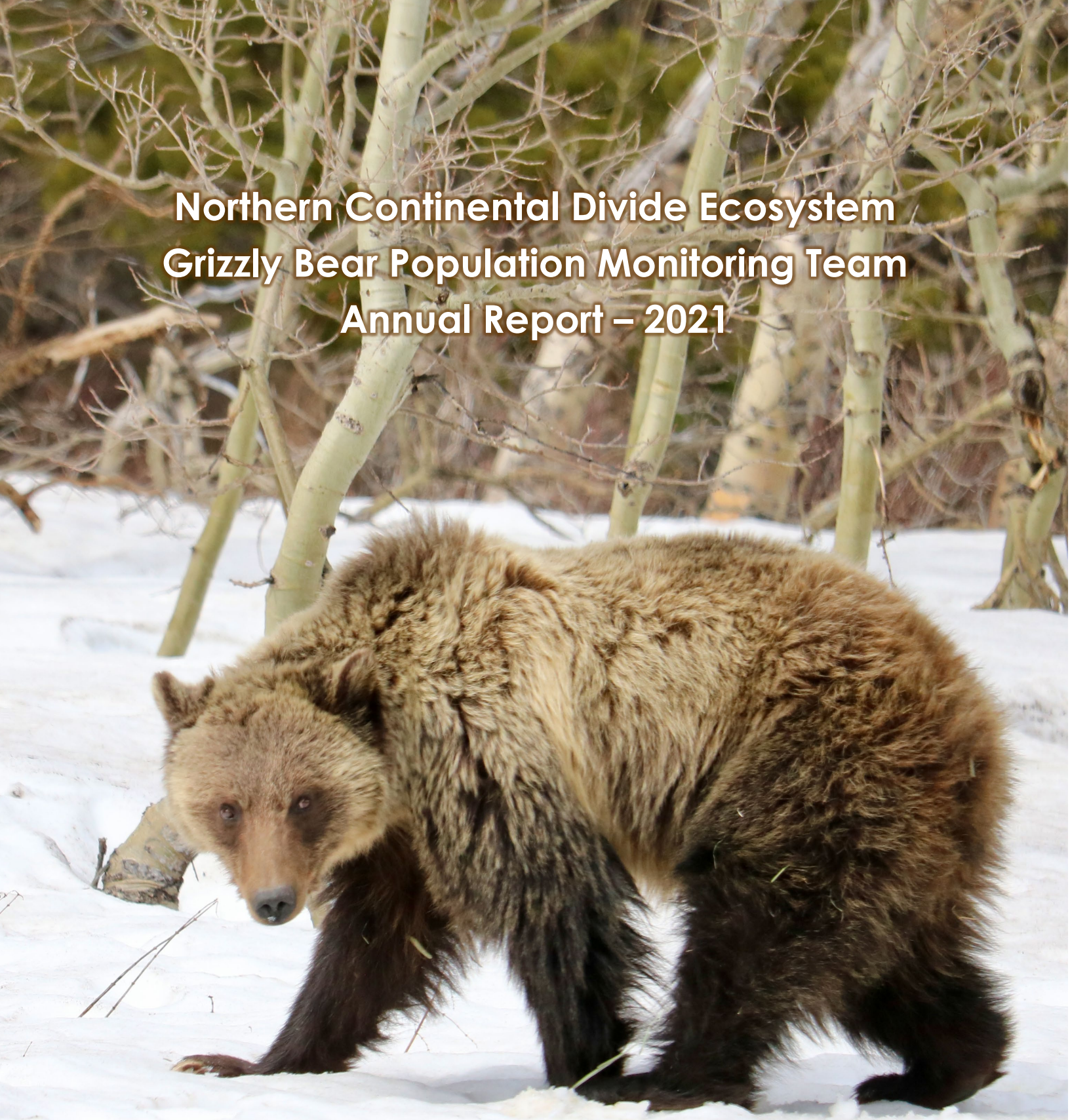
Northern Continental Divide Ecosystem Grizzly Bear Population Monitoring Team Annual Report – 2021



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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.

Suggested Citation:
Costello, C.M., and L.L. Roberts. 2022. Northern Continental Divide Ecosystem Grizzly Bear Monitoring Team Annual Report, 2021. Montana Fish, Wildlife & Parks, 490 N. Meridian Road, Kalispell, MT 59901.

This Annual Report is available on the web at:
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ABSTRACT

This report summarizes 2021 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 2021, we captured 16 grizzly bears (4F, 11M, 1U) for trend monitoring within the Demographic Monitoring Area (DMA) and 59 bears (32F, 24M, 3U) for management or other purposes inside and outside of the DMA. Including bears captured in previous years, we radio-monitored 27 bears (22F, 5 M) and documented 3 deaths (2F, 1M) for trend. For other purposes, we radio-monitored 44 bears (31F, 13M) and documented 4 deaths (1F, 3M). We recorded reproductive status of 30 females ≥4 years old, including 7 with cubs, 4 with yearlings, 4 with 2-year-olds, and 15 with no offspring. We documented 2 presumed mortalities among 3 cub litters (5 total cubs) and 3 presumed mortalities among 2 yearling litters (4 total yearlings). Including unmarked bears, we documented 55 known or probable mortalities of grizzly bears within the NCDE population. We evaluated demographic objectives set forth in the 2019 Conservation Strategy. During the 6-year period of 2016–2021, 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 2016–2021, we estimated an annual survival rate of 0.93 (± 0.01 SE) for independent females, meeting the minimum threshold rate of 0.93. Within the DMA, we estimated 24 total reported and unreported (TRU) mortalities for independent females and 27 TRU mortalities for independent males. During 2016–2021, average TRU mortalities were 15 and 23, below the maximum thresholds of 25 and 30, for independent females and males respectively. Recent genetic analyses provided evidence of movement by one male from the Cabinet Yaak Ecosystem to the NCDE and movements by 3 males from the NCDE toward the Bitterroot Ecosystem. To date, no movements have been detected between the NCDE and the Greater Yellowstone Ecosystem, and no interbreeding of bears from different ecosystems has been observed. Management specialists in the NCDE took >58 actions to prevent human-grizzly bear conflicts; responded to >272 incidents of conflict; and took 52 actions involving captured bears.

CONTENTS

ABSTRACT ii

INTRODUCTION 1

Fig. 1. Zones of the NCDE. 2

SUMMARY OF ANNUAL TREND MONIORING FIELD ACTIVITIES 2

Methods 2

Results 3

Table 1. Number of individual grizzly bears captured and fitted with radio-transmitters in the NCDE, 2021. 4

Fig. 2. Location of captures and mortalities of grizzly bears in the NCDE, 2021. 4

Table 2. Number of known or probable mortalities of grizzly bears in the NCDE, 2021. 5

Fig. 3. Locations of opportunistic samples from grizzly bears successfully genotyped in the NCDE, 2020. 6

Table 3. Annual numbers of grizzly bears genotyped from opportunistic DNA samples collected in the NCDE, 2011–2020 6

Fig. 4. Locations and results of remote cameras deployed to detect presence of grizzly bears in the central Wilderness areas of the NCDE, 2018–2021. 7

Table 4. Summary of effort and results of remote-camera sampling of grizzly bears within two wilderness Bear Management Units of the NCDE, 2018–2021. 8

EVALUATION OF CONSERVATION STRATEGY OBJECTIVES AND THRESHOLDS 8

Methods 9

Table 5. Projected annual population size of grizzly bears in the NCDE for the management period 2019–2023 10

Results 10

Fig. 5. Documented occupancy of female grizzly bears with offspring within 23 BMUs of the PCA and 7 OUs of Zone 1, 2021. 11

Table 6. Summary of independent grizzly bear mortalities within the DMA, NCDE, 2021. 11

Fig. 6. Locations of genotyped male bears monitored or detected outside of NCDE zones during 2020 and 2021, relative to color-coded annual home range centers for their mothers (triangles) and fathers (squares) 14

Fig. 7. Paths and apparent attempted crossings of the Interstate 90 transportation corridor by Bear 11072874 during fall 2020 and spring 2021. 14

SUMMARY OF HUMAN-GRIZZLY BEAR CONFLICT PREVENTION AND RESPONSE 14

Methods 14

Results 15

Table 7. Summary of preventative management actions to reduce grizzly-bear human conflict in the NCDE, 2021. 15

Table 8. Summary of human-grizzly bear conflicts in the NCDE, 2021. 16

Table 9. Summary of management-related captures of grizzly bears, NCDE and surroundings, 2021. 17

Fig. 8. General distribution of human-grizzly bear conflicts in the NCDE and surroundings, 2021. 17

SUMMARY OF OTHER RESEARCH AND MONITORING 17

ACKNOWLEDGEMENTS 18

LITERATURE CITED 18

APPENDICES 21

Appendix A. Fates of radio-monitored grizzly bears captured for trend monitoring within the DMA or other purposes inside and outside of the DMA, NCDE, 2021. 21

Appendix B. Observed reproductive status and offspring mortality for adult (≥4 years old) female grizzly bears radio-monitored in the NCDE, 2021. 23

Appendix C. Known and probable grizzly bear mortalities in the NCDE, 2021. 24

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, 2015–2020. 26

Appendix E. Thresholds and observed estimates for demographic objectives described in the 2019 Conservation Strategy, 2016–2021. 27

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).

Fig. 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 MONIORING 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 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 DMA. We attempted 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 (Kendall et al. 2009, Kendall et al. 2019). Grizzly bears were also captured and radio-marked for management and other purposes.

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 carcass or parts 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.

Between 2018 and 2021, we deployed motion-activated remote cameras in the Bob Marshall Wilderness pointed toward rub trees where females had been detected during the USGS DNA rub tree studies in 2004 or 2009–2012 (Kendall et al. 2009, Kendall et al. 2019). The cameras were deployed in the Continental Divide, Big Salmon, and Upper South Fork Flathead Bear Management Units (BMUs). When possible, we left cameras out over the winter to maximize fall and spring sampling.

Results

In 2021, we captured 75 individuals during 81 capture occasions (6 recaptures; Fig. 2). We captured 16 individuals for trend monitoring purposes within the DMA (Table 1), including 4 females, 11 males, and 1 unknown-sex yearling (released without handling). One male had been captured for management earlier in the year. Four females and 4 males were fitted with radio-transmitters, including the previously captured individual. In addition to trend captures, 55 bears were captured in association with management actions, although some were non-target individuals or were captured preemptively. These captures included 28 females, 24 males, and 3 unknown-sex cubs. Of these, 16 females and 9 males

were fitted with radio-transmitters. Four females were captured for research outside of the DMA and 3 were radio-marked.

Including bears collared during previous years, we radio-monitored 24 independent bears during all or part of 2021 for trend monitoring within the DMA: 21 females and 3 males. Among this trend sample, we documented the deaths of 3 radio-marked bears: a death from a natural cause (1F), a management removal due to injury (1F), and a poaching/malicious kill (1M). For management or other purposes, we monitored 45 bears: 29 independent females, 2 dependent females, 12 independent males, and 2 dependent males. The dependent bears were yearlings but separated from their mothers. Among this other sample, we documented the deaths of 4 radio-marked bears: a management removal (1M), an illegal defense of property kill (1M), and poaching/malicious kills (1F:1M). A summary of the fates of radio-marked bears during 2021 are presented in Appendix A.

Table 1. Number of individual grizzly bears captured and fitted with radio-transmitters in the NCDE, 2021.

	Captured				Radio-marked		
Type[1]	Female	Male	Unknown	Total	Female	Male	Total
Trend research in DMA	4	11	1	16	4	4	8
Management[2]	28	24	3	55	16	9	25
Research outside of DMA	4	0	0	4	3	0	3
Total	36	35	4	75	23	13	36

[1] Bears with multiple captures within the year were placed in only one category: research if it occurred anytime, otherwise first capture type. 2 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.

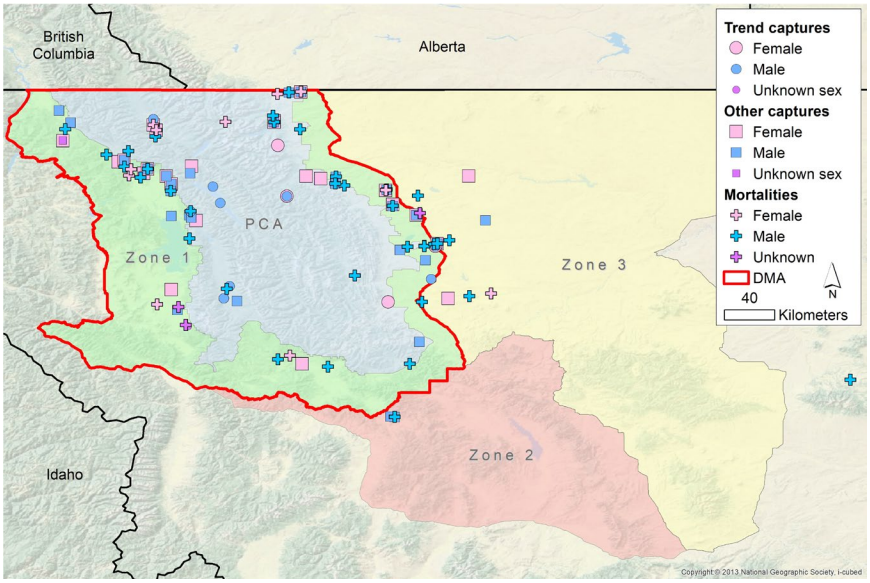

Fig. 2. Location of captures and mortalities of grizzly bears in the NCDE, 2021. Zones as described in Fig. 1.

We recorded the reproductive status of 30 females ≥4 years old during 2021, including 7 with cubs, 4 with yearlings, 4 with 2-year-old offspring, and 15 with no offspring. First observations for reproductive status ranged from 16 April (ground observation) to 15 October (new capture) and averaged 29 June. We documented 2 litters with 1 cub, 4 litters with 2 cubs, and 1 litter with 3 cubs. First observations for these litters ranged from 10 May (ground observation) to 3 Sep (new capture). Mean date of first verified litter size was 11 July. We were able to monitor survival of 3 cub litters (5 cubs) and 2 yearling litters (4 yearlings) through repeated observations during the year. We documented 2 presumed cub mortalities and presumed 3 yearling mortalities. A summary of the reproductive observations of radio-marked females are presented in Appendix B.

Fifty-five known or probable grizzly bear mortalities were documented in the NCDE during 2021 (Fig. 2; Table 2). Forty-four occurred within the DMA: 21 inside the PCA and 21 within Zone 1. Eleven mortalities occurred outside the DMA: 10 in Zone 3 and 1 outside of the zones currently recognized in the Conservation Strategy. Among 41 mortalities of independent bears, causes of death were: agency removal due to conflict (15); automobile collision (10); poaching/malicious kill (4); defense of life (3); illegal defense of property (2); accidental poisoning (1); agency removal due to injury (1); capture-related mortality (1); natural (1); and unknown or under investigation (3). Fourteen 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 (4); automobile collision (4); assumed dead due to orphaning (3); natural (2); and poaching/malicious kill (1). A summary of all documented mortalities in the NCDE during 2021 is reported in Appendix C.

Table 2. Number of known or probable mortalities of grizzly bears in the NCDE, 2021.

		Sex			
	Ageclass	Female	Male	Unknown	Total
Inside DMA	Dependent	6	4	1	11
	Independent	10	22	1	33
	Total	16	26	2	44
Outside DMA	Dependent	0	2	1	3
	Independent	2	6	0	8
	Total	2	8	1	11

During 2020, we collected 87 opportunistic samples. Among them, 44 (51%) 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 34 individuals were detected among these samples (Table 3). Number of total detections per individual ranged from 1–4 with an average of 1.3. Thirty-five percent of individuals had not been previously captured and were identified as new individuals.

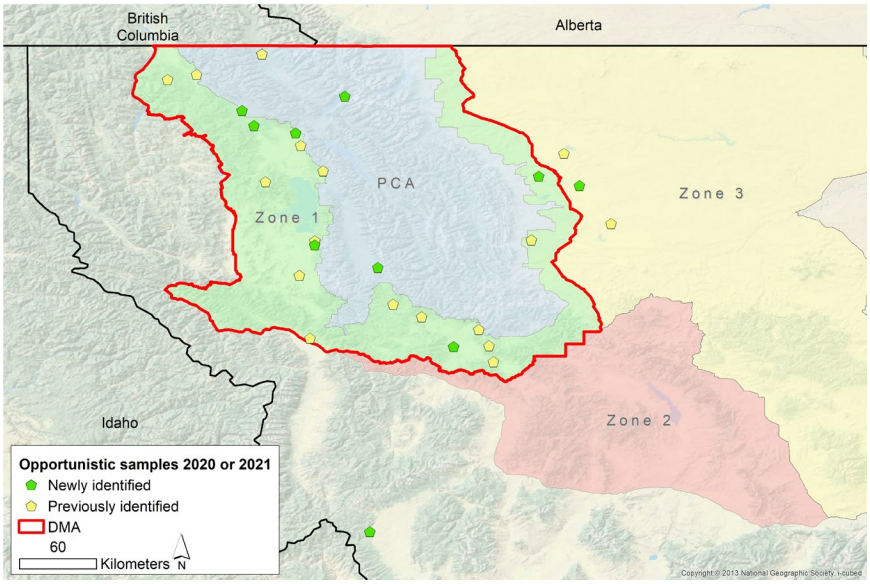

Fig. 3. Locations of opportunistic samples from grizzly bears successfully genotyped in the NCDE, 2020. Zones as described in Fig. 1.

Table 3. Annual numbers of grizzly bears genotyped from opportunistic DNA samples collected in the NCDE, 2011–2020, and percent newly versus previously identified.

	Year									
Individuals	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total genotyped	18	23	23	18	15	33	29	27	35	34
Newly identified	33%	43%	35%	28%	40%	48%	41%	52%	43%	35%
Previously identified	67%	57%	65%	72%	60%	52%	59%	48%	57%	65%

During 2018–2021, we deployed a total of 30 remote cameras within the Continental Divide, Big Salmon, and Upper Southfork Flathead BMUs pointing toward rub trees, primarily to evaluate if we could observe females with offspring within these wilderness BMUs (Fig. 4). The Continental Divide BMU was especially targeted because it is one of the most remote BMUs with the most infrequent sightings of reproductive females. All 4 cameras deployed in the Upper South Fork Flathead BMU were stolen, therefore no data were obtained.

In total, the remaining 26 cameras were functional during 4,878 active season days (i.e., excluding December 1st – March 31st) and we detected 56 grizzly bears at 16 sites (Table 4). On average, we detected a grizzly bear once per 87 camera-days, however no females with offspring were among the grizzly bears observed. The earliest detection of a grizzly bear was on the 31 Mar and the latest detection was 31 Oct. Detection rates were highest in May, June, and September. We also detected an array of other animals including mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus* virginianus), elk (*Cervus canadensis*), moose (*Alces alces*), black bear (*Ursus americanus*), wolf (*Canis lupus*), mountain lion (*Puma concolor*), red fox (*Vulpes vulpes*), wolverine (*Gulo gulo*), lynx (*Lynx canadensis*), bobcat (*Lynx rufus*), spruce grouse (*Falcipennis canadensis*), and snowshoe hare (*Lepus americanus)*.

We also opportunistically collected 16 hair samples from rub trees. Two samples were geotyped as grizzly bears, 2 were genotyped as black bears, and 9 samples were unsuccessful. Both grizzly bears were previously detected individuals. One genotyped grizzly bear had been previously sampled by the USGS in the 2004 and 2009-2012 DNA projects Kendal et al. 2009, Kendal et al. 2019) and the other individual had been previously captured in 2008 and 2011 on the Rocky Mountain Front.

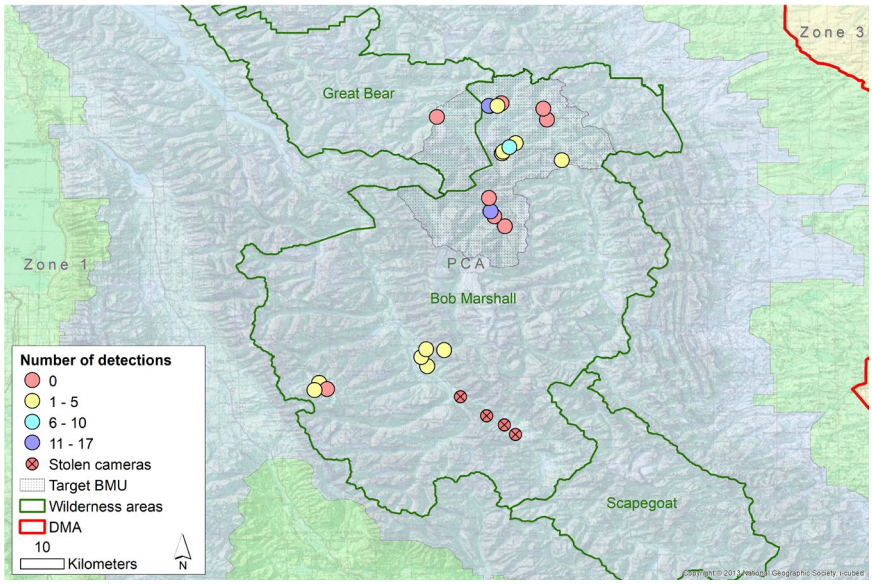

Fig. 4. Locations and results of remote cameras deployed to detect presence of grizzly bears in the central Wilderness areas of the NCDE, 2018–2021. The Continental Divide Bear Management Unit (shown stippled) was targeted for detecting the occupancy of females with offspring. Zones as described in Fig. 1.

Table 4. Summary of effort and results of remote-camera sampling of grizzly bears within two wilderness Bear Management Units of the NCDE, 2018–2021.

	Continental Divide BMU			Big Salmon BMU			Combined		
Period	No. days	No. bears	Days/ bear	No. days	No. bears	Days/ bear	No. days	No. bears	Days/ bear
April	270	3	90.0	210	0		480	3	160.0
May	279	14	19.9	217	0		496	14	35.4
June	279	9	31.0	210	0		489	9	54.3
July	374	2	187.0	348	0		722	2	361.0
August	637	3	212.3	434	7	62.0	1071	10	107.1
September	427	11	38.8	217	2	108.5	644	13	49.5
October	279	5	55.8	217	0		496	5	99.2
November	270	0		210	0		480	0	
Combined	2815	47	59.9	2063	9	229.2	4878	56	87.1

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 ≥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 ≥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 ≤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 ≥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 ≤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. 5). 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 5), 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 2021 was 0.93, the maximum threshold for the number of independent female mortalities in 2021 was 24, and the maximum threshold for the number of independent male mortalities in 2021 was 29 (NCDE Subcommittee 2019).

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.

Table 5. Projected annual population size of grizzly bears in the NCDE for the management period 2019–2023 assuming previously observed vital rates (Costello et al. 2016).

	Year				
Estimate	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

Results

During 2021, we verified presence of reproductive females within 17 of 23 BMUs (73%) and within 6 of 7 OUs (86%; Fig. 5). For the 6-year period 2016–2021, all 23 BMUS were occupied by females with offspring, thus 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.

For the 6-year period 2016–2021, we estimated an annual survival rate of 0.93 (± 0.01 SE) for independent females within the DMA, which meets the minimum threshold rate of 0.93 (NCDE Subcommittee 2019).

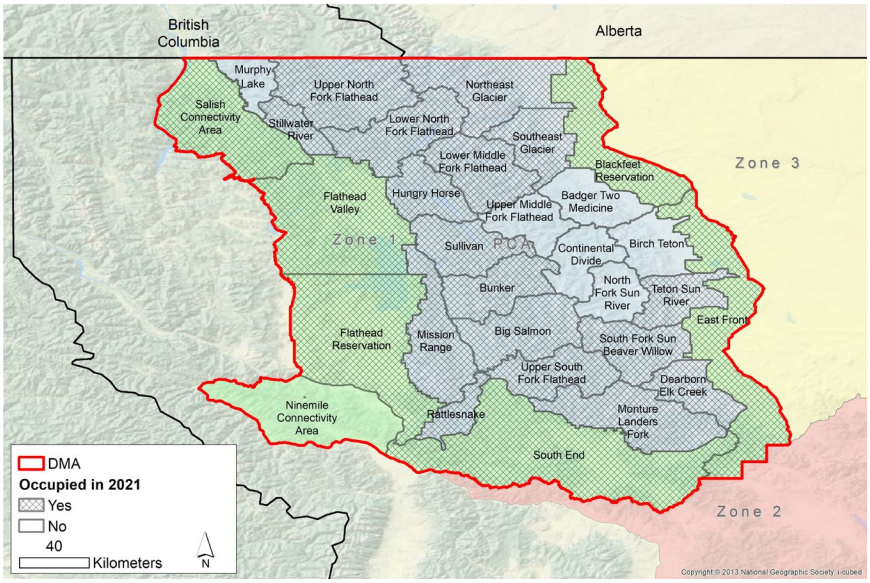

Fig. 5. Documented occupancy of female grizzly bears with offspring within 23 BMUs of the PCA and 7 OUs of Zone 1, 2021. Occupancy was documented in all units during the last 6 years. Zones as described in Fig. 1.

Within the DMA, there were 11 and 22 known mortalities reported for independent females and independent males during 2021, 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 24 TRU mortalities of independent females and 27 TRU mortalities of independent males within the DMA (Table 6). During 2016–2021, the average annual number of TRU mortalities for independent females within the DMA was 15, which falls below the maximum threshold of 25 (NCDE Subcommittee 2019). The average annual number for independent males was 23, falling below the maximum threshold of 30 (NCDE Subcommittee 2019). A summary of all demographic objectives for 2016–2021 are reported in Appendix E.

Table 6. Summary of independent grizzly bear mortalities within the DMA, NCDE, 2021.

	Documented mortalities by method of discovery				Estimated reported and unreported[e]	Estimated total mortality
Sex	Agency removal[a] (A)	Telemetry[b] (B)	Reported[c] (high)	Reported[d] (low)	(C)	(A + B + C)
Female	5	2	1	3	17	24
Male	8	2	11	1	17	27
Total	13	4	12	4	34	51

[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).

We completed genetic analysis of NCDE samples collected through 2020 (genotypes from 2021 NCDE samples are not yet available) and principal components analysis was conducted on 16-loci genotypes obtained from bears captured in the NCDE and the GYE. The discreetness of the clusters indicated that no individuals originated from the population other than where they were captured. Thus, to date, we have not detected evidence of immigration into the NCDE from the GYE or emigration from the NCDE into the GYE.

We examined genotype, capture, and monitoring data in the NCDE and other ecosystems to document movements among ecosystems. Among bears captured in the NCDE during 2020 and genotyped in 2021, one was identified as an immigrant from the Cabinet Mountains, based on pedigree analyses (Justin Tiesberg, USFWS, personal communication). NCDE Bear 842012037, captured at age 3 in the Stillwater watershed of the NCDE in 2020, was identified as an offspring of CYE Bear C20072F. No emigration or temporary movements by bears from the NCDE to the CYE were documented via monitoring in 2021 or from genetic analyses of samples collected in 2020. Although we have observed movements of bears between these ecosystems, we have not found evidence of interbreeding between residents and natural immigrants (i.e., "hybrid" offspring) in NCDE or CYE to date.

Analyses of DNA data from 2020 and 2021 provided evidence of three males that originated from the NCDE population and moved outside of the NCDE Conservation Strategy Zones in the direction of the Bitterroot Ecosystem, likely due to natal dispersal (Fig. 6).

A grizzly bear was detected via a remote camera in the Big Hole Valley in Apr 2020 and a hair sample was collected at the site. DNA analysis indicated this bear was a male and that it originated from the NCDE population. Using genetic analyses, we identified a probable father among our NCDE samples, but no probable mother was identified. His probable father (Bear 51272543) was captured and monitored between 2007 and 2011 and resided in the southern Lewis and Clark range in the Sun, Upper Missouri, and Dearborn watersheds. His probable father is not known to have died. The distance between this outlier detection and the home range center of his probable father was approximately 215 km.

Bear 11072874 was captured south of Interstate I-90 on the northern edge of the Flint Creek Range in Oct 2020, due to a conflict situation. This male was fitted with an Iridium collar and GPS locations were obtained between Oct 2020 and Aug 2021. The collar was shed in Sep 2021. Following capture, the bear was relocated within the southern boundary of the NCDE Recovery Zone, but eventually he moved back to the area of his original capture, where his locations suggested he had established a home range. His estimated birth year was 2016 and genetic analyses identified his probable mother and father among the NCDE genotypes. His probable mother (Bear 93586336) was captured and monitored during 2008 to

2009; his probable father (Bear 38100618) was captured in 2003; and both parents were residents of the Mission Mountains within the NCDE Recovery Zone. Neither probable parent is known to have died. By measuring the distance between the estimated home range center of his mother (i.e., his natal range) and that of his current range, we estimated a dispersal distance of about 128 km. Besides providing this information about natal dispersal outside of the NCDE, the movements of this bear also represented an interesting case study for the barrier effect of a transportation corridor. Following relocation, Bear 11072874 spent a few weeks moving around the Nevada Range and Blackfoot Valley. He then moved to an area in the southern Garnet Range, where it appears he made numerous attempts to cross back over the I-90 corridor, which also includes a railway. He was unsuccessful and in early December he headed north to the Mission range, where he denned for the winter. Upon den emergence, he moved through the northern Garnet Range and then made it back to the southern Garnet Range, where he again appeared to make numerous attempts to cross I-90. We classified locations within 500 m of I-90 as apparent attempts to cross I-90 (Fig. 7). Summarizing these locations, we estimated that Bear 11072874 made at least 29 attempts to cross I-90 over 29 days in fall 2020 and 17 attempts to cross over 24 days during spring 2021. He made it across the highway in early May 2021, probably by traveling under a pair of highway and railroad bridges over the Clarks Fork River. After this date, he was not located within 500 m of the highway again. These results suggested that the I-90 transportation corridor acted as a partial barrier to movement by this grizzly bear. After the crossing, he traveled back to the Flint Creek Range, where he spent most of the spring, summer, and fall. The only exception was a movement he made down through the Anaconda Range near Sula, where he was photographed with another grizzly bear as part of the USFWS camera survey (see below).

In Jun 2021, Bear 11072874 and another non-collared bear were detected together via remote camera in the Anaconda Range during the Southwest Montana DNA Project conducted by the USFWS. A hair sample collected at this site for the uncollared bear was successfully genotyped and results indicated it was a male and it originated from the NCDE population. Preliminary parentage analysis was conducted, but additional loci will be needed to verify the results. The possible father of this bear was captured and monitored in 2010 and the possible mother was detected as part of the USGS DNA Projects in the NCDE during 2010 to 2012 (Kendall et al. 2019). Both parents resided in the southern Lewis and Clark Range in the Blackfoot watershed. Neither parent is known to have died. Distance between this detection location and center of the mother's detection locations was about 140 km.

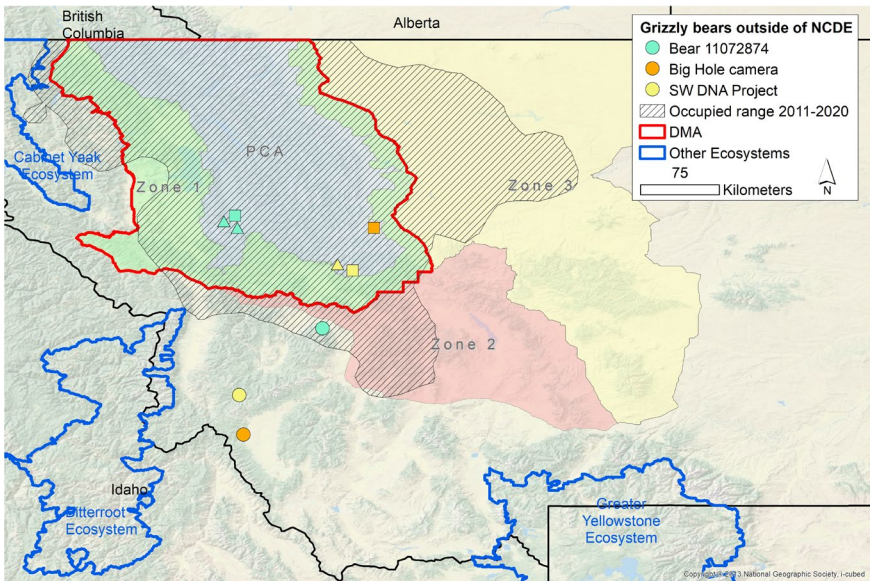

Fig. 6. Locations of genotyped male bears monitored or detected outside of NCDE zones during 2020 and 2021, relative to color-coded annual home range centers for their mothers (triangles) and fathers (squares) as estimated from genetic analyses. Centers for parents were determined during earlier years (2003–2012) from capture and monitoring or from non-invasive DNA sampling. To date, none of the parents were known to have died. Zones as described in Fig. 1.

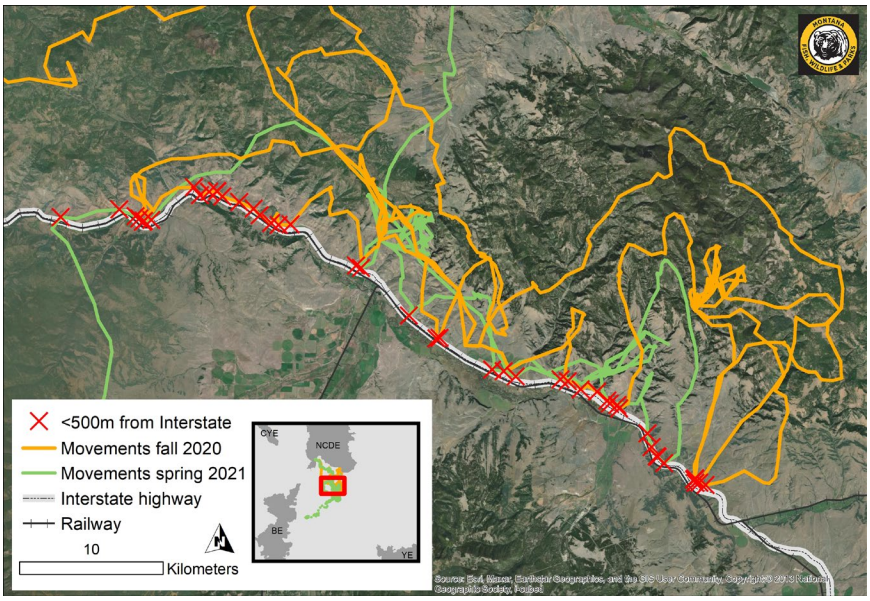

Fig. 7. Paths and apparent attempted crossings of the Interstate 90 transportation corridor by Bear 11072874 during fall 2020 and spring 2021.

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

We continued use of the ecosystem-wide management database during 2021, where we recorded grizzly bear conflicts, preventative actions taken, opportunistic samples collected, and bear observations. At present, reported data for the Blackfeet Reservation only include incidents where a bear was captured, due to corruption of electronic files when a computer failed. Combined records indicated that agency management specialists took >62 preventative actions to reduce grizzly bear-human conflict (Table 7). About 57% of actions were directly in response to the presence of grizzly bears near people or developments, while 43% were proactive actions.

Table 7. Summary of preventative management actions to reduce grizzly-bear human conflict in the NCDE, 2021.

Category	Detail	FWP R1	FWP R2	FWP R4	BNFW[1]	CSKT	Total
Attractant management	No history of conflict	9	3	1			13
	Previous conflict		11			1	12
Bear near people	Natural	10	6	4		2	22
	Human attractants	6	2	2		1	11
Total		25	22	7		4	58

[1] Data are incomplete at present; only data associated with captures are included.

Agency management specialists responded to >272 incidents of human-grizzly bear conflict (Table 8). About one third of incidents involved bears accessing unnatural foods, especially garbage or feed. Another fifth involved bears damaging property, primarily while attempting to access unnatural foods or residential chicken coops. Another third involved grizzly bear depredation, mostly of cattle or chickens. Conflicts related to grizzly bear interactions with humans or agriculture accounted for 10% conflicts. The most severe human interaction conflict during 2021 involved a human fatality (see Board of Review Report; Fortin-Noreus et al. 2022).

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 52 actions involving captured bears including: preemptively capturing 5 individuals to prevent conflict; releasing or translocating 6 non-target bears captured at conflict sites but likely not involved in conflict; translocating 24 bears involved in conflicts; and removing 17 bears involved in conflict (Table 9).

Table 8. Summary of human-grizzly bear conflicts in the NCDE, 2021. 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.

Category	Detail	FWP R1	FWP R2	FWP R4	BNFW[1]	CSKT	Other	Total
Unnatural foods	Garbage	38	5	3				46
	Pet/livestock feed	8	9	4		1		22
	Harvested grain	1	1	5				7
	Human foods	9	2			1		12
	Other	4	3	1				8
	Subtotal	60	20	13	0	2		95
Depredation	Chickens/poultry	35		1				36
	Cattle	2	11	23	6	1	1	44
	Goats	2				1		3
	Pigs	6						6
	Sheep			7				7
	Other	1	1			1		3
	Subtotal	46	12	31	6	3	1	99
Property damage	Building	10	14	3	1			28
	Vehicle	3	2					5
	Camp	1	3					4
	Other	5	6	4				15
	Subtotal	19	25	7	1	0		52
Human interaction	Aggressive encounter	3	6	4				13
	Fatality		1					1
	Habituation	2		1	1			4
	Subtotal	5	7	5	1	0		18
Agricultural damage	Orchard	4						4
	Beehives	1	1	1				3
	Crop					1		1
	Subtotal	5	1	1	0	1		8
Total		135	65	57	8	6	1	272

[1] Data are incomplete; only data associated with captures are included.

Numbers of conflict incidents were, by far, highest within FWP Region 1 (Table 8, Fig. 8). Numbers of conflicts were relatively low on the Flathead Reservation. Few incidents occurred in the PCA and the highest numbers of events occurred in Zone 1, especially on the west side of the Continental Divide.

Conflict incidents also occurred outside of recognized NCDE Zones in the Anaconda, Flint Creek, Boulder, and Snowy Mountain Ranges to the south and east.

Table 9. Summary of management-related captures of grizzly bears, NCDE and surroundings, 2021. Numbers in parentheses refer to dependent offspring with their mothers.

Event	Category	Preemptive capture	Non-target individual	Target individual translocated	Target individual removed
Preventative	Bear near people	5			
Conflict	Unnatural foods			14	
	Depredation		5	5 (3)	10
	Property damage		1	1	1 (3)
	Human interaction			1	3
	Total	5	6	21 (3)	14 (3)

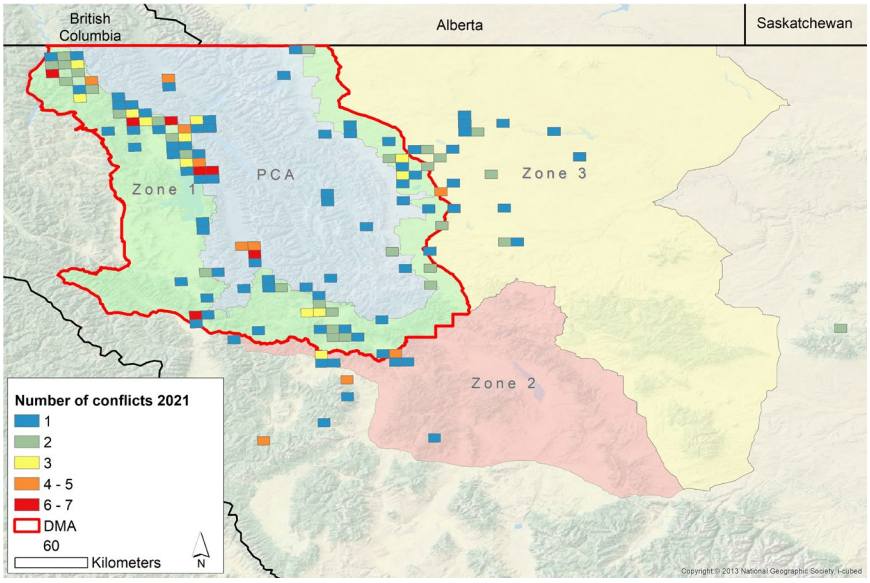

Fig. 8. General distribution of human-grizzly bear conflicts in the NCDE and surroundings, 2021. Colors correspond to counts of conflicts recorded within 7 km × 7km grid cells. Data are not entirely complete, because some records lacked spatial information and some electronic records from the Blackfeet Reservation were lost due to a computer malfunction. Zones as described in Fig. 1.

SUMMARY OF OTHER RESEARCH AND MONITORING

During 2021, members of the NCDE trend monitoring program were also involved in other research projects involving grizzly bear in the NCDE, Montana, and elsewhere.

Along with members of the Interagency Grizzly Bear Study Team, we continued our collaboration with Paul Lukacs and Josh Nowak (University of Montana) to develop an integrated population model for the GYE and NCDE populations. A working model has been developed for the GYE population, but refinements are continuing. As the NCDE does not have annual count data (such as the counts of females with cubs in the GYE), we continued testing inputs for the NCDE model.

We continued collaborating with Holly Nesbitt, Alex Metcalf, and Elizabeth Metcalf (University of Montana) to develop of manuscript from our statewide survey of Montanan's views on grizzly bears and their management. We anticipate submitting and publishing a journal article in 2022.

With collaborators from the CYE, the GYE, and Gates of the Arctic National Park and Preserve (AK), we continued analyses of female grizzly bear activity data obtained from GPS collars to test if parturition events are detectable during the denning season. We anticipate completion of a manuscript in 2022.

Collaborating with Mark Haroldson (USGS IGBST) and Jennifer Fortin-Noreus (USFWS), we continued collecting, verifying, and compiling records of outlier grizzly bear observations.

We began a collaboration with Dr. Sarah Sells (University of Montana) to use NCDE GPS data to develop models for predicting connectivity corridors among Recovery Zones and for predicting range expansion. We anticipate several manuscripts will be completed and submitted to journals in 2022.

We captured and GPS-collared several grizzly bears in FWP Region 4 to investigation grizzly bear use of grain bins. Monitoring and additional captures will continue in 2022.

For a collaborative study with Dr. Julie Young (Utah State University), we captured and GPS-collared several grizzly bears in FWP Region 4 to investigate if guard dogs are an effective deterrent for farmsteads with abundant grain spills. Monitoring and additional captures will continue in 2022.

We began a collaboration with Dr. Michael Proctor (Birchdale Ecological) to analyze responses and outcomes associated with residential human-grizzly bear conflicts in the NCDE and nearby populations in British Columbia.

ACKNOWLEDGEMENTS

We would like to thank the following people for their contributions to 2021 field activities: Kyle Yorke, Justine Vallieres, Jessy Coltrane, Kim Annis, Rory Trimbo, Eli Hampson, Eric Graham, Daniel McHugh, Jack Austin, Payton Adams, Susan Clothier, Steve Cross, Kraig Glazer, Rob Cherot, Ken Justus, Joe Rahn, , Nate Muhn, Bruce Montgomery, Nathan Reiner, Rob Davies, Mark Ruby, Scott Snelson, Michael Muñoz, Chris Martin, Jim Dahlstrom, Kristine Simpson, Jennifer Fortin-Noreus, Hilary Cooley, Two Bear Air, Jim Pierce, Red Eagle Aviation.

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APPENDICES

Appendix A. Fates of radio-monitored grizzly bears captured for trend monitoring within the DMA or other purposes inside and outside of the DMA, NCDE, 2021.

Sex	Purpose	DMA Subunit	Bear ID	Fate	Independent[1]
F	Trend	East Front	39036349	Alive	Y
F	Trend	East Front	41628288	Censored	Y
F	Trend	East Front	601608034	Alive	Y
F	Trend	Flathead Reservation	79558279	Alive	Y
F	Trend	Glacier National Park	10876305	Dead	Y
F	Trend	Glacier National Park	79597603	Alive	Y
F	Trend	Glacier National Park	601610593	Alive	Y
F	Trend	Glacier National Park	839830808	Censored	Y
F	Trend	Glacier National Park	842014813	Alive	Y
F	Trend	Glacier National Park	842017525	Dead	Y
F	Trend	Glacier National Park	842018043	Alive	Y
F	Trend	MF Flathead	41580379	Alive	Y
F	Trend	Multiple subunits	841778369	Alive	Y
F	Trend	NF Flathead	11052544	Alive	Y
F	Trend	NF Flathead	79570382	Alive	Y
F	Trend	NF Flathead	842020329	Censored	Y
F	Trend	SF Flathead-Swan	11060268	Censored	Y
F	Trend	SF Flathead-Swan	55598849	Censored	Y
F	Trend	SF Flathead-Swan	839826876	Censored	Y
F	Trend	SF Flathead-Swan	839839014	Alive	Y
F	Trend	SF Flathead-Swan	842016524	Censored	Y
F	Trend	South End	11018035	Alive	Y
F	Other	Blackfeet Reservation	79560108	Alive	Y
F	Other	Blackfeet Reservation	601602122	Alive	Y
F	Other	Blackfeet Reservation	604381104	Unknown	Y
F	Other	Blackfeet Reservation	604514826	Alive	Y
F	Other	Blackfeet Reservation	604516820	Alive	N
F	Other	Blackfeet Reservation	604521783	Alive	Y
F	Other	Blackfeet Reservation	604524782	Alive	Y
F	Other	Blackfeet Reservation	841793853	Censored	Y
F	Other	East Front	11044088	Censored	Y
F	Other	East Front	842016512	Censored	Y
F	Other	East Front	842029091	Censored	Y
F	Other	Glacier National Park	841802517	Unknown	Y
F	Other	Multiple subunits	93619344	Censored	Y
F	Other	Multiple subunits	604379286	Censored	Y
F	Other	Multiple subunits	605575337	Alive	Y
F	Other	Multiple subunits	842004858	Censored	Y
F	Other	NF Flathead	605563809	Alive	Y
F	Other	NF Flathead	842012050	Dead	Y
F	Other	NF Flathead	842014086	Censored	Y
F	Other	NF Flathead	842015615	Alive	Y
F	Other	NF Flathead	842027068	Alive	Y
F	Other	Outside DMA	601596579	Alive	Y
F	Other	Outside DMA	842006863	Alive	Y

Sex	Purpose	DMA Subunit	Bear ID	Fate	Independent[1]
F	Other	Outside DMA	842029879	Censored	Y
F	Other	Salish-Island Unit	95636784	Alive	Y
F	Other	SF Flathead-Swan	41379363	Censored	Y
F	Other	SF Flathead-Swan	605562550	Alive	Y
F	Other	SF Flathead-Swan	605566022	Alive	Y
F	Other	SF Flathead-Swan	841893590	Censored	N
F	Other	SF Flathead-Swan	842017311	Censored	Y
F	Other	SF Flathead-Swan	842032271	Alive	Y
F	Other	South End	10880078	Censored	Y
M	Trend	East Front	842001886	Alive	Y
M	Trend	East Front	842019074	Alive	Y
M	Trend	NF Flathead	842018075	Dead	Y
M	Trend	SF Flathead-Swan	601617019	Alive	Y
M	Trend	South End	41086114	Censored	Y
M	Other	Blackfeet Reservation	11035376	Dead	Y
M	Other	Blackfeet Reservation	841793853	Alive	Y
M	Other	East Front	601614092	Alive	Y
M	Other	Multiple subunits	10870331	Alive	Y
M	Other	Multiple subunits	11031532	Unknown	Y
M	Other	Multiple subunits	601614291	Dead	N
M	Other	Multiple subunits	842002302	Alive	N
M	Other	Multiple subunits	842012037	Censored	Y
M	Other	Multiple subunits	842030582	Dead	Y
M	Other	Outside DMA	11072874	Alive	Y
M	Other	SF Flathead-Swan	842002319	Alive	Y
M	Other	SF Flathead-Swan	842009086	Censored	Y

[1] Independent (≥2 years old), Y = Yes, N = No

Appendix B. Observed reproductive status and offspring mortality for adult (≥4 years old) female grizzly bears radio-monitored in the NCDE, 2021.

Sample	Bear ID	Status	Litter size	Offspring mortality	Multiple Observations[1]	Date first observed	Status previous year (if known)	Litter size previous year (if known)
Trend	842017525	Cub	2	0	Y	5/10/2021	None	
Trend	79570382	Cub	2	2	Y	5/12/2021	3-year-old	1
Trend	41379363	Cub	1	0	Y	5/18/2021	None	
Trend	842014813	Cub	1		N	9/2/2021		
Trend	79597603	Yearling	2	1	Y	4/20/2021	Cub	2
Trend	11060268	Yearling	1		N	5/12/2021	Cub	2
Trend	39036349	Yearling	2		N	6/13/2021		
Trend	11018035	2-year-old	2		N	5/5/2021	Yearling	2
Trend	601610593	2-year-old	2		N	5/12/2021	Yearling	2
Trend	55598849	None			N	4/20/2021	Yearling	1
Trend	839826876	None			Y	4/20/2021	None	
Trend	839839014	None			Y	4/20/2021	None	
Trend	41580379	None			N	6/25/2021		
Trend	79558279	None			Y	7/8/2021	2-year-old	3
Trend	841778369	None			N	7/21/2021	None	
Trend	839830808	None			N	7/27/2021	Yearling	2
Trend	842018043	None			N	7/27/2021	Yearling	2
Trend	11052544	None			N	7/27/2021	Cub	3
Trend	601608034	None			N	9/16/2021		
Other	11044088	Cub	2		N	7/20/2021	2-year-old	2
Other	842015615	Cub	2		N	9/3/2021		
Other	95636784	Cub	3		N	9/10/2021		
Other	604381104	Yearling	2	2	Y	4/18/2021	Cub	2
Other	842004858	2-year-old	2		N	4/16/2021	Yearling	2
Other	601602122	2-year-old	2	0	Y	10/8/2021		
Other	604514826	None			N	5/24/2021		
Other	842012050	None			Y	6/2/2021		
Other	842032271	None			Y	6/28/2021		
Other	604524782	None			N	6/29/2021	None	
Other	605563809	None			Y	10/15/2021	None	

[1] Y = Yes, N = No

Appendix C. Known and probable grizzly bear mortalities in the NCDE, 2021.

Date	Date accuracy	Certainty of death	DMA[1]	Sex[2]	Age Class[3]	Bear ID	Collared[1]	Cause
4/1/2021	Day	Known	Y	F	AD	10876305	Y	Natural
4/22/2021	Day	Known	Y	M	AD		N	Removal (depredation)
5/4/2021	2 weeks	Known	Y	M	YR		N	Natural
5/5/2021	Day	Known	Y	F	YR		N	Natural
5/8/2021	Day	Known	Y	F	AD		N	Automobile
5/12/2021	Day	Known	N	M	AD		N	Removal (depredation)
5/16/2021	Day	Known	N	M	CB		N	Automobile
5/18/2021	Day	Known	Y	M	SA	842018075	Y	Poached/malicious
5/23/2021	Day	Known	Y	M	AD	11035376	Y	Illegal DOP
5/24/2021	Day	Known	N	M	AD		N	Removal (depredation)
5/26/2021	Day	Known	Y	M	AD		N	Removal (depredation)
5/26/2021	Day	Known	Y	M	AD	839820364	N	Removal (depredation)
5/31/2021	Day	Known	Y	F	AD	11032039	N	Removal (depredation)
6/1/2021	Day	Known	Y	M	YR	842030352	N	Removal (depredation)
6/8/2021	Day	Known	N	M	AD		N	Automobile
6/9/2021	Day	Known	Y	F	SA		N	Capture-related
6/11/2021	Day	Known	N	M	SA		N	Automobile
6/22/2021	Day	Known	Y	M	AD	601624057	N	DOL
7/9/2021	Day	Known	N	F	AD		N	Automobile
7/9/2021	Day	Known	Y	M	AD		N	Removal (human fatality)
7/9/2021	Day	Probable	N	U	CB		N	Orphaned (automobile)
7/21/2021	Day	Known	Y	M	CB	841796009	N	Automobile
7/26/2021	Day	Known	Y	M	AD	39036887	N	Removal (depredation)
7/27/2021	Day	Known	Y	F	AD		N	Removal (depredation)
7/27/2021	Day	Known	Y	U	CB		N	Automobile
7/30/2021	Day	Known	Y	F	YR		N	Automobile
8/1/2021	Day	Known	Y	M	AD	11021630	N	Automobile
8/1/2021	Month	Known	Y	F	AD	55577095	N	Under investigation
8/1/2021	Season	Known	Y	U	SA		N	Undetermined
8/5/2021	Day	Known	N	M	AD		N	Removal (depredation)
8/22/2021	Day	Known	N	M	YR	601614291	Y	Poached/malicious
8/24/2021	Day	Known	Y	M	AD	842014875	N	Removal (depredation)
8/24/2021	Day	Known	Y	M	AD	79565520	N	Removal (depredation)
9/1/2021	Week	Known	N	F	AD		N	Undetermined
9/2/2021	Day	Known	Y	F	YR	842025639	N	Removal (site conflicts)
9/2/2021	Day	Known	Y	F	YR	841810257	N	Removal (site conflicts)
9/3/2021	Day	Known	Y	F	YR	842016097	N	Removal (site conflicts)
9/4/2021	Day	Known	Y	F	AD	67006850	N	Removal (site conflicts)
9/4/2021	Week	Known	Y	F	AD	55588533	N	Poached/malicious
9/6/2021	Day	Known	Y	M	AD	842010334	N	Poisoning
9/8/2021	Day	Known	Y	M	AD	51109069	N	Automobile
9/21/2021	day	Known	N	M	AD		N	Removal (depredation)

Date	Date accuracy	Certainty of death	DMA[1]	Sex[2]	Age Class[3]	Bear ID	Collared[1]	Cause
9/29/2021	Day	Known	Y	M	AD	605558326	N	DOL
9/30/2021	Day	Known	Y	F	AD	842017525	Y	Removal (injury)
9/30/2021	Day	Probable	Y	F	CB		N	Orphaned (removal)
9/30/2021	Day	Probable	Y	M	CB		N	Orphaned (removal)
10/7/2021	Day	Known	Y	M	AD		N	Automobile
10/14/2021	Day	Known	Y	M	SA	605570313	N	Automobile
10/17/2021	Day	Known	Y	M	AD	605562832	N	Illegal DOP
10/19/2021	Day	Known	Y	M	SA		N	Automobile
10/24/2021	Week	Known	Y	F	AD	842012050	Y	Under investigation
11/2/2021	Day	Known	Y	M	AD	842030582	Y	Removal (site conflicts)
11/10/2021	Day	Known	Y	M	SA		N	Automobile
11/14/2021	Week	Known	Y	M	AD		N	Poached/malicious
11/28/2021	Day	Known	Y	M	AD		N	DOL

[1] Y = Yes, N = No

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

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

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, 2015–2020. Units known occupied during a given year are signified by the symbol ×. Twenty-two of 23 BMUs and 7 of 7 OUs were occupied during a 6-year period ending with 2021.

Bear Management Unit (PCA)	2016	2017	2018	2019	2020	2021
Murphy Lake		×			×	
Upper North Fork Flathead	×	×		×	×	×
Northeast Glacier	×	×	×	×	×	×
Stillwater River			×	×	×	×
Lower North Fork Flathead	×	×	×	×	×	×
Hungry Horse	×	×	×	×	×	×
Lower Middle Fork Flathead	×	×	×	×	×	×
Southeast Glacier	×	×	×	×	×	×
Sullivan	×	×	×	×	×	×
Upper Middle Fork Flathead	×	×	×			
Badger Two Medicine	×	×	×	×	×	
Mission Range	×	×	×	×	×	×
Bunker	×	×	×	×	×	×
Continental Divide					×	
Birch Teton	×	×	×	×	×	
Big Salmon			×	×	×	×
North Fork Sun River		×	×	×	×	
Teton Sun River		×		×	×	×
Rattlesnake	×					×
Upper South Fork Flathead		×				×
South Fork Sun Beaver Willow		×	×	×	×	×
Monture Landers Fork	×	×		×	×	×
Dearborn Elk Creek		×		×	×	×
Occupied during year	14	19	15	18	20	17
Occupied during last 6 years	23	23	22	22	23	23
Occupancy Unit (Zone 1)						
Salish Connectivity Area	×	×	×	×	×	×
Flathead Valley	×	×	×	×	×	×
Flathead Reservation	×	×	×	×	×	×
Ninemile Connectivity Area			×	×	×	
South End	×	×	×	×	×	×
East Front	×	×	×	×	×	×
Blackfeet Reservation	×	×	×	×	×	×
Occupied during year	6	6	7	7	7	6
Occupied during last 6 years	7	7	7	7	7	7

Appendix E. Thresholds and observed estimates for demographic objectives described in the 2019 Conservation Strategy, 2016–2021. 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					
			2016	2017	2018	2019	2020	2020
Occupancy	PCA (BMUs)	Minimum	21	21	21	21	21	21
		Observed	23	23	22	22	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	0.93	0.93
		Observed	0.95	0.95	0.93	0.94	0.93	0.93
TRU mortalities	Female	Maximum	22	22	22	23	24	25
		Observed	16	14	15	16	13	15
	Male	Maximum	28	28	28	29	29	30
		Observed	15	19	21	21	21	23