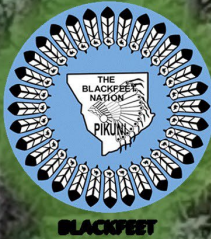


# Northern Continental Divide Ecosystem Grizzly Bear Population Monitoring Team Annual Report 2023



Prepared by  
Cecily M. Costello, Lori L. Roberts & Milan A. Vinks



Monitoring Team Cooperators:

Montana Fish, Wildlife & Parks (FWP)  
Blackfoot Nation Fish and Wildlife (BNFW)  
Confederated Salish and Kootenai Tribes Natural Resources Department (CSKT)  
National Park Service, Glacier National Park (GNP)  
U.S. Fish and Wildlife Service (USFWS)  
U.S. Forest Service  
Parks Canada, Waterton Lakes National Park, Alberta  
British Columbia Ministry of Forests

Core Field Team Members:

Payton Adams, CSKT  
Cecily Costello, FWP  
Jamie Jonkel, FWP  
Brandon Kittson, BNF  
Lori Roberts, FWP  
Wesley Sarmiento, FWP  
Justine Vallieres, FWP  
Milan Vinks, FWP  
John Waller, GNP  
Erik Wenum, FWP  
Chad White, FWP

*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.*

Suggested Citation:

Costello, C.M., L.L. Roberts, and M.A. Vinks. 2024. Northern Continental Divide Ecosystem Grizzly Bear Monitoring Team Annual Report 2023. Montana Fish, Wildlife & Parks, 490 N. Meridian Road, Kalispell, MT 59901.

This Annual Report is available on the web at:  
<https://fwp.mt.gov/conservation/wildlife-management/grizzly-bears>

## ABSTRACT

This report summarizes 2023 results of the interagency population monitoring program for grizzly bears in the Northern Continental Divide Ecosystem (NCDE) of Montana, initiated in 2004. The program is focused on modeling population trend using survival and reproductive rates obtained from captured and radio-marked bears, particularly females. The program also maintains all grizzly bear data; conducts research to meet management needs; summarizes agency actions to prevent and respond to human-grizzly bear conflict; and evaluates demographic objectives outlined in the NCDE Conservation Strategy. During 2023, we captured 11 grizzly bears (5F, 6M) for trend monitoring within the Demographic Monitoring Area (DMA) and 28 bears (16F, 12M) for management or other purposes inside and outside of the DMA. We radio-monitored 32 bears (27F, 5M) for trend and documented 3 deaths (3F). For other purposes, we radio-monitored 41 bears (25F, 16M) and documented 5 deaths (3F, 2M). We recorded reproductive status of 39 females  $\geq 4$  years old and documented 13 presumed cub mortalities and 3 presumed yearling mortalities. Including unmarked bears, we documented 47 known or probable mortalities of grizzly bears in or near the NCDE. During the 6-year period of 2018–2023, all 23 Bear Management Units (BMUs) and 7 Occupancy Units (OUs) were occupied by females with offspring, above the minimum thresholds of 21 BMUs and 6 OUs. During 2018–2023, we estimated an annual survival rate of 0.93 ( $\pm 0.01$  SE) for independent females, above the minimum threshold rate of 0.92. Within the DMA, we estimated 9 total reported and unreported (TRU) mortalities for independent females and 16 TRU mortalities for independent males. During 2018–2023, average TRU mortalities were 16 and 22, below the maximum thresholds of 26 and 31, for independent females and males respectively. Based on genetic data through 2022 or field data in 2023, we detected: movement of a subadult male from the Cabinet-Yaak population into the NCDE Primary Conservation Area; movement of a subadult male from the Greater Yellowstone Ecosystem into NCDE Zones 2 and 3; GPS locations and outlier observations outside of estimated occupied range in NCDE Zones 2 and 3 and outside of NCDE Zones. To date, no interbreeding of bears from different ecosystems has been observed. Management specialists in the NCDE responded to at least 246 incidents of human-grizzly bear conflict and another 98 reports or complaints not involving conflict behavior. They applied 652 tools or actions to prevent conflict and took another 35 actions involving captured bears.

## CONTENTS

ABSTRACT .....	ii
INTRODUCTION .....	2
Figure 1. Zones of the NCDE.....	3
SUMMARY OF ANNUAL TREND MONIORING FIELD ACTIVITIES.....	3
Methods.....	3
Results.....	4
Table 1. Number of individual grizzly bears captured and fitted with radio-transmitters in the NCDE, 2023. ....	5
Figure 2. Location of captures and mortalities of grizzly bears in the NCDE, 2023. ....	5
Table 2. Number of known or probable mortalities of grizzly bears in the NCDE, 2023. ....	7
Table 3. Annual numbers of grizzly bears genotyped from opportunistic DNA samples collected in the NCDE, 2013–2022 .....	7
Figure 3. Locations of opportunistic samples from grizzly bears successfully genotyped in the NCDE, 2022. ....	8
EVALUATION OF CONSERVATION STRATEGY OBJECTIVES AND THRESHOLDS .....	8
Methods.....	9
Results.....	11
Figure 4. Documented occupancy of female grizzly bears with offspring within 23 BMUs of the PCA and 7 OUs of Zone 1, 2023. ....	11
Table 4. Summary of independent grizzly bear mortalities within the DMA, NCDE, 2023. ....	12
Figure 5. Information on documented movements between ecosystems from genetic data through 2022 or field data in 2023.....	13
SUMMARY OF HUMAN-GRIZZLY BEAR CONFLICT PREVENTION AND RESPONSE .....	14
Methods.....	14
Results.....	15
Table 5. Summary of human-grizzly bear conflicts in the NCDE and surroundings, 2023. ....	15
Figure 6. General distribution of reported human-grizzly bear conflicts in the NCDE and surroundings, 2023. ....	16
Table 6. Summary of reports or complaints where grizzly bears were near people or property but not involved in conflict behavior in the NCDE and surroundings, 2023. ....	16
Table 7. Summary of non-capture management actions taken to reduce human-grizzly bear conflict, NCDE and surroundings, 2023. ....	17
SUMMARY OF OTHER RESEARCH AND MONITORING .....	18
ACKNOWLEDGEMENTS .....	19

LITERATURE CITED ..... 19

APPENDICES..... 22

    Appendix A. Fates of radio-monitored grizzly bears captured for trend monitoring within the DMA or for other purposes inside and outside of the DMA, NCDE, 2023. .... 22

    Appendix B. Observed reproductive status and offspring mortality for adult (≥4 years old) female grizzly bears radio-monitored in the NCDE, 2023. .... 24

    Appendix C. Known and probable grizzly bear mortalities in the NCDE, 2023. .... 26

    Appendix D. Observed occupancy of 23 Bear Management Units within the PCA and 7 Occupancy Units within Zone 1 by female grizzly bears with offspring, 2018–2023. .... 28

    Appendix E. Thresholds and observed estimates for demographic objectives described in the 2019 Conservation Strategy, 2018–2023. .... 29

## INTRODUCTION

The grizzly bear (*Ursus arctos horribilis*) was listed as threatened under the Endangered Species Act in the lower 48 states in 1975. The grizzly bear population in the Northern Continental Divide Ecosystem (NCDE) was considered to be the largest among the existing listed populations and was contiguous with populations in Canada. Various regional studies of ecology and population dynamics were conducted within this ecosystem during the 1970s through 1990s (e.g., Martinka, 1976, Servheen 1983, Zager et al. 1983, Mace and Jonkel 1986, Aune et al. 1994, Mace and Waller 1997). Attempts to estimate overall population size from counts of females with cubs, as described in the Recovery Plan (USFWS 1993), were compromised by the dense forest cover in many parts of the ecosystem and experimental photographic sighting methods for estimating population size (Mace et al. 1994) were not applied ecosystem wide. In 2004, our interagency team was formed to provide ecosystem-wide information on population size and trend (Mace 2005). An ecosystem-wide genetic mark-recapture study, led by the US Geological Survey (USGS), estimated the population size at 765 bears in 2004 (Kendal et al. 2009). Ongoing field studies, led by Montana Fish, Wildlife & Parks (FWP), allowed us to model population trend using survival and reproductive rates obtained from captured and radio-marked bears, particularly females (Mace et al. 2012, Costello et al. 2016). In 2019, these methods were used to develop a set of population objectives for the NCDE Conservation Strategy (NCDE Subcommittee 2019). Although the Conservation Strategy was intended to take effect upon removal of the NCDE grizzly bear population from threatened status under the Endangered Species Act, the objectives and thresholds represented the most recent monitoring methodologies. The Conservation Strategy also called for annual reporting of incidents of human-grizzly bear conflict and agency response.

Our trend monitoring program was focused within the Demographic Monitoring Area (DMA; Fig. 1), which encompasses the Primary Conservation Area (PCA: equivalent to the Federal Recovery Zone) and Zone 1, a 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 was also contiguous with those in the Canadian provinces of British Columbia and Alberta, therefore occasional captures and monitoring occurred north of the United States in Canada. For reporting field results within the DMA, we designated 9 DMA subunits (see Appendix A) based on watersheds, distinct land ownerships, and grizzly bear population management authorities.

Although our focus for trend monitoring was the DMA, we also worked in areas where grizzly bears were present outside of the DMA. Notable areas included: 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.

## SUMMARY OF ANNUAL TREND MONITORING 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 (IACUC# FWP08-2023). We tagged all bears subcutaneously with passive

transponder tags and pulled a premolar tooth for age determination when possible (Stoneberg and Jonkel 1966). For trend monitoring, we radio-marked most females and a sample of males with radio-transmitters. Currently deployed transmitters included: 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 trend bears throughout the various subunits of the DMA, attempting to distribute our sample of trend females roughly in proportion to relative grizzly bear density, based on the distribution of female bears detected at DNA hair traps in 2004 and more recent studies (Kendall et al. 2009, Kendall et al. 2019). Grizzly bears were also captured and radio-marked for management and other research outside of the DMA. Individual bears were classified as either trend bears or other (non-trend) bears using the terminology of Mace et al. (2012).

We monitored survival and reproduction using aerial telemetry flights conducted during the active season and 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 whole or partial carcass which substantiated death; probable mortalities lacked a carcass but involved strong evidence that a bear had 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, or 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 analyses of population genetics and provided additional information about captured individuals, such as conflict history or continued presence in the population.

## Results

In 2023, we captured 41 individuals during 46 capture occasions (5 recaptures; Fig. 2). We captured 11 individuals for trend monitoring purposes within the DMA (Table 1), including 5 females and 6 males. Five females and 3 males were fitted with radio-transmitters. In addition to trend captures, 29



bears were captured in association with management actions, although some were non-target individuals or were captured preemptively. These captures included 16 females and 13 males. Of these, 10 females and 7 males were fitted with radio-transmitters. One male 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, 2023.

Type <sup>1</sup>	Captured			Radio-marked		
	Female	Male	Total	Female	Male	Total
Trend research in DMA	5	6	11	5	3	8
Management <sup>2</sup>	16	13	29	10	7	17
Research outside of DMA	0	1	1	0	1	1
<b>Total</b>	<b>21</b>	<b>19</b>	<b>41</b>	<b>15</b>	<b>11</b>	<b>26</b>

<sup>1</sup> Bears with multiple captures within the year were placed in only one category: research if it occurred anytime, otherwise first capture type. <sup>2</sup> Management 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.

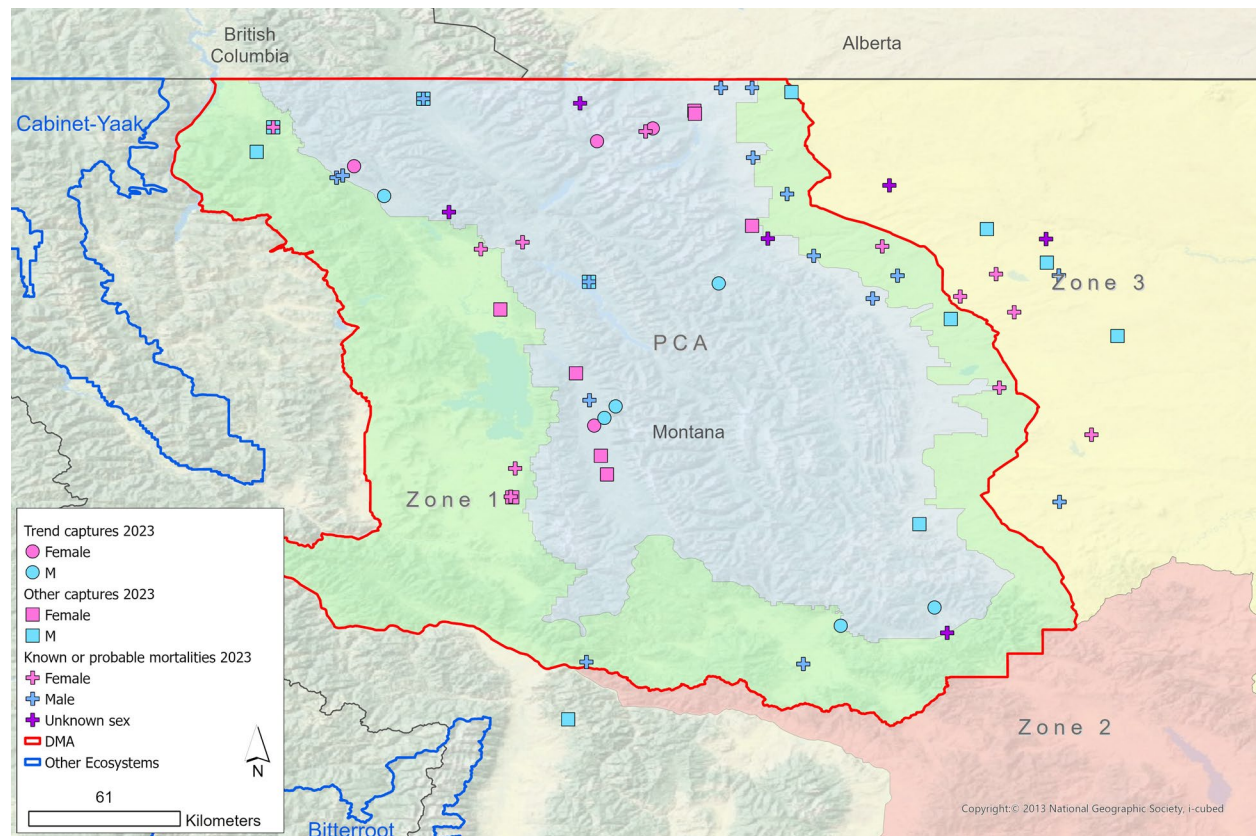


Figure 2. Location of captures and mortalities of grizzly bears in the NCDE, 2023. Zones as described in Fig. 1.

Including bears collared during previous years, we radio-monitored 32 independent bears during all or part of 2023 for trend monitoring within the DMA: 27 females and 5 males. Among this sample, we documented the deaths of 3 radio-marked bears: agency removal due to human-bear conflict (1F); train (1F); and under investigation (1F). For management or other purposes, we monitored 41 bears (25F, 16M). Among this other sample, we documented the deaths of 5 radio-marked bears: agency removal due to human-bear conflict (2F:1M); under investigation (1M); and undetermined (1F). A summary of the fates of radio-marked bears during 2023 are presented in Appendix A.

We recorded the reproductive status of 39 females  $\geq 4$  years old during 2023. Among all observations, there were 14 females with cubs (36%), 9 with yearlings (23%), 1 with 2-year-old offspring (3%), and 15 with no offspring (38%). Cub litter sizes ranges from 1 to 3, with a mean of 2.4. However, dates of first observations for reproductive status ranged from 3 May to 10 Oct and averaged 23 Jun, therefore some individuals may have changed status due to whole litter loss or independence of offspring. Among 22 females first observed in April or early May (soon after den emergence), we observed 7 females with cubs (32%), 6 with yearlings (27%), 1 with 2-year-olds (5%), and 8 with no offspring (36%). Litter size was 2 or 3 with an average of 2.6 cubs among 7 cub litters observed during this period. We monitored survival of 12 cub litters (29 cubs) and 5 yearling litters (10 yearlings) through repeated observations during different months of the year. This sample included 2 cub litters of mothers that died during 2023. We documented 13 presumed cub mortalities and 3 presumed yearling mortalities. A summary of the reproductive observations of females are presented in Appendix B.

Forty-seven known or probable grizzly bear mortalities were documented in or near the NCDE during 2023 (Fig. 3; Table 2). Thirty-seven occurred within the DMA: 24 inside the PCA and 13 within Zone 1. Ten mortalities occurred outside the DMA in Zone 3. Among 23 mortalities of independent bears, causes of death were: agency removal due to human-bear conflict (6); defense of life (4); automobile collision (3); train collision (2); illegal defense of property (2); poaching/malicious kill (2); mistaken id by black bear hunter (1); handling mortality (1); and under investigation (2). Twenty-four 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 (if fate is unknown, cubs were assumed dead). Causes of death were: agency removal due to conflict (6); agency removal due to disease (1); automobile collision (5); train collision (1); orphaned (5); natural (1); and unknown or under investigation (5). A summary of all documented mortalities in the NCDE during 2023 is reported in Appendix C.

Table 2. Number of known or probable mortalities of grizzly bears in the NCDE, 2023.

	Age class	Sex			Total
		Female	Male	Unknown	
Inside DMA	Dependent	4	6	7	17
	Independent	8	12	0	20
	Total	12	18	7	37
Outside DMA	Dependent	2	2	3	7
	Independent	3	0	0	3
	Total	5	2	3	10

During 2022, we collected 100 opportunistic samples. Among them, 44 (44%) 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 35 individuals were detected among these samples (Table 3). The number of total detections per individual ranged from 1–3 with an average of 1.3. Forty-nine percent of individuals had not been previously captured and were identified as new individuals.

Table 3. Annual numbers of grizzly bears genotyped from opportunistic DNA samples collected in the NCDE, 2013–2022, and percent newly versus previously identified.

Individuals	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total genotyped	23	18	15	33	29	27	35	34	36	35
Newly identified	35%	28%	40%	48%	41%	52%	43%	35%	50%	49%
Previously identified	65%	72%	60%	52%	59%	48%	57%	65%	50%	51%



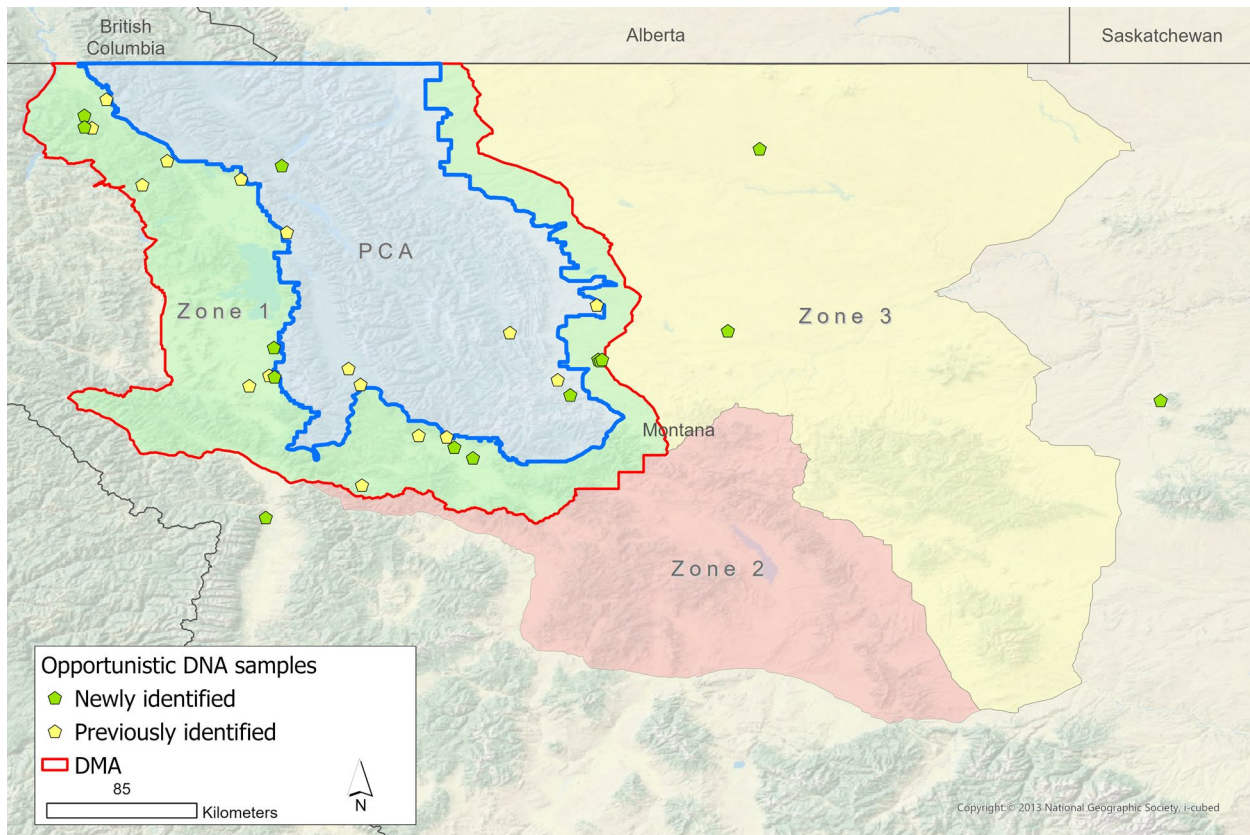


Figure 3. Locations of opportunistic samples from grizzly bears successfully genotyped in the NCDE, 2022. Zones as described in Fig. 1.

## EVALUATION OF 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  $\geq 0.90$ ; 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 groups (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. We estimated numbers of TRU mortalities of independent female and male grizzly bears within the DMA and assessed thresholds using an average for the last 6 years. For each sex, the number of TRU mortalities was the sum of: the count of agency-sanctioned management removals; the count of known or probable deaths of bears wearing functional radio-transmitters (excluding those that were agency removals); and an estimate of the numbers of other mortalities that were or were not reported or discovered. To obtain these estimates, we summed mortalities of non-radioed bears reported by the public or discovered by agency personnel for each sex. If sex was unknown, it was randomly assigned. Because these counts represented some unknown fraction of the true number, we applied reporting/discovery rates observed among deaths of radio-marked bears to inflate this count to an estimate of the numbers of reported plus unreported mortalities of non-radioed bears (Cherry et al. 2022, Costello et al. 2016).

Thresholds for Objective 2 were previously developed for a 6-year management period of 2019–2023 (NCDE Subcommittee 2019). 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 2023 was 0.92, the maximum threshold for the number of independent female mortalities in 2023 was 26, and the maximum threshold for the number of independent male mortalities in 2023 was 31 (NCDE Subcommittee 2019).

Cooperating with other agencies, we continued to collect data on verified outlier locations outside of occupied range (last estimated for 2008–2022), which was used to delineate total known extent of grizzly bear occurrence, known as the “may be present” map. For this analysis, 12-digit hydrologic unit-code watersheds were mapped to indicate presence of grizzly bear observations during a 10-year window (US Fish and Wildlife Service 2020).

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 2023, we verified presence of reproductive females within 19 of 23 BMUs (83%) and within 6 of 7 OUs (86%; Fig. 4). For the 6-year period 2018–2023, all 23 BMUs were occupied by females with offspring, exceeding the objective of 21 of 23 BMUs occupied (Appendix D). 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. Previously, we reported no occupancy of the Dearborn Elk Creek BMU by reproductive females in 2022 (Costello and Roberts 2023), but we have now verified occupancy during 2022 through GPS collar data collected in 2022, but not downloaded until 2023. This change is shown in Appendix D.

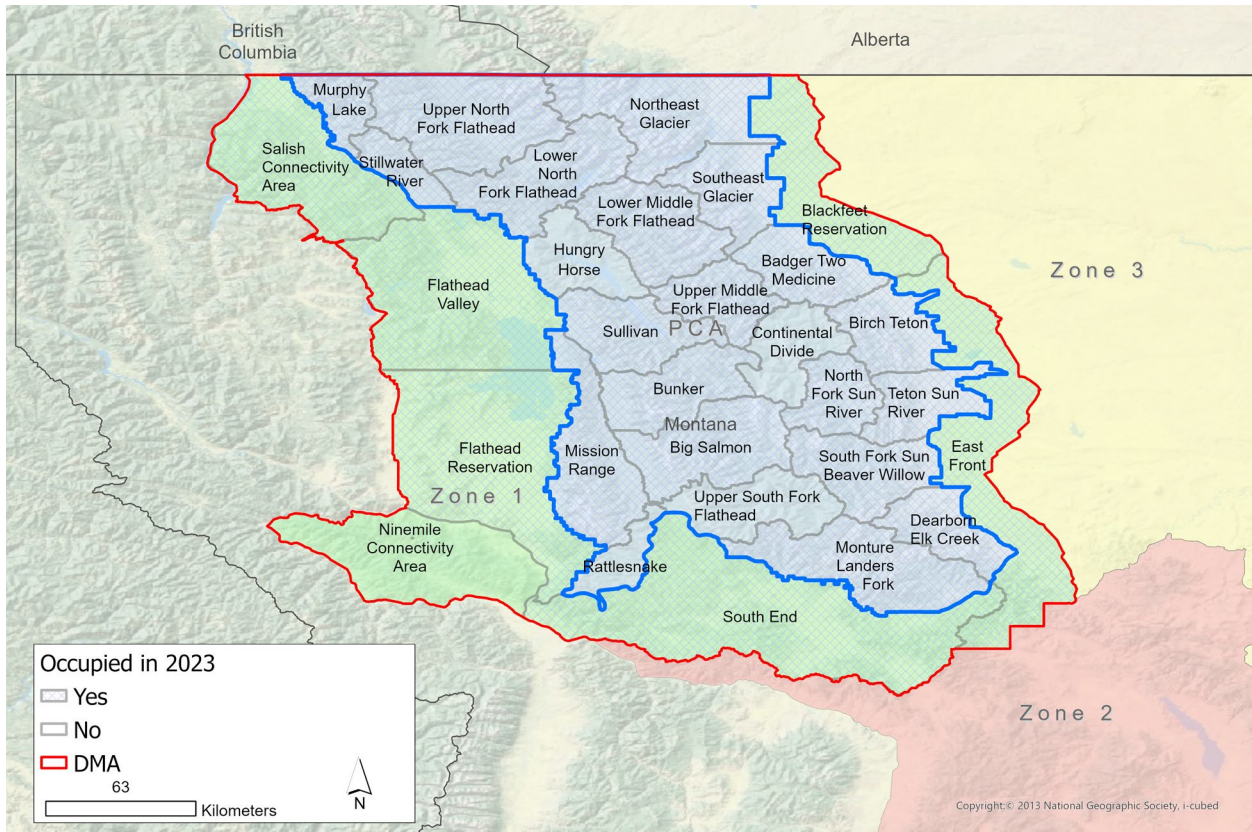


Figure 4. Documented occupancy of female grizzly bears with offspring within 23 BMUs of the PCA and 7 OUs of Zone 1, 2023. Occupancy was documented in all units during the last 6 years. Zones as described in Fig. 1.

For the 6-year period 2018–2023, we estimated an annual survival rate of 0.93 ( $\pm 0.01$  SE) for independent females within the DMA, which exceeds the minimum threshold rate of 0.92 (NCDE Subcommittee 2019).

Within the DMA, there were 8 and 12 known mortalities reported for independent females and independent males during 2023, 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 9 TRU mortalities of independent females and 16 TRU mortalities of independent males within the DMA (Table 4). During 2018–2023, the average annual number of TRU mortalities for independent females within the DMA was 16, which falls below the maximum threshold of 26 (NCDE Subcommittee 2019). The average annual number for independent males was 22, falling below the maximum threshold of 31 (NCDE Subcommittee 2019). A summary of all demographic objectives for 2018–2023 are reported in Appendix E.

Table 4. Summary of independent grizzly bear mortalities within the DMA, NCDE, 2023.

Sex	Documented mortalities by method of discovery				Estimated reported and unreported <sup>e</sup> (C)	Estimated total mortality (A + B + C)
	Agency removal <sup>a</sup> (A)	Telemetry <sup>b</sup> (B)	Reported <sup>c</sup> (high)	Reported <sup>d</sup> (low)		
Female	3	2	3	0	4	9
Male	4	0	7	1	12	16
Total	7	2	10	1	16	25

<sup>a</sup> Count of agency removals, including those involving radio-marked bears. <sup>b</sup> Count of deaths for bears wearing functional radio-transmitters, except for agency removals. <sup>c</sup> 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). <sup>d</sup> Count of non-radioed bear deaths reported by the public or discovered by agency personnel with low reporting rates (poaching/malicious, natural, undetermined). <sup>e</sup> Bayesian estimate of the total number of reported and unreported deaths of non-radioed bears (Cherry et al. 2002 and Costello et al. 2016).

We completed genetic analysis of NCDE samples collected through 2022 (genotypes from 2023 NCDE samples are not yet available). We examined genotype, capture, and monitoring data in the NCDE and other ecosystems to document movements among ecosystems.

In 2023, we obtained the following information about grizzly bear movements between the NCDE and the CYE. Based on a DNA sample collected in 2022, we detected the movement of a bear born in the CYE into the NCDE (Figure 5). In 2022, this individual died as the result of a vehicle collision in the Stillwater River drainage on the boundary of the NCDE Recovery Zone (NCDE ID: NCDE202248). His year of birth was estimated to be 2020 from cementum analysis of a tooth collected at that time. Within the CYE, this individual was first detected from a DNA sample collected at a rub post in 2020 and was last detected from another DNA sample collected in 2022 (CYE ID: C47499M). Pedigree analysis identified the bear as an offspring of two augmentation bears residing in the CYE. The probable mother is 920F, an augmentation female translocated from the Whitefish Mountains to the Cabinet Mountains in 2014 as a

two-year-old. The probable mother was also detected at the 2020 rub post site where this bear was first detected (i.e., the year of birth). The probable father is 723M, an augmentation male translocated from the Whitefish Mountains to the Cabinet Mountains in 2011 as a two-year-old. At the time of death, Bear NCDE202248 had moved a distance of 85 km from the approximate center of his maternal home range.

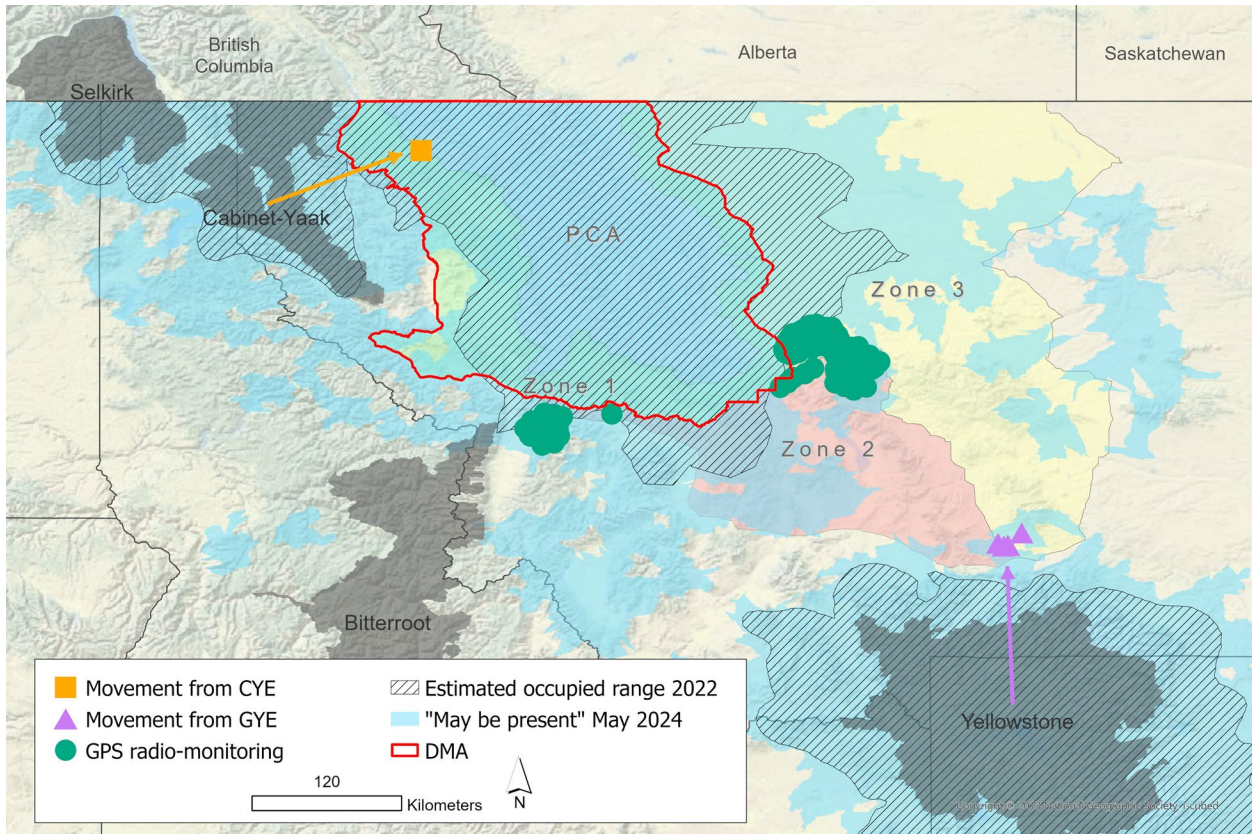


Figure 5. Information on documented movements between ecosystems from genetic data through 2022 or field data in 2023. Symbols represent a subadult male grizzly bear that moved from the Cabinet-Yaak Ecosystem to NCDE Primary Recovery Area (orange square); a subadult male that moved from the Greater Yellowstone Ecosystem to NCDE Zones 2 and 3 (purple triangles); and GPS locations of bears monitored outside of estimated occupied range (green circles). Also shown are occupied range (last estimated in 2022; stippled) and watersheds with verified outlier observation (last estimated in 2024; blue shading). Zones as described in Fig. 1.

In 2023, the following information was obtained about grizzly bear movements between the NCDE and the GYE. Radio-marked subadult male bear 601582786, originally captured and relocated in 2022, spent most of the 2023 active season in the Adel and Big Belt Mountains within NCDE Zones 2 and 3. Most of these GPS locations were outside of the estimated occupied range estimated for 2008–2022. This bear moved back into the NCDE Recovery Zone to den. In July 2023, an unmarked grizzly bear was observed over several days north of Interstate-90 at the southern ends of NCDE Zones 2 and 3. A hair sample was collected from a fence line traversed by this individual. The genotype revealed it was a male and



preliminary analyses indicated it originated from the GYE population. The distance between this observed bear and the 2008–2022 estimated occupied range of the NCDE population was about 149 km. In 2023, we obtained verified outlier observations of grizzly bears in the Boulder and Nevada Mountains within NCDE Zone 2.

In 2023, we obtained the following information about grizzly bear activity outside of NCDE zones. In 2023, subadult male bear 605568068 was captured, radio-collared, and monitored in the Sapphire Mountains. He was captured in a trap set for black bear research on the MPG Ranch. FWP staff were able to assist with the handling of the non-target bear and deploy a GPS radio-collar. This bear had been preemptively captured and relocated in 2021 as a yearling in the Mission Valley, along with a male sibling. At that time, neither bear was radio-marked. In 2023, Bear 605568068 remained in the Sapphire Mountains throughout the active season and denned there, but he shed his collar at the den in early 2024. Another bear, subadult male Bear 11021046 was radio-monitored in the Sapphire Mountains during part of 2023. This male was one of two siblings that were captured and relocated in the area between the NCDE and the BE in 2022. After their release in late 2022, both bears moved north across Interstate-90, reunited with one another, and then denned together within the NCDE Recovery Zone. The female sibling, Bear 11023062, shed her collar in the den. The male sibling, Bear 11021046, spent the spring and early summer of 2023 in areas of NCDE Zones 1 and 2, mostly in the Garnet Mountains. In late July, he crossed Interstate-90 to the south and spent all of August in the Sapphire Mountains before returning to areas of NCDE Zones 1 and 2. In early Oct 2023, he crossed Interstate-90 south a second time, but spent just a few days in the Sapphire Mountains before returning to areas of NCDE Zones 1 and 2. He shed his radio-collar in the Garnet Mountains within Zone 1 in early Nov. In 2023, we obtained verified outlier observations in the Reservation and Ninemile Divide Mountains. These locations fell outside of the 2022 estimated occupied range, but within the Ninemile Salish Connectivity Area, which is part of NCDE Zone 1. In 2023, we obtained verified outlier observations in the Bitterroot, West Pioneer, North Moccasin, and Bear Paw Mountains, and within the Teton, Marias, Missouri, and Judith River basins.

## **SUMMARY OF HUMAN-GRIZZLY BEAR CONFLICT PREVENTION AND RESPONSE**

### **Methods**

Our monitoring team agencies employ specialists involved in human-grizzly bear conflict prevention and response. 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, as described in the Conservation Strategy (NCDE Subcommittee 2019).

## Results

Agency management specialists responded to >246 incidents of human-grizzly bear conflict (Table 5). Conflicts 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.

Table 5. Summary of human-grizzly bear conflicts in the NCDE and surroundings, 2023.

Category	Detail	BIR <sup>1</sup>	FIR	FWP			GNP	Outside	Total
				R1	R2	R4			
Unnatural Foods	Garbage/waste site			23	34	1			58
	Pet/livestock feed		1	14	7	1		1	24
	Human foods			5	2		2		9
	Bird feeder			4					4
	Other		1	3	5	2			11
	Subtotal			2	49	48	4	2	1
Depredation	Chickens/poultry			16	1			1	18
	Cattle	6			9	15			30
	Sheep			1					1
	Other		4	4	1	3			12
	Subtotal	6	4	21	11	18		1	61
Property damage	Building			21		3			24
	Enclosure			5					5
	Other			3	4	1			8
	Subtotal			29	4	4			37
Human interaction	Aggressive encounter			5	5	1		3	14
	Habituation			4		1			5
	DOL shooting	2		2		1			5
	Human injury			1					1
	Subtotal	2		12	5	3		3	25
Agricultural damage	Orchard/fruit tree			6					6
	Stored grain	1				6			7
	Beehives					4			4
	Crop								
	Subtotal	1		6		10			17
<b>Total</b>		<b>9</b>	<b>6</b>	<b>117</b>	<b>68</b>	<b>39</b>	<b>2</b>	<b>5</b>	<b>246</b>

<sup>1</sup> Only data associated with captures or mortalities were reported.

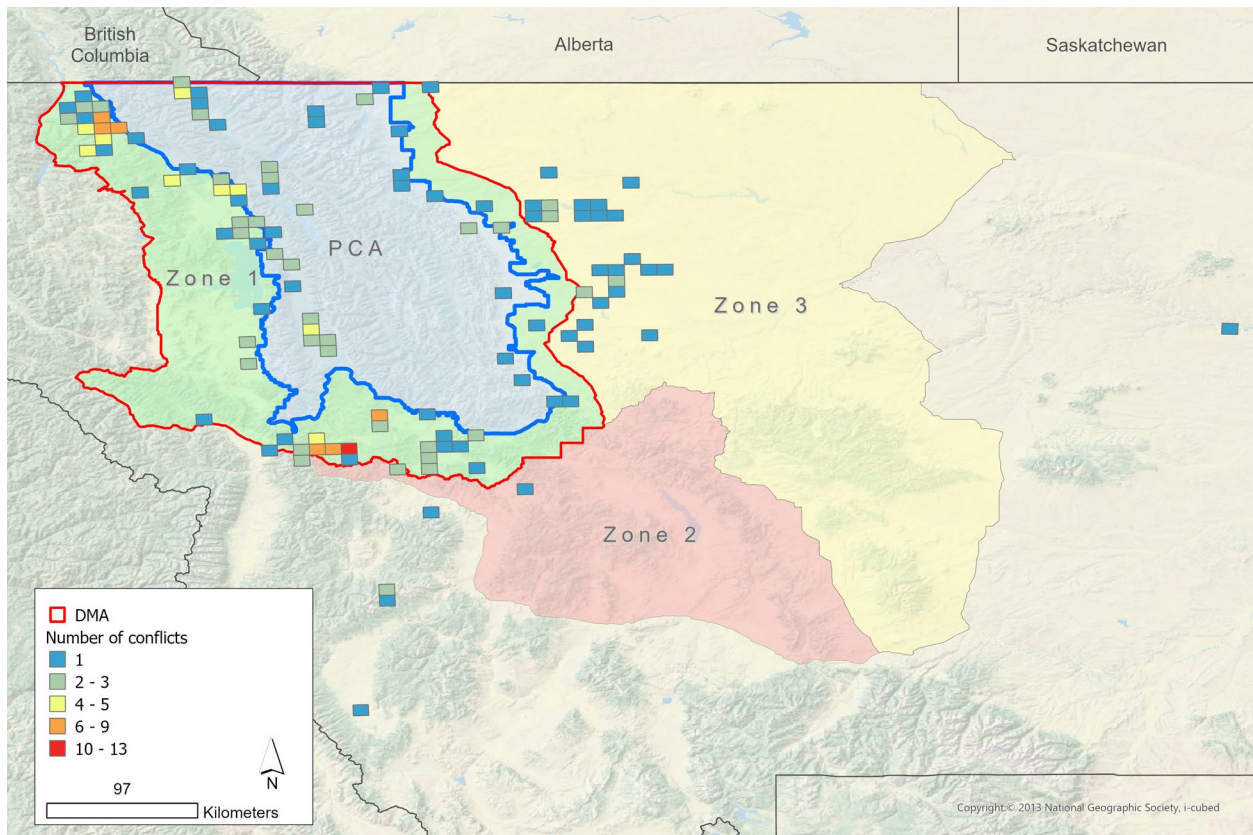


Figure 6. General distribution of reported human-grizzly bear conflicts in the NCDE and surroundings, 2023. Colors correspond to counts of conflicts recorded within 7 km × 7km grid cells. Zones as described in Fig. 1.

Table 6. Summary of reports or complaints where grizzly bears were near people or property but not involved in conflict behavior in the NCDE and surroundings, 2023.

Category	Detail	FIR	FWP R1	FWP R2	FWP R4	Outside	Total
Bear near people	Naturally	2	4	5	24	2	37
	Known or possible attractants	1	8	17	8	1	35
Bear near property	Livestock		2	5	5		12
	Spilled grain				5		5
	Boneyard or carcass	1	1		1		3
	Other	1		3	2		6
Total		5	15	30	45	3	98

<sup>1</sup> Data are incomplete at present; only data associated with captures are included.

They also responded to >98 other reports or complaints, where bears were near people or property, but not involved in conflict behavior (Table 6). About 43% of recorded human-bear conflicts involved bears accessing unnatural foods, especially garbage or feed. Another 15% involved bears damaging property, primarily while attempting to access unnatural foods or residential chicken coops.

About 25% involved grizzly bear depredation, mostly of chickens or cattle. Conflicts related to grizzly bear interactions with humans or agriculture accounted for 17% of conflicts.

Numbers of conflict incidents were highest within FWP Region 1 (Table 5, Fig. 5). Numbers of conflicts were low in Glacier National Park and relatively low on the Flathead Reservation. The majority of conflicts occurred in Zone 1 (60%), especially on the west side of the Continental Divide. The remainder occurred in the PCA (23%), Zone 3 (12%), Zone 2 (2%), and outside of NCDE Conservation Strategy Zones (2%).

In responding to conflicts, agency management specialists provided education and outreach and took many actions to prevent conflict: securing attractants (sometimes with electric fence); removing attractants (including carcass removal); monitoring (usually with remote cameras); hazing or use of scare devices; posting of warnings or temporary closures; and issuing warnings for violations related to food storage or feeding wildlife (Table 7). Management specialists took 35 actions involving captured bears including: preemptively capturing 5 bears to prevent conflict; releasing or relocating 6 non-target bears captured at conflict sites but likely not involved in conflict (1 capture-related mortality); relocating 10 bears involved in conflict; and removing 12 bears involved in conflict (Table 8).

Table 7. Summary of non-capture management actions taken to reduce human-grizzly bear conflict, NCDE and surroundings, 2023.

Event	Category	Education or outreach	Secured or removed attractants	Monitored cameras	Hazed or scare device	Posted warning or closure	Issued warning or citation	Total
None	Preventative	12	32	6				50
Report or complaint	Bear near people	31	20	24	11	1		87
	Bear near property	38	9	17	7	4		75
Conflict	Unnatural foods	82	72	54	12	3	4	227
	Depredation	18	32	24	2	2		78
	Property damage	18	24	17	14	1		74
	Human interaction	10	10	9		2		31
	Agricultural damage	5	12	9	4			30
	<b>Total</b>	<b>214</b>	<b>211</b>	<b>160</b>	<b>50</b>	<b>13</b>	<b>4</b>	<b>652</b>



Table 8. Summary of management-related captures or removals of grizzly bears, NCDE and surroundings, 2023. Numbers in parentheses refer to dependent offspring captured with their mothers.

Event	Category	Preemptive capture	Non-target capture	Target released onsite	Target relocated	Target removed	Total
Report or complaint	Bear near people	3				1 <sup>a</sup>	3
	Bear near property	2	2				4
Conflict	Unnatural foods		1		3 (1)	1 (1)	5 (2)
	Depredation		4 <sup>b</sup>		4	4 (2)	12 (2)
	Property damage			1		2 (1)	3 (1)
	Human interaction				1	1	2
	Agricultural damage				1		1
Total		5	7	1	9 (1)	8 (4)	30 (5)

<sup>a</sup> Captured bear euthanized due to disease

<sup>b</sup> One capture-related mortality among non-target captures

## SUMMARY OF OTHER RESEARCH AND MONITORING

During 2023, members of the NCDE trend monitoring program were also involved in other research projects involving grizzly bears in the NCDE, Montana, and elsewhere.

Collaborating with the University of Montana, we applied NCDE movement models (from Sells et al. 2022) to predict habitat selection by grizzly bears in the BE under scenarios of natural recolonization and reintroduction and published a paper (Sells and Costello 2024).

Collaborating with Utah State University, we published a paper examining the efficacy of using livestock guardian dogs to keep grizzly bears away from people and property (Young and Sarmiento 2024). We also published a paper on the efficacy of scare devices for deterring bears from farms (Sarmiento 2024).

Along with members of the Interagency Grizzly Bear Study Team (IGBST) and the University of Montana, we published a paper on the integrated population model developed for monitoring of the GYE grizzly bear population (Gould et al. 2024).

With collaborators from the CYE, IGBST, and Gates of the Arctic National Park and Preserve, we completed two manuscripts. The first described a method for detecting presence and timing of parturition events from activity data collected by GPS radio-collars (Roberts et al. *In prep*). The second tested two hypotheses for explaining the ultimate factor determining birth timing in grizzly bears (Costello et al. *In prep*).

With collaborators from the IGBST and USFWS, we completed a draft of a manuscript investigating whether litter production can be detected remotely in grizzly bears and polar bears based on movement patterns in the first few weeks after den emergence (Andersen et al. *In review*).

We completed data collection and began analyses for our investigation into use of grain bins by grizzly bears along the Rocky Mountain Front of the NCDE.

We began analyses on grizzly bear dispersal behavior in the NCDE, based on known and DNA-based parentage.

We began analyses on grizzly bear habitat selection in response to forest disturbance. The first part of this project aims to address if grizzly bears select or avoid forest disturbance patches (both harvested and burned patches); how selection (or avoidance) is mediated by spatial/temporal characteristics of disturbance patches; and how these patterns are influenced by variation in availability of forest disturbance within individual grizzly bear home ranges. This work is part of a PhD project at the University of Montana.

We continued our collaboration with Birchdale Ecological to analyze responses and outcomes associated with residential human-grizzly bear conflicts in the NCDE and nearby populations in British Columbia.

Collaborating with IGBST and USFWS, we continued the ongoing effort to collect, verify, and compile records of outlier grizzly bear observations.

## ACKNOWLEDGEMENTS

We would like to thank the many people that contributed to the 2023 field activities and administrative support, especially Kyle Yorke, Courtney Lockerby, Mackenzie Taylor, Kim Annis, Eli Hampson, Eric Graham, Bruce Montgomery, Brad Balis, Daniel McHugh, Jack Austin, Erin Fenger, Sarah Zielke, Kari Kingery, Paden Alexander, Steven Cross, Susan Clothier, Justin Gude, Ken McDonald, Ben Jimenez, Rory Trimbo, Amber Kornak, Morgan Vance, Mark Haroldson, Jennifer Fortin-Noreus, Hilary Cooley, Kraig Glazer, Rob Cherot, Ken Justus, Joe Rahn, Nathan Reiner, Rob Davies, Mark Ruby, Scott Snelson, Michael Muñoz, Chris Martin, Jim Dahlstrom, Kristine Simpson, Neil Cadwell, Two Bear Air, Jim Pierce, and Red Eagle Aviation.

## LITERATURE CITED

Andersen, E. M., J. G. Clapp, M. A. Vinks, T. C. Atwood, D. D. Bjornlie, C. M. Costello, D. D. Gustine, M. A. Haroldson, L. L. Roberts, K. D. Rode, F. T. van Manen, and R. R. Wilson. *In review*. Identifying

- presence or absence of grizzly and polar bear cubs from the movements of adult females with machine learning. *Movement Ecology*.
- Aune, K. and W. Kasworm. 1989. Final report: East Front grizzly bear study. Montana Fish, Wildlife, and Parks, Helena. 332pp.
- Bjornlie, D. D., D. J. Thompson, M. A. Haroldson, C. C. Schwartz, K. A. Gunther, S. L. Cain, D. B. Tyers, K. L. Frey, and B. C. Aber. 2014. Methods to estimate distribution and range extent of grizzly bears in the Greater Yellowstone Ecosystem. *Wildlife Society Bulletin* 38:182–187.
- Cherry, S., M. A. Haroldson, J. Robinson-Cox, and C. C. Schwartz. 2002. Estimating total human-caused mortality from reported mortality using data from radio-instrumented grizzly bears. *Ursus* 13: 175–184. 121pp.
- Costello, C. M., R. D. Mace, and L. Roberts. 2016. Grizzly bear demographics in the Northern Continental Divide Ecosystem, Montana: research results (2004–2014) and suggested techniques for management of mortality. Montana Department of Fish, Wildlife and Parks, Helena.
- Costello, C. M., L. L. Roberts, D. D. Bjornlie, J. G. Clapp, M. A. Haroldson, G. V. Hilderbrand, K. Joly, W. Kasworm, J. Nicholson, T. Radandt, M. Sorum, J. Teisberg, F. T. van Manen, M. A. Vinks. *In prep*. The ultimate driver of birth timing in grizzly bears: synchronized cues or energetic trade-off?
- Gould, M. J., J. C. Clapp, M. A. Haroldson, C. M. Costello, J. J. Nowak, H. W. Martin, M. R. Ebinger, D. D. Bjornlie, D. J. Thompson, J. A. Dellinger, M. A. Mumma, P. M. Lukacs, and F. T. van Manen. 2024. A unified approach to long-term population monitoring of grizzly bears in the Greater Yellowstone Ecosystem. *Global Ecology and Conservation* 14: e03133.
- Kendall, K. C., T. A. Graves, J. A. Royle, A. C. Macleod, K. S. McKelvey, J. Boulanger, and J. S. Waller. 2019. Using bear rub data and spatial capture-recapture models to estimate trend in a brown bear population. *Scientific Reports* 9: 1–11.
- Kendall, K. C., J. B. Stetz, J. Boulanger, A. C. McLeod, D. Paetkau, and G. C. White. 2009. Demography and genetic structure of a recovering grizzly bear population. *Journal of Wildlife Management* 73: 3–16.
- Mace, R. D. 2005. Interagency population monitoring plan for grizzly bears in the Northern Continental Divide Ecosystem, Montana. Montana Fish, Wildlife, and Parks, Kalispell. 23pp.
- Mace, R. D., D. W. Carney, T. Chilton-Radandt, S. A. Courville, M. A. Haroldson, R. B. Harris, J. Jonkel, B. McLellan, M. Madel, T.L. Manley, C. C. Schwartz, C. Servheen, G. Stenhouse, J. S. Waller, and E. Wenum. 2012. Grizzly bear population vital rates and trend in the Northern Continental Divide Ecosystem, Montana. *The Journal of Wildlife Management*, 76: 119–128.
- Mace, R. D., and C. J. Jonkel. 1986. Local food habitat of the grizzly bear in Montana. *International Conference on Bear research and Management* 6: 105–119.
- Mace, R. D., S. C. Minta, T. L. Manley, K. E. Aune. 1994. Estimating grizzly bear population size using camera sightings. *Wildlife Society Bulletin* 22: 74–83.
- Mace, R. D., and J. S. Waller. 1997. Final report: grizzly bear ecology in the Swan Mountains, Montana. Montana Fish, Wildlife, and Parks, Helena. 191pp.
- Martinka, C. J. 1976. Ecological role and management of grizzly bears in Glacier National Park, Montana. *International Conference on Bear research and Management* 3: 147–156.

- Montana Fish, Wildlife and Parks. 2004. Biomedical protocol for free-ranging Ursidae in Montana: black bears (*Ursus americanus*) and grizzly bears (*Ursus arctos horribilis*): capture, anesthesia, surgery, tagging, sampling, and necropsy procedures. Helena, Montana, USA.
- NCDE Subcommittee. 2019. Conservation strategy for the grizzly bear in the Northern Continental Divide Ecosystem. 170pp + appendices.
- Roberts, L. L., C. M. Costello, M. A. Vinks, D. D. Bjornlie, M. D. Cameron, J. G. Clapp, M. A. Haroldson, Grant V. Hilderbrand, K. Joly, W. Kasworm, J. Nicholson, T. Radandt, M. S. Sorum, J. Teisberg, F. T. van Manen. *In prep.* Using anomaly detection with radio-collar activity data to determine the presence and timing of grizzly bear parturition.
- Sarmiento, W. M. 2024. Bear deterrence with scare devices, a non-lethal tool in the use-of-force continuum. *Journal of Wildlife Management* 88: e22552.
- Sells, S. N., and C. M. Costello. 2024. Predicting future grizzly bear habitat use in the Bitterroot ecosystem under recolonization and reintroduction scenarios. *PLOS One* 19: e0308043.
- Sells, S. N., C. M. Costello, P. M. Lukacs, L. L. Roberts, and M. A. Vinks. 2022. Grizzly bear habitat selection across the Northern Continental Divide Ecosystem. *Biological Conservation* 276: 109813.
- Servheen, C. 1983. Grizzly bear food habits, movements, and habitat selection in the Mission Mountains, Montana. *The Journal of Wildlife Management*. 47: 1026–1035.
- Stoneberg, R. P., and C. J. Jonkel. 1966. Age determination in black bears by cementum layers. *Journal of Wildlife Management* 30: 411–414.
- U.S. Fish and Wildlife Service. 1993. Grizzly Bear Recovery Plan. U.S. Fish and Wildlife Service, Office of the Grizzly Bear Recovery Coordinator, University Montana, Missoula. 181pp.
- Young, J. K., and W. Sarmiento. 2024. Can an old dog learn a new trick?: efficacy of livestock guardian dogs at keeping an apex predator away from people. *Biological Conservation* 292: 110554.
- Zager, P., C. Jonkel, and J. Habeck. 1983. Logging and wildfire influence on grizzly bear habitat in northwestern Montana. *International Conference on Bear Research and Management* 5: 124–132.



## APPENDICES

Appendix A. Fates of radio-monitored grizzly bears captured for trend monitoring within the DMA or for other purposes inside and outside of the DMA, NCDE, 2023.

Purpose	Sex	Bear ID	DMA	Independent	Age	Fate <sup>1</sup>
Trend	Female	11018035	Yes	Yes	14	Censored
Trend	Female	11027854	Yes	Yes	11	Alive
Trend	Female	39036349	Yes	Yes	14	Alive
Trend	Female	41330870	Yes	Yes	5	Alive
Trend	Female	41519364	Yes	Yes	14	Alive
Trend	Female	41580379	Yes	Yes	14	Alive
Trend	Female	79597603	Yes	Yes	15	Alive
Trend	Female	97616524	Yes	Yes	21	Alive
Trend	Female	601582810	Yes	Yes	8	Dead
Trend	Female	601604325	Yes	Yes	2	Censored
Trend	Female	601608034	Yes	Yes	7	Censored
Trend	Female	601610593	Yes	Yes	13	Alive
Trend	Female	605564553	Yes	Yes	12	Alive
Trend	Female	605567617	Yes	Yes	9	Alive
Trend	Female	605569626	Yes	Yes	4	Censored
Trend	Female	605570788	Yes	Yes	11	Alive
Trend	Female	605572582	Yes	Yes	5	Alive
Trend	Female	605574067	Yes	Yes	4	Alive
Trend	Female	605575053	Yes	Yes	8	Alive
Trend	Female	605575821	Yes	Yes	4	Alive
Trend	Female	605576598	Yes	Yes	17	Censored
Trend	Female	606844805	Yes	Yes	11	Alive
Trend	Female	606845087	Yes	Yes	4	Alive
Trend	Female	839842014	Yes	Yes	4	Dead
Trend	Female	841778369	Yes	Yes	8	Dead
Trend	Female	841893020	Yes	Yes	6	Censored
Trend	Female	842014813	Yes	Yes	11	Alive
Trend	Male	601617019	Yes	Yes	7	Censored
Trend	Male	605562323	Yes	Yes	15	Censored
Trend	Male	605571605	Yes	Yes	6	Censored
Trend	Male	605572790	Yes	Yes	11	Alive
Trend	Male	605575053	Yes	Yes	8	Alive
Other	Female	11023062	No	Yes	2	Censored
Other	Female	36554859	Yes	Yes	8	Lost
Other	Female	95636784	Yes	Yes	16	Alive
Other	Female	601604325	Yes	Yes	3	Censored

Purpose	Sex	Bear ID	DMA	Independent	Age	Fate <sup>1</sup>
Other	Female	604521558	Yes	Yes	7	Alive
Other	Female	605559048	Yes	Yes	5	Alive
Other	Female	605561265	Yes	Yes	15	Censored
Other	Female	605561793	Yes	Yes	7	Dead
Other	Female	605564317	Yes	No	0	Censored
Other	Female	605566022	Yes	Yes	3	Alive
Other	Female	605569812	Yes	Yes	7	Alive
Other	Female	605570876	Yes	Yes	10	Alive
Other	Female	605571600	Yes	Yes	7	Censored
Other	Female	605573051	Yes	No	0	Censored
Other	Female	605573370	No	Yes	4	Dead
Other	Female	605575005	Yes	Yes	2	Alive
Other	Female	605576598	Yes	Yes	18	Censored
Other	Female	605577544	Yes	Yes	6	Alive
Other	Female	605633311	No	No	1	Alive
Other	female	606840028	Yes	No	1	Alive
Other	Female	606848792	Yes	Yes	9	Alive
Other	Female	842015615	Yes	Yes	9	Censored
Other	Female	842029091	Yes	Yes	4	Censored
Other	Female	842029879	No	Yes	3	Alive
Other	Female	605573811	Yes	Yes	7	Dead
Other	Male	999	No	Yes	4	Censored
Other	Male	11021046	No	Yes	2	Censored
Other	Male	41636273	Yes	Yes	14	Censored
Other	Male	601582786	No	Yes	3	Alive
Other	Male	604515023	Yes	Yes	4	Censored
Other	Male	604520568	Yes	Yes	15	Alive
Other	Male	604525600	Yes	Yes	2	Censored
Other	Male	605569805	No	No	1	Censored
Other	Male	606840545	Yes	Yes	5	Censored
Other	Male	606846815	Yes	Yes	7	Dead
Other	Male	41360823	Yes	Yes	23	Alive
Other	Male	601623097	Yes	Yes	11	Alive
Other	Male	605568068	No	Yes	3	Alive
Other	Male	605569099	No	No	1	Dead
Other	Male	605571127	Yes	Yes	5	Censored
Other	Male	606843514	Yes	Yes	1	Alive

<sup>1</sup> Fate (last known within year): Alive = alive and wearing transmitter, Censored = alive when transmitter was cast or removed, Dead = died wearing transmitter, Lost = lost contact with transmitter.

Appendix B. Observed reproductive status and offspring mortality for adult ( $\geq 4$  years old) female grizzly bears radio-monitored in the NCDE, 2023.

Sample	Collared	Bear ID	Age	Status	Litter size	Offspring mortality	Multiple observations	Date first observed	Status previous year (if known)	Litter size previous year (if known)
Trend	Yes	601608034	8	Yearling	3		No	4/11/2023	Cub	3
Trend	Yes	11018035	15	Yearling	1		No	4/12/2023	Cub	2
Trend	Yes	39036349	15	Yearling	3	0	Yes	4/12/2023	Cub	3
Trend	Yes	606845087	5	None				4/12/2023	None	
Trend	Yes	605570788	12	None				4/23/2023	None	
Trend	Yes	605575821	5	None				4/23/2023	None	
Trend	Yes	841893020	7	Yearling	1	1	Yes	4/23/2023	Cub	1
Trend	Yes	605574067	5	None				4/25/2023	None	
Trend	Yes	839842014	5	None				4/25/2023	None	
Trend	Yes	41580379	15	Yearling	2	2	Yes	5/3/2023	Cub	2
Trend	Yes	97616524	22	Cub	3	0	Yes	5/3/2023	None	
Trend	Yes	601582810	9	None				5/3/2023	None	
Trend	Yes	601610593	14	Cub	2	2	Yes	5/3/2023	None	
Trend	Yes	841778369	9	Cub	3	3	Yes	5/3/2023	None	
Trend	Yes	842014813	12	Cub	2	0	Yes	5/3/2023	Yearling	1
Trend	Yes	79597603	16	Cub	3	0	Yes	5/3/2023	2-year-old	1
Trend	Yes	41330870	5	None				6/1/2023		
Trend	Yes	605567617	10	Cub	3	3	Yes	6/14/2023		
Trend	Yes	605564553	13	None				7/5/2023	None	
Trend	Yes	41519364	15	None				7/6/2023	Cub	3
Trend	Yes	11027854	11	None				9/7/2023		
Trend	Yes	605572582	5	None				9/22/2023		
Trend	Yes	605579378	8	Cub	2	0	Yes	9/24/2023		
Other	Yes	605566022	4	None				4/25/2023		
Other	Yes	842015615	10	2-year-old	2	0	Yes	4/25/2023	Yearling	2
Other	Yes	605570876	9	Yearling	2	0	Yes	5/2/2023		
Other	Yes	605577544	5	None				5/2/2023		
Other	Yes	604521558	8	Cub	3	3	Yes	5/3/2023	None	

Sample	Collared	Bear ID	Age	Status	Litter size	Offspring mortality	Multiple observations	Date first observed	Status previous year (if known)	Litter size previous year (if known)
Other	Yes	605573370	5	Cub	2	2	Yes	5/5/2023	None	
Other	Yes	36554859	8	Yearling	1		No	5/18/2023	Cub	1
Other	Yes	605569812	8	None				5/18/2023	None	
Other	Yes	605571600	8	Yearling	2	0	Yes	5/18/2023	Cub	2
Other	Yes	606848792	9	None				5/27/2023		
Other	Yes	605559048	6	Cub	2	0	Yes	7/6/2023	None	
Other	Yes	605561265	16	Yearling	3		No	7/6/2023	Cub	3
Other	Yes	605576598	18	Cub	3	0	Yes	7/6/2023	None	
Other	Yes	605573811	7	Cub	1	0	Yes	8/7/2023		
Other	Yes	605561793	8	Cub	3		No	10/1/2023	None	
Other	Yes	842029879	4	Cub	2		No	10/10/2023	None	
Trend	Yes	601608034	8	Yearling	3		No	4/11/2023	Cub	3



Appendix C. Known and probable grizzly bear mortalities in the NCDE, 2023.

Date	Date accuracy	Certainty of death	Sex <sup>1</sup>	Age Class <sup>2</sup>	Age	Collared	Bear ID	Zone	Cause of death
3/12/2023	Day	Known	F	YR	1	No		Zone 3	Agency removal-Livestock depredation
4/20/2023	Day	Known	M	AD	6	No	41302269	Zone 1	Agency removal-Livestock depredation
4/29/2023	Day	Known	M	AD	7	Yes	606846815	PCA	Public-Illegal DOP
5/2/2023	Day	Known	M	AD	7	No		Zone 1	Public-Illegal DOP
5/9/2023	Day	Known	F	YR	1	No		PCA	Accidental-Automobile
5/11/2023	Day	Known	M	AD	15	No		PCA	Agency removal-Livestock depredation
5/16/2023	Day	Known	M	AD	10	No		PCA	Undetermined-Under investigation
5/17/2023	Day	Known	M	AD	7	No		PCA	Public-Mistaken ID
5/31/2023	Day	Known	F	CB	0	No		Zone 1	Agency removal-Bear injury/disease
6/4/2023	Week	Known	F	YR	1	No		Zone 3	Undetermined-Under investigation
6/15/2023	Week	Known	M	CB	0	No		PCA	Natural-Natural
7/16/2023	2 weeks	Known	M	YR	1	No		Zone 3	Undetermined-Unknown
7/18/2023	Day	Known	M	SA	4	No		PCA	Agency removal-Food/property/habituation
7/20/2023	Day	Known	F	AD	5	Yes	839842014	PCA	Agency removal-Food/property/habituation
7/25/2023	Day	Known	M	CB	0	No		PCA	Accidental-Automobile
7/25/2023	Day	Known	M	CB	0	No		PCA	Accidental-Automobile
8/4/2023	Day	Known	F	2YO	2	No		Zone 3	Accidental-Automobile
8/14/2023	Day	Known	U	CB	0	No		PCA	Accidental-Automobile
8/24/2023	Day	Known	M	YR	1	Yes	605569099	Zone 3	Agency removal-Food/property/habituation
8/26/2023	Day	Known	F	AD	17	No	36577520	PCA	Public-DOL
8/26/2023	Day	Probable	U	CB	0	No		PCA	Orphaned-DOL
8/26/2023	Day	Known	M	AD	9	No		Zone 1	Agency removal-Capture-related
8/26/2023	Day	Probable	U	CB	0	No		PCA	Orphaned-DOL
8/26/2023	Day	Probable	U	CB	0	No		PCA	Orphaned-DOL
8/29/2023	Day	Known	F	YR	1	No		Zone 1	Accidental-Automobile
9/1/2023	Week	Known	U	DEP	1	No		PCA	Undetermined-Unknown
9/6/2023	Day	Known	U	YR	1	No		Zone 3	Accidental-Train
9/7/2023	Day	Known	F	AD	12	Yes	601582810	PCA	Accidental-Train

Date	Date accuracy	Certainty of death	Sex <sup>1</sup>	Age Class <sup>2</sup>	Age	Collared	Bear ID	Zone	Cause of death
9/18/2023	Day	Known	F	AD	9	No		Zone 1	Accidental-Automobile
9/18/2023	Day	Known	M	AD	27	No		Zone 1	Accidental-Train
9/20/2023	Day	Known	F	AD	7	Yes	605573811	PCA	Agency removal-Food/property/habituation
9/20/2023	Day	Known	M	CB	0	No		PCA	Agency removal-Food/property/habituation
9/29/2023	Day	Known	M	CB	0	No		Zone 1	Agency removal-Food/property/habituation
9/29/2023	Day	Known	M	CB	0	No		Zone 1	Agency removal-Food/property/habituation
10/1/2023	Day	Known	F	AD	10	Yes	605561793	Zone 1	Agency removal-Food/property/habituation
10/3/2023	Day	Known	F	AD	9	Yes	841778369	PCA	Undetermined-Under investigation
10/3/2023	Day	Probable	U	CB	0	No		PCA	Undetermined-Under investigation
10/3/2023	Day	Probable	U	CB	0	No		PCA	Undetermined-Under investigation
10/6/2023	Day	Known	F	AD	5	Yes	605573370	Zone 3	Public-Poached/malicious
10/6/2023	Day	Probable	U	CB	0	No		Zone 3	Orphaned-Poached/malicious
10/6/2023	Day	Probable	U	CB	0	No		Zone 3	Orphaned-Poached/malicious
10/13/2023	Day	Known	F	AD	5	No		Zone 3	Public-Poached/malicious
10/14/2023	Day	Known	M	AD	9	No		PCA	Public-DOL
10/19/2023	Day	Known	M	AD	18	No	64035775	Zone 1	Accidental-Automobile
10/24/2023	Day	Known	F	SA	2	No		Zone 1	Public-DOL
11/2/2023	Day	Known	F	CB	0	No		Zone 1	Agency removal-Food/property/habituation
11/19/2023	Day	Known	M	AD	19	No		PCA	Public-DOL

<sup>1</sup> F = female, M = male, U = unknown sex

<sup>2</sup> AD = adult, SA = subadult, YR = yearling, CB = cub

Appendix D. Observed occupancy of 23 Bear Management Units within the PCA and 7 Occupancy Units within Zone 1 by female grizzly bears with offspring, 2018–2023. Units known occupied during a given year are signified by the symbol x. Twenty-three of 23 BMUs and 7 of 7 OUs were occupied during a 6-year period ending with 2023.

Bear Management Unit (PCA)	2018	2019	2020	2021	2022	2023
Murphy Lake			x		x	x
Upper North Fork Flathead		x	x	x	x	x
Northeast Glacier	x	x	x	x	x	x
Stillwater River	x	x	x	x	x	x
Lower North Fork Flathead	x	x	x	x	x	x
Hungry Horse	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
Badger Two Medicine	x	x	x		x	x
Mission Range	x	x	x	x	x	x
Bunker	x	x	x	x		x
Continental Divide			x		x	
Birch Teton	x	x	x	x		x
Big Salmon	x	x	x	x	x	x
North Fork Sun River	x	x	x		x	x
Teton Sun River		x	x	x	x	x
Rattlesnake				x		
Upper South Fork Flathead				x		
South Fork Sun Beaver Willow	x	x	x	x	x	x
Monture Landers Fork		x	x	x	x	x
Dearborn Elk Creek		x	x	x	x <sup>1</sup>	x
Occupied during year	15	18	20	18	18	19
Occupied during last 6 years	22	22	23	23	23	23
Occupancy Unit (Zone 1)						
Salish Connectivity Area	x	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	7	7	7	6	6	6
Occupied during last 6 years	7	7	7	7	7	7

<sup>1</sup> Observation from 2022 recorded from radio collar downloaded in 2023.

Appendix E. Thresholds and observed estimates for demographic objectives described in the 2019 Conservation Strategy, 2018–2023. 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					
			2018	2019	2020	2021	2022	2023
Occupancy	PCA (BMUs)	Minimum	21	21	21	21	21	21
		Observed	22	22	23	23	23	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	0.92	0.92
		Observed	0.93	0.94	0.93	0.93	0.93	0.93
TRU mortalities	Female	Maximum	22	23	24	25	25	26
		Observed	15	16	13	15	15	16
	Male	Maximum	28	29	29	30	30	31
		Observed	21	21	21	23	25	22