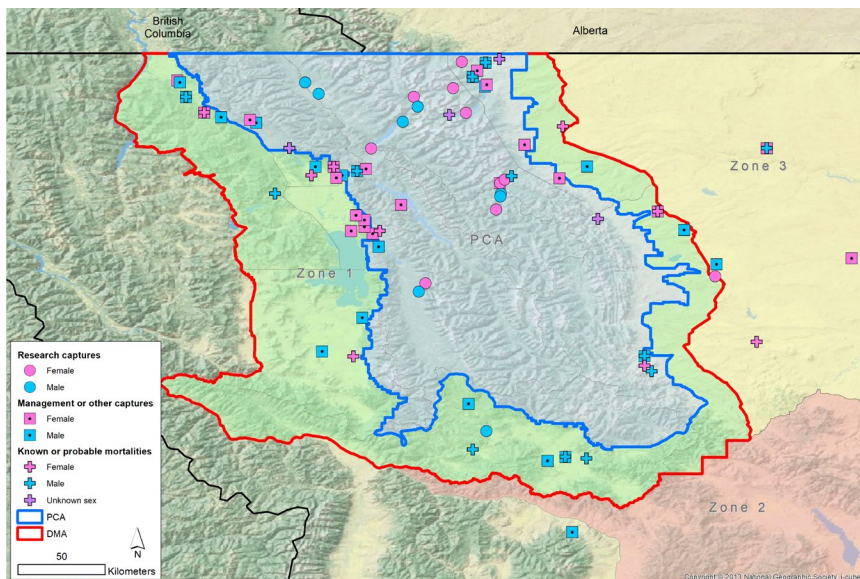


Figure 2. Location of captures and mortalities of grizzly bears in the NCDE, 2020. Zones as described in Figure 1.

Including bears collared during previous years, we radio-monitored 30 independent bears during all or part of 2020 for trend monitoring within the DMA: 28 females and 2 males. Among this trend sample, we documented the deaths of 2 female bears and both were poaching/malicious kills. For

management or other reasons, we monitored 52 bears: 25 independent females, 3 dependent females, 23 independent males, and 1 dependent male. The dependent bears were yearlings but separated from their mothers. Among this non-research sample, we documented the deaths of 5 radio-marked bears: 4 management removals (2F, 2M) and 1 poaching malicious kill (1F). A summary of the fates of radio-marked bears during 2020 are presented in Appendix A.

Among both samples, we recorded the reproductive status of 34 adult females during 2020, including 12 with cubs, 9 with yearlings, 4 with 2-year-old offspring, 1 with a three-year-old, and 8 with no offspring. First observations for reproductive status ranged from March 14 (ground observation) to October 7 (new capture) and averaged June 4. We documented 2 litters with 1 cub, 8 litters with 2 cubs, and 2 litters with 3 cubs. First observations for these litters ranged from April 4 (flight observation) to October 30 (new capture). Mean date of first verified litter size was June 14. We were able to monitor survival of 3 cub litters (7 cubs) and 4 yearling litters (7 yearlings) through repeated observations during the year. We documented 3 presumed cub mortalities and 2 yearling mortalities. A summary of the reproductive observations of radio-marked females are presented in Appendix B.

Thirty-seven known or probable grizzly bear mortalities were documented in the NCDE during 2020 (Table 2). Thirty-four occurred within the DMA: 13 inside the PCA and 21 within Zone 1 (Fig. 2). Three mortalities occurred outside the DMA in Zone 3. Among 24 mortalities of independent bears, causes of death were: agency removal due to conflict (10); defense of life (7); poaching/malicious kill (3); automobile collision (3); and illegal defense of property (1). Thirteen dependent bear mortalities included individuals that died, individuals that were orphaned and then captured and moved to zoos, or cubs that were orphaned and assumed dead (cubs only). Among dependent bears, causes of death were: assumed dead due to orphaning (4); agency removal due to orphaning (3); natural (2); poaching/malicious kill (2); and automobile collision (1). A summary of all documented mortalities in the NCDE during 2020 is reported in Appendix C.

Table 2. Number of known or probable mortalities of grizzly bears in the NCDE, 2020.

	Ageclass	Sex			Total
		Female	Male	Unknown	
Inside DMA	Dependent	5	1	6	12
	Independent	11	12		23
	Total	16	13	6	35
Outside DMA	Dependent	1	0	0	1
	Independent	0	1	0	1
	Total	1	1	0	2

One of the 2020 mortalities involved a male that was previously classified as an NCDE mortality in 2019 when it was translocated to the CYE for augmentation. During 2020, this radio-marked subadult male moved back into the NCDE and was killed in a defense of life incident. This mortality was removed from the 2019 records and included in the 2020 records. In addition, 1 mortality from 2019 was determined to be a black bear from analyses of its DNA, therefore this mortality was also removed from the 2019 records. These removed records are detailed in Appendix D.

During 2009–2019, we collected 804 opportunistic samples associated with 274 sites or events. Among them, 360 (45%) were successfully genotyped as grizzly bears (Fig 3). Other samples were found to be from black bears or were not successfully genotyped due to scarcity of hair follicles, mixture of individuals within the sample, or failure of DNA extraction or genotyping. A total of 194 individuals were detected among these samples. Number of total detections per individual ranged from 1–12 with an average of 1.9. Number of years detected per individual ranged from 1–5, with a mean of 1.4. Across the entire period, 120 of 195 individuals (62%) had not been previously captured and were identified as new individuals. On an annual basis, an average of 45% of individuals detected were new individuals (Table 3).

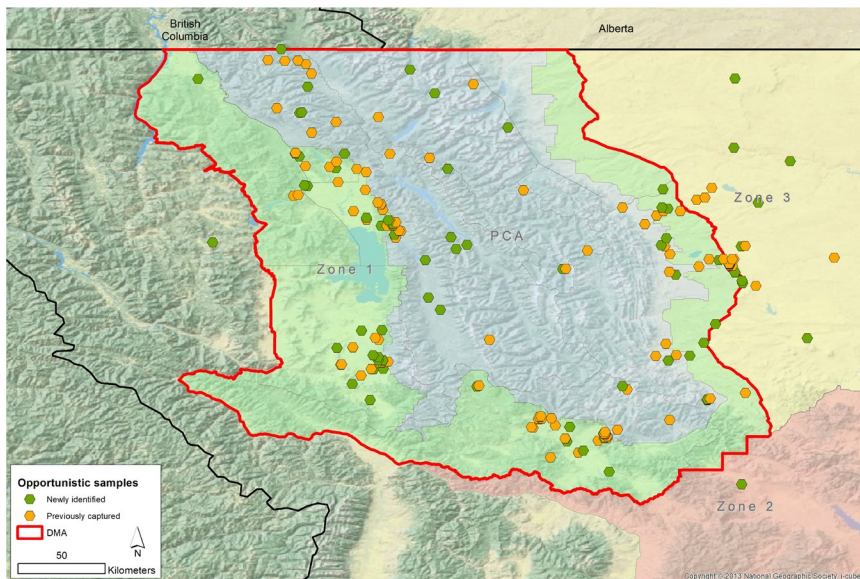


Figure 3. Locations of opportunistic samples from grizzly bears successfully genotyped in the NCDE, 2009–2019. Zones as described in Figure 1.

Table 3. Annual numbers of grizzly bears genotyped from opportunistic DNA samples collected in the NCDE, 2009–2019, and percent newly versus previously identified.

Individuals	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total genotyped	21	23	18	23	23	18	15	33	29	27	35
Newly identified	81%	48%	33%	43%	35%	28%	40%	48%	41%	52%	43%
Previously identified	19%	52%	67%	57%	65%	72%	60%	52%	59%	48%	57%

We initiated use of an ecosystem-wide management database during 2020, which recorded grizzly bear conflicts, preventative measures taken, and opportunistic samples collected. Because of some turnover in agency personnel during 2020, reported data for 2020 were incomplete for the Blackfoot Nation at the time of this writing. Nonetheless, records indicated that agency management specialists preemptively responded to ≥ 35 situations where grizzly bears were in areas near people (Table 4). Most situations involved bears attracted to areas near people because of natural foods or habitat, and less than half involved human attractants. Agency management specialists responded to ≥ 286 incidents of human-grizzly bear conflict (Table 4). Just over half of human-grizzly bear conflicts involved bears accessing unnatural foods, especially garbage, feed, or harvested grain. These incidents commonly involved unsecured attractants and did not involve property damage. About 7% of conflicts involved property damage by bears, primarily attempting to access foods. About one third of conflicts involved livestock. Chicken depredation was, by far, most frequent, followed by cattle. Conflicts related to grizzly bear interactions with humans accounted for 2% conflicts.

Numbers of events were, by far, highest within MFWP Region 1 (Table 4, Fig. 4). Numbers of conflicts were relatively low on the Flathead Indian Reservation and the Blackfoot Reservation. Very few events occurred in the PCA and the highest numbers of events occurred in Zone 1, especially on the west side of the Continental Divide.

In responding to conflicts, agency management specialists usually provided education and outreach or took actions other than capturing bears. Actions taken to prevent conflict included: monitoring with remote cameras; temporary closures; removing or securing attractants (including use of electric fencing); hazing; and use of scare devices. Management specialists took 46 actions involving captured bears including: preemptively capturing 4 individuals to prevent conflict; releasing or translocating 10 non-target bears captured at conflict sites but not involved in conflict; translocating 24 bears involved in conflicts; and removing 15 bears involved in conflict (Table 5).

Table 4. Summary of situations and incidents involving grizzly bears to which agencies responded in the NCDE, 2020. Preemptive responses involved bears that were not in conflict but were near people. Conflict incidents involved an interaction between a grizzly bear and human in which bears either did, or attempted to, damage property, kill or injure livestock, damage beehives, injure people, or obtain anthropogenic foods or attractants or agricultural crops.

Event	Category	Detail	MFWP	MFWP	MFWP	Black-	CSKT	Total
			R1	R2	R4	feet ¹		
Preemptive situation	Bear near people	Natural	9	4	9		1	23
		Human attractants	7	2	3			12
	Total			16	6	12	0	1
Conflict incident	Unnatural foods	Garbage	39	46	2	1		88
		Bird/deer feed	18	1				19
		Pet/livestock feed	14	1	3			18
		Harvested grain	2	3	11		1	17
		Human foods	4	6	1			11
		Other	1	1				2
		Subtotal		78	58	17	1	1
	Livestock	Chickens/poultry	41	3	1		1	46
		Cattle		10	15	5	1	31
		Goats	4			1		5
		Pigs	4					4
		Sheep		1	2			3
		Other	3					3
		Subtotal		52	14	18	6	2
	Property damage	Building	6	3				9
		Vehicle	4	2				6
		Equipment/gear	3	2				5
	Subtotal		13	7	0	0	0	20
	Human interaction	Aggressive encounter	5	2				7
		Injury	1		3			4
		Habituation	1					1
Subtotal		7	2	3	0	0	12	
Agricultural damage	Orchard	4	1				6	
	Beehives			1			1	
Subtotal		4	1	1		1	7	
Total			154	82	39	7	4	286

¹ Due are incomplete; only data associated with captures are included.

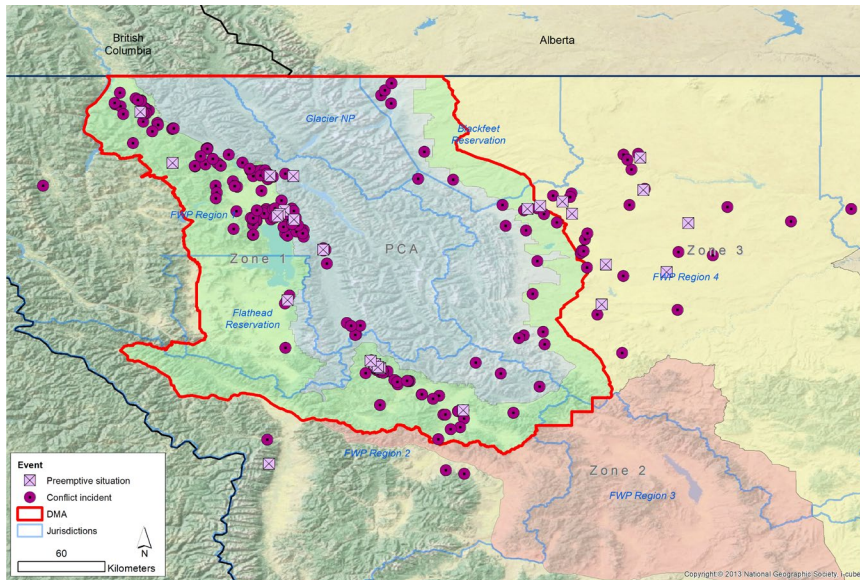


Figure 4. Locations of agency responses to grizzly bears in the NCDE, 2020. Zones as described in Figure 1.

Table 5. Summary of actions taken when grizzly bears were captured for management in the NCDE, 2020. Numbers in brackets refer to dependent offspring translocated or removed with their mother or removed due to orphaning.

Event	Category	Detail	Non-target individual	Target individual translocated	Target individual removed
Preemptive situation	Bear near people	Human attractants		7	
		Total	0	7	0
Conflict incident	Unnatural foods	Garbage	1	3 [1]	1
		Bird/deer food		3	
		Pet/livestock food	1		1
		Harvested grain		1 [2]	
		Human foods	1	4 [1]	4 [1]
		Subtotal	3	11 [4]	6 [1]
	Livestock	Chickens/poultry	1	2	4
		Cattle	3	2	4
		Goats			1
		Pigs		2	
	Subtotal	4	6	5	
Human interaction	Injury				[3]
		Subtotal	0	0	[3]
Total			7	17 [4]	11 [4]

5. CONSERVATION STRATEGY OBJECTIVES AND THRESHOLDS

The NCDE Conservation Strategy (NCDE Subcommittee 2019) articulated an overarching management goal to maintain a recovered, genetically diverse grizzly bear population throughout the DMA while maintaining demographic and genetic connections with Canadian populations and providing the opportunity for demographic and/or genetic connectivity with other ecosystems, with the following objectives and thresholds:

Objective 1: Maintain a well-distributed grizzly bear population within the DMA

- Occupancy threshold: Maintain the documented presence of females with offspring in at least 21 of 23 BMUs of the PCA and in at least 6 of 7 occupancy units of Zone 1 at least every 6 years.

Objective 2: Manage mortalities from all sources to support a $\geq 90\%$ estimated probability that the grizzly bear population within the DMA remains above 800 bears, considering the uncertainty associated with all the demographic parameters.

- Independent female survival threshold: Using a 6-year running average, maintain estimated annual survival of independent females within the DMA to: (a) a rate of ≥ 0.90 ; and (b) a rate at or above the minimum level consistent with a projected $\geq 90\%$ probability that the population within the DMA will remain above 800 bears based on population modeling.
- Independent female mortality threshold: Using a 6-year running average, limit annual estimated number of total reported and unreported (TRU) mortalities of independent females within the DMA to: (a) a number that is $\leq 10\%$ of the number of independent females estimated within the DMA based on population modeling; and (b) a number that is at or below the maximum level consistent with a projected $\geq 90\%$ probability that the population within the DMA will remain above 800 bears based on population modeling.
- Independent male mortality threshold: Using a 6-year running average, limit annual estimated number of TRU mortalities of independent males within the DMA to a number that is $\leq 15\%$ of the number of independent males estimated within the DMA based on population modeling.

Objective 3: Monitor demographic and genetic connectivity among populations

- Estimate spatial distribution of the NCDE grizzly bear population biennially.
- Identify the population of origin for individuals sampled inside and outside of the DMA to detect movements of individuals to and from other populations or recovery areas.

Methods

We documented presence of females with cub, yearling, or 2-year-old offspring within units, based on visual observations obtained from radio-marked females; verified remote camera photos; other verified visual observations; known or probable mortalities of family units (death of the mother, dependent young, or both); and telemetry or GPS locations of radio-marked females known to have offspring. For Objective 1, the PCA component represented a continuation of the occupancy targets established within the Recovery Zone prior to delisting (USFWS 1993) and utilized the same BMUs (Fig. 4). The Zone 1 component utilized Occupancy Units (OUs) demarcated using established political boundaries (i.e., state/tribal boundaries and FWP regional boundaries) and the boundaries of the 2 Demographic Connectivity Areas (NCDE Subcommittee 2019).

We estimated survival of independent females within the DMA based on known-fate analysis of data collected from radio-marked female bears within the DMA (Costello et al. 2016). Analysis incorporated the time series of survival data from known-fate monitoring since 2004 and differentiated the most recent 6 years of data to compare to the threshold. Based on the number of known and probable mortalities recorded each year, and the human reporting rate observed among radio-marked bears (Costello et al. 2016), we estimated numbers of TRU mortalities of independent female and male grizzly bears within the DMA and assessed the female and male mortality thresholds using an average for the last 6 years.

Thresholds for Objective 2 were previously developed for a 6-year management period of 2019–2023 (NCDE Subcommittee 2019). For this period, the NCDE grizzly bear population was projected to increase from approximately 1,068 bears in 2019 to 1,163 bears in 2023 (Table 6), assuming previously observed vital rates which are consistent with an annual growth rate of 2.3% per year (Costello et al. 2016). To establish thresholds, we simulated population growth using observed vital rates (Costello et al. 2016) to year 2012, and then projected another 25 years using multiple levels of independent female survival (i.e., 0.90, 0.91, 0.92, 0.93, and 0.94), while holding independent male survival at 0.85. By constraining the models to maximum allowable mortality for males, the resulting female thresholds would be the most conservative values associated with meeting Objective 2. Under simulations for the 6-year management period of 2019–2023, the minimum threshold for independent female survival in 2020 was 0.93, the maximum threshold for the number of independent female mortalities in 2020 was 24, and the maximum threshold for the number of independent male mortalities in 2020 was 29 (NCDE Subcommittee 2019).

Table 6. Projected population size of grizzly bears in the NCDE for the management period 2019–2023, assuming previously observed vital rates (Costello et al. 2016).

Estimate	Year				
	2019	2020	2021	2022	2023
Population size	1,068	1,092	1,114	1,138	1,163
95th percentile	906–1,243	923–1,276	938–1,305	958–1,335	971–1,366

We estimated the distribution of the NCDE grizzly bear population, by applying zonal analysis and ordinary kriging (Bjornlie et al. 2014) to 7-km x 7-km cells with verified grizzly bear locations documented during a 10-year window up to the current year. Verified locations were collected from GPS transmitters; VHF telemetry flights; capture and mortality locations; human-grizzly bear conflict sites; verified observations (sightings or tracks) or remote camera photos confirmed by agency personnel; and opportunistic samples of grizzly bear hair, blood, scat, or tissue confirmed by DNA analysis. Outside of this estimated occupied range, 12-digit hydrologic unit code watersheds were also mapped to indicate presence of verified outlier grizzly bear observations, based on data collected and shared among states and the US Fish and Wildlife Service (US Fish and Wildlife Service 2020). The US Fish and Wildlife Service “may be present” mapping included watersheds with verified locations as well as adjacent watersheds. Mapping in this report did not include adjacent watersheds.

DNA samples obtained during captures or at any of verified grizzly bear sites were analyzed for population of origin to document movement of individuals to and from other populations or recovery areas (Haroldson et al. 2010). Genetic samples are not submitted until the end of each field season and take some time to analyze, therefore there is typically a 1-year lag in reporting results for population of origin.

Results

During 2020, we verified presence of reproductive females within 20 of 23 BMUs (87%) and within 7 of 7 OUs (100%; Fig. 5). For the 6-year period 2015–2020, all 23 BMUS were occupied by females with offspring, thus exceeding the objective of 21 of 23 BMUs occupied (Appendix E). All 7 OUs were occupied during the last 6 years, exceeding the objective of 6 of 7 OUs occupied. Using the 6-year occupancy thresholds for the PCA and Zone 1 have been met each year since 2006.

For the 6-year period 2015–2020, we estimated an annual survival rate of 0.93 (\pm 0.01 SE) for independent females within the DMA, which meets the minimum threshold rate of 0.93 (NCDE Subcommittee 2019).

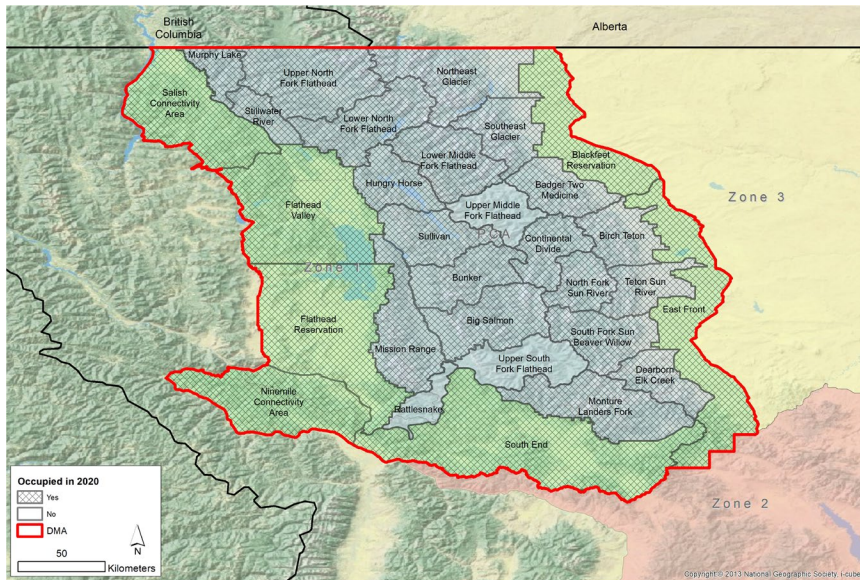


Figure 5. Documented occupancy of female grizzly bears with offspring within 23 BMUs of the PCA and 7 OUs of Zone 1, 2020. Occupancy was documented in all units during the last 6 years. Zones as described in Figure 1.

Within the DMA, there were 11 and 12 known mortalities reported for independent females and independent males, respectively (see Table 2). We estimated the number of total reported and unreported (TRU) mortalities of independent bears within the DMA using these numbers and the reporting rates observed among radio-marked bears. We estimated 12 TRU mortalities of independent females and 13 TRU mortalities of independent males within the DMA (Table 7). During 2015–2020, the average annual number of TRU mortalities for independent females within the DMA was 13, which falls below the maximum threshold of 24 (NCDE Subcommittee 2019). The average annual number for independent males was 21, falling below the maximum threshold of 29 (NCDE Subcommittee 2019). A summary of all demographic parameters documented during the 6-year period 2015–2020 are reported in Appendix F.

Table 7. Summary of independent grizzly bear mortalities within the DMA, NCDE, 2020.

Sex	Documented mortalities by method of discovery				Estimated reported and unreported ^e (C)	Estimated total mortality (A + B + C)
	Agency removal ^a (A)	Telemetry ^b (B)	Reported ^c (high)	Reported ^d (low)		
Female	5	3	3	0	4	12
Male	6	1	5	0	7	14
Total	11	4	8	0	11	26

^a Count of agency removals, including those involving radio-marked bears. ^b Count of deaths for bears wearing functional radio-transmitters, except for agency removals. ^c Count of non-radioed bear deaths reported by the public or discovered by agency personnel with high reporting rates (illegal defense-of-property, defense-of-life, train collision, automobile collisions, illegal hunting-misidentification). ^d Count of non-radioed bear deaths reported by the public or discovered by agency personnel with low reporting rates (poaching/malicious, natural, undetermined). ^e Bayesian estimate of the total number of reported and unreported deaths of non-radioed bears (Cherry et al. 2002 and Costello et al. 2016).

The estimated occupied range of the NCDE grizzly bear population during 2011–2020 encompassed 67,652 km² (Fig. 6). This represents an increase of about 6% from the 2009–2018 estimate or an annual increase of about 3%. Since 2004, the range has increase about 2.6% per year with the greatest biennial change occurring between 2014 and 2016. During the last 2 years, expansion was most obvious on the southern edge of the range in the Boulder, John Long, and Flint Creek Mountains. Slight expansion into the Cabinet Mountains was observed due to a temporary movement by a young female. Outside of this estimated occupied range, verified observations of grizzly bears during 2011–2020 occurred in watersheds of the Coeur d’Alene, Bitterroot, Anaconda, Pioneer, Beaverhead, Ruby, Elkhorn, Big Belt, Little Belt, and Adel Mountains, as well in the Upper Missouri-Dearborn, Marias, and Big Sandy watersheds. Genetic samples were not available for most outlier observations; therefore, we were unable to determine the population of origin for observed individuals. Specifically during 2020, we verified outlier observations in watersheds of the John Long, Beaverhead, and Pioneer Mountains, as well as the Big Sandy watershed.

Principal components analysis was conducted on 16-loci genotypes obtained from bears captured in the NCDE and the GYE through 2019 (genotypes from 2020 are not yet available). The discreteness of the clusters indicated that no individuals originated from the population other than where they were captured (Fig. 7). Thus, to date, we have not detected evidence of immigration into the NCDE from the GYE or emigration from the NCDE into the GYE.

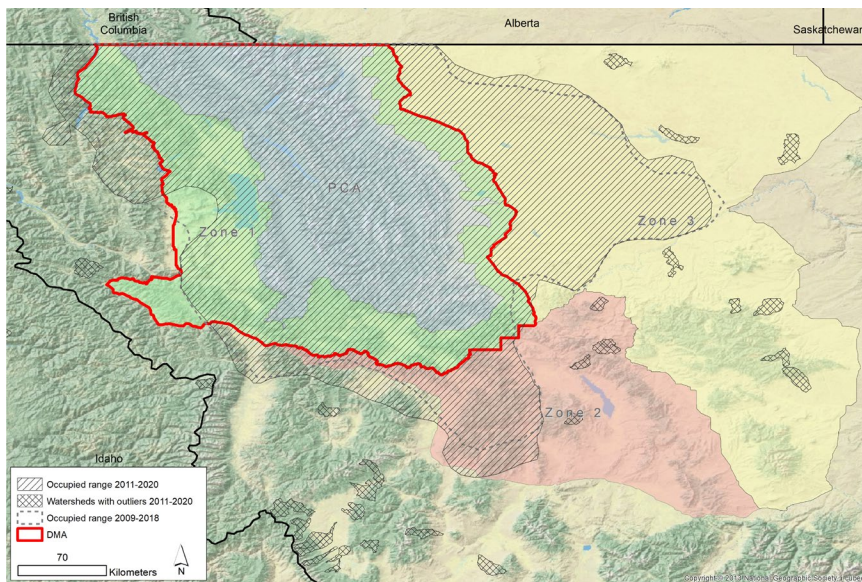
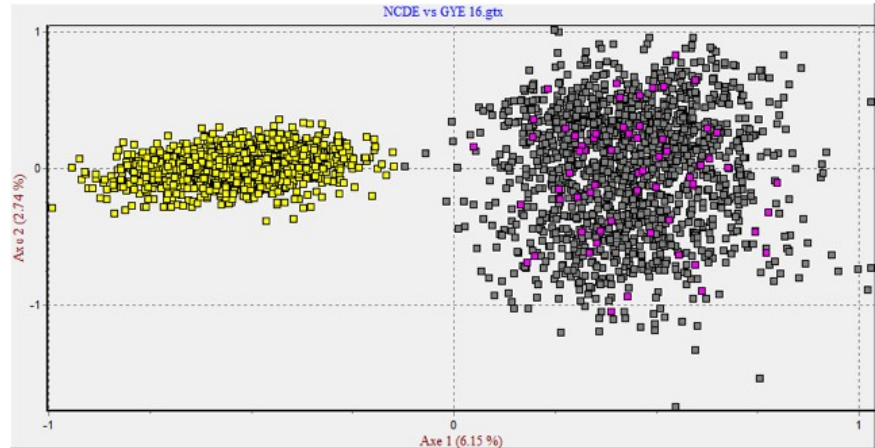


Figure 6. Occupied range of the NCDE grizzly bear population during 2011–2020, as estimated by applying zonal analysis and ordinary kriging to 7x7-km cells with verified grizzly bear locations documented during the 10-year window. The previous estimate for 2009–2018 is shown for comparison. Watersheds with verified outlier observations during 2011–2020 are also shown, however population of origin for the individuals observed has not been verified. Zones as described in Figure 1.

Figure 7. Principal components clustering of 16-loci genotypes for grizzly bears captured in the NCDE and GYE up to 2019. Genotypes of bears sampled in the NCDE during 2019 (pink) and during previous years (gray) were distinct from genotypes of bears sampled in the GYE (yellow).



Immigration or temporary movements by 2 bears into the NCDE from the CYE were documented prior to 2019 (Kasworm et al. 2020). Among bears captured in the NCDE during 2019 or 2020, none have been identified as immigrants from the CYE, based on eartags, collars, or DNA (although genotypes from 2020 are not yet available). During 2021, we will conduct parentage analysis with combined genotypes from both ecosystems to determine if any bears captured in the NCDE were offspring of parents in the CYE.

Emigration or temporary movements by 3 bears from the NCDE to the CYE were documented prior to 2019 (Kasworm et al. 2020). Movements of 2 of 3 individuals were influenced by management translocations, but movement of 1 bear appeared to have been associated with natal dispersal. In 2019, another individual was captured in the CYE whose genotype indicates its parents were residents of the NCDE (Justin Tiesberg, USFWS, personal communication). With no management or translocation history, this bear's movement also appears to have been associated with natal dispersal. Based on capture and telemetry monitoring or DNA detection in the NCDE, the 4 parents and a litter mate of these immigrants resided in the northwest area of the NCDE (Fig. 8). Specifically, a female monitored with telemetry in the northern Whitefish Range during 2004–2007 (Fig. 8, see #1) and a male captured in the northern Whitefish Range in 2008 (Fig. 8, see #2) were the probable parents of male bear YGB737M with an estimated birth year of 2006 (see Kasworm et al. 2020). This male was captured in the CYE in 2010 and was last detected there using DNA sampling in 2019, suggesting he is a permanent resident of the CYE. Additionally, a female captured and monitored with telemetry in the northern Whitefish Range and the Salish Range during 2009–2017 (Fig. 8, see #3) was a probable litter mate of YGB737M, based on matching estimated parentage and birth year. A male bear monitored with telemetry in the southern Whitefish range during 2012–2015 (Fig. 8, see #4) is the probable father of male bear C866M with an estimated birth year of

2015. This bear was captured in the CYE in 2019. The probable mother (Fig. 8, see #5) has not been captured but was detected in the southern Whitefish Range in 2004 by Kendall et al. (2009). To date, there is no evidence of either of these 2 immigrants or any other undetected immigrant from the NCDE interbreeding with CYE bears.

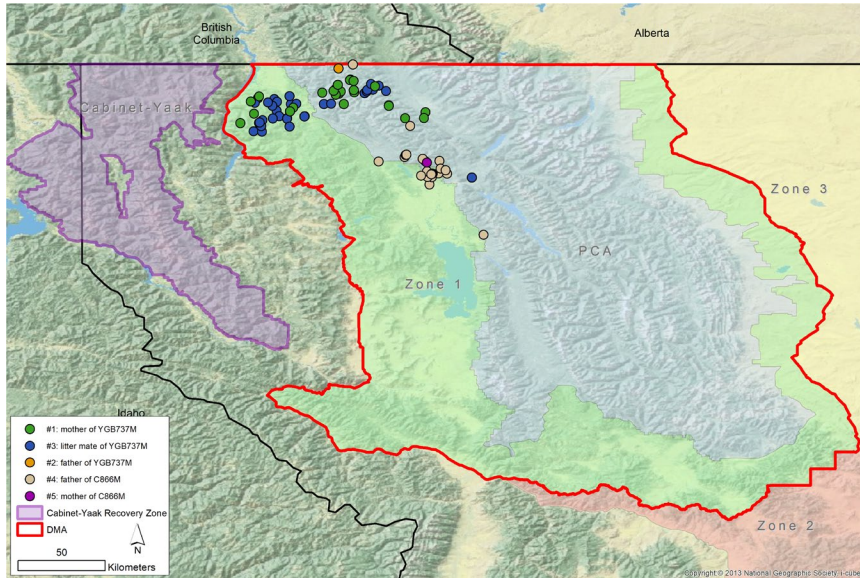


Figure 8. Capture and telemetry or DNA detection locations in the NCDE of 4 probable parents and 1 littermate of the 2 immigrant grizzly bears captured in the CYE. Zones as described in Figure 1.

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7. APPENDICES

Appendix A. Fates of grizzly bears captured for trend monitoring or other purposes (primarily management) and monitored with radio-telemetry in the NCDE, 2020.

Sex	Capture type	DMA subunit	Bear ID	Fate
Female	Trend research	Blackfeet Reservation	81278116	Censored
Female	Trend research	Blackfeet Reservation	839845540	Alive
Female	Trend research	Blackfeet Reservation	604378827	Censored
Female	Trend research	East Front	41628288	Alive
Female	Trend research	Flathead Reservation	41519364	Censored
Female	Trend research	Flathead Reservation	79558279	Alive
Female	Trend research	Glacier National Park	79597603	Alive
Female	Trend research	Glacier National Park	839830808	Alive
Female	Trend research	Glacier National Park	10876305	Alive
Female	Trend research	Glacier National Park	36554783	Dead
Female	Trend research	Glacier National Park	41078883	Censored
Female	Trend research	Glacier National Park	41515561	Censored
Female	Trend research	Glacier National Park	601610593	Alive
Female	Trend research	Glacier National Park	839846062	Censored
Female	Trend research	Glacier National Park	842017525	Alive
Female	Trend research	Glacier National Park	842018043	Alive
Female	Trend research	Multiple subunits	839822818	Unknown
Female	Trend research	Multiple subunits	841778369	Alive
Female	Trend research	NF Flathead	11052544	Censored
Female	Trend research	NF Flathead	601618304	Censored
Female	Trend research	NF Flathead	79570382	Alive
Female	Trend research	SF Flathead-Swan	11060268	Alive
Female	Trend research	SF Flathead-Swan	55598849	Alive
Female	Trend research	SF Flathead-Swan	601609326	Dead
Female	Trend research	SF Flathead-Swan	839826876	Alive
Female	Trend research	SF Flathead-Swan	839839014	Alive
Female	Trend research	South End	11065603	Censored
Female	Trend research	South End	11018035	Alive
Female	Other	Blackfeet Reservation	11044088	Alive
Female	Other	Blackfeet Reservation	41090260	Censored
Female	Other	Blackfeet Reservation	79560108	Alive
Female	Other	Blackfeet Reservation	604521783	Alive
Female	Other	Blackfeet Reservation	839823853	Dead
Female	Other	Blackfeet Reservation	839824884	Censored
Female	Other	Blackfeet Reservation	604379286	Alive
Female	Other	Blackfeet Reservation	604524782	Alive
Female	Other	East Front	39080331	Censored
Female	Other	East Front	41532565	Censored

Appendix A (continued).

Sex	Capture type	DMA subunit	Bear ID	Fate
Female	Other	East Front	41623606	Censored
Female	Other	East Front	604381104	Alive
Female	Other	East Front	839825532	Censored
Female	Other	Glacier National Park	841802517	Alive
Female	Other	Outside DMA	839825561	Unknown
Female	Other	Outside DMA	842004858	Alive
Female	Other	Outside DMA	842015512	Alive
Female	Other	Outside DMA	842029879	Alive
Female	Other	Salish-Island Unit	36554859	Alive
Female	Other	Salish-Island Unit	842003523	Dead
Female	Other	Salish-Island Unit	842006573	Dead
Female	Other	SF Flathead-Swan	41379363	Alive
Female	Other	SF Flathead-Swan	841893590	Alive
Female	Other	SF Flathead-Swan	842016524	Alive
Female	Other	SF Flathead-Swan	842017311	Alive
Female	Other	SF Flathead-Swan	842017516	Alive
Female	Other	SF Flathead-Swan	842020329	Alive
Female	Other	SF Flathead-Swan	93619344	Alive
Male	Trend research	East Front	41779283	Alive
Male	Trend research	South End	41086114	Alive
Male	Other	Blackfeet Reservation	839824321	Censored
Male	Other	Blackfeet Reservation	11009019	Censored
Male	Other	Blackfeet Reservation	11035376	Alive
Male	Other	Blackfeet Reservation	604524547	Alive
Male	Other	Blackfeet Reservation	841793853	Alive
Male	Other	East Front	39875815	Alive
Male	Other	NF Flathead	601619778	Censored
Male	Other	Outside DMA	11072874	Alive
Male	Other	Outside DMA	41546593	Alive
Male	Other	Outside DMA	601615340	Alive
Male	Other	Outside DMA	839820364	Alive
Male	Other	Outside DMA	839843617	Alive
Male	Other	Outside DMA	842019022	Alive
Male	Other	Outside DMA	842030832	Alive
Male	Other	Salish-Island Unit	72265294	Censored
Male	Other	Salish-Island Unit	842001817	Dead
Male	Other	Salish-Island Unit	842018605	Alive
Male	Other	SF Flathead-Swan	601608564	Dead
Male	Other	SF Flathead-Swan	842010334	Censored
Male	Other	SF Flathead-Swan	842012037	Alive

Appendix A (continued).

Sex	Capture type	DMA subunit	Bear ID	Fate
Male	Other	SF Flathead-Swan	842012606	Alive
Male	Other	South End	10870331	Alive
Male	Other	South End	10879881	Censored
Male	Other	South End	11054591	Censored

Appendix B. Observed reproductive status and mortality of offspring for adult female grizzly bears monitored with radio-telemetry in the NCDE, 2020.

DMA Subunit	Bear ID	Status	Litter size	Offspring mortality	Multiple Observations in 2020
Blackfeet Reservation	11044088	Two-year-olds	2		No
Blackfeet Reservation	79560108	Yearlings	3		No
Blackfeet Reservation	604521783	Cubs	1		No
Blackfeet Reservation	604378827	Cubs	3		No
Blackfeet Reservation	604524782	None			No
East Front	39080331	Cubs	2		No
East Front	41532565	Cubs	2		No
East Front	41623606	Yearlings	1		No
Flathead Reservation	79558279	Two-year-olds	3		Yes
Flathead Reservation	41519364	Cubs	2		Yes
Glacier National Park	36554783	Yearlings	1	1	No
Glacier National Park	79597603	Cubs	2		No
Glacier National Park	10876305	None			Yes
Glacier National Park	41078883	Two-year-olds	2		No
Glacier National Park	41515561	None			No
Glacier National Park	601610593	Cubs	2		No
Glacier National Park	839830808	Yearlings	2		Yes
Glacier National Park	839846062	Cubs	2		No
Glacier National Park	842017525	None			No
Glacier National Park	842018043	Yearlings	2		Yes
Multiple subunits	604381104	Cubs	2		No
Multiple subunits	841778369	None			No
NF Flathead River	11052544	Cubs	3	3	Yes
NF Flathead River	79570382	Three-year-olds	1		Yes
NF Flathead River	601618304	Two-year-olds	2		Yes
Outside DMA	842004858	Yearlings	2		No
Salish-Island Unit	36554859	None			No
SF Flathead River-Swan	11060268	Cubs	2		Yes
SF Flathead River-Swan	839826876	None			No
SF Flathead River-Swan	55598849	Yearlings	1	1	Yes
SF Flathead River-Swan	601609326	Yearlings	2	1	Yes
SF Flathead River-Swan	839839014	None			No
SF Flathead River-Swan	93619344	Cubs	1		No
South End	11018035	Yearlings	2		No

Appendix C. Known and probable grizzly bear mortalities in the NCDE, 2020.

Date	Date accuracy	Certainty of death	DMA ¹	Sex ²	Age Class ³	Bear ID	Collared ¹	Cause
3/20/2020	Day	Known	N	M	AD		N	Agency (livestock)
4/9/2020	Day	Known	Y	F	AD	39851084	N	Defense of life
4/10/2020	Day	Known	Y	F	CB	601617879	N	Agency (orphaned)
4/10/2020	Day	Known	Y	M	CB	601617314	N	Agency (orphaned)
4/10/2020	Day	Known	Y	F	CB	601625102	N	Agency (orphaned)
4/13/2020	Day	Known	Y	M	AD		N	Agency (livestock)
4/17/2020	Day	Known	Y	M	AD		N	Agency (livestock)
4/26/2020	Day	Known	Y	F	AD	842017512	N	Agency (site conflict)
4/26/2020	Day	Known	Y	F	YR	842000067	N	Agency (humane)
5/3/2020	Day	Known	Y	M	AD		N	Defense of life
5/4/2020	Day	Known	Y	F	AD	36554783	Y	Poached/malicious
5/12/2020	Week	Known	Y	F	SA	839823853	Y	Poached/malicious
5/16/2020	Day	Known	Y	M	AD		N	Illegal defense of property
5/24/2020	Day	Known	Y	M	SA		N	Defense of life
5/26/2020	Day	Known	Y	M	SA	842001817	Y	Defense of life
5/28/2020	Day	Known	Y	F	AD	79557267	N	Defense of life
5/28/2020	Day	Probable	Y	U	CB		N	Orphaned
5/28/2020	Day	Probable	Y	U	CB		N	Orphaned
6/3/2020	Week	Known	N	F	YR		N	Natural
6/4/2020	Day	Known	Y	M	SA	72107089 ⁴	Y	Defense of life
6/11/2020	Day	Known	Y	M	SA	601608564	Y	Agency (site conflict)
6/13/2020	Day	Known	Y	F	SA	842003523	Y	Agency (site conflict)
6/13/2020	Day	Known	Y	F	SA	842006573	Y	Agency (site conflict)
6/15/2020	Year	Known	Y	U	CB		N	Natural
6/19/2020	Day	Known	N	M	SA		N	Agency (site conflict)
7/23/2020	Day	Known	Y	F	SA		N	Agency (livestock)
7/24/2020	Day	Known	Y	M	AD	107574339	N	Agency (livestock)
8/25/2020	Year	Known	Y	U	YR		N	Poached/malicious
9/4/2020	Day	Known	Y	F	AD	38052875	N	Automobile
9/11/2020	Day	Known	Y	M	AD		N	Automobile
9/13/2020	Day	Known	Y	M	AD		N	Automobile
9/26/2020	Day	Known	Y	F	CB		N	Automobile
10/31/2020	Day	Known	Y	F	AD		N	Defense of life
10/31/2020	Day	Probable	Y	U	CB		N	Orphaned
10/31/2020	Day	Probable	Y	U	CB		N	Orphaned
11/9/2020	Day	Known	Y	F	AD	601609326	Y	Poached/malicious
11/9/2020	Day	Known	Y	F	YR	842020102	N	Poached/malicious

¹ Y = Yes, N = No

² F = female, M = male, U = unknown sex

³ AD = adult (≥5 years old), SA = subadult (2-4 years old), YR = yearling (1 year old), CB = cub (<1 year old)

⁴ Previously classified as mortality in 2019 when moved to CYE for augmentation

Appendix D. Records removed from of grizzly bear mortalities in the NCDE, 2019.

Date	Date accuracy	Certainty of death	DMA ¹	Sex ²	Age Class ³	Bear ID	Collared ¹	Cause
7/14/2019 ¹	Day	Known	Y	M	SA	72107089	N	Agency (augment)
11/9/2019 ²	Week	Known	Y	M	CB		N	Natural

¹ This bear was classified as a mortality in 2019 when it was removed from the NCDE population and moved to the Cabinet-Yaak population for augmentation. In 2020, the bear moved back to the NCDE and was subsequently killed. It is now included in the 2020 NCDE mortality records. ² These remains were determined to be those of a black bear from analyses of DNA.

Appendix E. Observed occupancy of 23 Bear Management Units within the PCA and 7 Occupancy Units within Zone 1 by female grizzly bears with offspring, 2015–2020. Units known occupied during a given year are signified by the symbol x. Twenty-two of 23 BMUs and 7 of 7 OUs were occupied during a 6-year period ending with 2020.

Bear Management Unit (PCA)	2015	2016	2017	2018	2019	2020
Murphy Lake			x			x
Upper North Fork Flathead	x	x	x		x	x
Northeast Glacier	x	x	x	x	x	x
Stillwater River				x	x	x
Lower North Fork Flathead	x	x	x	x	x	x
Hungry Horse	x	x	x	x	x	x
Lower Middle Fork Flathead	x	x	x	x	x	x
Southeast Glacier	x	x	x	x	x	x
Sullivan	x	x	x	x	x	x
Upper Middle Fork Flathead	x	x	x	x		
Badger Two Medicine	x	x	x	x	x	x
Mission Range	x	x	x	x	x	x
Bunker	x	x	x	x	x	x
Continental Divide						x
Birch Teton	x	x	x	x	x	x
Big Salmon				x	x	x
North Fork Sun River			x	x	x	x
Teton Sun River	x		x		x	x
Rattlesnake		x				
Upper South Fork Flathead			x			
South Fork Sun Beaver Willow	x		x	x	x	x
Monture Landers Fork	x	x	x		x	x
Dearborn Elk Creek			x		x	x
Occupied during year	15	14	19	15	18	20
Occupied during last 6 years	23	23	23	22	22	23
Occupancy Unit (Zone 1)						
Salish Connectivity Area		x	x	x	x	x
Flathead Valley	x	x	x	x	x	x
Flathead Reservation	x	x	x	x	x	x
Ninemile Connectivity Area				x	x	x
South End	x	x	x	x	x	x
East Front	x	x	x	x	x	x
Blackfeet Reservation	x	x	x	x	x	x
Occupied during year	5	6	6	7	7	7
Occupied during last 6 years	7	7	7	7	7	7

Appendix F. Thresholds and observed estimates for demographic parameters described in the 2019 Conservation Strategy, 2015–2020. Parameters include occupancy of females with offspring within 23 Bear Management Units (BMUs) in the Primary Conservation Area (PCA) and 7 Occupancy Units (OUs) in Zone 1, tallied over the last 6 years; survival rate of independent females within the Demographic Monitoring Area (DMA) averaged over the last 6 years; and numbers of total reported and unreported (TRU) mortalities of independent female and male grizzly bears within the DMA averaged over the last 6 years.

Parameter	Area or Sex	Threshold/ observed	Year					
			2015	2016	2017	2018	2019	2020
Occupancy	PCA (BMUs)	Minimum	21	21	21	21	21	21
		Observed	23	23	23	22	22	23
	Zone 1 (OUs)	Minimum	6	6	6	6	6	6
		Observed	7	7	7	7	7	7
Survival rate	Female	Minimum	0.93	0.93	0.93	0.93	0.93	0.93
		Observed	0.96	0.95	0.95	0.93	0.94	0.93
TRU mortalities	Female	Maximum	22	22	22	22	23	24
		Observed	14	16	14	15	16	13
	Male	Maximum	28	28	28	28	29	29
		Observed	16	15	19	21	21	21