Yellowstone Grizzly Bear Investigations 2020

Annual Report of the Interagency Grizzly Bear Study Team

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2020

U.S. Geological Survey
Wyoming Game and Fish Department
National Park Service
U.S. Fish and Wildlife Service
Montana Fish, Wildlife and Parks
U.S. Forest Service
Idaho Department of Fish and Game
Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department

Edited by Frank T. van Manen, Mark A. Haroldson, and Bryn E. Karabensh

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IGBST PARTNER WEBSITES

Interagency Grizzly Bear Study Team (U.S. Geological Survey):
https://www.usgs.gov/science/interagency-grizzly-bear-study-team

Grizzly Bear Recovery Program (U.S. Fish and Wildlife Service):
https://www.fws.gov/mountain-prairie/es/grizzlyBear.php

United States Forest Service:
https://www.fs.usda.gov/visit/know-before-you-go/bears

Yellowstone National Park and Grand Teton National Park (National Park Service):
http://www.nps.gov/yell/planyourvisit/bearsafety.htm
http://www.nps.gov/grte/planyourvisit/bearsafety.htm

Wyoming Game and Fish Department:
https://wgfd.wyo.gov/Wildlife-in-Wyoming/More-Wildlife/Large-Carnivore/Grizzly-Bear-Management

Montana Fish, Wildlife and Parks:
https://fwp.mt.gov/conservation/species/bear/management

Idaho Department of Fish and Game:
http://fishandgame.idaho.gov/public/wildlife/?getPage=248

Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department:
https://windriver.org/venue/shoshone-arapaho-fish-game/

TABLE OF CONTENTS

Acronyms Used in the Report

AIC_c	Akaike Information Criterion
AM	Animal month
BAU	Bear Analysis Unit
BMS	Bear Management Subunit
BMU	Bear Management Unit
BOA	Bear Observation Area
DMA	Demographic Monitoring Area
ESA	Endangered Species Act
GPS	Global Positioning System
GYE	Greater Yellowstone Ecosystem
GBRZ	Grizzly Bear Recovery Zone
IGBST	Interagency Grizzly Bear Study Team
LCS	Large Carnivore Section
LDR	Lander Development Recommendations
NPS	National Park Service
OMARD	Open Motorized Access Route Density
PCA	Primary Conservation Area
SD	Standard Deviation
TMARD	Total Motorized Access Route Density
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USSES	USDA Sheep Experiment Station
WGFD	Wyoming Game and Fish Department
YCT	Yellowstone cutthroat trout
YES	Yellowstone Ecosystem Subcommittee

INTRODUCTION

Frank T. van Manen and Mark A. Haroldson, U.S. Geological Survey, Interagency Grizzly Bear Study Team

This Report

This Annual Report summarizes results of grizzly bear (*Ursus arctos*) research and monitoring conducted in the Greater Yellowstone Ecosystem (GYE) by the Interagency Grizzly Bear Study Team (IGBST) during 2020. The research and monitoring program is focused on population estimation and demographics, food monitoring, and habitat monitoring. This report also presents a summary of grizzly bear management actions to address conflict situations and agency outreach efforts. The information presented in this report is a summary of annual data collections. Data, analyses, and summaries presented here supersede those published previously and may be subject to change contingent on additional information, future publications, and the peer-review process.

An Unusual Year…but not for Bears

Humanity will remember 2020 as the year that upended our lives. But for grizzly bears in the GYE it was business as usual, blissfully unaware of the global human toll of the pandemic. For grizzly bears, this was a year with relatively low mortality rates within the Demographic Monitoring Area (DMA), no major conflicts, average food production, and solid reproduction. In the spring of 2020, we did witness a relatively large number of human-bear encounters that resulted in human injuries, and we speculate this may have been associated with a greater number of recreationists in the backcountry, particularly in the early months of the pandemic. The pandemic-related lockdown and re-opening created opportunities for "natural experiments" to examine, for example, how wildlife species responded to the absence of people during closures of national parks, followed by quick returns to normal visitation levels. Research external to our study team is underway to examine these effects, with data contributions from the IGBST.

Despite the extra challenges of conducting field operations while maintaining a safe environment for all, IGBST partner agencies were able to continue much of the field monitoring efforts. This was only possible through the dedicated efforts of many individuals in the field and agency commitments to ensure 2020 would not become a "lost year" for the long-term grizzly bear research and monitoring program.

Population Monitoring

We follow monitoring protocols and recovery criteria established in the 2017 supplement to the Grizzly Bear Recovery Plan (U.S. Fish and Wildlife Service 2017) and as initially developed under the 2016 Conservation Strategy (Yellowstone Ecosystem Subcommittee 2016). In 2020, the model-averaged Chao2 estimate was 57 females with cubs within the DMA, from which we derived a total population estimate of 727 with a 95% confidence interval of 648 to 806 bears (see "***Estimating Number of Females with Cubs***"). These estimates are similar to those of previous years.

Total mortality rates for independent-age (2 years or older) females, independent-age males, and dependent young (cubs or yearlings) were 7.5, 8.7, and 1.8%, respectively. Referencing the total population estimate of 727 against mortality thresholds established in Table 2 of the 2016 Conservation Strategy (Yellowstone Ecosystem Subcommittee 2016), these estimates are below the corresponding thresholds of 9, 20, and 9%, respectively. Long-term mortality rates also are below these thresholds. For example, the mean total mortality rate for the period 2002–2020 was 6.8% for independent females and 9.9% for independent males. These data, particularly when considering the conservative nature of the Chao2 estimates (see section "***Estimating Number of Females with Cubs***") and additional demographic data, indicate the population status within the DMA remains stable to increasing.

Occupied Range

In this report, we present the 2-year update to our estimate of occupied grizzly bear range within the GYE (see section "***Grizzly bear occupied range in the Greater Yellowstone Ecosystem, 1990–2020***"). This update indicates that the rate of range expansion we have documented in the last several decades may be slowing. Whereas occupied range expanded by 3,887 km^2 from 2016 to 2018, from 2018 to 2020 range expansion was 1,732 km^2. Almost all suitable habitat in the GYE,

primarily defined by the DMA boundary (Interagency Grizzly Bear Study Team 2012:42), is now occupied.

Food Monitoring

Habitat monitoring includes documenting indices of abundance for 3 high-calorie foods throughout the GYE: 1) cutthroat trout (*Oncorhynchus clarkii*) spawning numbers, 2) bear use of army cutworm moth (*Euxoa auxiliaris*) sites, and 3) whitebark pine (*Pinus albicaulis*) cone production. As we noted in the 2017 Annual Report, we are no longer conducting surveys to document availability of winter-kill carcasses of large ungulates. However, we have added a new section to the report to assess ungulate consumption by grizzly bears in Yellowstone National Park (see section "***Grizzly Bear Consumption of Ungulates in Yellowstone National Park"***) and provide online references for herd statistics available through agency websites.

Besides IGBST surveys to index whitebark pine cone production, monitoring of the health of whitebark pine in the ecosystem continued with the cooperation of the Greater Yellowstone Whitebark Pine Monitoring Working Group. We reference these monitoring efforts in Appendix B. The protocol has been modified to document the mortality rate in whitebark pine from all causes, including mountain pine beetle (*Dendroctonus ponderosae*).

Habitat Monitoring

In this report we also detail findings from monitoring programs implemented since the 2007 delisting rule: 1) changes in secure habitat, open motorized access route density, and total motorized route density inside the designated Grizzly Bear Recovery Zone (hereafter Recovery Zone; also referred to as the Primary Conservation Area or PCA in the 2016 Conservation Strategy); 2) changes in number and capacity of developed sites inside the Recovery Zone; and 3) changes in number of commercial livestock allotments, changes in the number of permitted domestic sheep animal months inside the Recovery Zone, and livestock allotments with grizzly bear conflicts during the last 5 years (Appendix A).

History and Purpose of the IGBST

It was recognized as early as 1973 that a better understanding of the dynamics of grizzly bears in the GYE would best be accomplished by an independent research group responsible for collecting, managing, analyzing, and distributing information. To meet this need, agencies developed a Memorandum of Understanding and formed the IGBST, a consortium among the U.S. Geological Survey, National Park Service, U.S. Forest Service, U.S. Fish and Wildlife Service, and the state wildlife agencies of Idaho, Montana, and Wyoming. The Eastern Shoshone Tribe of the Wind River Reservation, Wyoming, and the Arapaho Tribe of the Wind River Reservation, Wyoming, formally joined the study team in 2009. Quantitative data on grizzly bear abundance, distribution, survival, mortality, nuisance activity, and bear foods are critical to formulating management strategies and decisions. Moreover, this information is necessary to evaluate the recovery process. The IGBST coordinates data collection and analysis on an ecosystem scale, prevents duplication of effort, and pools limited budgetary and personnel resources. Primary responsibilities of the IGBST are to: 1) conduct short- and long-term research projects addressing information needs for bear management; 2) monitor the bear population, including status and trend, numbers, reproduction, and mortality; 3) monitor grizzly bear habitats, foods, and impacts from humans; and 4) provide technical support to agencies and other groups responsible for the immediate and long-term management of grizzly bears in the GYE. Additional details are on the IGBST website: https://www.usgs.gov/science/interagency-grizzly-bear-study-team.

Previous and Recent Research

Since 1975, the IGBST has produced annual reports and numerous scientific publications summarizing the team's monitoring and research efforts within the GYE. Descriptions of the study area and sampling techniques are reported by Blanchard (1985), Mattson et al. (1991*a*), Haroldson et al. (1998), and Schwartz et al. (2006). Newly published studies reflect collaborations with several academic institutions, with a focus on physiology. Using data from captive grizzly bears at the Washington State University Bear Research and Conservation Center, Rogers et al. (2021) examined thermal constraints and energy balance of female grizzly

bears, and Carnahan et al. (2021) assessed energetics of bear movement. In both studies, application of findings to wild bears in the GYE provided crucial insights into the physiology and ecology of grizzly bears. Additionally, Christianson et al. (2021) measured fecal chlorophyll and stress hormone (cortisol) concentrations in grizzly bear and American black bear (*Ursus americanus*) scats collected in Yellowstone National Park during 2008–2009. Their findings suggested higher stress hormone concentrations corresponded with lower-quality diets, which were typically associated with consumption of less-nutritious but common foods, such as grasses and forbs. In a collaborative study with Montana State University, Hoegh et al. (2021) developed statistical techniques to improve predictions of bear movement by considering proximity of conspecific bears. The development of these techniques is essential for a next phase of research focused on predicting where and when future range expansion of grizzly bears in the GYE may occur. Several IGBST members also contributed to a comprehensive chapter on North American brown bears in a newly published book titled *Bears of the World - Ecology, Conservation and Management*.

Development and enhancement of data collection and demographic analysis techniques continues. We published a comprehensive report in April 2021 (Interagency Grizzly Bear Study Team 2021) to address two areas of potential improvement in the current Chao2 estimation approach. The first issue centered on addressing the primary source of underestimation bias associated with Chao2 estimates: based on simulations under different scenarios of population size, Schwartz et al. (2008) demonstrated that the Knight et al. (1995) rule set, used to identify unique females with cubs, returned increasingly negative-biased estimates as their numbers increased. This was a direct result of a conservative distance criterion in the rule set (30-km distance criterion) to distinguish unique females with cubs from sighting data. Secondly, although a model averaging technique developed for trend detection (Harris et al. 2007) proved useful to detect a slowing of population growth in the early 2000s, after almost 2 decades of robust growth, the approach has little power to accurately distinguish among future population scenarios that may involve periods of decline, stability, or growth.

We performed extensive simulation analyses to address these two areas of potential improvement in the current Chao2 estimation approach. The primary findings were that a 16-km criterion in the rule set would provide substantially greater accuracy of the number of females with cubs, without a risk of overestimation. We also enhanced techniques to monitor trend in the population over time, using more powerful statistical methods based on generalized additive models, or GAMs. Starting with the 2021 monitoring year, the IGBST will implement the findings of the reassessment report. Once implemented, the 16-km distance criterion will result in total population estimates, as derived from the Chao2 estimates, that are greater than those IGBST has reported in the past. This increase is due to a change in the implementation of the technique and more accurately represents the number of females with cubs and total population size in the GYE grizzly bear population.

The Chao2 reassessment reflects the first phase of a multi-year effort to enhance the grizzly bear monitoring program for the GYE. In the second phase, we are collaborating with researchers at the University of Montana to develop integrated population models, or IPMs. A key advancement of IPMs is that we can integrate the full suite of demographic data we collect on an annual basis: for example, besides the updated Chao2 estimates and mark-resight estimates, the IPM approach will incorporate known-fate data from radio-monitored bears. A key aspect of IPMs is that the integration of various data sources should allow the simultaneous estimation of multiple demographic parameters with greater accuracy and precision. One goal is to explicitly link changes in population size over time with variation in vital rates and associated environmental variables, thus providing managers with better tools for decision making. Additionally, the IPM framework may serve as a tool to examine how data collections can be streamlined or modified to increase the cost-effectiveness of the monitoring program. Prior to the potential implementation of an IPM for monitoring of the GYE grizzly bear population, rigorous testing and evaluation of model results is essential, a process that is still ongoing.

Acknowledgments

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BEAR MONITORING AND POPULATION TREND

Marked Animals *(Mark A. Haroldson, Chad Dickinson, and Bryn E. Karabensh, U.S. Geological Survey, Interagency Grizzly Bear Study Team; Jeremy Nicholson, Idaho Department of Fish and Game; and Dan D. Bjornlie, Wyoming Game and Fish Department)*

During the 2020 field season, we captured 95 individual grizzly bears on 113 occasions (Table 1), including 32 females (17 adult), 57 males (32 adult) and 6 bears (yearlings) of unknown sex (Table 1). All 6 bears of unknown sex were captured at research trap sites and were released without handling because their mothers were present and would not leave the site.

Sixty-one (64.2%) of the 95 individual bears were not previously marked. The percent of previously unmarked individual grizzly bears captured annually has remained relatively constant during the period 1998–2020, averaging 62%, with no evidence ($F = 0.100$, 1 *df*, $P = 0.754$) of a change in trend (Fig. 1). As we have noted in previous reports, this finding continues to support the notion that in this closed population bears are recruiting into the population at a relatively constant rate. We would expect the number of new bears encountered annually to decline if individuals were not recruiting into the population.

We conducted research trapping efforts for a total of 728 trap days (1 trap day = 1 trap set for 1 day) in the GYE. During research trapping operations we had 72 captures of 58 individual grizzly bears for a trapping success rate of 1 grizzly capture every 10.1 trap days. All research captures were within the DMA.

There were 41 management captures of 38 individual bears during 2020 (Tables 1 and 2), including 13 females (4 adults) and 25 males (13 adults). Fifteen management captures of 15 individual bears (6 females, 9 males) occurred outside the DMA. Thirteen individual bears (6 females, 7 males) were relocated because of conflict situations (Table 1). One adult male (#987, Table 1) was initially captured at a management trap site, relocated, and subsequently captured at a research trap site. Three bears (subadult male #1006, subadult female #1014, and subadult male #1015) were removed after previous management capture and relocation attempts (Table 1). In total, there were 28 management captures that resulted in removals (8 females, 20 males) during 2020 (Table 1).

We radio-monitored 104 individual grizzly bears during the 2020 field season, including 52 females, 39 of which were adults (Tables 2 and 3). Sixty grizzly bears entered their winter dens wearing active transmitters. Since 1975, 1,009 individual grizzly bears have been radiomarked in the GYE.

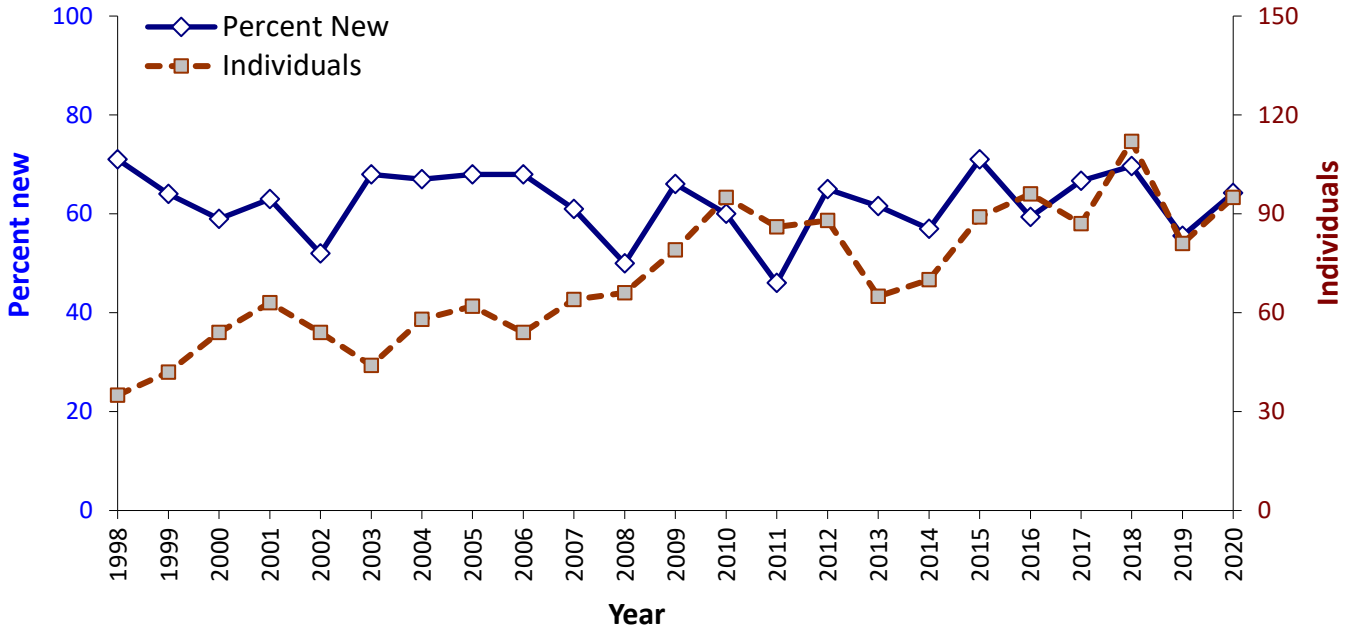

Fig. 1. Annual number of grizzly bears captured and percent previously unmarked individuals in the Greater Yellowstone Ecosystem, 1998–2020.

Table 1. Grizzly bears captured in the Greater Yellowstone Ecosystem, 2020.							
Bear	**Sex**	**Age**	**Date**	**General location[a]**	**Capture type**	**Release site[b]**	**Handler[c]**
984	Male	Subadult	04/25/20	Cottonwood Crk, BOR-WY	Management	Removed (202001)	WGFD
802	Male	Adult	04/29/20	Snake River, PR-WY	Management	Removed (202002)	WGFD
834	Male	Adult	05/05/20	North Fork Shoshone, PR-WY	Management	Removed (202003)	WGFD
987	Male	Adult	05/07/20	South Fork Shoshone, PR-WY	Management	Transported	WGFD
987	Male	Adult	06/26/20	Green Crk, SNF	Research	On site	WGFD
Unm202001	Male	Subadult	05/09/20	Cottonwood Crk, BOR-WY	Management	Removed (202005)	WGFD
988	Male	Subadult	05/17/20	South Fork Shoshone, PR-WY	Management	Transported	WGFD
989	Female	Adult	05/16/20	Hotel Crk, BLM-ID	Management	Transported	IDFG
G264	Female	Subadult	05/16/20	Hotel Crk, BLM-ID	Management	Transported	IDFG
990	Male	Subadult	05/21/20	Brent Crk, SNF	Research	On site	WGFD
990	Male	Subadult	06/01/20	Brent Crk, SNF	Research	On site	WGFD
991	Male	Subadult	05/22/20	Clarks Fork River, PR-WY	Management	Transported	WGFD
G265	Male	Subadult	05/27/20	Brent Crk, SNF	Research	On site	WGFD
G265	Male	Subadult	05/30/20	Brent Crk, SNF	Research	On site	WGFD
G265	Male	Subadult	06/03/20	Brent Crk, SNF	Research	On site	WGFD
G265	Male	Subadult	06/10/20	Brent Crk, SNF	Research	On site	WGFD
G265	Male	Subadult	06/14/20	Brent Crk, SNF	Research	On site	WGFD
G265	Male	Subadult	06/18/20	Brent Crk, SNF	Research	On site	WGFD
G266	Male	Subadult	05/27/20	Horse Crk, SNF	Research	On site	WGFD
992	Female	Subadult	06/05/20	Henrys Fork, CTNF	Research	On site	IDFG
993	Male	Adult	06/05/20	Charlie Crk, SNF	Research	On site	WGFD
994	Male	Subadult	06/06/20	Henrys Fork, CTNF	Research	On site	IDFG
409	Female	Adult	06/06/20	East Fork Long Crk, SNF	Research	On site	WGFD
879	Male	Adult	06/07/20	Wolf Crk, PR-MT	Management	Removed (202008)	WS/MTFWP
995	Male	Adult	06/08/20	Henrys Fork, CTNF	Research	On site	IDFG
996	Male	Adult	06/12/20	Henrys Fork, CTNF	Research	On site	IDFG
996	Male	Adult	07/03/20	Henrys Fork, CTNF	Research	On site	IDFG
747	Female	Adult	06/13/20	West Fork Long Crk, SNF	Research	On site	WGFD
Unm202002	Female	Adult	06/17/20	South Dry Crk, ST-MT	Management	Removed (202009)	WS
Unm202003	Male	Adult	06/17/20	South Fork Owl Crk, PR-WY	Management	Removed (202010)	WGFD
Unm202004	Female	Subadult	06/18/20	Ghost Crk, SNF	Management	Removed (202011)	WGFD
Unm202005	Male	Adult	06/19/20	Bear Crk, PR-MT	Management	Removed (202012)	WS/MTFWP
997	Male	Subadult	06/20/20	Brent Crk, SNF	Research	On site	WGFD
978	Male	Subadult	06/20/20	Trout Crk, SNF	Research	On site	WGFD
998	Female	Adult	06/21/20	Henrys Fork, CTNF	Research	On site	IDFG
999	Female	Adult	06/23/20	Trout Crk, SNF	Research	On site	WGFD
1000	Male	Yearling	06/26/20	Trout Crk, SNF	Research	On site	WGFD
G267	Male	Yearling	06/26/20	Trout Crk, SNF	Research	On site	WGFD

Table 1. Continued

Bear	Sex	Age	Date	General location[a]	Capture type	Release site[b]	Handler[c]
1001	Female	Subadult	07/01/20	Crow Crk, BTNF	Management	Transported	WGFD
936	Male	Adult	07/03/20	Fence Crk, BTNF	Management	Removed (202014)	WGFD
Unm202006	Male	Subadult	07/03/20	Grayling Arm, Hebgen Lake, CGNF	Management	Removed (202015)	MTFWP
588	Male	Adult	07/06/20	Sheridan Crk, CTNF	Research	On site	IDFG
373	Male	Adult	07/07/20	Warm River, CTNF	Research	On site	IDFG
Unm202007	Male	Subadult	07/12/20	West Rosebud Crk, PR-MT	Management	Removed (202016)	WS/MTFWP
899	Female	Adult	07/14/20	Henrys Fork, CTNF	Research	On site	IDFG
899	Female	Adult	08/06/20	Bear Crk, CTNF	Research	On site	IDFG
Unm202008	Unknown	Yearling	07/15/20	Deadman Crk, PR-MT	Research	On site	IGBST
Unm202009	Unknown	Yearling	07/15/20	Deadman Crk, PR-MT	Research	On site	IGBST
Unm202010	Unknown	Yearling	07/15/20	Deadman Crk, PR-MT	Research	On site	IGBST
653	Male	Adult	07/17/20	Warm River, CTNF	Research	On site	IDFG
653	Male	Adult	07/25/20	Henrys Fork, CTNF	Research	On site	IDFG
1002	Male	Adult	07/22/20	Wagon Crk, BTNF	Management	Transported	WGFD
Unm202011	Female	Subadult	07/23/20	Bear Crk, PR-MT	Management	Removed (202017)	WS/MTFWP
G268	Male	Subadult	07/23/20	Henrys Fork, CTNF	Research	On site	IDFG
G268	Male	Subadult	07/26/20	Henrys Fork, CTNF	Research	On site	IDFG
1003	Female	Adult	07/24/20	Eldridge Crk, CGNF	Research	On site	IGBST
1003	Female	Adult	08/06/20	Deadhorse Crk, CGNF	Research	On site	IGBST
1004	Male	Adult	07/26/20	Eldridge Crk, CGNF	Research	On site	IGBST
1005	Female	Subadult	07/26/20	Cream Crk, CGNF	Research	On site	IGBST
1006	Male	Subadult	07/28/20	Buffalo Fork, PR-WY	Management	Transported	WGFD
1006	Male	Subadult	08/07/20	Eagle Crk, SNF	Management	Removed (202021)	WGFD
686	Female	Adult	07/29/20	Eldridge Crk, CGNF	Research	On site	IGBST
1007	Male	Adult	07/30/20	Deadhorse Crk, CGNF	Research	On site	IGBST
168	Male	Adult	07/30/20	Wagon Crk, BTNF	Management	Removed (202018)	WGFD
813	Male	Adult	07/30/20	Tom Miner Crk, PR-MT	Management	Removed (202019)	MTFWP
G269	Male	Subadult	07/31/20	Leidy Crk, BTNF	Research	On site	WGFD
G269	Male	Subadult	08/05/20	Dry Lake Crk, BTNF	Research	On site	WGFD
Unm202012	Unknown	Yearling	07/31/20	Jesse Crk, CTNF	Research	On site	IDFG
Unm202013	Female	Subadult	08/02/20	South Fork Shoshone, PR-WY	Management	Removed (202020)	WGFD
949	Female	Subadult	08/02/20	Warm River, CTNF	Research	On site	IDFG
687	Male	Adult	08/02/20	Bear Crk, CTNF	Research	On site	IDFG
Unm202014	Unknown	Yearling	08/02/20	Jesse Crk, CTNF	Research	On site	IDFG
1008	Male	Adult	08/03/20	North Fork Spread Crk, BTNF	Research	On site	WGFD
913	Female	Adult	08/07/20	Bear Crk, CTNF	Research	On site	IDFG
1009	Female	Subadult	08/08/20	Grouse Crk, BTNF	Research	On site	WGFD
1009	Female	Subadult	08/12/20	Skull Crk, BTNF	Research	On site	WGFD

Table 1. Continued							
Bear	**Sex**	**Age**	**Date**	**General location[a]**	**Capture type**	**Release site[b]**	**Handler[c]**
1009	Female	Subadult	08/20/20	South Fork Spread Crk, BTNF	Research	On site	WGFD
1010	Male	Adult	08/08/20	South Fork Spread Crk	Research	On site	WGFD
819	Male	Adult	08/08/20	Dry Lake Crk, BTNF	Research	On site	WGFD
1011	Male	Subadult	08/11/20	Howard Crk, CTNF	Research	On site	IDFG
1012	Female	Yearling	08/11/20	Timber Crk, CTNF	Research	On site	IDFG
G270	Male	Yearling	08/11/20	Timber Crk, CTNF	Research	On site	IDFG
909	Female	Adult	08/12/20	Timber Crk, CTNF	Research	On site	IDFG
914	Female	Adult	08/14/20	Bootjack Crk, CTNF	Research	On site	IDFG
1013	Female	Adult	08/14/20	Timber Crk, CTNF	Research	On site	IDFG
727	Male	Adult	08/15/20	Howard Crk, CTNF	Research	On site	IDFG
805	Male	Adult	08/15/20	Dry Lake Crk, BTNF	Research	On site	WGFD
1014	Female	Subadult	08/16/20	Buttermilk Crk, PR-MT	Management	Transported	MTFWP
1014	Female	Subadult	09/01/20	Denny Crk, PR-MT	Management	Removed (202025)	MTFWP
1015	Male	Subadult	08/16/20	Buttermilk Crk, PR-MT	Management	Transported	MTFWP
1015	Male	Subadult	09/01/20	Denny Crk, PR-MT	Management	Removed (202026)	MTFWP
Unm202015	Female	Adult	08/29/20	Blaine Crk, PR-WY	Management	Removed (202023)	WGFD
Unm202016	Female	Subadult	08/30/20	Blaine Crk, PR-WY	Management	Removed (202024)	WGFD
Unm202017	Male	Subadult	09/01/20	South Fork Owl Crk, WRIR	Management	Removed (202027)	WGFD
499	Female	Adult	09/02/20	Raspberry Crk, BTNF	Management	Transported	WGFD
G271	Male	Subadult	09/02/20	Raspberry Crk, BTNF	Management	Transported	WGFD
679	Male	Adult	09/10/20	Pilgrim Crk, GTNP	Research	On site	IGBST
394	Male	Adult	09/16/20	Cascade Crk, YNP	Research	On site	IGBST
980	Female	Adult	09/17/20	Cascade Crk, YNP	Research	On site	IGBST
1016	Male	Adult	09/19/20	Trout Crk, YNP	Research	On site	IGBST
881	Male	Adult	09/21/20	Trout Crk, YNP	Research	On site	IGBST
1017	Female	Subadult	09/24/20	Trout Crk, PR-WY	Management	Transported	WGFD
Unm202018	Male	Adult	09/24/20	Timber Crk, PR-WY	Management	Removed (202030)	WGFD
G256	Male	Subadult	09/26/20	Volney Crk, PR-MT	Management	Removed (202033)	WS/MTFWP
Unm202019	Male	Subadult	09/29/20	South Fork Shoshone, PR-WY	Management	Removed (202036)	WGFD
Unm202020	Male	Adult	09/29/20	Green River, BTNF	Management	Removed (202037)	WGFD
Unm202021	Unknown	Yearling	09/18/20	Pilgrim Crk, GTNP	Research	On site	IGBST
460	Male	Adult	10/02/20	Pilgrim Crk, GTNP	Research	On site	IGBST
962	Female	Subadult	10/02/20	Snake River, GTNP	Research	On site	GTNP
1018	Female	Adult	10/18/20	Snake River, GTNP	Research	On site	GTNP
Unm202022	Female	Subadult	10/19/20	Horse Crk, BLM-WY	Management	Removed (202045)	WGFD
1019	Male	Subadult	10/30/20	Snake River, GTNP	Research	On site	GTNP
Unm202023	Male	Adult	11/04/20	Pat O'Hara Crk, PR-WY	Management	Removed (202048)	WGFD

[a] BDNF = Beaverhead-Deerlodge National Forest, BLM = Bureau of Land Management, BTNF = Bridger-Teton National Forest, CTNF = Caribou-Targhee National Forest, CGNF = Custer Gallatin National Forest, GTNP = Grand Teton National Park, SNF = Shoshone National Forest, YNP = Yellowstone National Park, WRIR = Wind River Reservation, PR = private.

[b] Numbers in parentheses are assigned mortality numbers.

[c] IDFG = Idaho Fish and Game; IGBST = Interagency Grizzly Bear Study Team, USGS; GTNP = Grand Teton National Park; MTFWP = Montana Fish, Wildlife and Parks; WS = Wildlife Services; WGFD = Wyoming Game and Fish Department; WRIR = Wind River Reservation, YNP = Yellowstone National Park.

Table 2. Annual number of grizzly bears monitored, captured, and transported in the Greater Yellowstone Ecosystem, 1980–2020.					
Year	Number monitored	Individuals trapped	Total captures		Transported
			Research	Management	
1980	34	28	32	0	0
1981	43	36	30	35	31
1982	46	30	27	25	17
1983	26	14	0	18	13
1984	35	33	20	22	16
1985	21	4	0	5	2
1986	29	36	19	31	19
1987	30	21	15	10	8
1988	46	36	23	21	15
1989	40	15	14	3	3
1990	35	15	4	13	9
1991	42	27	28	3	4
1992	41	16	15	1	0
1993	43	21	13	8	6
1994	60	43	23	31	28
1995	71	39	26	28	22
1996	76	36	25	15	10
1997	70	24	20	8	6
1998	58	35	32	8	5
1999	65	42	31	16	13
2000	84	54	38	27	12
2001	82	63	41	32	15
2002	81	54	50	22	15
2003	80	44	40	14	11
2004	78	58	38	29	20
2005	91	63	47	27	20
2006	92	54	36	25	23
2007	86	65	54	19	8
2008	87	66	39	40	30
2009	97	79	63	34	25
2010	85	95	36	75	52
2011	92	86	61	46	24
2012	112	88	47	56	35
2013	88	65	58	30	20
2014	94	70	51	30	20
2015	101	89	34	72	41
2016	106	96	59	49	18
2017	99	87	62	37	15
2018	106	112	57	72	27
2019	98	81	59	39	16
2020	104	95	72	41	13

Table 3. Grizzly bears radio-monitored in the Greater Yellowstone Ecosystem, 2020.						
				Monitored		
Bear	Sex	Age	Offspring	Out of den	Into den	Current status
373	Male	Adult		No	Yes	Active
394	Male	Adult		Yes	Yes	Active
409	Female	Adult	None	No	Yes	Active
419	Male	Adult		Yes	No	Cast
460	Male	Adult		No	Yes	Active
480	Male	Adult		Yes??	No	Cast
481	Female	Adult	None	Yes	Yes	Active
499	Female	Adult	1 yearling	No	Yes	Active
588	Male	Adult		No	No	Cast
589	Male	Adult		Yes	No	Cast
653	Male	Adult		Yes	No	Cast
679	Male	Adult		No	??	Active
686	Female	Adult	None	No	Yes	Active
687	Male	Adult		No	No	Killed
688	Male	Adult		Yes	No	Cast
695	Male	Adult		Yes	Yes	Active
706	Female	Adult	None	Yes	No	Cast
727	Male	Adult		No	Yes	Active
734	Female	Adult	1 2-yr-old weaned	Yes	Yes	Active
747	Female	Adult	1 cub	No	Yes	Active
762	Female	Adult	2 yearlings, 1 lost	Yes		Unresolved
773	Female	Adult	2 cubs	Yes	No	Cast
786	Female	Adult	3 yearlings, 3 lost?	Yes	No	Killed
791	Male	Adult		Yes	No	Cast
804	Male	Adult		Yes	No	Cast
805	Male	Adult		No	Yes	Active
812	Male	Adult		Yes	Yes	Active
819	Male	Adult		No	Yes	Active
862	Male	Adult		Yes	No	Cast
863	Female	Adult	None	Yes	No	Cast
880	Male	Adult		Yes	No	Cast
881	Male	Adult		No	Yes	Active
883	Female	Adult	None	Yes	Yes	Active
895	Female	Adult	3 2-yr-olds weaned	Yes	??	Active
896	Female	Adult	2 cubs	Yes	Yes	Active
899	Female	Adult	1 yearling, lost	Yes	Yes	Active
909	Female	Adult	2 yearlings	No	Yes	Active
911	Female	Adult	1 cub, lost	Yes	Yes	Active
913	Female	Adult	1 cub	Yes	Yes	Active
914	Female	Adult	None	Yes	Yes	Active
917	Male	Adult		Yes	Yes	Active
926	Female	Adult	2 cubs, 2 lost	Yes	Yes	Active
930	Female	Adult	2 cubs, 2 lost	Yes	Yes	Active
933	Female	Adult	None	Yes	No	Cast
936	Male	Adult		Yes	No	Removed
945	Male	Adult		Yes	No	Cast
947	Female	Adult	Not observed	Yes	No	Cast
948	Female	Adult	2 2-yr-olds weaned	Yes	Yes	Active
949	Female	Subadult	None	Yes	Yes	Active
952	Female	Adult	2 cubs	Yes	Yes	Active

Table 3. Continued

Bear	Sex	Age	Offspring	Monitored		Current status
				Out of den	Into den	
954	Female	Adult	1 yearling, lost	Yes	No	Cast
956	Female	Adult	3 cubs, 2 lost	Yes	Yes	Active
960	Male	Subadult		Yes	No	Cast
962	Female	Subadult	None	Yes	Yes	Active
963	Male	Adult		Yes	No	Cast
964	Female	Subadult	None	Yes	No	Cast
966	Female	Subadult	None	Yes	Yes	Active
967	Male	Adult		Yes	Yes	Active
969	Female	Adult	None seen	Yes	Yes	Active
974	Female	Subadult	None	Yes	Yes	Active
976	Female	Adult	1 cub, lost	Yes	Yes	Active
977	Female	Adult	1 or more cub/s	Yes	No	Cast
978	Male	Subadult		Yes	Yes	Active
979	Female	Adult	2 cubs	Yes	Yes	Active
980	Female	Adult	3 cubs, 3 lost	Yes	Yes	Active
981	Female	Subadult	None	Yes	Yes	Active
982	Male	Subadult		Yes	No	Cast
983	Male	Adult		Yes	No	Cast
984	Male	Subadult		Yes	No	Removed
985	Male	Adult		Yes	No	Cast
986	Female	Adult	2 yearlings	Yes	No	Cast
987	Male	Adult		No	No	Cast
988	Male	Adult		No	No	Cast
989	Female	Adult	1 yearling, lost	No	No	Cast
990	Male	Subadult		No	No	Cast
991	Male	Subadult		No	Yes	Active
992	Female	Subadult	None	No	Yes	Active
993	Male	Adult		No	No	Cast
994	Male	Subadult		No	Yes	Active
995	Male	Adult		No	No	Cast
996	Male	Adult		No	No	Cast
997	Male	Subadult		No	Yes	Active
998	Female	Adult	None	No	No	Cast
999	Female	Adult	None	No	Yes	Active
1000	Male	Yearling		No	Yes	Active
1001	Female	Subadult	None	No	Yes	Active
1002	Male	Adult		No	??	Active
1003	Female	Adult	None	No	Yes	Active
1004	Male	Adult		No	No	Cast
1005	Female	Subadult	None	No	No	Killed
1006	Male	Subadult		No	No	Removed
1007	Male	Adult		No	Yes	Active
1008	Male	Adult		No	Yes	Active
1009	Female	Subadult	None	No	Yes	Active
1010	Male	Adult		No	Yes	Active
1011	Male	Subadult		No	No	Cast
1012	Female	Yearling		No	Yes	Active
1013	Female	Adult	1 cub	No	Yes	Active
1014	Female	Subadult	None	No	No	Removed
1015	Male	Subadult		No	No	Removed
1016	Male	Subadult		No	Yes	Active
1017	Female	Subadult	None	No	Yes	Active
1018	Female	Adult	1 yearling	No	Yes	Active
1019	Male	Subadult		No	Yes	Active

Estimating Number of Females with Cubs *(Mark A. Haroldson, Bryn E. Karabensh, and Frank T. van Manen, U.S. Geological Survey, Interagency Grizzly Bear Study Team; and Daniel D. Bjornlie, Wyoming Game and Fish Department)*

I. Estimating Population Size and Assessing Trend from Observations of Unique Females with Cubs

Background

Under the 2017 Revised Demographic Criteria for the Yellowstone Ecosystem, which were amended to the Grizzly Bear Recovery Plan (USFWS 1993, USFWS 2017), the IGBST is tasked with annually estimating the number of female grizzly bears with cubs in the GYE population, determining trend for this segment of the population, and estimating size of specific population segments to assess annual mortalities relative to population size. Here, we present our 2020 findings for counts of unique females with cubs, and the total population estimate derived from numbers of females with cubs observed within the DMA.

Methods

We use a rule set developed by Knight et al. (1995) to estimate the number of unique females with cubs and tabulate sighting frequencies for each family. We note that findings from Schwartz et al. (2008) indicated the Knight et al. (1995) rule set underestimates the number of unique females with cubs and more so with increasing population size. Next, we obtain a nonparametric bias-corrected estimate (referred to as Chao2, which accounts for individual sighting heterogeneity) of the total number of females with cubs in the population ($\hat{N}_{Chao2}$) (Chao 1989, Wilson and Collins 1992, Keating et al. 2002, Cherry et al. 2007). We subsequently estimate trend and rate of change (λ) based on the natural log (*Ln*) of the annual $\hat{N}_{Chao2}$ estimates using linear and quadratic regressions with model averaging (Burnham and Anderson 2002). The quadratic model is included to detect changes in trend. Model AIC_c (Akaike Information Criterion) weight will favor the quadratic model if the rate of change levels off or begins to decline (IGBST 2006, Harris et al. 2007). This process smooths variation in annual estimates that result from sampling error or pulses in numbers of females producing cubs due to natural processes (i.e., process variation). Although some changes in previous model-averaged estimates for unique females with cubs ($\hat{N}_{MAFC}$) are expected with each additional year of data, retrospective adjustments to previous estimates are not done (IGBST 2006). Given the assumption of a reasonably stable sex and age structure, the trend for the females with cubs represents the rate of change for the entire population (IGBST 2006, Harris et al. 2007). It follows that estimates for specific population segments can be derived from $\hat{N}_{MAFC}$ and the estimated stable age distribution for the population. Estimates for specific population segments and associated confidence intervals follow IGBST (2012), which uses vital rates during 2002–2011 and is based on data from within the DMA.

2020 Sightings of Females with Cubs

We documented 234 verified sightings of females with cubs during 2020 in the GYE. The majority of observations were obtained from aerial sources (53.8%, Table 4). We differentiated 58 unique females with cubs from the 234 sightings using the rule set of Knight et al. (1995). Three sightings (1.3%) of 2 unique females occurred outside the DMA (Fig. 2). One female was initially observed inside the DMA on 3 separate occasions followed by 2 observations outside of DMA. The other female was initially observed once outside of DMA followed by 3 observations inside DMA. Forty-six (19.7%) observations from an estimated 7 unique females with cubs occurred within the boundary of Yellowstone National Park.

The total number of cubs observed during initial sightings of the 58 unique females with cubs was 113 and mean litter size was 1.95 (Table 5). There were 14 single cub litters, 34 litters of twins, 9 litters of triplets, and 1 litter of quadruplets (Table 5). Using the initial sightings of all females with cubs observed within the DMA, total cubs was 112 with a mean litter size of 1.93.

2020 DMA Chao2 and Population Estimate

Excluding the 3 sightings (2 females) observed outside the DMA and sightings of 5 family groups based on telemetry only, which are not independent observations, we obtained 178 observations of 51 unique families (Table 6) within the DMA. Using the sighting frequencies, our estimate of the number of unique females with cubs within the DMA was $\hat{N}_{DMAChao2}$ = 53. Applying the linear and quadratic regressions produced a model-averaged estimate of $\hat{N}_{DMAChao2}$ = 57 (95% CI = 47–70). The 2017 Revised Demographic Criteria specify a minimum of 48 females with cubs within the DMA (USFWS 2017). Applying the updated 2002–2011 vital rates to $\hat{N}_{DMAChao2}$ produced a total

population estimate for the DMA of 727 and estimates of population segments (Table 7).

We used the annual $\hat{N}_{Chao2}$ for the DMA during the period 1983–2020 (Table 6) to evaluate the trend for the female with cubs segment of the population (Fig. 3). With the 2020 addition, AIC_c weights (Table 8) continue to support the quadratic (95.9%) over the linear (4.1%) model (Table 8). These data are similar to previous years and show a leveling off of this estimator of females with cubs for the geographically restricted area of the DMA. Linear regression of $\hat{N}_{Chao2}$ with year for the period 2002–2020 shows some support for a positive trend (F = 3.875, 1 df, P = 0.066), but next year's data will be important to determine if this trend continues.

Table 4. Method of observation for female grizzly bears with cubs sighted in the Greater Yellowstone Ecosystem, 2020.

Method of observation	Frequency	%	Cumulative %
Fixed wing aircraft–incidental	4	1.7	1.7
Fixed wing aircraft–observation flight	40	17.1	18.8
Fixed wing aircraft–telemetry flight	63	26.9	45.7
Fixed wing aircraft–ferry time	0	0	45.7
Helicopter–other researcher	19	8.1	53.8
Ground sighting	106	45.3	99.1
Trap	2	0.9	100
Total	234	100	

Table 5. Number of unique females with cubs ($\hat{N}_{Obs}$), litter frequencies, total number of cubs, and average litter size at initial observation, Greater Yellowstone Ecosystem, 1983–2020.

Year	$\hat{N}_{Obs}$	Total no. of sightings	Litter size				Total no. of cubs	Mean litter size
			1 cub	2 cubs	3 cubs	4 cubs		
1983	13	15	6	5	2	0	22	1.69
1984	17	41	5	10	2	0	31	1.82
1985	9	17	3	5	1	0	16	1.78
1986	25	85	6	15	4	0	48	1.92
1987	13	21	1	8	4	0	29	2.23
1988	19	39	1	14	4	0	41	2.16
1989	16	33	7	5	4	0	29	1.81
1990	25	53	4	10	10	1	58	2.32
1991[a]	24	62	6	14	3	0	43	1.87
1992	25	39	2	12	10	1	60	2.4
1993	20	32	4	11	5	0	41	2.05
1994	20	34	1	11	8	0	47	2.35
1995	17	25	2	10	5	0	37	2.18
1996	33	56	6	15	12	0	72	2.18
1997	31	80	5	21	5	0	62	2
1998	35	86	9	17	9	0	70	2
1999	33	108	11	14	8	0	63	1.91
2000	37	100	9	21	7	0	72	1.95
2001	42	105	13	22	7	0	78	1.86
2002	52	153	14	26	12	0	102	1.96
2003	38	60	6	27	5	0	75	1.97
2004	49	223	14	23	12	0	96	1.96
2005	31	93	11	14	6	0	57	1.84
2006	47	172	12	21	14	0	96	2.04
2007	50	335	10	22	18	0	108	2.16
2008	44	118	10	28	6	0	84	1.91
2009	42	117	10	19	11	2	89	2.12
2010	51	286	15	23	12	1	101	1.98
2011	39	134	13	17	9	0	74	1.9
2012	49	124	14	25	10	0	94	1.92
2013	58	183	8	35	14	3	126	2.17
2014	50	119	16	22	12	0	96	1.92
2015	46	156	15	17[b]	14[b]	0	91[b]	1.98[b]
2016	50	144	15	22	13	0	98	1.96
2017	58	180	15	30	12	1	115	1.98
2018	58	172	11	33	14	0	119	2.05
2019	50	172	13	28	8	1	97	1.94
2020	58	234	14	34	9	1	113	1.95

[a] One female with unknown number of cubs; average litter size was calculated based on 23 females.

[b] Corrected values for 2015; online version of 2015 Annual Report has also been corrected.

Table 6. Annual Chao2 estimates for the numbers of female grizzly bears with cubs in the Greater Yellowstone Ecosystem, 1983–2020. Estimates in parenthesis for 2012–2020 are specific to the Demographic Monitoring Area (DMA). The number of unique females observed ($\widehat{N}_{Obs}$) includes those located using radio telemetry; m is the number of unique females observed using random sightings only and $\widehat{N}_{Chao2}$ gives the nonparametric bias-corrected estimate, per Chao (1989). Also included are the number of females with cubs sighted once (f_1) or twice (f_2) and the annual estimate of relative sample size ($n/\widehat{N}_{Chao2}$), where n is the total number of observations obtained without the aid of telemetry. Females with cubs sighted ≥3 times can be derived ($f_3+ = m–(f_1 + f_2)$).

Year	$\hat{N}_{Obs}$	m	f_1	f_2	$\hat{N}_{Chao2}$	n	$n/\hat{N}_{Chao2}$
1983	13	10	8	2	19	12	0.6
1984	17	17	7	3	22	40	1.8
1985	9	8	5	0	18	17	0.9
1986	25	24	7	5	28	82	3
1987	13	12	7	3	17	20	1.2
1988	19	17	7	4	21	36	1.7
1989	16	14	7	5	18	28	1.6
1990	25	22	7	6	25	49	2
1991	24	24	11	3	38	62	1.6
1992	25	23	15	5	41	37	0.9
1993	20	18	8	8	21	30	1.4
1994	20	18	9	7	23	29	1.3
1995	17	17	13	2	43	25	0.6
1996	33	28	15	10	38	45	1.2
1997	31	29	13	7	39	65	1.7
1998	35	33	11	13	37	75	2
1999	33	30	9	5	36	96	2.7
2000	37	34	18	8	51	76	1.5
2001	42	39	16	12	48	84	1.7
2002	52	49	17	14	58	145	2.5
2003	38	35	19	14	46	54	1.2
2004	49	48	15	10	58	202	3.5
2005	31	29	6	8	31	86	2.8
2006	47	43	8	16	45	140	3.3
2007	50	48	12	12	53	275	5.1
2008	44	43	16	8	56	102	1.8
2009	42	39	11	11	44	100	2.3
2010	51	51	11	9	56	256	4.6
2011	39	39	14	10	47	123	2.6
2012	49 (48)	44 (43)	16 (15)	7 (7)	59 (56)	110 (108)	1.9 (1.9)
2013	58 (57)	53 (52)	13 (14)	11 (11)	60 (60)	160 (152)	2.6 (2.5)
2014	50 (47)	46 (44)	23 (21)	13 (13)	64 (59)	92 (90)	1.4 (1.5)
2015	46 (44)	43 (41)	15 (14) [a]	10 (10) [a]	53 (49) [a]	134 (130)	2.6 (2.8)
2016	50 (45)	50 (45)	15 (12)	15 (13)	56 (50)	129 (121)	2.3 (2.4)
2017	58 (57)	54 (53)	19 (19)	16 (15)	64 (64)	127 (125)	2.0 (1.9)
2018	58 (56)	52 (50)	16 (16)	23 (23)	57 (55)	123 (116)	2.2 (2.1)
2019	50 (47)	45 (42)	23 (20)	7 (7)	77 (66)	111 (108)	1.4 (1.6)
2020	58 (58)	51 (51)	10 (10)	18 (18)	53 (53)	179 (178)	3.4 (3.4)

[a] Corrected sighting frequencies and Chao2 estimate in 2015; online version of 2015 Annual Report has also been corrected.

Table 7. Estimates and 95% confidence intervals (CI) for population segments and total grizzly bear population size derived using the Chao2 estimate for females with cubs within the Demographic Monitoring Area, 2020.

Segment	Estimate	95% CI	
		Lower[a]	Upper[a]
Independent females (≥2 years old)	252	201	303
Independent males (≥2 years old)	252	196	307
Dependent young (cubs and yearlings)	223	201	245
Total	727	648	806

[a] Calculated using the delta method.

Table 8. Parameter estimates and model selection results from fitting linear and quadratic models for Ln($\widehat{N}_{Chao2}$) (number of female grizzly bears with cubs) with year for the time period 1983–2020. During 2012–2020, Chao2 estimates were restricted to the Demographic Monitoring Area.

Model	Parameter	Estimate	Standard error	*t* value	*P*
Linear					
	β_0	3.03841	0.07379	40.18	<0.0001
	β_1	0.03171	0.00330	9.61	<0.0001
	SSE	1.78965			
	AIC_c	-109.406			
	AIC_c weight	0.041			
Quadratic					
	β_0	2.79955	0.10340	27.07	<0.0001
	β_1	0.06754	0.01223	5.52	<0.0001
	β_2	-0.00092	0.00030	3.02	0.0047
	SSE	1.41942			
	AIC_c	-115.707			
	AIC_c weight	0.959			

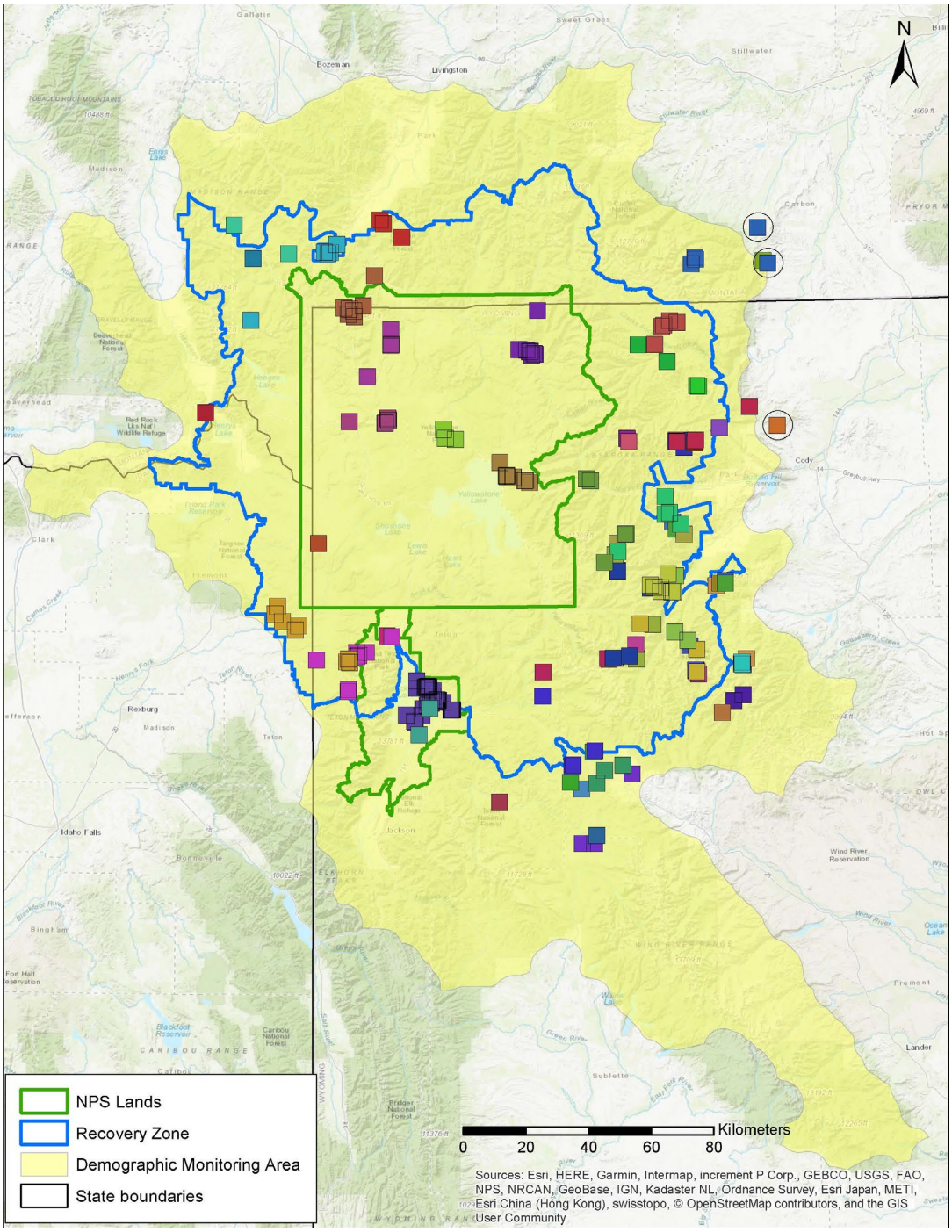

Fig. 2. Distribution of 234 sightings of 58 (indicated by unique colors) unduplicated female grizzly bears with cubs observed in the Greater Yellowstone Ecosystem, 2020. Only sightings from females with cubs occurring within the Demographic Monitoring Area (DMA) are used for population estimation. During 2020, 3 sightings (black circles around symbols) from 2 unique females with cubs occurred outside the DMA. Neither of these females were only observed outside the DMA.

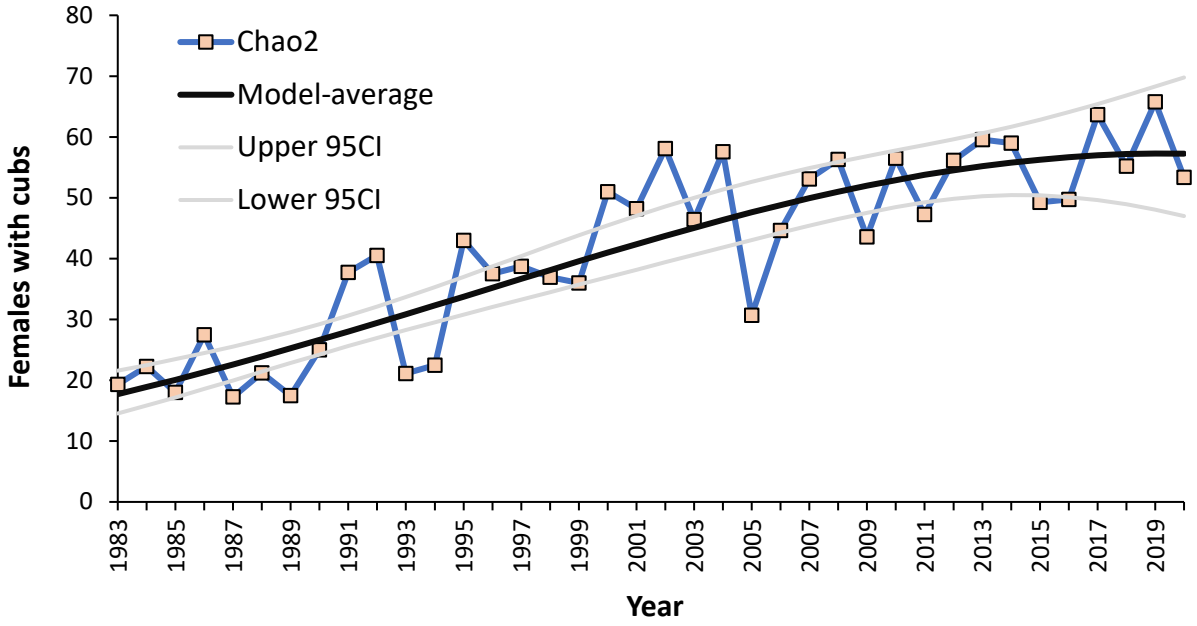

Fig. 3. Model-averaged estimates for the number of unique female grizzly bears with cubs, 1983–2020, where the linear and quadratic models of $Ln(\hat{N}_{Chao2})$ *were fitted. Estimates for 2012–2020 were restricted to the Demographic Monitoring Area (DMA). The inner set of gray solid lines represents a 95% confidence interval on the predicted population size.*

II. Mark-Resight Technique to Estimate Females with Cubs

Schwartz et al. (2008) demonstrated biases inherent in the method of estimating population size based on the Chao2 estimator (see previous section) using counts of unique females with cubs and the associated rule set of Knight et al. (1995). The IGBST invited partner agencies and quantitative ecologists to participate in 3 workshops held in February 2011, July 2011, and February 2012 to consider alternative approaches. An important product of these workshops was a recommendation to use systematic flight observation data conducted since 1997. The mark-resight estimator yields an annual estimate of the number of females with cubs based on 1) the presence of a radio-marked sample and 2) 2 systematic observation flights/year, during which all bears observed are recorded and, following observation, checked for marks (i.e., radio collar) using telemetry. Pilots note whether family groups observed include cubs, yearlings, or 2-year-old offspring. Mark-resight designs for population estimation are commonly used for wildlife monitoring because they can provide a cost-efficient and reliable monitoring tool. However, inference from such designs is limited when data are sparse, either from a low number of marked animals, a low probability of detection, or both. In the GYE, annual mark-resight data collected for female grizzly bears with cubs suffer from both limitations. As an important outcome of the 3 workshops, Higgs et al. (2013) developed a technique to overcome difficulties due to data sparseness by assuming homogeneity in sighting probabilities over 16 years (1997–2012) of biannual aerial surveys. They modeled counts of marked and unmarked grizzly bears with cubs as multinomial random variables, using the capture frequencies of marked females with cubs for inference regarding the latent multinomial frequencies for unmarked females with cubs (Fig. 4).

One important assumption of the mark-resight technique is that the geographic distribution of radio-marked female bears is generally representative of the geographic distribution and relative density of female bears in the population. Conclusions from workshop discussions were that this assumption is likely not violated within the GYE, with one exception. A subset of bears in the southeastern portion of the GYE annually spend 6 to 10 weeks in late summer (mid-Jul to late Sep) in alpine scree slopes feeding on army cutworm moths (Mattson et al. 1991*b*, Bjornlie and Haroldson 2011). These bears are highly visible and constitute a substantial proportion of bears seen during observation flights. However, capturing and marking of bears is difficult because these remote, high-elevation areas are snow-covered early in the capture season and access is limited due to high spring runoff. When access improves later in the season, most bears have already begun feeding on army cutworm moths and are difficult to capture. Thus, the proportion of radio-marked females with cubs among those feeding on these high-visibility sites is lower than in the remainder of the ecosystem. Applying mark-resight estimates to the entire ecosystem without considering these moth sites would result in overestimation bias. However, moth sites are now well defined, and the study team annually monitors these sites. Thus, the decision was made to exclude confirmed moth sites (defined as areas within 500 meters (m) from sites where multiple observations of bears feeding occurred >1 year) from the mark-resight analyses and conduct separate aerial census surveys of confirmed moth sites to add the observed number of females with cubs (marked and unmarked) to the mark-resight estimate for that year.

Higgs et al. (2013) performed simulations based on a known population of 50 females with cubs and resighting frequencies and proportions of bears sighted 0, 1, and 2 times from the observation flight data to determine accuracy and precision of the mark-resight technique. Accuracy was high, indicating that this technique addressed the bias concerns associated with estimates based on the Chao2 estimator. However, the simulations also indicated that precision was low. Peck (2016) reported on the poor ability of the mark-resight technique to detect declines of 1 and 2% in annual estimates of the number of females with cubs but moderate effectiveness to detect a 5% annual decline. Although the IGBST concluded that this technique was insufficient for effective monitoring of population trend, this method does produce relatively unbiased estimates. Because mark-resight estimates will likely be used in the potential implementation of Integrated Population Models (see "***Introduction***"), we continue to report these estimates.

2020 Mark-Resight Results

In 2020, only 1 round of observation flights was conducted and no mark-resight estimation was feasible. We did not conduct moth site-only flights to count females with cubs on army cutworm moth aggregation sites during 2020.

Table 9. Data used in mark-resight analysis on female grizzly bears with cubs, Greater Yellowstone Ecosystem, 1997–2020, including number of radio-marked female grizzly bears available for sighting during observation flights (m), the number seen zero time (Y_0), seen once (Y_1), the number seen twice (Y_2), and the number of unmarked females bears with cubs (S). Estimates exclude females with cubs observed <500 m from army cutworm moth aggregation sites.

Year	m	Y_0	Y_1	Y_2	S
1997	6	4	2	0	4
1998	4	2	2	0	7
1999	6	5	1	0	7
2000	7	7	0	0	11
2001	8	4	4	0	17[a]
2002	5	5	0	0	29[a]
2003	4	3	1	0	7
2004	4	2	2	0	20
2005	3	3	0	0	14
2006	7	7	0	0	23[a]
2007	5	3	2	0	23[b]
2008	5	3	1	1	19[a]
2009	6	6	0	0	14
2010	3	3	0	0	23[a]
2011	3	2	1	0	16
2012	5	3	2	0	12
2013	10	10	0	0	28
2014	5	4	1	0	12
2015	1	0	1	0	22
2016	2	1	1	0	19
2017	6	4	2	0	18
2018	7	6	1	0	19
2019	8	6	2	0	16
2020[c]	No data for mark-resight estimation				

[a] Numbers decreased from 2013 data due to boundary changes of moth sites.

[b] Numbers increased from 20 to 23 due to boundary changes of moth sites.

[c] Mark-resight estimation was not feasible because of only 1 round of observation flights.

Table 10. Results from mark-resight analysis of female grizzly bears with cubs, Greater Yellowstone Ecosystem, 1997–2019. Data from all years were used to inform sightability, and previous years' posterior distributions were updated based on data from radio-marked females with cubs in 2017. Estimates exclude females with cubs observed <500 m from army cutworm moth aggregation sites.

					Quartile		
Year	Sighted	Marked	Mean	Median	0.025	0.975	$P \leq 48$
1997	4	6	17	15	5	37	0.99
1998	7	4	29	27	12	57	0.93
1999	7	6	29	27	12	57	0.93
2000	11	7	46	44	22	83	0.60
2001	17	8	71	68	38	119	0.11
2002	29	5	121	117	72	192	0
2003	7	4	29	27	12	57	0.93
2004	20	4	83	80	47	138	0.03
2005	14	3	58	56	30	101	0.30
2006	23	7	96	92	55	156	0.01
2007	23	5	96	93	55	156	0.01
2008	19	5	79	76	44	132	0.04
2009	14	6	58	56	30	101	0.30
2010	23	3	96	93	55	155	0.01
2011	16	3	67	64	36	113	0.16
2012	12	5	50	48	25	88	0.49
2013	28	10	117	113	69	186	0
2014	12	5	50	48	25	88	0.50
2015	22	1	92	88	52	150	0.01
2016	19	2	79	76	44	132	0.04
2017	18	6	75	72	41	126	0.07
2018	19	7	81	78	45	137	0.04
2019	16	8	68	65	37	114	0.14
2020[a]	No estimate						

[a] Mark-resight estimation was not feasible because of only 1 round of observation flights.

Table 11. Three-year moving average for mark-resight estimates of female grizzly bears with cubs, Greater Yellowstone Ecosystem, 1998–2019. Estimates exclude females with cubs observed <500 m from army cutworm moth aggregation sites.

				Quartile		
Year	Mean	Median	Mode	0.025	0.975	$P \leq 48$
1998	25	24	23	14	42	0.99
1999	35	34	31	20	56	0.92
2000	49	47	44	30	76	0.54
2001	79	77	75	51	120	0.01
2002	74	72	67	47	112	0.03
2003	78	76	70	50	118	0.02
2004	57	55	53	36	88	0.27
2005	79	77	71	51	120	0.01
2006	83	81	76	54	126	0.01
2007	90	88	81	59	136	0
2008	78	76	72	50	118	0.02
2009	78	76	72	50	117	0.02
2010	74	72	70	47	111	0.03
2011	71	69	68	45	108	0.05
2012	78	76	72	50	118	0.02
2013	72	70	65	46	110	0.04
2014	86	84	81	56	130	0
2015	74	72	68	47	112	0.03
2016	82	80	79	53	124	0.01
2017	80	77	73	52	123	0.01
2018	75	73	69	49	112	0.02

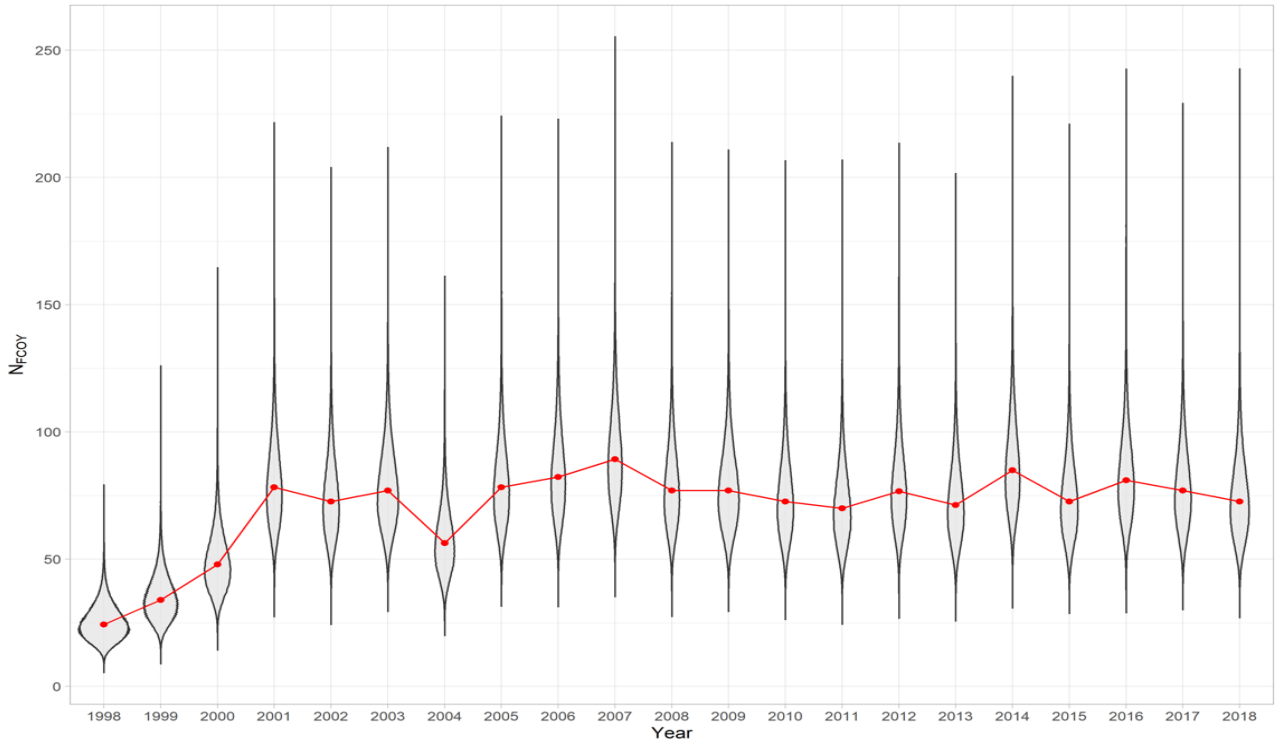

Fig. 4. Annual mark-resight estimates (3-year moving average [red dots], 95 % inter quartile [gray area]) of the number of female grizzly bears with cubs, Greater Yellowstone Ecosystem, 1998–2019. Estimates exclude females with cubs observed <500 m from army cutworm moth aggregation sites.

Occupancy of Bear Management Units (BMU) by Females with Young *(Mark A. Haroldson and Bryn Karabensh, Interagency Grizzly Bear Study Team, U.S. Geological Survey)*

Dispersion of reproductive females throughout the ecosystem is assessed by verified observations of female grizzly bears with young (cubs, yearlings, 2-year-olds, or young of unknown age) by BMU. The requirements specified in the Demographic Recovery Criteria (USFWS 2007*b*) state that 16 of the 18 BMUs must be occupied by females with young on a running 6-year sum with no 2 adjacent BMUs unoccupied. All 18 BMUs had verified observations of female grizzly bears with young during 2020 (Table 12). Eighteen of 18 BMUs contained verified observations of females with young in at least 4 years of the last 6-year (2015–2020) period.

Table 12. Bear Management Units in the Greater Yellowstone Ecosystem occupied by females with young (cubs, yearlings, 2-year-olds, or young of unknown age), as determined by verified reports, 2015–2020.

Bear Management Unit	2015	2016	2017	2018	2019	2020	Years occupied
1) Hilgard	X	X	X	X	X	X	6
2) Gallatin	X	X	X	X	X	X	6
3) Hellroaring/Bear	X	X	X	X	X	X	6
4) Boulder/Slough	X	X	X	X	X	X	6
5) Lamar	X	X	X	X	X	X	6
6) Crandall/Sunlight	X	X	X	X	X	X	6
7) Shoshone	X	X	X	X	X	X	6
8) Pelican/Clear	X	X	X	X	X	X	6
9) Washburn	X	X	X	X	X	X	6
10) Firehole/Hayden	X	X	X	X	X	X	6
11) Madison	X	X	X	X	X	X	6
12) Henry's Lake	X	X	X	X	X	X	6
13) Plateau	X	X	X	X	X	X	6
14) Two Ocean/Lake	X	X	X	X	X	X	6
15) Thorofare	X	X	X	X	X	X	6
16) South Absaroka	X	X	X	X	X	X	6
17) Buffalo/Spread Creek	X	X	X	X	X	X	6
18) Bechler/Teton		X		X	X	X	4
Total	17	18	17	18	18	18	

Grizzly Bear Occupied Range in the Greater Yellowstone Ecosystem, 1990–2020 *(Daniel D. Bjornlie, Wyoming Game and Fish Department; and Mark A. Haroldson, Interagency Grizzly Bear Study Team, U.S. Geological Survey)*

The GYE grizzly bear population had been reduced to only a few hundred bears when it was first listed as threatened under the Endangered Species Act (ESA) in 1975. As the population increased in the intervening years, grizzly bears have reoccupied areas of their former range, including areas where their presence has not been known for over 100 years. Documenting range expansion has become an important part of grizzly bear population monitoring, providing researchers, managers, and the public with spatial data on grizzly bear presence necessary to inform conservation and management.

From its inception, the IGBST has recorded confirmed locations of grizzly bears throughout the GYE as part of routine population monitoring. These locations have been used to create periodic estimates of occupied grizzly bear range since the early 1980s (Basile 1982, Blanchard 1992, Schwartz et al. 2002, Schwartz et al. 2006). Bjornlie et al. (2014) developed a new technique that uses all confirmed grizzly bear locations. Those locations are first overlaid on a grid of 3-km cells to determine occupancy and the areas surrounding the centers of occupied cells are then interpolated to create a surface of occupied range (Bjornlie et al. 2014). Since the adoption of this method, biannual updates of grizzly bear occupied range have revealed steady range expansion. Additionally, reanalysis of location data dating back to the 1970s provides estimates of historical grizzly bear range for direct comparison with current results.

Because grizzly bears are a long-lived species and the collection of confirmed locations over the entire GYE is not feasible on an annual basis, Bjornlie et al. (2014) recommended that location data be pooled over a 15–20 year period to ensure the data provide an accurate representation of grizzly bear occupied range. Therefore, we used a 15-year period of location data in a moving window analysis to provide annual estimates of occupied range. Thus, an annual estimate contains location data from that year and the previous 14 years (e.g., 2006–2020 for the reported year 2020). This report is an update of the 2018 occupied range analysis presented in the 2018 IGBST annual report (Bjornlie and Haroldson 2019).

Using this technique, analysis of grizzly bear locations from 1976 through 1990 produced an estimate of GYE grizzly bear occupied range almost entirely contained within the Grizzly Bear Recovery Zone established in the 1993 Grizzly Bear Recovery Plan (USFWS 1993) (Fig. 5). By 2000, occupied range had grown slightly to the south and east but was still mostly contained within the Recovery Zone (Fig. 5). However, in the 2000s, range expansion gained momentum and larger increases were seen, especially in mountainous terrain to the northwest and southeast of the GYE Recovery Zone (Fig. 5). The addition of 2019–2020 location data resulted in nearly all the Absaroka and Beartooth Ranges falling within grizzly bear occupied range, as well as the entire Wind River Range. To the west, the entirety of the Centennial Mountains and Gravelly Range were included, along with a portion of the Ruby Range, a recent increase from the previous 2018 analysis (Bjornlie and Haroldson 2019) (Fig. 5). To provide spatial perspective, the southeastern extent of 2020 occupied range at the tip of the Wind River Range is closer to the towns of Salt Lake City, Utah (294 km), and Fort Collins, Colorado (366 km), than it is to Bozeman, Montana (405 km), at the northern extent of GYE grizzly bear range.

From 1990 through 2020, the area of occupied range has increased steadily at a rate of 4% per year from just over 23,000 to 70,468 km^2 (Figs. 5 and 6). Grizzly bear occupied range now includes 97.9% of the DMA and has expanded 40 kilometers (km) beyond the DMA boundary to the east and west and by as much as 60 km in the Wyoming Range in the southwestern portion of the GYE. The 2020 data show that 30.6% of GYE grizzly bear range is now outside the DMA boundary (Fig. 6). As grizzly bears advance into new areas, they are encountering more human-dominated landscapes, many of which are private lands dominated by agricultural uses. By 1990, just over 600 km^2 of private lands were encompassed within grizzly bear occupied range, an area half the size of Grand Teton National Park. By 2020, over 12,000 km^2 of private lands occurred within occupied range, an area more than 2,000 km^2 larger than Yellowstone and Grand Teton National Parks and the John D. Rockefeller Parkway combined (Fig. 7). The expansion into private lands can result in an increased potential for human-bear conflicts.

There were only a few confirmed grizzly bear locations outside occupied range in 2019 and 2020. The location farthest beyond occupied range was a 2020 verified location at the southern tip of the Wyoming Range in western Wyoming, approximately 33 km north of the town of Kemmerer and over 100 km south of the DMA boundary (Fig. 8). This site is the most southerly confirmed location of a grizzly bear in the GYE since well before recovery efforts began. This location adds to other wide-ranging locations of bears from 2018 when

grizzly bear tracks were confirmed near Ocean Lake, approximately 25 km northwest of Riverton, Wyoming, and a family group that was captured near the town of Byron, approximately 50 km northeast of Cody, Wyoming.

Verified locations of grizzly bears in places novel in recent history have become relatively common in many areas of the GYE and beyond. Confirmed locations from 2018–2020 west of Interstate Highway 15 in the Pioneer Mountains and Big Hole Valley near Wisdom, Montana, and in the Bitterroot Recovery Zone in central Idaho, are located outside the Yellowstone Distinct Population Segment and could be bears originating from either the Greater Yellowstone population or the Northern Continental Divide population in northwestern Montana. These outlying locations do not necessarily constitute occupied range but reveal the leading edges of grizzly bear expansion within and between ecosystems. The recovery of grizzly bears in the GYE is an important wildlife conservation success story, but this success presents formidable new challenges for wildlife managers and people living, working, and recreating in these areas, particularly in recently occupied areas where bear resistant infrastructure often does not exist.

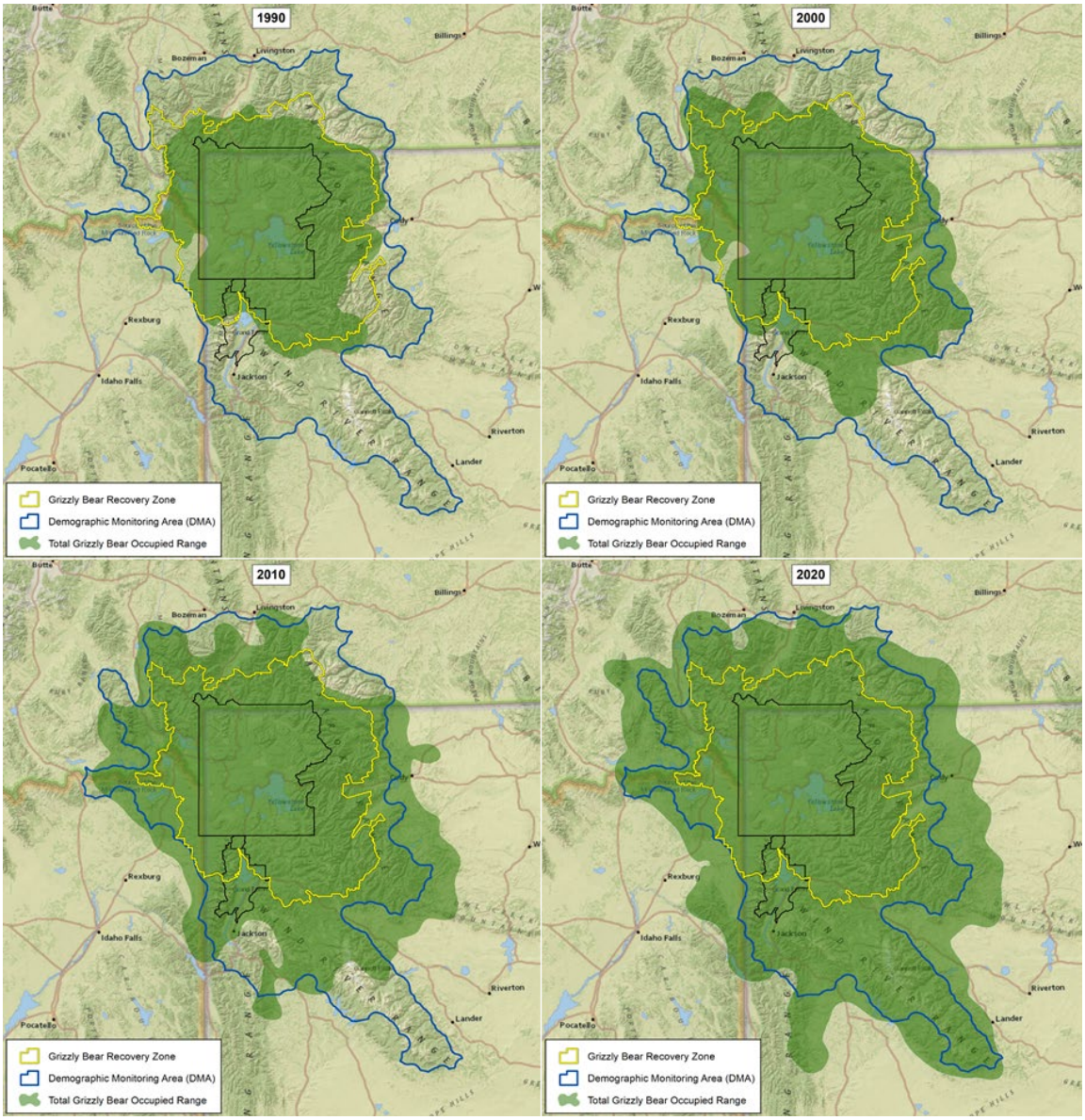

Fig. 5. Grizzly bear occupied range (green shaded area) in the Greater Yellowstone Ecosystem based on 15-year data windows ending in 1990, 2000, 2010, and 2020. Base Map Source: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

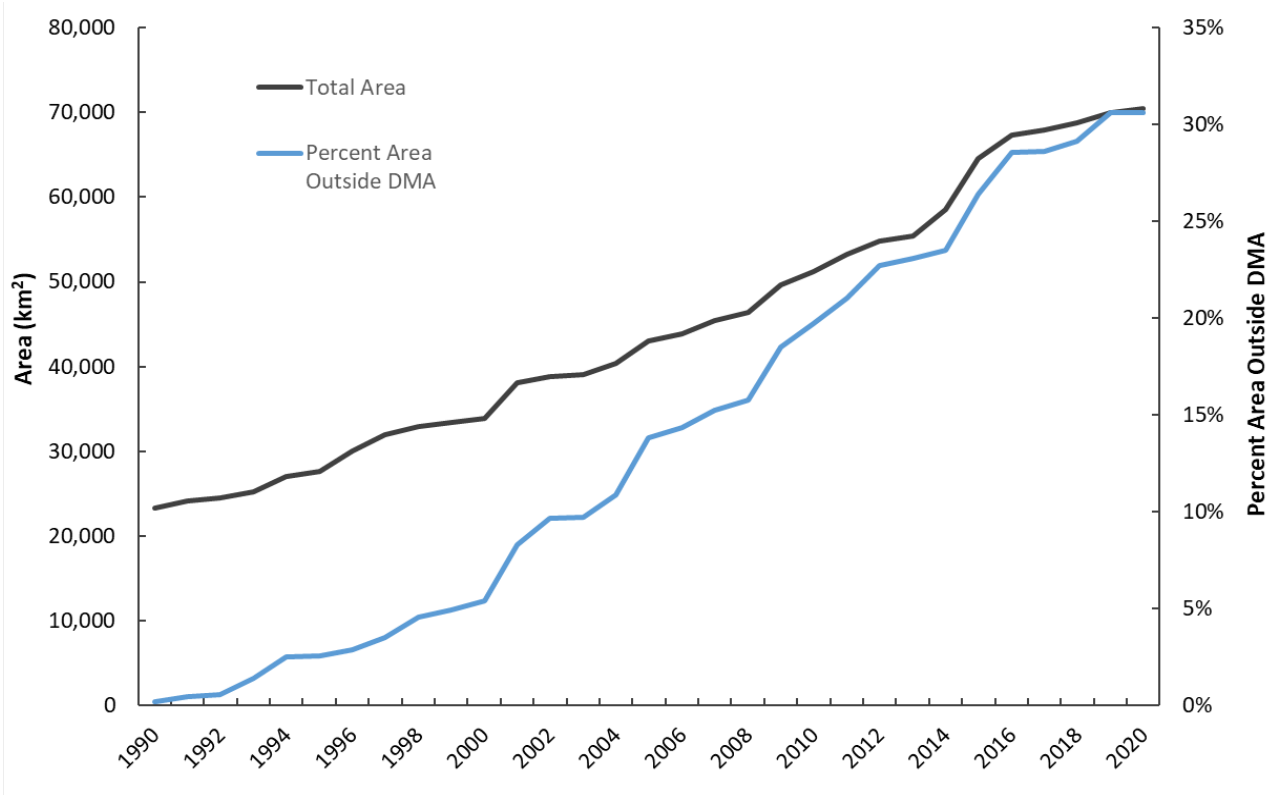

Fig. 6. Total area of grizzly bear occupied range and percent of area of occupied range outside the Demographic Monitoring Area (DMA) in the Greater Yellowstone Ecosystem, 1990–2020.

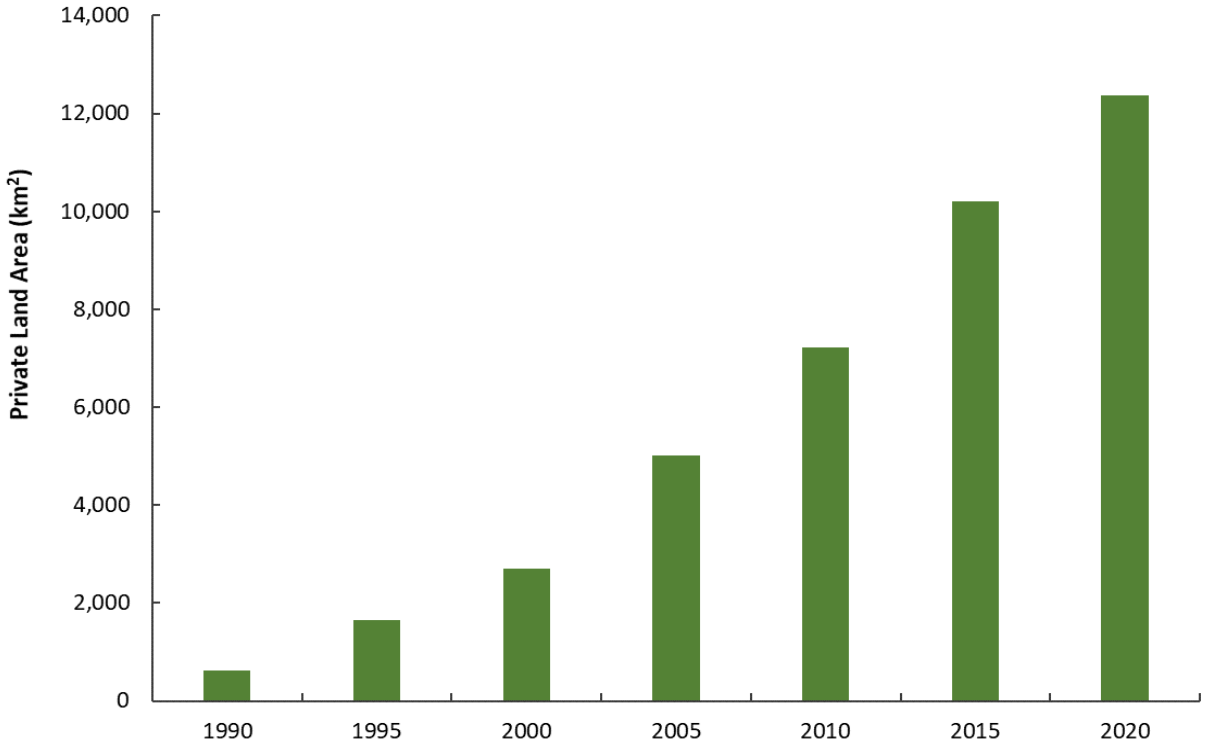

Fig. 7. Area of private land within grizzly bear occupied range in the Greater Yellowstone Ecosystem in 5-year intervals, 1990–2020.

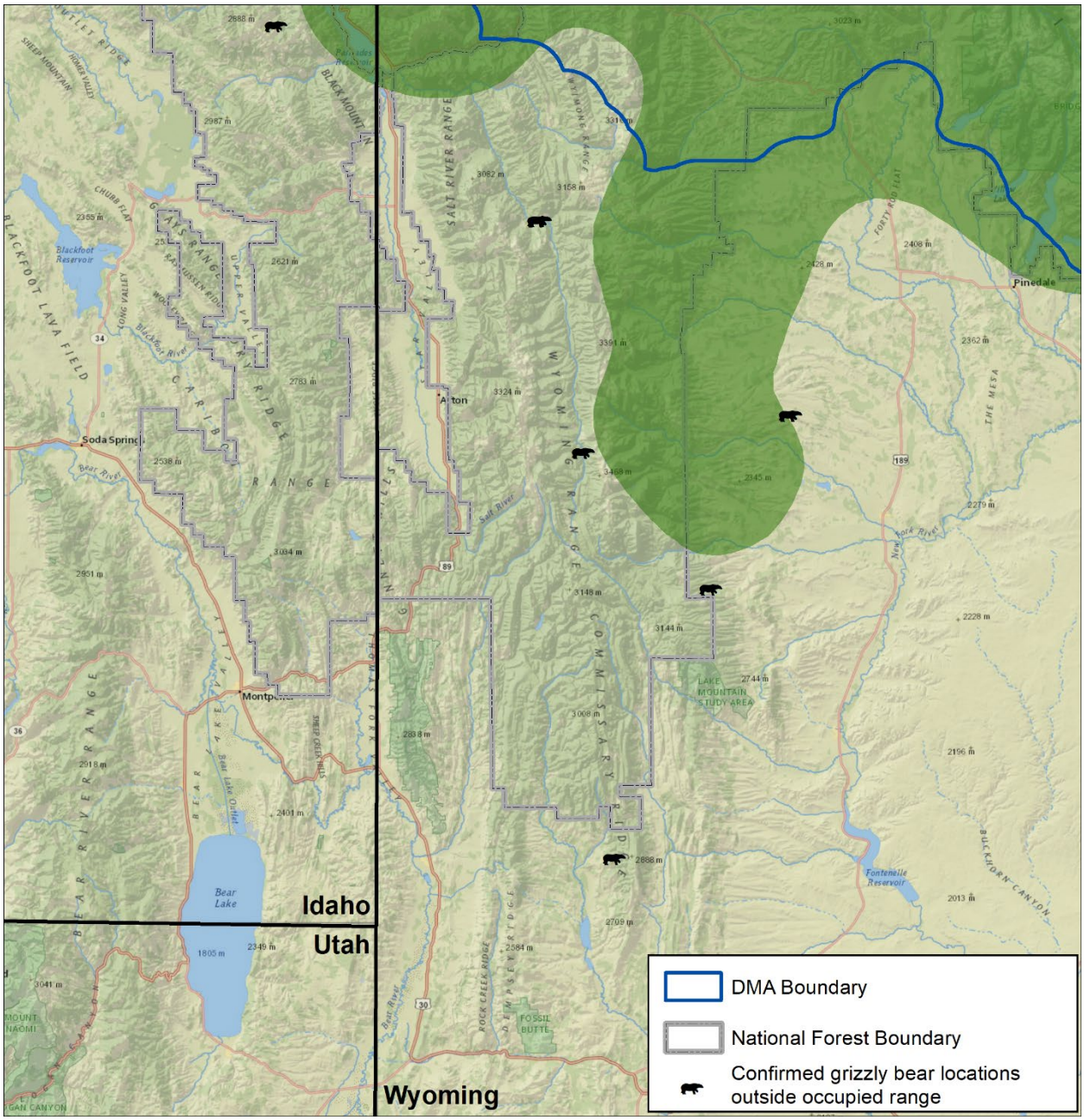

Fig. 8. Grizzly bear occupied range (green shaded area) and confirmed locations at the southern extent of the Wyoming Range in western Wyoming, 2020 (2006-2020 data). Base Map Source: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Observation Flights *(Bryn E. Karabensh, Interagency Grizzly Bear Study Team, U.S. Geological Survey)*

Fifty-four Bear Observation Areas (BOAs, Fig. 9) were established in 2014. In 2020, one round of observation flights was conducted: 36 BOAs were surveyed during this round 1 (10 Jun–16 Aug). Total duration of observation flight time was 78.5 hours; average duration of individual flights was 2.2 hours (Table 13). Excluding dependent young, 303 bear sightings were recorded during observation flights. Of the 303 sightings, 9 were radio-marked bears (2 females with young, 5 females without young, and 2 males), 222 were solitary unmarked bears, and 72 were unmarked females with young (Table 13). Our observation rate was 3.86 bears/hour for all bears. A total of 129 young (71 cubs, 54 yearlings, and 4 2-year-olds) were observed (Table 14). Observation rates for females with dependent young were 0.94 females with young/hour and 0.51 females with cubs/hour (Table 13).

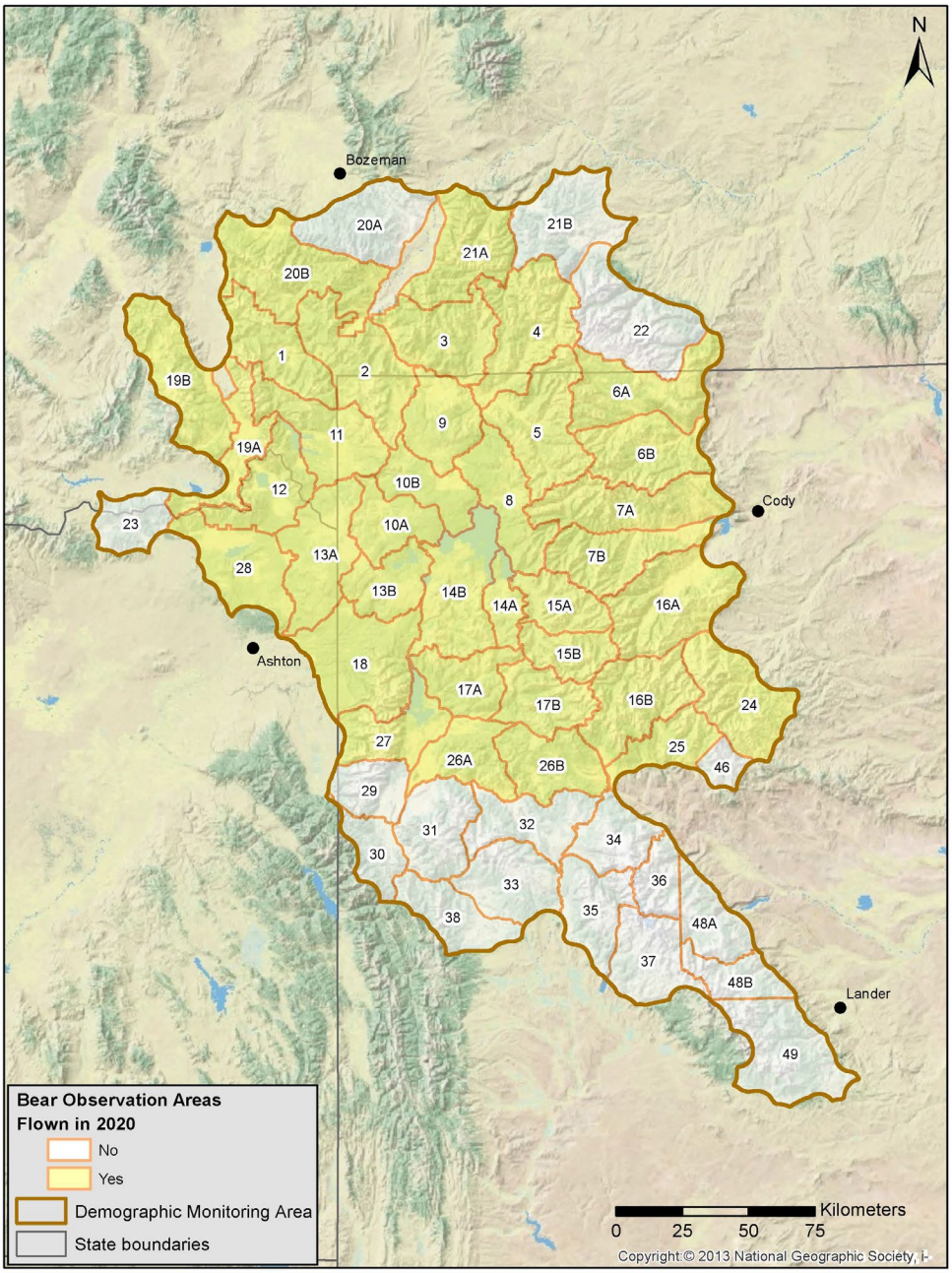

Fig. 9. Grizzly bear observation areas for aerial surveys, Greater Yellowstone Ecosystem, 2020. Areas in yellow were surveyed in 2020, areas in white shading were not surveyed. Numbers represent the 54 Bear Observation Areas, with several larger areas split into 2 subsections (A and B). Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

Table 13. Annual summary statistics for grizzly bear observation flights, Greater Yellowstone Ecosystem, 2006–2020.

Year	Observation period	Total hours	Number of flights	Average hours/flight	Bears seen					Observation rate (bears/hour)		
					Marked		Unmarked		Total number of groups	All groups	With young	With cubs
					Lone	With young	Lone	With young				
2006[a]	Round 1	89.3	37	2.4	2	1	106	35	144	1.61		
	Round 2	77	33	2.3	3	1	76	24	104	1.35		
	Total	166.3	70	2.3	5	2	182	59	248	1.49	0.37	0.27
2007[a]	Round 1	99	44	2.3	2	1	125	53	181	1.83		
	Round 2	75.1	30	2.5	0	4	96	20	120	1.6		
	Total	174.1	74	2.4	2	5	221	73	301	1.73	0.45	0.29
2008[a]	Round 1	97.6	46	2.1	2	1	87	36	126	1.29		
	Round 2	101.5	45	2.3	2	3	185	53	243	2.39		
	Total	199.1	91	2.2	4	4	272	89	369	1.85	0.47	0.23
2009[a]	Round 1	90.3	47	1.9	1	0	85	21	107	1.18		
	Round 2	93.6	47	2	2	0	157	34	193	2.06		
	Total	183.9	94	2	3	0	242	55	300	1.63	0.3	0.15
2010[a]	Round 1	101.1	48	2.1	0	2	93	22	117	1.16		
	Round 2	93.3	46	2	0	0	161	41	202	2.17		
	Total	194.4	94	2.1	0	2	254	63	319	1.64	0.33	0.2
2011[a]	Round 1	88.9	47	1.9	2	1	153	31	187	2.1		
	Round 2	71	35	2	4	0	109	23	136	1.92		
	Total	159.8	82	1.9	6	1	262	54	323	2.02	0.34	0.18
2012[a]	Round 1	95.4	48	2	4	2	178	35	219	2.3		
	Round 2	73.7	35	2.1	2	1	117	30	150	2.04		
	Total	169.1	83	2	6	3	295	65	369	2.18	0.4	0.23
2013[a]	Round 1	97	48	2	2	1	152	44	199	2.05		
	Round 2	72.8	35	2.1	4	1	171	48	224	3.08		
	Total	169.8	83	2.1	6	2	323	92	423	2.49	0.55	0.39
2014[a]	Round 1	104	52	2	2	2	170	47	221	2.13		
	Round 2	88.6	43	2.1	3	1	188	60	252	2.84		
	Total	192.6	95	2	5	3	358	107	473	2.46	0.57	0.27
2015[a]	Round 1	104	52	2	4	1	126	34	165	1.59		
	Round 2	88.6	44	2	1	2	142	41	186	2.1		
	Total	192.7	96	2	5	3	268	75	351	1.82	0.4	0.23
2016[a]	Round 1	106.8	53	2	5	3	133	36	177	1.66		
	Round 2	86.5	42	2.1	1	2	95	32	130	1.5		
	Total	193.3	95	2	6	8	228	68	307	1.59	0.4	0.24
2017[a]	Round 1	105.5	54	1.95	7	2	153	36	198	1.88		
	Round 2	79	40	1.98	8	2	127	36	173	2.19		
	Total	184.5	94	1.97	15	4	280	72	371	2	0.4	0.27
2018[a]	Round 1	105.8	54	1.96	6	3	185	58	252	2.38		
	Round 2	73.6	40	1.84	1	1	105	35	142	1.93		
	Total	179.4	94	1.91	7	4	290	93	394	2.2	0.54	0.32
2019[a]	Round 1	107.8	54	2	7	4	183	56	251[b]	2.33		
	Round 2	91	42	2.17	9	1	188	43	242[c]	2.66		
	Total	198.8	96	2.07	16	5	371	99	493	2.48	0.52	0.21
2020[a]	Round 1	78.5	36	2.18	7	2	222	72	303	3.86		
	Round 2											
	Total	78.5	36	2.18	7	2	222	72	303	3.86	0.94	0.51

[a] Dates of flights (Round 1, Round 2): 2006 (5 Jun–9 Aug, 30 Jun–28 Aug); 2007 (24 May–2 Aug, 21 Jun–14 Aug); 2008 (12 Jun–26 Jul, 1 Jul–23 Aug); 2009 (26 May–17 Jul, 8 Jul–27 Aug); 2010 (8 Jun–22 Jul, 10 Jul–24 Aug); 2011 (15 Jun–17 Aug, 21 Jul–29 Aug); 2012 (29 May–30 Jul, 9 Jul–23 Aug); 2013 (6 Jun–25 Jul, 7 Jul–20 Aug); 2014 (10 Jun–25 Jul, 7 Jul–29 Aug); 2015 (1 Jun–21 Jul, 1 Jul–31 Aug); 2016 (2 Jun–24 Jul, 7 Jul–28 Aug); 2017 (1 Jun–31 Aug, 4 Jul–28 Aug); 2018 (12 Jun-13 Aug, 10 Jul-29 Aug); 2019 (4 Jun–6 Aug, 4 Jul–28 Aug); 2020 (10 Jun–16 Aug, not surveyed).

[b] Includes observation of 3 COY without adult female present

[c] Includes observation of 2 COY without adult female present

Table 14. Size and age composition of grizzly bear family groups seen during observation flights, Greater Yellowstone Ecosystem, 2006–2020.

		Females with cubs (number of cubs)			Females with yearlings (number of yearlings)			Females with 2-year-olds or young of unknown age (number of young)		
Year	Round	1	2	3	1	2	3	1	2	3
2006[a]	Round 1	8	12	7	4	2	2	1	0	0
	Round 2	5	11	2	2	1	0	2	2	0
	Total	13	23	9	6	3	2	3	2	0
2007[a]	Round 1	7	21	9	8	6	0	2	1	0
	Round 2	2	6	6	3	2	3	0	2	0
	Total	9	27	15	11	8	3	2	3	0
2008[a]	Round 1	3	10	0	9	5	2[b]	6	2	0
	Round 2	9	21	3	7	8	3	3	2	0
	Total	12	31	3	16	13	5[b]	9	4	0
2009[a]	Round 1	0	6	4	2	3	1	3	1	0
	Round 2	6	11	1	3	7	1	4	1	1
	Total	6	17	5	5	10	2	7	1	1
2010[a]	Round 1	2	7	2	2	6	1	4	0	0
	Round 2	10	10	7	5	4	3	1	4	3
	Total	12	17	9	7	10	4	5	4	3
2011[a]	Round 1	4	8	3	3	6	1	2	2	3
	Round 2	2	8	4	2	2	1	1	3	0
	Total	6	16	7	5	8	2	3	5	3
2012[a]	Round 1	5	19	1	2	3	4	0	2	1
	Round 2	5	9	0	4	6	2	1	3	1
	Total	10	28	1	6	9	6	1	5	2
2013[a]	Round 1	8	20	4	1	5	0	3	4	0
	Round 2	11	21	3[c]	2	7	0	0	5	0
	Total	19	41	7[c]	3	12	0	3	9	0
2014[a]	Round 1	8	17	3	6	14	0	1	0	0
	Round 2	1	15	8	11	18	3	2	2	1
	Total	9	32	11	17	32	3	3	2	1
2015[a]	Round 1	6	18	15	2	20	6	0	2	0
	Round 2	9	22	12	2	24	6	2	0	4[d]
	Total	15	40	27	4	44	12	2	2	4[d]
2016[a]	Round 1	3	16	2	5	8	1	2	2	0
	Round 2	8	11	6	2	4	1	1	1	0
	Total	11	27	8	7	12	2	3	3	0
2017[a]	Round 1	6	14	3	4	7	2	0	2	0
	Round 2	5	20	2	5	3	0	1	1	1
	Total	11	34	5	9	10	2	1	3	1
2018[a]	Round 1	7	24	10	5	7	2[b]	3	3	0
	Round 2	5	8	4	6	11	2	0	0	0
	Total	12	32	14	11	18	4	3	3	0
2019[a]	Round 1	11	10	2[c]	9	16	5	6	0	1
	Round 2	2	14	3	8	14	2	0	1	0
	Total	13	24	5	17	30	7	6	1	1
2020[a]	Round 1	10	29	1	12	18	2	0	2	0
	Round 2									
	Total	10	29	1	12	18	2	0	2	0

[a] Dates of flights (Round 1, Round 2): 2006 (5 Jun–9 Aug, 30 Jun–28 Aug); 2007 (24 May–2 Aug, 21 Jun–14 Aug); 2008 (12 Jun–26 Jul, 1 Jul–23 Aug); 2009 (26 May–17 Jul, 8 Jul–27 Aug); 2010 (8 Jun–22 Jul, 10 Jul–24 Aug); 2011 (15 Jun–17 Aug, 21 Jul–29 Aug); 2012 (29 May–30 Jul, 9 Jul–23 Aug); 2013 (6 Jun–25 Jul, 7 Jul–20 Aug); 2014 (10 Jun–25 Jul, 7 Jul–29 Aug); 2015 (1 Jun–21 Jul, 1 Jul–31 Aug); 2016 (2 Jun–24 Jul, 7 Jul–28 Aug); 2017 (1 Jun–31 Aug, 4 Jul–28 Aug); 2018 (12 Jun-13 Aug, 10 Jul-29 Aug); 2019 (4 Jun–6 Aug, 4 Jul–28 Aug); 2020 (10 Jun–16 Aug, not surveyed).

[b] Includes 1 female with 4 yearlings.

[c] Includes 1 female with 4 cubs.

[d] Includes 1 female with 4 young of unknown age.

Telemetry Location Flights *(Bryn E. Karabensh, Interagency Grizzly Bear Study Team, U.S. Geological Survey)*

Ninety-six telemetry location flights were conducted during 2020, resulting in 271.1 hours of search time (excluding ferry time to and from airports; Table 15). Flights were conducted at least once during all months, with 69% of telemetry flights in May–November. During telemetry flights, 1,017 locations of bears equipped with radio transmitters were collected, 294 (29%) of which included a visual sighting. Fifty-five sightings of unmarked bears were also obtained during telemetry flights, including 41 solitary bears and 10 females with cubs. No females with yearlings or 2-year-old bears were observed during these flights in 2020. Rate of observation for all unmarked bears during telemetry flights was 0.20 bears/hour; and 1.08 bears/hour for marked bears. The observation rate during telemetry flights for unmarked females with cubs was 0.04 females with cubs/hour.

To reduce flight time and costs associated with aerial telemetry and obtain higher-frequency data, we began deploying satellite Global Positioning System (GPS) collars in 2012 using Argos and Iridium platforms. Since 2014, only Iridium satellite collars have been deployed. These GPS collars are different from those that store GPS locations onboard, which we have deployed since 2000, by providing the ability to download GPS location data via satellites at will or on a fixed schedule. Only Iridium platforms were on the air in 2020. We deployed 30 Iridium GPS collars in 2020, obtaining over 114,900 GPS locations from 50 grizzly bears (newly and previously deployed GPS collars).

Table 15. Summary statistics for radio-telemetry flights to locate grizzly bears, Greater Yellowstone Ecosystem, 2020.

				Radio-marked bears			Unmarked bears observed					
								Number of females			Observation rate (no. groups/hour)	
Month	No. hours	No. flights	Mean no. hours/flight	No. locations	No. seen	Observation rate (no. groups/hr)	Lone bears	With cubs	With yearlings	With young	All groups	Females with cubs
Jan	4.4	5	0.9	53	0	---	0	0	0	0	---	---
Feb	4.2	5	0.8	50	0	---	0	0	0	0	---	---
Mar	16.9	7	2.4	106	4	---	0	0	0	0	---	---
Apr	27	8	3.4	109	38	---	0	0	0	0	---	---
May	30.8	9	3.4	91	59	---	0	0	0	0	---	---
June	35.2	12	2.9	88	52	1.48	14	1	0	0	0.40	0.03
July	27.8	10	2.8	86	50	1.80	14	6	0	0	0.50	0.22
Aug	30.2	9	3.4	91	38	1.26	12	3	0	0	0.40	0.10
Sept	34.1	9	3.8	87	19	0.56	5	0	0	0	0.15	---
Oct	28.3	8	3.5	92	25	---	0	0	0	0	---	---
Nov	20.4	9	2.3	95	9	---	0	0	0	0	---	---
Dec	11.8	5	2.4	69	0	---	0	0	0	0	---	---
Total	271.1	96	2.8	1017	294	1.08	45	10	0	0	0.17	0.04

Documented Grizzly Bear Mortalities in the GYE and Estimated Percent Mortality for the Demographic Monitoring Area *(Mark A. Haroldson, U.S. Geological Survey, Interagency Grizzly Bear Study Team; and Kevin L. Frey, Montana Fish, Wildlife and Parks)*

Under the 2017 Revised Demographic Criteria for the Yellowstone Ecosystem, which were amended to the Grizzly Bear Recovery Plan (USFWS 1993, USFWS 2017), the IGBST is tasked with documenting grizzly bear mortalities in the DMA and evaluating mortality levels (Demographic Recovery Criterion 3). We evaluate mortalities for population segments within the DMA by deriving estimates of total mortality for independent-age (≥2 years old) females and independent-age males, including estimates of unknown/unreported mortalities (Cherry et al. 2002). We then determine the total annual mortality rate for these segments as a percent of their respective population estimates. For dependent bears (≤2 years old), we determine the percent of human-caused mortality relative to size of the population segment but do not include estimates of unknown/unreported mortality. Here, we report numbers of known and probable mortalities in the GYE, numbers by sex and age class inside and outside the DMA, and estimates of percent total mortality relative to population segments within the DMA.

We use the definitions provided in Craighead et al. (1988) to classify grizzly bear mortalities in the GYE relative to the degree of certainty regarding each event. Cases in which a carcass is physically inspected or when a management removal occurs are classified as "known" mortalities. Instances are classified as "probable" where evidence strongly suggests a mortality has occurred, but no carcass is recovered. When evidence is circumstantial, with no prospect for additional information, a "possible" mortality is designated. Possible mortalities are not included in the assessment of percent annual mortalities. We continue to tabulate possible mortalities because they provide an additional source of location information for grizzly bears and possible causes of mortalities in the GYE.

2020 Mortality Results

We documented 62 known and probable mortalities in the GYE during 2020, of which 2, both adult females (Table 16, #202007, #202040), occurred during 2019. These 2 mortalities occurred within the DMA and one (#202007) remains under investigation.

Of the 60 known and probable mortalities that occurred during 2020, 47 (78.3%) were attributable to human causes (Table 16, Fig. 10). Ten of the 60 known and probable losses remain under investigation by U.S. Fish and Wildlife Service and state law enforcement agencies (Table 16). Specific information related to these mortalities is not provided because of ongoing investigations. However, these 10 mortalities are included in the following summaries.

Ten (21.3%) of the 47 human-caused losses were the result of reported self-defense kills, 7 from hunting-related incidents, 1 by a horn hunter, 1 in a sheep camp, and 1 by a range rider investigating a domestic cow carcass. One of the self-defense kills by a hunter involved a female accompanied by 2 cubs, one of which was killed by another bear at the site after the mother was killed and the other was considered a probable loss. Fourteen (29.8%) of the 47 human-caused losses were due to management removals for livestock depredations. Fourteen (29.8%) were related to anthropogenic site conflicts. Other human-caused losses included 5 (10.6%) mortalities from vehicle strikes, 3 bears maliciously killed by gunshots and left in the field, and 1 mistaken identity kill by a black bear hunter.

We documented 11 natural mortalities in 2020 (Table 16). All were cubs lost from 6 different radio-marked females who lost from 1 to 3 cubs each.

We recorded 2 mortalities for which cause of death could not be determined. These were discovered and reported during the fall of 2020.

We documented 4 incidents considered possible mortalities during 2020 (Table 16). Two of these events involved shots fired in self-defense at charging bears by archery hunters. Another involved a resident responding to a barking dog and encountering a bear at close range breaking into a feed shed where shots were fired at the bear. In all 3 of these instances, no evidence was found that a mortality was likely to have occurred. Lastly, we include as a possible mortality a bear that was struck by a vehicle and laid in the ditch for several minutes after the impact before it was able to stand and walk away from the scene.

We evaluated known and probable mortalities relative to population estimates only for the DMA. Of the 60 known and probable documented mortalities occurring in 2020, 41 occurred within the boundaries of the DMA and 19 (32%) occurred outside (Table 17, Fig. 10). Sex determination for 2 reported mortalities of independent-age bears from 2020 is pending DNA results. We used a random generator to attribute sex to these 2 incidents with results indicating male for both (#202049 and #202051; Table 16). During 2020, we documented 10 mortalities of independent-age female bears within the DMA (Table 17). There were 2 management removals, 2 radio-marked losses, and 6 reported losses (Table 18). Estimated total mortality for

independent-age females was 7.5% of the 2020 estimate for this segment of the population (Table 18). Fourteen known and probable mortalities of independent-age males occurred within the DMA (Table 17). We documented 11 management removals, 1 radio-marked loss, and 2 reported losses of independent-age males within the DMA, plus the 2 reported mortalities for which sex was unknown that the random generator assigned as males (Table 17). Estimated total mortality for independent males was 8.7% of the 2020 estimate for this segment of the population (Table 18). There were 4 known or probable human-caused losses of dependent young documented in the DMA during 2020 (Table 18). Estimated human-caused loss for dependent young was 1.8% within the DMA (Table 18).

One documented mortality from 2012 remains under investigation, as do 3 from 2013, 4 from 2015, 8 from 2016, 3 from 2017, 14 from 2018, and 7 from 2019 (including #202007). No mortalities documented during 2009, 2010, 2011, or 2014 remain under investigation. Specific information pertaining to closed mortality investigations will be updated in the respective annual IGBST Mortality Lists as they become available. We remind readers that some cases can remain open and under investigation for extended periods. The study team cooperates with federal and state law enforcement agencies and cannot release information that could compromise ongoing investigations.

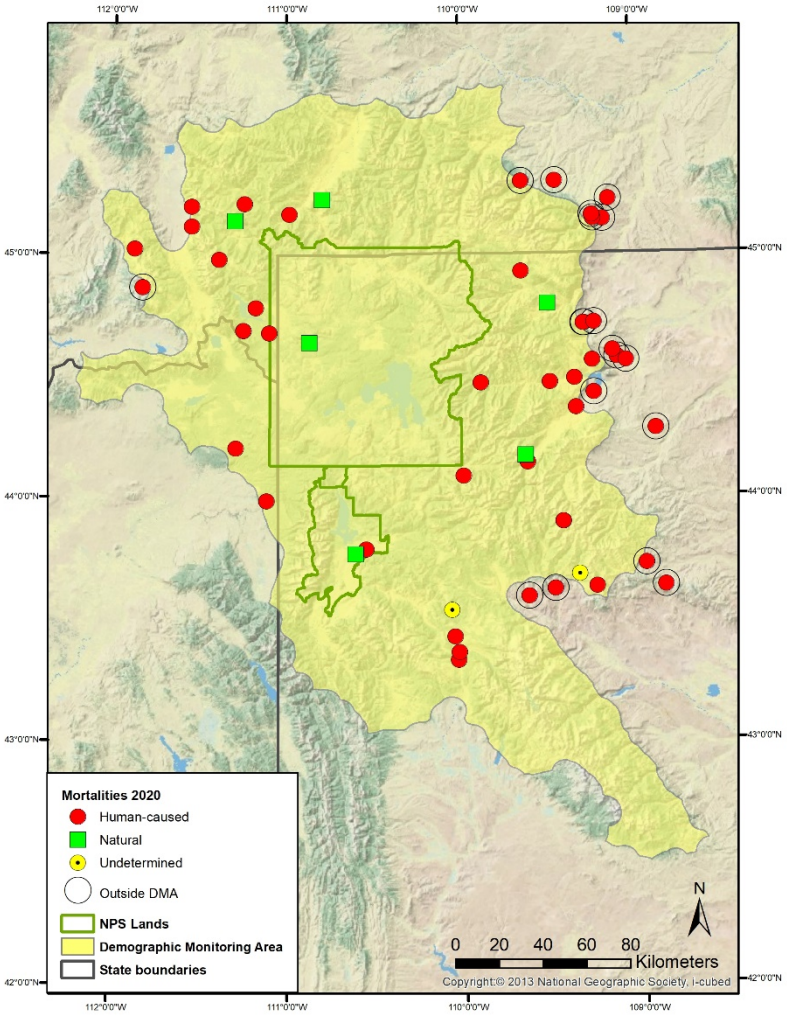

Fig. 10. Distribution of 62 known and probable grizzly bear mortalities documented in the Greater Yellowstone Ecosystem during 2020, including 2 mortalities that likely occurred during the fall of 2019. Forty-one of the documented mortalities occurring in 2020 were within the Demographic Monitoring Area (DMA), of which 28 were attributed to human causes. Nineteen mortalities occurred outside the DMA (black circles around symbols), all of which were attributed to human causes. Due to multiple bear mortalities at a specific location or separate mortalities occurring close to one another, not all 62 locations are visible on this map. Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

Table 16. Grizzly bear mortalities documented in the Greater Yellowstone Ecosystem, 2020.								
Unique #	Bear [a]	Sex [b]	Age [c]	Date	Location [d]	Monitoring Area [e]	Certainty	Loss
202001	984	M	Subadult	4/25/2020	Cottonwood Crk, BOR-WY	Outside DMA	Known	Human-caused, management removal of bear #984 for repeated conflicts in developed areas and failed attempts to haze bear away from developments.
202002	802	M	Adult	4/29/2020	Snake River, PR-WY	Inside DMA	Known	Human-caused, management removal of bear #802 for obtaining numerous food rewards, property damage, and entering structures.
202003	834	M	Adult	5/5/2020	North Fork Shoshone, PR-WY	Inside DMA	Probable	Human-caused, management removal of bear #834 for repeat offenses in developed area, property damage, and killing chickens.
202004	G263	M	Subadult	5/7/2020	Cottonwood Crk, PR-WY	Outside DMA	Known	Human-caused, vehicle strike of bear G263 on State Highway 120.
202005	Unm	M	Subadult	5/9/2020	Cottonwood Crk, BOR-WY	Outside DMA	Known	Human-caused, management capture and removal of subadult male for frequenting developed areas and close proximity to Cody.
202006				2020	WY	Outside DMA	Known	UNDER INVESTIGATION.
202007				2019	WY	Inside DMA	Known	UNDER INVESTIGATION.
202008	879	M	Adult	6/7/2020	Wolf Crk, PR-MT	Outside DMA	Known	Human-caused, management capture and removal of bear #879 for cattle depredations.
202009	Unm	F	Adult	6/17/2020	South Dry Crk, ST-MT	Outside DMA	Known	Human-caused, management capture and removal for cattle depredations.
202010	Unm	M	Adult	6/17/2020	South Fork Owl Crk, PR-WY	Outside DMA	Known	Human-caused, management capture and removal for cattle depredations.
202011	Unm	F	Subadult	6/18/2020	Ghost Crk, SNF-WY	Inside DMA	Known	Human-caused, management capture and removal for bold and aggressive behavior towards humans.
202012	Unm	M	Subadult	6/19/2020	Bear Crk, PR-MT	Outside DMA	Known	Human-caused, management capture and removal for cattle depredations.
202013	Unm	M	Subadult	6/20/2020	South Fork Dry Crk, PR-WY	Outside DMA	Known	Human-caused, vehicle strike on State Highway 120.
202014	936	M	Adult	7/3/2020	Fence Crk, BTNF-WY	Inside DMA	Known	Human-caused, management capture and removal of bear #936 for cattle depredations.
202015	Unm	M	Subadult	7/3/2020	Grayling Arm-Hebgen Lake, CGNF-MT	Inside DMA	Known	Human-caused, management capture and live removal for multiple food rewards and nuisance activity at a campground and private residences.
202016	Unm	M	Subadult	7/12/2020	West Rosebud Crk, PR-MT	Outside DMA	Known	Human-caused, management capture and removal for cattle depredations.

Table 16. Continued.								
Unique #	Bear [a]	Sex [b]	Age [c]	Date	Location [d]	Monitoring Area [e]	Certainty	Loss
202017	Unm	F	Subadult	7/23/2020	Bear Crk, PR-MT	Outside DMA	Known	Human-caused, management capture and removal for cattle depredations.
202018	168	M	Adult	7/30/2020	Wagon Crk, BTNF-WY	Inside DMA	Known	Human-caused, management capture and removal of bear #168 for cattle depredations. Bear was in poor condition.
202019	813	M	Adult	7/30/2020	Tom Miner Crk, PR-MT	Inside DMA	Known	Human-caused, management capture and removal of bear #813 for cattle depredations.
202020	Unm	F	Subadult	8/2/2020	South Fork Shoshone, PR-WY	Outside DMA	Known	Human-caused, management capture and removal for nuisance activity, obtaining food rewards, and habituated behavior at multiple residencies.
202021	1006	M	Subadult	8/7/2020	Eagle Crk, SNF-WY	Inside DMA	Known	Human-caused, management capture and removal of bear #1006 for nuisance activity, obtaining food rewards, and habituated behavior at multiple sites.
202022	Unm	F	Subadult	8/28/2020	Elk River, BDNF-MT	Outside DMA	Known	Human-caused, self-defense kill in sheep camp.
202023	Unm	F	Adult	8/29/2020	Blaine Crk, PR-WY	Outside DMA	Known	Human-caused, management capture and removal for cattle depredations.
202024	Unm	F	Subadult	8/30/2020	Blaine Crk, PR-WY	Outside DMA	Known	Human-caused, management capture and removal for cattle depredations.
202025	1014	F	Subadult	9/1/2020	Denny Crk, PR-MT	Inside DMA	Known	Human-caused, management capture and removal of bear #1014 for property damage and obtaining food rewards at multiple residences.
202026	1015	M	Subadult	9/1/2020	Denny Crk, PR-MT	Inside DMA	Known	Human-caused, management capture and removal of bear #1015 for property damage and obtaining food rewards at multiple residences.
202027	Unm	M	Subadult	44075	South Fork Owl Crk, PR-WY	Outside DMA	Known	Human-caused, management capture and removal for sheep depredations.
202028				2020	WY	Inside DMA	Known	UNDER INVESTIGATION.
202029	786	F	Adult	44096	Middle Fork Warm Spring Crk, BDNF-MT	Inside DMA	Known	Human-caused, self-defense of bear #786 by range rider at remains of cow carcass. Three yearlings present.
202030	Unm	M	Adult	9/24/2020	Timber Crk, PR-WY	Inside DMA	Known	Human-caused, management capture and removal for obtaining multiple food rewards and nuisance activity at residences.
202031				2020	WY	Inside DMA	Known	UNDER INVESTIGATION.
202032	Unm	M	Subadult	9/26/2020	Trout Crk, PR-WY	Inside DMA	Known	Human-caused, vehicle strike.

Table 16. Continued.

Unique #	Bear [a]	Sex [b]	Age [c]	Date	Location [d]	Monitoring Area [e]	Certainty	Loss
202033	G256	M	Subadult	9/26/2020	Volney Crk, PR-MT	Outside DMA	Known	Human-caused, management capture and removal of bear #G256 for cattle depredations.
202034	1005	F	Subadult	9/27/2020	Madison River, CGNF-MT	Inside DMA	Known	Human-caused, vehicle strike of bear #1005.
202035				2020	WY	Inside DMA	Known	UNDER INVESTIGATION.
202036	Unm	M	Adult	9/29/2020	South Fork Shoshone, PR-WY	Inside DMA	Known	Human-caused, management capture and removal for obtaining multiple food rewards, aggression, and nuisance activity at residences.
202037	Unm	M	Subadult	9/29/2020	Green River, BTNF-WY	Inside DMA	Known	Human-caused, management capture and removal for cattle depredations.
202038				2020	ID	Inside DMA	Known	UNDER INVESTIGATION.
202039	Unm	F	Adult	10/4/2020	Sentinel Crk, CGNF	Inside DMA	Known	Human-caused, self-defense kill by hunters.
202040	Unm	F	Adult	Summer 2019	Trout Crk, YNP-WY	Inside DMA	Known	Undetermined cause, remains found by YNP staff, likely died summer or fall 2019. Mortality date is approximate.
202041	Unm	Unk	Cub	10/8/2020	Gallatin River, PR-MT	Inside DMA	Known	Human-caused, vehicle strike. Verified from photos, carcass may have been illegally taken.
202042				2020	WY	Inside DMA	Known	UNDER INVESTIGATION.
202043				2020	WY	Inside DMA	Known	UNDER INVESTIGATION.
202044				2020	WY	Inside DMA	Probable	UNDER INVESTIGATION.
202045	Unm	F	Subadult	10/19/2020	Horse Crk, BLM-WY	Outside DMA	Known	Human-caused, management removal of subadult female for property damages and habituation.
202046	Unm	F	Adult	10/25/2020	Indian Crk, BDNF-MT	Inside DMA	Known	Human-caused, self-defense kill by hunter.
202047	Unm	F	Subadult	10/29/2020	Cameron Crk, BDNF-MT	Inside DMA	Known	Human-caused, mistaken identity kill.
202048	Unm	M	Adult	11/4/2020	Pat O'Hara Crk, PR-WY	Outside DMA	Known	Human-caused, management capture and removal for frequenting ranch buildings, property damage, and obtaining multiple food rewards.

Table 16. Continued.								
Unique #	Bear [a]	Sex [b]	Age [c]	Date	Location [d]	Monitoring Area [e]	Certainty	Loss
202049	Unm	Unk	Subadult	10/1/2020	Devils Basin Crk, BTNF-WY	Inside DMA	Known	Undetermined cause. Remains found and reported by elk hunter. Mortality date is approximate.
202050				2020	ID	Inside DMA	Known	UNDER INVESTIGATION.
202051				2020	WY	Inside DMA	Known	UNDER INVESTIGATION.
202052	Unm	Unk	Cub	5/25/2020	Buck Crk, CGNF-MT	Inside DMA	Probable	Natural, radiomarked female #911 lost her cub between 5/8/2020 and 6/10/2020.
202053	Unm	Unk	Cub	5/27/2020	Russell Crk, SNF-WY	Inside DMA	Probable	Natural, radiomarked female #930 lost 1 of 2 cubs between 5/1/2020 and 6/21/2020.
202054	Unm	Unk	Cub	5/27/2020	Russell Crk, SNF-WY	Inside DMA	Probable	Natural, radiomarked female #930 lost 2nd of 2 cubs between 5/1/2020 and 6/21/2020.
202055	Unm	Unk	Cub	5/28/2020	Deer Crk, SNF-WY	Inside DMA	Probable	Natural, radiomarked female #956 lost 1 of 2 cubs between 5/1/2020 and 6/21/2020.
202056	Unm	Unk	Cub	5/28/2020	Deer Crk, SNF-WY	Inside DMA	Probable	Natural, radiomarked female #956 lost 2nd of 2 cubs between 5/1/2020 and 6/21/2020.
202057	Unm	Unk	Cub	5/29/2020	Madison River, YNP	Inside DMA	Probable	Natural, radiomarked female #980 lost 1 of 3 cubs between 5/18/2020 and 6/9/2020.
202058	Unm	Unk	Cub	5/29/2020	Madison River, YNP	Inside DMA	Probable	Natural, radiomarked female #980 lost 2nd of 3 cubs between 5/18/2020 and 6/9/2020.
202059	Unm	Unk	Cub	5/29/2020	Madison River, YNP	Inside DMA	Probable	Natural, radiomarked female #980 lost 3rd of 3 cubs between 5/18/2020 and 6/9/2020.
202060	Unm	Unk	Cub	5/31/2020	Snake River, GTNP	Inside DMA	Probable	Natural, radiomarked female #926 lost 1 of 2 cubs between 5/19/2020 and 6/11/2020.
202061	Unm	Unk	Cub	5/31/2020	Snake River, GTNP	Inside DMA	Probable	Natural, radiomarked female #926 lost 2nd of 2 cubs between 5/19/2020 and 6/11/2020.

Table 16. Continued.

Unique #	Bear [a]	Sex [b]	Age [c]	Date	Location [d]	Monitoring Area [e]	Certainty	Loss
202062	Unm	Unk	Cub	6/2/2020	Sheep Crk, CGNF-MT	Inside DMA	Probable	Natural, radiomarked female #976 lost 1 cub between 5/25/2020 and 6/10/2020.
202063	Unk	Unk	Subadult	9/2/2020	Timber Crk, SNF-WY	Inside DMA	Possible	Human-caused, self-defense by archery hunters, shots fired and bear hit in leg, no carcass found.
202064	Unk	Unk	Adult	9/12/2020	Big Thumb Crk, YNP-WY	Inside DMA	Possible	Human-caused, vehicle strike, bear laid in ditch for several minutes, got up and walked away, was moving well when it went out of view. Bear was tagged, hair samples were obtained for DNA identify.
202065	Unk	Unk	Subadult	9/14/2020	Cottonwood Crk, PR-WY	Outside DMA	Possible	Human-caused, self-defense, bear had been breaking into feed shed, resident encountered bear after responding to barking dog, shots fired and bear possibly hit, no carcass found.
202066	Unk	Unk	Adult	9/14/2020	Eldridge Crk, CGNF-MT	Inside DMA	Possible	Human-caused, self-defense by archery hunters, shots fired and bear hit, very little blood found, no carcass found.

[a] Number indicates bear number; Unm = unmarked bear; Mkd = previously marked bear but identity unknown.

[b] Unk = unknown sex.

[c] Cub = less than 1 year old; yearling = 1 to 2 years old; subadult = 2 to 4 years old; adult = 5 years or older; Unk = unknown age.

[d] BTNF = Bridger-Teton National Forest, BLM = Bureau of Land Management, CTNF = Caribou-Targhee National Forest, CGNF = Custer Gallatin National Forest, GTNP = Grand Teton National Park, SNF = Shoshone National Forest, YNP = Yellowstone National Park, Pr = private.

[e] Location relative to Demographic Monitoring Area.

Table 17. Counts of documented known and probable grizzly bear mortalities that occurred in 2020 by sex, age class, and location relative to the Demographic Monitoring Area (DMA), Greater Yellowstone Ecosystem.

		Age class		
Area	Sex	Dependent (<2 years old)	Independent (≥2 years old)	Total
Inside DMA	Female	0	10	10
	Male	1	14	15
	Unknown	14	2	16
	Total	15	26	41
Outside DMA	Female	0	8	8
	Male	0	11	11
	Unknown	0	0	0
	Total	0	19	19

Table 18. Annual population estimates ($\hat{N}$) and mortality statistics by population segment for grizzly bears in the Demographic Monitoring Area (DMA), Greater Yellowstone Ecosystem 2020. Population estimates for the DMA were derived using the most recent vital rates (IGBST 2012).

Population segment	$\hat{N}$	Human-caused loss	Sanctioned removals (*a*)	Radio-marked loss (*b*)	Reported loss	Estimated [a] reported + unreported loss (*c*)	Estimated total mortality (*a* + *b* + *c*)	Annual % mortality
Dependent young[b]	223	4						1.8
Females 2+	252	10	2	2	6[b]	15[c]	19[c]	7.5
Males 2+	252	14	11	1	4[b]	10[c]	22[c]	8.7

[a] Unknown, unreported mortality estimated based on Cherry et al. (2002).

[b] Only human-caused losses are counted against the mortality threshold for dependent young.

[c] Numbers may change pending DNA determination of sex for 2 reported mortality from 2020.

MONITORING OF GRIZZLY BEAR FOODS

Grizzly Bear Consumption of Ungulates in Yellowstone National Park *(Kerry A. Gunther, Travis C. Wyman, and Eric G. Reinertson, Yellowstone National Park)*

Bison (*Bison bison*), moose (*Alces alces*), elk (*Cervus canadensis*), and deer (*Odocoileus spp.*) are concentrated sources of protein and calories consumed by grizzly bears through scavenging and predation. Bears show preferential selection of ungulate meat over many other foods. Craighead et al. (1995) observed as many as 23 individual grizzly bears congregating at a single bison carcass.

State and federal management of bison, elk, and deer populations in the GYE for recreational hunting and to address disease, property damage, crop damage, and other factors could influence the number of ungulates on the landscape available to grizzly bears for scavenging and predation. To monitor broad-scale trends in grizzly bear consumption of ungulate meat, we record opportunistic sightings of grizzly bears throughout the park. These records include the number of sightings where the observed bears consumed bison, moose, elk, mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), pronghorn (*Antilocapra americana*), bighorn sheep (*Ovis canadensis*) or mountain goat (*Oreamnos americanus*).

In 2020, we recorded 700 opportunistic sightings of grizzly bears and their tracks in Yellowstone National Park. In 84 (12%) of these sightings, the observed grizzly bears fed on ungulate carcasses (Table 19). Grizzly bears were observed consuming ungulate carcasses from March through October (Fig. 11), with most use occurring in June (n = 19), August (n = 18), September (n = 14), and October (n = 10). Bison (45%, n = 38) and elk (36%, n = 30) were the species of ungulate most often consumed by grizzly bears. In contrast, black bears fed on ungulate carcasses in only 10 (2%) of 536 opportunistic observations (Table 19). Interference competition from grizzly bears likely inhibits black bear use of many ungulate carcasses.

The number of opportunistic observations of grizzly bears feeding on ungulates in 2020 (n = 84) was lower than in 2019 (n = 109) but similar to the long-term average of 74.3 (± 32.5 SD [standard deviation]) recorded during 1982–2019 (Fig. 12). The proportion of the total number of opportunistic sightings where grizzly bears fed on ungulate carcasses in 2020 (12%) was slightly higher than the long-term average of 9% recorded during 1982–2019 (Fig. 13).

A bull elk killed by a grizzly bear in the Yellowstone River in Hayden Valley in late September. Five days after the kill was made, the carcass was usurped by a second grizzly bear. (photo courtesy of J. Hadley, National Park Service)

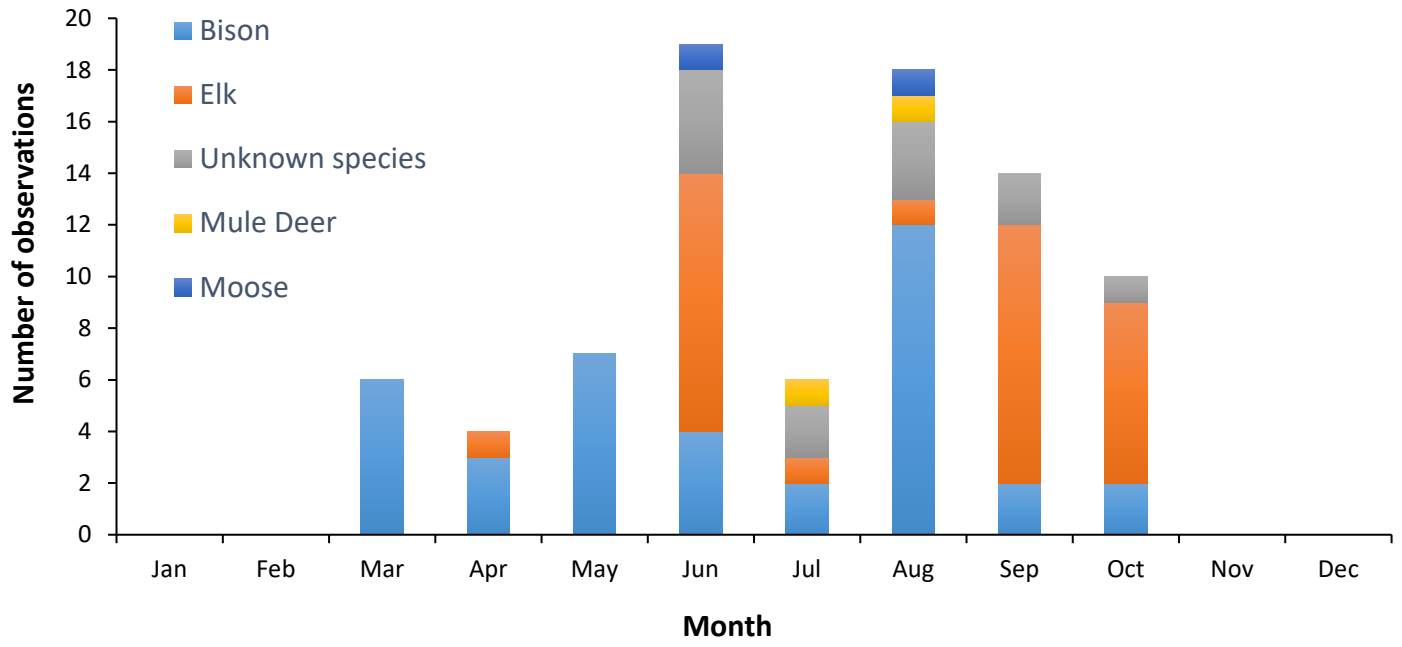

Fig. 11. Number of opportunistic observations of grizzly bears consuming ungulate meat by month in Yellowstone National Park, 2020.

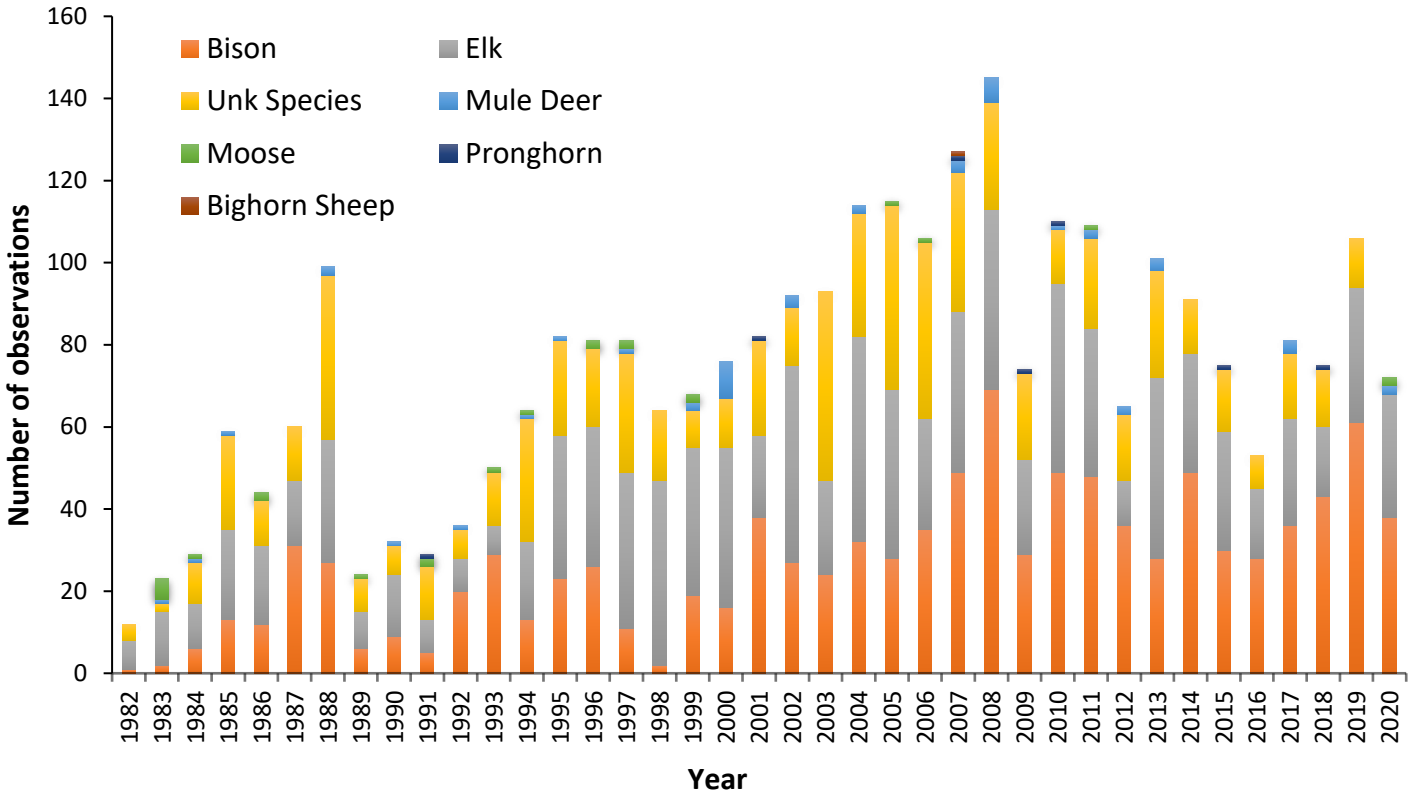

Fig. 12. Number of opportunistic observations of grizzly bears feeding on ungulate carcasses in Yellowstone National Park, 1982–2020.

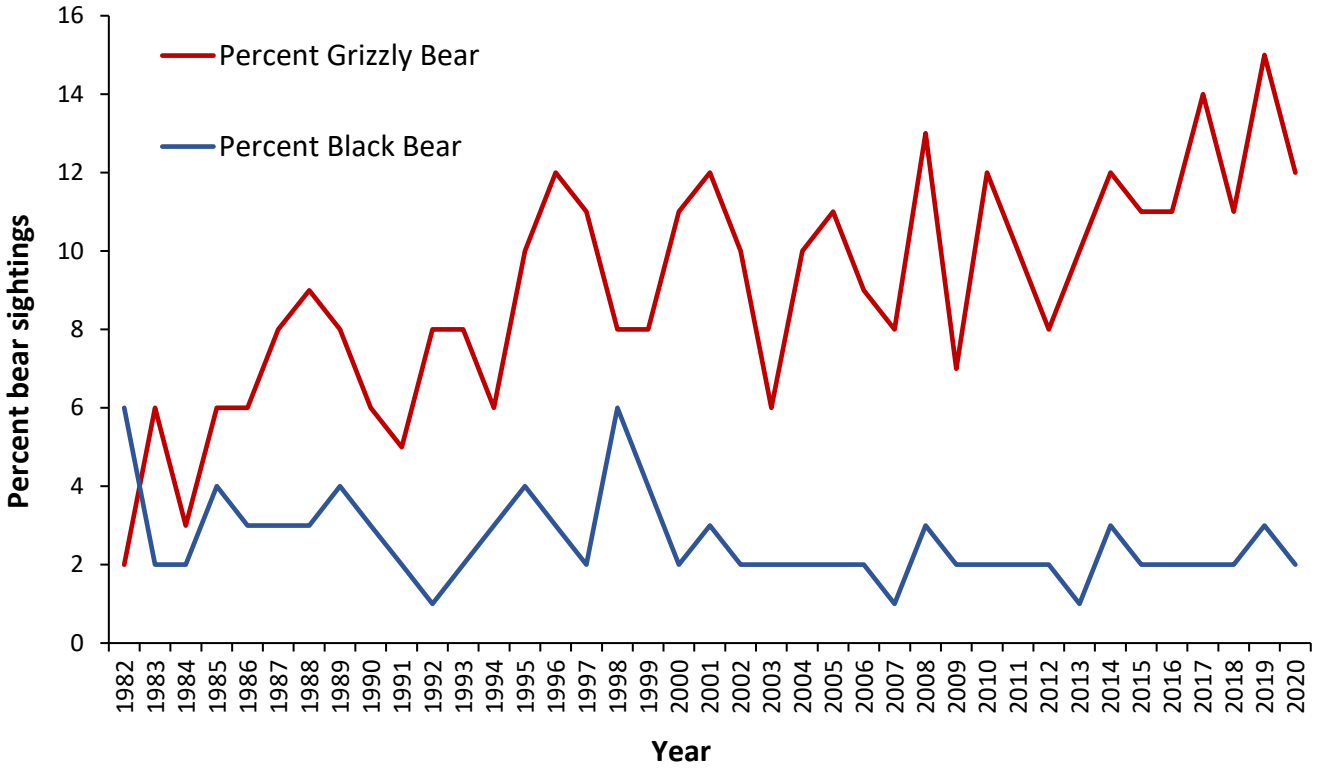

Fig. 13. Proportion of the total number of opportunistic observations of grizzly bears where the observed bears were feeding on ungulate carcasses, Yellowstone National Park, 1982–2020.

Table 19. Number of opportunistic observations of grizzly bears and black bears where the observed bear fed on ungulate carcasses, Yellowstone National Park, 2020.

Species of bear	Species of ungulate consumed									
	Bison	Moose	Elk	Mule Deer	White-tailed deer	Bighorn sheep	Mountain goat	Pronghorn	Unknown ungulate	Total
Grizzly	38	2	30	2	0	0	0	0	12	84
Black	3	0	3	1	0	0	0	1	2	10

Spawning Cutthroat Trout Availability and Use by Grizzly Bears in Yellowstone National Park *(Kerry A. Gunther, Eric G. Reinertson, Travis C. Wyman, Todd M. Koel, and Patricia E. Bigelow, Yellowstone National Park)*

In spring and early summer, grizzly bears with home ranges near Yellowstone Lake feed on spawning Yellowstone cutthroat trout (YCT, *Oncorhynchus clarkii bouvieri*) during years when trout are abundant in tributary streams (Gunther et al. 2014). Bears also occasionally prey on cutthroat trout in other areas of the park, including Fan Creek (Westslope cutthroat trout, YCT, or Westslope × YCT hybrid) in the northwest section of the park and the inlet creek to Trout Lake (YCT or YCT × Rainbow Trout *O. mykiss* hybrids) located in the northeast section of the park.

Non-native lake trout (*Salvelinus namaycush*), whirling disease caused by an exotic parasite (*Myxobolus cerebralis*), and drought have substantially reduced the native YCT population in Yellowstone Lake (Koel et al. 2005, 2006, 2019). The combined effect of all these factors has reduced the YCT population by 90% (Koel et al. 2005) and resulted in a noticeable decrease in bear fishing activity (Haroldson et al. 2005). Because of the YCT decline and associated trophic changes, as well as preferential use of YCT as a food source by grizzly bears in the Yellowstone Lake watershed, monitoring of the YCT population is a component of the habitat monitoring program of the 2016 Conservation Strategy (Yellowstone Ecosystem Subcommittee 2016). The YCT population was historically monitored through counts at a fish trap located on Clear Creek on the east shore of Yellowstone Lake. The Clear Creek fish weir and trap are no longer operational. Visual stream surveys of North Shore and West Thumb tributaries of the lake have been conducted annually since 1989 (Fig. 16). Visual stream surveys are also conducted along the Trout Lake inlet creek in the northeast section of the park. In 2014, we began visual stream surveys along 3 Yellowstone Lake backcountry spawning streams (Flat Mountain Creek, stream #1138, and stream #1141) on the west shore of Yellowstone Lake.

Yellowstone Lake

Front-country Visual Stream Surveys

Beginning as early as mid-April, depending on snowpack and ice-off, several streams including Lodge Creek, Hatchery Creek, Incinerator Creek, Wells Creek, and Bridge Creek on the North Shore of Yellowstone Lake, and Sandy Creek, Sewer Creek, Little Thumb Creek, and stream #1167 in the West Thumb area are checked periodically to detect the presence of adult YCT (Fig. 11, Andrascik 1992, Olliff 1992). Once adult YCT are found (i.e., onset of spawning), weekly surveys of YCT in these streams are conducted. Sample methods follow Reinhart (1990), as modified by Andrascik (1992) and Olliff (1992). In each stream on each sample day, a minimum of two people walked from the stream mouth to the upstream extent that fish have been observed in past years and record the number of adult YCT counted. Sampling continues one day per week until two consecutive weeks when no trout are observed in the creek (i.e., end of spawn). The length of the spawning season is calculated as the number of days from the first day spawning trout are observed through the last day spawning trout are observed. The average number of spawning cutthroat trout counted per stream survey conducted during the spawning season is used to identify annual trends in the number of cutthroat trout spawning in Yellowstone Lake tributaries.

The ice melted off Yellowstone Lake on May 25, 2020. Data collected in 2020 continued to show low numbers of spawning YCT in North Shore and most West Thumb tributary streams (Table 20). In North Shore streams, only 18 spawning YCT were counted. Seventeen spawning YCT were counted in Bridge Creek and 1 in Hatchery Creek. No spawning YCT were observed in Incinerator Creek, Lodge Creek, or Wells Creek. No grizzly bear tracks and no evidence of bear fishing activity (i.e., observations of bears fishing, fish parts, bear scats containing fish parts) were observed along any of the monitored North Shore streams in 2020. One set of bear tracks that could not be identified to species was observed along Bridge Creek.

On West Thumb streams, 165 spawning YCT were counted, including 154 in Little Thumb Creek and 11 in Sandy Creek. No spawning YCT were observed in Sewer Creek or stream #1167. Grizzly bear tracks were observed along Little Thumb Creek, Sandy Creek, Sewer Creek, and stream #1167. Two bear scats containing vegetation and elk calf parts were observed along Little Thumb Creek. Black bear tracks were also observed along Little Thumb Creek. A trail camera set up on Little Thumb Creek captured photos of 1 black bear fishing in the creek. Grizzly bear tracks and fish parts thought to be associated with bear consumption were also found on Little Thumb Creek. No bear scats were found along Sandy Creek, Sewer Creek, or stream #1167.

The number of spawning YCT counted in North Shore (Fig. 15) and West Thumb (Fig. 16) streams has decreased significantly since 1989. Although the increased spawning activity observed in Little Thumb

Creek in recent years is promising, very few spawning YCT have been observed in all other North Shore and West Thumb tributary streams.

Backcountry Visual Stream Surveys

In 2020, we surveyed 3 backcountry tributary streams including Flat Mountain Creek, stream #1138, and stream #1141. Backcountry stream surveys followed the same methods used on front-country streams. In backcountry streams, we counted 19 spawning YCT, 13 in stream #1138, 4 in stream #1141, and 2 in Flat Mountain Creek. We observed grizzly bear tracks and fish parts along all 3 backcountry streams; a bear scat was observed along Flat Mountain Creek. We did not observe any black bear tracks along any of the backcountry streams.

Trout Lake

Beginning in mid-May of each year, the Trout Lake inlet creek is checked once per week for the presence of spawning YCT (and Cutthroat × Rainbow Trout hybrids). Counts and mean number of spawners are obtained using the methods previously described for Yellowstone Lake North Shore and West Thumb tributary streams.

We observed the first movement of spawning trout from Trout Lake into the inlet creek on June 17. The spawn lasted approximately 36 days with the last spawning trout observed in the inlet creek on July 22. During the once per week visual surveys, 365 spawning cutthroat trout (and cutthroat trout × rainbow trout hybrids) were counted, an average of 61 per visit during the spawning season (Table 20). We observed no evidence of grizzly bear or black bear fishing activity along Trout Lake or the inlet creek during the surveys. The number of fish observed per survey in the Trout Lake inlet creek has ranged from a low of 31 in 2004, to a high of 306 in 2010 (Fig. 17).

Outlook for Yellowstone Cutthroat Trout

The number of spawning YCT counted in all surveyed tributary streams of Yellowstone Lake reached an all-time low in approximately 2004 (Figs. 15-17). A Native Fish Conservation Plan/Environmental Assessment was completed in 2010 (Koel et al. 2010). The plan outlines an adaptive management program designed to protect the native YCT population through suppression of lake trout and other methods. As part of these management efforts, park fisheries biologists and private-sector (contracted) netters caught and removed 325,952 lake trout from Yellowstone Lake in 2020. Since lake trout suppression efforts began in 1994, >3.7 million lake trout have been removed from the lake through suppression gillnetting. Population models indicate the removal program has slowed lake trout population growth and likely started to send the population into decline (Syslo et al. 2011, Gresswell et al. 2015). Juveniles are again recruiting into the YCT population (Koel et al. 2019). Spawning adult cutthroat trout are returning to some tributaries and bears are once again preying on YCT in a few streams. If the removal program results in a significant long-term reduction in predatory lake trout, managers hope that native YCT will reestablish at higher numbers than at present in Yellowstone Lake and its tributary streams. If the YCT restoration program is successful, YCT may once again become an important diet item for grizzly bears and other terrestrial, aquatic, and avian predators in the Yellowstone Lake watershed (Bergum et al. 2017).

Table 20. Summary statistics for spawning cutthroat trout surveys, Yellowstone National Park, 2020.

Stream	Start of spawn	Last day of spawn	Duration of spawn (days)	Number of surveys during spawning period	Number of fish counted	Average no. fish/survey	Evidence of bear fishing[b]
North Shore Streams							
Lodge Creek			No spawn				
Hatchery Creek	05/26/2020	05/26/2020	1	1	1	1.0	No
Incinerator Creek			No spawn				
Wells Creek			No spawn				
Bridge Creek	05/26/2020	06/02/2020	8	2	17	8.5	No
West Thumb Streams							
1167 Creek			No spawn				
Sandy Creek	05/19/2020	05/31/2020	13	3	11	3.7	No
Sewer Creek			No spawn				
Little Thumb Creek	06/01/2020	06/15/2020	15	3	154	51.3	Yes
Total front-country[a]				9	183	20.3	
Backcountry Streams							
Flat Mountain Creek	06/01/2020	06/01/2020	1	1	2	2.0	Yes
Stream #1138	05/27/2020	06/01/2020	6	2	13	6.5	Yes
Stream #1141	05/27/2020	06/01/2020	6	2	4	2.0	Yes
Total backcountry				5	19	3.8	
Northern Range							
Trout Lake Inlet	06/17/2020	07/22/2020	36	6	365	60.8	No

[a] Total for North Shore and West Thumb streams that had a spawn.
[b] Includes direct observations of bears fishing, trail camera evidence of bears fishing, fish parts with associated bear tracks, or bear scats containing fish parts.

Fig. 14. Locations of Yellowstone Lake cutthroat trout spawning streams surveyed in 2020. Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

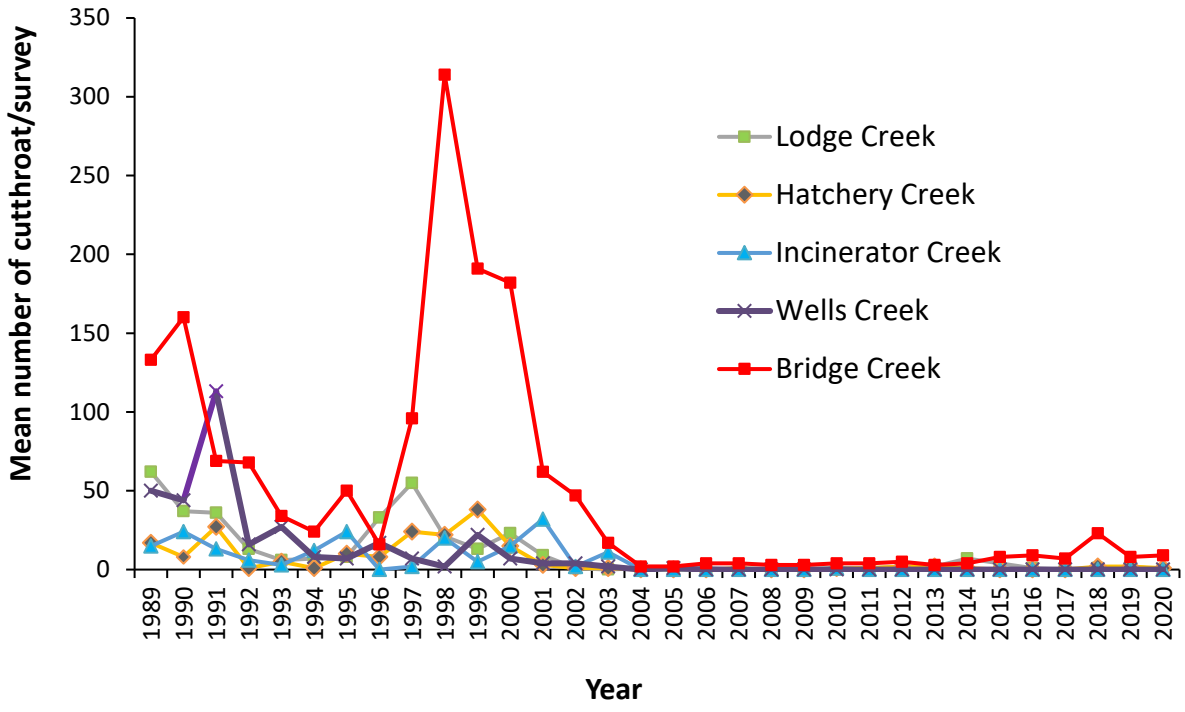

Fig. 15. Mean number of spawning Yellowstone cutthroat trout observed during weekly visual surveys of 5 North Shore spawning stream tributaries to Yellowstone Lake, Yellowstone National Park, 1989–2020.

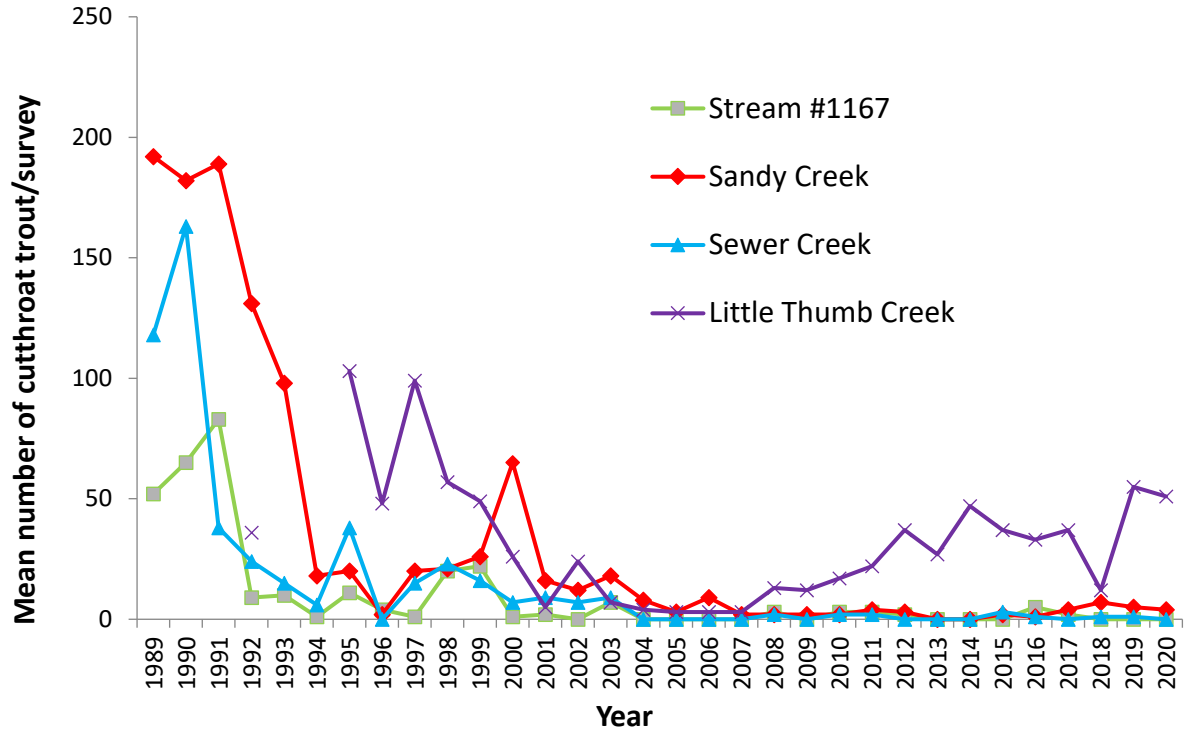

Fig. 16. Mean number of spawning Yellowstone cutthroat trout observed during weekly visual surveys of 4 West Thumb spawning stream tributaries to Yellowstone Lake, Yellowstone National Park, 1989–2020.

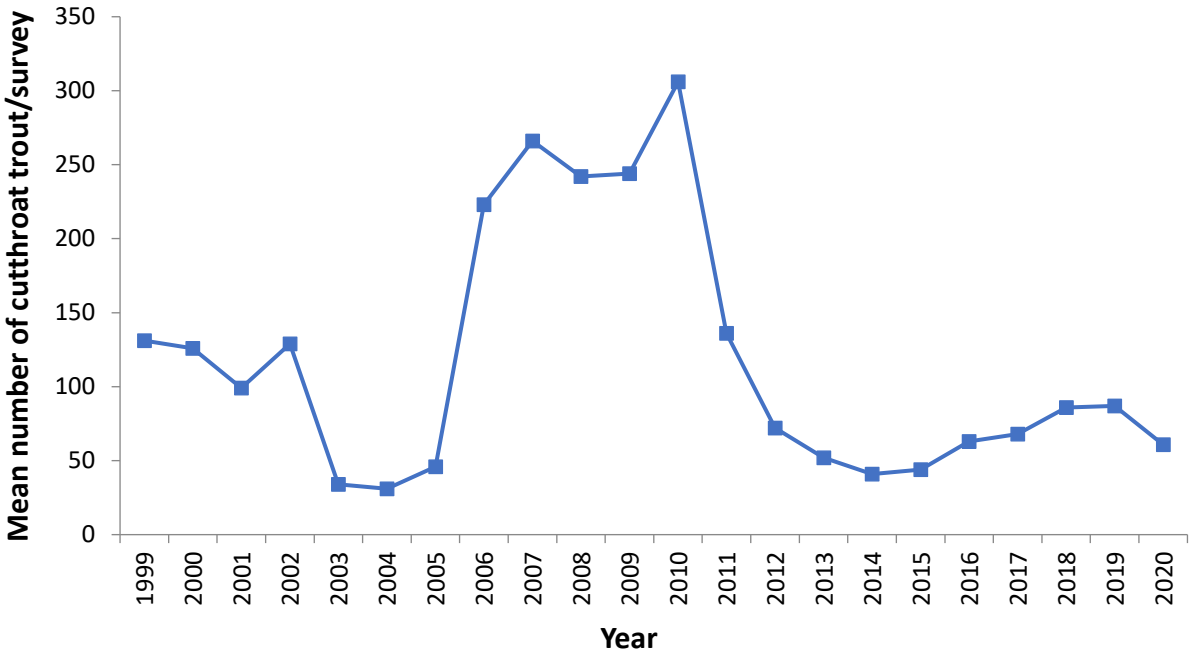

Fig. 17. Mean number of spawning Yellowstone cutthroat trout (including cutthroat × rainbow trout hybrids) observed during weekly visual surveys of the Trout Lake inlet creek, Yellowstone National Park, 1999–2020.

Grizzly Bear Use of Insect Aggregation Sites *(Daniel D. Bjornlie, Wyoming Game and Fish Department; and Mark A. Haroldson, Interagency Grizzly Bear Study Team, U.S. Geological Survey)*

Army cutworm moths (*Euxoa auxiliaris*) were first recognized as an important food source for grizzly bears in the GYE during the mid-1980s (Mattson et al. 1991*b*, French et al. 1994). Early observations indicated that moths, and subsequently bears, showed specific site fidelity. These sites are generally high alpine areas dominated by talus and scree adjacent to areas with abundant alpine flowers. Because insects other than army cutworm moths may be present and consumed by bears (e.g., ladybird beetles [Coccinellidae family]) as well, we generally refer to such areas as "insect aggregation sites." Within the GYE, observations indicate army cutworm moths are the primary food source at these sites.

Since the discovery of bears feeding at insect aggregation sites, numerous bears have been observed at or near these sites. Observability is high because of lack of tree cover and numbers of bears using the sites. However, complete tabulation of grizzly presence at insect sites is extremely difficult. Only a few sites have been investigated by ground reconnaissance and the boundaries of sites are not clearly known. In addition, it is likely that the size and location of aggregation sites fluctuate from year to year with moth abundance and variation in environmental factors such as snow cover.

Our knowledge of these sites has increased over time, and techniques for monitoring grizzly bear use of these sites have changed. We developed a technique in 2000 that delineates sites by buffering only the locations of bears observed actively feeding at insect aggregation sites by 500 m; this distance was used to account for errors in aerial locations. The borders of the overlapping buffers at individual insect sites are dissolved to produce a single polygon for each site. These sites are identified as "confirmed" sites. Because these polygons are only created around feeding locations, the resulting site conforms to the topography of the mountain or ridge top where bears feed and does not include large areas of non-talus habitat that are not suitable for cutworm moths. Records from the grizzly bear location database from July 1 through September 30 of each year are then overlaid on these polygons and enumerated. Areas suspected as insect aggregation sites but dropped from the list of confirmed sites, and sites with only one observation of an actively feeding bear or multiple observations in a single year, are termed "possible" sites and will be monitored in subsequent years for additional observations of actively feeding bears. These sites may then be added to the confirmed sites list. When the status of a site is changed to confirmed, analysis is done on all data back to 1986 to determine the historical use of that site. Therefore, the number of bears using insect aggregation sites in past years may change as new sites are added, and data from this annual report may not match those of past reports. New observations of grizzly bears actively feeding in previously undocumented areas will be added as possible sites and monitored for future use. In addition, as new observations of actively feeding bears are added along the periphery of existing sites, the polygons defining these sites increase in size and, thus, more overlaid locations fall within the site. This retrospective analysis brings us closer each year to the "true" number of bears using insect aggregation sites in past years.

COVID-19 safety protocols resulted in a reduced number of observation flights, and most of those flights were conducted with only the pilot and no secondary observer. However, analysis of grizzly bear use of insect aggregation sites in 2020 still resulted in an additional 101 observations of actively feeding grizzly bears on previously identified confirmed sites. In addition, there were observations of actively feeding grizzly bears at 1 site previously classified as possible and 1 observation of an actively feeding grizzly bear at a previously undocumented site. Thus, 1 previous possible site was reclassified to confirmed, and 1 new possible site was added in 2020, bringing the number of sites to 34 confirmed and 20 possible.

Overall insect aggregation site use by grizzly bears in 2020 (n = 343) was the third highest recorded since the beginning of the monitoring period in 1986 (Table 21). This number includes all grizzly bear locations from aerial observation flights, telemetry flights, and observations made during flights for other species. The number of grizzly bears documented on sites and the percentage of confirmed sites with documented use by grizzly bears varies from year to year, suggesting that moth numbers may be greater in some years than others (Fig. 18), which may be due to variable snow conditions or the number of moths migrating from the plains. In 1993, a year with unusually high snowpack, the percentage of confirmed sites used by bears (Fig. 18) and the number of observations recorded at insect sites were very low (Table 21). In all other years, the percentage of insect aggregation sites used by grizzly bears varied between 47 and 85% (Fig. 18).

However, when we control for the amount of observation effort by including only bears observed during regularly conducted observation flights (see "***Observation Flights***"), the number of bears observed

using insect aggregation sites per hour of flights has shown an overall increasing trend since these flights began in 1997 (Fig. 19). While the number of bears observed and observation flight hours in 2020 were about 30 and 40% lower than average, respectively, due to COVID-19 protocols, the number of observations per hour increased slightly from 2019 (n = 204 observations, 19.3 survey hours, 10.6 observations/survey hour) (Fig. 19). The increase in reported observations of grizzly bears using insect aggregation sites from ground-based observers and our increased use of GPS collars with satellite technology has resulted in the need to censor these locations to prevent a bias in comparisons with previous years. The number of aerial telemetry locations and observations from Table 21 reflect this change and may differ from previous annual reports.

The IGBST maintains an annual list of unique females observed with cubs (see Table 5 in "***Estimating Number of Females with Cubs***"). Since 1986, 1,334 initial sightings of unique females with cubs have been recorded, of which 384 (28.8%) have occurred at (<500 m, n = 356) or near (<1,500 m, n = 28) insect aggregation sites (Table 22). In 2020, 18 of the 58 (31.0%) initial sightings of unique females with cubs were observed at insect aggregation sites; higher than the mean of 26.4% for the previous five years (2015–2019, Table 22).

Survey flights at or near (<1,500 m) insect aggregation sites contribute to the count of unique females with cubs. However, the contribution from these flights is typically low, with a 10-year mean of 16.0 initial sightings/year since 2011 (Table 22). If these sightings are excluded, a similar trend in the annual number of unique sightings of females with cubs is still evident (Fig. 20), suggesting that other factors besides observation effort at insect aggregation sites are responsible for the increase in sightings of females with cubs over time.

Table 21. Summary statistics for grizzly bear use of confirmed insect aggregation sites, Greater Yellowstone Ecosystem, 1986–2020.

Year	Number of confirmed sites[a]	Number of sites used[b]	Number of aerial telemetry locations	Number of ground or aerial observations
1986	4	2	7	5
1987	5	3	3	17
1988	5	3	11	28
1989	9	7	9	41
1990	14	11	9	77
1991	16	13	13	169
1992	18	12	6	108
1993	19	3	1	2
1994	19	9	1	32
1995	21	12	7	40
1996	23	15	21	68
1997	24	16	17	84
1998	27	22	9	185
1999	27	14	26	156
2000	27	13	49	97
2001	28	18	23	128
2002	29	20	30	251
2003	29	20	9	163
2004	29	16	2	134
2005	31	19	16	198
2006	31	17	15	147
2007	31	19	19	161
2008	31	23	16	181
2009	33	23	11	170
2010	33	18	3	134
2011	34	21	9	164
2012	34	24	20	253
2013	34	23	27	297
2014	34	24	11	343
2015	34	21	13	210
2016	34	20	11	208
2017	34	21	20	279
2018	34	20	18	267
2019	34	29	20	335
2020	34	27	19	324
Total			501	5,456

[a] The year of discovery was considered the first year a telemetry location or aerial observation was documented at a site. Sites were considered confirmed after additional locations or observations in a subsequent year and every year thereafter regardless of whether or not additional locations were documented.

[b] A site was considered used if ≥1 location or observation was documented within the site during July–September of that year.

Table 22. Initial sightings of unique females with cubs on or near insect aggregation sites, Greater Yellowstone Ecosystem, 1986–2020.

Year	Number of unique females with cubs[a]	Number of sites with an initial sighting[b]	Initial sightings			
			Within 500 m[b]		Within 1,500 m[c]	
			n	%	*n*	%
1986	25	0	0	0.0	0	0.0
1987	13	0	0	0.0	0	0.0
1988	19	1	2	10.5	2	10.5
1989	16	1	1	6.3	1	6.3
1990	25	4	4	16.0	5	20.0
1991	24	7	13	54.2	14	58.3
1992	25	5	7	28.0	9	36.0
1993	20	1	1	5.0	1	5.0
1994	20	3	5	25.0	5	25.0
1995	17	2	2	11.8	2	11.8
1996	33	7	7	21.2	8	24.2
1997	31	8	11	35.5	11	35.5
1998	35	10	13	37.1	13	37.1
1999	33	3	6	18.2	7	21.2
2000	37	6	9	24.3	10	27.0
2001	42	7	13	31.0	13	31.0
2002	52	11	18	34.6	18	34.6
2003	38	11	20	52.6	20	52.6
2004	49	11	17	34.7	17	34.7
2005	31	5	7	22.6	8	25.8
2006	47	11	15	31.9	16	34.0
2007	50	10	17	34.0	17	34.0
2008	44	7	11	25.0	14	31.8
2009	42	4	6	14.3	7	16.7
2010	51	7	9	17.6	9	17.6
2011	39	6	7	17.9	7	17.9
2012	49	6	13	26.5	13	26.5
2013	58	8	14	24.1	15	25.9
2014	50	11	21	42.0	23	46.0
2015	46	7	11	23.9	13	28.3
2016	50	7	13	26.0	17	34.0
2017	58	7	12	20.7	12	20.7
2018	58	8	18	31.0	20	34.5
2019	49	8	15	30.6	17	34.7
2020	58	15	18	31.0	20	34.5
Total	1,334		356		384	
Mean	38.1	6.4	10.2	24.4	11.0	26.2

[a] Initial sightings of unique females with cubs; see Table 5.

[b] Insect aggregation site is defined as a 500-m distance around a cluster of observations of bears actively feeding.

[c] This distance is 3 times what is defined as an insect aggregation site for this analysis because some observations may be of bears traveling to and from insect aggregation sites.

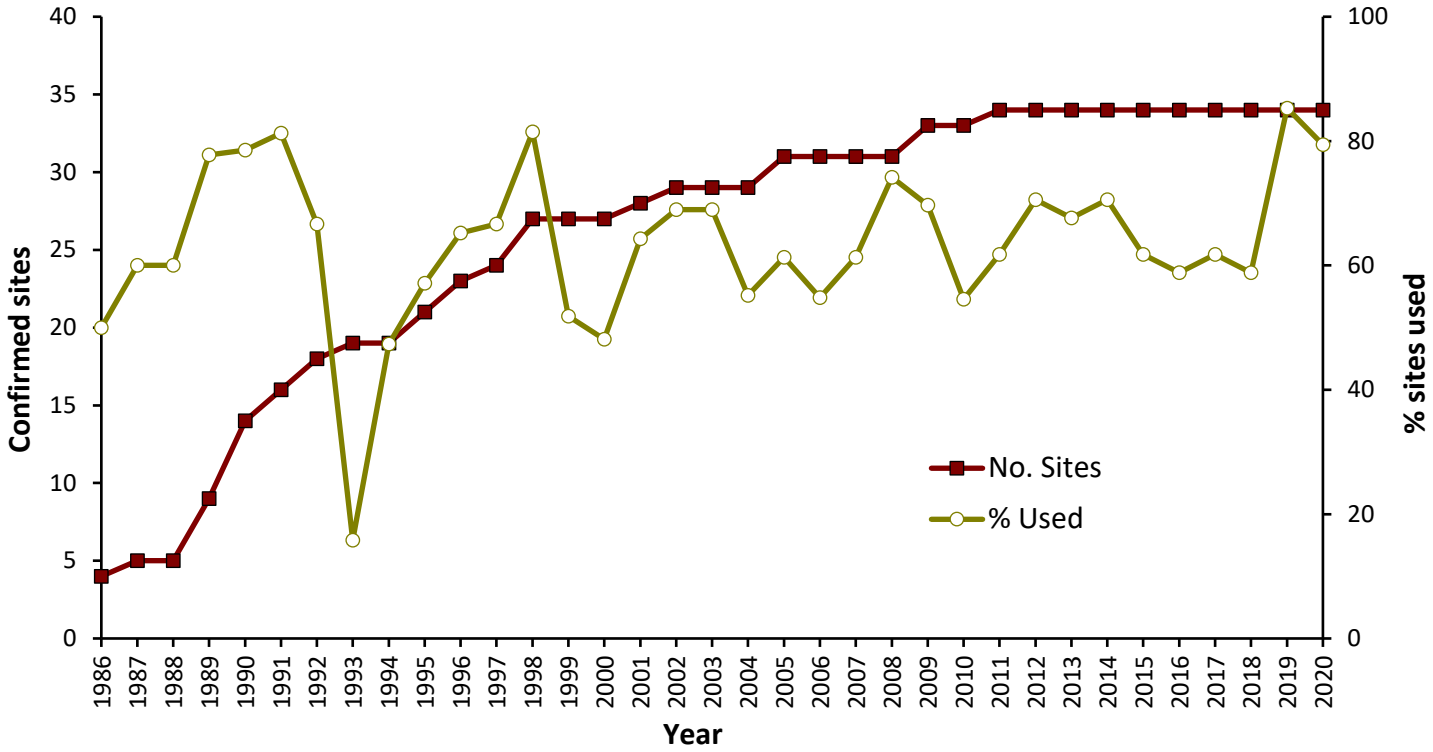

Fig. 18. Annual number of confirmed insect aggregation sites and percent of those sites at which telemetry relocations of marked bears or visual observations of unmarked bears were recorded, Greater Yellowstone Ecosystem, 1986–2020.

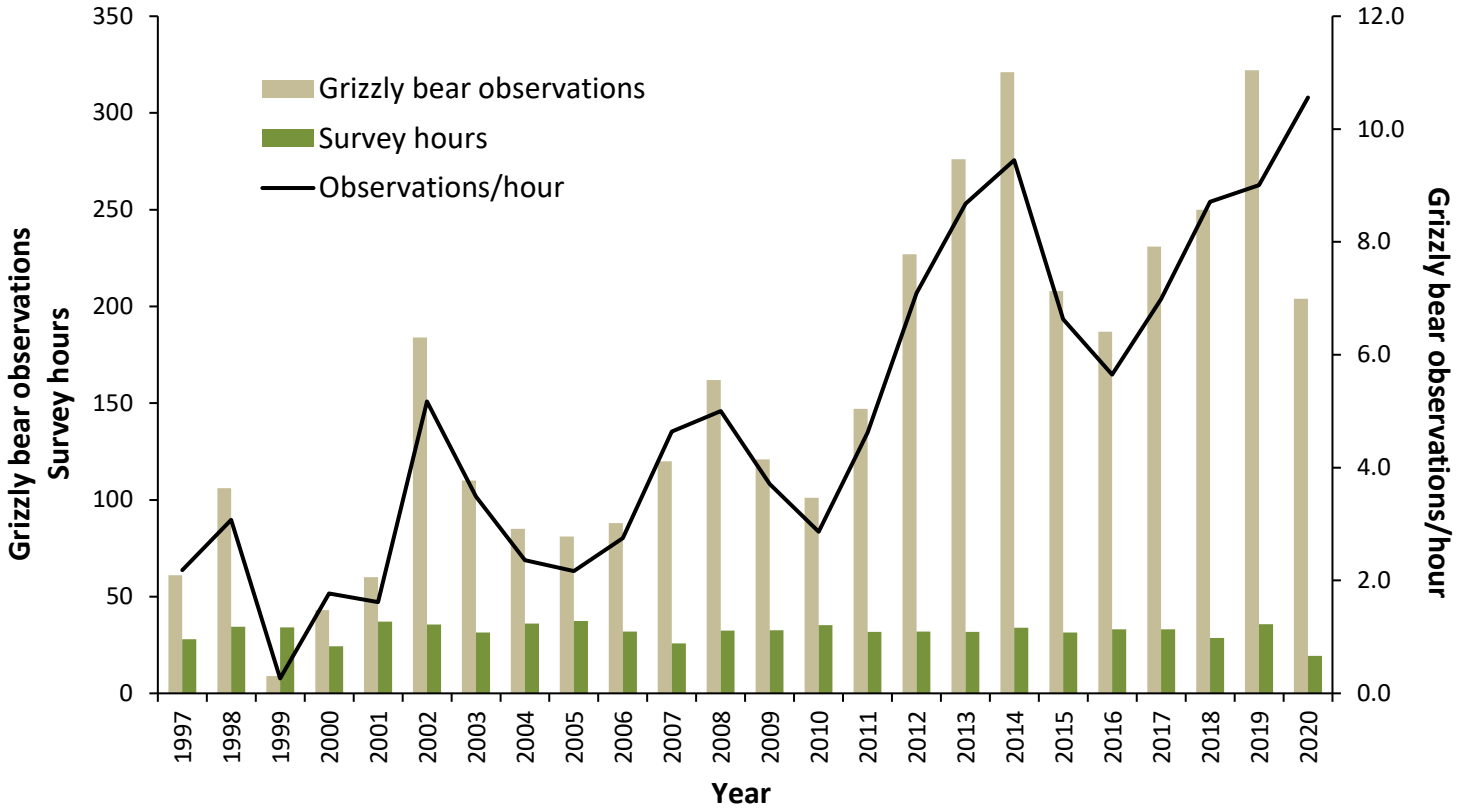

Fig. 19. Number of grizzly bears observed (tan bars) on insect aggregation sites during observation flights only, survey hours (green bars) for these bear management units (BMU), and grizzly bear observations per survey hour (black line) during observation flights of BMUs containing all known insect aggregation sites, Greater Yellowstone Ecosystem, 1997–2020.

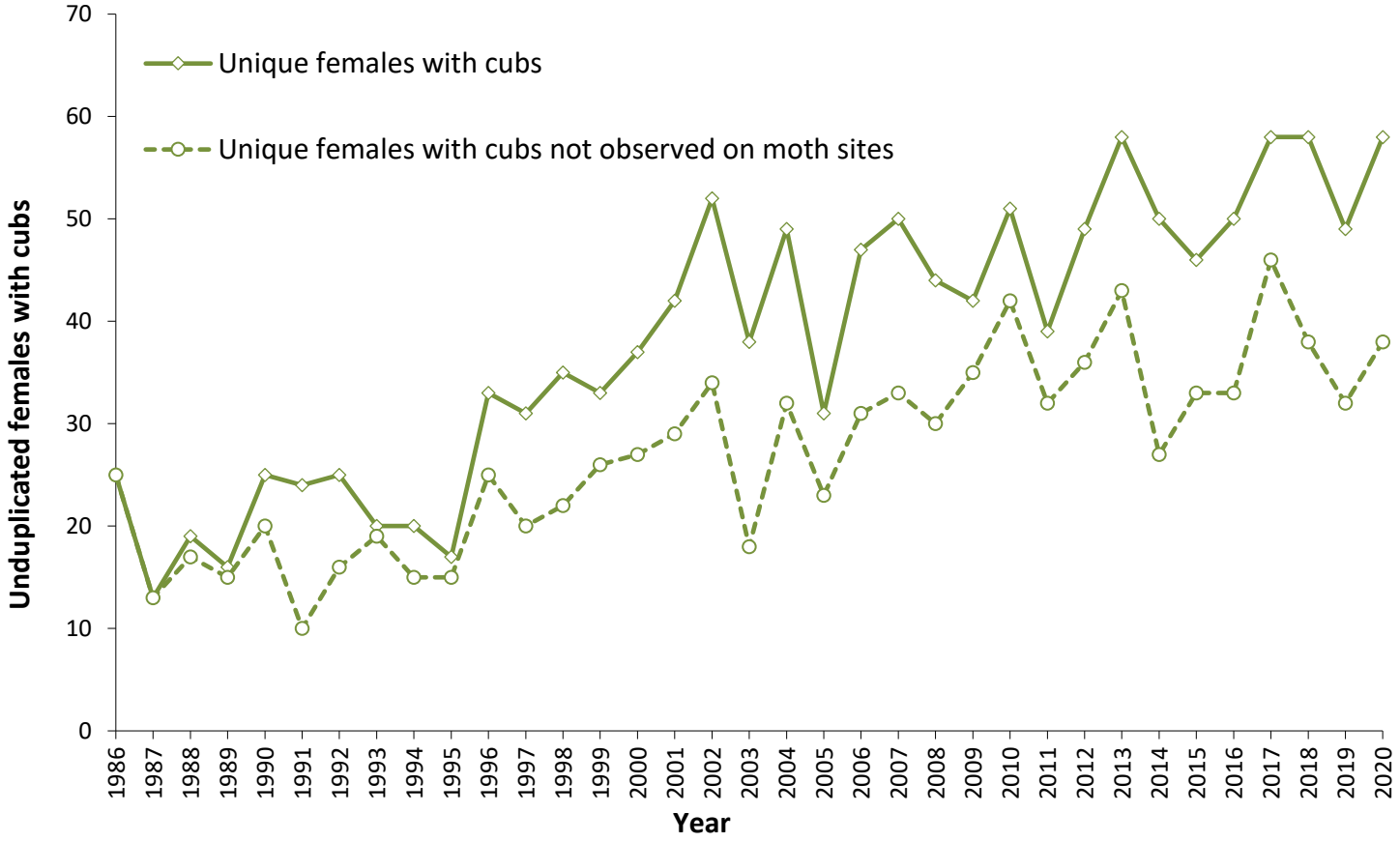

Fig. 20. Total number of unique females with cubs observed annually in the Greater Yellowstone Ecosystem and the number of unique females with cubs not found within 1,500 m of known insect aggregation sites, 1986–2020.

Whitebark Pine Cone Production *(Mark A. Haroldson, Interagency Grizzly Bear Study Team, U.S. Geological Survey)*

Whitebark pine (*Pinus albicaulis*) surveys on 21 established transects indicated slightly above average cone production for 2020 (Fig. 21). Overall, the mean cones/tree of 19.4 (Table 23) was similar to the long-term average of 17 cones/tree for the period 1980–2020 (Fig. 22). Cone production was generally higher on the northern transect and lower on the southern (Fig. 21, Table 24). The southern exception was transect CSG with an average of 54.9 cones/tree (Fig. 21, Table 24).

Occasional tree mortality caused by mountain pine beetle (*Dendroctonus ponderosae*) may still occur in stands that contain our cone production transects. However, during 2020 we did not observe additional beetle-caused mortality among individual trees that have been surveyed since 2002. Total mortality on transect trees since 2002 remains at 75.8% (144/190) with 100% (19/19) of transects containing beetle-killed trees. Cumulative loss among the original 190 trees has not changed in almost a decade (Fig. 23). Similar to findings reported by the Greater Yellowstone Whitebark Pine Monitoring Working Group, these data support the interpretation that the mountain pine beetle outbreak has run its course.

Table 23. Summary statistics for whitebark pine cone production surveys, Greater Yellowstone Ecosystem, 2020.

Total			Trees				Transect			
Cones	Trees	Transects	Mean cones	SD	Min	Max	Mean cones	SD	Min	Max
3,727	192	21	19.4	25	0	136	177.5	168	0	549

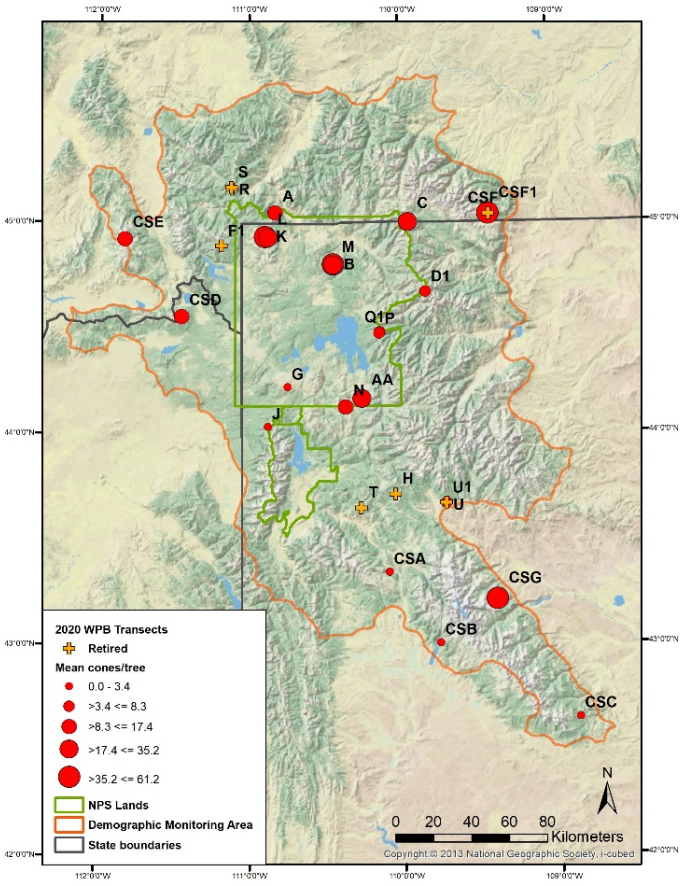

Fig. 21. Locations and mean number of cones/tree for 21 whitebark pine cone production transects, Greater Yellowstone Ecosystem, 2020. Labels reflect transect identifiers (see Table 24). Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

Table 24. Results of whitebark pine cone production surveys, Greater Yellowstone Ecosystem, 2020.

Transect	Number of cones	Number of trees	Mean number of cones/tree	SD
A	58	4	14.5	25.7
B	416	10	41.6	13.0
C	287	10	28.7	15.3
D1	83	10	8.3	6.7
F1		-----Transect retired in 2008-----		
G	34	10	3.4	4.8
H		-----Transect retired in 2008-----		
J	28	10	2.8	3.2
K	428	7	61.1	35.2
L	352	10	35.2	23.2
M	239	10	23.9	17.7
N	143	10	14.3	13.0
P	47	10	4.7	6.2
Q1	59	10	5.9	5.2
R		-----Transect retired in 2009-----		
S		-----Transect retired in 2010-----		
T		-----Transect retired in 2008-----		
U		-----Transect retired in 2016-----		
U1	241	10	24.1	18.9
AA	169	10	16.9	10.3
CSA	368	9	40.9	31.5
CSB	718	10	71.8	56.7
CSC	1106	10	110.6	129.0
CSD	105	10	10.5	8.9
CSE	0	2	0.0	0.0
CSF		-----Transect retired in 2019-----		
CSF1[a]	446	10	44.6	43.9
CSG	305	10	30.5	34.4

[a] Retired transect CSF replaced with CSF1 in 2020.

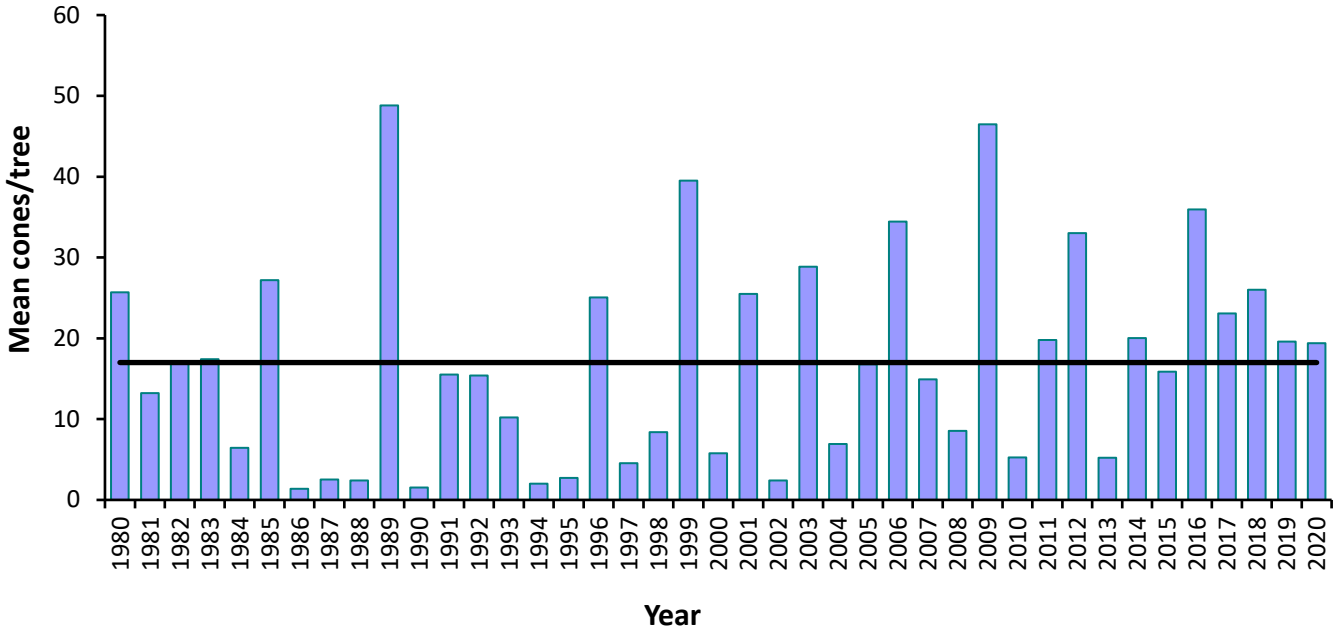

Fig. 22. Annual mean number of cones/tree observed along whitebark pine cone production transects, Greater Yellowstone Ecosystem, 1980–2020. The overall average for the time period (17 cones/tree) is shown as a solid line.

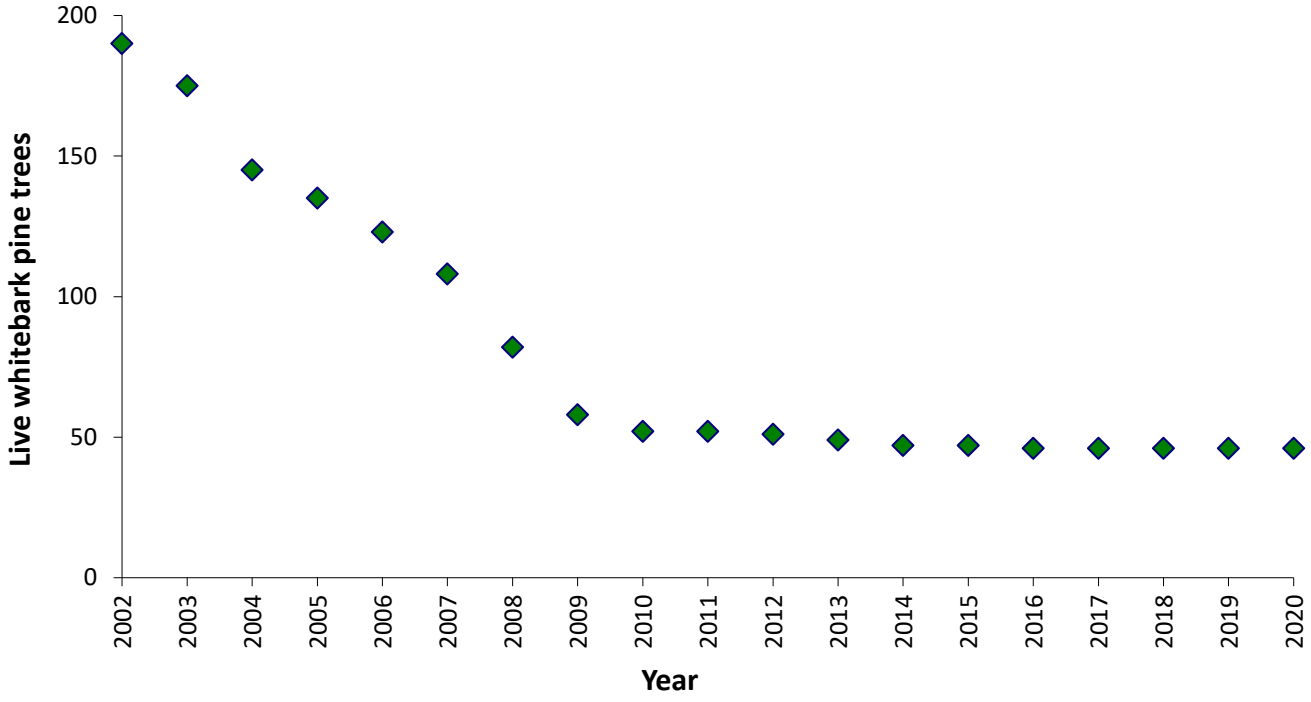

Fig. 23. Number of live whitebark pine trees on cone production transects among 190 individual trees monitored since 2002, Greater Yellowstone Ecosystem, 2002–2020.

Ungulate Herd Statistics *(Dan J. Thompson, Wyoming Game and Fish Department; Jeremy M. Nicholson, Idaho Department of Fish and Game; Jeremiah Smith, Montana Fish, Wildlife and Parks; Kerry A. Gunther, National Park Service; and Katharine R. Wilmot, National Park Service)*

We provide the following agency web links for readers as a resource to obtain statistics and data regarding the status, distribution, and harvest of ungulate herds within the Greater Yellowstone Ecosystem:

Idaho Department of Fish and Game:
https://idfg.idaho.gov/sites/default/files/seasons-rules-big-game-2021-elk.pdf

Montana Fish, Wildlife and Parks:
https://fwp.mt.gov/conservation/species/elk

Wyoming Game and Fish Department:
https://wgfd.wyo.gov/WGFD/media/content/PDF/Hunting/JCRS/2020-BG-Mgmt-Summary_March_2021.pdf

https://wgfd.wyo.gov/Hunting/Job-Completion-Reports/2020-Big-Game-Job-Completion-Reports

Grand Teton National Park
https://www.nps.gov/grte/learn/nature/vital-signs.htm

Yellowstone National Park
Bison: http://ibmp.info/library.php (under Winter Operations and Status/Surveillance/Harvest Plans)

Elk: https://fwp.mt.gov/conservation/species/elk/population-and-distribution (under Elk Population Status for HD 313)

RECREATION MONITORING

Grand Teton National Park *(Katharine R. Wilmot, Grand Teton National Park)*

Grand Teton National Park encompasses 125,362 ha of occupied grizzly bear habitat in the Greater Yellowstone Ecosystem. Most of the land in Grand Teton National Park is undeveloped, and 52% of the area is designated as recommended or potential wilderness and is managed as wilderness per National Park Service policy (National Park Service 2006). In addition, 33% of Grand Teton National Park is included in the Grizzly Bear Recovery Zone.

Grand Teton National Park manages visitors and bears in the same manner as Yellowstone National Park, using 3 broad zones: developed areas, road corridors, and backcountry (See Yellowstone Recreation Report page 62, Table 29). Backcountry camping in Grand Teton National Park requires a permit and is managed by a quota system.

In 2020, total visitation in Grand Teton National Park was 4,509,667 visits, including recreational, commercial (e.g., Jackson Hole Airport), and incidental (e.g., traveling through the Park on U.S. Highway 191 but not recreating) use.

Recreational visits alone totaled 3,289,638, which is the fourth highest number of recreation visits on record (Table 25) and only 201,513 visitors shy of being the highest year on record. Park visitation in 2020 was particularly interesting because the park was closed March 24 to May 18, 2020, in response to the COVID-19 pandemic. Similar to Yellowstone National Park, most of Grand Teton National Park's recreational visitation occurred from May through October; however, in 2020 most of the visitation occurred between June and October. Since 2008, total annual visitation to Grand Teton National Park has increased by 28%.

In 2020, Grand Teton National Park had the highest number of backcountry user nights on record (40,249) and the highest number of overnight stays in developed, roadside campgrounds (314,398). Long- and short-term trends of recreational visitation and backcountry user nights are shown in Table 26 and Fig. 24.

Visitor use numbers in this report may differ from previous reports. The data in this report are consistent with publicly available data (found at: https://irma.nps.gov/STATS/Reports/Park/GRTE).

Table 25. Ten highest years for recreational visits to Grand Teton National Park, 1979–2020.

Rank	Year[a]	Recreational visits
1	2018	3,491,151
2	2019	3,405,614
3	2017	3,317,000
4	2020	3,289,638
5	2016	3,270,076
6	2015	3,149,921
7	2014	2,791,392
8	1998	2,757,060
9	1996	2,733,439
10	1995	2,731,015

[a] Grand Teton National Park did not differentiate between recreational and non-recreational visits until 1979.

Table 26. Average annual recreational visitation and average annual backcountry use nights in Grand Teton National Park by decade from 1951 through 2020.		
Decade	**Average annual recreational visitation[a]**	**Average annual backcountry use nights**
1950s	1,102,518	Data not available
1960s	2,326,580	Data not available
1970s	2,689,306	Data not available
1980s	1,728,218	22,614
1990s	2,362,833	28,592
2000s	2,497,899	27,515
2010s	3,007,602	33,400
2020	3,289,638	40,249

[a] Grand Teton National Park did not differentiate between recreational and non-recreational visitation until 1979. In 1983 and 1992 the park updated methods for counting visitation. These updates may be the cause of some large fluctuations in visitation numbers between years, therefore park-wide visitation data are not strictly comparable between years of different counting methodology.

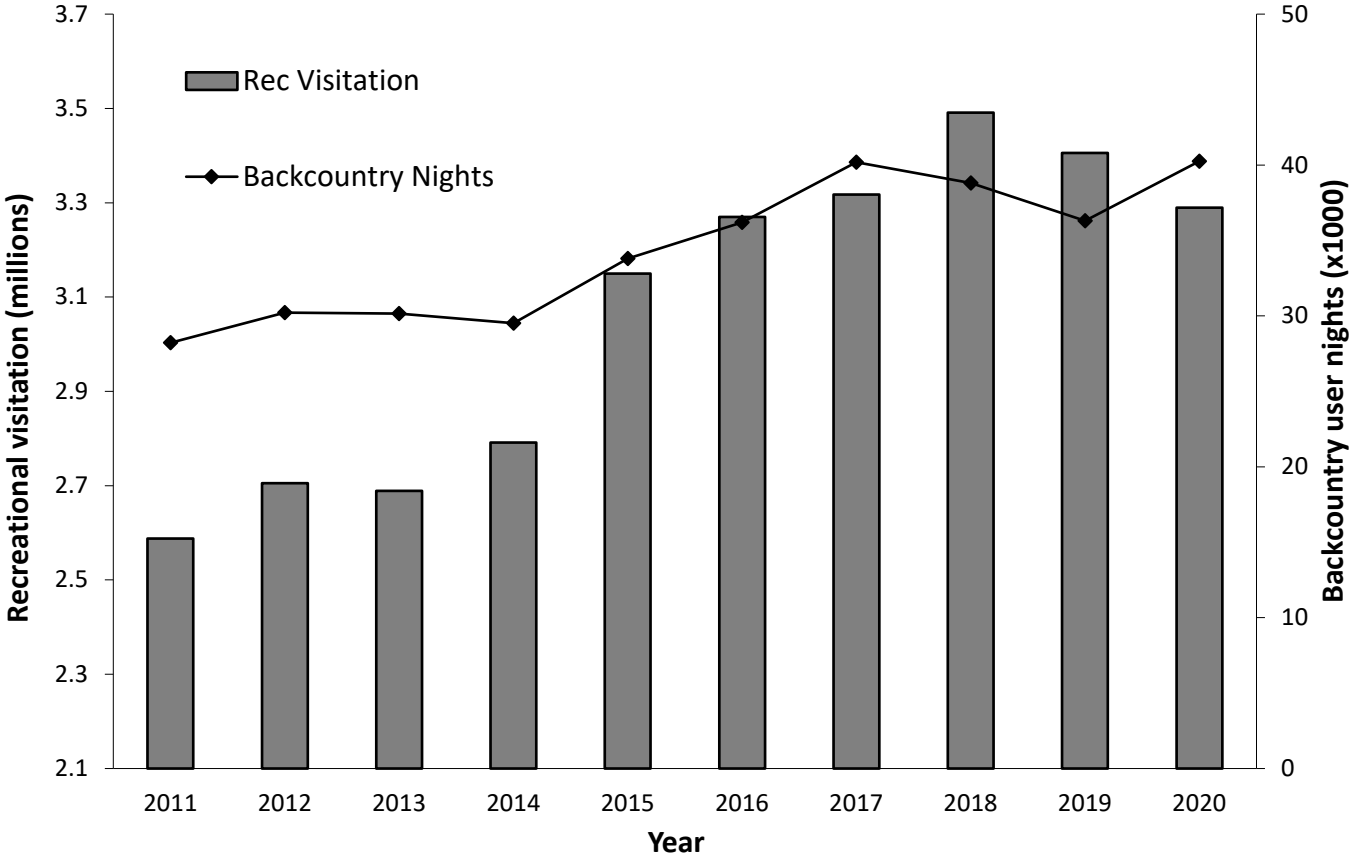

Fig. 24. Trends in recreational visitation and backcountry user nights in Grand Teton National Park, 2011–2020.

Yellowstone National Park Recreational Use *(Kerry A. Gunther, Yellowstone National Park)*

Yellowstone National Park encompasses 899,139 ha in the core of occupied grizzly bear habitat in the GYE. Most (~99%) of the habitat in the park is relatively pristine, undeveloped land; 92% of the park has been recommended for wilderness designation, and by National Park Service policy is managed so as not to preclude that designation in the future (National Park Service 1974, 2006). Only ~1% of the park's natural habitat has been significantly altered through construction of roads, buildings, and developments. Yellowstone National Park is located entirely within the boundaries of the Yellowstone Ecosystem Grizzly Bear Recovery Zone established by the U.S. Fish and Wildlife Service (USFWS 1993).

The National Park Service is mandated to preserve the cultural and natural resources of Yellowstone National Park unharmed for the benefit and enjoyment of future generations. This mandate requires providing recreational experiences for visitors on a landscape shared with grizzly bears. Visitor activities are carefully regulated to ensure minimal effects to free-ranging grizzly bears and their habitat. Visitors and bears in Yellowstone National Park are managed in 3 broad zones: developed areas, road corridors, and backcountry/proposed wilderness. Each zone has different strategies for managing the human-bear interface (Table 27). Human activities are prioritized in developed areas, road corridors are managed for use by both people and bears, and bears are generally given priority in backcountry areas.

To reduce disturbance of bears in important backcountry habitat and to prevent displacement of bears from high-quality food resources, Yellowstone National Park has designated 16 Bear Management Areas encompassing 464,638 acres (21% of Yellowstone National Park) of the highest quality bear habitat within the park. Recreational activity is limited within Bear Management Areas through a variety of seasonal trail, campsite, and area closures, no off-trail travel requirements, and time-of-day use restrictions implemented during the active bear season.

Backcountry recreation related disturbance of bears is further reduced by implementing a designated backcountry campsite system in the park. The designated backcountry campsite system limits the number of people and parties that can camp in the backcountry each night, thereby reducing the frequency of encounters with bears. In addition, by making overnight recreational activity more predictable to bears, the designated backcountry campsite system reduces the potential for confrontations at campsites. The danger of bear-human confrontations decreases if grizzly bears know where to expect people (Herrero 2002). Bear-resistant food storage devices (food hanging poles or bear-proof food storage lockers) are provided at every designated backcountry campsite, thereby reducing the frequency that bears obtain human foods, cause conflicts in campsites, and need to be killed in subsequent management actions.

In 2020, Yellowstone National Park was closed on March 24th due to health and safety concerns related to COVID-19. Two Wyoming entrances (East Entrance and South Entrance) to the park and associated roads reopened on May 18, and 3 Montana entrances and associated roads reopened on June 1. The COVID-19 related park closure likely contributed to slightly lower visitation in 2020. Total visitation to Yellowstone National Park was 4,928,751 visits (https://irma.nps.gov/STATS/Reports/Park/YELL), including recreational and non-recreational use. Recreational visits in 2020 totaled 3,806,306, the sixth busiest year on record (Table 28). Most of the park's recreational visitation occurred during the 6-month period from May through October, the same period that all sex and age classes of grizzly bears were out of their winter dens and active on the landscape. In 2020, there were 3,653,901 recreational visits (96%) during those peak months, an average of 20,686 recreational visits per day. Park visitors spent 448,286 overnight stays in roadside campgrounds, and 39,193 overnight stays in remote backcountry campsites in the park.

Average annual recreational visitation increased each decade from an average of 7,378 visits/year during the late 1890s to 3,012,653 visits/year in the 1990s (Table 29, Fig. 25). Average annual recreational visitation decreased slightly during 2000–2009 to an average of 2,968,037 visits/year. The decade 2000–2009 was the first in the history of the park that visitation did not increase from the previous decade. However, the decade 2010–2019 set a new record for Yellowstone National Park visitation, with 9 of 10 years ranking in the top 10 highest years for visitation (Table 28). The average number of overnight stays in roadside campgrounds in the park has also increased considerably in the last decade (Table 29, Fig. 26). Although total park recreational visitation has increased steadily over time, the average number of overnight stays in backcountry areas, the most important bear habitat in the park, has been relatively stable, ranging from 39,280 to 45,615 overnight stays per year per decade (Table 29, Fig. 27). The number of overnight stays in the backcountry is limited by the number and capacity of designated backcountry campsites in the park.

Table 27. Management zone, proportion of park within the management zone, and management prescription for the visitor-bear interface in Yellowstone National Park.

Management zone	Area	Management prescription
Developments	2,212 ha (5,467 acres) (<1% of park)	• Managed for people to the exclusion of bears • Bears conditioned to human foods are removed (euthanized or sent to zoos) • Visitors are given priority when visitor and bear activities are not compatible
Road corridors	654 ha (1,617 acres) (<1% of park)	• Managed for transportation and bear viewing • Bears tolerated in roadside habitats for foraging and other natural behaviors • Habituation of bears to people is expected • Bears conditioned to human foods are removed
Wilderness and undeveloped lands	886,552 ha (2,190,718 acres) (~ 99% of park)	• Managed primarily for bears and other wildlife • Overnight visitation is capped by a limited number of designated backcountry campsites • Most recreational day use is <5 km (3 miles) from roads • Implementation of seasonal recreational closures for high use bear areas • Bears are generally given priority in recreation management decisions where bear and human activities are not compatible • Bears conditioned to human foods are removed

Table 28. Ten highest years for recreational visits to Yellowstone National Park, 1895–2020.

Rank	Year	Visitation
1	2016	4,257,177
2	2017	4,116,525
3	2018	4,114,999
4	2015	4,097,710
5	2019	4,020,287
6	2020	3,806,306
7	2010	3,640,184
8	2014	3,513,484
9	2012	3,447,727
10	2011	3,394,321

Table 29. Average annual recreational visitation, auto campground overnight stays, and backcountry campsite overnight stays by decade, Yellowstone National Park, 1895–2020.

Decade	Average annual number of recreational visits	Developed campground average annual overnight stays	Backcountry campsite average annual overnight stays
1890s	7,378[a]	Data not available	Data not available
1900s	17,110	Data not available	Data not available
1910s	31,746	Data not available	Data not available
1920s	157,676	Data not available	Data not available
1930s	300,564	82,331[b]	Data not available
1940s	552,227	139,659[c]	Data not available
1950s	1,355,559	331,360	Data not available
1960s	1,955,373	681,303[d]	Data not available
1970s	2,240,698	686,594[e]	45,615[f]
1980s	2,344,485	656,093	39,280
1990s	3,012,653	647,083	43,605
2000s	2,968,037	624,450	40,362
2010s	3,779,045	720,875	41,637
2020	3,806,306	448,286[g]	39,193

[a] Data from 1895–1899. During 1872–1894, visitation was estimated to be not fewer than 1,000 and no more than 5,000 each year.
[b] Data from 1930–1934.
[c] Average does not include data from 1940 and 1942.
[d] Data from 1960–1964.
[e] Data from 1975–1979.
[f] Backcountry use data available for 1972–1979.
[g] Several National Park Service campgrounds were closed for a portion of 2020 due to COVID safety concerns.

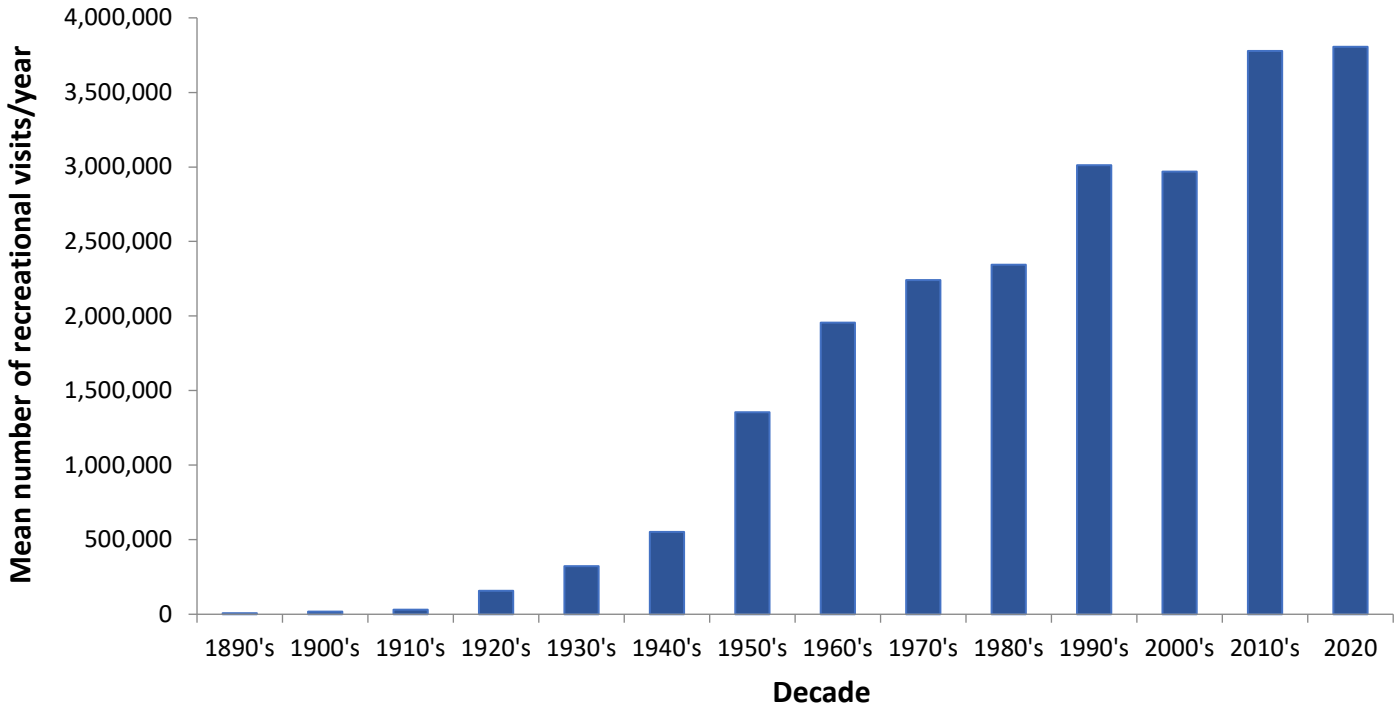

Fig. 25. Average annual number of recreational visits by decade, Yellowstone National Park, 1895–2020.

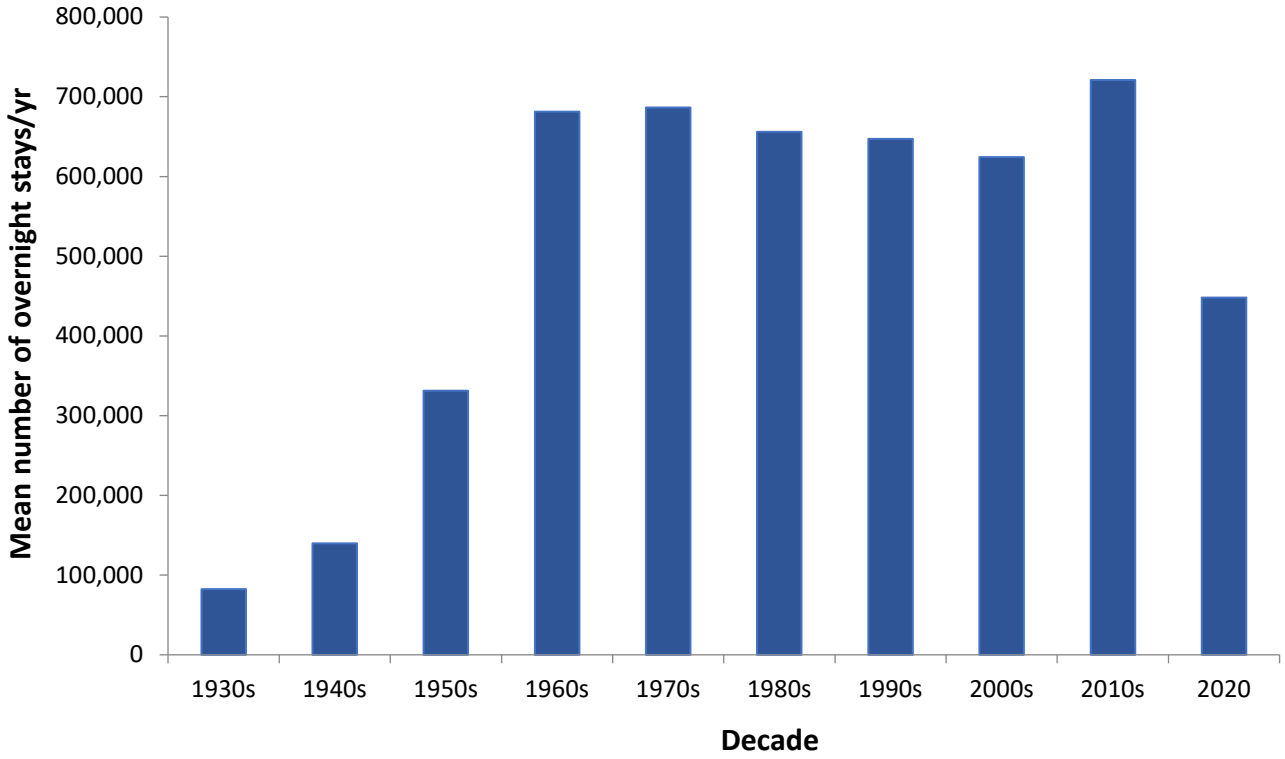

Fig. 26. Average annual number of overnight stays in roadside campgrounds by decade, Yellowstone National Park, 1930–2020. Several National Park Service campgrounds were closed for a portion of the spring and early summer of 2020 due to COVID safety concerns.

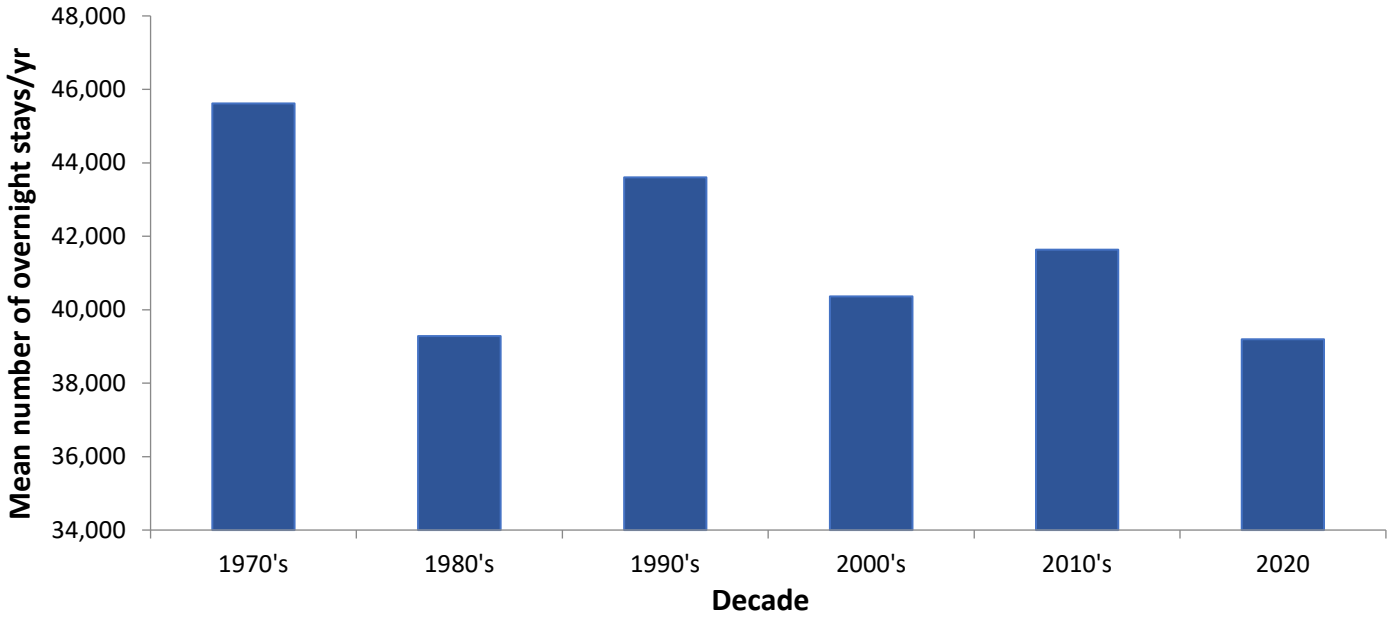

Fig. 27. Average annual number of overnight stays in backcountry campsites and dispersed camping zones by decade, Yellowstone National Park, 1972–2020.

HUMAN-GRIZZLY BEAR CONFLICTS IN THE GREATER YELLOWSTONE ECOSYSTEM

Human-Grizzly Bear Conflicts in Grand Teton National Park and John D. Rockefeller, Jr. Memorial Parkway (Katharine R. Wilmot, Grand Teton National Park)

No management actions were taken on grizzly bears in Grand Teton National Park in 2020, however, one human-grizzly bear conflict was recorded. On April 20, 2020, a lone grizzly bear entered the National Park Service housing area in Moose, Wyoming, and broke a glass window on a door at one residence and damaged a screen on the outer door at another residence.

Management of nonfood-conditioned, human-habituated bears required considerable effort to prevent conflicts from occurring. Grizzly bears were hazed out of a developed area 9 times and off park roads 32 times. Grand Teton National Park recorded a minimum of 436 bear jams (231 grizzly, 172 black, and 33 jams where the species was not recorded) created when habituated bears frequented roadsides and the outskirts of other developments and drew crowds of onlookers. Grizzly bear jams peaked in June and black bear jams peaked in September. The park's Wildlife Brigade managed most of these jams, and enforced food storage regulations at campgrounds, picnic areas, and other developments. Wildlife Brigade volunteers contributed over 5,900 hours towards this important bear conservation and public education program.

Due to the global pandemic of 2020, park interpretive staff did not provide formal programs for the public. In lieu of formal programs, park interpretive staff focused efforts to be in the field in the highest visited areas of the park to provide visitor orientation, information, and interpretation. Park staff provided bear safety information and bear spray demonstrations in the field during relevant opportunities. Staff also provided bear safety demonstrations in the two visitor centers that remained open during the pandemic for all bear spray canisters sold at park bookstores (~1,200). Staff contacted 227,000 visitors in 2020 with many of those contacts discussing bear safety. Grand Teton National Park continued its partnership with the Grand Teton National Park Foundation to cost-share expenses for the purchase and installation of bear-resistant food storage lockers. Fifty-two bear boxes (30 cubic feet each) were installed in 2020, bringing the total number of bear boxes in campgrounds and other developed sites to 911. Four of the parks 6 roadside campgrounds, including Jenny Lake, Signal Mountain, Colter Bay, and Lizard Creek Campgrounds, have a food storage locker in each site.

Human-Grizzly Bear Conflicts in Yellowstone National Park *(Kerry A. Gunther, Travis C. Wyman, and Eric G. Reinertson, Yellowstone National Park)*

Management Strategy

Yellowstone National Park's management strategy for reducing grizzly bear-human conflicts and human causes of grizzly bear mortality places significant emphasis on prevention of bear-human conflicts rather than post conflict management (e.g., capture and translocations) of bears involved in conflicts. This strategy is accomplished by: 1) providing park visitors with information on how to hike, camp, recreate, and store anthropogenic bear attractants in a manner that reduces the chances of bear-human conflicts, 2) providing park visitors with bear-proof infrastructure (e.g., bear-resistant garbage cans and food storage devices, etc.) so that food and garbage storage regulations are easy and convenient to comply with, and 3) rigorously enforcing food and garbage storage regulations through campground food security patrols and backcountry campsite patrols.

Occasionally, park visitors fail to store food or garbage appropriately, park staff fail to detect or correct improperly stored anthropogenic attractants, or grizzly bears simply outsmart park visitors and Yellowstone National Park staff or defeat food storage infrastructure and obtain human food rewards. In incidents where bears behave aggressively towards people, injure people, or damage property in their attempts to gain access to human foods (offensive aggression), the bears are generally killed, even if it is their first offense. However, in relatively benign incidents where bears inadvertently happen upon improperly stored food, the bears are generally left to roam free on the landscape. In addition, no action is taken against bears that injure people in defensive reactions to surprise encounters occurring in backcountry areas (defensive aggression). Although killing bears conditioned to human foods after just one aggressive conflict with people may seem severe, on a long-term basis this management strategy results in considerably fewer bear-human conflicts overall, and equally important, considerably fewer bears being killed in management actions to address conflicts. This management strategy promotes and favors occupation of available habitat by bears that don't seek anthropogenic foods.

Bears exhibit social learning behavior (Gilbert 1999, Mazur and Seher 2008, Morehouse et al. 2016). Human food-conditioned bear foraging behavior is often transmitted through social learning from mother bears to cubs, and from their grown female offspring to their cubs and future cubs (Cole 1976, Gilbert 1999, Mazur and Seher 2008). Cubs learn foods by watching their mothers and sharing their mother's food during the 1.5-3.5 years spent under her care (Meagher and Fowler 1989, Gilbert 1999). Yellowstone National Park managers attempt to break the chain of learned conflict behavior passed from mothers to offspring and adult female offspring to future offspring (Cole 1976, Meagher and Fowler 1989). Breaking the sequence of learned conflict behaviors is important so that conflict behavior, such as damaging property or injuring people to obtain anthropogenic foods, does not become a traditional behavior that persists across multiple generations of matriarchal linages in a large segment of the bear population (Mazur and Seher 2008). Once a conflict bear has been removed, the next bear to reoccupy that habitat, area, or general range may be an immigrating subadult that exhibits wild behaviors rather than human food-conditioned conflict behaviors (Cole 1976, Meagher and Fowler 1989). If the next bear to occupy the area exhibits conflict behaviors, it is also removed.

With a foundation of bear-proof infrastructure, effective educational efforts, and enforcement of food storage regulations, eventually the area will be re-occupied by a dispersing subadult from another area exhibiting wild behaviors. By consistently implementing this strategy over the long term, a population of bears once dominated by conflict behaviors, such as bears in Yellowstone National Park from the 1930s–1960s (Cole 1971, 1976, Meagher and Phillips 1983, Schullery 1992, Wondrak Biel 2006), can be converted to and maintained as a population composed of individuals exhibiting primarily wild behaviors (Cole 1976), such as bears in Yellowstone National Park from the 1980s to the present (Meagher and Phillips 1983, Gunther 1994, Garshelis et al. 2017). The removal of bears conditioned to human foods and exhibiting conflict behaviors allows young bears that are not conditioned to human foods to recruit into and progressively replace conflict bears in the local population (Cole 1976, Meagher and Fowler 1989). Occasional removal of food-conditioned bears will still sometimes be necessary, as bear innovators periodically reestablish conflict behaviors (Mazur and Seher 2008).

The described management strategy has been highly successful at reducing grizzly bear-human conflicts and management removals of grizzly bears on national park lands where humans are temporary visitors and their activities are highly controlled (Meagher and Phillips 1983, Gunther 1994, Garshelis et al. 2017, White et al. 2017). For example, during the last decade (2010-2019), there were 37.8 million recreational visits to Yellowstone National Park. These visitors spent >7.2

million overnight stays in roadside campgrounds, >400,000 overnight stays in remote backcountry campsites, and an estimated 2.6 million person-recreation days hiking in backcountry bear habitat in the park. Given the high level of human recreational activity in Yellowstone National Park during the last 10 years, grizzly bears undoubtedly had some opportunities to come into conflict with people. Despite intense efforts to prevent bears from obtaining human foods, on any given night there was likely a bear-resistant dumpster with a broken latch, a few coolers left out overnight in roadside campgrounds, or food that was not properly stored in backcountry campsites. However, under the parks strategy of aggressively removing bears conditioned to human foods and promoting occupation of habitat by bears that are not conditioned to human foods, few bears in the park sought anthropogenic attractants. From 2010–2019, there were only 29 ($\bar{x}$ = 2.9 ± 1.9 SD/year) incidents in the park where grizzly bears obtained human foods or damaged property while attempting to access anthropogenic attractants. In response to those incidents, only 3 ($\bar{x}$ = 0.3 ± 0.5 SD/year) independent age grizzly bears were removed (2 killed, 1 sent to a zoo) in management actions.

Limiting management removals of bears to sustainable rates while operating under the park's aggressive bear management strategy requires significant investment of resources into conflict prevention. To effectively allocate resources for implementing management actions designed to prevent grizzly bear-human conflicts, Yellowstone National Park managers need baseline information regarding the types, causes, locations, and recent trends of conflicts. To address this need, all reported grizzly bear-human conflicts are recorded annually. Conflicts are grouped into broad categories using standard definitions described by Gunther et al. (2012).

Human-Bear Conflicts

There were 3 human-grizzly bear conflicts reported in Yellowstone National Park in 2020 (Table 30). On June 22 at approximately 10 a.m., a woman hiking alone on the Fairy Falls Trail in the Old Faithful area sustained minor injuries from an adult female grizzly bear accompanied by 1 or possibly 2 yearlings. The woman encountered the bears at very close range digging roots next to the trail. The adult bear charged and knocked the woman down. She sustained a scratch on her thigh and minor injuries to her face (she turned just before the bear hit her and fell face first into the ground). The woman declined medical attention. Investigation of the site indicated that the bears were digging the corms of Yellowbells (*Fritillaria pudica*) next to the trail where the incident occurred. After the incident, the trail was closed for several days; bear warnings were placed on the trail after reopening. No action was taken against the bear.

On July 14 sometime between 8 and 10 a.m., a grizzly bear damaged an unoccupied tent in backcountry campsite 5E2 on the east shore of Yellowstone Lake. While the party was eating breakfast at the fire-ring/food pole area, a grizzly bear knocked down and tore up their tent, sleeping bags, and sleeping pads. The tent was set up 75–90 m (80–100 yards) away from the core camp and was not visible from where the group was eating breakfast. The group had observed a grizzly bear about 730 m (800 yards) from their campsite the night before the incident. The group continued their backcountry trip and reported the incident 3 days later after returning to the front-country. In the interim between the incident and when the incident was reported, other campers had stayed at campsite 5E2 and nearby campsites without incident. After receiving the report of the incident, bear warnings were placed on all nearby campsites, patrols of the area were increased, and campers staying in the area interviewed. Because there were no further conflicts in the area and the bear could not be identified to individual, no action was taken against the bear.

On October 26 at 4:15 p.m., a pair of subadult grizzly bears entered the Mammoth seasonal worker housing area where new housing was being constructed. The bears climbed into the back of a contractor's pickup truck and ate unsecured dogfood and garbage that had been left in the pickup bed. The contractors immediately called park dispatch and Rangers and Bear Management staff arrived in less than 15 minutes and hazed the bears away with bean bag rounds and cracker shells. The dog food and garbage were removed from the pickup bed. Bear Management staff stayed at the scene and hazed the bears 2 more times that night and again at first light the next morning when the bears returned. After the fourth hazing the bears left the area and did not return.

Many factors including the availability of natural bear foods, grizzly bear population numbers, and park visitation influence the annual number of bear-human conflicts in Yellowstone National Park. The annual number of conflicts in the park decreased substantially after efforts to prevent bears from obtaining anthropogenic foods were implemented in the late 1960s and early 1970s (Fig. 28, Meagher and Phillips 1983, Gunther 1994, Garshelis et al. 2017).

Grizzly Bear Mortality

During 2020, there were no known grizzly bear mortalities in the Yellowstone National Park portion of the GYE. On October 6, the bones of an old, 17–19

year-old (based on tooth wear) adult female grizzly bear were found in Hayden Valley. Based on the amount of sun bleaching and cracks forming in the canines, the bear had likely died sometime the previous year (2019).

Trends in causes of grizzly bear mortality inside Yellowstone National Park have changed considerably over time. From the late 1950s through the 1970s, most grizzly mortality in the park was due to human causes (Fig. 29), primarily management removals of bears involved in bear-human conflicts (Craighead et al. 1988). Over the last 4 decades (1980–2019), most grizzly mortality in the park is from natural causes, primarily complications of old age and intra- and inter-specific strife and predation.

Management Actions

Although grizzly bears caused few conflicts in the park in 2020, park staff dedicated considerable management effort towards preventing conflicts from occurring (Table 31). In response to grizzly bear activity in visitor use areas, park staff posted bear warning signs at 7 locations and temporary trail or area closure signs at 19 locations. To prevent grizzly bears from being attracted into visitor use areas by wildlife carcasses, park staff removed 96 large mammal carcasses from developments, auto campgrounds, roadsides, trails, and backcountry campsites. Wildlife carcasses removed from visitor use areas included 33 mule deer, 32 bison, 22 elk, 2 moose, 2 coyotes, 1 white-tailed deer, 1 bighorn sheep, 1 black bear, 1 mountain lion, and 1 wolf. To discourage grizzly bears from entering areas of concentrated visitor use, park staff hazed grizzly bears out of human use areas 32 times. Staff hazed grizzly bears out of primary road corridors 23 times, out of park developments 7 times, and out of picnic areas twice. In addition, as part of the park's strategy for preventing bears from obtaining human foods, 44 bear-proof food storage lockers (30 cubic feet each) were purchased with donations raised by the Yellowstone Forever Foundation and installed in roadside campgrounds and backcountry campsites. With the installation of 39 food storage lockers in roadside campgrounds, 985 (52%) of the park's 1,907 roadside campground campsites now have bear-proof food storage lockers. Seven of the parks 11 campgrounds, including Pebble Creek, Slough Creek, Tower Falls, Mammoth, Indian Creek, Norris, and Lewis Lake, have food storage lockers in every campsite. As part of this program, some food storage lockers have also been installed in the Canyon Village (70% of sites), Madison (54% of sites), Bridge Bay (34% of sites), and Grant Village (7% of sites) campgrounds. It is the park's goal to provide visitors with bear-proof food storage lockers in every roadside campsite in the park. In addition, 5 food storage lockers were installed in backcountry campsites to replace broken food poles. All 300 designated backcountry campsites in Yellowstone National Park currently have a food storage device (food hanging poles in 261 campsites and bear-proof food storage lockers in 39 campsites). When camping in non-designated sites in dispersed camping zones, backcountry campers are required to use hard-sided food storage canisters approved by the Interagency Grizzly Bear Committee or rig their own food-hanging device.

Management of Roadside Bear Viewing

In 2020, considerable effort was dedicated to management of roadside bear-viewing opportunities. Staff and visitors reported 261 roadside traffic-jams caused by visitors stopping to view human-habituated (but not food-conditioned) grizzly bears along park roads. Thousands of visitors viewed bears at these bear jams. Park staff responded to 160 (61%) of the grizzly bear jams and spent 863 personnel hours managing habituated grizzly bears, the traffic associated with the bear jams, and the visitors that stopped to view and photograph habituated grizzly bears along roads. On average, park personnel spent 5.4 staff-hours managing each grizzly bear jam in 2020. The objectives of managing visitors at roadside bear-viewing opportunities include: 1) keeping visitor behavior as predictable as possible to bears, 2) keeping visitors at least 100 m from bears, and 3) preventing visitors from feeding, approaching, encircling, or following bears. The habituation of some bears to people combined with the presence of large areas of non-forested habitat in Yellowstone National Park, has created exceptional bear viewing opportunities, resulting in significant growth of bear viewing as a local industry in park gateway communities. Bear viewing is now one of the primary activities of visitors to Yellowstone National Park (Taylor et al. 2014, Richardson et al. 2015) and contributes millions of dollars to the economies of park gateway communities annually (Richardson et al. 2014).

Table 30. Number of incidents of grizzly bear-human conflict reported in Yellowstone National Park, 2020.

Conflict type	Number of conflicts
Property damage–without food reward	1
Anthropogenic food reward	1
Human injury	1
Human fatality	0
Livestock depredation[a]	0
Total conflict incidents	3

[a]There are no cattle or sheep grazing allotments inside of Yellowstone National Park. Horses, mules, and llamas used as riding or pack stock are the only domestic livestock in the park that can potentially be killed by grizzly bears. Forty-one Commercial Outfitters have contracts to provide stock day rides and overnight pack trips in the park. In 2020, 1,268 stock animals (horses, mules, llamas) spent 4,051 nights in Yellowstone National Park's backcountry.

Table 31. Number of management actions taken to reduce the potential for conflicts with grizzly bears in Yellowstone National Park, 2020.

Management action	Number of incidents
Bear warnings posted	7
Temporary area closures	19
Wildlife carcass removal from visitor use areas	96
Bear-jam management	160
Management hazing	32
Attempt capture–unsuccessful	0
Capture, mark, and release on site	0
Capture and relocate	0
Capture and remove (euthanize or send to zoo)	0
Capture for humane reasons	0
Total management actions	314

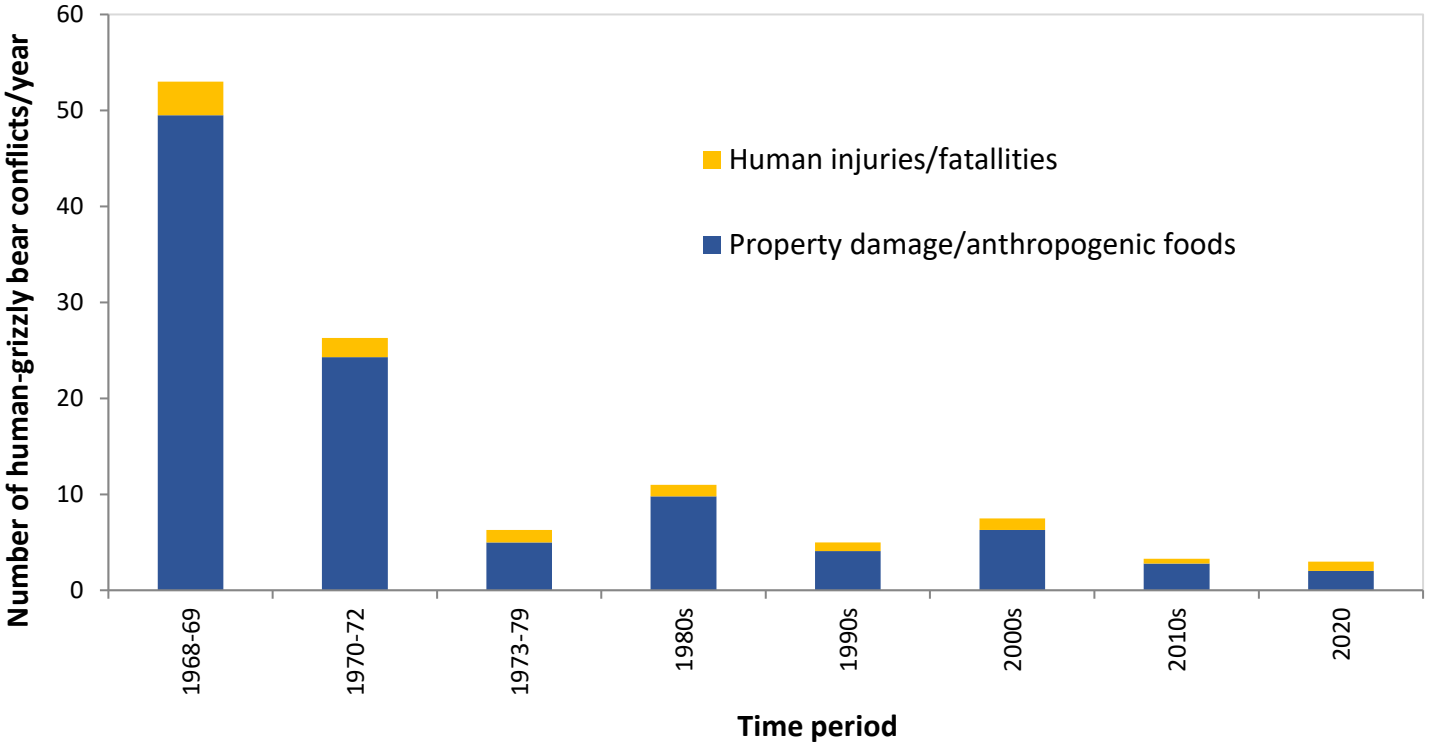

Fig. 28. Number of human-grizzly bear conflicts, Yellowstone National Park, 1968–2020.

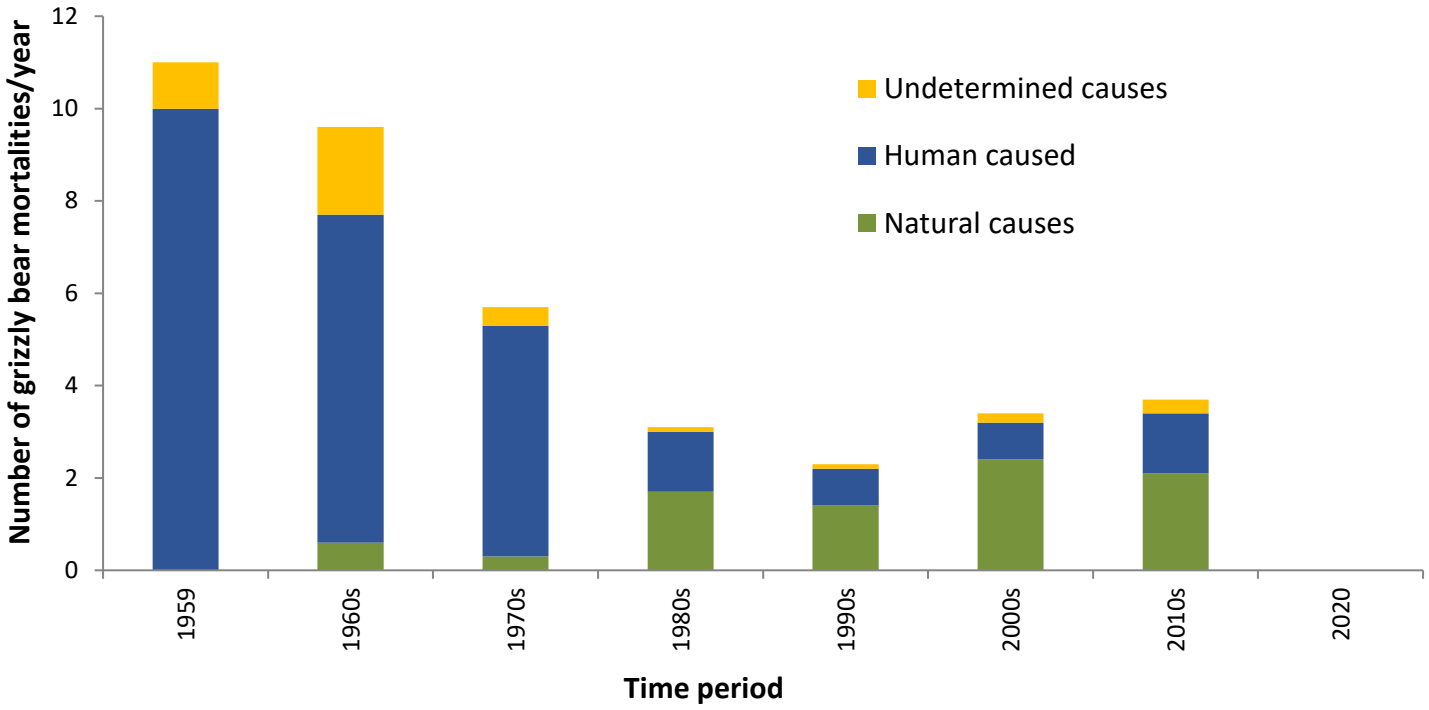

Fig. 29. Number of known and probable grizzly bear mortalities, Yellowstone National Park, 1959–2020.

Human-Grizzly Bear Conflicts in Idaho *(Jeremy Nicholson, Idaho Department of Fish and Game)*

The Idaho Department of Fish and Game responded to 34 human-grizzly bear conflicts in 2020 (Table 32, Fig. 30). Conflicts have consistently occurred in Idaho's portion of the Greater Yellowstone Ecosystem since 2005 (Fig. 31). Since 1992, the vast majority (92%) of conflicts have occurred inside the DMA (Fig. 32). All conflicts were inside the DMA in 2020.

Table 32. Human-grizzly bear conflicts in the Idaho portion of the Greater Yellowstone Ecosystem, 2020.

Conflict type	Number of conflicts
Human injury	2
Encounter situations	2
Public safety threat (habituated, near developed site, etc.)	15
Anthropogenic foods	4
Property damage–without food reward	3
Livestock depredation–cattle	6
Human-caused bear mortality	2
Total	34

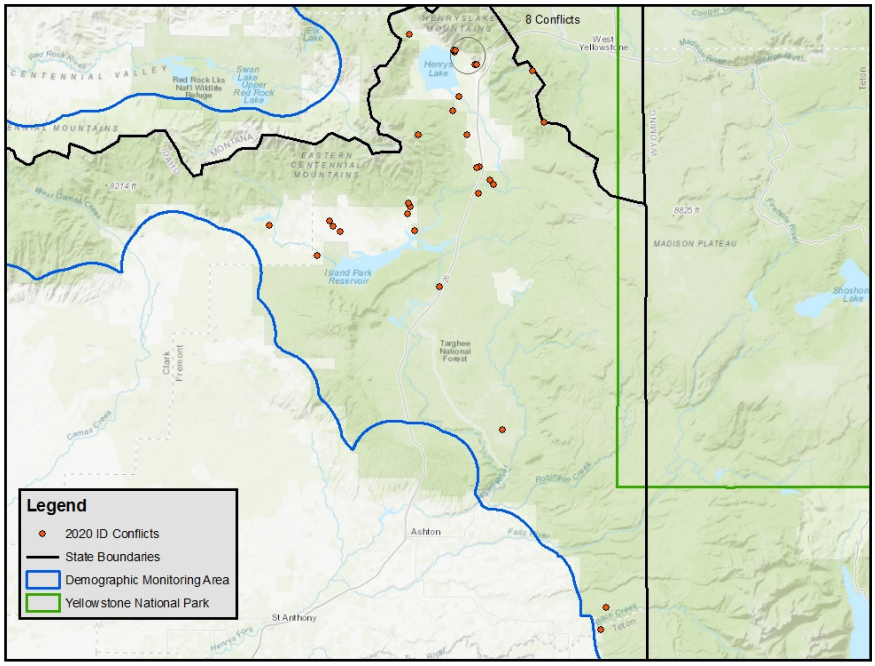

Fig. 30. Locations of human-grizzly bear conflicts in the Idaho portion of the Greater Yellowstone Ecosystem, 2020. Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

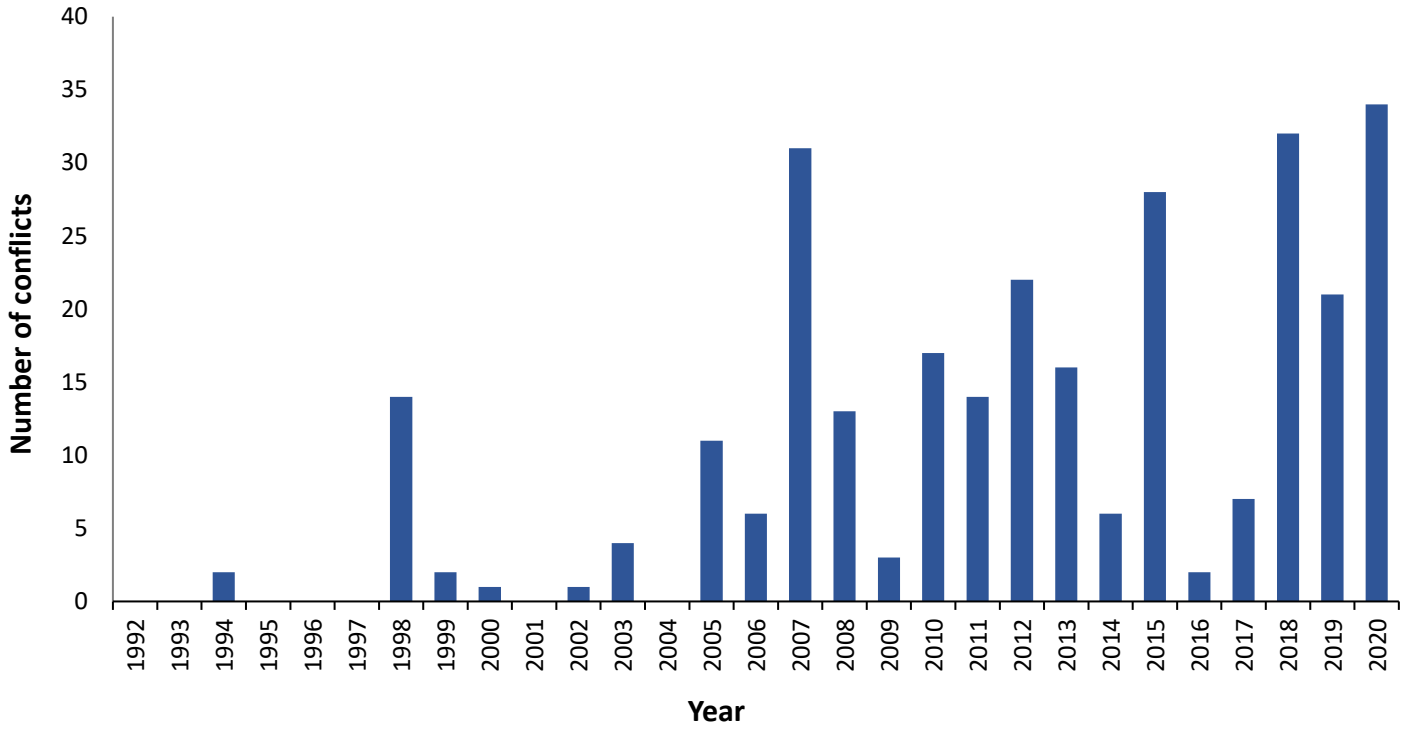

Fig. 31. Number of documented human-grizzly bear conflicts in the Idaho portion of the Greater Yellowstone Ecosystem, 1992–2020.

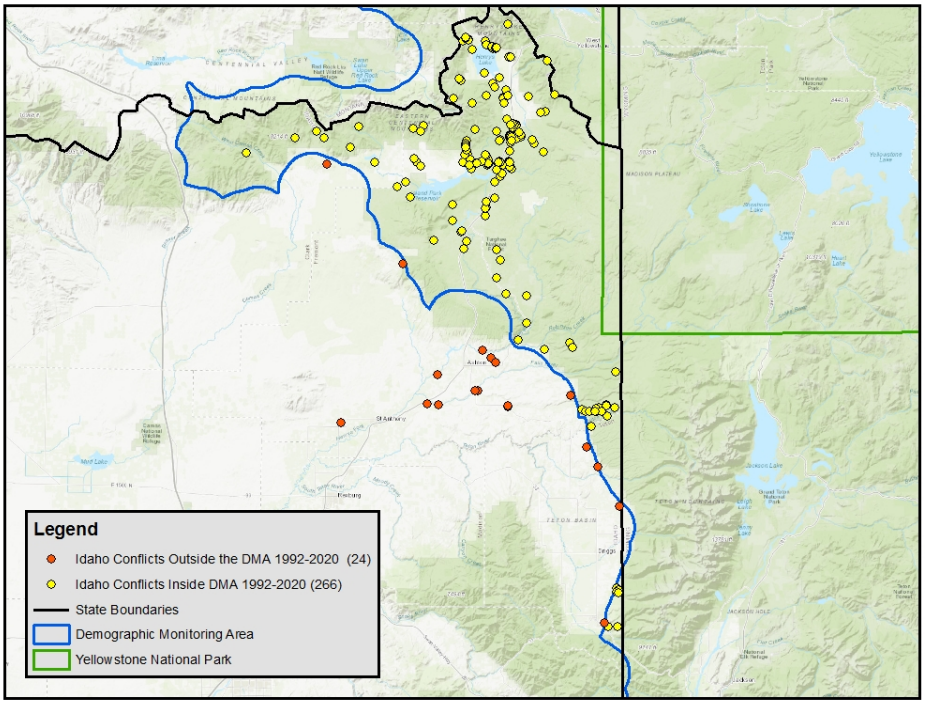

Fig. 32. Location of documented human-grizzly bear conflicts inside and outside the Demographic Monitoring Area in the Idaho portion of the Greater Yellowstone Ecosystem, 1992–2020. Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

Human-Grizzly Bear Conflicts in Montana *(Kevin L. Frey and Jeremiah F. Smith, Montana Fish, Wildlife and Parks)*

During 2020 in Montana's portion of the Greater Yellowstone Ecosystem, there were a total of 101 investigated human-bear conflicts and 17 documented grizzly bear mortalities. The number of conflicts is shown by type in Table 33 and annual variation in conflicts and grizzly bear mortalities are shown in Fig. 33. For 2011–2020, the average number of grizzly bear conflicts was 81.5 per year and 9.7 grizzly bear mortalities per year.

Table 33. Human-grizzly bear conflict types in Montana portion of the Greater Yellowstone Ecosystem, 2020.

Conflict type	Number of conflicts
Encounter situations	14 *(4 defense of life mortalities)
Livestock - cattle	31 - 32 cattle killed or injured
Livestock - sheep	1 to 2
Livestock - poultry	1 to 6
Other property loss	3
Anthropogenic foods	9
Anthropogenic foods with property damage	3
At developed sites–safety concerns	24
Bear mortalities	10-14 management, 3 others + *4 defense of life = 17
Management relocations	1 to 2
Total	**101**

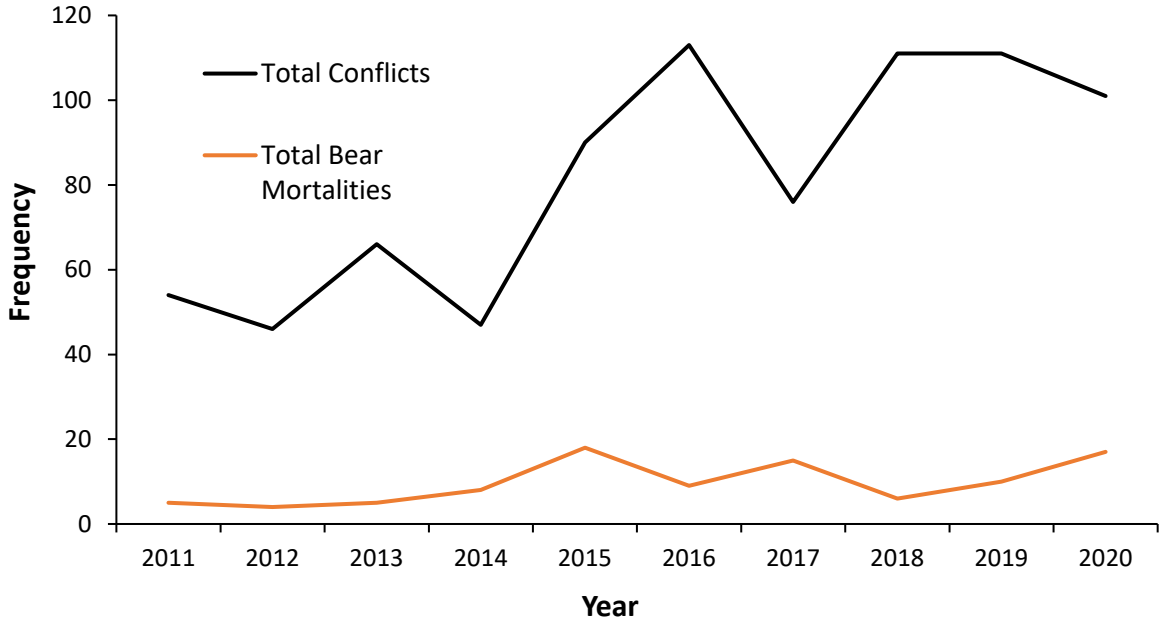

Fig. 33. Trends of total grizzly bear conflicts and bear mortalities in Montana portion of the Greater Yellowstone Ecosystem, 2011–2020.

The distribution of grizzly bear conflicts by land jurisdiction is shown in Table 34. During 2020, the largest percentage (63%) of conflicts occurred on private land.

The trend in close encounters that can lead to human injuries or defense of life grizzly bear mortalities from 2011 through 2020 are shown in Fig. 34. The yearly average of these conflicts is 12 close encounters, 3 human injuries, and 2.5 defense of life grizzly bear mortalities. During 2020, there were 14 close encounters resulting in 4 human injuries and 4 grizzly bear mortalities.

Cattle depredations are increasing as grizzly bear numbers and geographic distribution increases. The annual variation and overall increases in the western portion of Montana Fish, Wildlife and Parks Region 3 and in Region 5 are shown in Fig. 35. From 2011 through 2020, the yearly average for the geographic portions are approximately 10 depredations in Region 3 West, 3 in Region 3 East, and 12 in Region 5. During 2020, there were 13 cattle depredations in Region 3 West, 1 in Region 3 East, and 17 in Region 5.

Fig. 36 displays a map of all 2020 conflict types and grizzly bear mortalities showing the distribution of management efforts and grizzly bear distribution. There is annual variation in these distributions and the numbers of conflicts in any geographic area.

Table 34. Total conflicts by land jurisdiction in Montana portion of the Greater Yellowstone Ecosystem, 2020.

Jurisdiction	Number of conflicts
Private	64 (63% of total)
State	4
County or local government	2
Federal	2
Bureau of Land Management	0
Custer Gallatin National Forest	9
Beaverhead-Deerlodge National Forest	19
USFWS–National Wildlife Refuge	1
Total	**101**

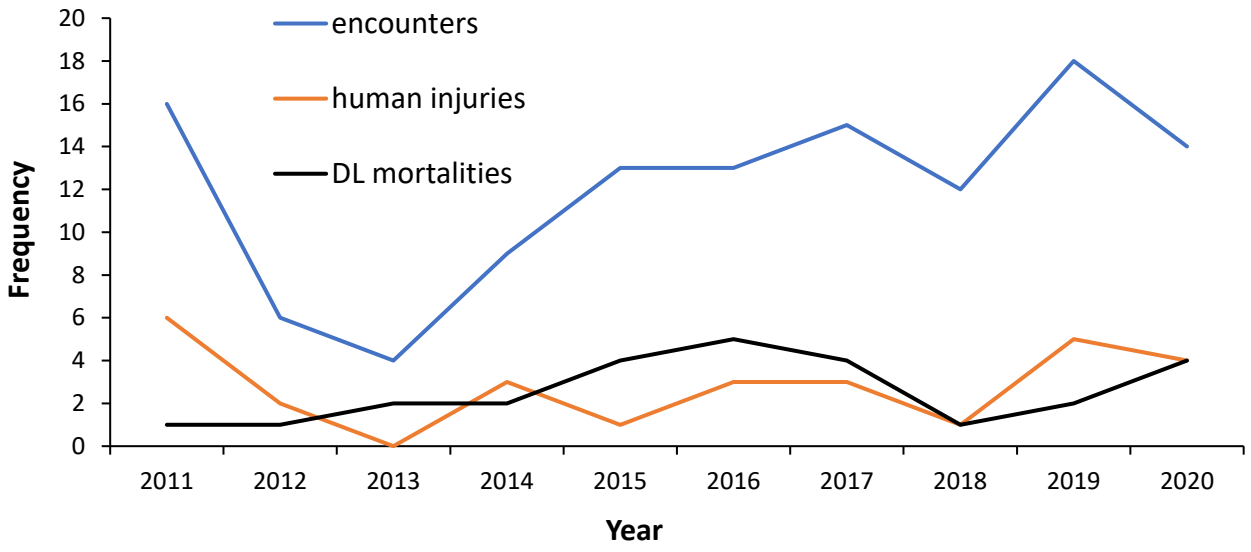

Fig. 34. Trends of bear encounters, resulting human injuries and defense of life (DL) bear mortalities in Montana portion of the Greater Yellowstone Ecosystem, 2011–2020.

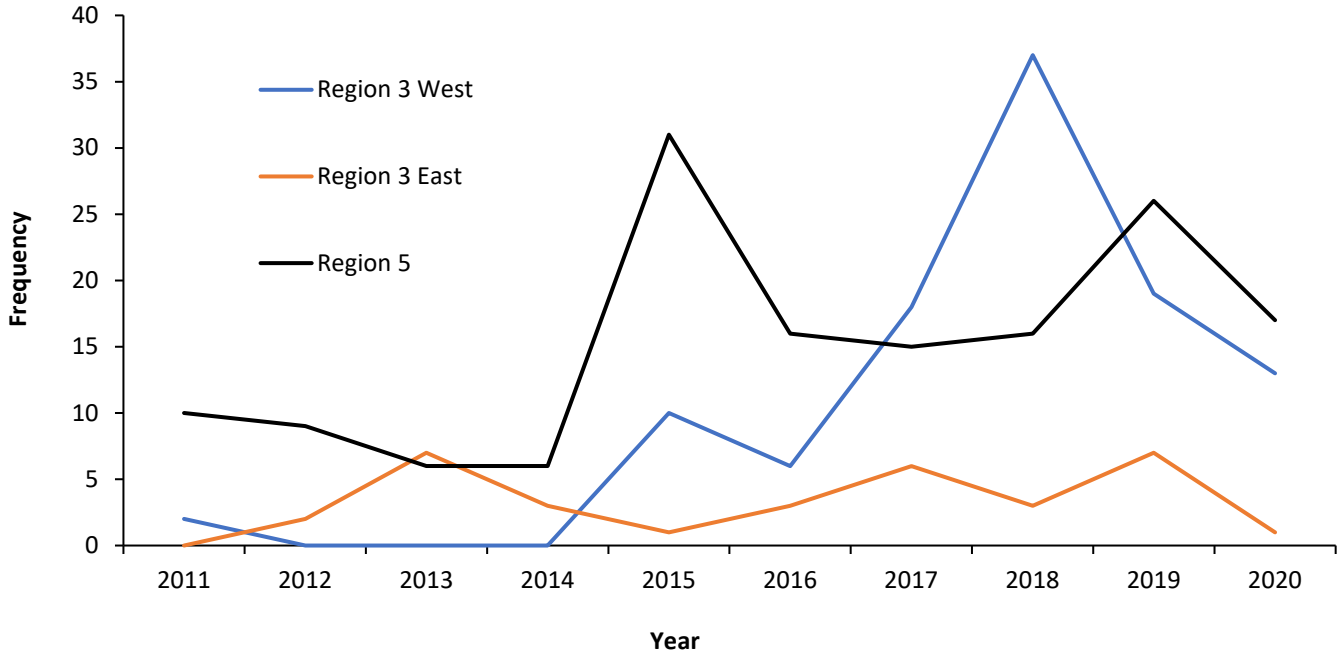

Fig. 35. Trend of cattle depredation conflicts in Montana portion of the Greater Yellowstone Ecosystem, 2011–2020.

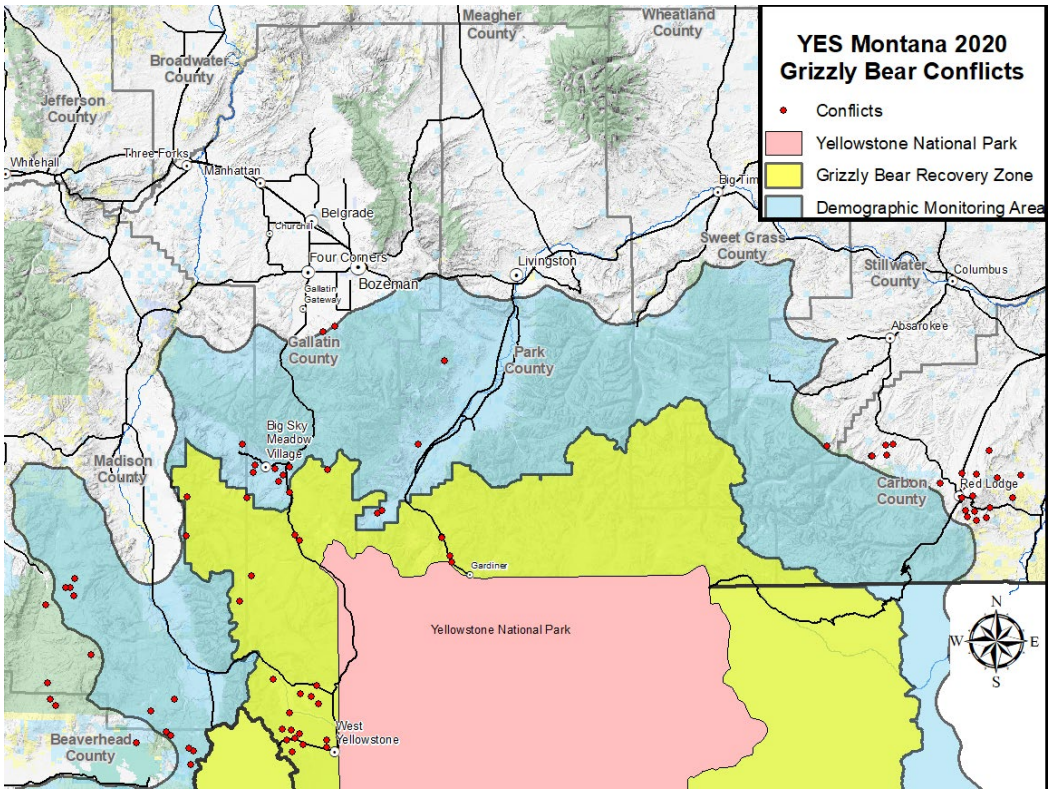

Fig. 36. Locations of all conflict types and grizzly bear mortalities in Montana portion of the Greater Yellowstone Ecosystem, 2020. Base Map: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community.

Human-Grizzly Bear Conflicts in Wyoming *(Brian DeBolt, Zach Turnbull, Luke Ellsbury, Michael Boyce, Dustin Lasseter, Phil Quick, Zach Gregory, Rebecca Lyon, and Daniel J. Thompson; Large Carnivore Section, Wyoming Game and Fish Department)*

Human-bear interactions and conflicts in Wyoming are typically a result of bears seeking unnatural foods in association with people and property, close encounters with humans or when bears depredate livestock. The number and location of human-bear conflicts is influenced by unsecured unnatural attractants (e.g., human foods, garbage), natural food distribution and abundance, bear density and distribution, and human and livestock use patterns on the landscape.

The preferred resolution is to minimize human-bear conflicts in Wyoming through preventative measures or to secure the bear attractant. In addition, the Wyoming Game and Fish Department (WGFD) manages grizzly bears in accordance with state and federal law, regulation, and policy. Capturing bears in areas where they may come into conflict with people and relocating them to remote locations is a common practice throughout the world. Relocating bears achieves several social and conservation functions: 1) reduces the possibility of property damage, livestock damage, or human interactions in areas where the potential for conflict is high; 2) reduces the potential for bears to become food conditioned or human habituated, which often results in destructive and dangerous behaviors; 3) allows bears the opportunity to forage on natural foods and remain wary of people; and 4) may prevent removing bears from the population, which may be beneficial in meeting population management objectives. The practice of relocation has served as an integral conservation tool to provide for recovery of GYE grizzly bears for multiple decades. Removal refers to lethal or live removal (e.g., placement with a zoo or other captive bear facility) from the population.

During 2020, the WGFD captured 26 individual grizzly bears in 27 capture events in an attempt to prevent or resolve conflicts (i.e., 1 bear was captured twice) (Fig. 37 and Tables 35 and 36). Of the 26 individual grizzly bears, 8 were female and 18 were male. Most captures were adult males (n = 12). Of the 27 capture events, 13 captures were a result of bears killing livestock (primarily cattle), 13 were captures involving bears that obtained food rewards (pet, livestock food, garbage, fruit trees), or were frequenting developed sites or human populated areas unsuitable for grizzly bear
occupancy. One event was a non-target capture, but the bear was relocated a short distance as a preventative measure. Of the 27 capture events, 15 (56%) were in Park County, 5 (19%) were in Sublette County, 3 (11%) were in Fremont County, 2 (7%) were in Hot Springs County, and 2 (7%) were in Teton County (Table 35 and Fig. 37).

Of the 27 capture events, 9 involved relocation. All relocated grizzly bears were released on U.S. Forest Service lands in or adjacent to the Recovery Zone (Fig. 38). Of the 9 relocations, 6 were conducted in Park County (67%), 2 (22%) were in Teton County, and 1 (11%) was in Fremont County (Fig. 38 and Table 35).

Grizzly bears are removed from the population (lethally or through live placement in an approved facility) due to a history of previous conflicts, a known history of close association with humans, or they are deemed unsuitable for release into the wild (e.g., orphaned cubs, poor physical condition, or human safety concern). Of the 26 individual bears captured, 18 bears were removed from the population. Of these 18 human-caused mortalities associated with management captures, 9 were outside of the DMA. Removal of grizzly bears in Wyoming is dependent upon authorization from the U.S. Fish and Wildlife Service, after careful and thorough deliberation, taking into account multiple factors unique to each conflict situation.

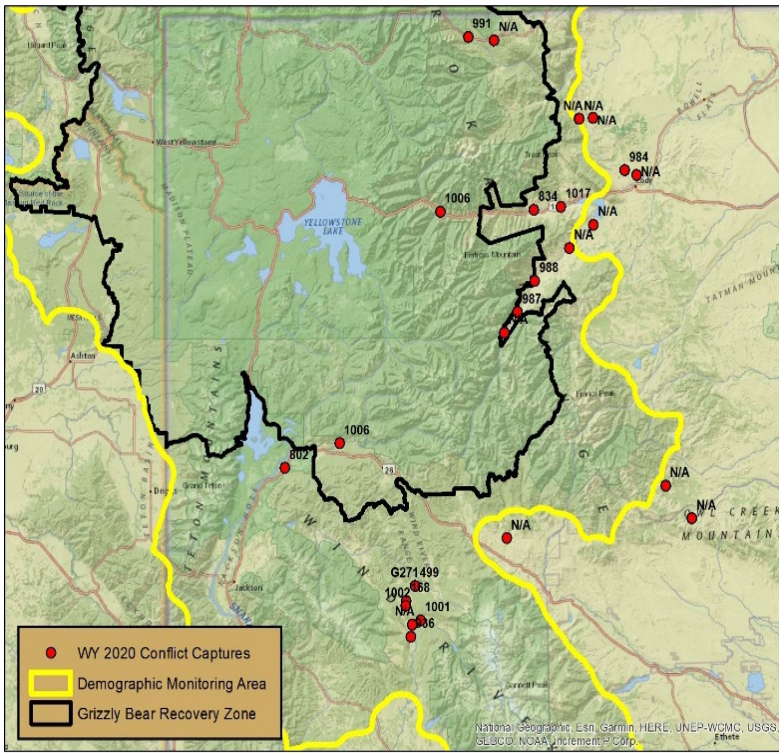

Fig. 37. Capture locations (n = 27) for grizzly bears captured in conflict management efforts in Wyoming portion of the Greater Yellowstone Ecosystem, 2020. Grizzly bears with "G" in front of their number were marked but not fitted with radio collars typically because they were too young to be collared. Because of the mapping scale, some locations are combined at one symbol. A complete list is provided in Table 35. Base Map Source: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

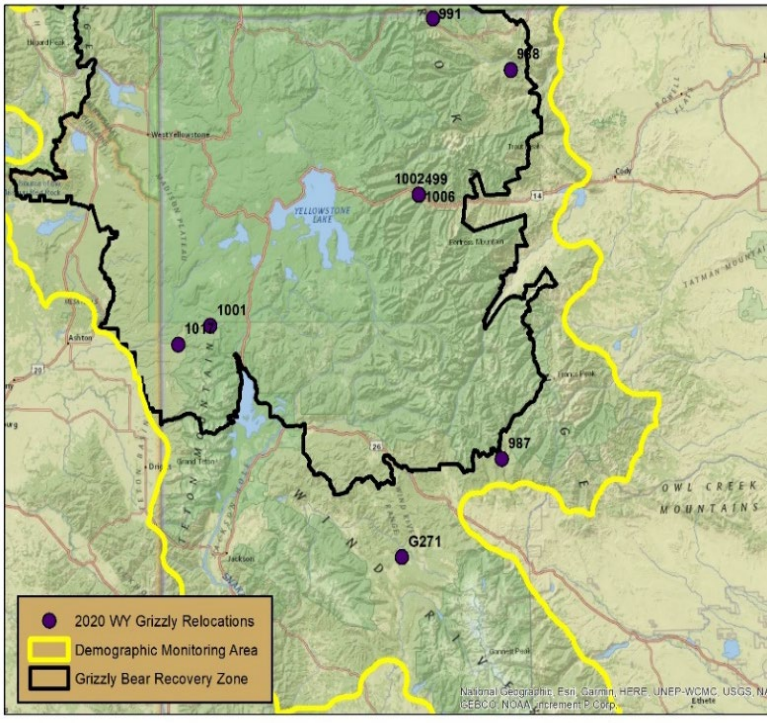

Fig. 38. Release locations (n = 9) for grizzly bears captured, relocated, or released on site in conflict management efforts in Wyoming portion of the Greater Yellowstone Ecosystem, 2020. Grizzly bears with "G" in front of their number were ear-marked but not fitted with a radio collar upon release, typically because they were too young to be collared. Because of the mapping scale, some locations are combined at one symbol. A complete list is provided in Table 35. Base Map Source: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Table 35. Summary of grizzly bear conflict management captures in Wyoming portion of the Greater Yellowstone Ecosystem, 2020. Grizzly bears identified with "N/A" were removed from the population without receiving an identification number.

Date	ID	Capture county	Relocation site	Release county	Reason for capture
4/25/2020	984	Park			Removed for previous conflict history of garbage and pet/livestock feed, and several failed attempts to haze away from developed areas
4/29/2020	802	Teton			Removed for numerous conflicts involving garbage, pet/livestock feed, property damage and entering structures
5/5/2020	834	Park			Removed for killing chickens and damaging the coop, frequenting developed areas and repeated failed relocation attempts
5/7/2020	987	Park	Wiggins Fork	Fremont	Captured for pig depredation and property damage
5/9/2020	N/A	Park			Removed for frequenting developed areas and close proximity to the city of Cody
5/17/2020	988	Park	Camp Creek	Park	Captured for frequenting ranch housing area, failure to leave after several hazing attempts
5/22/2020	991	Park	Fox Creek	Park	Non-target capture at developed site
6/17/2020	N/A	Hot Springs			Removed for cattle depredations on private lands
6/18/2020	N/A	Park			Removed for very bold and aggressive behavior towards people
7/1/2020	1001	Sublette	Grassy Lake	Teton	Captured for cattle depredation
7/3/2020	936	Sublette			Removed for repeated livestock conflicts and depredations
7/22/2020	1002	Sublette	Mormon Creek	Park	Captured for cattle depredations
7/28/2020	1006	Teton	Five Mile Creek	Park	Captured for repeated nuisance behavior in subdivision and food rewards (grain in scat)
7/30/2020	168	Sublette			Removed for repeated cattle depredations and extremely poor condition
8/2/2020	N/A	Park			Removed for habituated behavior and conflicts involving beehives, birdfeeders, and apple trees
8/7/2020	1006	Park			Removed for multiple food rewards, aggressive behavior, and failed recent relocation
8/29/2020	N/A	Park			Removed for repeated cattle depredations
8/30/2020	N/A	Park			Removed for cattle depredations
9/1/2020	N/A	Hot Springs			Removed for sheep depredations
9/2/2020	499	Fremont	Five Mile	Park	Captured for cattle depredations
9/2/2020	G271	Fremont	Five Mile	Park	Captured with mother (499) for cattle depredations
9/22/2020	1017	Park	Squirrel Meadows	Teton	Captured for frequenting yards and residential areas with fruit trees, frequenting areas around buffalo bill state park
9/24/2020	N/A	Park			Removed for multiple conflicts involving garbage, birdfeeders, and livestock feed
9/29/2020	N/A	Park			Removed for multiple food rewards including garbage and aggressive behavior towards people
9/29/2020	N/A	Sublette			Removed for repeated cattle depredations
10/19/2020	N/A	Fremont			Removed for habituated behavior, property damage, and human safety (near subdivision, town, and school)
11/4/2020	N/A	Park			Removed for multiple food rewards, frequenting ranch, and property damage

WGFD personnel investigated and recorded 208 human-grizzly bear conflicts in 2020 (Table 36, Fig. 39). As a result of vigilant education and conflict prevention efforts, the general pattern of conflicts is relatively steady within currently occupied habitat (Figs. 40 and 41). However, as occupied grizzly bear range has expanded, conflicts continue to occur in areas farther from the Recovery Zone and outside the DMA, often on private lands. Bears are increasingly coming into conflict with people in areas where grizzly bears have not been present in recent history. Although the joint efforts of the WGFD, U.S. Forest Service, non-governmental organizations, and particularly the public, have resulted in reducing conflicts through education and attractant storage in many areas, the distribution of grizzly bear conflicts in Wyoming continues to expand with the population. Bears frequent lower elevations and developed areas regularly during the non-denning period. Grizzly bear-cattle depredation was the most frequent type of conflict documented in 2020. The annual variation in livestock depredation incidents is not easily explained. Although most human-bear conflicts are correlated with natural food abundance, the numbers of cattle and sheep killed annually do not follow the same pattern. As grizzly bears expand farther into human-dominated landscapes outside the DMA, the potential for conflict between bears and humans increases, resulting in negative outcomes for both grizzly bears and people. The WGFD continues to explore and use multiple options to reduce grizzly bear-livestock conflicts and expand our education and outreach efforts (see Bear Wise Wyoming Report, Appendix C).

Half of the grizzly bear conflicts in Wyoming occurred on private lands and the majority were outside of Recovery Zone (Figs. 40 and 41). The increasing distribution of grizzly bears is reflected in the annual documentation of conflicts farther from suitable habitat and continued expansion outside the DMA. As bears expand and occupy habitats commonly used by humans, there is a greater potential for conflicts to occur. Education and conflict-prevention efforts are used anywhere bears and people coexist, and management actions will be a function of human values and effects on the grizzly bear population in those areas.

Long-term trends in the number of conflicts are likely a result of grizzly bears increasing in numbers and distribution and expanding into areas used by humans, including livestock production, on public and private lands. There is also growing potential for roadside bear problems. Some people engage in unethical wildlife viewing practices, often resulting in habituated or food-conditioned grizzly bears. These situations will continue to spark difficult challenges for bear managers in the future. As the GYE grizzly bear population continues to grow and expand into less suitable habitat, bears are more likely to encounter food sources such as garbage, pet food, livestock and livestock feed, and a myriad of other attractants, resulting in increased property damage and threats to human safety. Conflict prevention measures such as attractant storage, deterrence, and education are a priority for WGFD. Nevertheless, conflict management is often reactive. In general, there is less social tolerance and biological suitability for bear occupancy in areas farther from the Recovery Zone due to development, land use patterns, and various forms of recreation. Although prevention is the preferred option to reduce conflicts, each situation is managed on a case-by-case basis with education, securing of attractants, relocation or removal of individual bears, or a combination of methods applicable for long-term conflict resolution and conservation of grizzly bears.

Table 36. Type and number of human-grizzly bear conflicts in Wyoming portion of the Greater Yellowstone Ecosystem, 2020.

Conflict type	Number	Percent (%)
Cattle	127	61
Pet/ livestock/birdfeed	21	10
Garbage	12	6
Aggression towards humans	12	6
Other	9	4
Property damage	8	4
Animal death	4	2
Beehive	4	2
Animal injury	3	1
Poultry	3	1
Sheep	2	>1
Unsecured attractants	2	>1
Swine	1	>1
Total	208	100

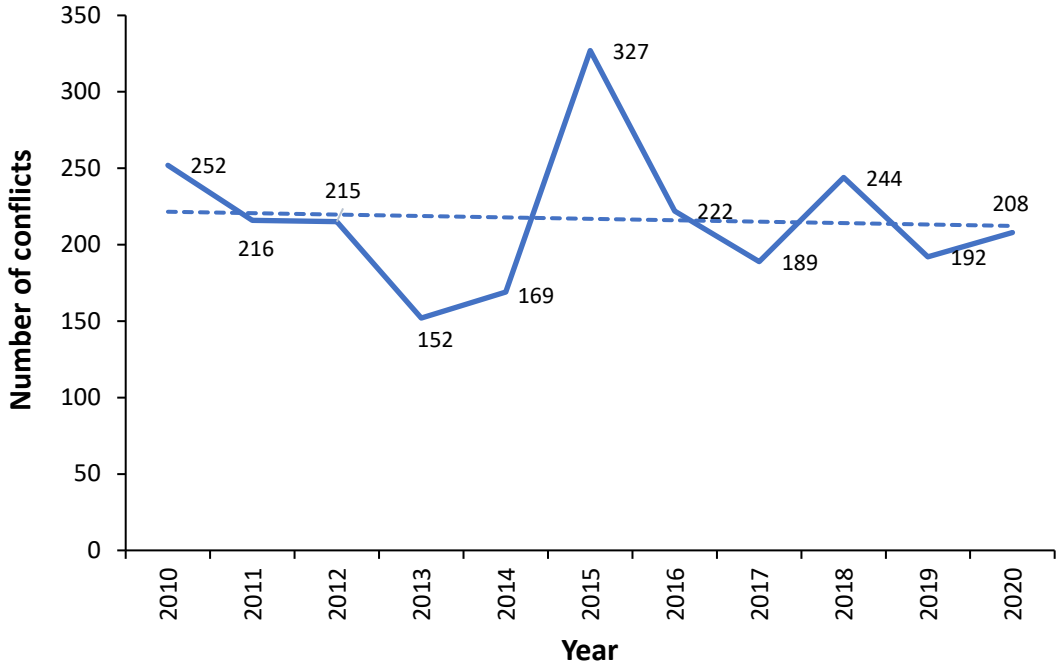

Fig. 39. Number of human-grizzly bear conflicts in Wyoming portion of the Greater Yellowstone Ecosystem, 2010–2020.

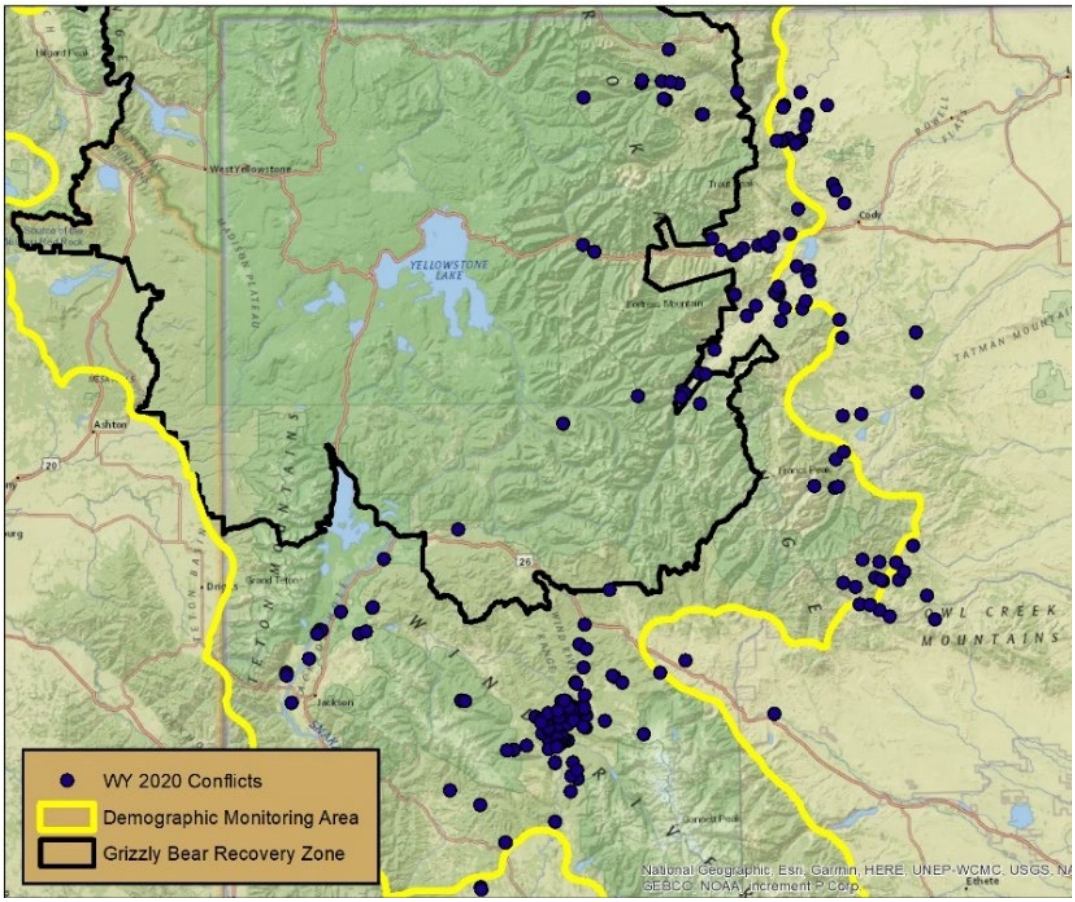

Fig. 40. Location of human-grizzly bear conflicts in Wyoming portion of the Greater Yellowstone Ecosystem outside of national parks (n = 208) in relation to the Recovery Zone and Demographic Monitoring Area, 2020. Base Map Source: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

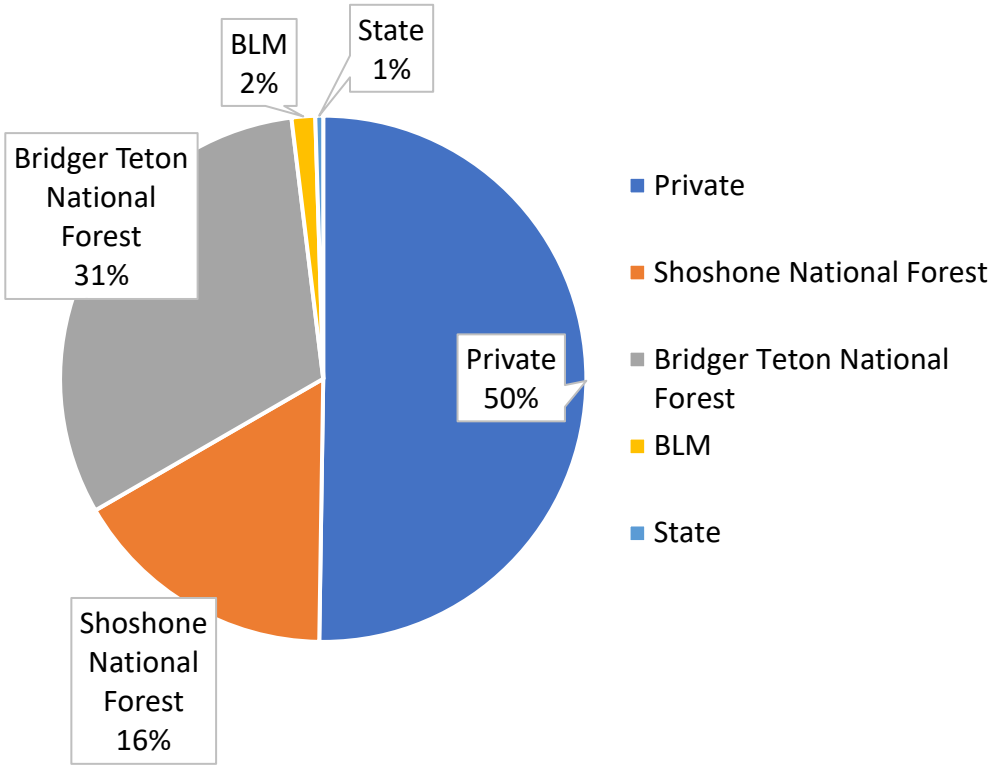

Fig. 41. Percent of human-grizzly bear conflicts on private and public lands in Wyoming portion of the Greater Yellowstone Ecosystem, 2020

Human-Grizzly Bear Conflicts on the Wind River Reservation (*Pat Hnilicka, Lander Fish and Wildlife Conservation Office, U.S. Fish and Wildlife Service; and Art Lawson, Eastern Shoshone and Northern Arapaho Tribal Fish and Game Department*)

No conflicts were reported in 2020. Conflicts are defined as incidents where bears cause a human safety issue (habituated, in developed areas), damage property, kill or injure livestock, obtain human foods or garbage, or injure people.

Four encounters were reported in 2020 (Fig. 42). Encounters occur when bears and people meet and are both aware of each other's presence, but with no ensuing conflict. These four encounters occurred in the North Fork Little Wind River drainage inside the Demographic Monitoring Area. During late July and within a 2-week period, backcountry users encountered a solitary grizzly on 4 occasions. No aggressive behavior or food rewards were reported. In response, agency personnel increased signage of bear warnings and awareness at the St. Lawrence trailhead and provided outreach to the outfitter and backcountry users.

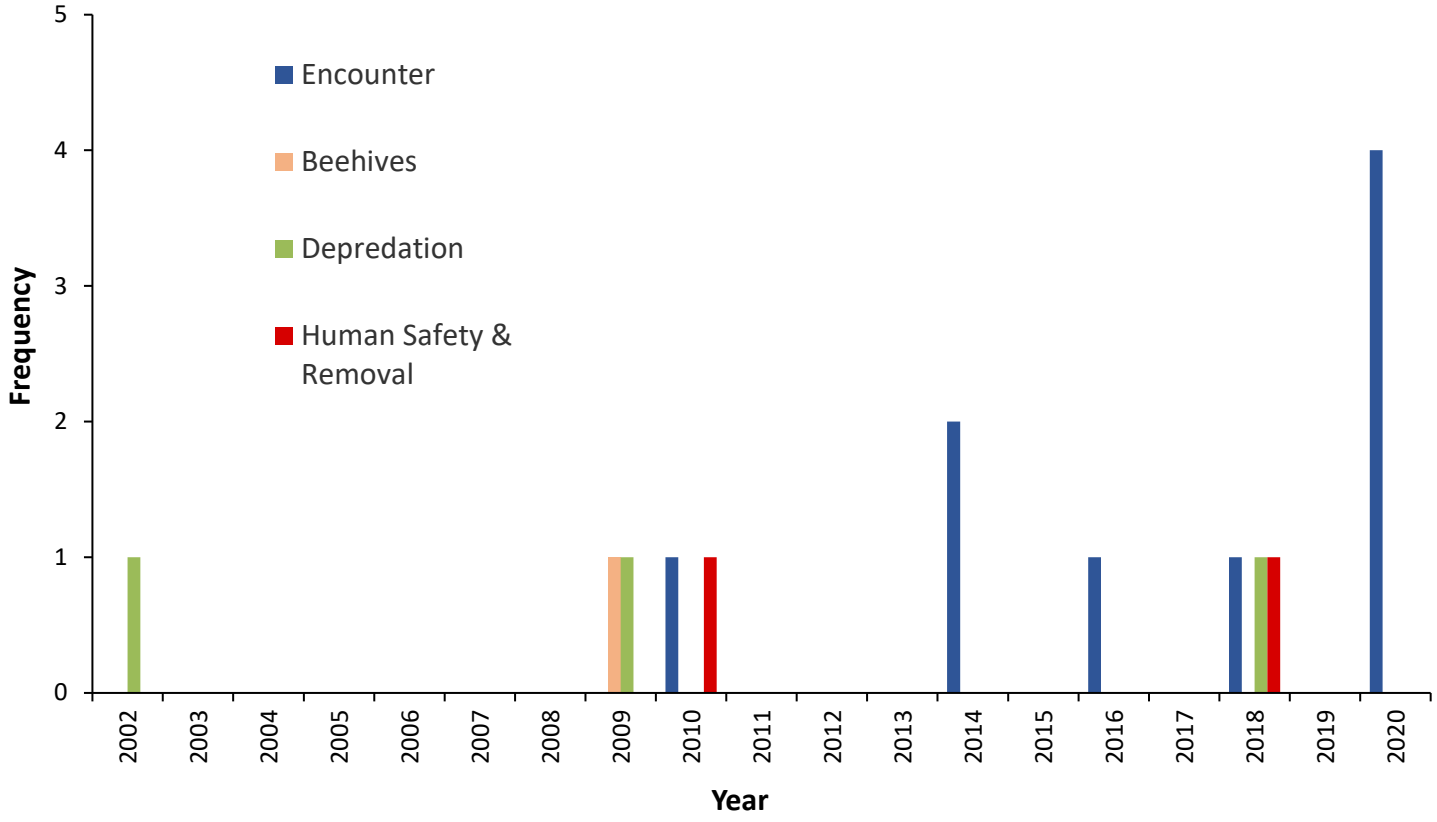

Fig. 42. Reported grizzly bear encounters and conflicts in the Wind River Reservation of the Greater Yellowstone Ecosystem, 2020.

Human-Grizzly Bear Interactions in Yellowstone National Park *(Kerry A. Gunther, Travis C. Wyman, and Eric G. Reinertson, Yellowstone National Park)*

Knowledge of the relative risk of bear attack assists park managers in prioritizing bear safety messages for different types of recreational activities occurring in the park. Knowing the probability of attack for different recreational activities also provides managers with quantitative information on the significance of risk when making decisions on implementing voluntary versus regulatory mechanisms designed to reduce the frequency of bear attacks. To address this need, we recorded information on human-bear interactions in Yellowstone National Park. Because the risk of bear attack varies depending on visitor location and activity, we grouped human-bear interactions into 5 broad categories based on the locations where they occurred, including: 1) front-country developments, 2) road corridors, 3) backcountry campsites, 4) backcountry trails, and 5) off-trail backcountry areas. We considered all human-grizzly encounters where the person involved believed that the bear was aware of their presence as an interaction.

Human-Bear Interactions within Developed Front-country Sites

Bears enter front-country developments in the park for a variety of reasons including travel, foraging for natural foods, and avoiding more dominant bears. In addition, human food conditioned bears sometimes enter park developments seeking human foods or garbage. However, since implementation of a new bear management program in 1970, it is rare for bears to obtain anthropogenic food rewards in park developments. Under the park's Bear Management Plan, front-country developments are managed for people and bears are actively excluded through hazing, capture and relocation, or capture and removal.

Activity of Bears in Front-country Developed Sites

In 2020, there were 19 reported incidents where grizzly bears entered park developments (Table 37). The bear's primary activity was recorded in 15 of the incidents. In 60% (n = 9) it appeared that the bears were just traveling through the development, and in 27% (n = 4) of the incidents the bears foraged for natural foods within developments. Other activities of bears in developments included investigating the porch of a residence (n = 1) and eating dog food and garbage from the back of a contractor's pickup truck (n = 1).

Reactions of Bears to the Presence of People in Front-country Developments

Grizzly bears were known to have encountered people in 14 of the 19 incidents where they entered developments and the bears' reaction was recorded in all 14 of those incidents (Table 38). Bears reacted with a flight response in 64% (n = 9) of the incidents and in a neutral manner in 36% (n = 5). Bears did not display warning signals, aggressive behavior, or attack people in any of the 14 encounters that occurred within developments.

Human-Bear Interactions along Roads

Bears frequent habitat adjacent to roads in the park for many reasons including traveling, foraging for natural foods, avoiding more dominant bears, and occasionally seeking discarded food scraps or human food handouts. In the past (1910–1969), bears commonly panhandled along park roads for food handouts from visitors (Schullery 1992). Strict enforcement of regulations prohibiting the feeding of bears since 1970 has mostly eliminated this behavior in park bears. However, bears are still regularly observed near park roads traveling and foraging for native foods. Unlike park developments that are managed solely for people and bears are actively excluded, under the park's bear management strategy, roadside habitats are managed for both human and bear uses. Although bears are not allowed to remain or linger on the paved road, roadside pull-outs, road shoulder, or adjacent drainage ditch, they are tolerated in roadside meadows and are not actively discouraged from using roadside habitats to forage for natural foods as long as park visitors maintain a 90-m (100-yard) distance from them and do not feed them.

Bear Activity along Roadsides

In 2020, 261 reports of grizzly bears frequenting habitat along park roads were recorded (Table 39). The primary activity of roadside bears was recorded in 258 of these reports. In most of these incidents, the roadside bears' primary activity was foraging for natural foods (66%, n = 170) or traveling (31%, n = 79). Other activities reported included courtship (1%, n = 3), swimming (1%, n = 3), bedded/sleeping (1%, n = 2), and climbing on a picnic table (<1%, n = 1).

Bear Reactions to the Presence of People Along Roadsides

Grizzly bears were noticeably aware of the presence of people in 162 of the 261 reports of bear activity along roads. The reaction of bears to people was reported for 157 of these 162 roadside encounters (Table 38) and were classified as neutral in 76% (n = 119) and as a flight response in 22% (n = 35) of the incidents. Grizzly bears displayed curious behavior and walked towards people in 1% (n = 1) of the roadside encounters and exhibited stress/warning behavior in 1% (n = 1). In 1 incident (1%) a grizzly bear charged toward people during a roadside encounter but did not make contact. Grizzly bears did not injure any visitors along park roads in 2020.

Human-Bear Interactions in Backcountry Areas

Bears are generally given priority in recreation management decisions where bear and human activities are not compatible in backcountry areas of the park. Yellowstone National Park implements seasonal closures and restrictions on recreational use of backcountry areas during periods when bear activity is concentrated on specific foods in predictable locations. In addition, trails, campsites, and off-trail areas are temporarily closed to recreational use for short periods when human activities conflict with natural bear activities and behaviors in backcountry areas.

Activity of Bears in Occupied Backcountry Campsites

Bears occasionally enter designated backcountry campsites while the campsites are occupied by recreational users. In 2020, there were 5 incidents reported where grizzly bears entered occupied backcountry campsites (Table 40). The bears' primary activity in the core camp was reported for all 5 incidents. Reported activities of bears in occupied campsites included walking through the core campsite (n = 2), foraging on native foods (n = 2) in the campsite, and damaging the tent (n = 1).

Bear Reactions to the Presence of People in Backcountry Campsites

In 2 of the 5 incidents where grizzly bears entered occupied backcountry campsites, the campers and bears were mutually aware of each other's presence in the campsite. The bears' reaction was reported in both of those incidents. In 1 incident the grizzly exhibited a flight response and ran away after being detected; in 1 incident the grizzly initially approached the core camp in a curious manner, then slowly left after one of the campers yelled at the bear and shined a flashlight on it (Table 38). Grizzly bears did not injure any visitors in backcountry campsites in 2020.

Bear Reactions to Encounters with People on Backcountry Trails

In 2020, there were 11 reported incidents where people encountered grizzly bears on backcountry trails (Table 38). Grizzly bears reacted to encounters with people along backcountry trails with neutral behaviors in 36% (n = 4), flight behaviors in 36% (n = 4), following mobile people in 9% (n = 1), charging without making contact in 9% (n = 1), and charging, making contact and injuring someone in 9% (n = 1).

Bear Reactions to Encounters with People in Off-Trail Backcountry Areas

In 2020, there were 8 reported incidents where people encountered grizzly bears while traveling off-trail in backcountry areas (Table 38). Grizzly bear reactions to these encounters included neutral behaviors (25%; n = 2), curious behaviors (25%, n = 2), fleeing (25%; n = 2), stress/warning behaviors (huffing noises, 13%, n = 1), and charging without making contact in 13% (n = 1). Grizzly bears did not attack people in any of the off-trail encounters in 2020.

Risk of Bear Attack

Almost all bear attacks occur in backcountry areas and most backcountry attacks involve people who surprise bears while hiking. We evaluated the risk of being injured by a bear by comparing the number of bear-inflicted human injuries to the number of reported backcountry encounters with bears. From 1991 to 2020, the years for which we had backcountry encounter data, there were 2,120 reported encounters between grizzly bears and backcountry recreationists. In 23 of those encounters, the grizzly bear attacked and injured people. Therefore, the risk of being injured by a grizzly bear was 1 attack for every 92 backcountry encounters. This estimate is likely biased high, because benign encounters where bears flee or behave in a neutral or unaggressive manner are less likely to be reported than injurious encounters.

Another method to evaluate the risk of bear attack is to compare the number of people injured while engaged in different types of recreational activities to the number of park visitors that participate in those activities. Bear-inflicted human injury data from 1979–2020 likely provide a reasonably accurate evaluation of the current risk of bear attack in the park. Prior to 1979, most injuries involved bears that were conditioned to

human foods and garbage. In 1970, Yellowstone National Park implemented a new bear management program. The foundation of the program was to reduce bear-human conflicts by preventing bears from becoming conditioned to human foods, garbage, and other anthropogenic attractants (Meagher and Phillips 1983). By 1979, sources of anthropogenic attractants had been made bear-proof, most human food conditioned bears had been removed from the park population (killed or sent to zoos), and bear-human conflicts declined significantly thereafter.

From 1979 to 2020, grizzly bears injured (n = 33) or killed (n = 5) a total of 38 recreationists in Yellowstone National Park. During1979–2020, 126,741,413 recreational visits were made to the park. The injury rate was 1 visitor injured for every 3.3 million recreational park visits. However, not all visitors had equal exposure to the risk of grizzly bear attack. For visitors that remained within front-country areas (within developments, along roadsides, and on boardwalk trails) while in the park, there was 1 injury per 63.4 million visits. For visitors that camped overnight in roadside campgrounds there was 1 injury per 27.7 million overnight stays. For visitors that camped overnight in remote backcountry campsites or dispersed camping zones, there was 1 injury per 1.7 million overnight stays. Recreationists that traveled on foot (day hikers, backpackers while hiking, anglers, photographers, bird watchers, etc.) in backcountry areas incurred the greatest risk, with 1 injury for every 299,351 backcountry recreation days (data for people traveling on foot in the backcountry available from 1992–2020 only; 24 hikers injured in 7,184,432 backcountry hiker recreation days).

Summary

Grizzly bears reacted aggressively toward people in only 4 of 192 encounters reported in Yellowstone National Park in 2020 (Table 41). What we observed in 2020 is similar to long-term results from 1991–2020 (Table 42). In 6,734 encounters between grizzly bears and people reported from 1991–2020, bears reacted with neutral behaviors in 58% (n = 3,911), by fleeing in 34% (n = 2,303), curious behaviors in 3% (n = 216), and with stress, bluster, or warning behaviors in 1% (n = 41) of reported encounters. Grizzly bears reacted with aggression without contact in 4% (n = 240) of the reported encounters. Less than 1% (n = 23) of the 6,734 reported encounters between people and grizzly bears in Yellowstone National Park during 1991–2020 resulted in human injuries. All those injuries occurred in backcountry areas. Attacks occurred at a higher rate during off-trail interactions (2%, 7 attacks in 441 reported encounters) than during on-trail interactions (1%, 16 attacks in 1,470 encounters). During 1991–2020, there were no grizzly bear attacks during interactions in areas where human presence was predictable and could be expected by bears, such as along primary roads (0 attacks in 3,936 encounters), within developments (0 attacks in 678 encounters), and in designated backcountry campsites (0 attacks in 209 encounters). Despite their ferocious reputations, 30 years of monitoring human-bear interactions in Yellowstone National Park suggests that grizzly bears are tolerant of people in most encounters and injured people in <1% of all interactions occurring in the park. However, in rare incidents where contact was made, injuries were sometimes severe or fatal. We recommend that all backcountry recreationalists in Yellowstone National Park and the Greater Yellowstone Ecosystem carry a bear deterrent. Although the type of deterrent to carry is a personal choice, bear spray has proven easy to use and highly effective at stopping or reducing the length and severity of bear attacks (Herrero and Higgins 1998, Smith et al. 2008, 2020).

Table 37. Activity of bears that entered front-country developments, Yellowstone National Park, 2020.	
Activity of bear while inside development	**Number of incidents**
Not reported or unknown	4
Travel through	9
Forage for natural foods	4
Investigate anthropogenic foods but no food reward and no property damage	0
Investigate and damage property but no food reward	0
Investigate and obtain anthropogenic foods	1
Attack people	0
Other	1
Total	19

Table 38. Reactions of grizzly bears to encounters with people, Yellowstone National Park, 2020.

Reaction of bear	Development	Along roadside	Backcountry campsite	On trail	Off trail	Total
Not reported/not known	0	5	0	0	0	5
Flight response						
Run away	6	13	1	4	1	25
Walk away	3	22	0	0	1	26
Adult climb tree	0	0	0	0	0	0
Cubs climb tree/adult remain	0	0	0	0	0	0
Flight behavior subtotal	9	35	1	4	2	51
Neutral behaviors						
No overt reaction	4	119	0	4	2	129
Stand up on hind legs	1	0	0	0	0	1
Circle down wind	0	0	0	0	0	0
Neutral behavior subtotal	5	119	0	4	2	130
Curious behaviors						
Walk towards-curious	0	1	1	0	2	4
Follow mobile person	0	0	0	1	0	1
Investigate vehicle	0	0	0	0	0	0
Curious behavior subtotal	0	1	1	1	2	5
Stress/agitation/warning signals						
Salivate	0	0	0	0	0	0
Sway head side to side	0	0	0	0	0	0
Make huffing noises	0	0	0	0	1	1
Pop jaws/teeth clacking noises	0	0	0	0	0	0
Stood ground watched/stared	0	1	0	0	0	1
Slap ground with paw	0	0	0	0	0	0
Flatten ears/erect spinal hairs	0	0	0	0	0	0
Stiff legged walk/hop	0	0	0	0	0	0
Stress/warning behavior subtotal	0	1	0	0	1	2
Aggressive behaviors						
Growl	0	0	0	0	0	0
Aggressive approach	0	0	0	0	0	0
Stalk	0	0	0	0	0	0
Run towards/aggressive charge	0	1	0	1	1	3
Aggressive behavior subtotal	0	1	0	1	1	3
Attack behaviors						
Defensive attack	0	0	0	1	0	1
Predatory attack	0	0	0	0	0	0
Attack unknown cause	0	0	0	0	0	0
Attack behavior subtotal	0	0	0	1	0	1
Total	14	162	2	11	8	197

Table 39. Primary activity of grizzly bears along roadsides, Yellowstone National Park, 2020.

Activity of bear	Number of incidents
Not reported/unknown	3
Traveling	79
Foraging natural foods	170
Courtship	3
Swimming	3
Nursing young	0
Playing	0
Bedded/sleeping	2
Investigating vehicles/seeking anthropogenic foods; no food reward	0
Obtain anthropogenic foods	0
Damage property	0
Aggressive approach/posture towards people	0
Attack people	0
Other	1
Total	261

Table 40. Primary activity of grizzly bears that entered occupied backcountry campsites, Yellowstone National Park, 2020.

Activity of bear	Number of incidents
Not reported/unknown	0
Walked past edge of campsite	0
Walked through core camp	2
Forage native foods	2
Investigate tent without damage/no food reward	0
Investigate food pole without food reward	0
Investigate food storage locker without food reward	0
Attempt to get human foods (not successful)	0
Damage property	1
Obtain anthropogenic foods	0
Investigate latrine (buried human feces/toilet paper)	0
Lay down/rest in campsite	0
Aggressive approach/posture towards people in campsite	0
Attack people	0
Total	5

Table 41. Grizzly bear reactions reported in 192 interactions with people in different location settings, Yellowstone National Park, 2020.

Location of encounter	Reaction of bear											
	Flee		Neutral behavior		Curious		Stress/agitation		Aggression without contact		Attack	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Park development	9	64	5	36	0	0	0	0	0	0	0	0
Roadside corridor	35	22	119	76	1	1	1	1	1	1	0	0
Backcountry campsite	1	50	0	0	1	50	0	0	0	0	0	0
Backcountry trail	4	36	4	36	1	9	0	0	1	9	1	9
Backcountry off-trail	2	25	2	25	2	25	1	13	1	13	0	0
Total	51	27	130	68	5	3	2	1	3	2	1	<1

Table 42. Grizzly bear reactions to interactions with people (*n* = 6,734) in different location settings, Yellowstone National Park, 1991–2020.

Location of encounter	Reaction of bear											
	Flee		Neutral behavior		Curious		Stress/agitation		Aggression without contact		Attack	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Park development	329	49	321	47	17	3	3	0.4	8	1	0	0
Roadside corridor	915	23	2,897	74	52	1	11	<1	61	2	0	0
Backcountry campsite	86	41	94	45	19	9	1	1	9	4	0	0
Backcountry trail	729	50	462	31	112	8	23	2	128	9	16	1
Backcountry off-trail	244	55	137	31	16	4	3	1	34	8	7	2
Total	2,303	34	3,911	58	216	3	41	1	240	4	23	<1

Visitor Compliance with Bear Spray and Hiking Group Size Bear Safety Recommendations in Yellowstone National Park *(Kerry A. Gunther, Eric G. Reinertson, and Travis C. Wyman, Yellowstone National Park)*

Improvements in information and education efforts aimed at recreational safety in bear country are paramount in the face of significant increases in visitation to Yellowstone National Park, concurrent with grizzly bear recovery in the Greater Yellowstone Ecosystem.

Two human behaviors that can reduce the risk of bear attack include hiking with large party sizes (Herrero 2002) and carrying bear deterrent spray to deter aggressive encounters (Herrero and Higgins 1998, Smith et al. 2008). To reduce the risk of bear attack in Yellowstone National Park, park managers distribute safety information to visitors recommending that backcountry recreationists traveling by foot maintain group sizes of ≥3 people and carry bear spray. To evaluate visitor compliance with these safety recommendations, we conduct annual surveys to determine the proportion of recreationists that hike in groups of ≥3 people and the proportion that carry bear spray or use other deterrents, such as firearms, or warning devices such as bear bells.

Due to time, budget, and staffing constraints, we conducted opportunistic surveys. While working on other bear research, monitoring, and management projects throughout the park, we recorded how many recreationists that we encountered at trailheads and on trails and boardwalks were carrying bear spray or other deterrents. We also recorded information on group size and type of recreational activity. We grouped recreational activity into 6 broad categories: 1) day hikers (including anglers and photographers), 2) overnight backpackers, 3) boardwalk trail users, 4) stock (horse or mule) day riders, 5) stock overnight riders, and 6) day-use bicyclist trail riders. We conducted our surveys visually. We recorded the presence of bear spray and other deterrents that were visible and therefore quickly retrievable. Bear spray or other deterrents stored in backpacks, saddlebags, panniers, or carried under coats would likely not be retrievable fast enough for use during surprise encounters with bears.

In 2020, we surveyed 1,393 people in 479 groups at 33 different backcountry trails. We did not survey boardwalk trails in 2020 because of staff safety concerns related to COVID-19 and the high density of visitors and lack of social distancing on boardwalk trails. Our surveys included 1,287 backcountry day hikers, 55 overnight backpackers, 7 stock day riders, 18 overnight stock riders, and 26 day-use bicyclists.

Day Hikers

Yellowstone National Park contains >1,600 km (1,000 miles) of backcountry hiking trails accessible from 92 trailheads located throughout the park (Yellowstone National Park 2014). We surveyed 1,287 day hikers traveling in 448 groups on 31 different trails. Average party size was 2.9 people (Table 43). The most common group size (mode) and the median group size were 2 people per party. Fifty-nine percent (n = 264) of day hiking parties had less than the recommended party size of 3 people and 12% (n = 53) hiked alone. Of the 1,287 day hikers, 249 (19%) carried bear spray, 13 (1%) had bear bells, and 6 (<1%) carried firearms (Table 44). Of the 448 groups of day hikers, 196 (44%) had at least 1 member that carried bear spray, 13 groups (3%) had at least 1 person with bear bells, and 6 groups (1%) had at least one person carrying a firearm.

Overnight Backpackers

Yellowstone National Park has 300 designated backcountry campsites (Yellowstone National Park 2014). We surveyed 55 backpackers in 19 groups on 7 different trails. Average party size was 2.9 people (Table 43). The most common group size (mode) and the median group size were 2 people per party. Sixty-three percent (n = 12) of the backpacking groups had less than the recommended party size of 3 people and 21% (n = 4) hiked alone. Of the 55 backpackers, 35 (64%) carried bear spray, 3 (6%), had bear bells, and 1 (2%) carried a firearm (Table 44). Of the 19 groups of backpackers, 16 (84%) had at least 1 person in the party that carried bear spray, 3 (16%) groups had at least 1 person with bear bells, and 1 group (5%) had at least one person carrying a firearm.

Stock Day Riders

We surveyed 7 stock day riders in 2 groups (Table 43) on 1 trail. None of the day riders carried bear spray, firearms, or bear bells (Table 44).

Stock Overnight Riders

We surveyed 18 people in 2 groups on 2 different trails that were riding stock on overnight camping trips (Table 43). Two (11%) of the overnight stock riders carried bear spray and 1 (6%) carried a firearm. None of the overnight stock riders had bear bells.

Day Use Bicycle Trail Riders

Yellowstone National Park contains 13 designated bike trails. One of the 13 trails provides' access to a designated backcountry campsite. We surveyed 26 people in 8 groups riding bicycles on day

trips on 3 different trails. Average party size was 3.3 people per party (Table 43). One (4%) of the bicyclists carried bear spray and 1 (4%) had bear bells (Table 44). None of the bicyclists carried firearms.

Use of Bear Spray

In 2020, 2 incidents where people deployed bear spray during encounters with grizzly bears inside Yellowstone National Park were reported. On June 22 at approximately 10 a.m., a woman hiking alone on the Fairy Falls Trail sustained minor injuries from an adult female grizzly bear accompanied by 1 or 2 yearlings. The woman first encountered a yearling that immediately ran away into the forest on her right. The woman paused briefly, then continued down the trail and encountered an adult grizzly with one yearling on the left side of the trail. The bears were digging roots about 15 m (50 feet) to the side of the trail. The adult bear charged but veered off and ran into the forest, then immediately turned and charged again. The woman deployed her bear spray when the bear was approximately 3 m (10 feet) away but was unsure if the spray hit the bear in the face. The woman turned away from the charging bear just before it made contact and knocked her down. She sustained a scratch on her thigh from the bear's claws. She also sustained minor abrasions to her face when she turned away from the charging bear and it knocked her down face first into the ground. The woman declined medical attention. Investigation of the site indicated that the bears were digging the corms of Yellowbells (*Fritillaria pudica*) next to the trail where the incident occurred. After the incident, the trail was closed for several days; bear warnings were placed on the trail after reopening it a week later. No action was taken against the bear.

On August 5th at approximately 1:30 a.m., a man and his daughter who were camped at backcountry campsite 4G3 at Grebe Lake heard a noise and smelled a musky, pungent odor. The man exited the tent and saw a grizzly bear approximately 12 m (40 feet) away. The man yelled at the bear, which then stood up onto 2 legs, looked at him, then dropped down and slowly walked farther away from the tent but still within view. The bear then circled around the tent at a distance several times. The man sprayed his bear spray at the bear, but the bear was too far away, and he did not think the spray reached the bear. The man then chambered a round into his 9-millimeter (mm) pistol equipped with a powerful flashlight and pointed at the bear, but the bear walked away and did not come back, so he did not fire. After the incident was reported, backcountry campsite 4G3 was temporarily closed, bear warnings were posted on all other Grebe Lake campsites, and bear management patrols of Grebe Lake were increased.

Discussion

In 2020, overnight backpackers had the highest level of compliance with the park's bear spray recommendation; 64% of individual backpackers carried bear spray; 84% of backpacking groups had at least one member that carried bear spray. Overnight backpackers have had the highest proportion of individuals and groups traveling on foot that carried bear spray during all 10 years surveys have been conducted (Table 45 and 46). We suspect the high level of compliance by this type of recreationist is due to the methods used to convey bear safety information to overnight backpackers. In Yellowstone National Park, permits are required for camping in the backcountry. During the permitting process, backpackers receive face-to-face verbal information about bears and bear spray from the ranger issuing the permit and are required to watch a safety video containing information on hiking and camping in bear country and how to use bear spray. Backpackers also receive the "Beyond Roads End" booklet containing information on use of bear spray and safety recommendations for hiking and camping in bear country. Surveys indicate that Yellowstone National Park visitors retain verbal information from uniformed park staff better than written information from signs or brochures (Taylor et al. 2014).

The most common party size observed among backpackers was 2 people per party, indicating that many backpackers did not follow the park's recommended group size of 3 or more people for hiking in bear country. The most common party size (mode) for overnight backpackers during all 10 years of the study has been 2 people per party (Table 47).

Only 19% of day hikers carried bear spray, however, 44% of day hiking groups had at least one member that carried bear spray. Fewer than 25% of day hikers have carried bear spray in each of the 10 years surveys have been conducted (Table 45). Permits are not required for day hiking so day hikers may not receive the same level of bear safety information as backpackers. Visitors day hiking in Yellowstone National Park can seek and obtain bear safety information from the Yellowstone National Park web page, park app, park newspaper, day hike trip planning handouts, safety cards and brochures, and from rangers at visitor centers. However, the only bear safety information day hikers receive if they do not seek it out themselves is from signs posted at trailheads. We speculate that many day hikers that arrive at trailheads without bear spray are unlikely to go obtain bear spray

before starting their hikes even after reading the trailhead information sign. The most frequently observed group size among day hikers was 2 people per group indicating that many day hikers did not comply with the recommended group size of ≥3 for hiking in bear country. Because most (67%) grizzly bear attacks in Yellowstone National Park involve day hikers (31 of 46 backcountry attacks since 1970), the low level of compliance with bear safety recommendations among day hikers is a concern of park managers.

Two of the of the overnight stock riders and none of the day riders surveyed in 2020 carried bear spray. Bear spray is not very useful while in the saddle, as deploying it from horseback could result in the rider being bucked off their horse. In general, people riding stock are less likely to be involved in surprise encounters and bear attacks. Horses usually sense a bear's presence before a person does (Herrero 2002), alerting the rider and reducing the chances of surprise encounters at close distances. The large size of horses is also more intimidating to bears making them less likely to charge and initiate contact with a person on horseback during a surprise encounter. In addition, unlike humans, when charged by bears, horses have enough speed and agility to outrun bears, thus providing an added margin of safety if the rider can stay in the saddle. Although stock users are less likely to have surprise encounters with bears, bear spray is useful and encouraged for carry by stock groups for use during rest stops along the trail and when in camp.

Only 1 of the 26 bicyclists we encountered on our surveys carried bear spray. Bicyclists incur greater risk of surprise encounters because bicycles are fast and relatively quiet, therefore increasing the odds of surprise encounters.

Although some backcountry recreationists in Yellowstone National Park carry firearms, and it is legal to do so, it is illegal to discharge them within the park, so they are not considered a viable bear deterrent. Only a small proportion of all types of recreationists openly carried firearms in the 10 years we conducted our surveys. Firearms were openly carried by <1% of the recreationists we observed in 2020. Overnight stock riders (6%) had the highest frequency of firearms carry. Recreationists riding horses often carry firearms for euthanizing injured stock, however if these firearms were carried in saddle bags or pannier's they would not have been visible during our surveys and would not have been readily available as a bear deterrent during surprise encounters.

Bear bells were carried by <2% of all recreationists surveyed in Yellowstone National Park in 2020. Overnight backpackers (6%) had the highest frequency of bear bell use. The low use of bear bells likely reflects their lack of demonstrated effectiveness as an auditory warning device (Herrero 2002). Although bear bells may provide some benefit in alerting bears to the presence of approaching hikers (Jope 1985), they are generally not considered effective at preventing surprise encounters when hiking in strong winds, near fast moving water, or in dense brush or forest which muffles the bells sound (Herrero 2002).

Table 43. Group size characteristics for different types of recreational activities in Yellowstone National Park, 2020.

Type of recreational activity	Total people	Total groups	Average group size	Median group size	Mode group size
Boardwalk trail (foot travel walking)	Not surveyed				
Day hiker (e.g., day use foot travel-hiker, angler, photographer)	1,287	448	2.9	2	2
Overnight backpacker (foot travel camping overnight)	55	19	2.9	2	2
Stock–day use	7	2	3.5	3	1, 6
Stock–overnight use	18	2	9.0	9	8, 10
Day bicycle trip	26	8	3.3	3	1, 2, 5
Total	1,393	479	2.9	2	2

Table 44. Number and percent (%) of people and groups of recreationists surveyed that carried bear spray, firearms, or bear bells, Yellowstone National Park, 2020.

	Type of recreation/mode of travel						
	Boardwalk trail	Day hiker	Day use bicycle	Overnight backpacker	Stock day use	Stock overnight use	Total (all types)
Total people surveyed	n/a	1,287	26	55	7	18	1,393
(# of parties surveyed)	n/a	448	8	19	2	2	479
People with bear spray							
Total	n/a	249	1	35	0	2	287
Percent	n/a	19.3	3.8	63.6	0	11.1	20.6
Parties with bear spray							
Total	n/a	196	1	16	0	1	214
Percent	n/a	43.8	12.5	84.2	0	50.0	44.7
People with firearms							
Total	n/a	6	0	1	0	1	8
Percent	n/a	0.5	0	1.8	0	5.6	0.6
Parties with firearms							
Total	n/a	6	0	1	0	1	8
Percent	n/a	1.3	0	5.3	0	50.0	1.7
People with bear bells							
Total	n/a	13	1	3	0	0	17
Percent	n/a	1.0	3.8	5.5	0	0	1.2
Parties with bear bells							
Total	n/a	13	1	3	0	0	17
Percent	n/a	2.9	12.5	15.8	0	0	3.5

Table 45. Percent (%) of people engaged in different types of backcountry recreational activities that carried bear spray, Yellowstone National Park, 2011–2020.

Year	Overnight backpackers	Day hiker	Boardwalk	Stock day use	Stock overnight use	Bicycle day use
2011	53	15	Not surveyed	0	60	Not surveyed
2012	47	11	0	9	44	0
2013	60	16	0	11	22	0
2014	48	14	<1	0	35	33
2015	50	14	<1	Not surveyed	14	0
2016	52	19	<1	0	100	0
2017	62	21	1	0	0	43
2018	47	21	1	0	25	0
2019	75	21	2	14	0	50
2020	64	19	Not surveyed	0	11	4
2011–2020 combined data	55	17	1	6	29	15

Table 46. Percent (%) of groups engaged in different types of backcountry recreational activities that had at least one member that carried bear spray, Yellowstone National Park, 2011–2020.

Year	Overnight backpackers	Day hiker	Boardwalk	Stock day use	Stock overnight use	Bicycle day use
2011	64	34	Not surveyed	0	50	Not surveyed
2012	73	27	0	67	50	0
2013	82	33	0	33	60	0
2014	73	29	1	0	60	67
2015	100	35	2	Not surveyed	100	0
2016	79	43	2	0	100	0
2017	93	46	3	0	0	67
2018	81	46	3	0	50	0
2019	92	51	4	50	0	60
2020	84	44	Not surveyed	0	50	13
2011–2020 combined data	83	39	2	23	52	22

Table 47. Group size characteristics for different types of recreational activities, Yellowstone National Park, 2011–2020.

Type of recreational activity	Total people	Total groups	Average group size	Median group size	Mode group size
Boardwalk	9,401	3,336	2.8	2	2
Day hiker (e.g., day foot travel- hiker, angler, photographer)	17,264	5,833	3.0	2	2
Overnight backpacker (overnight-foot travel)	1,223	406	3.0	2	2
Horse–day use	120	22	5.5	5	1, 3
Horse–overnight use	122	23	5.3	5	2
Day bicycle trip	87	37	2.4	2	2
Total	28,217	9,657	2.9	2	2

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Appendix A

2020 Grizzly Bear Habitat Monitoring Report

Grizzly Bear Habitat Modeling Team, Greater Yellowstone Ecosystem

Background

This report is the collective response from the national forests and national parks within the Greater Yellowstone Ecosystem (GYE) to monitoring and reporting obligations established in the *2016 Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Area* (Yellowstone Ecosystem Subcommittee 2016). The Conservation Strategy requires annual monitoring and reporting to evaluate federal adherence of habitat standards for the Yellowstone grizzly bear population. These monitoring requirements and habitat standards were formalized for the 6 national forests (now 5) in the *Forest Plan Amendment for Grizzly Bear Habitat Conservation for the Greater Yellowstone Area National Forests, Record of Decision* (herein referred to as Forest Plan Amendment; U. S. Department of Agriculture Forest Service 2006a, b). Likewise, the Superintendents' Compendia incorporated the Strategy habitat standards into the legal plans for the 2 respective national parks in the GYE.

The Conservation Strategy and the habitat standards therein provide management direction for a recovered grizzly bear population once it has been removed from federal protection under the Endangered Species Act (ESA). In June 2017, the USFWS removed the Yellowstone population from the federal list of endangered and threatened wildlife (Federal Register 2017). In August 2018, a coalition of nonprofit organizations and Native American Tribes challenged the delisting rule in court. In September 2018, a U.S. District Court of Montana reinstated ESA protections for the GYE grizzly bear population. In December 2018 the USFWS, along with the states of Idaho, Montana, and Wyoming, each filed for an appeal of the September court decision. In July 2020, the U.S. Court of Appeals for the 9th Circuit upheld the 2018 decision to vacate the delisting rule. Regardless of the legal status of the Yellowstone grizzly bear, land managers throughout the GYE are committed to abiding by habitat standards identified in the Conservation Strategy for the long-term protection and health of the grizzly bear population.

Introduction

The primary intent of habitat standards established in the Conservation Strategy is to preserve adequate and secure habitat to sustain a viable grizzly bear population into the foreseeable future. Three distinct habitat standards were enumerated in the Conservation Strategy pertaining to: 1) secure habitat (roadless areas), 2) human development, and 3) commercial livestock grazing. All three factors are surrogate measures of human presence (or absence) on the land. Research identifies humans as the driving factor of grizzly bear mortality and displacement in occupied areas across the landscape. These standards impose measurable limits on levels of human activity to reduce the negative impacts of human presence. The standards call for no net loss in secure habitat, and no net increase in the number of human developed sites and livestock grazing allotments with respect to that which existed in 1998. The delineation of 1998 as a meaningful baseline is predicated on evidence that habitat conditions at that time, and for the preceding decade, contributed to the 4–7% annual growth of the Yellowstone grizzly bear population observed between 1983 and 2001. Habitat standards apply only within the Grizzly Bear Recovery Zone (GBRZ)[1] located at the core of the GYE (Fig. A1).

[1] The Grizzly Bear Recovery Zone (GBRZ) is a term used when the Yellowstone grizzly bear population is protected as a threatened species under the ESA. The same area is referred to as the Primary Conservation Area (PCA) when the bear is delisted or removed from federal protection. The GBRZ term is used in this 2020 report to reflect the current protected status of the Yellowstone grizzly bear population.

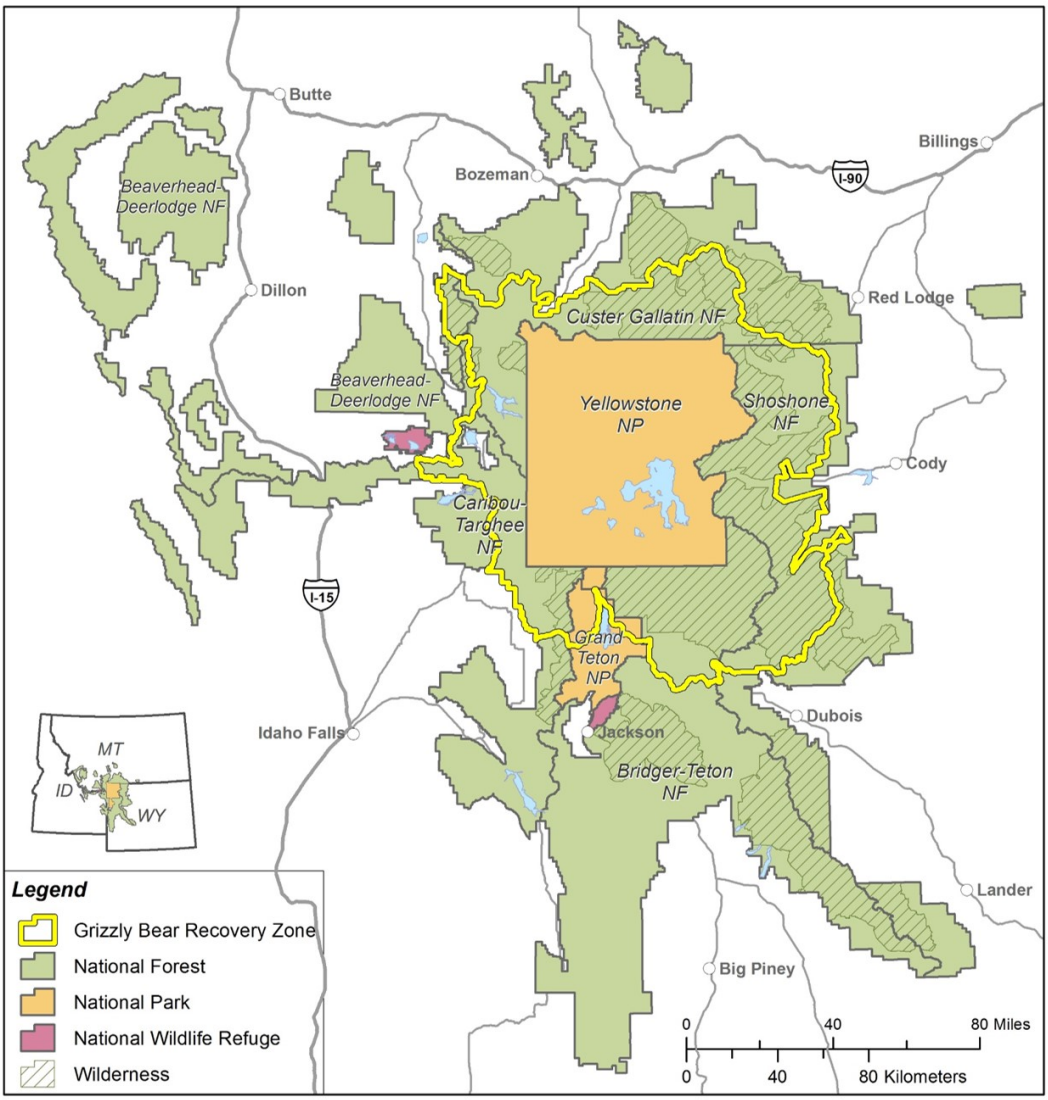

Figure A1. Federal lands comprising the Greater Yellowstone Ecosystem and the Grizzly Bear Recovery Zone (GBRZ).

Annual Monitoring Requirements inside the GBRZ

In compliance with annual habitat monitoring protocol, this report summarizes habitat changes incurred annually inside the GBRZ and compares current habitat status with that of 1998 for the following monitored parameters: 1) number and acreage of commercial livestock grazing allotments and permitted domestic sheep animal months, 2) number of developed sites, 3) percent secure habitat, and 4) motorized access route densities. In addition, all incidental and recurring grizzly bear conflicts associated with livestock allotments occurring on public land are summarized annually for the ecosystem, both inside and outside the GBRZ. Current status of secure habitat and motorized route densities are evaluated, summarized, and reported against 1998 levels annually for each of the 40 subunits within the 18 Bear Management Units (BMU, Fig. A2). The number and status of livestock allotments is annually reported against 1998 levels for each national forest and park unit inside the GBRZ. The 1998 habitat baseline represents the most current and accurate information available documenting habitat conditions inside the GBRZ during 1998. U.S. Forest Service and National Park Service personnel continue to improve the quality of their information to reflect more accurately what was on the landscape in 1998.

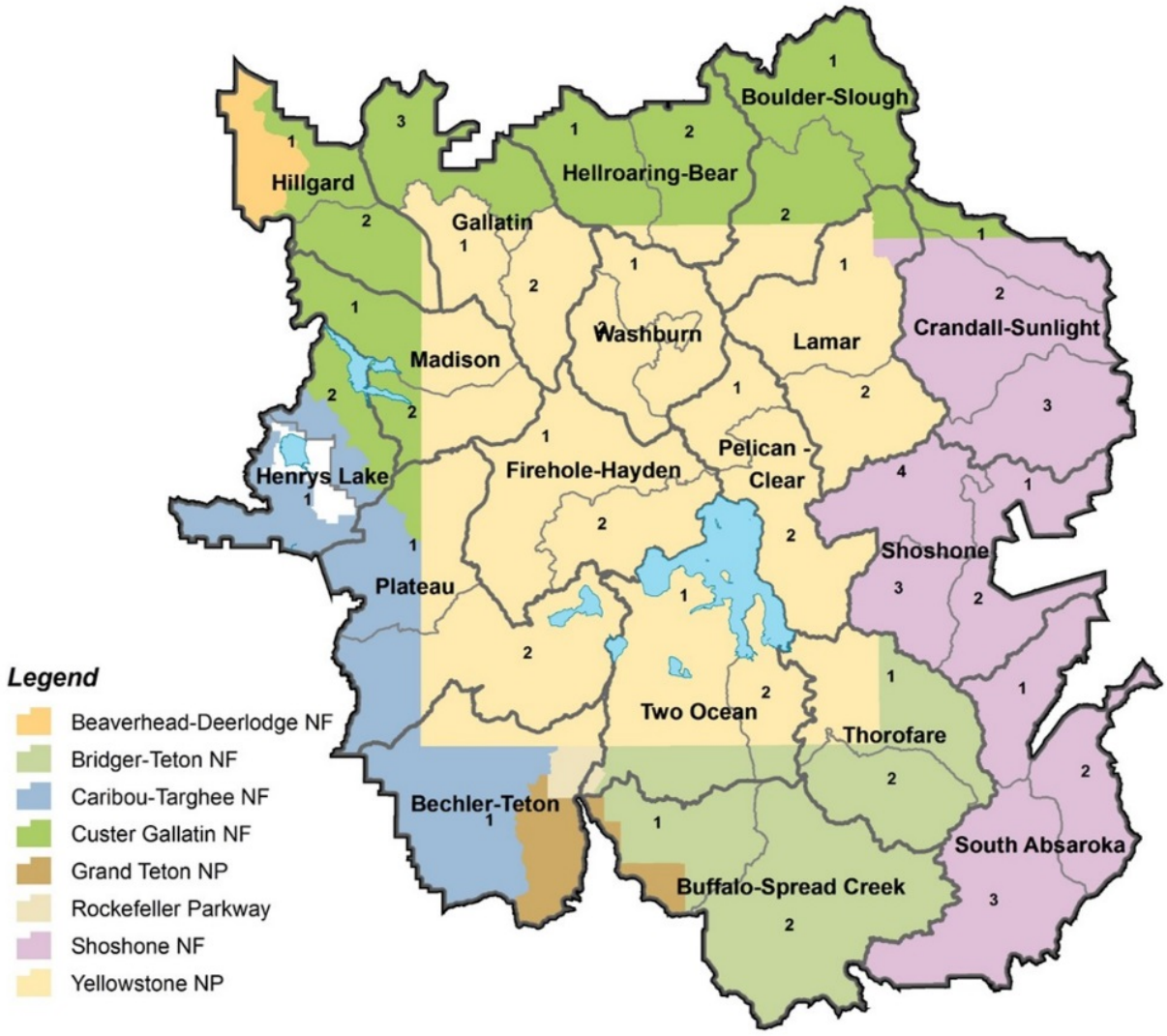

Figure A2. Bear Management Units and subunits comprising the Grizzly Bear Recovery Zone in the Greater Yellowstone Ecosystem.

Biennial Monitoring Requirements outside the GBRZ

In addition to annual monitoring requirements identified in the Conservation Strategy, the 2006 Forest Plan Amendment requires the reporting of changes in percent secure habitat on national forest lands outside the GBRZ every 2 years. Although the requirement is to report changes by national forest, it was determined that Bear Analysis Units (BAU) were more consistent with reporting protocol inside the GBRZ. Boundaries of BAUs are tied to areas determined to be biologically suitable and socially acceptable for grizzly bear occupancy and coincide with areas the states are currently managing for grizzly bear populations or are considering for future management. Habitat standards do not apply outside the GBRZ; however, percent secure habitat is reported for monitoring and tracking purposes. There are 43 BAUs (Fig. A3), each the approximate size of BMU subunits inside the GBRZ.

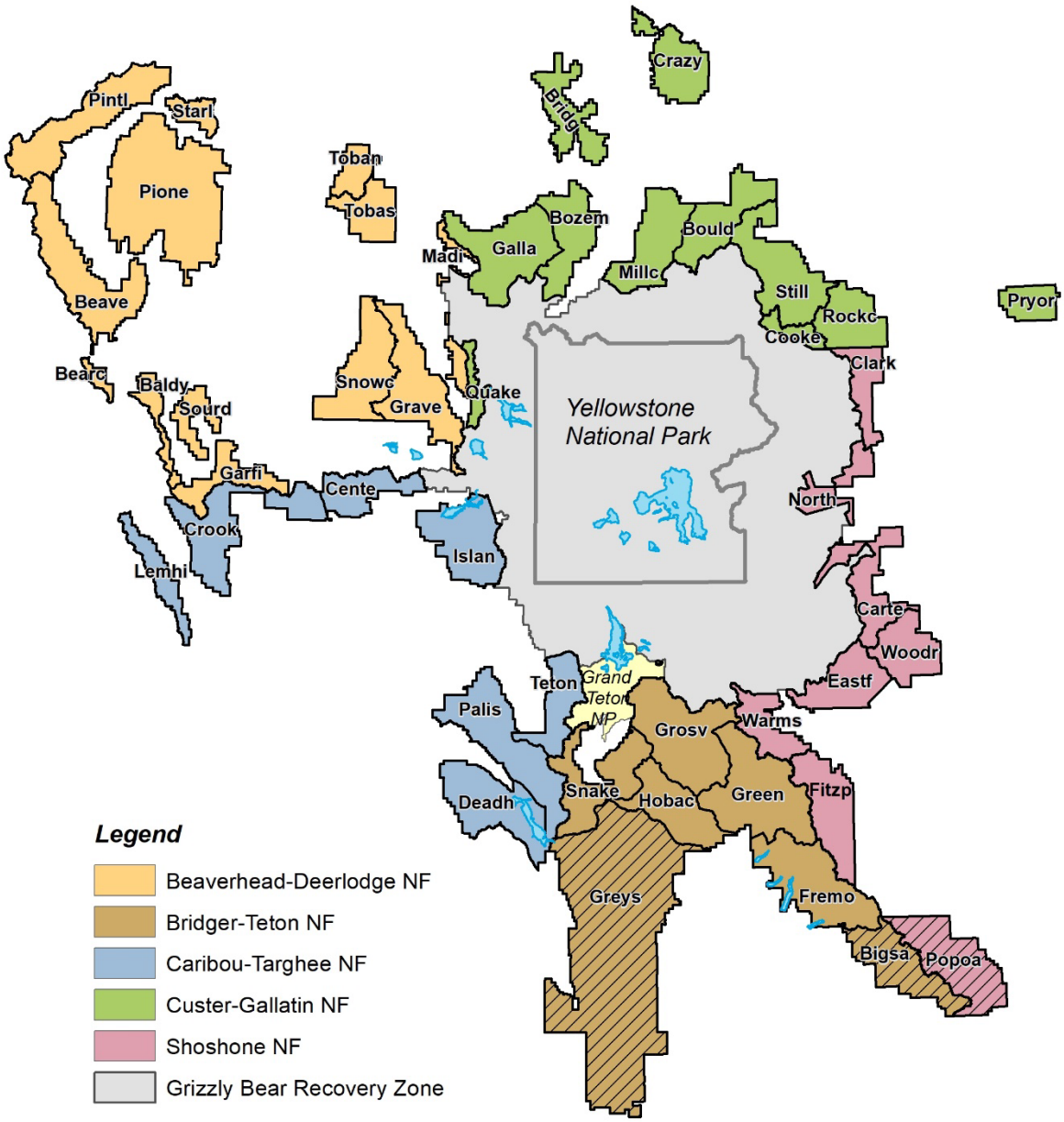

Figure A3. Bear Analysis Units outside the Grizzly Bear Recovery Zone on the 5 national forests in the Greater Yellowstone Ecosystem. Hatched areas are currently not reported as they are determined socially unacceptable for grizzly bear occupancy.

Monitoring of Livestock Grazing

The habitat standard for livestock allotments identified in the Conservation Strategy requires there be no net increase in the number or acreage of active commercial livestock grazing allotments and no increase in permitted sheep animal months on federal lands inside the GBRZ from that which existed in 1998. Changes in active and vacant livestock allotments cited in this report account for all commercial grazing allotments occurring on federal lands within the GBRZ. Livestock grazing on private inholdings and horse grazing associated with recreational use and backcountry outfitters are not covered by the grazing standard and are not covered in this report. Operational status of allotments is categorized as *active*, *vacant*, or *closed*. An active allotment is one with a current grazing permit. However, an active allotment can be granted a "no-use" permit on a year-by-year basis when a permittee chooses not to graze livestock or when management seeks a resolution to grazing conflicts. Vacant allotments are those without an active permit, but which may be grazed periodically by other permittees at the discretion of the land management agency. Such reactivation of grazing on vacant allotments is typically on a temporary basis to resolve resource issues or other management concerns. Vacant allotments can be assumed non-grazed unless otherwise specified. A closed allotment is one that has been permanently deactivated such that commercial grazing will not be permitted to occur anytime in the future. Sheep animal months are derived by multiplying the number of permitted sheep by the number of months of permitted grazing on a given allotment. Existing sheep allotments are to be phased out as opportunity arises with willing permittees.

Commercial grazing allotments on public lands inside the GBRZ are tracked through time to evaluate adherence to the habitat standard at 1998 levels or lower. The number of commercial livestock allotments, by itself, is not a meaningful metric of change because individual allotments can be combined or divided without affecting the overall footprint of commercially grazed land. Likewise, allotment boundaries can be reconfigured or modified over time to enclose smaller or larger areas. Thus, the total acreage of grazed lands constitutes a more meaningful metric of overall change on the landscape. See Table A1 for 2020 status of livestock allotments compared against the 1998 baseline.

Change in cattle allotments since 1998

Since 1998, the total acreage of active cattle grazing on public lands inside the GBRZ has been reduced by 32% (213,673 acres, 865 km^2). Approximately 93% of this net reduction was the result of permanent closures, and 7% was from active allotments that were vacated. With closure of the only cattle allotment inside Grand Teton National Park in 2011, there currently is no livestock grazing occurring on National Park Service lands inside the GYE. (Table A1)

Change in sheep allotments since 1998

Domestic sheep allotments on public lands inside the GBRZ have largely been phased out since 1998. In 1998 there were 11 active sheep allotments on public lands inside the GBRZ, amounting to 148,368 acres (600 km^2). Since 1998, there has been a 98% net reduction in the acreage grazed by sheep on public lands inside the GBRZ. Of the 11 actively grazed sheep allotments, 8 have been permanently closed and 2 were converted to cattle allotments in 2003 that remain active today (the Beartooth and Pearson allotments on the Shoshone National Forest). The only active sheep allotment remaining on public lands inside the GBRZ today is the Meyers Creek allotment located on the Caribou-Targhee National Forest and part of the USDA Sheep Experiment Station (USSES). Although "active," the Myers Creek has not been issued a grazing permit since the Willow Creek fire in 2008. Consequently, there has been no domestic sheep grazing on public lands inside the GBRZ for the past 13 years. (Table A1)

Change in livestock allotments during 2020

In late 2016, the Bridger-Teton National Forest acquired 28 acres of formerly private land adjacent to the Lava Creek Allotment within the PCA. In 2020, this Hatchet Pasture was added to the grazing permit authorization of the Allotment, increasing the acreage but not the authorized amount of Animal Unit Months for cattle and horse grazing. Previously (circa 2003), the Bridger-Teton National Forest closed the adjacent Blackrock-Spread Creek Allotment. This earlier action reduced the area of active allotments in the PCA by 74,560 acres, so even with this

added pasture the Bridger-Teton National Forest remains 74,532 acres below the 1998 baseline measure for active allotments. The number of active allotments on the Bridger-Teton National Forest is unchanged.

***Table A1**. Number of commercial livestock grazing allotments and sheep animal months (AMs) inside the Primary Conservation Area in 1998 and 2020.*

Administrative unit	Cattle allotments				Sheep allotments				Sheep animal months	
	Active		Vacant		Active		Vacant			
	1998	2020	1998	2020	1998	2020	1998	2020	1998	2020
Beaverhead-Deerlodge National Forest	3	3	2	0	0	0	0	0	0	0
Bridger-Teton National Forest	9	6	0	1	0	0	0	0	0	0
Caribou-Targhee National Forest [a]	11	7	1	1	7	1	4	0	14,163	1,970[a]
Custer Gallatin National Forest	23	14	10	5	2	0	4	0	3,540	0
Shoshone National Forest	25	25	0	0	2	0	2	0	5,387	0
Grand Teton National Park	1	0	0	0	0	0	0	0	0	0
Total count in GBRZ	72	55	13	7	11	1	10	0	23,090	1.970
Total acres in GBRZ	661,770	456,068	67,846	31,679	148,368	3,504	77,066	0		
Total area in GBRZ (km^2)	2,678	1,846	275	128	600	14	312	0		

[a] The Meyers Creek allotment, the only active sheep grazing unit remaining inside the GBRZ, did not request a permit in 2020.

Livestock Conflicts throughout the GYE

Conflicts between grizzly bears and livestock have historically led to the capture, relocation, and removal of grizzly bears in the GYE. This section summarizes the reported grizzly bear conflicts associated with livestock grazing on sheep and cattle grazing allotments and forage reserves on national forest land within the GYE. Livestock-grizzly bear conflicts associated with outfitters in backcountry settings, and conflicts occurring on private or state lands are not included in this report.

Livestock conflicts in 2020

In 2020, a total of 99 grizzly bear conflicts associated with livestock depredation on U.S. Forest Service lands were reported inside the GYE (Fig. A4). These conflicts occurred on 30 distinct commercial grazing allotments distributed throughout the ecosystem. All but one of the 99 incidents in 2020 involved cattle depredations and accounted for the injury or mortality of at least 2 cows, 3 steers, and 64 calves or yearlings. One incident on the Beaverhead-Deerlodge National Forest involved lamb depredation on a sheep allotment outside of the GBRZ. Conflicts were reported on 3 national forests in the GYE, including the Beaverhead-Deerlodge (n = 14), Bridger-Teton (n = 63), and the Shoshone National Forests (n = 22). Approximately 92% (n = 91) of the conflicts occurred outside the GBRZ. Of the 99 livestock-related conflicts, 56% (n = 55) occurred on the Upper Green River cattle allotment located outside the GBRZ on the north portion of the Bridger-Teton National Forest. During 2020, management actions in direct response to livestock depredations on public lands led to the removal of 3 male

grizzly bears (one 34-year-old adult, one 6-year-old adult, and one subadult). All 3 management removals were due to persistent cattle depredations on the Upper Green River allotment.

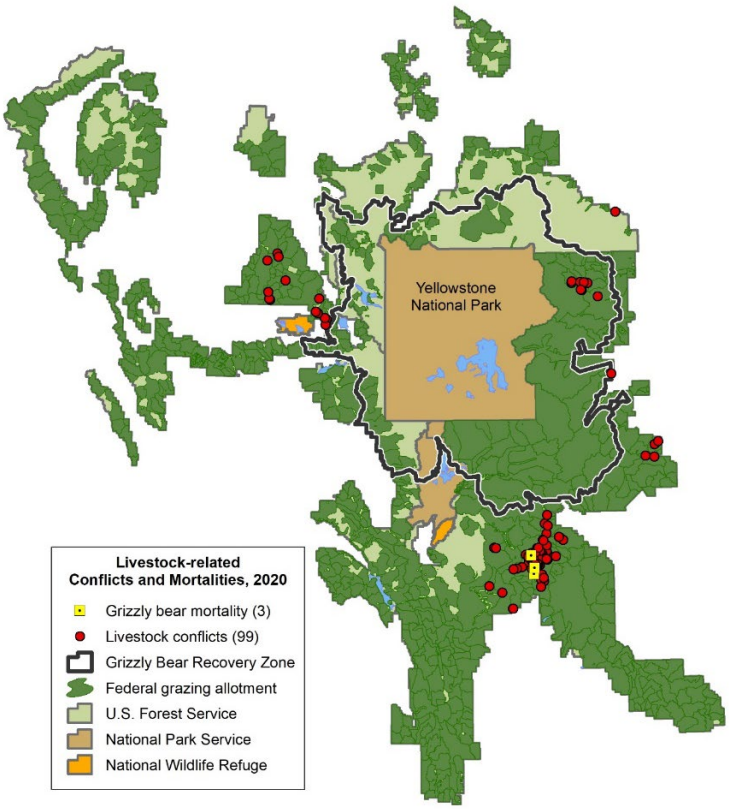

Figure A4. Grizzly bear conflicts and mortalities related to commercial livestock grazing on federal lands in the Greater Yellowstone Ecosytem during 2020.

Recurring livestock conflicts 2016–2020

Livestock conflicts are considered 'recurring' when cattle and/or sheep depredation incidents involving grizzly bears are reported on a given allotment in 3 or more years during the preceding 5-year period. During 2016–2020, 533 livestock conflict incidents were reported on grazing allotments on national forest lands inside the GYE (Table A2). Approximately 92% (n = 492) of these conflicts occurred outside the GBRZ. Of the 533 conflicts, 58% (n = 307) occurred on the Upper Green River cattle allotment located outside the GBRZ on the Bridger-Teton National Forest. Twenty allotments experienced recurring conflicts: 8 on the Beaverhead-Deerlodge National Forest, 3 on the Bridger-Teton National Forest, 1 on the Caribou-Targhee National Forest, 1 on the Custer Gallatin National Forest, and 7 on the Shoshone National Forest (Table A2). Over the past 5 years, 30 grizzly bears were removed from the population due to persistent livestock depredation on U.S. Forest Service allotments. These 30 management removals included 4 females (3 adult, 1 subadult), 25 males (19 adult, 5 subadult, 1 yearling), and 1 adult of unknown gender. Twenty-one (70%) of the 30 management-sanctioned grizzly bear removals were due to cattle depredations on the Upper Green River allotment.

***Table A2**. Commercial livestock allotments on public lands with documented grizzly bear conflicts during the past 5 years. Allotments with conflicts in 3 or more of the past 5 years are considered to be recurring conflicts.*

U.S. Forest Service allotment name	Total acres	Livestock-related conflicts					Total conflicts (2016–2020)	Recurring conflicts
		2016	2017	2018	2019	2020		
Beaverhead–Deerlodge National Forest								
Anderson/Cox	29,826	0	1	0	0	0	1	No
Barnett	6,454	0	0	0	0	1	1	No
Bufiox	13,077	0	3	1	0	3	7	Yes

***Table A2**. Commercial livestock allotments on public lands with documented grizzly bear conflicts during the past 5 years. Allotments with conflicts in 3 or more of the past 5 years are considered to be recurring conflicts.*

U.S. Forest Service allotment name	Total acres	Livestock-related conflicts					Total conflicts (2016–2020)	Recurring conflicts
		2016	2017	2018	2019	2020		
Burnt Creek	2,992	0	0	0	1	0	1	No
Cliff Lake Bench	2,279	0	0	0	0	1	1	No
Clover Meadows	10,398	0	0	1	1	1	3	Yes
Conklin	3,654	0	1	0	0	0	1	No
Elk Mountain	4,415	0	0	0	0	1	1	No
Eureka Basin	11,617	0	1	5	1	0	7	Yes
Hidden Lake Bench	6,609	0	1	0	1	2	4	Yes
Lobo Cascade	11,941	0	0	1	0	0	1	No
Lyon Wolverine	16,188	0	0	1	0	0	1	No
North Saddle	3,454	1	2	1	0	1	5	Yes
Poison Basin	6,863	1	0	0	1	0	2	No
Red Rock	3,909	0	0	0	0	1	1	No
Standard Creek	12,833	0	0	0	4	0	4	No
Upper Ruby	44,395	0	2	5	0	2	9	Yes
Warm Springs	22,518	0	1	0	4	1	6	Yes
West Fork	53,096	2	9	13	13	1	25	Yes
Wigwam Trail	12,742	**0**	0	1	0	0	1	No
Bridger-Teton National Forest								
Badger Creek	7,254	0	0	0	1	0	1	No
Beaver-Twin	22,030	0	0	0	1	2	3	No
Fish Creek [a]	76,217	1	0	0	0	0	1	No
Fisherman Creek	47,629	0	0	0	1	1	2	No
Green River (Drift)	1,003	0	1	0	0	0	1	No
Jack Creek	18,673	0	0	0	0	1	1	No
Lime Creek	4,973	1	0	0	0	0	1	No
Noble Pasture	762	0	0	4	1	0	5	No
North Cottonwood	28,177	0	0	2	0	0	2	No
Roaring Fork	8,416	0	1	0	1	0	2	No
Salt Creek	10,005	0	1	0	0	0	1	No
Sherman C&H	8,287	1	1	0	0	0	2	Yes
Tosi Creek	14,090	1	0	0	0	0	1	No
Union Pass	47,600	0	0	0	0	2	2	No
Upper Green River	131,94	54	69	72	57	55	307	Yes
Upper Gros Ventre	67,497	0	4	3	0	2	9	Yes
Caribou-Targhee National Forest								
Ching Creek	3,911	1	0	0	0	0	1	No
High Five	21,943	0	0	1	0	0	1	No
Squirrel Meadows	28,797	1	1	0	1	0	3	Yes
Custer Gallatin National Forest								
Hogan Creek	1,522	0	0	0	0	1	1	No
Wigwam	2,762	1	2	0	2	0	5	Yes
Shoshone National Forest								
Basin	73,119	0	0	0	0	1	1	No
Bear Creek	33,672	0	1	0	0	0	1	No

***Table A2**. Commercial livestock allotments on public lands with documented grizzly bear conflicts during the past 5 years. Allotments with conflicts in 3 or more of the past 5 years are considered to be recurring conflicts.*

U.S. Forest Service allotment name	Total acres	Livestock-related conflicts					Total conflicts (2016–2020)	Recurring conflicts
		2016	2017	2018	2019	2020		
Bench (Clarks Fork)	28,751	4	0	4	0	0	8	No
Crandall	18,641	0	0	0	3	3	6	No
Dick Creek	9,569	0	0	0	0	2	2	No
Dunn Creek	4,520	1	0	0	0	0	1	No
Dunoir	52,875	0	0	1	1	0	2	No
Fish Lake	12,743	0	2	3	0	2	7	Yes
Ghost Creek	11,579	3	0	0	1	2	6	Yes
Hardpan/Table Mountain	17,575	0	0	0	0	1	1	No
Horse Creek	29,980	2	1	0	0	0	3	No
Kirwin	17,588	0	0	0	0	1	1	No
North Absaroka	146,766	0	0	0	0	2	2	No
Piney	14,287	1	0	0	0	0	1	No
Reef Creek	11,449	3	0	0	0	0	3	No
Salt Creek	8,263	5	1	0	0	1	7	Yes
Table Mountain	13,895	4	1	3	4	0	12	Yes
Trout Creek	12,799	1	0	0	0	1	2	No
Union Pass	39,497	0	1	4	0	3	8	Yes
Warm Springs	16,875	3	3	2	3	1	12	Yes
Wiggins Fork	37,653	1	0	0	0	0	1	No
Wind River	44,158	1	0	1	5	1	8	Yes
Wood River	4,049	0	0	0	0	1	1	No
Total conflicts		**94**	**110**	**128**	**102**	**99**	**533**	

[a] The Fish Creek and Union Pass grazing units on the Bridger-Teton National Forest are forage reserves that are grazed only occasionally as a short-term solution to reduce conflict, protect resources, or compensate for natural landscape hazards (i.e., fire) in other grazing areas.

Monitoring of Developed Sites inside the GBRZ

Habitat standards identified in the Conservation Strategy require that the number of developed sites and capacity of human use of developed sites on public lands inside the GBRZ be maintained at or below levels existing in 1998. Administrative site expansions are exempt from mitigation if such developments are deemed necessary for enhanced management of public lands and when other viable alternatives are not plausible. Developed sites include all sites or facilities on public land with infrastructure intended for human use and which accommodates administrative needs and public recreational use. Examples of developed sites include, but are not limited to, campgrounds, trailheads, lodges, administrative structures, service stations, summer homes, restaurants, visitor centers, and permitted natural resource development sites such as oil and gas exploratory wells, production wells, mining activities, and work camps. Developments on private lands inside the GBRZ are not counted against this standard.

Changes in developed sites since 1998

The number of distinct developed sites known to exist in 1998 was 593. In the intervening years, a number of sites have been condemned or permanently closed and dismantled. New sites that were built have been mitigated for by closing one or more sites of equivalent human use within the same subunit. Today, the number of known developed sites on public lands inside the GBRZ is 576, accounting for a net decrease of 17 sites between 1998 and 2018. From 1998 to the present, the number of developed sites has remained at or below 1998 counts for all subunits

inside the GBRZ except for the Hilgard #2 subunit, which increased by a count of one. This increase occurred in 2005 when the Taylor Falls/Lightning trailhead, originally located in subunit #1 of the Hilgard BMU, was moved from one side of a road to the other, placing it in subunit #2 of the Hilgard BMU. In this case, the loss in one subunit yielded a gain in the other. Although this transfer technically accounted for an increase in developed sites on Hilgard #2, it was determined to have no detrimental effect on grizzly bears and did not violate the intent of the developed site standard. Table A3 shows a comparison of developed site counts between 1998 and 2018.

Changes in developed sites in 2020:

In 2020, the Caribou-Targhee National Forest made improvements to the Big Springs canoe take-out location (Henry's Lake #1 Subunit) to prevent resource damage as allowed under the application rules defined in the Conservation Strategy. The improvement included re-grading the parking lot, placing barrier rock, installing a pit toilet, and improving the canoe ramp. Similarly, Grand Teton National Park improved a roadside pullout just north of the Moran Entrance (Buffalo/Spread Creek #1 Subunit) with a pit toilet and bear-resistant garbage cans.

Through an April 2019 land exchange, the Custer Gallatin National Forest acquired portions of the Slip 'n Slide Ranch north of Gardiner, Montana, in the Hellroaring-Bear #1 Subunit. Included in the parcel is a non-motorized access to the forest, which the Custer Gallatin will maintain as a trailhead. Under the 2016 Application Rules, developed sites acquired through land exchanges are exempt from mitigation. This addition will bring the baseline count of developed sites within the GBRZ to 594 from 593 (1988), and existing count from 576 to 577 (2020).

Refer to Table A3 for 1998 and current counts of developed sites per bear management subunit.

Future review of developed sites

Since 2007, when the grizzly bear habitat standards were first implemented, the number of visitors on public lands throughout the GYE has increased significantly. In Yellowstone National Park alone, annual visitation increased by more than 40% during the period 2008–2018, surpassing 3.8 million visits per year since 2015 (National Park Service 2021). However, the habitat standards have not proved to be flexible enough to allow managers the ability to adequately respond to such extraordinary increases in visitation. In direct response to this administrative challenge, federal land managers requested that the 1998-based habitat standards be re-evaluated.

Consequently, a placeholder was added to the 2016 Conservation Strategy that called for an interagency technical team (Developed Sites Technical Team) to be established. The team was tasked with recommending changes to the habitat standard and application rules that would provide managers the needed flexibility for authorizing new infrastructure to accommodate the demands of increased public visitation and aging infrastructure. Imposed constraints require that these recommendations strike a balance between management needs and habitat protection and adhere to the original intent of the 1998 habitat standards. The Developed Sites Technical Team presented an overview of their recommendations at the 2019 spring meeting of the Yellowstone Ecosystem Subcommittee (YES). Once the YES committee finalizes proposed changes to the habitat standard and application rules, the proposed revisions will be released for public comment.

Table A3. *Number of developed sites in 1998 and 2020 on public lands per bear management subunit in the Greater Yellowstone Ecosystem.*

Bear management subunit	Admin unit [1]	Summer home complexes		Developed campgrounds		Trailheads		Major developed sites [2]		Administrative or maintenance sites		Other		Plans of operation [3]		Total count developed sites in PCA	
		1998	2020	1998	2020	1998	2020	1998	2020	1998	2020	1998	2020	1998	2020	1998	2020
Bechler-Teton #1	CTNF	0	0	1	1	5	5	2	2	4	4	16	16	0	0	58	58
	GTNP	0	0	8	8	3	3	1	1	3	3	9	9	0	0		
	YNP	0	0	0	0	2	2	0	0	2	2	2	2	0	0		
Boulder-Slough #1	CGNF	0	0	1	1	7	7	0	0	1	1	3	3	8	2	20	14
Boulder-Slough #2	CGNF	0	0	0	0	0	0	0	0	2	2	0	0	0	0	9	9
	YNP	0	0	1	1	3	3	0	0	2	2	1	1	0	0		
Buffalo-Spread Creek #1	BTNF	0	0	1	1	1	1	0	0	0	0	2	2	0	0	18	18
	GTNP	0	0	1	1	7	7	2	2	1	1	3	3	0	0		
Buffalo-Spread Creek #2	BTNF	1	1	4	2	3	5	3	3	5	5	5	3	1	1	22	20
Crandall-Sunlight #1	CGNF	0	0	2	2	2	2	0	0	0	0	5	5	0	0	23	23
	SNF	0	0	2	2	5	5	1	1	1	1	5	5	0	0		
Crandall-Sunlight #2	CGNF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	18
	SNF	0	0	5	5	4	4	1	1	2	2	5	5	1	1		
Crandall-Sunlight #3	SNF	0	0	2	2	3	3	0	0	1	1	2	2	0	0	11	11
	WG&F	0	0	2	2	0	0	0	0	1	1	0	0	0	0		
Firehole-Hayden #1	YNP	0	0	1	1	5	5	1	1	6	6	13	13	0	0	26	26
Firehole-Hayden #2	YNP	0	0	1	1	3	3	1	1	2	2	8	8	0	0	15	15
Gallatin #1	YNP	0	0	0	0	3	3	0	0	1	1	0	0	0	0	4	4
Gallatin #2	YNP	0	0	2	2	5	5	1	1	12	12	1	1	0	0	21	21
Gallatin #3	CGNF	0	0	2	2	9	9	0	0	0	0	6	6	0	0	18	18
	YNP	0	0	0	0	0	0	0	0	1	1	0	0	0	0		
Hellroaring-Bear #1 [4]	CGNF	0	0	4	4	12	12	0	0	3	3	8	8	8	8	37	37
	YNP	0	0	0	0	1	1	0	0	0	0	1	1	0	0		
Hellroaring-Bear #2	CGNF	0	0	0	0	1	1	0	0	1	1	0	0	0	0	4	4
	YNP	0	0	0	0	0	0	0	0	2	2	0	0	0	0		

Table A3. *Number of developed sites in 1998 and 2020 on public lands per bear management subunit in the Greater Yellowstone Ecosystem.*

Bear management subunit	Admin unit [1]	Summer home complexes		Developed campgrounds		Trailheads		Major developed sites [2]		Administrative or maintenance sites		Other		Plans of operation [3]		Total count developed sites in PCA	
		1998	2020	1998	2020	1998	2020	1998	2020	1998	2020	1998	2020	1998	2020	1998	2020
Henrys Lake #1	CTNF	2	2	3	3	1	1	0	0	3	3	11 [4]	11	1	0	21	20
Henrys Lake #2	CGNF	5	5	3	3	4	4	0	0	0	0	2	3	0	0	18	18
	CTNF	0	0	0	0	1	1	0	0	1	0	1	1	1	1		
Hilgard #1	BDNF	0	0	0	0	0	0	0	0	3	1	0	0	0	0	14	11
	CGNF	0	0	0	0	6	5	1	1	2	2	2	2	0	0		
Hilgard #2	CGNF	0	0	0	0	4	5	0	0	1	1	1	1	0	0	9	10
	YNP	0	0	0	0	3	3	0	0	0	0	0	0	0	0		
Lamar #1	CGNF	0	0	2	2	7	7	0	0	6	6	3	3	8	8	37	36
	SNF	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	YNP	0	0	1	1	5	5	0	0	3	3	2	1	0	0		
Lamar #2	YNP	0	0	0	0	0	0	0	0	4	4	0	0	0	0	4	4
Madison #1	CGNF	0	0	1	1	11	11	0	0	1	1	8	7	0	0	21	20
	YNP	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Madison #2	CGNF	8	8	2	2	1	1	1	1	4	4	5	5	0	0	25	25
	YNP	0	0	0	0	1	1	0	0	2	2	1	1	0	0		
Pelican-Clear #1	YNP	0	0	0	0	2	2	0	0	0	0	0	0	0	0	2	2
Pelican-Clear #2	YNP	0	0	1	1	4	4	1	1	4	4	3	3	0	0	13	13
Plateau #1	CGNF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
	CTNF	1	1	0	0	0	0	0	0	0	0	1	1	0	0		
	YNP	0	0	0	0	0	0	0	0	1	1	0	0	0	0		
Plateau #2	CTNF	0	0	0	0	1	1	0	0	1	1	1	1	0	0	7	7
	YNP	0	0	0	0	0	0	0	0	4	4	0	0	0	0		
Shoshone #1	SNF	1	1	2	2	0	0	0	0	0	0	6	5	0	0	9	8
Shoshone #2	SNF	0	0	0	0	1	1	1	1	0	0	0	0	0	0	2	2
Shoshone #3	SNF	2	2	0	0	1	0	1	1	0	0	0	0	0	0	4	3
Shoshone #4	SNF	3	3	3	2	3	3	6	6	0	0	8	9	0	0	23	23
South Absaroka #1	SNF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A3. *Number of developed sites in 1998 and 2020 on public lands per bear management subunit in the Greater Yellowstone Ecosystem.*

Bear management subunit	Admin unit [1]	Summer home complexes		Developed campgrounds		Trailheads		Major developed sites [2]		Administrative or maintenance sites		Other		Plans of operation [3]		Total count developed sites in PCA	
		1998	2020	1998	2020	1998	2020	1998	2020	1998	2020	1998	2020	1998	2020	1998	2020
South Absaroka #2	SNF	0	0	0	0	0	0	0	0	2	2	0	0	0	0	2	2
South Absaroka #3	SNF	1	1	3	3	4	4	1	1	1	1	5	4	0	0	15	14
Thorofare #1	BTNF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4
	YNP	0	0	0	0	0	0	0	0	4	4	0	0	0	0		
Thorofare #2	BTNF	0	0	0	0	0	0	0	0	2	2	0	0	0	0	2	2
	YNP	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Two Ocean Lake #1	BTNF	0	0	1	1	0	0	0	0	0	0	0	0	0	0	14	13
	GTNP	0	0	0	0	0	0	0	0	1	1	1	0	0	0		
	YNP	0	0	2	2	3	3	1	1	3	3	2	2	0	0		
Two Ocean Lake #2	BTNF	0	0	0	0	0	0	0	0	2	2	0	0	0	0	4	4
	YNP	0	0	0	0	0	0	0	0	1	1	1	1	0	0		
Washburn #1	YNP	0	0	2	2	8	8	2	2	7	7	6	6	0	0	25	25
Washburn #2	YNP	0	0	1	1	6	6	0	0	1	1	4	4	0	0	12	12
Total count in GBRZ		**24**	**24**	**67**	**64**	**161**	**162**	**28**	**28**	**117**	**114**	**169**	**164**	**28**	**21**	**594**	**577**

Note: The 1998 baseline values in this table may vary from those tabulated in the 2007 Conservation Strategy since corrections have been made with time. The numbers in this table represent the best estimates currently available for developed sites on public lands inside the Grizzly Bear Recovery Zone of the Greater Yellowstone Ecosystem.

[1] Abbreviations for administrative units: BDNF = Beaverhead-Deerlodge National Forest, BTNF = Bridger-Teton National Forest, CGNF = Custer Gallatin National Forest, CTNF = Caribou-Targhee, GTNP = Grand Teton National Park, SNF = Shoshone National Forest, WG&F = Wyoming Game and Fish, YNP = Yellowstone National Park.

[2] Major developed areas such as Grant, Lake, Fishing Bridge, Old Faithful, Canyon, and Mammoth in YNP and are comprised of a combination of recreation and administrative facilities. All buildings and facilities comprising a given major developed area are tracked collectively as a single developed site.

[3] A single plan of operation may have multiple mining claims and not all plan sites have active projects.

[4] The Slip & Slide trailhead site was appended in 2020 as an exempted addition to the 1998 Baseline. This baseline correction added 1 count to the CGNF, Hellroaring-Bear subunit #1, "Trailhead" category, causing the total baseline counts to go from 593 to 594 (1998) and 576 to 577 (2020). The trailhead existed prior to 1998 and was acquired through a land exchange.

Monitoring Secure Habitat and Motorized Access inside the GBRZ

Habitat standards identified in the Conservation Strategy require that there be no net loss in grizzly bear secure habitat with respect to levels that existed in 1998 for each of the 40 subunits inside the GBRZ. The sole exception to the 1998 baseline applies to 3 subunits identified in the 2007 Conservation Strategy (Gallatin #3, Henrys Lake #2, and Madison #2) as "*in need of improvement*" above 1998 levels. In 2016, new baseline values were established that hold these 3 subunits to improved levels of secure habitat. These increased levels were achieved in 2016 with full implementation of the Gallatin National Forest 2006 Travel Management Plan. New threshold values raise the baseline bar for these 3 subunits and supersede 1998 values for secure habitat.

Calculations of secure habitat are based entirely on proximity to motorized routes (roads and trails) and serve as a metric of human presence in grizzly bear habitat. Secure habitat is defined as any contiguous area ≥10 acres in size and more than 500 m from an open or gated motorized route. Lakes larger than 1 mi^2 (2.59 km^2) in size are excluded from habitat calculations.

The Conservation Strategy does not impose mandatory standards on motorized route density; however, changes in this parameter are monitored and reported annually for tracking purposes. The monitoring protocol requires that secure habitat, open motorized access route density (OMARD), and total motorized access route density (TMARD) be reported annually against baseline levels per subunit inside the GBRZ. OMARD is a measure of the density of routes open to public motorized use at least one or more days during the non-denning portion of the year when grizzly bears are considered active (March 1–November 30). TMARD is a measure of the density of roads and trails that are open to the public and/or administrative personnel for motorized use on one or more days during the active season. Route densities are reported as the percent area of each subunit where OMARD >1 mi/mi^2 (>0.62 km/km^2) and TMARD >2 mi/mi^2 (>1.2 km/km^2). Thus, although TMARD is a measure of total route density, values are typically lower than OMARD because the threshold density is at a higher level. Table A4 shows historical and current values of secure habitat and motorized route density. Routes that are gated and closed to the public yearlong but accessible to administrative personnel detract from secure habitat and contribute to TMARD only.

Gains in secure habitat are achieved primarily through decommissioning of open, motorized access routes. In context to the measurement of grizzly bear secure habitat, a route is considered decommissioned when it has been treated on the ground so that motorized access by the public and administrative personnel is effectively restricted. Road decommissioning can range from complete obliteration of the road prism to physical barriers permanently and effectively blocking motorized access. Decommissioned roads do not detract from secure habitat and do not contribute to OMARD or TMARD.

Permanent changes in secure habitat since 1998 (inside GBRZ)

The standard calling for "no net loss" in secure habitat with respect to 1998 baseline levels has been consistently met in all 40 subunits inside the GBRZ since it was initially formalized in the 2007 Conservation Strategy. For the 3 subunits identified in the 2007 Conservation Strategy as in need of improvement above 1998 levels (Gallatin #3, Henrys Lake #2, and Madison #2), new baseline thresholds ensure that secure habitat will be maintained well into the future at levels higher than what was attained in 1998. Since 1998, a net gain of approximately 131 $miles^2$ (339 km^2) in secure habitat has been attained inside the GBRZ. This gain is comparable in size to the area of Yellowstone Lake. The greatest improvement in secure habitat is the 17.2% increase occurring on the Gallatin #3 Bear Management Subunit (BMS) on the Custer Gallatin National Forest. The gain in secure habitat for this subunit, as well as Henrys Lake #2 (6 %) and Madison #2 (1.0%) was achieved by road closures commissioned for implementation of the Gallatin Travel Management Plan. Values achieved with full implementation of the Gallatin Travel Management Plan constitute new baselines against which future change will be measured (Table A4 footnote). Other notable gains in secure habitat range from 3.4% on the Hellroaring-Bear #1 subunit to 13.4% on the Hilgard #1 subunit. Changes in secure habitat, when averaged over all 40 subunits, account for a mean gain of 1.4% since 1998. All gains in secure habitat throughout the GBRZ were achieved by the decommissioning of

motorized routes on public lands. Permanent changes in secure habitat, OMARD, and TMARD inside the GBRZ are reported with respect to baseline levels in Table A4.

Permanent changes in secure habitat during 2020 (inside GBRZ)

During 2020 several changes in the status of motorized access on public land yielded changes to secure habitat.

- *Buffalo Spread Creek #2*: The Blackrock/Togwotee area was closed to off-trail vehicle use by 2019. The motorized access data in the area were verified, and secure habitat is now calculated solely based on motorized routes in the area. Previously, the entire area was considered non-secure habitat due to the possible off-trail access. Additionally, a 0.65-mile administrative road north of Fourmile Meadow was decommissioned in 2020. Collectively, these changes in motorized access resulted in a measured increase of 6.9% in secure habitat for the Buffalo Spread Creek #2 subunit.
- *Hellroaring/Bear #1*: In 2019, the Custer Gallatin National Forest acquired portions of the former Slip & Slide Ranch through the Shooting Star Land Exchange. An existing ranch road was developed as a trailhead access road (approximately 0.09 miles) open to the public. An administrative road (1.2 miles) was added to connect to an existing ranch road (1.4 miles) to be used for administrative purposes only. An additional 0.6 miles of ranch roads were retained for administrative use while approximately 1.5 miles were decommissioned. Collectively, the project increased secure habitat in the subunit by 33 acres.
- *Madison #1*: The Custer Gallatin National Forest discovered a small road that was in existence for decades prior to 1998. Road 287CB is 0.13 miles long and is surrounded by other open roads. The baseline was updated, and the addition had no effect on the calculated secure habitat either baseline or current.

Table A4. *1998 and 2020 percent areas of open motorized access route density (OMARD, total motorized access route density (TMARD), and secure habitat per bear management subunit inside the Grizzly Bear Recovery Zone of the Greater Yellowstone Ecosystem.*

Bear management subunit	% OMARD (subunit % > 1 miles / mile²)			% TMARD (subunit % > 2 miles / mile²)			% Secure Habitat			Area (miles²) (excluding major lakes)		
										Subunit	Secure Habitat	
	1998	2020	% chg	1998	2020	% chg	1998	2020	% chg		1998	2020
Bechler/Teton	17.0	17.0	-0.1	5.8	5.8	0.1	78.1	78.1	0.0	534.3	417.0	417.2
Boulder/Slough #1	3.2	3.3	0.0	0.3	0.4	0.1	96.6	96.6	0.1	281.9	272.2	272.4
Boulder/Slough #2	2.1	2.1	0.0	0.0	0.0	0.0	97.7	97.7	0.0	232.4	227.1	227.1
Buffalo/Spread Creek #1	11.5	10.9	-0.6	5.3	5.6	0.3	88.3	89.0	0.7	219.9	194.1	195.6
Buffalo/Spread Creek #2	15.6	15.0	-0.5	12.7	9.5	-3.2	74.3	81.8	7.5	507.6	377.2	412.2
Crandall/Sunlight #1	19.3	18.5	-0.8	7.2	6.3	-0.9	81.1	81.9	0.8	129.8	105.2	106.2
Crandall/Sunlight #2	16.6	16.0	-0.6	11.7	9.8	-1.9	82.3	82.7	0.4	316.2	260.3	261.4
Crandall/Sunlight #3	19.2	18.5	-0.6	10.6	9.1	-1.5	80.4	81.2	0.8	221.8	178.3	180.1
Firehole/Hayden #1	10.4	10.5	0.1	1.7	1.7	0.0	88.3	88.3	0.0	339.2	299.7	299.6
Firehole/Hayden #2	9.0	9.0	0.0	1.5	1.5	0.0	88.4	88.4	0.0	172.2	152.3	152.3
Gallatin #1	3.6	2.5	-1.0	0.5	0.1	-0.4	96.3	97.0	0.7	127.7	122.9	123.9
Gallatin #2	9.5	9.1	-0.4	4.5	4.5	0.0	90.2	90.2	0.0	155.2	139.9	139.9
Gallatin #3 *	46.0	27.4	-18.5	22.9	12.5	-10.4	**55.3**	72.5	17.2	217.6	120.2	157.7
Hellroaring/Bear #1	23.1	17.8	-5.4	15.8	12.1	-3.7	77.0	80.3	3.4	184.7	142.2	148.7
Hellroaring/Bear #2	0.1	0.0	-0.1	0.0	0.0	0.0	99.5	99.6	0.1	228.9	227.8	228.0
Henry's Lake #1	49.0	49.2	0.2	31.2	31.3	0.1	45.4	46.0	0.6	191.2	86.8	88.0
Henry's Lake #2 *	49.9	40.6	-9.4	35.2	28.3	-6.9	**45.7**	51.8	6.1	140.2	64.1	72.6
Hilgard #1	29.0	13.3	-15.7	15.3	4.4	-10.9	69.8	83.1	13.4	201.2	140.3	167.2
Hilgard #2	21.0	16.1	-4.9	13.6	4.6	-8.9	71.4	80.2	8.8	140.5	100.4	112.7
Lamar #1	9.9	9.7	-0.1	3.8	4.0	0.2	89.4	89.9	0.5	299.9	268.1	269.6
Lamar #2	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0	180.8	180.8	180.8
Madison #1	29.5	20.3	-9.2	12.5	7.5	-5.0	71.5	80.7	9.2	227.9	162.9	183.9
Madison #2 *	33.7	32.0	-1.7	24.0	21.6	-2.4	**66.5**	67.5	1.0	149.4	99.4	100.9
Pelican/Clear #1	2.0	2.0	0.0	0.5	0.5	0.0	97.8	97.8	0.0	108.4	106.0	106.0

Table A4. *1998 and 2020 percent areas of open motorized access route density (OMARD, total motorized access route density (TMARD), and secure habitat per bear management subunit inside the Grizzly Bear Recovery Zone of the Greater Yellowstone Ecosystem.*

Bear management subunit	% OMARD (subunit % > 1 miles / mile²)			% TMARD (subunit % > 2 miles / mile²)			% Secure Habitat			Area (miles²) (excluding major lakes)		
										Subunit	Secure Habitat	
	1998	2020	% chg	1998	2020	% chg	1998	2020	% chg		1998	2020
Pelican/Clear #2	5.4	5.4	0.0	0.4	0.4	0.0	94.1	94.1	0.0	251.6	236.7	236.7
Plateau #1	22.2	19.0	-3.3	12.9	10.3	-2.7	68.8	70.6	1.8	286.3	197.0	202.1
Plateau #2	8.5	8.5	0.0	3.5	3.2	-0.2	88.7	88.8	0.1	419.9	372.3	372.7
Shoshone #1	1.5	1.5	0.0	1.1	1.0	-0.1	98.5	98.5	0.1	122.2	120.3	120.4
Shoshone #2	1.3	1.1	-0.2	0.7	0.6	-0.2	98.8	99.0	0.1	132.4	130.9	131.0
Shoshone #3	3.9	2.8	-1.1	2.1	1.5	-0.6	97.0	97.8	0.8	140.7	136.5	137.6
Shoshone #4	5.3	5.3	0.0	2.9	2.7	-0.2	94.9	94.9	0.0	188.8	179.1	179.1
South Absaroka #1	0.6	0.6	0.0	0.1	0.1	0.0	99.2	99.2	0.0	163.2	161.9	161.9
South Absaroka #2	0.0	0.0	0.0	0.0	0.0	0.0	99.9	99.9	0.0	190.6	190.3	190.3
South Absaroka #3	2.4	2.4	0.0	2.7	1.7	-1.1	96.8	96.8	0.0	348.3	337.1	337.2
Thorofare #1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0	273.4	273.4	273.4
Thorofare #2	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0	180.1	180.1	180.1
Two Ocean/Lake #1	3.5	3.6	0.2	0.3	0.5	0.2	96.3	96.3	0.0	371.9	358.3	358.2
Two Ocean/Lake #2	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0	124.9	124.9	124.9
Washburn #1	16.1	16.1	0.0	4.2	4.2	0.0	83.0	83.0	0.0	178.3	147.9	147.9
Washburn #2	7.4	7.4	0.0	1.1	1.1	0.0	92.0	92.0	0.0	144.1	132.6	132.6
GBRZ Mean / Total Area	**12.7**	**10.9**	**-1.8**	**6.7**	**5.2**	**-1.5**	**85.6**	**87.4**	**1.8**	**9,025**	**7,724**	**7,890**

**As of 2016, three subunits (Gallatin #3, Henrys Lake #2, and Madison #2) have new secure habitat baselines established at thresholds achieved with full implementation of the 2006 Gallatin National Forest Travel Management Plan. These 3 subunits were identified in the 2007 Conservation Strategy as needing improved secure habitat levels above 1998 conditions. New baseline thresholds established in 2016 raise the bar for these 3 subunits and supersede 1998 baseline values for secure habitat.*

Travel Plan Baselines (supersedes 1998 thresholds)		
Bear management subunit	**% Secure habitat baseline**	**Area (mile²) Secure habitat**
Gallatin #3	70.7	153.9
Henrys Lake # 2	51.7	72.5
Madison #2	67.5	100.9

Temporary Changes to Secure Habitat, 2020 (inside GBRZ)

Reductions in secure habitat below baseline levels are allowed on a temporary basis inside the GBRZ when associated with authorized federal projects. In these cases, adherence to the "one percent" application rule and other provisions must be met. The one percent rule states that any temporary loss of secure habitat below baseline values within a given BMU cannot exceed 1% of the total acreage of the largest subunit within that BMU. Application rules allow only one temporary project to be active in a particular subunit at any given time. During 2020 five projects involving temporary reductions in secure habitat were operational inside the GBRZ (Table A5). Below is a brief summary of these five Forest Service projects.

Yale Creek Wildland-Urban-Interface: The Yale Creek Fuels Reduction Project was authorized to reduce hazardous fuels and produce a timber product on public lands interfacing with private lands in the Yale Creek and Shotgun subdivisions in the north portion of the Ashton-Island Park Ranger District on the Caribou-Targhee National Forest. One temporary road (0.4 miles) was opened in 2019 and another (0.1 miles) in 2020. Both roads were closed and rehabbed in 2020.

Black Mountain Salvage Project: Authorized by the Black Mountain CE (2019), the purpose of this project is to salvage 138 acres of wind-thrown mature lodgepole pine on the Madison-Pitchstone Plateau of the Ashton-Island Park Ranger District on the Caribou-Targhee National Forest. Only 1 of the 3 timber sales employed temporary roads, 2 roads totaling 0.2 miles were installed in 2020 and will be used in 2021 as well.

Budworm Response Project: This fuel reduction and salvage-sanitation silvicultural project was authorized under the Budworm Response Project Finding of No Significant Impact. There are several timber sales that will occur during project implementation. During FY2019, 13 temporary roads (20 total road segments ranging 0.023–0.86 miles in length) were created to support the Sugarloaf Timber Sale. All but 1 of the temporary roads extended directly from the Chief Joseph Highway. As of the end of calendar year 2019, all but 4 of the temporary roads were closed (and barricaded) to preclude motorized access. Of the remaining 4 temporary roads, 2 were closed on April 21st, 2020, and 2 remained open through the end of 2020. No other temporary roads were in use on the entire Budworm Response Project during 2020.

Wolf Creek Salvage: This timber sale was authorized under the 2015 Long Creek Project EA and Decision Notice, and is located within the South Absaroka #3 Subunit near the Wolf Creek Trailhead. The sale consists of live and dead sawtimber. The sale began operations in Summer of 2020. The Purchaser is using a Level 1 NFSR 513.3C. The road is gated and closed to all other traffic. There are several more units farther down the road, and temporary roads will be constructed off 513.3C in the future. Sale activity will resume in the summer of 2021.

Knob Hill Salvage*:* Timber harvest authorized on the Shoshone National Forest under the 2018 Lava Mountain Project EA and Decision Notice. The project is outside the GRBZ but near the boundary of the Buffalo/Spread Creek #2 Subunit on the Bridger-Teton NF. The timber sale began operations in fall of 2020. The purchaser opened a decommissioned road for logging operations. The sale will resume operations in the summer of 2021.

Table A5. *Secure habitat affected by temporary projects inside the Grizzly Bear Recovery Zone, 2020.*

Project name and National Forest	BMU Subunit	Secure Habitat (miles^2)					Project status
		Allowed reduction below Baseline [a]	Baseline	2018 (without project)	2018 (with project)	Reduction in Secure Habitat	
Knob Hill Salvage Shoshone N.F.	Buffalo/Spread Creek #2	3.8	377.2	412.2	412.2	0	Open
Budworm Response Project Shoshone N.F.	Crandall-Sunlight #2	3.2	260.3	261.5	261.4	0.1	Open
Yale Creek WUI Caribou-Targhee N.F.	Henry's Lake #1	0.9	86.8	88	87.9	0.1	Closed
Black Mountain Salvage Caribou-Targhee N.F.	Plateau #1	3.7	197.0	202	202	0	Open
Wolf Creek Salvage Shoshone N.F.	South Absaroka #2	3.4	190.3	190.3	190.3	0	Open

[a] The maximum allowed temporary reduction in secure habitat below baseline is 1% of the area of the largest subunit within the BMU.

Monitoring Secure Habitat outside the GBRZ

The 2006 Forest Plan Amendment requires monitoring and reporting of changes in percent secure habitat on national forest lands outside the GBRZ every 2 years in areas identified in state management plans as biologically suitable and socially acceptable for grizzly bear occupancy (USDA 2006, p.45, 52). Table A6 represents the best estimates available for current values of percent secure habitat per Bear Analysis Unit (BAU) outside the GBRZ. Refer to Fig. 3A for delineation of BAU.

Changes in secure habitat outside the GBRZ (2018–2020)
Several changes in motorized routes yielded changes in secure habitat on Forest Service lands outside the GBRZ (Table A6). Below is a listed of changes to motorized routes and secure habitat that have occurred outside the GBRZ since last reported in 2018:

Crazy Mountains BAU: The Custer Gallatin National Forest enacted a project to relocate the Porcupine Ibex 267 trail, which involved decommissioning 5.4 miles of motorized trail and establishing 9.4 miles of non-motorized trail to the east of the old trail. About half of the decommissioned route occurs off-forest lands and outside of the BAU. This increased the percentage of secure habitat in the BAU by 0.0001%.

Gallatin BAU: The South Deer Creek Access Project replaced a motorized route with a non-motorized trail (0.33 miles) and constructed 2 new parking accesses (0.16 miles). This increased secure habitat within the BAU by 0.007%.

Island Park BAU: Several changes were implemented in the Island Park BAU on the Caribou-Targhee National Forest. A new open motorized cross-country area on the West End was established and a new motorized trail system totaling 4.1 miles was established in that area. The Eccles F area was closed to cross-country travel and a new system of trails (20.1 miles) was created or converted from roads in 2019. A portion of the Buttermilk F area was also closed to cross-country travel and 4.5 miles of motorized trail were added to the travel system. Collectively, these changes increased secure habitat in the BAU by 4.8 square miles, or 1.45%.

Table A6. *Percent secure habitat in Bear Analysis Units (BAU) outside the Grizzly Bear Recovery Zone for each of the five national forests inside the Greater Yellowstone Ecosystem. Current levels of secure habitat are compared against previous reporting year levels.*

Bear Analysis Unit (BAU)	Percent Secure Habitat			BAU area * (miles^2)
	2018	2020	Change (2018–2020)	
Beaverhead-Deerlodge National Forest				
Baldy Mountain	55.0	55.0	0.0	96.9
Bear Creek	62.6	62.6	0.0	36.4
Beaver Creek	57.3	57.3	0.0	478.9
Garfield	71.6	71.6	0.0	182.0
Gravelies	58.5	58.5	0.0	384.4
Madison Range	99.4	99.4	0.0	89.2
Pintler Mountains	57.6	57.6	0.0	410.3
Pioneer Mountains	55.1	55.1	0.0	912.2
Snowcrest Range	74.8	74.8	0.0	357.2
Sourdough	46.9	46.9	0.0	111.2
Starlight	34.8	34.8	0.0	79.0
Tobacco Roots North	53.4	53.4	0.0	106.7
Tobacco Roots South	47.5	47.5	0.0	186.3
Mean Secure / Total Area	**59.6**	**59.6**	**0.0**	**3,431**
Bridger-Teton National Forest				
Fremont	88.2	88.2	0.0	440.0
Green River	65.7	65.7	0.0	527.9
Gros Ventre	64.0	64.0	0.0	507.7
Hoback Range	58.9	58.9	0.0	292.9
Snake River	64.2	64.2	0.0	348.9
Mean Secure / Total Area	**68.2**	**68.2**	**0.0**	**2,117**
Caribou-Targhee National Forest				
Centennials	50.9	50.9	0.0	199.1
Crooked Creek	59.5	59.5	0.0	403.0
Dead Horse Ridge	50.2	50.2	0.0	364.8
Island Park	36.7	38.1	1.45	333.9
Lemhi Mountains	70.0	70.0	0.0	143.1
Palisades Reservoir	59.8	59.8	0.0	472.5
Teton	75.8	75.8	0.0	209.5
Mean Secure / Total Area	**57.6**	**57.8**	**0.21**	**2,126**
Custer-Gallatin National Forest				
Boulder	69.7	69.7	0.0	277.9
Bozeman	59.3	59.3	0.0	270.5
Bridger	38.4	38.4	0.0	236.3
Cooke City	99.6	99.6	0.0	68.7
Crazy	67.9	67.9	0.0001	254.8
Gallatin	59.6	59.6	0.01	415.0
Mill Creek	83.8	83.8	0.0	312.2
Pryor Mountains	38.8	38.8	0.0	121.8

Table A6. *Percent secure habitat in Bear Analysis Units (BAU) outside the Grizzly Bear Recovery Zone for each of the five national forests inside the Greater Yellowstone Ecosystem. Current levels of secure habitat are compared against previous reporting year levels.*

Bear Analysis Unit (BAU)	Percent Secure Habitat			BAU area * (miles^2)
	2018	2020	Change (2018–2020)	
Quake	92.1	92.1	0.0	66.2
Rock Creek	83.8	83.8	0.0	237.2
Stillwater	85.5	85.5	0.0	404.7
Mean Secure / Total Area	**70.8**	**70.8**	**0.0**	**2,023**
Shoshone National Forest				
Carter	77.9	77.9	0.0	261.1
Clarks Fork	70.1	70.1	0.0	160.5
East Fork	73.2	73.2	0.0	251.0
Fitzpatrick	98.4	98.4	0.0	317.8
North Fork	78.0	78.0	0.0	143.2
Warm Springs	30.1	30.1	0.0	183.0
Wood River	85.3	85.3	0.0	228.5
Mean Secure / Total Area	**72.3**	**73.3**	**0.0**	**1,545**

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Appendix B

Monitoring Whitebark Pine in the Greater Yellowstone Ecosystem – 2020 Annual Report

The 2020 whitebark pine monitoring report was not yet available at time of publication of the IGBST 2020 annual report. Once finalized, it can be obtained in digital format from the Greater Yellowstone Network website (https://www.nps.gov/im/gryn/reports-publications.htm) and the Natural Resource Publications Management website (https://www.nps.gov/im/publication-series.htm). If you have difficulty accessing information in this publication, particularly if using assistive technology, please email irma@nps.gov.

Appendix C

2020 Wyoming Bear Wise Wyoming Project Update

Introduction

The Bear Wise Community Program is a proactive initiative that seeks to minimize human-bear (black and grizzly) conflicts, minimize management-related bear mortalities associated with preventable conflicts, and to safeguard human communities in northwest Wyoming. The overall objective of Bear Wise is to promote individual and community ownership of ever-increasing human-bear conflict issues, moving toward creating a social conscience regarding responsible attractant management and behavior in bear habitat. This project seeks to raise awareness and proactively influence local waste management infrastructures with the specific intent of preventing conflicts from recurring. Strategies used to meet the campaign's objectives are: 1) minimize accessibility of unnatural attractants to bears in developed areas; 2) employ a public outreach and education campaign to reduce knowledge gaps about bears and the causes of conflicts; and 3) employ a bear resistant waste management system and promote bear-resistant waste management infrastructure.

This report provides a summary of program accomplishments in 2020. Past accomplishments are reported in the 2006–2019 annual reports of the Interagency Grizzly Bear Study Team (IGBST) and in the 2011–2019 Annual Job Completion Reports of the Wyoming Game and Fish Department (WGFD).

Background

In 2004, a subcommittee of the IGBST conducted an analysis of causes and spatial distribution of grizzly bear mortalities and conflicts in the Greater Yellowstone Area (GYA) for the period of 1994–2003. The analysis identified that the majority of known, human-caused grizzly bear mortalities occurred due to agency management actions in response to conflicts (34%), self-defense killings, primarily by big game hunters (20%), and vandal killings (11%). The report made 33 recommendations to reduce human-grizzly bear conflicts and mortalities with focus on 3 actions that could be positively influenced by agency resources and personnel: 1) reduce conflicts at developed sites; 2) reduce self-defense killings; and 3) reduce vandal killings (Servheen et al. 2004).

To address action number 1, the committee recommended that a demonstration area be established to focus proactive, innovative, and enhanced management strategies where developed site conflicts and agency management actions resulting in relocation or removal of grizzly bears had historically been high. Spatial examination of conflicts identified the Wapiti area in northwest Wyoming as having one of the highest concentrations of black bear and grizzly bear conflicts in the GYA. The North Fork of the Shoshone River west of Cody was then chosen as the first area composed primarily of private land to have a multi-agency/public approach to reducing conflicts at developed sites.

In 2005, the Department began implementation of the Bear Wise Community Program. Although the program's efforts were focused primarily in the Wapiti area, the Department initiated a smaller scale project in Teton County to address the increasing number of black and grizzly bear conflicts in the Jackson, Wyoming, area. For the last 16 years, the Bear Wise Community Programs in Northwest Wyoming have deployed a multi-faceted education and outreach campaign in an effort to minimize human-bear conflicts and promote proper attractant management. Although a wide array of challenges remain and vary between communities, many accomplishments have been made and progress is expected to continue as Bear Wise efforts gain momentum. In an effort to broaden the scope of the program, this work was rebranded as the Bear Wise Wyoming Program.

Cody Project Update

The Cody Bear Wise Community Program continues to utilize radio, television and print media, mass mailings, and the use of signing on private and public land to convey the educational messages surrounding human-bear conflict prevention. Conflict prevention information is also disseminated through public workshops and presentations and by contact with local community groups, governments, the public school system, and various youth organizations. To compliment educational initiatives, the program uses an extensive outreach campaign that assists the community in obtaining and utilizing bear-resistant products and implementing other practical methods of attractant management. Ongoing efforts and new accomplishments for 2020 are as follows:

1. The Carcass Management Program continues to provide a domestic livestock carcass removal service for livestock producers located in occupied grizzly bear habitat within Park County, Wyoming. The program has been traditionally funded by the Park County Predator Management District and Wyoming Animal Damage Management Board. In addition to those donors, the program received contributions from Bureau of Land Management and the National Fish and Wildlife Foundation. The program provides livestock producers and owners with an alternative to the use of on-site carcass dumps, which are a significant bear attractant and indirectly contribute to numerous human-bear conflicts. Since June 2008, 1,376 domestic livestock carcasses have been removed from private lands.

2. Recommendations concerning the proper storage of garbage and other attractants are provided to the Park County Planning and Zoning Commission for new developments within the greater Cody area. The Coordinator reviews proposed developments on a case-by-case basis, attends monthly meetings, and contacts applicants directly to discuss conflict prevention measures. To date, these comments have been adopted as either formal recommendations or as a condition of approval for 25 new developments within Park County.

3. A public service announcement (PSA) was recorded by WGFD personnel on “Staying Safe in Bear Country” and broadcast over the radio in the spring of 2020 on the Bighorn Basin Radio Network. LCS personnel also took part of several radio interviews.

4. In the Cody Region, Large Carnivore Section (LCS) built 10 permanent electric fences around bee apiaries that have been in the same place long term (see photo below). These project were completed in cooperation with USDA wildlife service non-lethal specialist and funding to do livestock conflict prevention.

5. Large Carnivore personnel along with USDA wildlife service non-lethal specialist also built a permanent electric fence around a landowners’ chickens and goats. The landowners’ small livestock were in a high density grizzly bear area adjacent to a regularly used corridor.

6. The carcass management program received grant funding from the National Fish and Wildlife Foundation. This funding is from restitution of federal wildlife violations and will be used to reduce human-bear conflicts.

A permanent electric fences around a bee apiary in the Cody region (photo courtesy of Wyoming Game and Fish Department)

7. Three (3) collapsible bear boxes were placed at backcountry campsites in the Beartooth Mountains. These bear boxes will be used by many outdoor recreationalists who travel from all over the country and world to utilize the Beartooth Mountains. Although, there are food storage regulations on these Forest Service lands the backcountry campsites lack infrastructure for campers. Providing bear boxes sends a clear message that the area is occupied grizzly bear habitat.

8. In the spring, LCS personnel put on 2 "Living in Large Carnivore Country" workshops in Story and Sheridan, Wyoming. The objective of these workshops was to reach out to the public and give them the opportunity to learn how to live with bears, mountain lions, and wolves. In 2020, we gave presentations and hands on demonstrations to 71 attendees.

9. Numerous informational presentations were given that focused on human-bear conflict prevention to students at the following schools Powell High School, Cody Elementary Schools, Basin Middle School, and Northwest College. Several of these presentations were given by zoom due to COVID-19 concerns.

10. A booth containing information on bear identification, attractant storage, hunting and recreating safely in bear country, and the proper use of bear spray was staffed at the Lander Winter Fair.

11. A 100 canisters of bear spray were purchased with funding from the Rocky Mountain Elk Foundation, Western Bear Foundation, and Wyoming Outdoorsman. The cans of bear spray were given free of charge to hunters in anglers in early in September.

Bear spray canisters were given free of charge at the Cody Rodeo
(photo courtesy of Wyoming Game and Fish Department)

12. A "Working Safely in Bear Country" workshop was conducted for the Park County Weed and Pest District, Park County Wilderness EMTs, and Rocky Mountain Power employees.

13. A permanent electric fence was erected in 2018 at the Park County Landfill. To ensure the fence is in good working order WGFD personal spent several days repairing and maintain the fence in 2020.The partnerships with Wyoming Outdoorsmen, Bureau of Land Management, Park County Commissioners, Western Bear Foundation, and Greater Yellowstone Coalition were vital in making this project a reality.

14. The 2020 Antelope, Deer, and Elk hunting regulations have a section on being *Bear Aware*. Specifically, there is information regarding game retrieval and handling, how to react to an aggressive/defensive bear encounter, how to properly use bear spray, and what to do if a bear comes into camp.

Pinedale Area Update

In 2011, a Bear Wise Community effort was initiated targeting residential areas north of Pinedale, Wyoming where the occurrence of human-bear conflict has increased in recent years. Accomplishments for the Pinedale area in 2020 are as follows:

1. Hunting in Bear Country presentations were given to hunter safety classes throughout the region in an effort to educate future sportsmen and women and increase safety potential.

2. LCS personnel provided range rider safety training to local cowboys and ranches that have a high potential of encounters with grizzly bears and livestock.

3. Bear safety presentations were given to the Sublette County Weed and Pest employees and volunteers. These personnel have the potential to encounter grizzly bears during the course of their work activities.

4. LCS personnel provided training for Regional fisheries crews and local Sublette County Conservation District employees.

Objectives for 2021 include continued expansion of the program into the other areas of the state where human-bear conflicts continue to be a chronic issue and the continuation of current educational and outreach efforts in the Cody area with specific focus on areas that have not adopted proper attractant management methods.

The Wapiti and Pinedale area Bear Wise Community programs face the ongoing challenges of: 1) the absence of ordinances, regulations, or laws prohibiting the feeding of bears; 2) limited educational opportunities and contact with portions of the community due to a large number of summer-only residents and the lack of organized community groups and; 3) decreased public tolerance for grizzly bears due to record numbers of human-bear conflicts and continued federal legal protection. The future success of the Bear Wise program lies in continued community interest and individual participation in proper attractant management.

Jackson Hole Project Update

The Bear Wise Jackson Hole program continues educational and outreach initiatives in an effort to minimize human-bear conflicts within the community of Jackson and surrounding areas. In 2020, the program's public outreach and educational efforts included the use of signage, public workshops and presentations, distribution of informational pamphlets, promoting awareness about bear spray, carcass and fruit tree management, and utilizing our bear education trailer.

1. A bear education trailer was purchased in August 2010 with funding contributions from the Department, Grand Teton National Park, Bridger Teton National Forest and Jackson Hole Wildlife Foundation. Two bear mounts (1 grizzly bear and 1 black bear) have been placed in the trailer along with other educational materials. The bear mounts were donated to the Department through a partnership with the United States Taxidermist Association and the Center for Wildlife Information. The trailer was displayed and staffed at various events and locations including Teton National Park, Jackson Elk Fest, Fourth of July Parade and the National Elk Refuge Visitor Center.

2. Public service announcements were broadcast on four local radio stations in Jackson for a total of six (6) weeks throughout the spring, summer, and fall of 2020. The announcements focused on storing attractants so they are unavailable to bears and hunting safely in bear country.

3. Numerous educational talks were presented to various groups including homeowner's associations, guest ranches, youth camps, Jackson residents, tourists, school groups and Government employees.

4. Door flyers with detailed information about attractant storage and bear conflict avoidance were distributed in Teton County residential areas where high levels of bear/human conflicts were occurring.

5. A considerable amount of time was spent removing ungulate and livestock carcasses from residential areas and ranches in the Jackson Region.

6. LCS personnel continued to work with a Jackson catering company, Roots Kitchen & Cannery. They have been involved in picking apples from trees that have been identified as a source of bear conflict by WGFD. In 2020, they harvested fruit from 161 trees removing 13,000 pounds of apples, which was made into cider.

7. Numerous personal contacts were made with private residents in Teton County. This has proven to be a useful way to establish working relationships with residents and maintain an exchange of information about bear activity in the area.

8. A booth containing information on bear identification, attractant storage, hunting and recreating safely in bear country, and the proper use of bear spray was staffed at the Jackson Hole Antler Auction.

9. LCS personnel assisted hunting outfitters and with the installation and maintenance of electric fence systems around their field camps located in the Bridger-Teton National Forest. Annually, personnel meet with hunters and outfitters to reduce to conflict potential between humans and grizzly bears.

10. LCS biologists assisted Teton County Transfer Station staff with an electric fence design for their new facility in order to be proactive and reduce conflict potential for black and grizzly bears.

11. Signage detailing information on hunting safely in bear country, bear identification, recent bear activity, and proper attractant storage were placed at USFS trailheads and in private residential areas throughout Teton County.

12. Consultations were conducted at multiple businesses and residences where recommendations were made regarding sanitation infrastructure and compliance with the Bear Conflict Mitigation and Prevention Lander Development Recommendations (LDR).

13. Bear Aware educational materials were distributed to school groups, campground hosts, hunters, and numerous residents in Teton County.

14. Several radio and newspaper interviews were conducted regarding conflict prevention in the Jackson area.

15. Educational black bear/grizzly bear identification materials were distributed to black bear hunters who registered bait sites with the Wyoming Game and Fish Department in the Jackson region.

16. LCS personnel worked with a Jackson sanitation company and East Jackson residents on placing new bear resistant garbage cans in several East Jackson neighborhoods.

17. LCS biologists provided bear safety information including bear spray demonstrations with the "bear charger" at the Fire in the Mountains music festival in the Buffalo Valley. Several hundred attendees joined the workshops and donations were made by the festival to procure an install a bear proof food storage box during the summer of 2020.

Objectives for the Bear Wise Jackson Hole program in 2021 will be focused on supporting Teton County and local waste management companies with projects that will help disseminate information and achieve compliance with the recently adopted Teton County Bear Conflict Mitigation and Prevention LDR. In addition, more work will be done to identify areas within the city limits of Jackson and Star Valley communities where better attractant management and sanitation infrastructure is needed.

The recent implementation of the Teton County Bear Conflict Mitigation and Prevention LDR has greatly reduced the amounts of available attractants on the landscape and is a tremendous step forward for the Bear Wise Jackson Hole program. The new challenges faced by the Department will be achieving full compliance with this regulation, even in years with low conflict when it may appear that the conflict issues are resolved. The Bear Wise Jackson Hole Program will convey the importance of compliance and strive to maintain public support for the LDR through public outreach and education projects. In order for the Jackson program to be successful, the program must continually identify information and education needs within the community while being adaptive to changing situations across different geographic areas. This will require the Department to coordinate with other government agencies and local non-government organizations working across multiple jurisdictions to develop a uniform and consistent message. If this level of coordination is achieved, the Department will be more effective in gaining support and building enthusiasm for Bear Wise Jackson Hole, directing resources to priority areas, and reaching all demographics.

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Information and Education

2020 Accomplishments

1) Electronic and Print Media

   a) As per Wyoming Statute, grizzly bear relocation from one county to another must be announced through local media and to the local sheriff of the county into which the bear was relocated. Each announcement is posted in a timely fashion to the web page. In 2019, 14 notifications were distributed and posted on the website.
   b) Personnel issued multiple educational news releases throughout the season informing readers and listeners of bear safety, behavior, conflict avoidance, food storage and natural food availability.

2) Grizzly Bear Management Web Page

   a) The grizzly bear management web page continues to be maintained and updated on a regular basis in order to provide timely information to the public regarding grizzly bear management activities conducted by the department. The web page contents include various interagency annual reports and updates and links to other grizzly bear recovery web sites.

3) Hunter Education

   a) Every hunter education class in Wyoming is required to discuss how to hunt safely in bear country. To assist instructors, most have been provided inert bear spray canisters for demonstration purposes and DVDs titled *Staying Safe in Bear Country, A Behavioral Based Approach to Reducing Risk.* A section on bear safety is included in the student manual. Approximately 5,000 students are certified each year.

Publications

The primary link to other publications, annual reports, and peer-reviewed literature for the Yellowstone population of grizzly bears is summarized on the U. S. Geological Survey web site: https://www.usgs.gov/science/interagency-grizzly-bear-study-team.

For information specific to the Wyoming Game and Fish Department's grizzly bear management program; including links to publications, reports, updates, and plan visit: https://wgfd.wyo.gov/wildlife-in-wyoming/more-wildlife/large-carnivore/grizzly-bear-management

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