Yellowstone Grizzly Bear Investigations 2022

Annual Report of the Interagency Grizzly Bear Study Team

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Some data contained in this report are preliminary or provisional and are subject to revision. They are being provided to meet the need for timely best science. Data in this report were collected and assembled by the consortium of the Interagency Grizzly Bear Study Team. The data are provided on the condition that neither U.S., State, nor Tribal Governments shall be held liable for any damages resulting from the authorized or unauthorized use of the data. Please obtain permission prior to citation. To give credit to authors, please cite the section within this report as a chapter in a book. Below is an example:

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YELLOWSTONE GRIZZLY BEAR

INVESTIGATIONS

Annual Report of the Interagency Grizzly Bear Study Team

2022

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

U.S. Department of the Interior

U.S. Geological Survey

2023

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

U. S. 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/wildlife-management/bear

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/

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Acronyms Used in the Report

DMA	Demographic Monitoring Area
et al.	and others
GPS	Global Positioning System
GTNP	Grand Teton National Park
GYE	Greater Yellowstone Ecosystem
GBRZ	Grizzly Bear Recovery Zone
IGBST	Interagency Grizzly Bear Study Team
IPM	Integrated Population Model
NPS	National Park Service
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WGFD	Wyoming Game and Fish Department
YCT	Yellowstone cutthroat trout
YNP	Yellowstone National Park

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 2022. Our efforts were focused on population estimation and demographic trends, in conjunction with monitoring important bear foods and habitats. This report also presents a summary of grizzly bear management actions to address conflict situations and agency outreach efforts. The information presented herein is a summary of annual data collections. Data, analyses, and summaries presented here supersede those published previously and may be subject to change contingent upon additional information, future publications, and the peer-review process.

Enhancements to Demographic Monitoring

Starting in 2017, we embarked on a multi-year effort to enhance several important aspects of our demographic monitoring program. In a report (IGBST 2021) and a subsequent publication (van Manen et al. 2022), we addressed underestimation bias in estimates of female grizzly bears with cubs-of-the-year (females with cubs) and presented generalized additive models as a flexible trend analysis technique. Another theme of this multi-year effort was devoted to development of an integrated population model (IPM) to enhance our understanding of the GYE grizzly bear population. A key advancement of IPMs is that we can integrate the full suite of demographic data we collect on an annual basis, allowing 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 variations in vital rates, thus providing managers with improved techniques for decision making. Additionally, the IPM framework may serve as a tool to examine how data collection can be streamlined or modified to increase the cost-effectiveness of the monitoring program. At the 2022 fall meeting of the Yellowstone Ecosystem Subcommittee of the Interagency Grizzly Bear Committee, we presented the latest findings of these efforts and indicated that implementation of the IPM would start with the completion of 2022 data collections. This annual report contains the inaugural version of a new section focused on reporting of population and vital rate parameters based on the IPM (see "***Population Size and Vital Rates***"). With the introduction of this section, we can now present important annual updates on the demographic parameters and rates that directly influence population size and trend over time, providing timely information to inform management and policy decisions. A manuscript detailing the IPM for the GYE grizzly bear population is being prepared at this writing.

Population Monitoring

We follow monitoring protocols and recovery criteria established in the 2017 supplement to the Grizzly Bear Recovery Plan (USFWS 2017) and as initially developed under the 2016 Conservation Strategy (Yellowstone Ecosystem Subcommittee 2016). In 2022, the Chao2 estimate based on implementation of the 16-km (kilometers) distance criterion was 60 females with cubs (see "***Estimating Number of Females with Cubs***") within the DMA, from which we estimated a total population size of 965 using the IPM, with a 95% credible interval of 819 to 1,121 bears (see "***Population Size and Vital Rates***").

Estimates of total mortality rate were 5.1% for independent-age females and 6.3% for independent-age males. Human-caused mortality rate estimates were 3.8% for dependent-age males and 2.8% for dependent-aged females. Referencing the total population estimate of 965 against mortality thresholds established in Table 2 of the 2016 Conservation Strategy (Yellowstone Ecosystem Subcommittee 2016) as updated based on the 2021 tri-state memorandum of agreement, these estimates are below the corresponding thresholds of 9%, 20%, and 9% for independent females, independent males, and dependent young, respectively.

Occupied Range

In this report, we present the bi-annual year update of our estimate of occupied grizzly bear range within the GYE (see section "***Grizzly Bear Occupied Range in the Greater Yellowstone Ecosystem, 2008–***

2022"). In combination with occupied range estimates we presented in previous annual reports, the rate of increase in occupied range is slowing. The estimate based on 2008–2022 data was 70,101 km^2, reflecting essentially no change from the previous estimate (2006–2020). The DMA, which was primarily defined by suitable habitat (Interagency Grizzly Bear Study Team 2012:42), is now 97% occupied, with large areas of occupied range extending beyond the DMA boundaries and numerous outlier observations beyond occupied range. A recently obtained outlier observation is particularly noteworthy: genetic analysis of a 2021 DNA sample from a male bear removed for cattle depredation in the foothills of the Snowy Mountains located in central Montana (east of the Northern Continental Divide Ecosystem) revealed this bear had GYE ancestry. Samples of related individuals were previously collected by IGBST near the northeastern periphery of the GYE, approximately 180 km south of its Snowy Mountains conflict location. Assuming that male bears from the Northern Continental Divide Ecosystem would be able to disperse similar distances, this observation provides evidence that genetic connectivity between the two ecosystems is currently achievable via natural movement. Given that the GYE ancestry of this individual was confirmed in 2023, this record will be entered as an outlier observation for the 2023 reporting year.

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 moths (*Euxoa auxiliaris*) sites, and 3) whitebark pine (*Pinus albicaulis*) cone production. As we noted in the 2017 Annual Report (van Manen et al. 2018), 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 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 GBRZ; also referred to as the Primary Conservation Area in the 2016 Conservation Strategy); 2) changes in number and capacity of developed sites inside the GRBZ; and 3) changes in number of commercial livestock allotments, permitted domestic sheep animal months inside the GRBZ, 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 science consortium among the U.S. Geological Survey (USGS), National Park Service (NPS), U.S. Forest Service (USFS), U.S. Fish and Wildlife Service (USFWS), 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, limits 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 grizzly bear management; 2) monitor the grizzly 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 our investment into improvements of the monitoring program and continuing collaborations with several academic institutions. The enhancements to the Chao2 estimation technique we mentioned previously were detailed in the journal *Ursus* (van Manen et al. 2022). In 2023, we published a study that addressed questions remaining from our 2013 Food Synthesis Report, namely how the body composition of grizzly bears has responded to changes in food resources and bear density during 2000–2020 (Corradini et al. 2023). An important finding from that work was that lean body mass (total body mass minus body fat) of grizzly bears was negatively related to local bear density for males and females, indicating intrinsic factors play an important role in the population as bear density increases. That relationship was particularly strong for growing-age females (< [less than] 7 years old), likely because they may experience reduced access to high-calorie foods where bear densities are high because of competition with dominant, physically mature bears. In contrast, the rate of body fat accumulation was not associated with bear density and did not change over the 2 decades, despite substantial changes in high-calorie food resources. That finding supports the notion that grizzly bears prioritize fat storage over lean body mass when allocating energy from food consumption in preparation for hibernation. An important conclusion from that work was the opportunistic omnivore strategy of grizzly bears has allowed them to make successful use of changing food resources in the ecosystem, a resilience that will be important as the ecosystem experiences further perturbations in the future. We collaborated on a study investigating the genetic architecture and evolution of color variation in American black bears, which included genetic comparisons with grizzly bears (Puckett et al. 2023). That study showed the cinnamon color morph in black bears and the characteristic brown color in brown/grizzly bears are the result of separate loss-of-function alleles that impair protein localization to melanosomes. The black bear allele arose about 9,400 years ago in the southwestern range and may provide a selective advantage. Finally, we collaborated on a study that used Global Positioning System (GPS) telemetry data from the Northern Continental Divide Ecosystem population to predict habitat use for nearby populations, including the GYE (Sells et al. 2023). Findings from that study showed high transferability of movement models across landscapes in the Northern Rocky Mountains, indicating they may be used to identify grizzly bear habitat and connectivity throughout the region to inform conservation planning.

Acknowledgments

This report is a combined effort of the partner agencies and individual members of the IGBST, and many individuals contributed directly or indirectly to its preparation. To that end, we have identified author(s). Additionally, we wish to thank the following individuals for their valuable contributions to data collection, analysis, and other phases of IGBST research. **Idaho Department of Fish and Game**: C. Anderson, J. Brower, R. Cavallaro, H. Davie, N. Dickan, J. Heald, C. Hendricks, J. Hussman, C. Johnson, M. Lee, J. Locke, E. Lowrimore, D. Newman, J. Nicholson, T. Nicholson, A. Sorensen, T. Swearingen; **Montana State University**: N. Bowersock, A. Litt, E. Loggers; **Montana Fish, Wildlife and Parks**: M. Becker, S. Brozovich, H. Burt, C. Costello, J. Cunningham, D. Fagone, K. Frey, M. Heaton, K. Kimbel, B. Lloyd, R. Pickens, R. Pohle, J. Ramsey, J. Smith, D. Scott, S. Stewart, G. Todd, M. Wemple, D. Waltee; **Yellowstone National Park**: A. Bramblett, M. Curtis, O. Dalling, K. Gunther, M. Gutt, Z. Haroldson, M. King, W. Larson, E. Reinertson, K. Schafer, P. J. White, J. Wright, T. Wyman; **Grand Teton National Park:** B. Apel, L. Apel, T. Brasington, C. Butler, M. Clark, R. Clark, S. Dewey, C. Faustman, C. Faustman, L. Fisher, T. Fisher,

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Finally, we thank Todd Atwood (USGS, Alaska Science Center) and P. J. White (NPS, Yellowstone National Park) for their reviews of an earlier draft of this report as part of the USGS's Fundamental Science Practices (https://pubs.usgs.gov/circ/1367/).

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[1], Idaho Department of Fish and Game; and Justin G. Clapp, Wyoming Game and Fish Department)*

[1] *Current affiliation: National Park Service, Denali National Park*

During the 2022 field season, we captured 84 individual grizzly bears on 100 occasions from research and management capture efforts (Table 1), including 26 females (13 adult), 55 males (35 adult) and 3 yearling bears of unknown sex (Table 1). The 3 bears of unknown sex were captured at research trap sites and released without handling.

Fifty-two (61.9%) of the 84 individual bears were not previously marked. The percent of previously unmarked individual grizzly bears captured annually has remained relatively constant during the period 1998–2022, averaging 62%, with no evidence (F = [equals] 0.252, 1 df [degrees of freedom], P [significance or probability value] = 0.621) of a change in trend (Fig. 1). This finding continues to support the interpretation that in this closed population, recruitment through reproduction is occurring at a relatively constant rate. We would expect the number of new bears encountered annually to decline if this were not the case.

We conducted research trapping for a total of 420 trap days (1 trap day = 1 trap set for 1 day). During research trapping operations, we had 60 captures of 47 individual grizzly bears with a trapping success rate of 1 grizzly bear capture for every 7.0 trap days. All research captures occurred within the Demographic Monitoring Area (DMA).

There were 40 management captures of 37 individual bears during 2022 (Tables 1 and 2), including 13 females (8 adults), and 24 males (10 adults). Sixteen of the 40 management captures (2 females, 14 males) occurred outside the DMA.

Twelve individual bears (2 females, 10 males) were relocated because of conflict situations (Table 1). A female and her 2 cubs (#1089, G279, and Unm202218) were removed after a previous management capture and relocation attempt (Table 1). In total, there were 26 management captures that resulted in removals (10 females, 16 males; Table 1). Fourteen (2 females, 12 males) of these removals occurred outside the DMA.

We radio-monitored 112 individual grizzly bears during the 2022 field season, including 53 females, 41 of which were adults (Tables 2 and 3). Seventy-one grizzly bears entered their winter dens wearing active transmitters. Since 1975, 1,081 individual grizzly bears have been radiomarked in the GYE.

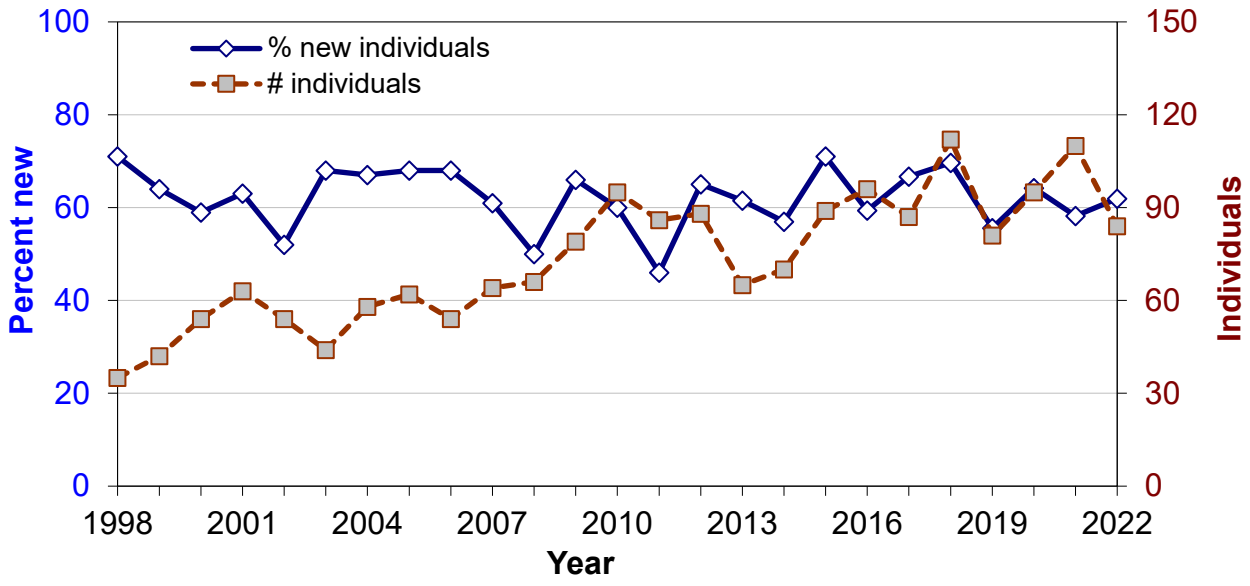

Fig. 1. Annual number of grizzly bears captured and percent previously unmarked individuals in the Greater Yellowstone Ecosystem, 1998–2022. Line colors match those of their respective axis labels.

Table 1. Grizzly bears captured in the Greater Yellowstone Ecosystem, 2022.							
Bear	**Sex**	**Age**	**Date**	**General location[a]**	**Capture type**	**Release site[b]**	**Handler[c]**
1050	Male	Adult	4/25/22	Greybull River, PR-WY	Management	Removed (202203)	WGFD
1059	Male	Adult	5/4/22	South Fork Shoshone, PR-WY	Management	Transported	WGFD
1060	Male	Adult	5/21/22	Beam Gulch, SNF	Research	On site	WGFD
1061	Male	Adult	5/21/22	Gravelbar Crk, SNF	Research	On site	WGFD
1061	Male	Adult	5/29/22	Gravelbar Crk, SNF	Research	On site	WGFD
989	Female	Adult	5/21/22	Crow Crk, CTNF	Management	Removed (202205)	IDFG
Unm202201	Male	Yearling	5/21/22	Crow Crk, CTNF	Management	Removed (202206)	IDFG
1062	Female	Adult	5/22/22	Sunlight Crk, SNF	Research	On site	WGFD
516	Male	Adult	5/24/22	Beam Gulch, SNF	Research	On site	WGFD
998	Female	Adult	5/25/22	Crow Crk, CTNF	Management	Removed (202209)	IDFG
Unm202202	Female	Yearling	5/24/22	Crow Crk, CTNF	Management	Removed (202210)	IDFG
Unm202203	Male	Yearling	5/24/22	Crow Crk, CTNF	Management	Removed (202211)	IDFG
994	Male	Adult	5/26/22	Snake River, GTNP	Research	On site	IGBST
G275	Male	Subadult	5/27/22	Ghost Crk, SNF	Research	On site	WGFD
G275	Male	Subadult	5/30/22	Ghost Crk, SNF	Research	On site	WGFD
G276	Male	Adult	5/28/22	Sunlight Crk, SNF	Research	On site	WGFD
1063	Female	Subadult	5/29/22	Pilgrim Crk, GTNP	Research	On site	IGBST
1063	Female	Subadult	6/6/22	Snake River, GTNP	Research	On site	IGBST
1064	Female	Subadult	6/3/22	Pacific Crk, GTNP	Research	On site	IGBST
1065	Female	Subadult	6/9/22	Deadman Crk, SNF	Research	On site	WGFD
1019	Male	Adult	6/17/22	Snake River, GTNP	Research	On site	IGBST
1066	Male	Adult	6/20/22	Lizard Crk, GTNP	Research	On site	IGBST
Unm202204	Female	Subadult	6/21/22	Beartooth Crk, SNF	Management	Removed (202224)	WGFD
794	Male	Adult	6/22/22	Pilgrim Crk, GTNP	Research	On site	IGBST
Unm202205	Male	Adult	6/24/22	Sheep Crk, PR-WY	Management	Removed (202225)	WGFD
940	Male	Adult	6/27/22	Henrys Fork, CTNF	Research	On site	IDFG
1067	Male	Adult	7/6/22	Howard Crk, CTNF	Research	On site	IDFG
1067	Male	Adult	7/27/22	East Dry Crk, CTNF	Research	On site	IDFG
1068	Male	Subadult	7/8/22	Wagon Crk, BTNF	Management	Transported	WGFD
G277	Male	Subadult	7/9/22	Henrys Fork, CTNF	Research	On site	IDFG
G277	Male	Subadult	7/19/22	Enget Crk, CTNF	Research	On site	IDFG
G277	Male	Subadult	8/24/22	Enget Crk, CTNF	Research	On site	IDFG
1057	Male	Subadult	7/12/22	Boulder Crk, PR-WY	Management	Removed (202226)	WGFD
Unm202206	Male	Subadult	7/13/22	Slab Crk, PR-WY	Management	Removed (202227)	WGFD
1051	Male	Subadult	7/13/22	Ingals Crk, CTNF	Research	On site	IDFG
1051	Male	Subadult	8/25/22	Ingals Crk, CTNF	Research	On site	IDFG
1069	Male	Subadult	7/16/22	East Fork Wind River, PR-WY	Management	Transported	WGFD
1070	Female	Adult	7/16/22	North Fork Fish Crk, BTNF	Research	On site	WGFD
1071	Female	Subadult	7/16/22	Red Crk, BTNF	Research	On site	WGFD
419	Male	Adult	7/16/22	Ingals Crk, CTNF	Research	On site	IDFG
1072	Female	Subadult	7/17/22	Hereford Crk, BTNF	Research	On site	WGFD
Unm202207	Unkown	Yearling	7/16/22	East Dry Crk, CTNF	Research	On site	IDFG
Unm202208	Unkown	Yearling	7/18/22	Henrys Fork, CTNF	Research	On site	IDFG
938	Male	Adult	7/19/22	Ingals Crk, CTNF	Research	On site	IDFG

Table 1. Continued.							
Bear	**Sex**	**Age**	**Date**	**General location[a]**	**Capture type**	**Release site[b]**	**Handler[c]**
1073	Female	Subadult	7/20/22	Deadman Crk, PR-MT	Research	On site	IGBST
1073	Female	Subadult	8/3/22	Deadman Crk, PR-MT	Research	On site	IGBST
1074	Male	Subadult	7/21/22	Papoose Crk, BTNF	Research	On site	WGFD
1075	Male	Adult	7/22/22	North Fork Fish Crk, BTNF	Research	On site	WGFD
1038	Female	Subadult	7/24/22	East Fork Cream Crk, CGNF	Research	On site	IGBST
1038	Female	Subadult	7/29/22	Enget Crk, CTNF	Research	On site	IDFG
1038	Female	Subadult	8/22/22	East Fork Cream Crk, CGNF	Research	On site	IGBST
1076	Female	Adult	7/24/22	Cottonwood Crk, BTNF	Research	On site	WGFD
Unm202209	Female	Adult	7/27/22	Curry Crk, PR-WY	Management	On site	WGFD
373	Male	Adult	7/30/22	Ingals Crk, CTNF	Research	On site	IDFG
1077	Male	Subadult	7/31/22	Curry Crk, PR-WY	Management	Transported	WGFD
1078	Male	Adult	8/1/22	South Fork Fish Crk, BTNF	Management	Transported	WGFD
Unm202210	Male	Subadult	8/1/22	Slab Crk, PR-WY	Management	Removed (202228)	WGFD
1079	Male	Subadult	8/7/22	Howard Crk, CTNF	Research	On site	IDFG
942	Female	Adult	8/7/22	East Dry Crk, CTNF	Research	On site	IDFG
1080	Male	Adult	8/10/22	Tepee Crk, CGNF	Research	On site	IGBST
856	Male	Adult	8/14/22	Rock Crk, CTNF	Research	On site	IDFG
1082	Female	Subadult	8/16/22	Ingals Crk, CTNF	Research	On site	IDFG
1082	Female	Subadult	8/20/22	Ingals Crk, CTNF	Research	On site	IDFG
1081	Female	Subadult	8/18/22	Yellowstone River, PR-MT	Management	Transported	MTFWP
Unm202211	Unkown	Yearling	8/18/22	Bear Crk, CTNF	Research	On site	IDFG
1083	Male	Subadult	8/20/22	Enget Crk, CTNF	Research	On site	IDFG
Unm202212	Female	Subadult	8/20/22	Tom Miner, ST-MT	Management	Removed (202229)	WS/MTFWP
1045	Male	Adult	8/21/22	Rock Crk, CTNF	Research	On site	IDFG
1084	Female	Adult	8/24/22	Tepee Crk, CGNF	Research	On site	IGBST
1085	Male	Adult	8/26/22	Stephens Crk, YNP	Research	On site	IGBST
699	Male	Adult	8/30/22	Meadow Crk, PR-WY	Management	Removed (202230)	WGFD
769	Male	Adult	8/31/22	Stephens Crk, YNP	Research	On site	IGBST
1086	Female	Adult	9/2/22	Tepee Crk, BTNF	Management	On site	WGFD
1087	Male	Adult	9/4/22	Bridge Crk, YNP	Research	On site	IGBST
1087	Male	Adult	9/5/22	Arnica Crk, YNP	Research	On site	IGBST
514	Male	Adult	9/10/22	Pacific Crk, BTNF	Management	Removed (202232)	WGFD
630	Male	Adult	9/15/22	Cascade Crk, YNP	Research	On site	IGBST
630	Male	Adult	9/17/22	Antelope Crk, YNP	Research	On site	IGBST
812	Male	Adult	9/17/22	Antelope Crk, YNP	Research	On site	IGBST
520	Male	Adult	9/19/22	Cascade Crk, YNP	Research	On site	IGBST
1088	Male	Adult	9/19/22	Sharp Crk, PR-MT	Management	Transported	MTFWP
800	Female	Adult	9/20/22	Yellowstone River, PR-MT	Management	Removed (202233)	MTFWP
Unm202213	Female	Cub	9/21/22	Yellowstone River, PR-MT	Management	Removed (202234)	MTFWP
G190	Female	Adult	9/27/22	Greybull River, PR-WY	Management	Removed (202236)	WGFD
Unm202214	Male	Cub	9/27/22	Greybull River, PR-WY	Management	Removed (202237)	WGFD
Unm202215	Male	Cub	9/27/22	Greybull River, PR-WY	Management	Removed (202238)	WGFD
Unm202216	Male	Adult	10/5/22	South Fork Shoshone, PR-WY	Management	Removed (202239)	WGFD
804	Male	Adult	10/6/22	Antelope Crk, YNP	Research	On site	IGBST

Table 1. Continued.

Bear	Sex	Age	Date	General location[a]	Capture type	Release site[b]	Handler[c]
Unm202217	Male	Adult	10/8/22	Greybull River, PR-WY	Management	Removed (202240)	WGFD
314	Male	Adult	10/12/22	Henrys Fork, CTNF	Research	On site	IDFG
1089	Female	Adult	10/17/22	Yellowstone River, PR-MT	Management	Transported	MTFWP
1089	Female	Adult	11/9/22	Middle Leigh Crk, PR-ID	Management	Removed (202242)	IDFG
G279	Male	Subadult	10/17/22	Yellowstone River, PR-MT	Management	Transported	MTFWP
G279	Male	Subadult	11/9/22	Middle Leigh Crk, PR-ID	Management	Removed (202244)	IDFG
Unm202218	Male	Subadult	10/17/22	Yellowstone River, PR-MT	Management	Transported	MTFWP
Unm202218	Male	Subadult	11/10/22	Middle Leigh Crk, PR-ID	Management	Removed (202245)	IDFG
416	Female	Adult	10/20/22	Gallatin River, PR-MT	Management	Removed (202241)	MTFWP
1090	Male	Cub	10/20/22	Gallatin River, PR-MT	Management	Transported	MTFWP
1091	Male	Cub	10/20/22	Gallatin River, PR-MT	Management	Transported	MTFWP
845	Male	Adult	12/5/22	Greybull River, PR-WY	Management	Removed (202247)	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, Crk = creek, 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 Department of 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, 1980–2022.					
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
2021	120	110	51	59	19
2022	112	84	60	40	12

Table 3. Grizzly bears radio-monitored in the Greater Yellowstone Ecosystem, 2022.						
				Monitored		
Bear	Sex	Age	Offspring	Out of den	Into den	Current status
314	M	Adult		No	No	Vehicle strike-dead
373	M	Adult		No	Yes	Active
409	F	Adult	3 yearlings, 1 lost	Yes	No	Cast[a]
419	M	Adult		No	Yes	Active
424	M	Adult		Yes	No	Cast
460	M	Adult		Yes	No	Cast
476	F	Adult	None	Yes	Yes	Active
499	F	Adult	1 cub	Yes	Yes	Active
520	M	Adult		No	Yes	Active
560	F	Adult	3 cubs	Yes	No	Cast
630	M	Adult		No	Yes	Active
639	M	Adult		Yes	No	Cast
747	F	Adult	2 cubs, 1 lost	Yes	Yes	Active
769	M	Adult		No	Yes	Active
782	M	Adult		Yes	No	Cast - killed
794	M	Adult		No	No	Cast
800	F	Adult	2 cubs, 1 lost; 1 live removal	Yes	No	Removed
804	M	Adult		No	Yes	Active
819	M	Adult		Yes	No	Cast
856	M	Adult		No	Yes	Active
864	F	Adult	2 cubs	Yes	Yes	Active
881	M	Adult		Yes	No	Cast
883	F	Adult	3 cubs	Yes	Yes	Active
886	F	Adult	1 yearling	Yes	Yes	Active
896	F	Adult	2 2-yr-olds weaned	Yes	Yes	Active
906	F	Adult	1 cub	Yes	No	Cast
908	M	Adult		Yes	Yes	Active
911	F	Adult	None	Yes	No	Probable battery failure
912	F	Adult	2 cubs	Yes	Yes	Active
913	F	Adult	3 cubs	Yes	No	Cast
938	M	Adult		No	Yes	Active
940	M	Adult		Yes	No	Cast
942	F	Adult	2 yearlings	No	Yes	Active
948	F	Adult	2 yearlings, 2 lost?	No	Yes	Active
949	F	Adult	2 yearlings	Yes	Yes	Active
952	F	Adult	1 2-yr-old, weaned	Yes	Yes	Active
953	M	Adult		Yes	No	Cast
967	M	Adult		Yes	Yes	Active
970	M	Adult		Yes	No	Cast
976	F	Adult	Not observed	Yes	No	Cast
980	F	Adult	2 cubs, 2 lost	Yes	Yes	Active
981	F	Adult	None	Yes	Yes	Active
994	M	Adult		No	Yes	Active
997	M	Adult		Yes	No	Cast
999	F	Adult	None	Yes	Yes	Active
1003	F	Adult	Not observed	No	No	Cast
1007	M	Adult		Yes	Yes	Active
1009	F	Adult	None	Yes	No	Cast
1012	F	Subadult	None	Yes	No	Cast

Table 3. Continued.

Bear	Sex	Age	Offspring	Monitored		Current status
				Out of den	Into den	
1013	F	Adult	1 cub, lost	Yes	No	Cast
1016	M	Adult		Yes	No	Cast
1018	F	Adult	None	Yes	No	Cast
1019	M	Adult		Yes	Yes	Active
1023	M	Adult		Yes	No	Cast
1025	F	Adult	None	Yes	Yes	Active
1027	F	Adult	2 2-yr-olds weaned	Yes	Yes	Active
1030	M	Adult		Yes	No	Cast
1031	F	Adult	2 cubs, 2 lost	Yes	Yes	Active
1032	F	Adult	2 cubs, 1 lost	Yes	Yes	Active
1033	M	Adult		Yes	Yes	Active
1034	F	Adult	Not observed	Yes	No	Cast
1035	F	Adult	None	Yes	Yes	Active
1038	F	Subadult	None	Yes	Yes	Active
1039	M	Adult		Yes	No	Cast
1040	M	Adult		Yes	No	Cast
1041	F	Adult	None	Yes	Yes	Active
1042	F	Adult	3 cubs, 3 lost	Yes	No	Cast
1044	F	Subadult	None	Yes	Yes	Active
1045	M	Adult		No	Yes	Active
1046	F	Subadult	None	Yes	Yes	Active
1050	M	Adult		Yes	No	Removed
1051	M	Subadult		Yes	Yes	Active
1052	M	Adult		Yes	No	Dead
1053	M	Adult		Yes	Yes	Active
1054	F	Adult	2 yearlings	Yes	Yes	Active
1055	M	Adult		Yes	No	Cast
1056	M	Subadult				Active
1057	M	Subadult		Yes	No	Cast - removed
1058	M	Subadult		Yes	No	Cast
1059	M	Adult		No	Yes	Active
1060	M	Adult		No	Yes	Active
1061	M	Adult		No	Yes	Active
1062	F	Adult	None	No	Yes	Active
1063	F	Subadult	None	No	Yes	Active
1064	F	Subadult	None	No	No	Cast
1065	F	Subadult	None	No	Yes	Active
1066	M	Adult		No	Yes	Active
1067	M	Adult		No	Yes	Active
1068	M	Subadult		No	Yes	Active
1069	M	Subadult		No	Yes	Active
1070	F	Adult	None	No	Yes	Active
1071	F	Subadult	None	No	Yes	Active
1072	F	Subadult	None	No	Yes	Active
1073	F	Subadult	None	No	Yes	Active
1074	M	Subadult		No	Yes	Active
1075	M	Adult		No	Yes	Active
1076	F	Adult	2 yearlings	No	Yes	Active
1077	M	Subadult		No	Yes	Active
1078	M	Adult		No	Yes	Active
1079	M	Subadult		No	Yes	Active
1080	M	Adult		No	Yes	Active

Table 3. Continued.

Bear	Sex	Age	Offspring	Monitored		Current status
				Out of den	Into den	
1081	F	Subadult	None	No	No	Cast
1082	F	Yearling	None	No	No	Cast
1083	M	Adult		No	Yes	Active
1084	F	Adult	Not observed	No	Yes	Active
1085	M	Adult		No	Yes	Active
1086	F	Adult	None	No	Yes	Active
1087	M	Adult		No	Yes	Active
1088	M	Adult		No	No	Cast
1089	F	Adult	2 cubs, 2 removed	No	No	Removed
1090	M	Cub		No	Yes	Active
1091	M	Cub		No	Yes	Active

[a]Includes all instances in which a radio collar was pre-programmed to drop off, the cotton spacer deteriorated, or the collar was removed by the animal.

Estimating Number of Females with Cubs *(Bryn E. Karabensh, Mark A. Haroldson, and Frank T. van Manen, U.S. Geological Survey, Interagency Grizzly Bear Study Team; and Daniel D. Bjornlie[1], Wyoming Game and Fish Department)*

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

Background

Under the 2017 Revised Demographic Criteria for the GYE, which were amended to the Grizzly Bear Recovery Plan (USFWS 1993, 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 the sizes of specific population segments to assess annual mortalities relative to population size. Here we present our 2022 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

Traditionally, we used a technique developed by Knight et al. (1995) to estimate the number of unique females with cubs and tabulate sighting frequencies for each family. An important component of the original rule set was a distance criterion of > (greater than) 30 km to distinguish sightings as belonging to unique females with cubs. Findings from Schwartz et al. (2008), however, indicated the Knight et al. (1995) rule set underestimated the number of unique females with cubs and this underestimation bias increased with increasing population size. During 2021–2022, the IGBST completed a comprehensive reassessment, using extensive simulations to evaluate a distance criterion that resulted in relatively unbiased estimates for the number of females with cubs (IGBST 2021, van Manen et al. 2022). An important outcome of the study was that a 16-km distance criterion resulted in more accurate estimates while minimizing the risk of overestimation. The IGBST started implementing this change in the rule set in 2021.

Using the number of unique females with cubs observed from aerial surveys conducted during June–August (see section "***Observation Flights***") and ground-based sightings, 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 ($\widehat{N}_{Chao2-16\,km}$) (Chao 1989, Wilson and Collins 1992, Keating et al. 2002, Cherry et al. 2007). The raw $\widehat{N}_{Chao2-16\,km}$ estimates are an important input to the newly implemented IPM.

We assess trend in the $\widehat{N}_{Chao2-16\,km}$ estimates by applying generalized additive models and first derivative values. The models are applied to 3-year moving averages of the raw $\widehat{N}_{Chao2-16\,km}$ estimates, based on recommendations from IGBST (2021:50–51) and van Manen et al. (2022), which reduces bias and increases power to detect change. 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 estimates for unique females with cubs 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).

2022 Sightings of Females with Cubs

We documented 206 verified sightings of females with cubs during 2022 in the GYE. Unlike in previous years where most observations were obtained from aerial sources, in 2022 aerial observations were about half (49%, Table 4). We differentiated 61 unique females with cubs from the 206 sightings using the Knight et al. (1995) rule set with the 16-km distance criterion. Six sightings (3%) of 5 unique females occurred outside the DMA (Fig. 2). Three of the females were only observed outside the DMA. Therefore, we identified 58 unique females with cubs inside the DMA. One of the females was observed twice inside the DMA, followed by an observation out of the DMA, with 2 more subsequent observations inside the DMA. The other female was initially observed once inside the DMA, followed with 1 observation out of the DMA. Forty-six (22%) observations from an estimated 15 unique females with cubs based on 16-km distance criterion occurred within the boundary of Yellowstone National Park (YNP).

The total number of cubs observed during initial sightings of the 61 unique females with cubs was 120 and mean litter size was 2 (Table 5). There were 16 single cub litters, 31 litters of twins, and 14 litters of triplets (Table 5). Using only the initial sightings of all

females with cubs observed within the DMA, there were a total of 114 cubs, with a mean litter size of 2.

2022 DMA Chao2

Excluding the 6 sightings (3 females) observed outside the DMA and sightings of 9 family groups based on telemetry only, which are not independent observations, we obtained 140 observations of 49 unique females with cubs (Table 6) within the DMA. Using the sighting frequencies, our estimate of the number of unique females with cubs within the DMA was $\hat{N}_{DMAChao2-16\,km} = 60$. We used this estimate as an input to the IPM (see "***Population Size and Vital Rates***").

Using generalized additive models, we applied the annual $\hat{N}_{Chao2-16\,km}$ estimates for the DMA during the period 2001–2022 (Table 6) to evaluate the trend for the female with cubs segment of the population (Fig. 3). There was no statistical evidence of population growth for 2022. Although previous studies indicated a slowing of population growth occurred starting in the early 2000s (IGBST 2012), we note that data for the period 2001–2022 continue to show statistical evidence of population growth in all but 5 years (Fig. 3).

Table 4. Method of observation for female grizzly bears with cubs sighted in the Greater Yellowstone Ecosystem, 2022.

Method of observation	Frequency	%	Cumulative %
Fixed wing aircraft–incidental	14	6.8	6.8
Fixed wing aircraft–observation flight	34	16.5	23.3
Fixed wing aircraft–telemetry flight	52	25.2	48.8
Fixed wing aircraft–ferry time	0	0	48.5
Helicopter–other researcher	1	0.5	49.0
Ground sighting	104	50.5	99.5
Trap	1	0.5	100
Total	206	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 using the Knight et al. (1995) rule set based on the 16-km distance criterion for differentiating unique females with cubs, Greater Yellowstone Ecosystem, 2020–2022.

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		
2020	72	234	17	44	10	1	139	1.93
2021	73	203	23	36	14	0	137	1.88
2022	61	206	16	31	14	0	120	1.97

Table 6. Annual Chao2 estimates for the numbers of female grizzly bears with cubs in the Demographic Monitoring Area of Greater Yellowstone Ecosystem, 2020–2022. The number of unique females observed ($\hat{N}_{Obs}$) includes those located using radio telemetry; *m* is the number of unique females observed using random sightings only and $\hat{N}_{Chao2}$ 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 ($n/\hat{N}_{Chao2}$), 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*	$n/\hat{N}_{Chao2}$
2020	72	65	32	14	98	178	1.82
2021	71	63	30	20	84	130	1.55
2022	61	49	20	17	60	140	1.65

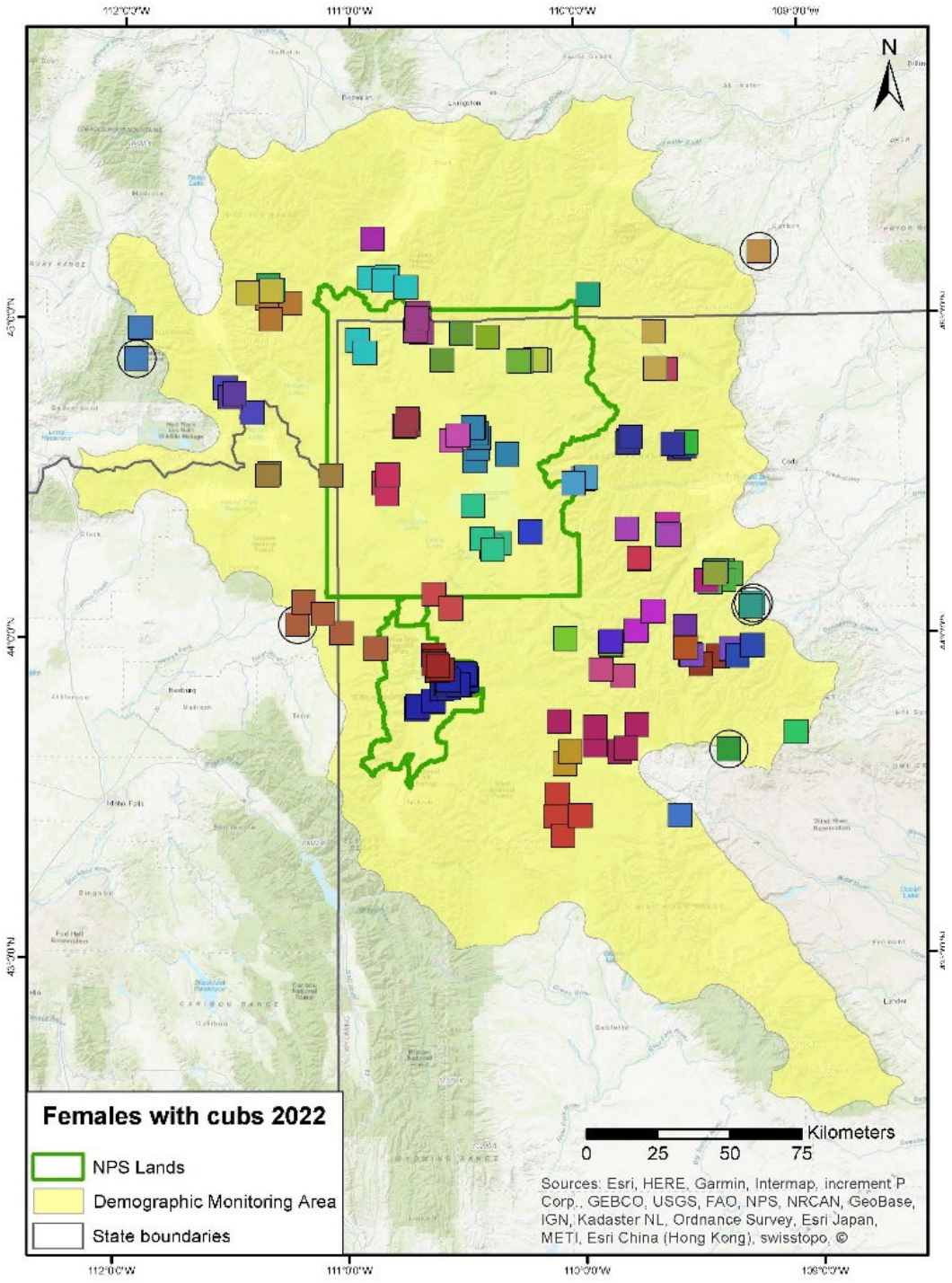

Fig. 2. Distribution of 206 sightings of 61 (indicated by colors) unique female grizzly bears with cubs observed based on the 16-km distance criterion in the Knight et al. (1995) rule set, Greater Yellowstone Ecosystem, 2022. Only sightings from females with cubs occurring within the Demographic Monitoring Area (DMA) are used for population estimation. During 2022, 6 sightings (black circles around symbols) from 5 unique females with cubs occurred outside the DMA. Three of these females were only observed outside the DMA.

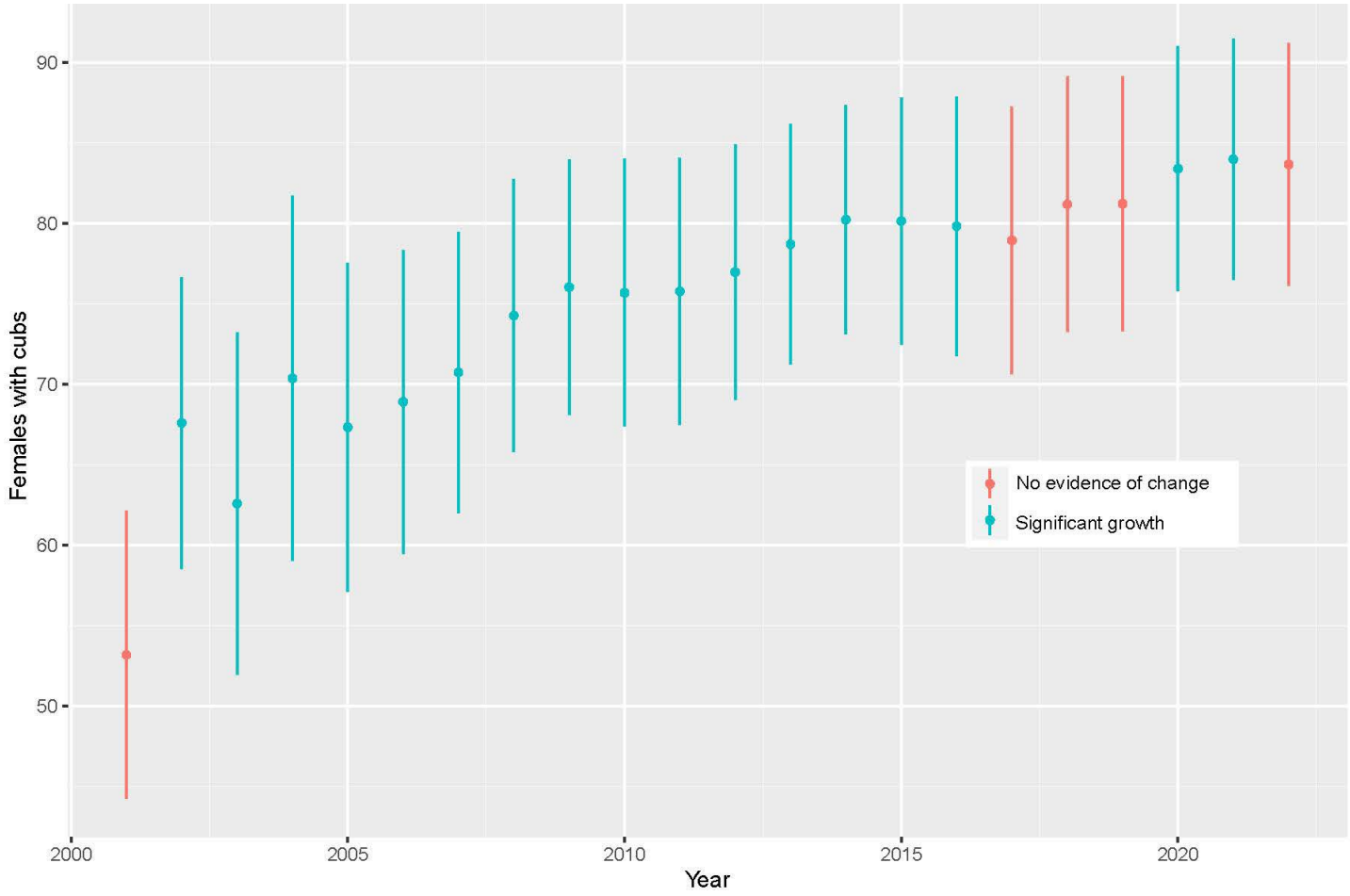

Fig. 3. Estimated number of unique female grizzly bears with cubs in the Greater Yellowstone Ecosystem, 2001–2022. Time series is based on a generalized additive model of 3-year moving averages of Chao2 estimates derived based on applying a 16-km distance criterion in the Knight et al. (1995) rule set. Estimates for each year represent the endpoint of time series data starting in 1992 (i.e., the 2001 estimate represents the endpoint of the 1992–2001 time series, the 2002 estimate is the endpoint of the 1992–2022 time series, and so on). Estimates for 2012–2022 were restricted to the Demographic Monitoring Area. Observations and standard errors in blue represent periods with statistically significant positive population growth based on first derivative values, whereas observations in red represent years without statistical evidence of growth (IGBST 2022). Estimates of females with cubs from generalized additive models are strictly for trend detection; only raw $Chao2_{16\,km}$ *estimates are used as inputs to the integrated population model.*

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 2011–2012 to consider alternative approaches. A 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 the presence of a radio-marked sample and 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 the biannual aerial surveys (see section "***Observation Flights***"). 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 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. In place of this metric, counts of females with cubs only (marked and unmarked) from independent aerial census surveys of confirmed moth sites are added to the mark-resight estimate for a given 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 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 this technique was insufficient for effective monitoring of population trend, it does produce relatively unbiased estimates. Because mark-resight estimates are used in our evaluation of IPMs, we continue to report these estimates.

2022 Mark-Resight Results

Similar to 2020 and 2021, in 2022 we were only able to conduct 1 round of observation flights and no mark-resight estimation was feasible (Tables 7–9, Fig. 4). We did not conduct moth site-only flights to count females with cubs on army cutworm moth aggregation sites during 2022.

Table 7. Data used in mark-resight analysis on female grizzly bears with cubs, Greater Yellowstone Ecosystem, 1997–2022, including number of radio-marked female grizzly bears available for sighting during observation flights (*m*), the number not sighted (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 meters 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				
2021[c]	No data for mark-resight estimation				
2022[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 8. Results from mark-resight analysis of female grizzly bears with cubs, Greater Yellowstone Ecosystem, 1997–2022. 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 meters 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			
2021[a]				No estimate			
2022[a]				No estimate			

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

Table 9. Three-year moving average for mark-resight estimates of female grizzly bears with cubs, Greater Yellowstone Ecosystem, 1998–2022. Estimates exclude females with cubs observed <500 meters 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
2019	Insufficient data for 3-year moving average					
2020	Insufficient data for 3-year moving average					
2021	Insufficient data for 3-year moving average					
2022	Insufficient data for 3-year moving average					

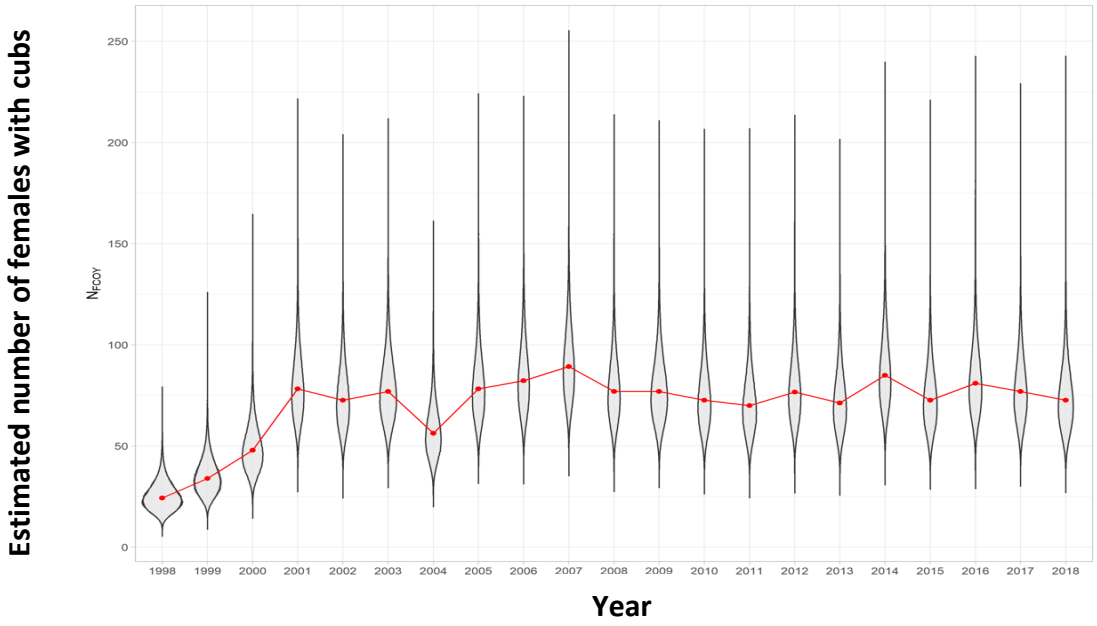

Fig. 4. Annual mark-resight estimates (3-year moving average [red dots], 95% inter quartile [gray area]) of the number of female grizzly bears with cubs (N_{FCOY}), Greater Yellowstone Ecosystem, 1998–2018. Estimates exclude females with cubs observed <500 meters from army cutworm moth aggregation sites. No mark-resight estimates were obtained in 2020, 2021, and 2022.

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

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 bear management unit (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 2022 (Table 10). Eighteen of 18 BMUs contained verified observations of females with young in at least 5 years of the last 6-year (2017–2022) period.

Table 10. 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, 2017–2022.

Bear Management Unit	2017	2018	2019	2020	2021	2022	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	X	5
Total	17	18	18	18	18	18	

Grizzly Bear Occupied Range in the Greater Yellowstone Ecosystem, 2008–2022 *(Justin A. Dellinger, Wyoming Game and Fish Department; Bryn E. Karabensh and Mark A. Haroldson, U.S. Geological Survey, Interagency Grizzly Bear Study Team)*

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 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 technique that uses all confirmed grizzly bear locations, including sightings, captures, mortalities, conflicts, and telemetry locations and observation. 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.

Bjornlie et al. (2014) recommended location data be pooled over a 15–20 year period to provide an accurate representation of grizzly bear occupied range. 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., 2008–2022 for the reported year 2022). This report is an update of the occupied range analysis presented in the 2020 IGBST annual report (Bjornlie and Haroldson 2021).

Using this technique, analyses of grizzly bear locations from 1976 through 1990 produced an estimate of GYE grizzly bear occupied range almost entirely contained within the GBRZ established in the 1993 Grizzly Bear Recovery Plan (USFWS 1993). By 2000, occupied range had grown slightly to the south and east but was still mostly contained within the GRBZ (Fig. 5). However, in the 2000s, range expansion gained momentum and larger increases were seen, particularly in mountainous terrain to the northwest and southeast of the GRBZ (Fig. 5). The addition of 2021–2022 location data resulted in inclusion of more eastern portions of the Greybull River falling within grizzly bear occupied range. Overall, there appears to be a stabilizing of grizzly bear occupied range, which may be due to the species filling out most of the suitable habitat within the GYE (Fig. 5). To provide spatial perspective, the southeastern extent of 2022 occupied range at the tip of the Wind River Range is substantially closer to the towns of Salt Lake City, Utah (294 km), and Fort Collins, Colorado (366 km), than to Bozeman, Montana (405 km) at the northern extent of grizzly bear range.

From 1990 through 2022, the area of occupied range has increased steadily at a rate of 3.7% per year from just over 23,000 km^2 in 1990 to 70,468 km^2 in 2020 (Figs. 5 and 6). The apparent stabilization in range from 2020 to 2022 (70,101 km^2) could be an indicator that grizzly bears are now occupying all the ecologically and socially suitable areas in the GYE (Fig. 6). Grizzly bear occupied range now includes 97% of the DMA and has expanded 45 km beyond the DMA boundary to the east and west and by as much as 45 km in the Wyoming Range in the southwestern portion of the GYE. The 2022 data show that 31% 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 (GTNP). By 2022, 11,402 km^2 of private lands occurred within occupied range, an area nearly 1,200 km^2 larger than YNP and GTNP and the John D. Rockefeller Parkway combined (Fig. 7). Grizzly bear 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 2021 and 2022. The location farthest beyond occupied range was a 2020 verified location in the Wyoming Range approximately 33 km north of the town of Kemmerer, Wyoming and over 100 km south of the DMA boundary. 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 and 2022 west of Interstate Highway 15 in the Pioneer Mountains and Big Hole Valley near Wisdom, Montana are located outside the Yellowstone Distinct Population Segment and likely are from bears originating from either the GYE population or the Northern Continental Divide Ecosystem 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 to reduce access to anthropogenic foods often does not exist.

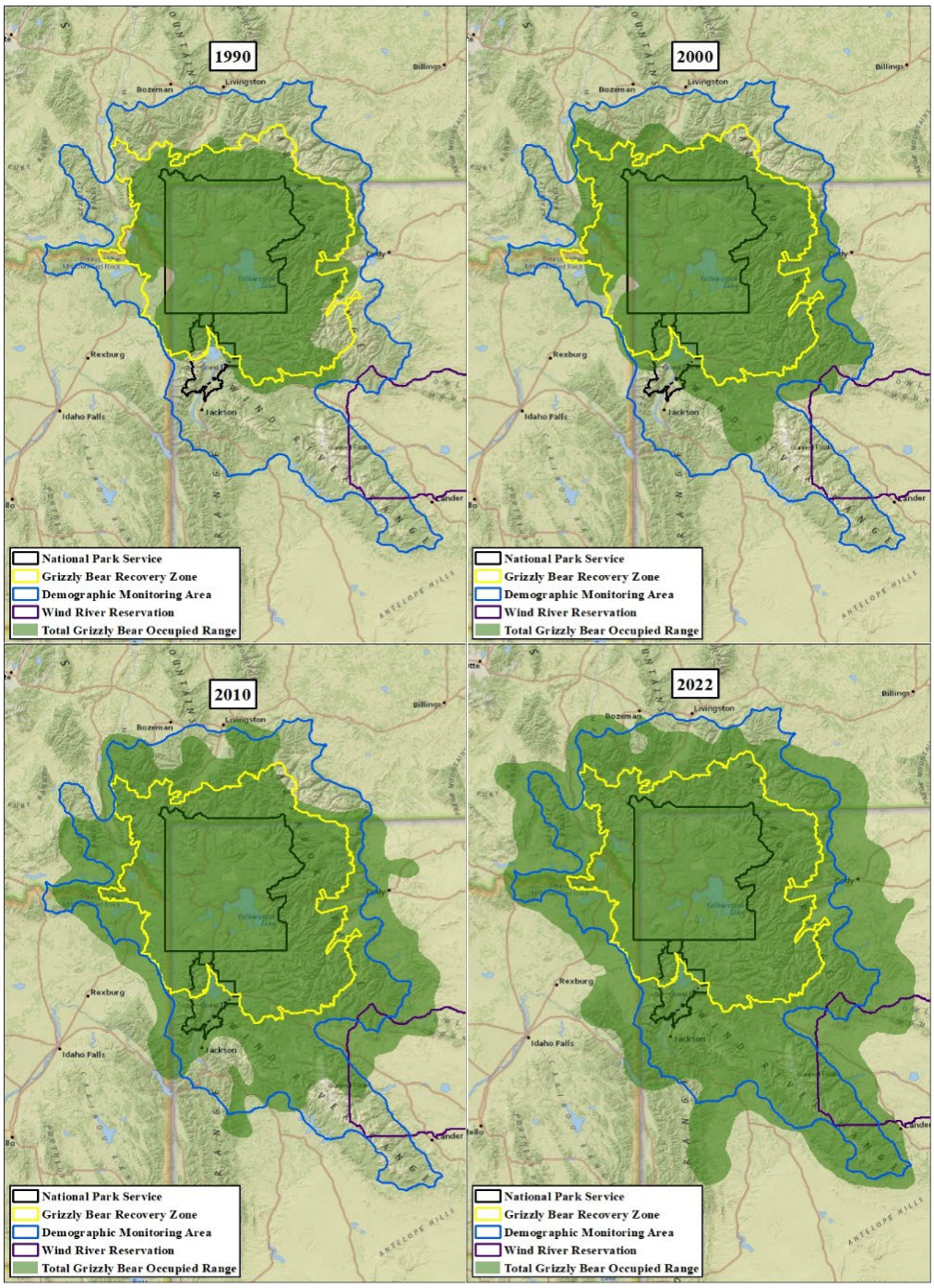

Fig. 5. Grizzly bear occupied range (green shaded area) in the Greater Yellowstone Ecosystem based on 15-year data windows ending in 1990, 2000, 2010, and 2022. Base Map Source: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

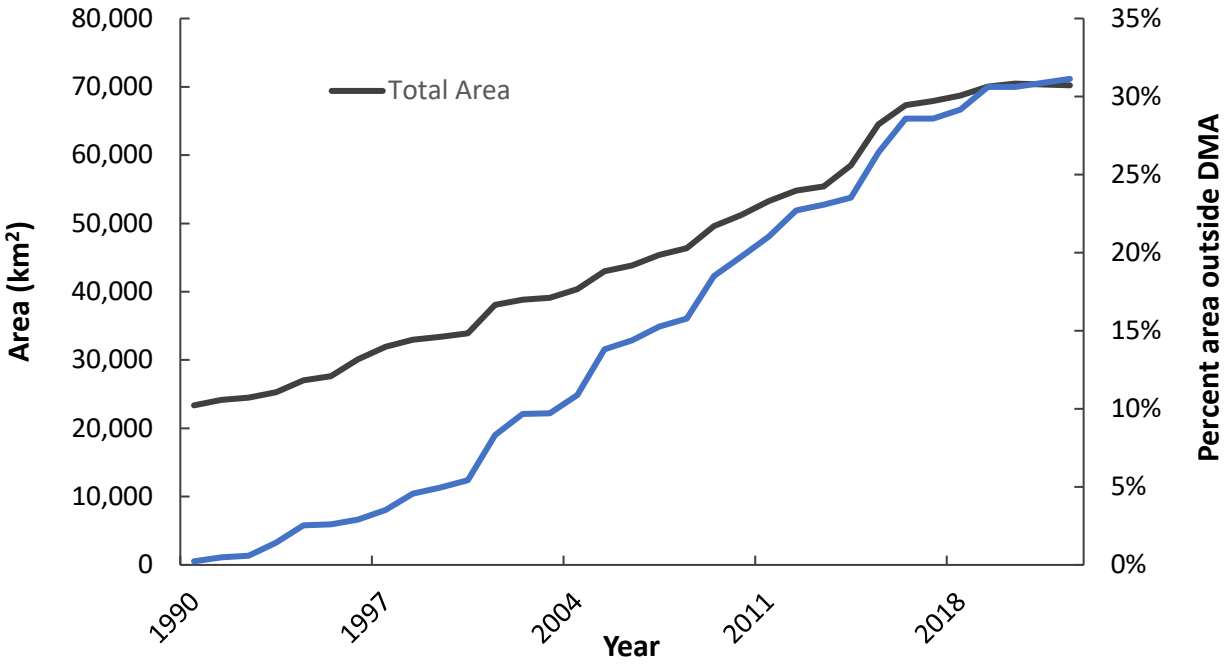

Fig. 6. Total area of grizzly bear occupied range and percent of occupied range outside the Demographic Monitoring Area (DMA) in the Greater Yellowstone Ecosystem, 1990–2022.

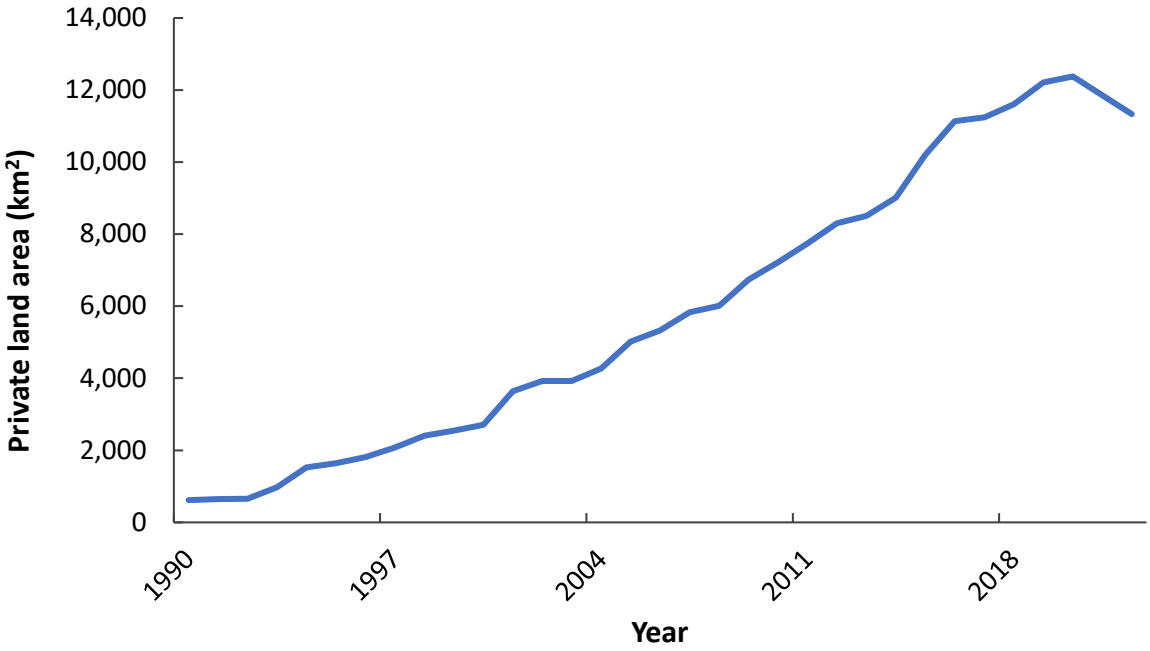

Fig. 7. Area of private land within grizzly bear occupied range in the Greater Yellowstone Ecosystem, 1990–2022.

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

Fifty-four Bear Observation Areas (Fig. 8) were established in 2014. In 2022, 1 round of observation flights was conducted: 36 BOAs were surveyed during this round (26 Jun–23 Aug). Total duration of observation flight time was 75 hours; average duration of individual flights was 2.1 hours (Table 11). Excluding dependent young, 299 bear sightings were recorded during observation flights. Of the 299 sightings, 14 were radio-marked bears (2 females with young, 7 females without young, and 5 males), 228 were solitary unmarked bears, and 57 were unmarked females with young (Table 11). Our observation rate was 4.0 bears per hour for all bears. A total of 104 young (56 cubs, 46 yearlings, and 2 2-year-olds) were observed (Table 12). Observation rates for females with dependent young were 0.8 females with young per hour and 0.4 females with cubs per hour (Table 11).

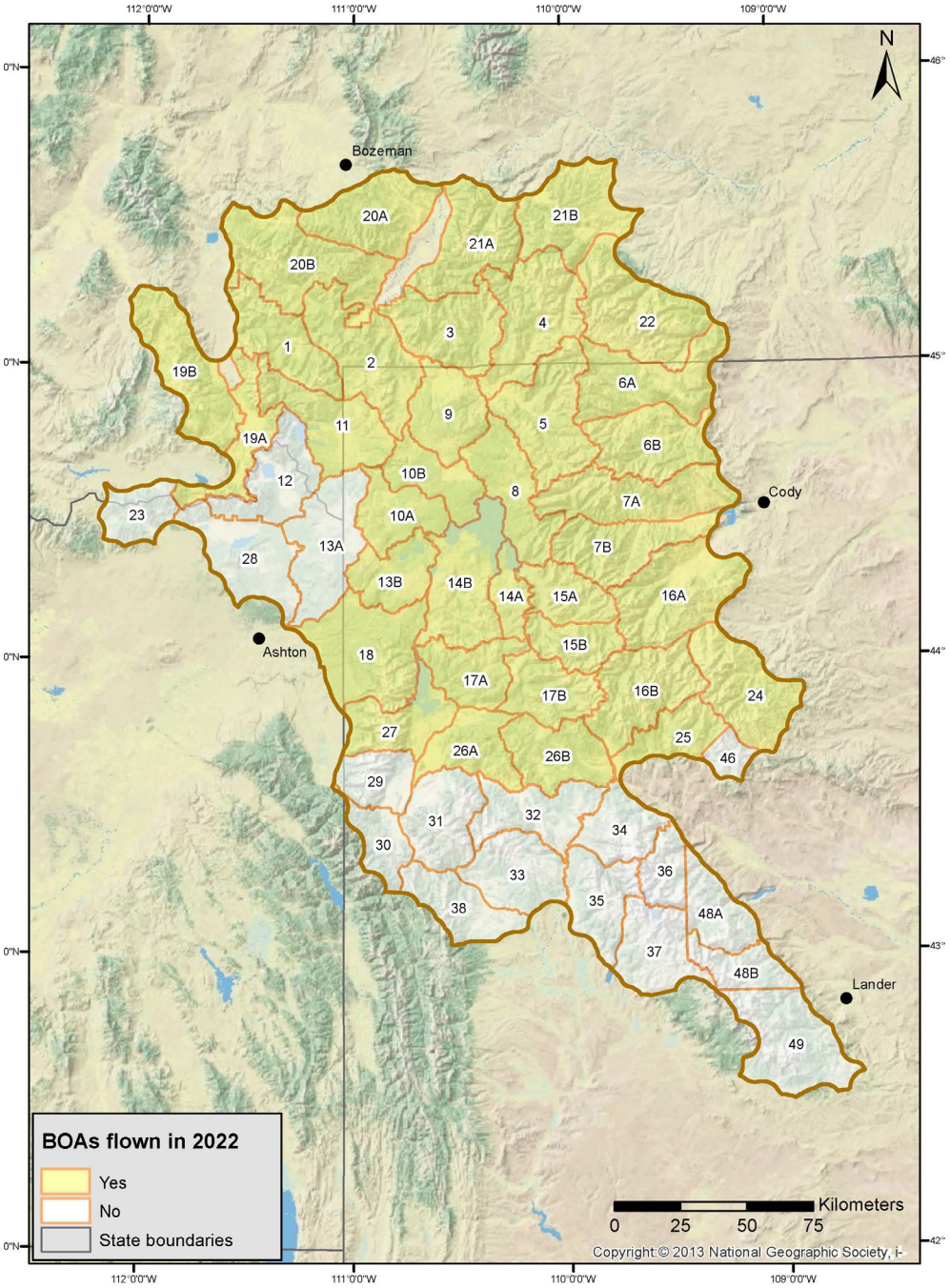

Fig. 8. Grizzly bear observation areas for aerial surveys, Greater Yellowstone Ecosystem, 2022. Areas in yellow were surveyed in 2022, areas in white shading were not surveyed. Numbers represent the 54 Bear Observation Areas (BOAs), with several larger areas split into 2 subsections (A and B). Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

Table 11. Annual summary statistics for grizzly bear observation flights, Greater Yellowstone Ecosystem, 2008–2022.

Year[a]	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				
2008	Round 1	97.6	46	2.1	2	1	87	36	126	1.3		
	Round 2	101.5	45	2.3	2	3	185	53	243	2.4		
	Total	199.1	91	2.2	4	4	272	89	369	1.9	0.5	0.2
2009	Round 1	90.3	47	1.9	1	0	85	21	107	1.2		
	Round 2	93.6	47	2.0	2	0	157	34	193	2.1		
	Total	183.9	94	2.0	3	0	242	55	300	1.6	0.3	0.2
2010	Round 1	101.1	48	2.1	0	2	93	22	117	1.2		
	Round 2	93.3	46	2.0	0	0	161	41	202	2.2		
	Total	194.4	94	2.1	0	2	254	63	319	1.6	0.3	0.2
2011	Round 1	88.9	47	1.9	2	1	153	31	187	2.1		
	Round 2	71.0	35	2.0	4	0	109	23	136	1.9		
	Total	159.8	82	1.9	6	1	262	54	323	2.0	0.3	0.2
2012	Round 1	95.4	48	2.0	4	2	178	35	219	2.3		
	Round 2	73.7	35	2.1	2	1	117	30	150	2.0		
	Total	169.1	83	2.0	6	3	295	65	369	2.2	0.4	0.2
2013	Round 1	97.0	48	2.0	2	1	152	44	199	2.1		
	Round 2	72.8	35	2.1	4	1	171	48	224	3.1		
	Total	169.8	83	2.1	6	2	323	92	423	2.5	0.6	0.4
2014	Round 1	104.0	52	2.0	2	2	170	47	221	2.1		
	Round 2	88.6	43	2.1	3	1	188	60	252	2.8		
	Total	192.6	95	2.0	5	3	358	107	473	2.5	0.6	0.3
2015	Round 1	104.0	52	2.0	4	1	126	34	165	1.6		
	Round 2	88.6	44	2.0	1	2	142	41	186	2.1		
	Total	192.7	96	2.0	5	3	268	75	351	1.8	0.4	0.2
2016	Round 1	106.8	53	2.0	5	3	133	36	177	1.7		
	Round 2	86.5	42	2.1	1	2	95	32	130	1.5		
	Total	193.3	95	2.0	6	8	228	68	307	1.6	0.4	0.2
2017[a]	Round 1	105.5	54	2.0	7	2	153	36	198	1.9		
	Round 2	79.0	40	2.0	8	2	127	36	173	2.2		
	Total	184.5	94	2.0	15	4	280	72	371	2.0	0.4	0.3
2018	Round 1	105.8	54	2.0	6	3	185	58	252	2.4		
	Round 2	73.6	40	1.8	1	1	105	35	142	1.9		
	Total	179.4	94	1.9	7	4	290	93	394	2.2	0.5	0.3
2019	Round 1	107.8	54	2.0	7	4	183	56	251b	2.3		
	Round 2	91.0	42	2.2	9	1	188	43	242c	2.7		
	Total	198.8	96	2.1	16	5	371	99	493	2.5	0.5	0.2
2020	Round 1	78.5	36	2.2	7	2	222	72	303	3.9		
	Round 2											
	Total	78.5	36	2.2	7	2	222	72	303	3.9	0.9	0.5
2021	Round 1	69.9	33	2.1	8	4	214	71	297	4.3		
	Round 2											
	Total	69.9	33	2.1	8	4	214	71	297	4.3	1.1	0.6
2022	Round 1	75.0	36	2.1	12	2	240	71	299	4.0		
	Round 2											
	Total	75.0	36	2.1	12	2	240	71	299	4.0	0.79	0.43

[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 flown); 2021 (11 Jun–15 Aug, not flown); 2022 (26 Jun-23 Aug, not flown).

[b] Includes observation of 3 cubs of the year without adult female present.

[c] Includes observation of 2 cubs of the year without adult female present.

Table 12. Size and age composition of grizzly bear family groups seen during observation flights, Greater Yellowstone Ecosystem, 2008–2022.

		No. of females with cubs by litter size			No. of females with yearlings by litter size			No. of females with 2-year-olds or young of unknown age by litter size		
Year[a]	Round	1	2	3	1	2	3	1	2	3
2008	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	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	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	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	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	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	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	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	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	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	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	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	Round 1	10	29	1	12	18	2	0	2	0
	Round 2									
	Total	10	29	1	12	18	2	0	2	0
2021	Round 1	10	21	10	9	21	3	1	0	0
	Round 2									
	Total	10	21	10	9	21	3	1	0	0
2022	Round 1	11	18	3	8	16	2	0	1	0
	Round 2									
	Total	11	18	3	8	16	2	0	1	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); 2021 (11 Jun–15 Aug, not flown); 2022 (26 Jun-23 Aug, not flown).

[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, U.S. Geological Survey, Interagency Grizzly Bear Study Team)*

We conduct telemetry flights to locate grizzly bears and, if possible, obtain visual confirmation of their status. Additionally, for females, telemetry flights allow us to document when they reproduce and the age and number of offspring. Changes in litter size over the active season provides important data for estimation of cub and yearling survival. Eighty-nine telemetry location flights were conducted during 2022, resulting in 300 hours of search time (excluding ferry time to and from airports; Table 13). Flights were conducted at least once during all months, with 73% of telemetry flights from May–November. During telemetry flights, 1,018 locations of bears equipped with radio transmitters were collected, 282 (28%) of which included a visual sighting. Eighty-one sightings of unmarked bears were also obtained during telemetry flights, including 64 solitary bears,16 adult females with cubs, and 1 adult female with yearlings. No 2-year-old bears were observed during these flights. Rate of observation for all unmarked bears (i.e., bears without radio transmitters) during telemetry flights was 0.27 bears per hour, and 0.94 bears per hour for marked bears. The observation rate during telemetry flights for unmarked adult females with cubs was 0.05 females with cubs per hour.

To reduce flight time and costs associated with aerial telemetry and obtain higher-frequency data, we began deploying satellite 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. We deployed 36 Iridium GPS collars in 2022 and monitored an additional 27 GPS collars that were deployed in previous years. We obtained over 148,650 GPS locations from the 63 individual grizzly bears we monitored.

Table 13. Summary statistics for radio-telemetry flights to locate grizzly bears, Greater Yellowstone Ecosystem, 2022.

				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	12.5	3	4.2	68	0	---	0	0	0	0	---	---
Feb	8.1	2	4.1	57	0	---	0	0	0	0	---	---
Mar	19.0	5	3.8	125	3	0.2	1	0	0	0	0.05	---
Apr	31.7	7	4.5	105	26	0.8	0	0	0	0	---	---
May	33.0	8	4.1	88	56	1.7	3	0	0	0	0.09	---
Jun	31.5	7	4.5	81	50	1.6	13	0	0	0	0.41	---
Jul	33.1	10	3.3	87	46	1.4	43	7	1	0	1.54	0.21
Aug	29.8	8	3.7	78	37	1.2	3	5	0	0	0.27	0.17
Sep	26.0	6	4.3	78	35	1.3	1	3	0	0	0.15	0.12
Oct	29.5	8	3.7	72	18	0.6	0	1	0	0	0.03	0.03
Nov	33.9	9	3.8	113	11	0.3	0	0	0	0	---	---
Dec	11.6	4	2.9	66	0	---	0	0	0	0	---	---
Total	299.7	77	46.9	1018	282	0.94	64	16	1	0	0.27	0.05

Documented Grizzly Bear Mortalities *(Matthew J. Gould, Mark A. Haroldson, U.S. Geological Survey, Interagency Grizzly Bear Study Team; and Jeremiah Smith, Montana Fish, Wildlife and Parks)*

Under the 2017 Revised Demographic Criteria for the GYE, which were amended to the Grizzly Bear Recovery Plan (USFWS 1993, 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 known and probable mortalities for independent-age (≥2 years old) females and independent-age males and estimating unknown/unreported mortalities (Cherry et al. 2002). We used these data as input for the IPM to 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 human-caused mortality but do not include estimates of unknown/unreported mortality. Here, we report numbers of known and probable mortalities in the GYE and numbers by sex and age class inside and outside 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.

2022 Mortality Results

We documented 48 known and probable mortalities in the GYE during 2022, of which 2 (Table 14, #202201, #202202) were estimated to have died prior to 2022. Of the 46 known and probable mortalities for bears that died during 2022, 10 (#202215, #202216, #202218, #202219, #202220, #202221, #202222, #202223, #202231, and #202348) remain under investigation by USFWS and state law enforcement agencies. Specific information related to these mortalities cannot be provided (Table 14, Fig. 9). However, these 10 mortalities are included in the following summaries of all documented mortalities for bears that died during 2022.

Forty of the 46 known and probably mortalities during 2022 were attributed to human causes. Among these 40, 6 (15%) were due to management removals for livestock depredations. Twenty (50%) were related to anthropogenic site conflicts. Six (15%) of the 40 human-caused mortalities were the result of reported self-defense kills: 3 from hunting-related incidents (including 1 female accompanied by 1 cub) and 3 from hiking-related incidents (including 1 female accompanied by 3 cubs, which resulted in 3 additional mortalities for humane removal concerns [7.5%]). Other human-caused mortalities included 3 (7.5%) from mistaken identity kills by black bear hunters and 2 (5%) mortalities from vehicle strikes.

We documented 7 natural mortalities in 2022 (Table 14). Six of those bears were killed by another bear, including 2 cubs, 1 subadult, and 3 adults. One of the natural mortalities (#202217, Table 14) involved a marked female found dead in the Crooked Creek drainage of Wyoming in June. It was determined to be of natural causes, but no indication of specific cause was evident. There were 9 probable mortalities of cubs from 6 different radio-marked females who lost 1 to 3 cubs each. We did not document any possible mortalities during 2022 (Table 14).

Of the 46 known and probable documented mortalities occurring in 2022, 29 (63%) occurred within the boundaries of the DMA and 17 (37%) occurred outside (Table 15, Fig. 9). During 2022, we documented 11 mortalities of independent-age female bears within the DMA (Table 15). There were 6 management removals, 0 radio-marked mortalities, and 5 reported mortalities (Table 16). Nine known and probable mortalities of independent-age males occurred within the DMA (Table 15). We documented 2 management removals, 2 radio-marked mortalities, and 5 reported losses of independent-age males within the DMA (Table 15). There were 7 known or probable human-caused mortalities of dependent young documented in the DMA during 2022 (Table 16). The human-caused mortality rate was 3.8% for dependent-age males and 2.8% for dependent-age females.

Specific information pertaining to closed mortality investigations since 2015 will be updated on the 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.

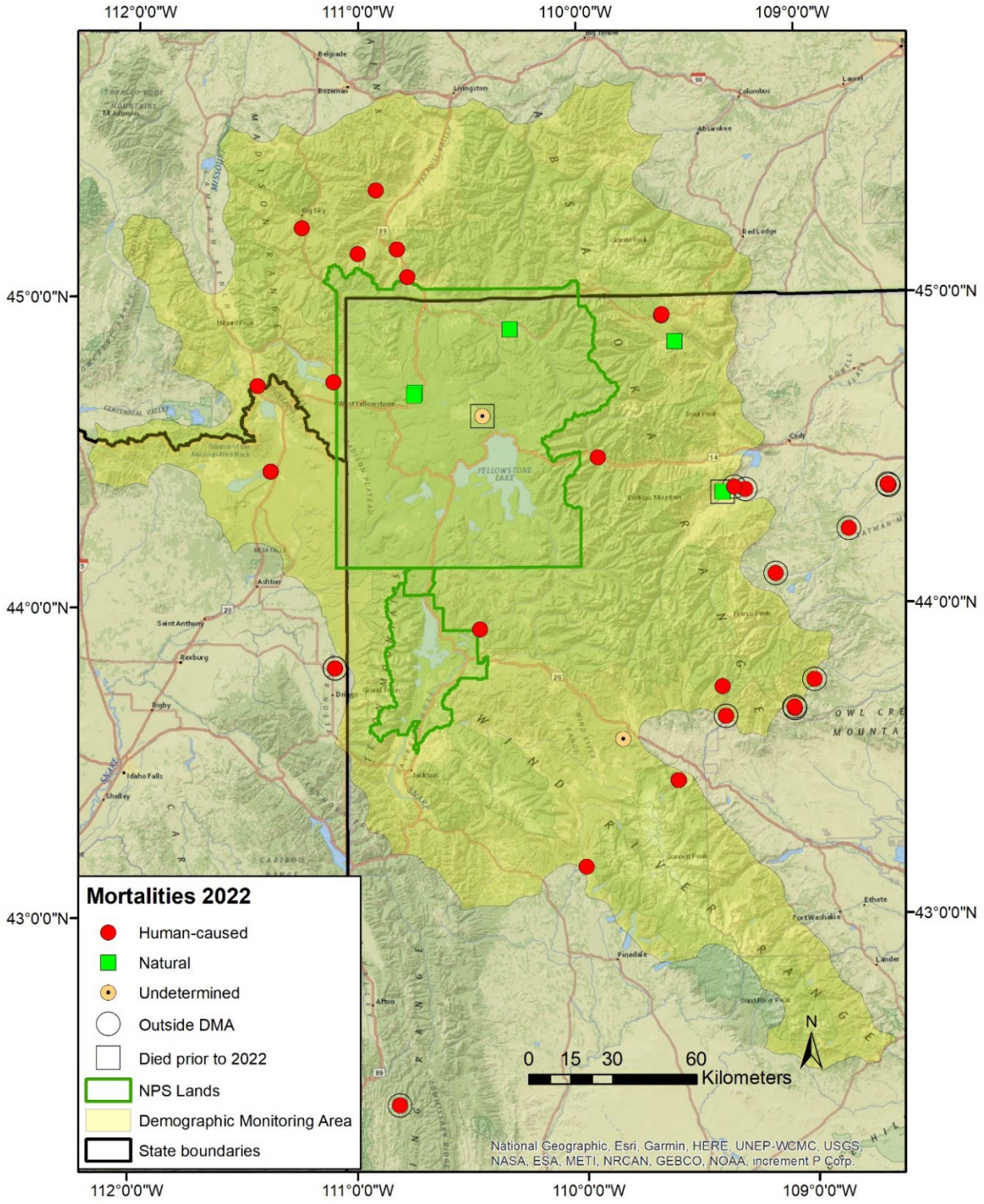

Fig. 9. Distribution of 48 known and probable grizzly bear mortalities documented in the Greater Yellowstone Ecosystem during 2022, including 2 mortalities that occurred prior to 2022 (black squares around symbols). Twenty-nine of the documented mortalities in 2022 were within the Demographic Monitoring Area (DMA), of which 23 were attributed to human causes. Seventeen mortalities in 2022 were 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 48 locations are visible on this map. Base map source: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, MRCAN, GEBCO, COALL, increment P Corp.

Table 14. Grizzly bear mortalities documented in the Greater Yellowstone Ecosystem, 2022.								
Unique #	**Bear[a]**	**Sex[b]**	**Age[c]**	**Date**	**Location[d]**	**Monitoring Area[e]**	**Certainty**	**Notes**
202201	Unm	Unk	Adult	Spring 2021	South Fork Shoshone River, PR-WY	Inside DMA	Known	Natural cause; evidence suggests killed by another bear, remains found by person looking for deer antlers.
202202	589	M	Adult	Spring 2021	Yellowstone River, YNP	Inside DMA	Known	Undetermined cause; remains of bear #589 found by NPS employee February 2022, likely died Spring 2021.
202203	1050	M	Adult	4/25/2022	Greybull River, PR-WY	Outside DMA	Known	Human cause; management capture and removal of bear #1050 for cattle depredations. Bear had an active collar.
202204	925	M	Adult	5/5/2022	Reef Crk, SNF-WY	Inside DMA	Known	Natural cause; old adult male #925 in poor condition killed by another bear. Bear was not collared at time of death.
202205	989	F	Adult	5/21/2022	Crow Crk, CTNF-ID	Inside DMA	Known	Human caused; management capture and removal of bear #989 for numerous site related conflicts, food rewards and aggressive behavior. Bear was not collared when removed.
202206	Unm	M	Yearling	5/21/2022	Crow Crk, CTNF-ID	Inside DMA	Known	Human cause; management capture and removal of yearling offspring of bear #989 for numerous site-related conflicts, food rewards and aggressive behavior.
202207	Unm	M	Subadult	5/22/2022	Obsidian Crk, YNP	Inside DMA	Known	Natural cause; killed by an adult male with a female (mating pair). Subadult was unmarked.
202208	1052	M	Adult	5/14/2022	Crystal Crk, YNP	Inside DMA	Known	Natural cause; bear #1052 was killed by another bear. Bear had an active collar at time of death, but discovery was by the public.
202209	998	F	Adult	5/25/2022	Crow Crk, CTNF-ID	Inside DMA	Known	Human cause; management capture and removal of bear #998 for numerous site related conflicts, Bear was not rewards and aggressive behavior. Not collared when removed.
202210	Unm	F	Yearling	5/25/2022	Crow Crk, CTNF-ID	Inside DMA	Known	Human cause; management capture and removal of bear Unm202202 (#998's yearling) for numerous site-related conflicts, food rewards and aggressive behavior. Bear was not collared when removed.
202211	Unm	M	Yearling	5/25/2022	Crow Crk, CTNF-ID	Inside DMA	Known	Human cause; management capture and removal of bear Unm202203 (#998's yearling) for numerous site-related conflicts, food rewards and aggressive behavior. Bear was not collared when removed.

Table 14. Continued.

Unique #	Bear[a]	Sex[b]	Age[c]	Date	Location[d]	Monitoring Area[e]	Certainty	Notes
202212	Unm	M	Cub	5/28/2022	Gibbon River, YNP	Inside DMA	Known	Natural cause; 1st of 2 cubs of female #980's killed by another bear.
202213	Unm	Unk	Cub	5/28/2022	Gibbon River, YNP	Inside DMA	Known	Natural cause; 2nd of 2 cubs of female #980's killed by another bear.
202214	782	M	Adult	5/28/2022	Timber Crk, CTNF-ID	Inside DMA	Known	Human cause; #782 mistaken identity kill by black bear hunter in ID. Bear was not collared when killed
202215				2022	WY	Inside DMA	Known	UNDER INVESTIGATION
202216				2022	WY	Outside DMA	Known	UNDER INVESTIGATION
202217	612	F	Adult	6/2/2022	Crooked Crk, PR-WY	Inside DMA	Known	Natural cause; bear #612 found dead from natural causes. Bear was not collared at time of death.
202218				2022	WY	Outside DMA	Known	UNDER INVESTIGATION
202219				2022	WY	Outside DMA	Probable	UNDER INVESTIGATION
202220				2022	WY	Inside DMA	Known	UNDER INVESTIGATION
202221				2022	WY	Inside DMA	Known	UNDER INVESTIGATION
202222				2022	WY	Inside DMA	Known	UNDER INVESTIGATION
202223				2022	WY	Inside DMA	Known	UNDER INVESTIGATION
202224	Unm	F	Subadult	6/21/2022	Beartooth Crk, SNF-WY	Inside DMA	Known	Human cause; management capture and removal for food-conditioned behavior and being fed by people from vehicles multiple times.
202225	Unm	M	Adult	6/24/2022	Sheep Crk, PR-WY	Outside DMA	Known	Human cause; management capture and removal for cattle depredation.
202226	1057	M	Subadult	7/12/2022	Boulder Crk, PR-WY	Inside DMA	Known	Human cause; management capture and removal due to safety concerns for exhibiting bold behavior, frequenting residential areas, and actively seeking and gaining access to human foods. Bear was not collared when removed.
202227	Unm	M	Subadult	7/13/2022	Slab Crk, PR-WY	Outside DMA	Known	Human cause; management capture and removal for sheep depredation.

Table 14. Continued.

Unique #	Bear[a]	Sex[b]	Age[c]	Date	Location[d]	Monitoring Area[e]	Certainty	Notes
202228	Unm	M	Subadult	8/1/2022	Slab Crk, PR-WY	Outside DMA	Known	Human cause; management capture and removal for sheep depredation.
202229	Unm	F	Subadult	8/19/2022	Tom Miner Crk, ST-MT	Inside DMA	Known	Human cause; management capture and removal for cattle depredation.
202230	699	M	Adult	8/30/2022	Meadow Crk, PR-WY	Outside DMA	Known	Human cause; management capture and removal for cattle depredation. Number 699 was probably tattoo match. Certainty pending DNA results. Bear was not collared when removed.
202231				2022	WY	Inside DMA	Known	UNDER INVESTIGATION
202232	514	M	Adult	9/10/2022	Pacific Crk, BTNF-WY	Inside DMA	Known	Human cause; management capture and removal for food-conditioned behavior. Observed entering camps nightly and previously captured and relocated from the same area for conflict activity in camps. Bear was not collared when removed.
202233	800	F	Adult	9/20/2022	Yellowstone River, PR-MT	Inside DMA	Known	Human cause; management capture and removal of bear #800 for habituation, property damage, depredations, and human safety concerns. Bear was wearing an active collar when removed.
202234	Unm	F	Cub	9/21/2022	Yellowstone River, PR-MT	Inside DMA	Known	Human cause; management capture and live removal to zoo of bear Unm (single cub of #800) for habituation, property damage, depredations, and human safety concerns.
202235	Unm	M	Adult	9/20/2022	Hyalite Creek, CGNF-MT	Inside DMA	Known	Human cause; self-defense kill by two archery hunters.
202236	G190	F	Adult	9/27/2022	Greybull River, PR-WY	Outside DMA	Known	Human cause; management capture and removal of bear G190 with 2 cubs (Morts #202237 and #202238) for bold behavior and nuisance activity in agricultural fields. Bear was not collared at time of removal.
202237	Unm	M	Cub	9/27/2022	Greybull River, PR-WY	Outside DMA	Known	Human cause; management capture and removal (1st of 2 cubs of G190) for bold behavior and nuisance activity in agricultural fields.
202238	Unm	M	Cub	9/27/2022	Greybull River, PR-WY	Outside DMA	Known	Human cause; management capture and removal (2nd of 2 cubs of G190) for bold behavior and nuisance activity in agricultural fields.

Table 14. Continued.

Unique #	Bear[a]	Sex[b]	Ag[c]	Date	Location[d]	Monitoring Area[e]	Certainty	Notes
202239	Unm	M	Adult	10/5/2022	South Fork Shoshone River, PR-WY	Outside DMA	Known	Human cause; management capture and removal for property damage, poultry depredation, and obtaining livestock feed.
202240	Unm	M	Adult	10/8/2022	Greybull River, PR-WY	Outside DMA	Known	Human cause; management capture and removal for bold behavior and nuisance activity in agricultural fields.
202241	416	F	Adult	10/21/2022	Gallatin River, PR-MT	Inside DMA	Known	Human cause; management capture and removal for nuisance activity and obtaining food rewards, 2 cubs (#1090 and #1091) relocated. Bear was not collared.
202242	314	M	Adult	10/23/2022	Madison River, CGNF-MT	Inside DMA	Known	Human cause; vehicle strike of adult male. Bear was collared.
202243	1089	F	Adult	11/9/2022	Middle Leigh Creek, PR-ID	Outside DMA	Known	Human cause; management removal of bear #1089 with 2 cubs (G279 and Unm202218; mortality #202244 and #202245, respectively) for frequenting the vicinity of residences and public safety concerns.
202244	G279	M	Cub	11/9/2022	Middle Leigh Creek, PR-ID	Outside DMA	Known	Human cause; management removal of bear G279 (1st of 2 cubs of #1089) for frequenting the vicinity of residences and public safety concerns.
202245	Unm	M	Cub	11/10/2022	Middle Leigh Creek, PR-ID	Outside DMA	Known	Human cause; management removal of bear Unm202218 (2nd of 2 cubs of #1089) for frequenting vicinity of residences and public safety concerns.
202246	Unm	Unk	Adult	Fall 2022	Yellowstone River, PR-MT	Inside DMA	Probable	Assumed human cause; potential vehicle strike. Bear was observed on trail camera dragging hind legs likely due to a broken spine.
202247	845	M	Adult	12/5/2022	Greybull River, PR-WY	Outside DMA	Known	Human cause; management capture and removal for crop damage, beehive damage, and nuisance activity in agricultural areas. Bear was not collared.
202248				2022	WY	Inside DMA	Known	UNDER INVESTIGATION

[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 15. Counts of documented known and probable grizzly bear mortalities that occurred in 2022 by sex, age class, and location relative to the Demographic Monitoring Area (DMA), Greater Yellowstone Ecosystem.

Area	Sex	Age class		Total
		Dependent (<2 years old)	Independent (≥2 years old)	
Inside DMA	Female	3	11	14
	Male	5	9	14
	Unknown	1	0	1
	Total	9	20	29
Outside DMA	Female	0	3	3
	Male	4	9	13
	Unknown	1	0	1
	Total	5	12	17

Table 16. Mortality statistics by population segment for grizzly bears in the Demographic Monitoring Area , Greater Yellowstone Ecosystem, 2022.

Population segment	Human-caused mortality	Sanctioned removals	Radio-marked mortality	Reported mortality	Estimated reported + unreported mortality[a]
Dependent young	7	--	--	--	--
Independent females (≥2 years old)	10[b]	6	0	5	15
Independent males (≥2 years old)	6	2	2	5	15

[a] Unknown, unreported mortality estimated based on Cherry et al. (2002); estimates are derived from reported mortality counts and an estimate of the reporting rate developed from mortalities of radio-marked bears over the period 1983–2022. This estimate is not the summation of human-caused mortality, sanctioned removals, radio-marked mortality, and reported mortality.

[b] Includes one probable mortality where the unknown sex of the bear was randomly generated and assigned as female.

Population Size and Vital Rates *(Matthew J. Gould, Frank T. van Manen, and Mark A. Haroldson, U.S. Geological Survey, Interagency Grizzly Bear Study Team; Justin G. Clapp, Justin A. Dellinger, Dan Thompson, Wyoming Game and Fish Department; and Cecily M. Costello, Montana Fish, Wildlife and Parks)*

Background

Starting in 2017, the IGBST began investigating the merits of an IPM to estimate and monitor vital rates and population abundance of grizzly bears in the GYE. Traditionally, our population modeling first derived estimates of demographic vital rates such as survival and fecundity from a sample of radio-marked individuals. These vital rates were then used in a projection or matrix model to estimate population trend. With the addition of other count data, such as estimates for numbers of females with cubs, we produced estimates of total population size (IGBST 2012). Uncertainty associated with each component was difficult to propagate throughout the process, and confidence bounds for estimates of total population size were underestimated. Because there are separate estimation processes for each parameter, interruptions in data collection for any one process could affect the ability to estimate other parameters. Additionally, preparing data sets for estimating various demographic parameters was time and labor intensive, which is why we previously only reported vital rates and population trends periodically (i.e., 1983–2001 [Schwartz et al. 2006], 2002–2011 [IGBST 2012]).

The enhanced analytical capabilities of the IPM offer important advancements to our demographic monitoring program. Collection of rigorous, long-term data has always been a key strength of the IGBST, and analytical advances now allow us to fully integrate those robust data collections. Implementation of the IPM enables us to annually update vital rates and other demographic parameters relevant to Chapter 2 of the 2016 Conservation Strategy.

Integrated Population Model

With recent advances in analytics and data collections in the field of wildlife science, more unified approaches allow consolidation of independent sources of data and analyses into a single, joint analysis. Based on Bayesian inference (where available knowledge about parameters in a statistical model is updated with information in observed data), this union is realized in the IPM by simultaneously linking population-level count data with individual-based survival and reproductive data, through what is termed a "state-space model." A state-space model is composed of process and observation submodels, with the former describing the true state of the population over time and the latter linking temporal changes of the population with observation data. The process submodel is a population projection matrix model whereby annual abundance is a function of abundance and population survival and fecundity rates in the preceding year. The observation data (i.e., the population count data) are conditional on the ecological process and it is assumed that changes in the observation data (affected by some degree of observation error) track changes in population abundance. The addition of the population count data provides two benefits: 1) direct information on population abundance over time; and 2) indirect information on survival and productivity because these parameters inherently control population abundance. Because of limited demographic information provided by count data, additional information is needed to estimate survival and reproduction through analyses specific to each demographic parameter. By combining count, survival, and reproduction data into a single analysis, more information is available in the estimation of the parameters shared among the state-space, survival, and reproduction submodels.

Implementation of the IPM within IGBST's population monitoring program provides multiple benefits. First, because several parameters are linked across multiple submodels, there is more information available for the estimation process, resulting in what is termed "self-consistent estimates." This refers to the notion that within the IPM analytical framework, estimates from different data sources must reconcile with one another, which generally leads to greater precision and accuracy of estimates. The IPM framework improves our ability to annually update demographic parameters and assess and understand changes in population structure over time. Moreover, because of the inherent flexibility of an IPM, it can accommodate a variety of data collected over different time periods, including interruptions in efforts, and make better use of IGBST's extensive data collections. This flexibility also allows us to modify monitoring protocols and harness future analytical and technological advancements.

The IPM for the GYE grizzly bear population was developed by researchers at the University of Montana and SpeedGoat Wildlife Solutions, an independent research group, in conjunction with members of the IGBST. The IPM is composed of survival, reproduction, and state-space submodels, each incorporating data from the monitoring program. Telemetry and observation flight data inform a known-fate survival model for independent-age (≥2 years old)

bears. A joint reproduction and survival model is used to estimate survival of dependent-age (<2 years old) bears, and the number of cubs born is estimated based on observed litter size data and the number of adult females expected to give birth (Haroldson et al. 2006, Schwartz et al. 2006, Schwartz and White 2008, IGBST 2012). The latter parameter is based on data from annual ground observations and standardized aerial surveys to estimate the total number of females with cubs in the DMA, based on the $Chao2_{16\ km}$ estimator (Knight et al. 1995; Keating et al. 2002; Cherry et al. 2007; Schwartz et al. 2008; IGBST, 2012, 2021). Data from the aerial observation flights are also analyzed within a mark-resight framework as a second annual estimate of the total number of females with cubs (Higgs et al. 2013). With ancillary data on the annual probability of females transitioning among reproductive states (no offspring, cubs, yearlings, 2-year-old offspring), the total number of adult females can be estimated. Combined with estimates of survival for each population segment, abundance of all remaining cohorts is estimated to obtain annual estimates of total population abundance and population growth. Finally, known, probable, and estimated unknown/unreported mortality data (Cherry et al. 2002) collected since 1983 serve as additional population count data, providing information on the abundance of independent-age male and non-reproductive female population segments. We report estimates of vital rates for adults (≥3 years old), subadults (2 years old), yearlings (1 year old), and cubs (<1 year old), along with estimates of population size and growth rates during 1983–2022.

Vital Rates

Over the 1983–2022 period, median survival rates (median [95% credible interval]) were highest for adult females (0.95 [0.94–0.96]) and adult males (0.95 [0.93–0.96]) followed by subadult females (0.92 [0.91–0.94]) and subadult males (0.90 [0.88–0.92]; Fig. 10). As expected, survival rates for dependent-age bears were lower than independent-age bears: survival for yearling males (0.66 [0.07–0.99]) was slightly higher than yearling females (0.58 [0.05–0.98]) with cub survival lower than yearling survival for both male and female cubs (0.51 [0.13–0.90]; the IPM assumes cub survival for both sexes is equal). Cohort-specific survival rates were similar to those reported by Schwartz et al. (2006) and IGBST (2012) and followed a similar pattern with higher survival rates as individuals reach prime age classes. The male to female sex ratio was approximately equal (i.e., 1.0:1.0). Median proportion of adult females with cubs was 0.29 (0.26–0.30) and median litter size was 2.49 (2.01–3.01) cubs per female (Table 17).

Population Size, Growth Rate, and Mortality Rates

Estimated total abundance at den emergence in 2022 was 965 (819–1,121) individual grizzly bears in the DMA (Figs. 11 and 12). The median population growth rate from 2021 to 2022 was $\lambda = 1.03$ (0.91–1.17), a 3% growth from one year to the next (Fig. 12; Table 17). Decadal growth rates were 3.0% during the 1980s, 5.8% in the 1990s, 2.3% in the 2000s, and 0.9% in the 2010s (Fig. 12). Total mortality rate estimates for 2022 were higher for independent-age males (6.3%) compared with independent-age females (5.1%). We note these estimates of total mortality are obtained through the unified framework of the IPM and are not directly comparable to estimates of total mortality rates for years prior to implementation of the IPM. We now report IPM-based estimates of total mortality because these estimates must be self-consistent with other monitoring data that direct or indirect inform these estimates, thus providing a more robust estimation of overall mortality.

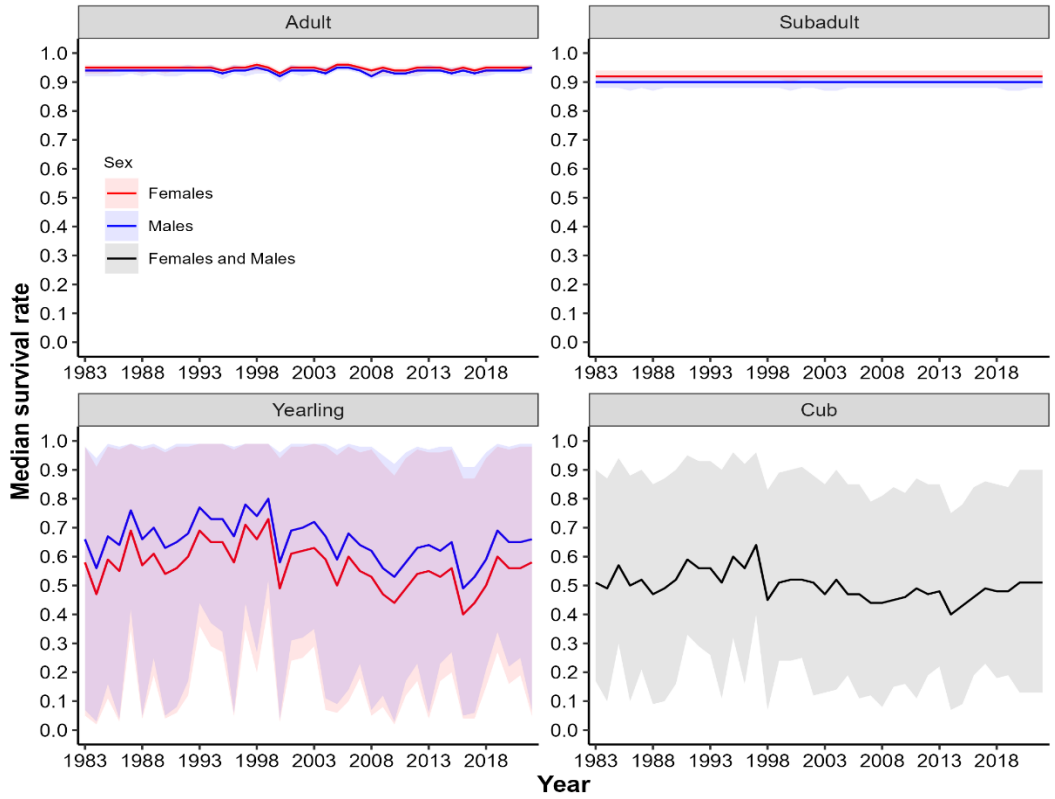

Fig. 10. Estimated median annual survival rates (solid lines) and their 95% credible intervals (shaded areas) for grizzly bears in the Demographic Monitoring Area of the Greater Yellowstone Ecosystem, 1983–2022.

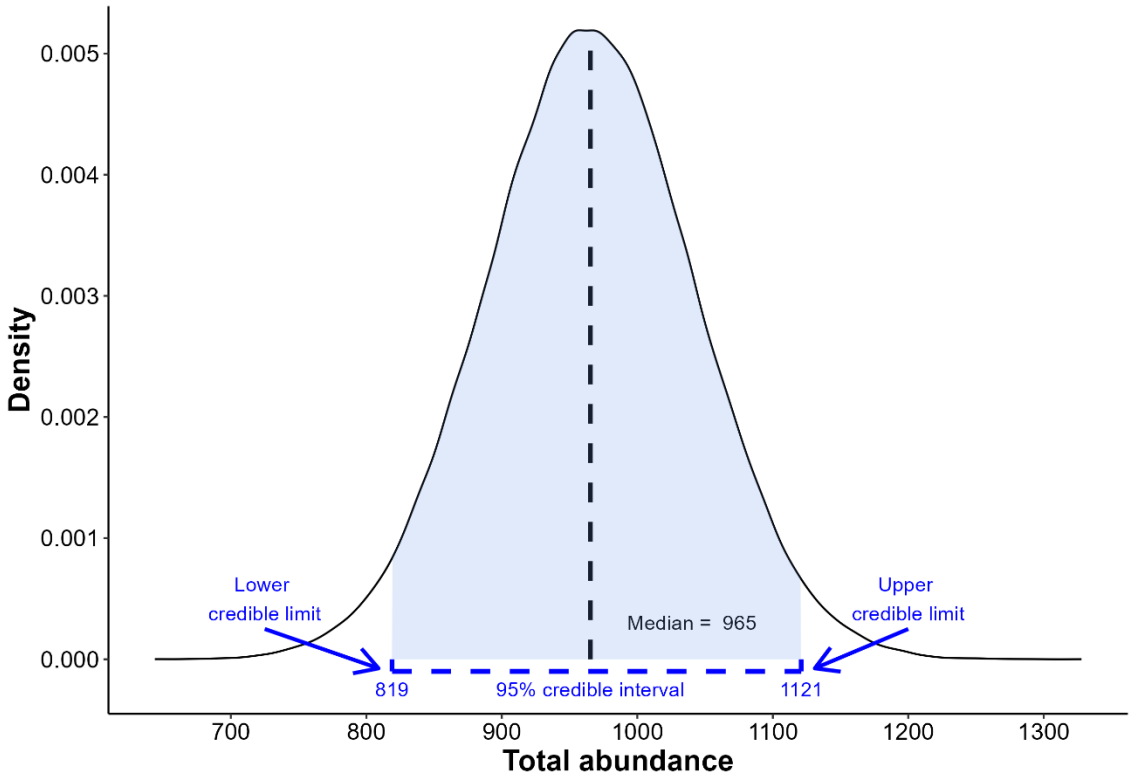

Fig. 11. Approximated posterior density plot of estimated abundance at den emergence for grizzly bears in the Demographic Monitoring Area of the Greater Yellowstone Ecosystem, 2022. The plot visualizes the distribution of potential values for the estimated parameter. The area under the curve represents all possibilities with 'peaks' representing values with a higher probability of occurrence. The distribution can be characterized by the mean (average value), median (middle value), mode (most frequent value), or percentiles (range of values, e.g., 2.5 and 97.5 percentiles [i.e., the 95% credible interval]).

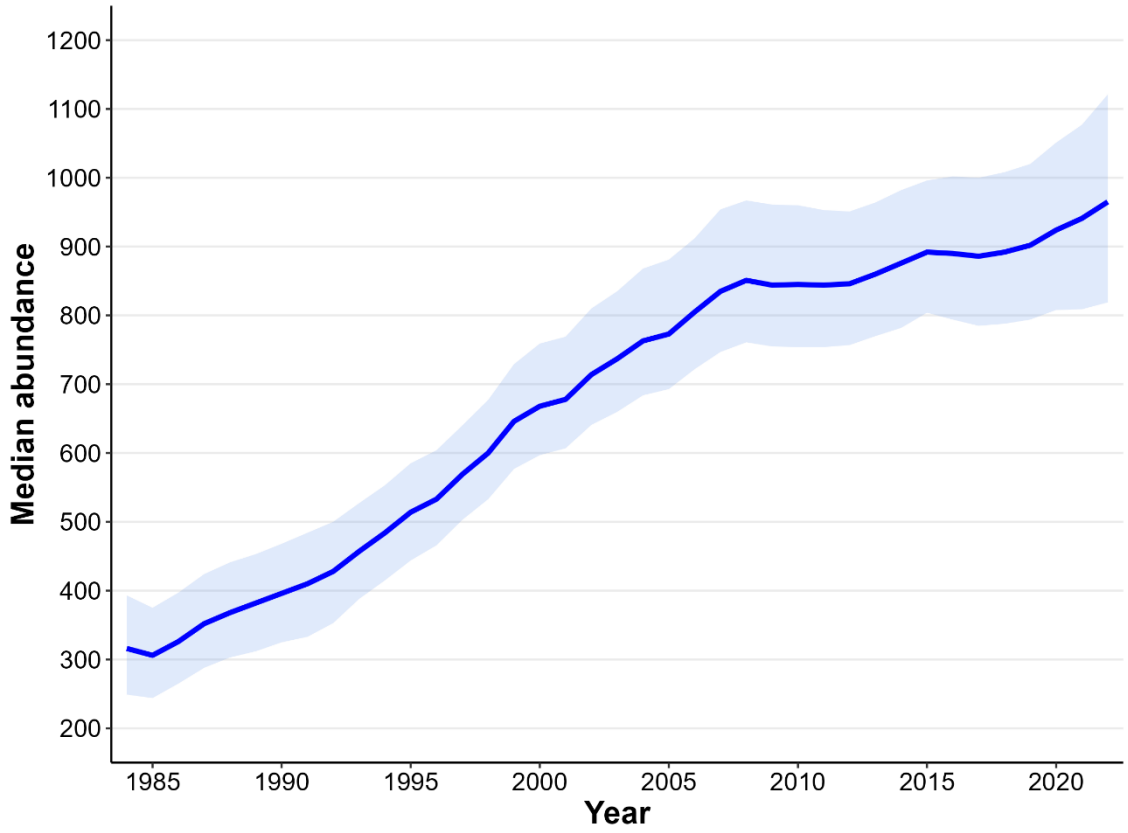

Fig. 12. Estimated median total population abundance (solid line) at den emergence and its 95% credible interval (shaded area) for grizzly bears in the Demographic Monitoring Area of the Greater Yellowstone Ecosystem, 1983–2022. Median total population size in 2022 was estimated at 965 grizzly bears (95% credible interval = 819–1,121).

Table 17. Estimated vital rates, population metrics, and mortality rates for grizzly bears in the Greater Yellowstone Ecosystem, 2022[a].

Demographic parameter	Median	95% credible interval
Survival by population segment		
Cubs (assumed equal for females and males)	0.51	0.13–0.90
Yearling females	0.58	0.05–0.98
Yearling males	0.66	0.07–0.99
Subadult females	0.92	0.91–0.94
Subadult males	0.90	0.88–0.92
Adult females	0.95	0.94–0.96
Adult males	0.95	0.93–0.96
Reproduction		
Litter size	2.49	2.01–3.01
Proportion of females with cubs	0.29	0.26–0.30
Population size and growth rate		
Population abundance (2022)	965	819–1,121
Population growth rate (lambda, 2021–2022)	1.03	0.91–1.17
Percent mortality		
Independent females	5.11	--
Independent males	6.37	--
Dependent females (human-caused only)	2.75	--
Dependent males (human-caused only)	3.77	--

[a]Estimates are specific to the reporting year 2022, based on data inputs for the period 1983–2022.

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 calories and protein 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 in YNP.

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

In 2022, we recorded 833 opportunistic observations of grizzly bears, their tracks, and feeding sign in YNP. In 68 (8%) of these observations, grizzly bears fed on ungulate carcasses (Table 18). Grizzly bears were observed consuming ungulate carcasses from March through November (Fig. 13), with most use occurring in May (34%, $n = 23$), June (21%, $n = 14$), and August (21%, $n = 14$). Bison (53%, $n = 36$) and elk (32%, $n = 22$) were the species of ungulate most often consumed by grizzly bears. In contrast, black bears fed on ungulate carcasses in only 25 (3%) of 842 opportunistic observations (Table 18). Interference competition from grizzly bears and wolves likely inhibits black bear use of many ungulate carcasses.

The 68 observations of grizzly bears feeding on ungulates in 2022 was approximately equal to the long-term average of 72 (± 33 standard deviation) recorded over the last 43 years (1980–2022) (Fig. 14). The 8% proportion of the total number of sightings where grizzly bears fed on ungulate carcasses in 2022 was slightly lower than the long-term average of 9% recorded during 1980–2022 (Fig. 15).

A grizzly bear scavenges a winter-killed bison carcass in Pelican Valley, Yellowstone National Park in mid-March. Grizzly bears begin emerging from hibernation around March 1st and move to ungulate winter ranges to scavenge winter-killed and wolf killed bison, moose, elk, and deer carcasses. (Photo courtesy of K. Cassidy, National Park Service)

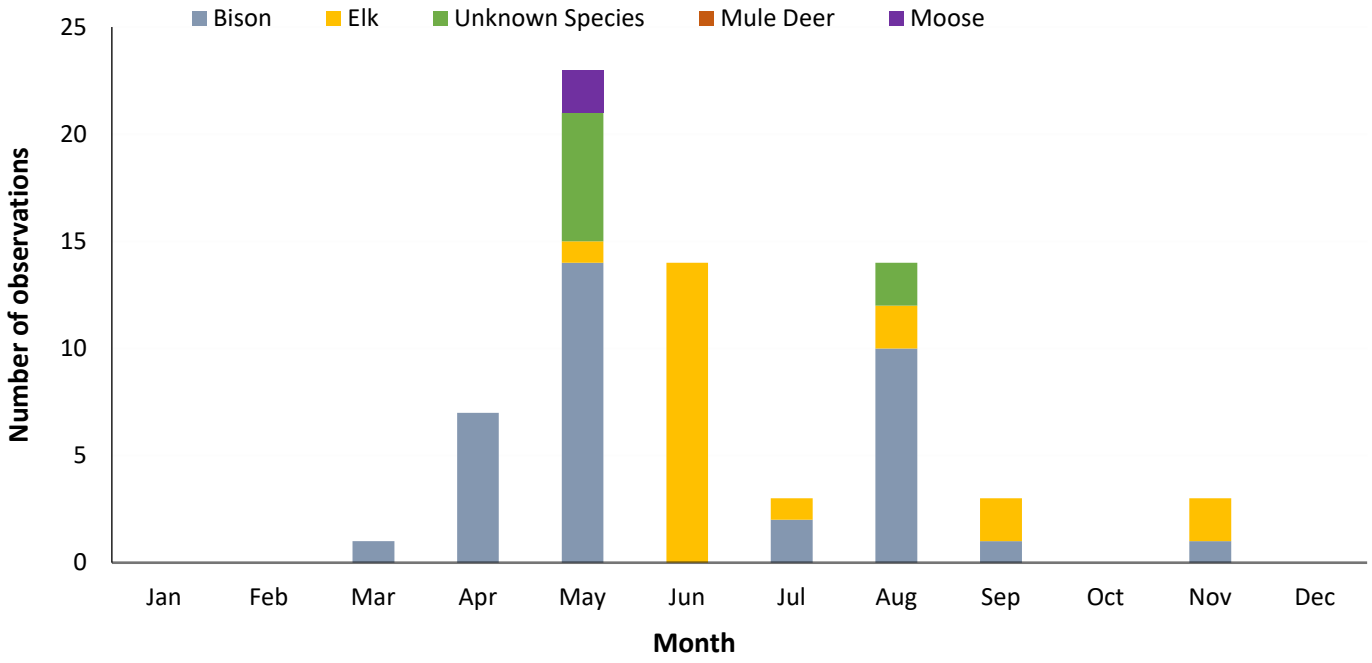

Fig. 13. Number of opportunistic observations of grizzly bears consuming ungulate meat by month in Yellowstone National Park, 2022.

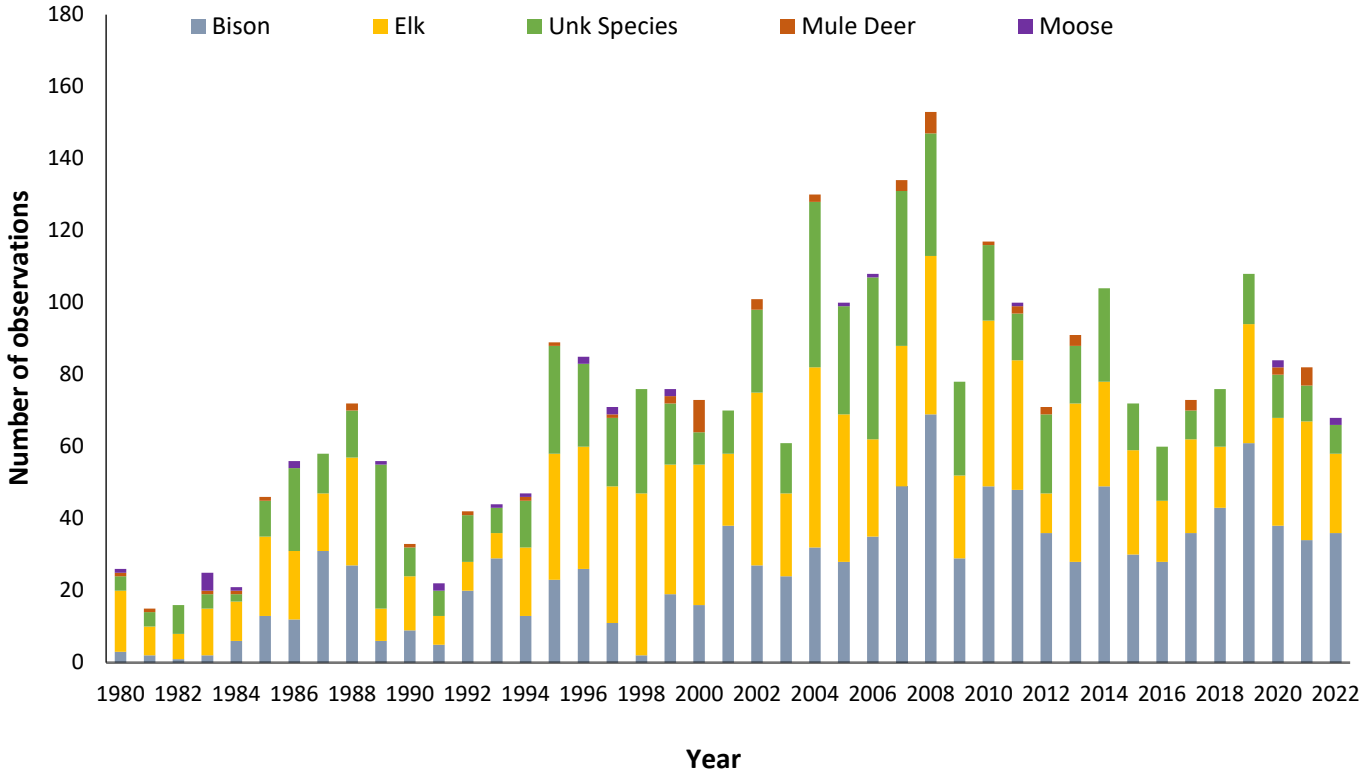

Fig. 14. Number of opportunistic observations of grizzly bears feeding on ungulate carcasses in Yellowstone National Park, 1980–2022.

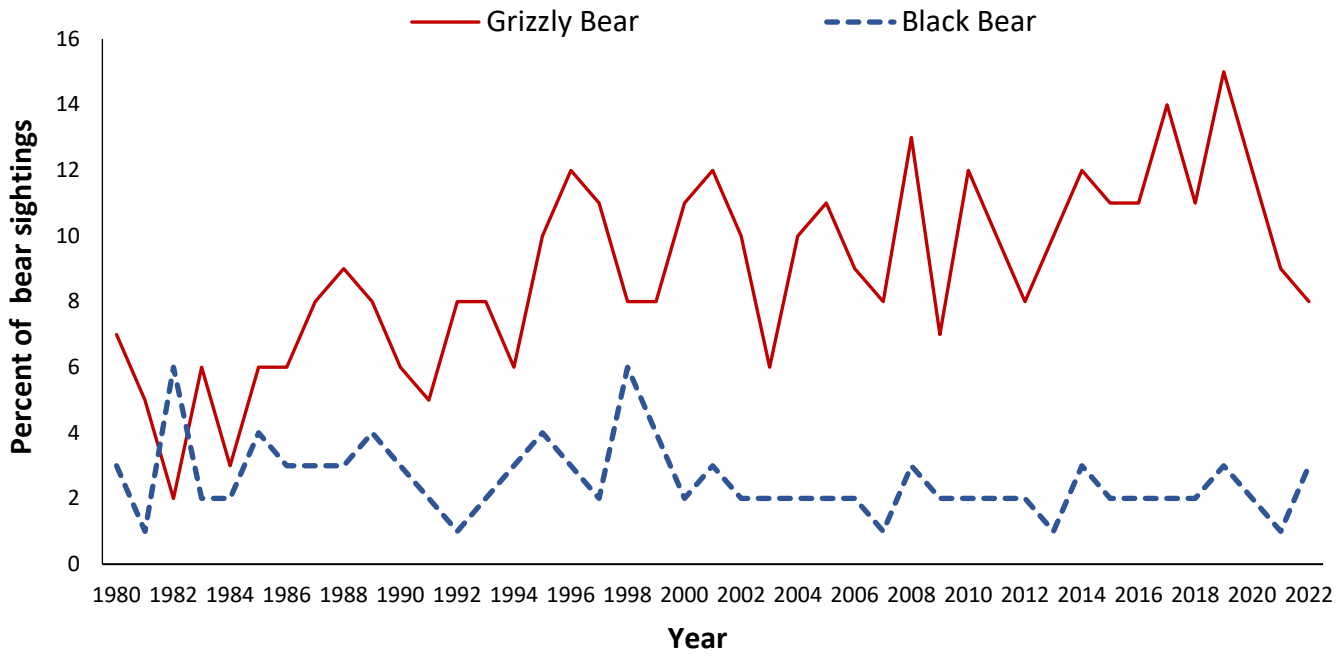

Fig. 15. Proportion of the total number of opportunistic observations of grizzly bears and American black bears where the observed bears were feeding on ungulate carcasses, Yellowstone National Park, 1980–2022.

Table 18. Number of opportunistic observations of grizzly bears and American black bears where the observed bear fed on ungulate carcasses, Yellowstone National Park, 2022.

Species of bear	Species of ungulate consumed									
	Bison	Moose	Elk	Mule Deer	White-tailed deer	Bighorn sheep	Mountain goat	Pronghorn	Unknown ungulate	Total
Grizzly	36	2	22	0	0	0	0	0	8	68
Black	1	1	23	0	0	0	0	0	0	25

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 in the Yellowstone Lake watershed prey on spawning native Yellowstone cutthroat trout (YCT, *Oncorhynchus clarkii bouvieri*) in tributary streams of the lake. Bears also occasionally prey on cutthroat trout in other areas of YNP, including Fan Creek (westslope cutthroat trout, YCT, or westslope × YCT hybrids) 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.

The YCT population in Yellowstone Lake was substantially reduced in the late-1990s and 2000s through predation by non-native lake trout (*Salvelinus namaycush*), whirling disease caused by an exotic parasite (*Myxobolus cerebralis*), and reduced juvenile recruitment due to drought conditions (Koel et al. 2005, 2006). The combined effect reduced YCT abundance by >90% in some spawning tributaries (Koel et al. 2006, 2019) and resulted in a noticeable decrease in bear fishing activity around the lake (Haroldson et al. 2005). Because of the YCT decline and associated trophic changes, and preferential use of YCT as a food source by some grizzly bears in the Yellowstone Lake watershed, monitoring of the YCT population is a component of the habitat monitoring program of the 2016 Yellowstone Grizzly Bear Conservation Strategy (Yellowstone Ecosystem Subcommittee 2016).

The YCT spawning 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. A long-term netting assessment program conducted annually in August is now used to monitor lake-wide status and trend of the YCT population (Koel et al. 2020). Visual stream surveys of North Shore and West Thumb tributaries of the lake are used as indices of trout abundance and associated bear fishing activity. These surveys 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. Methods used for visual spawning stream surveys are described in Gunther at al. (2022).

Yellowstone Lake

Front-country Visual Stream Surveys

Ice-off on Yellowstone Lake occurred on June 5, 2022. Data collected in 2022 continued to indicate low numbers of spawning YCT in North Shore and most West Thumb tributary streams that are monitored (Table 19). In North Shore streams, only 174 spawning YCT were counted. One-hundred-sixty-two spawning YCT were counted in Bridge Creek, and 12 in Hatchery Creek. No spawning YCT were observed in Lodge Creek, Incinerator Creek, or Wells Creek. No grizzly bear observations, tracks, or evidence of bear fishing activity (i.e., observations of grizzly bears fishing for trout or grizzly bear tracks associated with fish parts or bear scats containing fish parts) were observed along any of the monitored North Shore streams in 2022.

In West Thumb streams, 191 spawning YCT were counted, including 174 in Little Thumb Creek, 9 in Stream #1167, 5 in Sandy Creek, and 3 in Sewer Creek. A grizzly bear was observed along Sandy Creek. Grizzly bear tracks were observed along Sandy Creek, Stream #1167, and Sewer Creek. A black bear was observed fishing in Little Thumb Creek.

The number of spawning YCT counted in North Shore (Fig. 17) and West Thumb (Fig. 18) streams has decreased significantly since 1989. Although the increased spawning activity observed in Little Thumb and Bridge creeks in recent years is promising for YCT recovery, very few spawning YCT have been observed in all other monitored North Shore and West Thumb tributary streams.

Backcountry Visual Stream Surveys

In 2022, we surveyed 3 backcountry tributary streams including Flat Mountain Creek, stream #1138, and stream #1141. In these streams, we counted 103 spawning YCT, including 52 in stream #1138, 50 in stream #1141, and 1 in Flat Mountain Creek. We observed grizzly bear tracks along Flat Mountain Creek and Stream #1138. Trail camera photos documented 3 unique grizzly bears and 1 black bear fishing in Stream #1138.

Trout Lake

Trout Lake was not surveyed in 2022 due to spring flooding on June 13, which kept the Tower to Northeast Entrance Road closed for most of the

summer. In previous years, fish counts in the Trout Lake inlet creek have ranged from 31 to 306 fish per survey (Fig. 19).

Outlook for Yellowstone Cutthroat Trout

The number of spawning YCT counted in all surveyed tributary streams of Yellowstone Lake reached an all-time low around 2004 (Figs. 17-19). A Native Fish Conservation Plan/Environmental Assessment was completed in 2010 (Koel et al. 2010*a*,*b*). The plan outlines an adaptive management program designed to protect the native YCT population through suppression of lake trout and other methods (Koel et al. 2020). As part of these management efforts, park fisheries biologists and private-sector (contracted) netters caught and removed 281,486 lake trout from Yellowstone Lake in 2022. Since lake trout suppression efforts began in 1994, >4.3 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 sent the population into decline beginning in 2012 (Syslo et al. 2020). Over the past decade, adult predatory lake trout (age 5+) have been reduced by about 92% (Gresswell et al. 2021, Koel et al. 2022). Adult YCT now weigh twice what they did prior to the lake trout invasion, probably due to reduced competition, and juveniles are again recruiting into the YCT population (Koel et al. 2020). Spawning adult YCT 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 native YCT will reestablish at higher numbers 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).

A grizzly bear catches a Yellowstone cutthroat trout (YCT) in a tributary stream of Yellowstone Lake. The combined effects of whirling disease, drought, and predation by non-native lake trout caused a >90% reduction in the YCT population in Yellowstone Lake and a concurrent reduction in bear fishing activity. An increase in observations of bear predation on YCT in a few streams in recent years suggests the fish population may be rebounding in some tributaries. (2022 NPS remote camera photo)

Table 19. Summary statistics for spawning cutthroat trout surveys, Yellowstone National Park, 2022.							
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	05/29/2022	06/12/2022	15	3	12	4.0	No
Incinerator Creek			No Spawn				
Wells Creek			No Spawn				
Bridge Creek	05/23/2022	06/19/2022	28	5	162	32.4	No
West Thumb Streams							
1167 Creek	05/24/2022	05/31/2022	8	2	9	4.5	No
Sandy Creek	05/24/2022	05/31/2022	8	2	5	2.5	No
Sewer Creek	06/07/2022	06/07/2022	1	1	3	3.0	No
Little Thumb Creek	06/15/2022	06/27/2022	13	3	174	58.0	Yes
Total front-country[a]				16	365	22.8	
Backcountry Streams							
Flat Mountain Creek	06/08/2022	06/08/2022	1	1	1	1.0	No
Stream #1138	06/08/2022	06/21/2022	14	3	52	17.3	Yes
Stream #1141	06/08/2022	06/15/2022	8	2	50	25.0	No
Total backcountry				6	103	17.2	
Northern Range							
Trout Lake Inlet	Not	Surveyed					

[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. 16. Locations of Yellowstone Lake cutthroat trout spawning streams surveyed in 2022. Base map: Geographic Society, i-cubed, Washington, D.C.

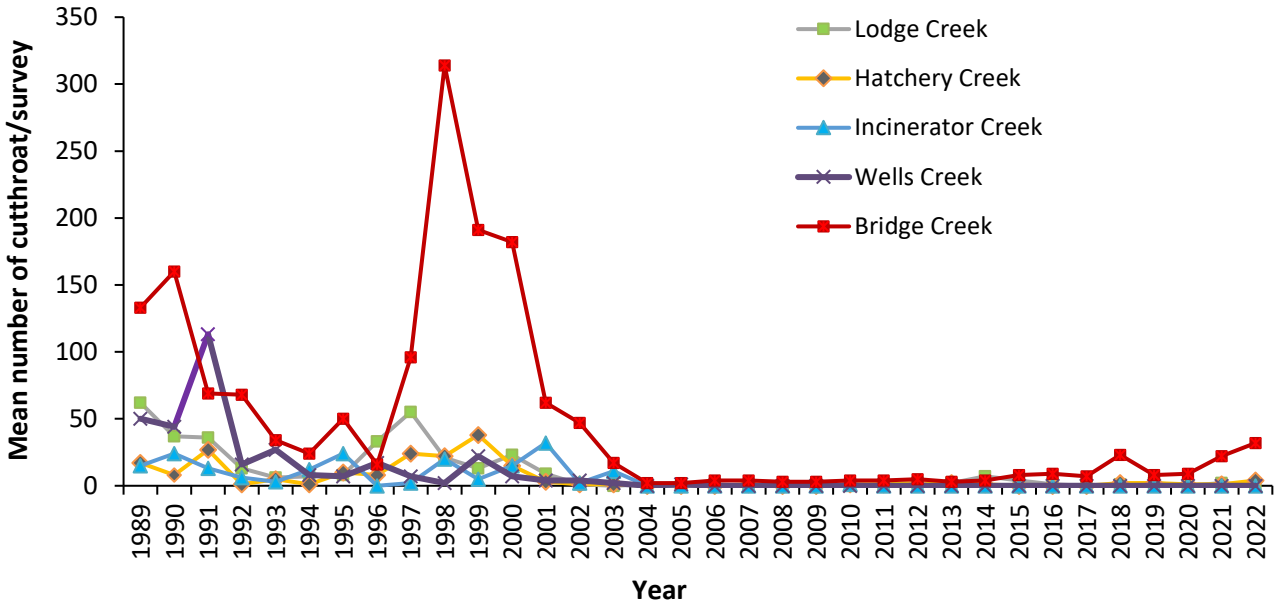

Fig. 17. Mean number of spawning Yellowstone cutthroat trout observed during weekly visual surveys of 5 North Shore spawning stream tributaries to Yellowstone Lake, Yellowstone National Park, 1989–2022.

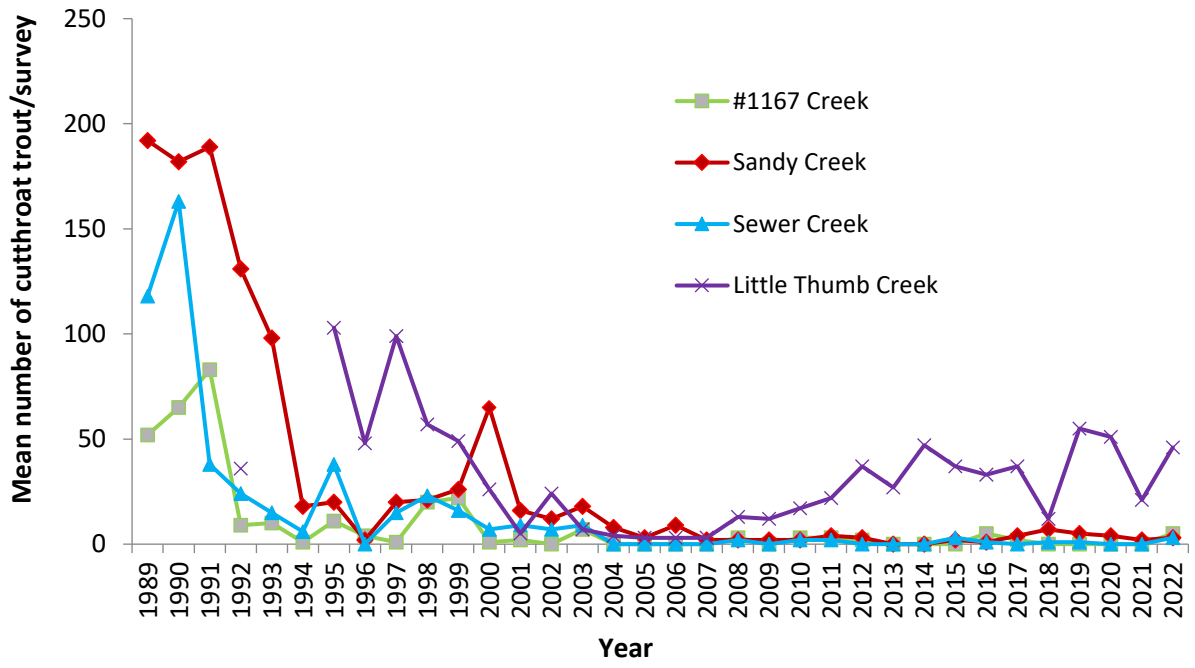

Fig. 18. Mean number of spawning Yellowstone cutthroat trout observed during weekly visual surveys of 4 West Thumb spawning stream tributaries to Yellowstone Lake, Yellowstone National Park, 1989–2022.

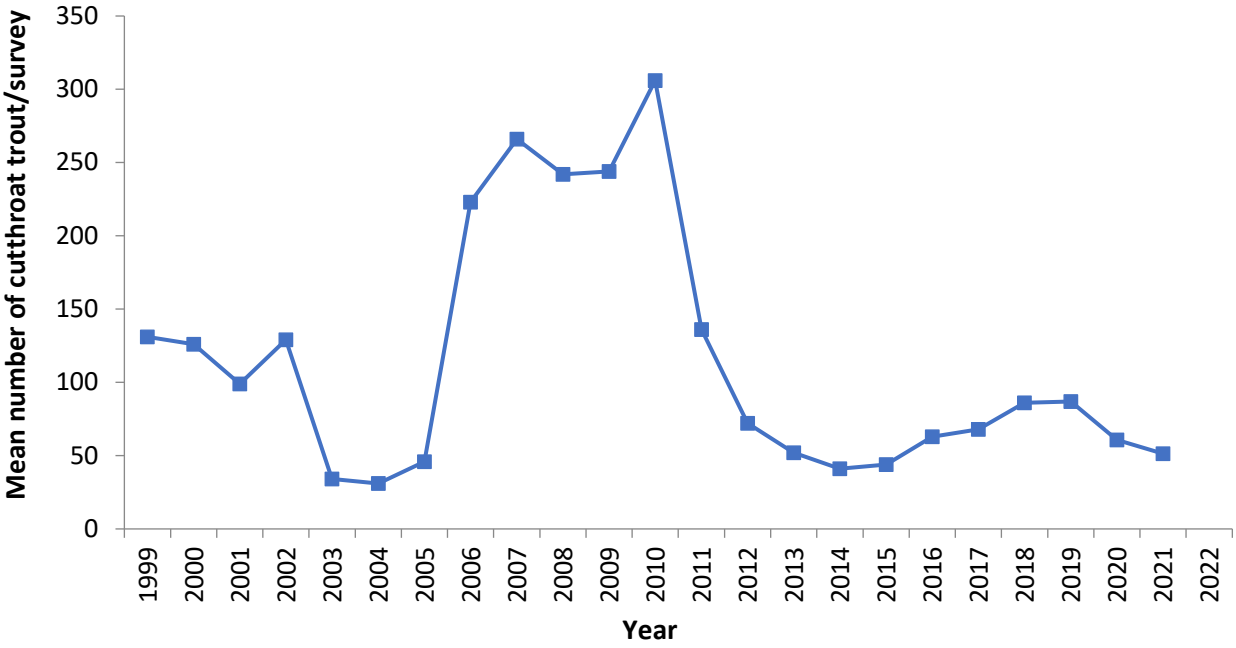

Fig. 19. Mean number of spawning Yellowstone cutthroat trout (including cutthroat × rainbow trout hybrids) observed during weekly visual surveys of the Trout Lake inlet creek, Yellowstone National Park, 1999–2022. Stream surveys were not conducted on the Trout Lake inlet creek in 2022 because the Tower to Northeast Entrance Road was washed out by a flood on June 13; the road did not reopen until November.

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

Army cutworm moths (*Euxoa auxiliaris*; moths) 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 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 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 number 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 the size and location of aggregation sites fluctuate from year to year with moth abundance and variations 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 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 1 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.

As in 2021, only 1 round of grizzly bear observation flights was conducted in 2022. Thus, the number of hours flown over insect aggregation sites was again reduced compared with pre-2020 flight totals. However, unlike 2020, and similar to 2021, most observation flights (84%) were conducted with a secondary observer in addition to the pilot. There were 225 observations of actively feeding grizzly bears on previously identified, confirmed sites in 2022. In addition, there was an observation of an actively feeding grizzly bear at a previously undocumented site. Thus, 1 new possible site was added in 2022, bringing the number of sites to 35 confirmed and 19 possible.

Overall, the number of locations with grizzly bears on insect aggregation sites in 2022 (n = 314; 84 telemetry locations plus 230 ground and aerial observations) was a decrease from the record high in 2021 (Table 20). 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. 20), which may be due to variable snow conditions or the number of moths migrating from the plains. For example, in 1993, a year with unusually high snowpack, the percentage of confirmed sites used by bears (Fig. 20) and the number of observations recorded at insect aggregation sites were very low (Table 20). In all other years, the percentage of insect aggregation sites used by grizzly bears varied between 47% and 83% (Fig. 20).

When we control for 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. 21). Whereas the number of bears observed in 2022 was near the average for the previous 10 years, the number of hours flown was 44% lower than years in which 2 rounds of flights were conducted. Thus, like in 2021, the number of observations per hour flown was higher in 2022 than in previous years when 2 flights were conducted (Fig. 21).

Table 20. Summary statistics for grizzly bear use of confirmed insect aggregation sites, Greater Yellowstone Ecosystem, 1986–2022.

Year	Number of confirmed aggregation 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	30	21	33	256
2003	30	20	9	163
2004	30	16	2	134
2005	32	19	16	198
2006	32	17	15	147
2007	32	19	19	162
2008	32	23	16	181
2009	34	23	12	170
2010	34	18	3	136
2011	35	22	10	165
2012	35	24	20	253
2013	35	23	27	297
2014	35	24	11	343
2015	35	21	13	211
2016	35	20	11	208
2017	35	21	20	279
2018	35	20	18	267
2019	35	29	20	335
2020	35	27	19	325
2021	35	23	30	327
2022	35	24	84	230

[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] An aggregation site was considered used if ≥1 location or grizzly bear observation was documented within the site during July–September of that year.

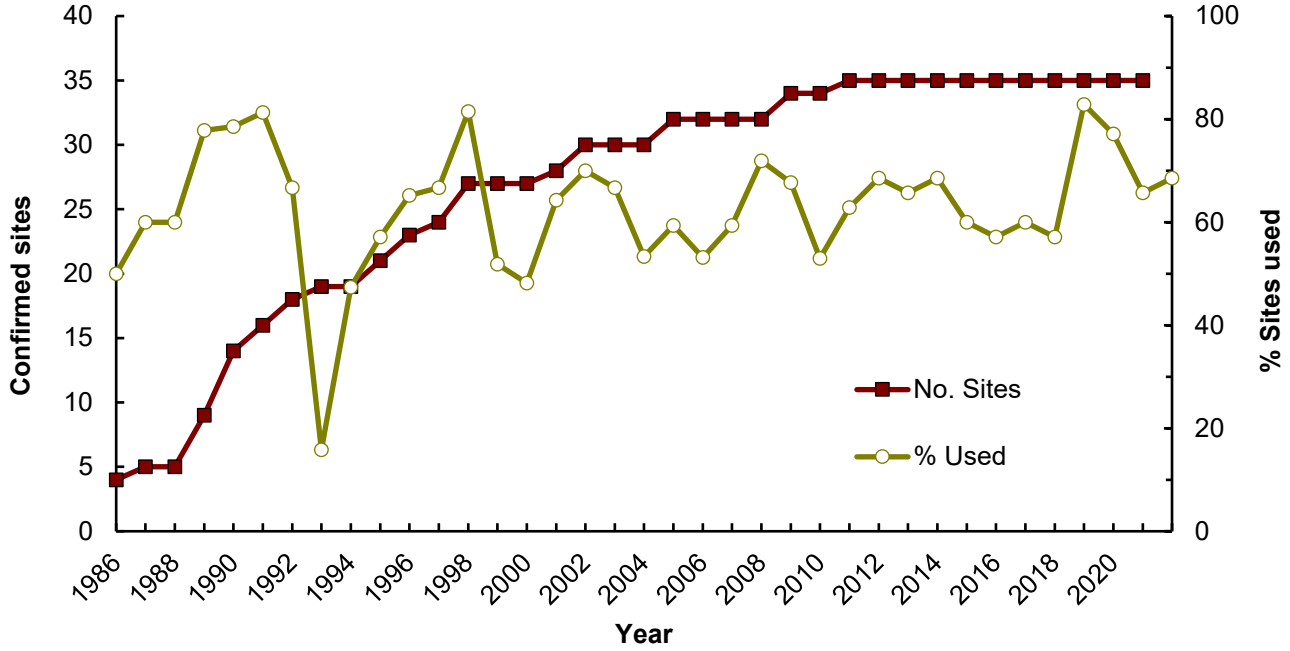

Fig. 20. Annual number of confirmed insect aggregation sites and percent of those sites at which telemetry locations of marked bears or visual observations of unmarked bears were recorded, Greater Yellowstone Ecosystem, 1986–2022.

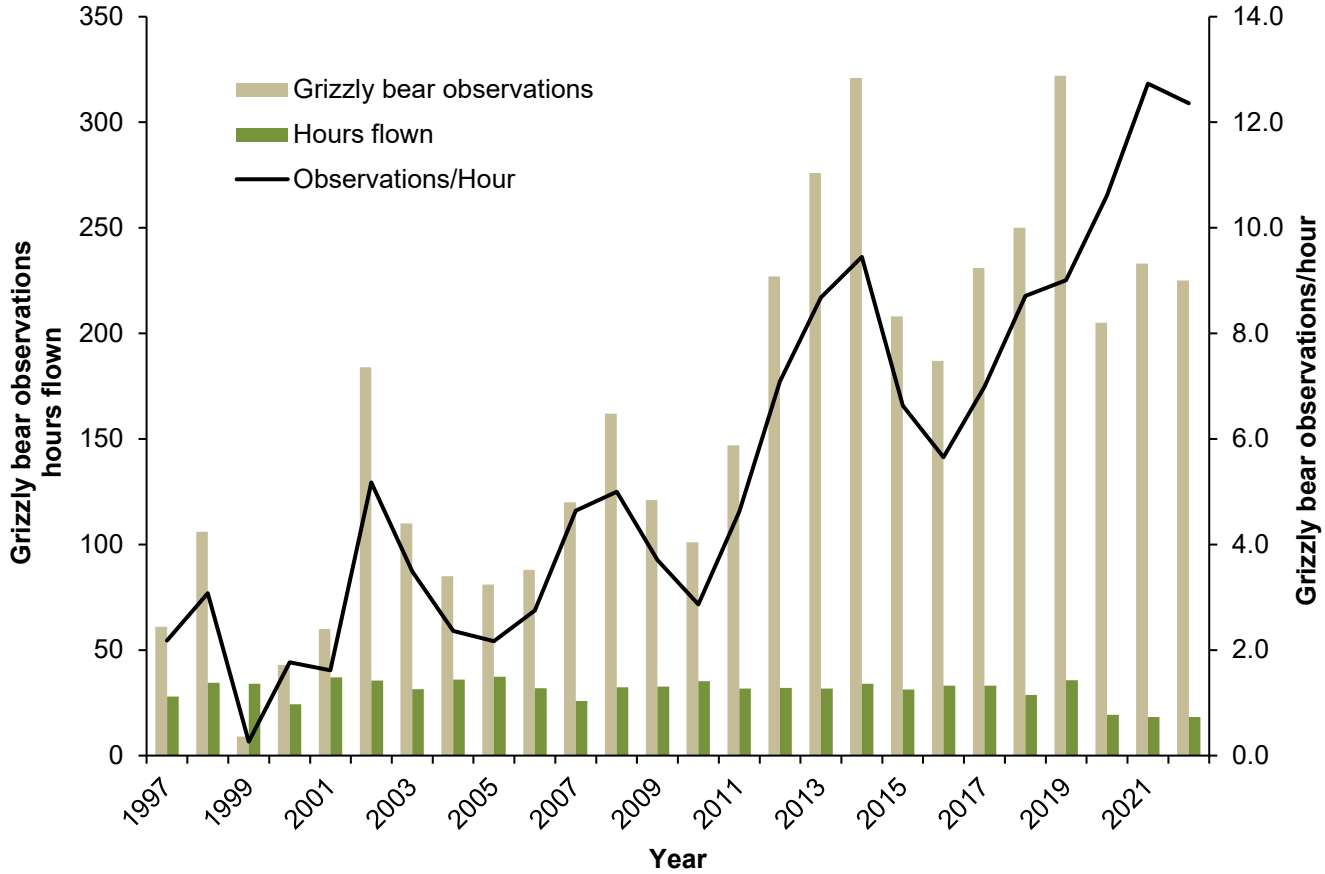

Fig. 21. Number of grizzly bears observed (tan bars) on insect aggregation sites during observation flights only, survey hours (green bars) for these Bear Management Units, and grizzly bear observations per survey hour (black line) during observation flights units containing all known insect aggregation sites, Greater Yellowstone Ecosystem, 1997–2022.

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

Whitebark pine (*Pinus albicaulis*) nuts provide a high-calorie food source for grizzly bears during late summer and fall. Whitebark pine trees have experienced substantial mortality throughout the GYE since the early 2000s, primarily due to mountain pine beetle (*Dendroctonus ponderosae*), blister rust (*Cronartium ribicola*), and fire. Whitebark pine surveys were conducted on 21 established transects indicated slightly above average cone production for 2022 (Fig. 22). Overall, the mean number of cones per tree, 21 (Table 21), was slightly higher than the long-term average of 17 cones per tree for the period from 1980–2022 (Fig. 23). Cone production was generally higher on southern transects than northern transects (Fig. 1, Table 22).

Occasional tree mortality caused by mountain pine beetle may still occur in stands that contain the cone production transects. During 2022, we observed no additional beetle-caused mortality among individual trees that had been surveyed since 2002. Total mortality on transect trees since 2002 is now 76% (145/190) with 100% (19/19) of transects containing beetle-killed trees. Cumulative mortality among the original 190 trees has been minimal for most of the last decade (Fig. 24). Similar to findings reported by the Greater Yellowstone Whitebark Pine Monitoring Working Group, these data support the interpretation that this mountain pine beetle outbreak has run its course.

Table 21. Summary statistics for whitebark pine cone production surveys, Greater Yellowstone Ecosystem, 2022.

Total			Trees				Transect			
Cones	Trees	Transects	Mean cones	SD	Min	Max	Mean cones	SD	Min	Max
3,957	192	21	20.6	32.3	0	201	188.4	215.8	14	807

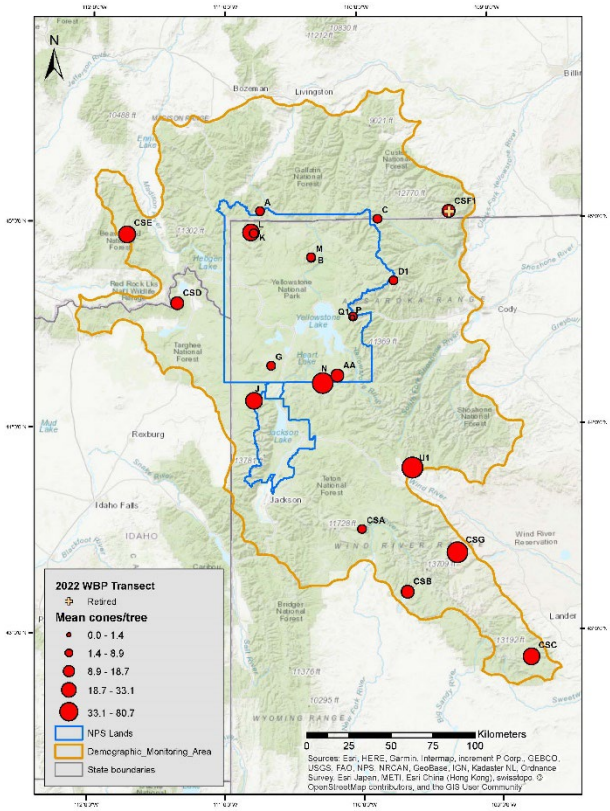

Fig. 22. Locations and mean number of cones per tree for 21 whitebark pine cone production transects, Greater Yellowstone Ecosystem, 2022. Labels reflect transect identifiers (see Table 22). Base map source: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, ©OpenStreetMap contributors, and the GIS User Community

Table 22. Results of whitebark pine cone production surveys, Greater Yellowstone Ecosystem, 2022.

Transect	No. of cones	No. of trees	Mean no. cones/tree	SD
A	21	4	5.3	10.5
B	32	10	3.2	5
C	89	10	8.9	8.9
D1	31	10	3.1	3.0
G	67	9	7.4	8.4
J	283	10	28.3	31.9
K	186	7	26.6	20
L	82	10	8.2	9.6
M	51	10	5.1	6.0
N	807	10	80.7	49.3
P	14	10	1.4	2.0
Q1	37	10	3.7	4.3
U1	611	10	61.1	55.9
AA	171	10	17.1	15.7
CSA	33	10	3.3	6.1
CSB	115	10	11.5	20.2
CSC	331	10	33.1	37
CSD	170	10	17	30
CSE	57	2	28.5	33.2
CSF	----Transect retired in 2019----			
CSF1[a]	187	10	18.7	18.6
CSG	582	10	58.2	32.2

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

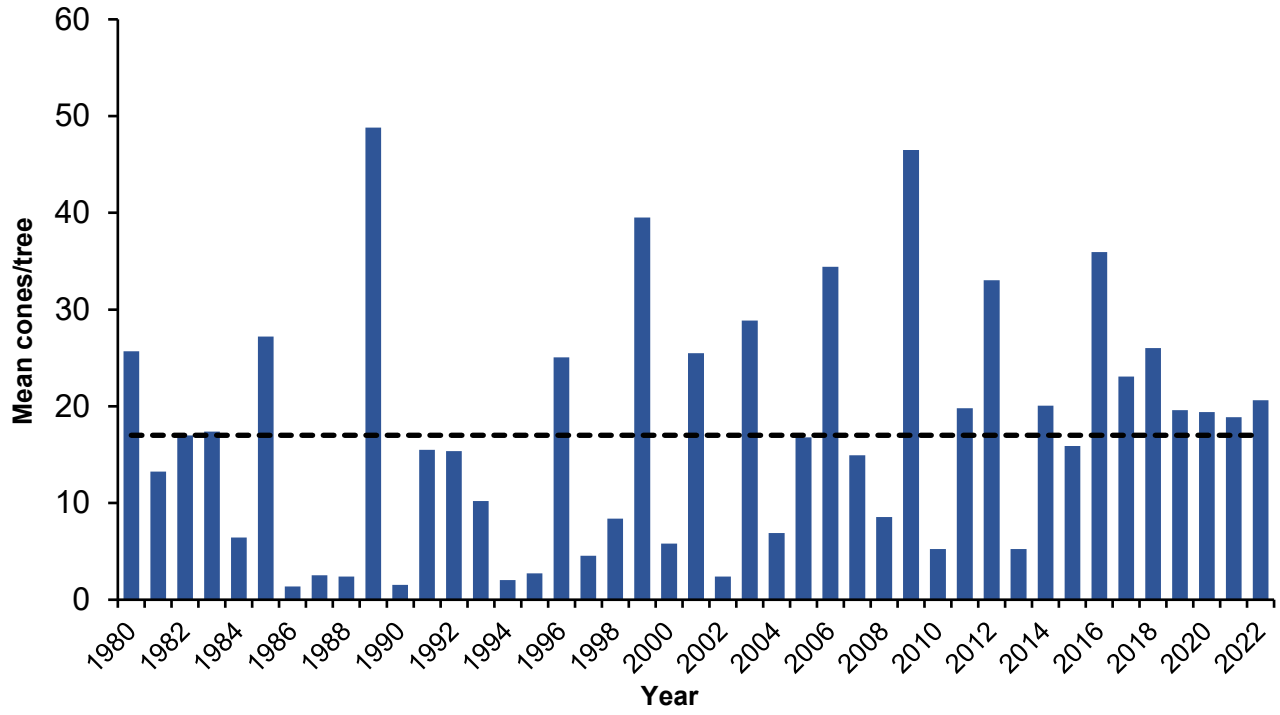

Fig. 23. Annual mean number of cones per tree observed along whitebark pine cone production transects, Greater Yellowstone Ecosystem, 1980–2022. The overall average for the time period (17 cones per tree) is shown as a dashed line.

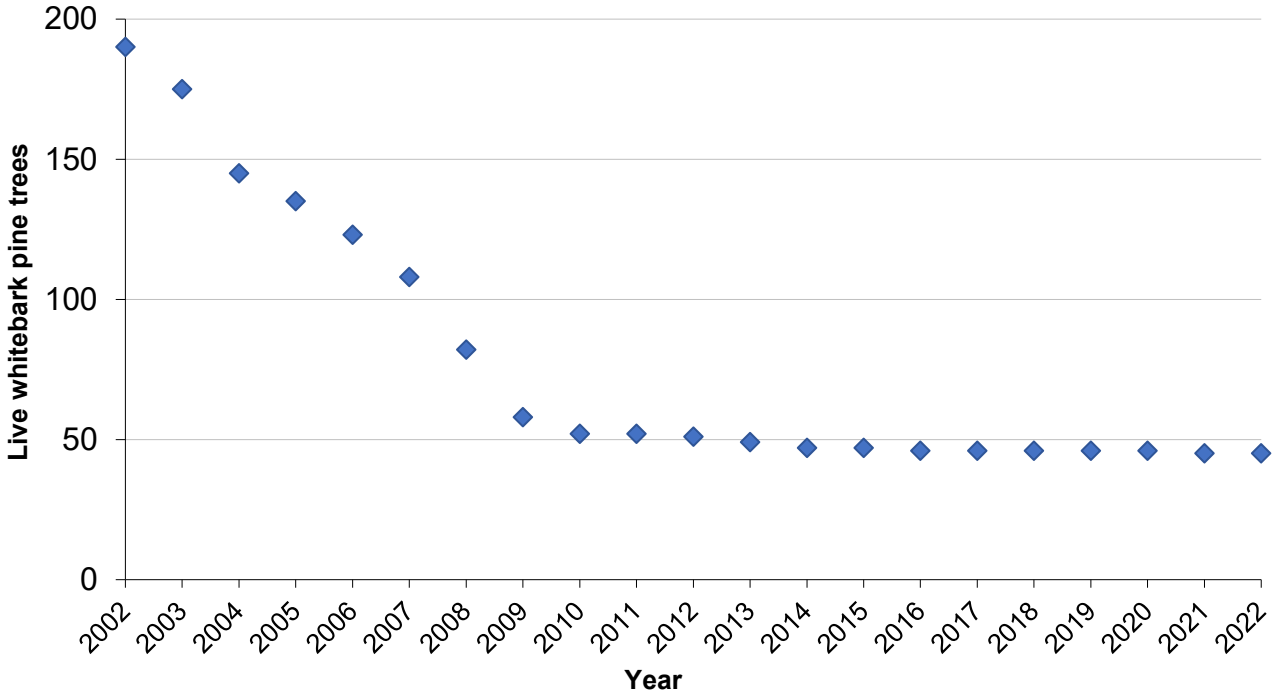

Fig. 24. Number of live whitebark pine (WBP) trees on cone production transects among 190 individual trees monitored since 2002, Greater Yellowstone Ecosystem, 2002–2022.

Ungulate Herd Statistics *(Dan J. Thompson, Wyoming Game and Fish Department; Jeremy M. Nicholson*[1]*, 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)*

[1] *Current affiliation: National Park Service, Denali National Park*

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 GYE:

Idaho Department of Fish and Game:
https://idfg.idaho.gov/sites/default/files/seasons-rules-big-game-2022-elk.pdf

Montana Fish, Wildlife and Parks:
https://fwp.mt.gov/binaries/content/assets/fwp/conservation/elk/elk-count-2022.pdf
(under Elk Population Status for HD 313)

Wyoming Game and Fish Department:
https://wgfd.wyo.gov/Hunting/Harvest-Reports/2022-Harvest-Report

https://wgfd.wyo.gov/Hunting/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)

RECREATION MONITORING

Grand Teton National Park *(Justin K. Schwabedissen and Katharine R. Wilmot, Grand Teton National Park)*

Grand Teton National Park encompasses 125,452 ha (hectares) of occupied grizzly bear habitat in the GYE. Most of the land in the park is undeveloped. Over half of the park (52%) is designated as recommended or potential wilderness and thus managed as wilderness lands per NPS policy. In addition, 33% of GTNP is included within the GBRZ established by the USFWS.

Grand Teton National Park manages visitors and bears using three broad zones: developed areas, road corridors, and backcountry. Backcountry camping in the park requires a permit and is managed using a quota system.

In 2022, total visitation in GTNP was 4,342,988 visits, including recreational, commercial (e.g., Jackson Hole Airport), and incidental (e.g., traveling through the park on U.S. Highway 89/191 but not recreating) use.

Recreational visits totaled 2,806,223, which is significantly below the trend of the past decade (Table 23) and substantially below the record set in 2021 of 3,885,230 visits. Numerous factors likely explained the dramatic differences, including flooding and associated road closures in YNP, the post-pandemic reopening of international destinations, and a changing economic climate. Most recreational visitation to GTNP occurred from May through October with visits peaking in July.

Although overall recreational visits were down in 2022, GTNP had the third highest number of backcountry user nights on record (40,010) and the highest number of overnight stays in front-country campgrounds ever recorded (402,336). Thus, while there were fewer recreational visits overall, interest in the park's backcountry and overnight camping remained strong. Long- and short-term trends of recreational visitation and backcountry user nights are shown in Table 24 and Fig. 25.

Due to slight revisions in the data, visitor use numbers in this report may differ from previous reports. The data in this report are consistent with the most current publicly available data (found at: https://irma.nps.gov/STATS/Reports/Park/GRTE).

Table 23. Ten highest years for recreational visits to Grand Teton National Park, 1979–2021.

Rank	Year[a]	Recreational visits
1	2021	3,885,230
2	2018	3,491,151
3	2019	3,405,614
4	2017	3,317,000
5	2020	3,289,638
6	2016	3,270,076
7	2015	3,149,921
8	2022	2,806,223
9	2014	2,791,392
10	1998	2,757,060

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

Table 24. Average annual recreational visitation and average annual backcountry use nights in Grand Teton National Park by decade, 1951–2019.		
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

[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 methods.

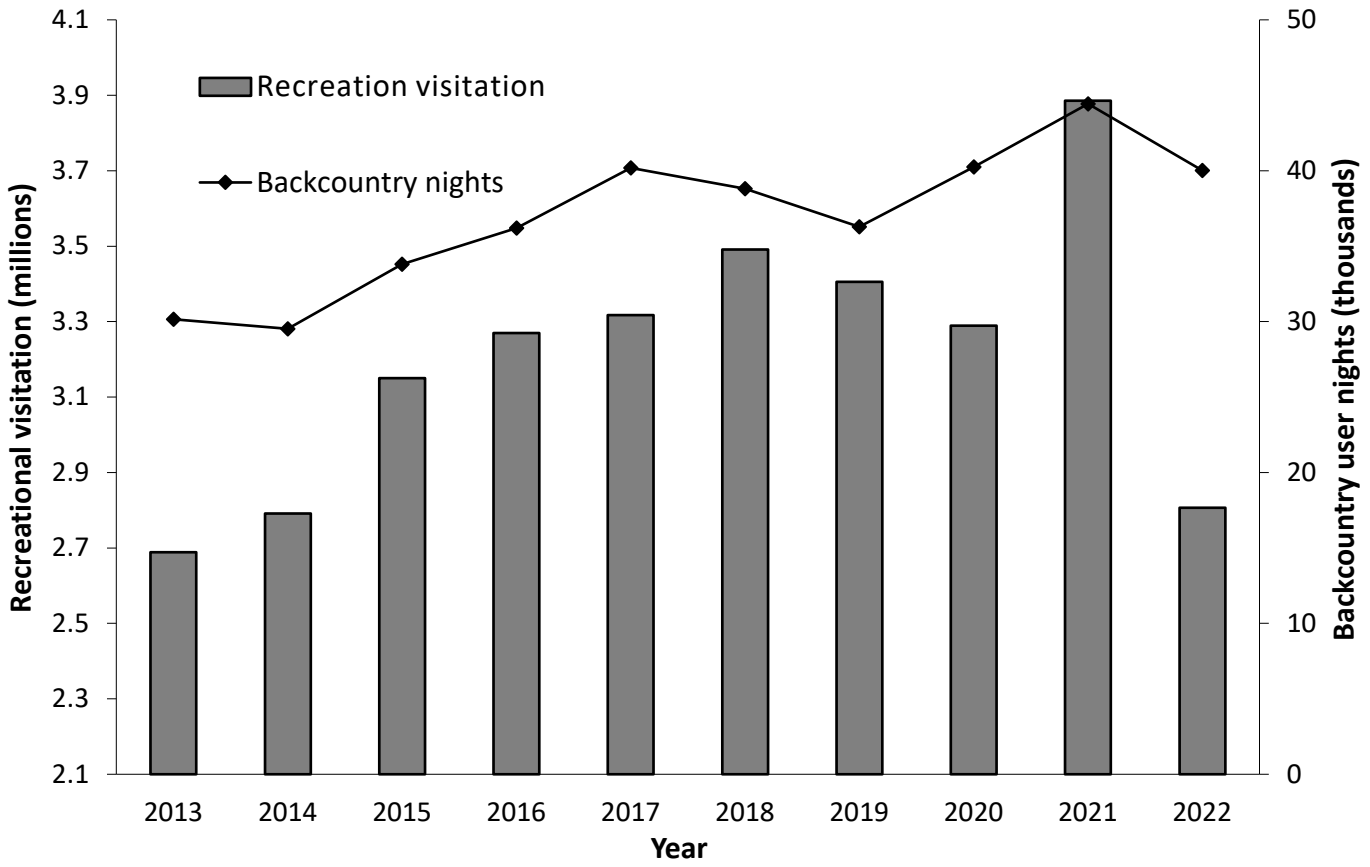

Fig. 25. Trends in recreational visitation and backcountry user nights in Grand Teton National Park, 2013–2022.

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 NPS policy, is managed so as not to preclude that designation in the future (NPS 1974, 2006). Only ~1% of the park's natural landscape has been significantly altered through construction of roads, buildings, and developments. YNP is located entirely within the boundaries of the Yellowstone Ecosystem GBRZ (USFWS 1993). Therefore, the habitat protections implemented through the 2016 Conservation Strategy for Grizzly Bears in the GYE apply to all lands within the park.

The NPS is mandated to preserve the cultural and natural resources of YNP unharmed for the benefit and enjoyment of future generations. This mandate requires protecting the ecological integrity of the park and 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 the 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 25). Human activities are prioritized in developed areas, road corridors are managed for use by both visitors and bears, and bears are generally given priority in backcountry areas.

Recommended wilderness status protects 92% of the grizzly bear habitat in YNP from construction of roads and developments. To further reduce disturbance of bears in important backcountry habitat and to prevent displacement of bears from high-quality food resources, YNP has also designated 16 Bear Management Areas encompassing 188,032 ha (21% of the 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 periods when bear activity is concentrated on specific high-quality foods in predictable locations.

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 human-bear encounters. 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 and bear-inflicted human injuries decreases when 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 making bear-resistant food storage easy and convenient, thereby reducing the frequency that bears obtain human foods, cause conflicts in campsites, and need to be killed in subsequent management actions.

In 2022, YNP was closed from June 13 through June 21 due to damage caused to roads, utility infrastructure, and visitor facilities by a 1 in 500-year spring flooding event. Three-park entrances re-opened on June 22. The Pebble Creek, Slough Creek, Tower Falls, Mammoth, Indian Creek, and Norris Campgrounds were closed the entire summer. Total visitation to the park in 2022 was 4,626,875 visits (https://irma.nps.gov/STATS/Reports/Park/YELL), including recreational and non-recreational use. Recreational visits in 2022 totaled 3,290,242 (Table 26). Most of the park's recreational visitation in 2022 occurred during the 6-month period from May through October, the same period that all sex and age classes of grizzly bears are out of their winter dens and active on the landscape. In 2022, there were 3,031,970 recreational visits (92%) during those peak months, an average of 16,478 recreational visits per day. Park visitors spent 474,929 overnight stays in roadside campgrounds, and 34,714 overnight stays in remote backcountry campsites and dispersed camping zones in the park.

Average annual recreational visitation has increased from 7,378 visits per year during the late 1890s to 3,779,045 visits per year during 2010–2019 (Table 27, Fig. 26). Temporary park and campground closures during the 2020 COVID pandemic year and the spring flood of 2022 resulted in fewer overnight stays in roadside campgrounds during those years (Table 27, Fig. 27). 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 39,068 to 45,615 overnight stays per year per decade (Table 27, Fig. 28). The number of overnight stays in the backcountry is limited by the number and

capacity of designated backcountry campsites in the park.

Table 25. 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, bear viewing, and bear use of roadside habitats ▪ Bears are 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 and campsite capacity limits ▪ Most recreational day use is <5 km (3 miles) from roads ▪ Implementation of seasonal recreational closures and restrictions 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 26. Ten highest years for recreational visits to Yellowstone National Park, 1895–2022.

Rank	Year	Visitation
1	2021	4,860,537
2	2016	4,257,177
3	2017	4,116,525
4	2018	4,114,999
5	2015	4,097,710
6	2019	4,020,287
7	2020	3,806,306
8	2010	3,640,184
9	2014	3,513,484
10	2012	3,447,727

Table 27. Average annual recreational visitation, auto campground overnight stays, and backcountry campsite overnight stays by decade, Yellowstone National Park, 1895–2022.

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[g]	41,637
2020–2022	3,985,695	493,710[h]	39,068

[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 campsite use data available for 1972–1979.
[g] The Fishing Bridge Recreational Vehicle Campground was closed in 2019 for remodeling.
[h] The Norris Campground was closed in 2020, 2021, and 2022. The Fishing Bridge Recreational Vehicle Campground was closed in 2020 and 2021 for remodeling. The Tower Falls Campground was closed in 2020, 2021, and 2022 due to a road reconstruction project. The Pebble Creek, Slough Creek, Mammoth, Indian Creek, and Norris Campgrounds were closed in 2022 due to flood damage to the campgrounds or associated utility infrastructure.

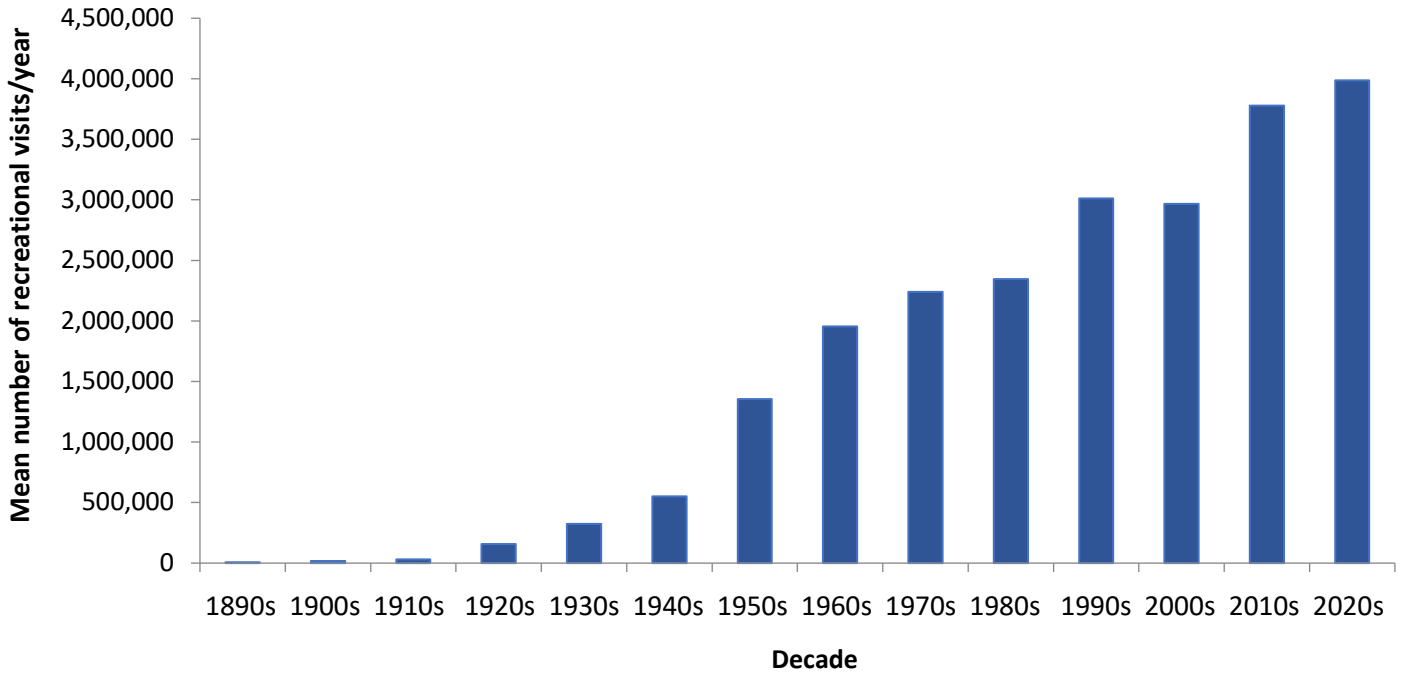

Fig. 26. Average annual number of recreational visits per year by decade, Yellowstone National Park, 1895–2022.

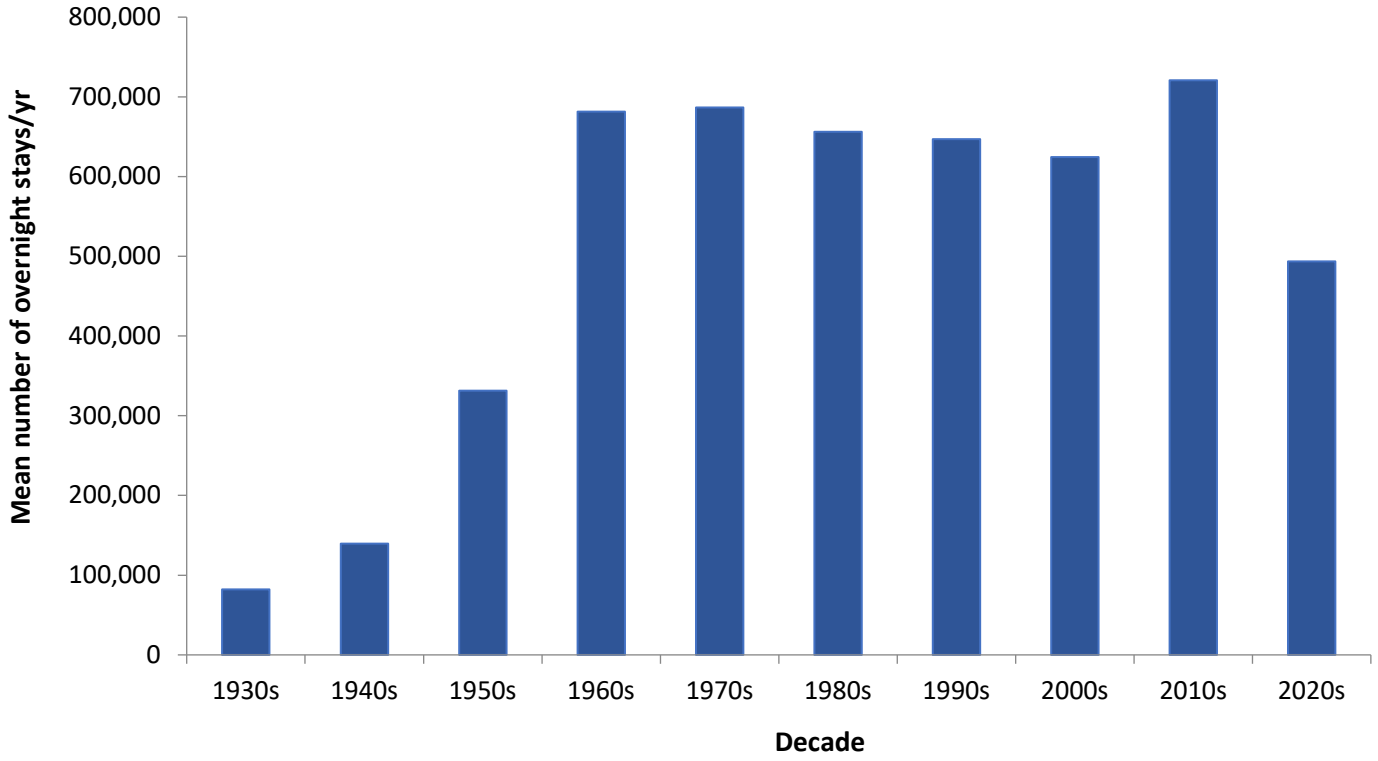

Fig. 27. Average annual number of overnight stays in roadside campgrounds per year by decade, Yellowstone National Park, 1930–2022. Several National Park Service campgrounds were closed for a portion of the spring and early summer of 2020 due to COVID safety concerns; the Norris Campground was closed the entire summer in 2020 and 2022. The Pebble Creek, Slough Creek, Tower Fall, Mammoth, and Norris Campgrounds were closed the entire 2022 season.

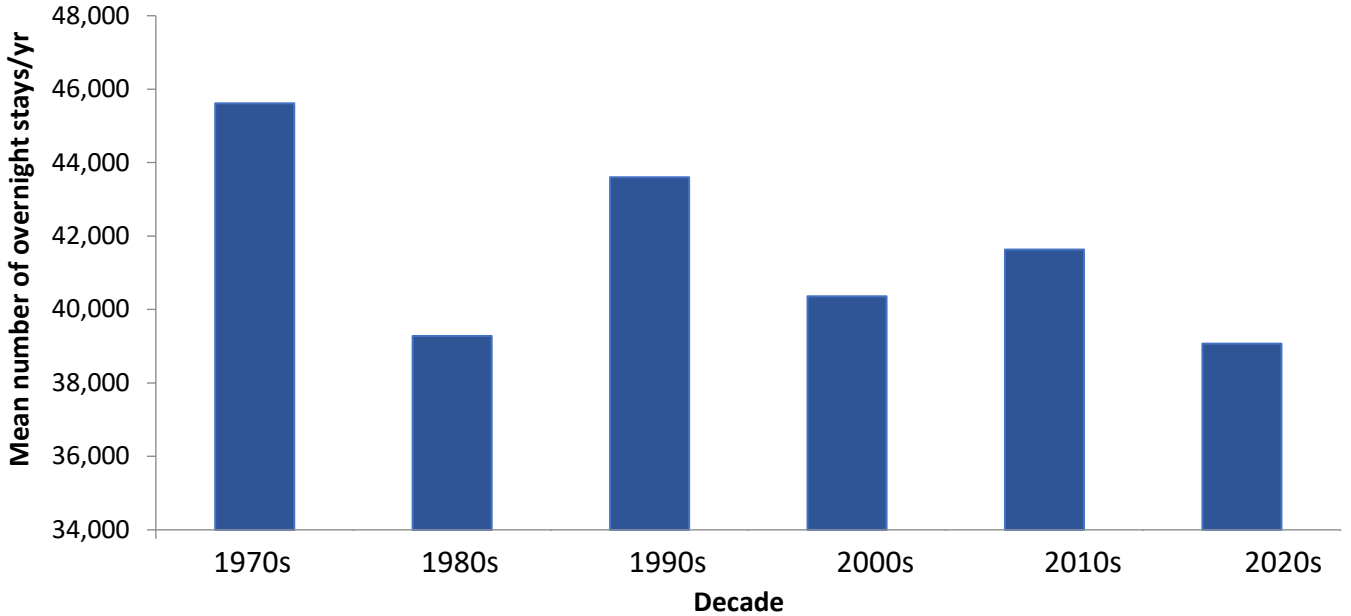

Fig. 28. Average annual number of overnight stays in backcountry campsites and dispersed camping zones per year by decade, Yellowstone National Park, 1972–2022.

HUMAN-GRIZZLY BEAR CONFLICTS IN THE GREATER YELLOWSTONE ECOSYSTEM

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

No human-grizzly bear conflicts were recorded in GTNP and the John D. Rockefeller, Jr. Memorial Parkway in 2022, and no grizzly bear management actions were necessary.

Management of non-food-conditioned, human-habituated bears required considerable effort to minimize human-bear conflicts. The Wildlife Brigade, a group of volunteers that help to facilitate safe interactions between visitors and wildlife, continued to provide dedicated staffing to facilitate the human-bear interface in the park. In 2022, the team was composed of one permanent biologist, two seasonal employees, and 31 volunteers. The Wildlife Brigade managed a minimum of 536 bear jams (210 grizzly bear, 325 black bear, and one occasion where bear species could not be determined), which resulted when habituated bears frequented roadway corridors drawing crowds of wildlife watchers. Grizzly bear jams peaked in early June, and black bear jams peaked in September. Grizzly bears were hazed out of developed areas on eight occasions and off park roadways 15 times. The Wildlife Brigade also patrolled campgrounds, picnic areas, and other front-country areas for unsecured attractants and provided visitors information about food storage requirements. In addition, the team routinely staffed a bear education trailer at a popular park turnout, educating thousands of visitors on how to safely recreate in bear country and use bear spray. Wildlife Brigade volunteers contributed over 12,105 hours toward bear conservation and public education efforts within the park. Complementing the efforts of the Wildlife Brigade, interpretative staff provided bear safety information and bear spray demonstrations at park visitor centers.

Grand Teton National Park continued its partnership with the GTNP Foundation to cost-share expenses for the purchase and installation of bear-resistant food storage lockers (i.e., bear boxes). During the 2022 season, 52 modern bear boxes were installed in front-country campsites, bringing the total number of bear boxes in park campgrounds and other developed sites to 1,067. A bear box is now available in every campsite within the park's six front-country campgrounds, including Gros Ventre, Jenny Lake, Signal Mountain, Colter Bay, Lizard Creek, and Headwaters Campgrounds.

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 relocation). Relocation of conflict bears was a common management practice in the park for the first 25 years after grizzly bears were listed as a federally threatened species in 1975. Although success rates were low (Brannon 1987, Blanchard and Knight 1995), relocations deferred removals of some adult females long enough for completion of additional reproductive cycles, thereby contributing to population recovery and range expansion. However, because of its demonstrated low long-term efficacy, relocation was deemphasized as a management tool in the late 1990s when grizzly bears in the national park began showing signs of biological recovery and density-dependent effects on demographics (van Manen et al. 2016).

Grizzly bears have strong fidelity to their established home ranges where they know their standing in the social hierarchy and are familiar with the local food resources (Craighead et al. 1995). Grizzly bears also have a remarkable homing ability (Cole 1972, Craighead and Craighead 1972, Miller and Ballard 1982). Therefore, relocation as a management tool works best when conflict bears are moved long distances into high-quality habitats in areas with low risk for repeat conflicts (Brannon 1987, Blanchard and Knight 1995, Stenhouse et al. 2022). Choosing release sites with low densities of other bears to reduce density-dependent social intolerance and associated displacement and mortality may also improve relocation success rates (Davis 1949, Cole 1972, Rogers 1986, Riley et al. 1994). Yellowstone National Park is not geographically large enough to relocate grizzly bears far enough so that they do not return to the original conflict site (Cole 1972, Craighead and Craighead 1972) or have opportunity for further conflicts in the relocation area. Relocation distances of >75 km for females, and >100 km for males, are needed to keep return rates <50% (Blanchard and Knight 1995). Those distances are not attainable within the park for grizzly bears captured at most of the parks developed areas and campgrounds, the sites where most conflicts occur. The furthest point from a road a conflict bear can be released in the park is 35 km; the furthest point from a development or campground a bear can be released is 41 km. Portions of the park also have among the highest densities of bears in the GYE and the park receives millions of human recreational visits annually, making it a poor candidate for relocation success.

Monitoring the fate of relocated bears on a long-term basis confirms very low success rates in the park. From 1980 to 2022, 28 grizzly bears involved in conflicts inside the park were captured and relocated to other areas of the park (Table 28). Of these bears, 19 (68%) were known to cause further conflicts after relocation. During the same period, an additional 94 grizzly bears involved in conflicts outside of the park were captured by state agencies and accepted for relocation into the park (Table 29). More than half (n = 50, 53%) of these bears were known to cause further conflicts after relocation. Of the 122 conflict bears relocated within or into the park, we know the final fate of 62. Of these, 53 (86%) were removed (killed or sent to zoo's) in management actions (n = 44) or killed by the public in defense of life or property incidents (n = 9). Other causes of mortality for relocated bears included illegal killings (n = 5), being killed by a black bear hunter (n = 1) and being struck and killed by a vehicle (n = 1). Only 2 (3%) of the 62 relocated conflict bears with known fates died of natural causes; most (97%, n = 60) relocated conflict bears died from human causes after relocation.

The park's current strategy to reduce conflicts and human-causes of mortality uses an aggressive, proactive program focused on conflict prevention. 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 human-bear conflicts; 2) implementing bear-resistant human food and garbage storage requirements through the Code of Federal Regulations and Superintendents Compendium; 3) providing park visitors with bear-proof infrastructure (e.g., bear-resistant garbage cans, dumpsters, and food storage devices) so that food and garbage storage regulations are easy and convenient to comply with; 4) rigorously enforcing food and garbage storage regulations through bear-attractant security patrols in front-country developed sites, roadside campgrounds, and backcountry campsites; and 5) fostering, through removal of human food-conditioned bears (rather than relocation), a population of bears in the park that generally do not seek anthropogenic attractants or test bear-proof infrastructure.

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 national park

staff or defeat food storage infrastructure and obtain human food rewards. In incidents where bears specifically seek out anthropogenic attractants or behave aggressively toward 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 unsecured food, the bears are generally left to roam free on the landscape. 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 1 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 do not seek anthropogenic foods. In contrast, tolerance and overprotection of human food-conditioned bears can promulgate a population where conflict behaviors become so pervasive as to result in the development of a tradition or culture of conflict behaviors in a large segment of the population. Bears that supplement natural foods with anthropogenic food sources can attain larger body sizes, better body condition, better cub nutrition, faster maturation, earlier age of first reproduction, and shorter inter-birth interval, likely giving conflict bears a competitive advantage over non-conflict bears. Over the long term, that competitive advantage could result in conflict bears replacing non-conflict bears in the population.

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). Park managers attempt to break the chain of learned conflict behavior passed from mothers to offspring and grown 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 and garbage storage regulations, eventually the area will be re-occupied by a dispersing subadult exhibiting wild behaviors. By consistently implementing this strategy over the long term, a population of bears once dominated by a culture of conflict behaviors, such as bears in YNP during 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 the 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 the opportunistic behavior of bears can 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 bear-proof infrastructure is provided and there is rigorous enforcement of food and garbage storage regulations (Meagher and Phillips 1983, Gunther 1994, Garshelis et al. 2017, White et al. 2017). For example, during 2012–2021, there were >39.4 million recreational visits to YNP. These visitors spent >6.8 million overnight stays in roadside campgrounds and >400,000 overnight stays in remote backcountry campsites. Given the high level of human recreational activity in the park during those recent 10 years, grizzly bears undoubtedly had some opportunities to obtain unsecured human foods. Despite intense efforts to prevent bears from obtaining human foods, on any given night there were likely a few bear-resistant dumpsters with broken latches, several coolers left out overnight in roadside campgrounds, or food that was not properly hung in backcountry campsites. However, under the park's strategy of aggressively removing bears that seek human foods and promoting

occupation of habitat by bears that do not search out human foods, few bears in the park sought anthropogenic attractants or tested bear-proof infrastructure. During 2012–2021, there were only 26 ($\bar{x}$ = 2.6 ± 2.0 SD/year) documented incidents in the park where grizzly bears obtained human foods or damaged property while attempting to access anthropogenic attractants. In response to the 26 incidents, 2 ($\bar{x}$ = 0.2 ± 0.4 SD/year) independent-age grizzly bears were killed in management actions. These numbers are remarkable considering YNP currently receives >4 million recreational visits per year and has a high density of grizzly bears throughout much of the park.

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 efficiently and effectively allocate resources for implementing management actions designed to prevent grizzly bear-human conflicts, 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 (Table 30).

Management Actions

In 2022, park staff dedicated considerable management effort toward preventing grizzly bear-human conflicts from occurring (Table 31). In response to grizzly bear activity in visitor use areas, park staff posted bear warning signs at 14 locations and implemented temporary trail or area closures at 20 locations. To prevent grizzly bears from being attracted into visitor use areas by animal carcasses, park staff removed 83 large mammal carcasses from developments, roadside campgrounds, road corridors, trails, backcountry campsites, and other visitor use areas. Animal carcasses removed from visitor use areas included 28 elk, 22 mule deer, 20 bison, 6 black bear, 3 coyotes, 1 moose, 1 pronghorn, 1 beaver, and 1 domestic mule. To discourage grizzly bears from entering areas of concentrated visitor use, park staff hazed grizzly bears out of human use areas 58 times. Staff hazed grizzly bears out of primary road corridors 43 times and out of park developments 15 times. In addition, as part of the park's strategy for preventing bears from obtaining human foods, 172 bear-proof food storage lockers (30 cubic feet; ft^3) were purchased with donations raised by the Yellowstone Forever foundation and installed in roadside campgrounds. With the installation of 172 food storage lockers, 1,338 (70%) of the park's 1,914 roadside campground campsites now have bear-proof food storage lockers. Eight of the parks 11 campgrounds, including Pebble Creek, Slough Creek, Tower Falls, Mammoth, Indian Creek, Norris, Canyon, and Lewis Lake, have food storage lockers in every campsite. As part of the program, some food storage lockers have also been installed in the Madison (81% of sites), Bridge Bay (76% 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. All 300 designated backcountry campsites in YNP currently have a food storage device (food hanging poles in 260 campsites and bear-proof food storage lockers in 40 campsites). When camping in non-designated sites in dispersed camping zones, backcountry campers are required to use Interagency Grizzly Bear Committee approved hard-sided food storage canisters or rig their own food-hanging device.

Management of Roadside Bear Viewing

The objectives of managing visitors at roadside bear-viewing opportunities include: 1) preventing visitors from feeding roadside bears; 2) keeping visitor behavior as predictable as possible to bears; 3) keeping visitors at least 100 yards from bears; and 4) preventing visitors from approaching, encircling, or following roadside bears. The habituation of some bears to people combined with the presence of large areas of non-forested habitat with good visibility in YNP 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 the park (Taylor et al. 2014, Richardson et al. 2015) and contributes millions of dollars to the economies of gateway communities annually (Richardson et al. 2014).

Park staff spent considerable time managing visitors at roadside bear-viewing opportunities in 2022. Staff and visitors reported 396 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 traffic jams. Park staff responded to 251 (63%) of the grizzly bear jams and spent 1,104 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 4.4 staff-hours managing each grizzly bear-jam.

In addition, 587 traffic-jams caused by black bears were reported. Park staff responded to 498 (85%)

of the black bear jams and spent 1,363 personnel hours managing habituated black bears, the traffic associated with the bear jams, and the visitors that stopped to view and photograph habituated black bears along roads. On average, park personnel spent 2.7 staff-hours managing each black bear-jam.

Human-Bear Conflicts

There were 3 human-grizzly bear conflicts reported in YNP in 2022 (Table 32). On May 18 at approximately 7:40 p.m., a subadult grizzly bear was grazing the lush vegetation along the shoulder of the Mammoth to Norris Road near North Twin Lake when a family in a pickup truck drove up and threw a couple of pieces of bread out their window to the bear. When other park visitors that had been watching and photographing the bear yelled at the family to stop feeding the bear, the family in the pickup truck drove away. The bear ate the bread, then continued grazing the succulent early spring vegetation along the shoulder of the road. After this incident, Bear Management staff began closely monitoring the North Twin Lake area and hazed the subadult bear away from the road every time they encountered it. After repeated hazing efforts, the bear began keeping a further distance from the road and traffic, thereby reducing the chances the bear would get fed by visitors again. Four days later, a grizzly bear matching the description of the subadult that had been fed bread was killed by a mating pair of grizzly bears at nearby Clearwater Springs.

On the early morning of August 17, an adult grizzly bear (based on a track left on the garbage can) pulled paper and cardboard food wrappers out of the over-stuffed hood on a bear-resistant garbage can at the Xanterra Service Center, inside the park immediately adjacent to Gardiner, Montana. The bear likely only obtained a small amount of food residue from the wrappers and plastic bottles it pulled out of the garbage can. Because the garbage can was overflowing, the bear did not damage any property and the food reward was very minimal, no action was taken against the bear. The bear-resistant garbage can was emptied and a schedule to regularly empty the can was implemented. No further conflict incidents took place at the service center the remainder of the year.

On August 29, at approximately 9:30 a.m., a hiker at Grebe Lake stopped, took off his pack, and ate half of a granola bar, then set the remaining portion of the granola bar on his pack on the ground and walked approximately 30 yards down to the shore of the Lake. While at the lake shore, he heard a noise, turned around, and saw a grizzly bear eating the remaining portion of his granola bar. He yelled at the bear and it began walking away down the shore of the lake. As it walked down the shore it passed by 2 fishermen standing in the water near the shore. The fishermen sprayed the bear with bear spray, and it ran off into the forest. Because the bear had not acted aggressively to obtain the granola bar and had received an aversive conditioning treatment by being bear-sprayed, no further action was taken against the bear. Bear warnings were posted on the Grebe Lake trail and campsites. There were no further incidents at Grebe Lake for the remainder of the year.

Many factors including the availability of natural bear foods, grizzly bear population numbers, and park visitation influence the annual number of bear-human conflicts occurring in YNP. 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. 29, Meagher and Phillips 1983, Gunther 1994, Garshelis et al. 2017).

Grizzly Bear Mortality

During 2022, there were 4 known grizzly bear mortalities in the YNP portion of the GYE. All 4 known mortalities were caused by other bears, indicative of density-dependent factors influencing bear survival in the national park.

On May 22, at approximately 12:30 p.m., a subadult male grizzly bear (estimated at 3 years old based on tooth eruption and wear) weighing about 148 pounds was killed by a mating pair of grizzly bears near Clearwater Springs along the Mammoth to Norris Road. The subadult was digging in a meadow when attacked by the mating pair. The adult female grizzly attacked the subadult first, followed by the adult male. The subadult incurred massive head, neck, and spinal column wounds as well as a broken right shoulder and a large hole in the right flank exposing its internal organs.

On May 24, the carcass of 10-year-old, radio-collared male grizzly bear #1052 was discovered in the Crystal Creek drainage in Lamar Valley. Grizzly Bear #1052 had bear-sized canine puncture wounds on the right side of its head. An upper canine puncture had penetrated the brain cavity and was the likely cause of death.

On May 28, at approximately 8:30 a.m., grizzly bear #980's 2 cubs-of-the-year were found dead next to the road in the north end of Gibbon Canyon. Visitors observed grizzly bear #980 carry one of the dead cubs up the cliffs on the side of the road. The other cub was collected and examined. It died from canine puncture wounds that penetrated and crushed the skull. The

canine puncture wounds were consistent with those of an adult male grizzly bear.

Trends in causes of grizzly bear mortality inside YNP have changed considerably over time. From the late 1950s through the 1970s, most grizzly bear mortality in the park was due to human causes (Fig. 30), primarily management removals of bears involved in bear-human conflicts (Craighead et al. 1988). Over the last 4 decades (1980–2022), most grizzly mortality in the park has been from natural causes, primarily complications of old age and intra- and inter-specific strife and predation involving other grizzly bears and wolves.

Table 28. Long-term fate of 28 unique grizzly bears involved in bear-human conflicts inside of Yellowstone National Park that were captured and relocated to remote areas of the park, 1980–2022.

Fate	Number
Caused further conflicts after relocation, later removed in management action	10
Caused further conflicts after relocation, later killed in defense of life or property incident outside of park	2
Caused further conflicts after relocation, later killed illegally outside of park	1
Caused further conflicts after relocation, later killed by black bear hunter (mistaken identification) outside of park	1
Caused further conflicts after relocation, later struck and killed by a vehicle outside of park	1
Caused further conflicts after relocation, final fate unknown	4
No known conflicts after relocation, final fate unknown	9
No known conflicts after relocation, died of natural causes	0
Total	28

Table 29. Long-term fate of 94 unique grizzly bears involved in bear-human conflicts outside of Yellowstone National Park that were captured and accepted for relocation into the park, 1980–2022.

Fate	Number
Caused further conflicts after relocation, later removed in management action	34
Caused further conflicts after relocation, later killed in defense of life or property incident outside of park	7
Caused further conflicts after relocation, later killed illegally outside of park	2
No known conflicts after relocation, later killed illegally outside of park	2
Killed by black bear hunter (mistaken identification)	0
Struck and killed by vehicle	0
Caused further conflicts after relocation, final fate unknown	7
No known conflicts after relocation, final fate unknown	40
No known conflicts after relocation, died of natural causes	2
Total	94

Table 30. Definition of terms used in human-bear conflict management in Yellowstone National Park.

Term	Definition
Human-bear conflict	Incidents where bears injured or killed people, damaged property, obtained human foods, garbage, or other anthropogenic attractants, or injured or killed livestock or pets.
Property damage – without food reward	Incidents where bears damaged property including vehicles, buildings, tents, and camping equipment, etc., but did not obtain human-food rewards.
Anthropogenic food reward	Incidents where grizzly bears obtained human-related foods including garbage, groceries, grease, pet foods, livestock feed or other edible human-related attractants.
Human injury	Incidents where bears injured 1 or more people, including minor scratches, bites, and contusions.
Human fatality	Incidents where bears killed people intentionally or unintentionally in offensive encounters or during defensive reactions to encounters.
Livestock depredation	Incidents where bears killed or injured domestic horses, mules, burro's, donkeys, or llamas.

Table 31. Number of management actions taken to reduce the potential for human-grizzly bear conflicts in Yellowstone National Park, 2022.

Management action	Number of incidents
Bear warnings posted	14
Temporary area closures implemented	20
Wildlife carcass removal from visitor use areas	83
Bear-jam management	251
Management hazing	58
Attempted capture–unsuccessful	0
Captured, marked, and released on site	0
Captured and relocated	0
Captured and removed (euthanized or live placement in zoo)	0
Captured for humane reasons	0
Total management actions	426

Table 32. Number of incidents of human-grizzly bear conflict reported in Yellowstone National Park, 2022.

Conflict type	Number of conflicts
Property damage–without food reward	0
Anthropogenic food reward	3
Human injury	0
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 commercial outfitters have contracts to provide stock day rides and overnight pack trips in the park. In 2022, stock animals (horses, mules, llamas) spent 6,427 nights on overnight pack trips in Yellowstone National Park's backcountry.

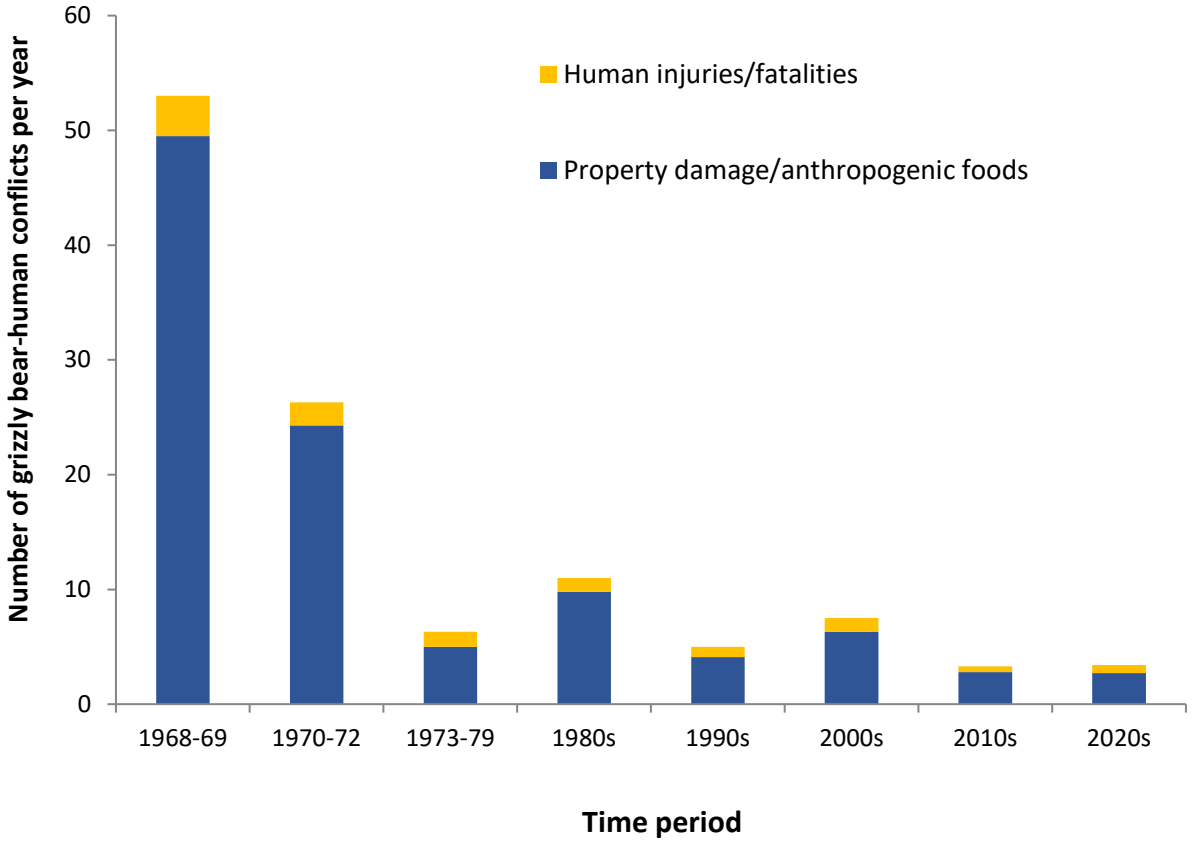

Fig. 29. Average number of human-grizzly bear conflicts per year by time-period, Yellowstone National Park, 1968–2022.

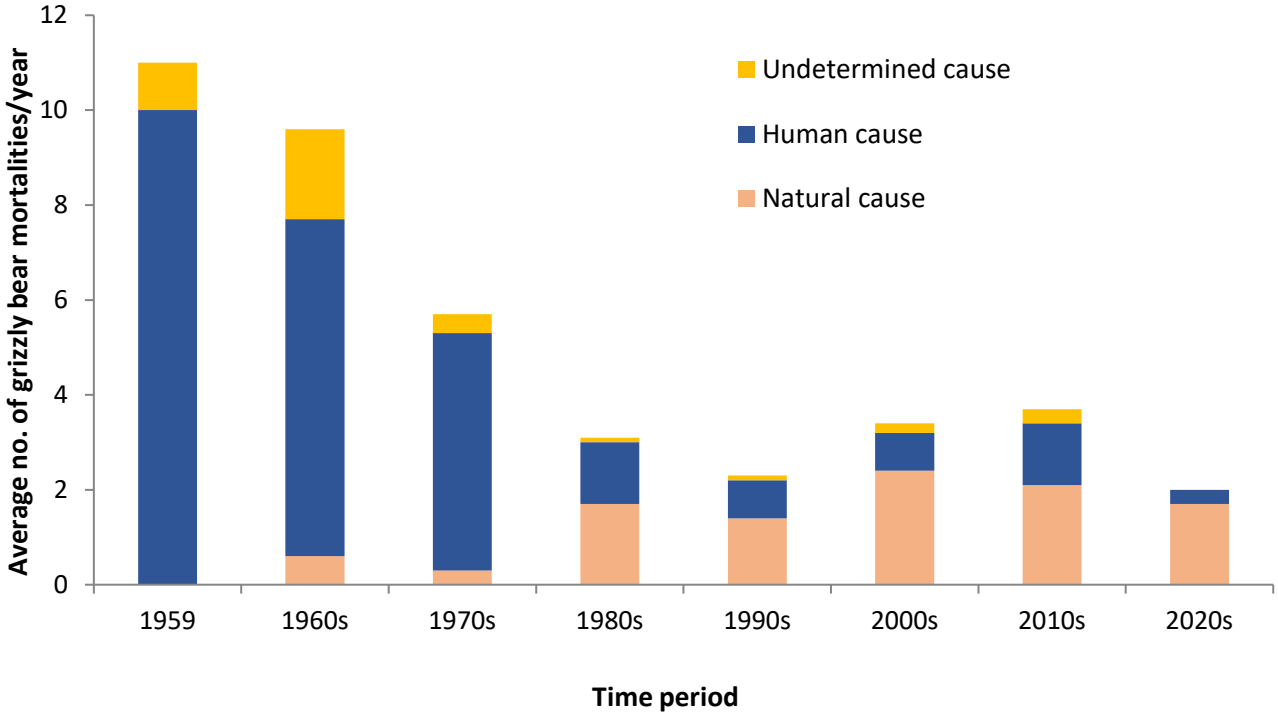

Fig. 30. Average number of known and probable grizzly bear mortalities per year by time-period, Yellowstone National Park, 1959–2022.

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

The Idaho Department of Fish and Game responded to 49 human-grizzly bear conflicts in 2022 (Table 33, Fig. 31). Conflicts have consistently occurred in Idaho's portion of the GYE since 2005 (Fig. 32). Since 1992, the vast majority (93%) of conflicts have occurred inside the DMA (Fig. 33). Only 2 conflicts occurred outside the DMA in 2022.

Table 33. Human-grizzly bear conflicts in the Idaho portion of the Greater Yellowstone Ecosystem, 2022.

Conflict type	Number of conflicts
Public safety threat (e.g., habituated, near developed site)	24
Anthropogenic foods	13
Livestock depredation	6
Encounter situations	3
Property damage–without food reward	2
Human-caused bear mortality	1
Human injury	0
Total	49

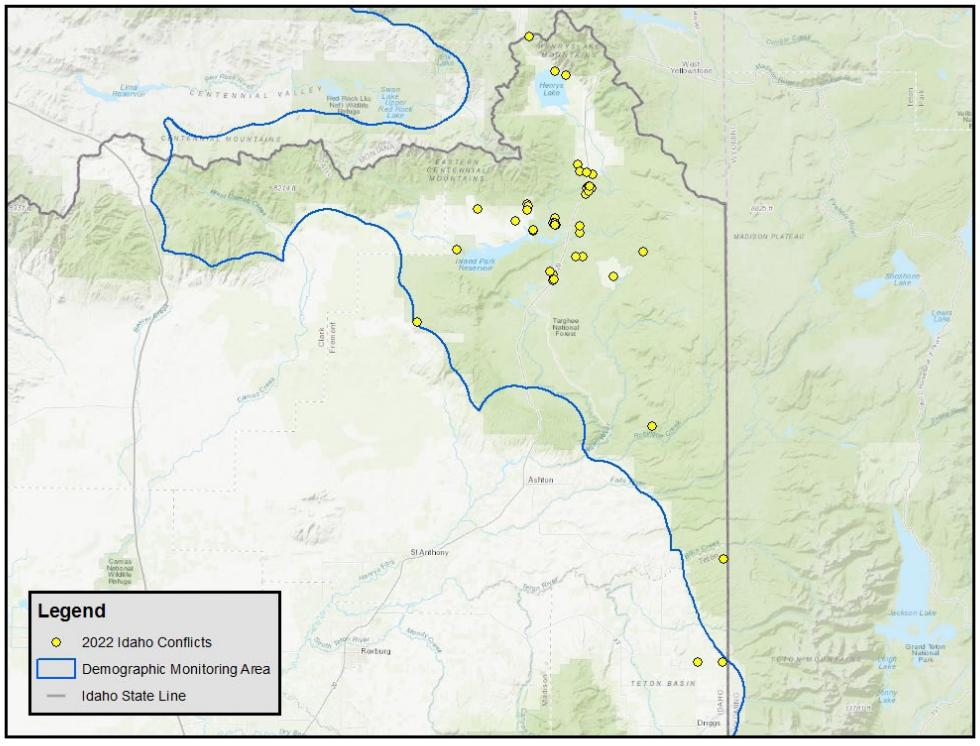

Fig. 31. Locations of human-grizzly bear conflicts in the Idaho portion of the Greater Yellowstone Ecosystem, 2022. Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

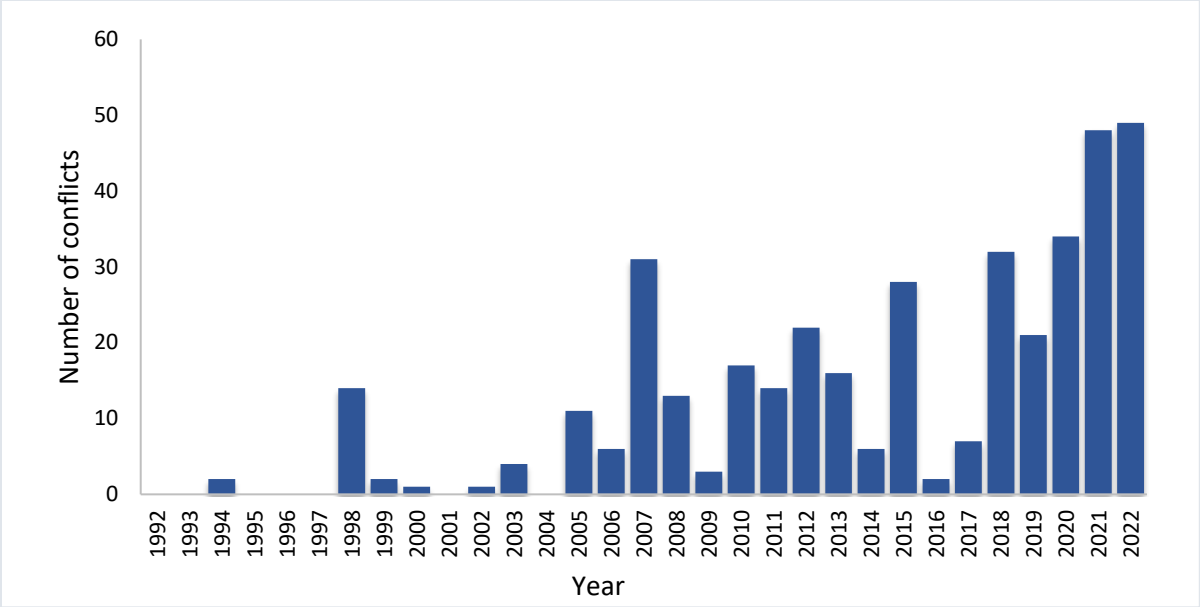

Fig. 32. Number of documented human-grizzly bear conflicts in the Idaho portion of the Greater Yellowstone Ecosystem, 1992–2022.

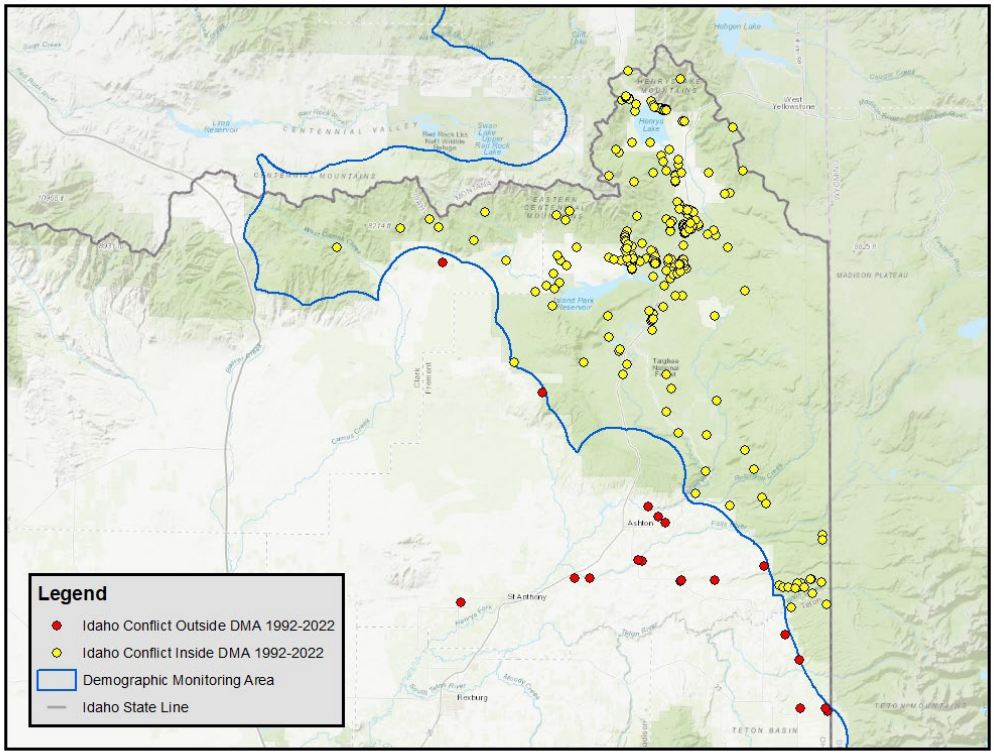

Fig. 33. Location of documented human-grizzly bear conflicts inside and outside the Demographic Monitoring Area in the Idaho portion of the Greater Yellowstone Ecosystem, 1992–2022. Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

Human-Grizzly Bear Conflicts in Montana *(Jeremiah Smith, Kylie Kembel, and Kyle Orozco Montana Fish, Wildlife and Parks)*

During 2022 in Montana's portion of the GYE, there were a total of 152 investigated human-bear conflicts and 7 documented grizzly bear mortalities. The number of conflicts is shown by type in Table 34 and annual variation in conflicts and grizzly bear mortalities are shown in Fig. 34. For 2013–2022, the average number of grizzly bear conflicts was 99.4 per year and 10.5 grizzly bear mortalities per year.

Table 34. Human-grizzly bear conflict types in the Montana portion of the Greater Yellowstone Ecosystem, 2022.

Conflict type	Number of conflicts
Livestock - cattle	20 (20 cattle killed or injured)
Livestock - sheep	0 (0 sheep killed)
Livestock - poultry	13 (96 poultry killed)
Other property loss	17
Anthropogenic foods	26
Anthropogenic foods with property damage	9
At developed sites–safety concerns	44
Bear mortalities	7 (4 management, 2 others, and 1 defense of life)
Encounters and human injuries	15 (resulting in 1 fatality)
Management action (other)	1 (vehicle strike)
Total	152

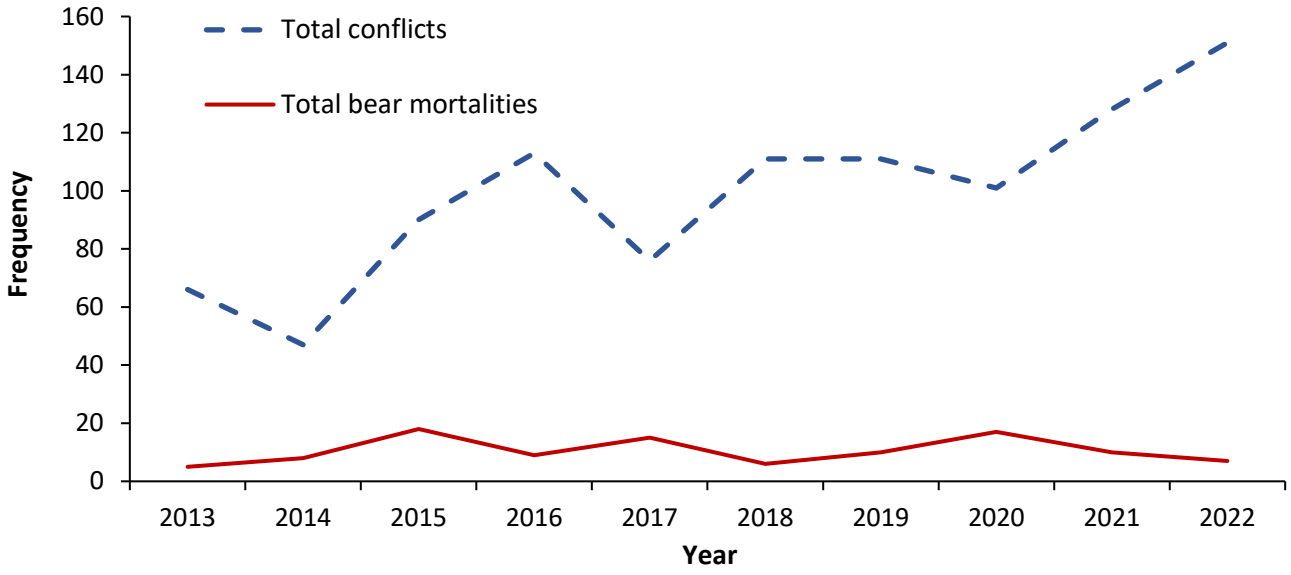

Fig. 34. Frequency of total grizzly bear conflicts and bear mortalities in the Montana portion of the Greater Yellowstone Ecosystem, 2013–2022.

The distribution of grizzly bear conflicts by land jurisdiction is shown in Table 35. During 2022, the largest percentage (74%) 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 2013 through 2022 are shown in Fig. 35. The yearly average of these conflicts is 12.6 close encounters, 2.2 human injuries, and 2.8 defense of life grizzly bear mortalities. During 2022, there were 15 close encounters resulting in 0 human injuries, 1 human fatality, and 1 grizzly bear mortality.

Cattle depredations are increasing as grizzly bear numbers and geographic distribution increases. The annual variation and overall increases in Montana Fish, Wildlife and Parks Region 3 and Region 5 are shown in Fig. 36. From 2013 through 2022, the yearly average for the geographic portions are 20.1 depredations in Region 3 and 15.3 in Region 5. During 2022, there were 20 documented cattle depredations in Region 3 and 0 in Region 5.

Fig. 37 displays a map of all 2022 grizzly bear mortalities in Montana's portion of the GYE. Fig. 38 displays a map of all 2022 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 35. Total conflicts by land jurisdiction in the Montana portion of the Greater Yellowstone Ecosystem, 2022.

Jurisdiction	Number of conflicts
Private	111
State	2
County or local government	6
Federal	1
Bureau of Land Management	0
Custer Gallatin National Forest	15
Beaverhead-Deerlodge National Forest	17
USFWS–National Wildlife Refuge	0
Total	152

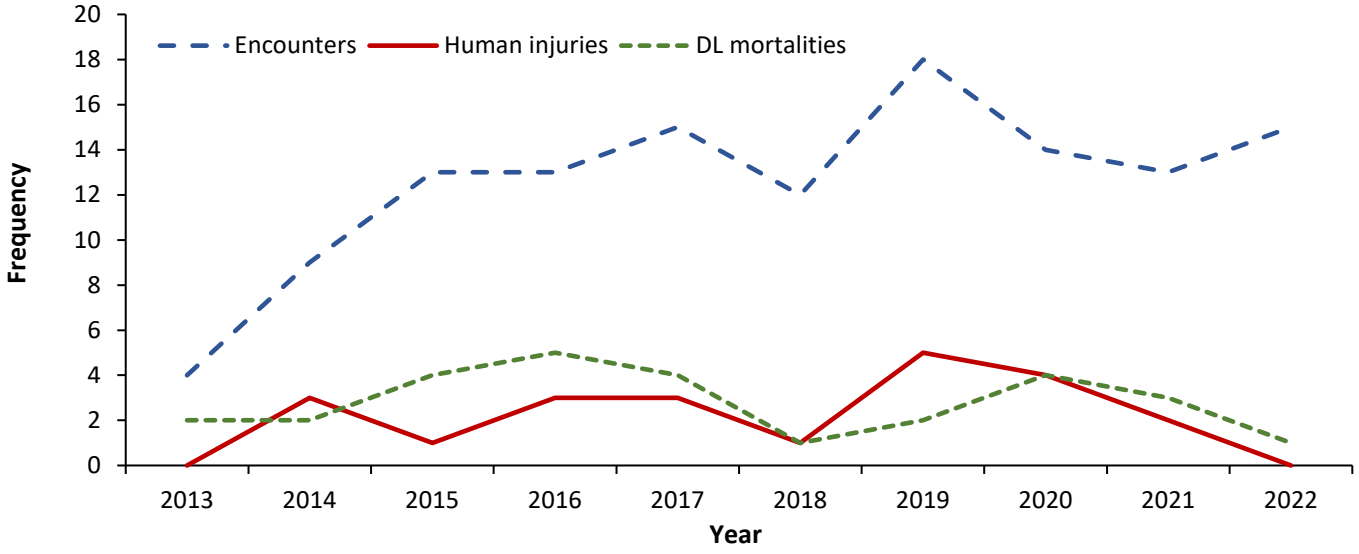

Fig. 35. Frequency of bear encounters, resulting human injuries and defense of life (DL) bear mortalities in the Montana portion of the Greater Yellowstone Ecosystem, 2013–2022.

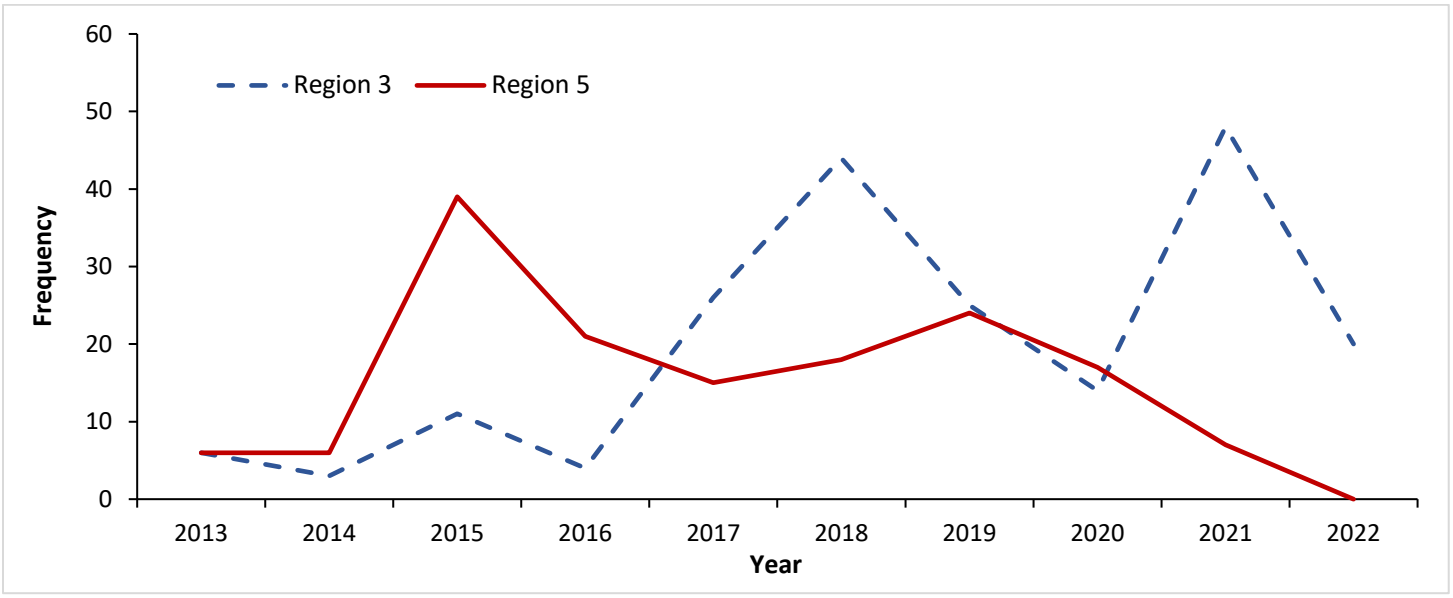

Fig. 36. Frequency of cattle depredation conflicts in the Montana portion of the Greater Yellowstone Ecosystem, 2013–2022.

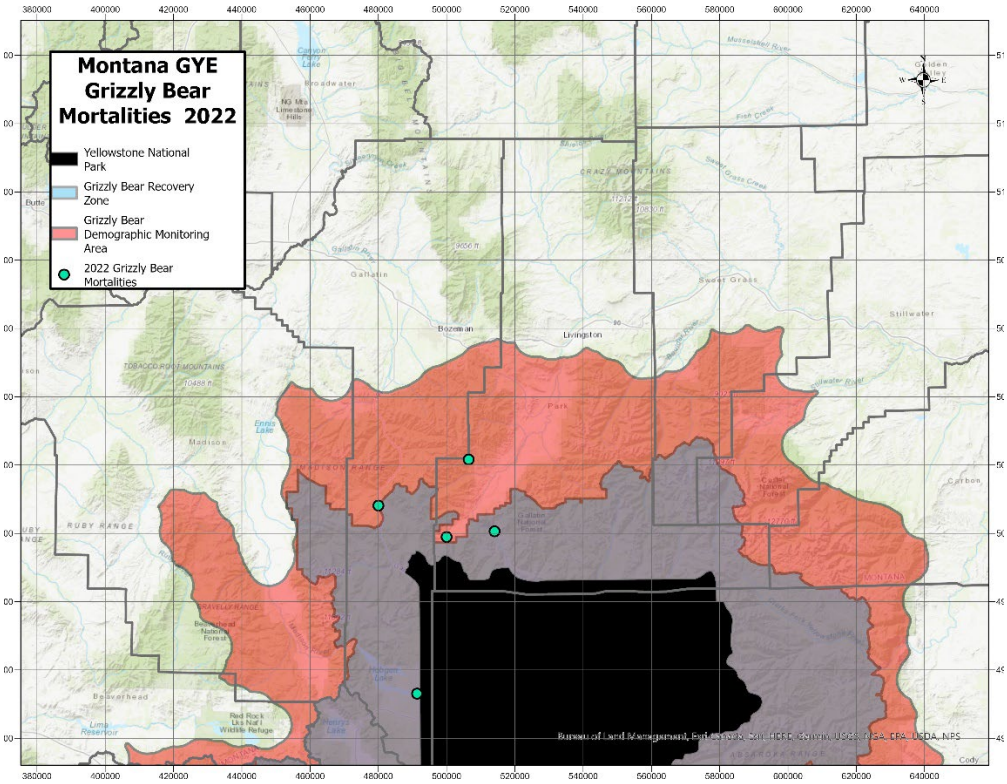

Fig. 37 Locations of all grizzly bear mortalities in the Montana portion of the Greater Yellowstone Ecosystem, 2022. Base Map: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL.

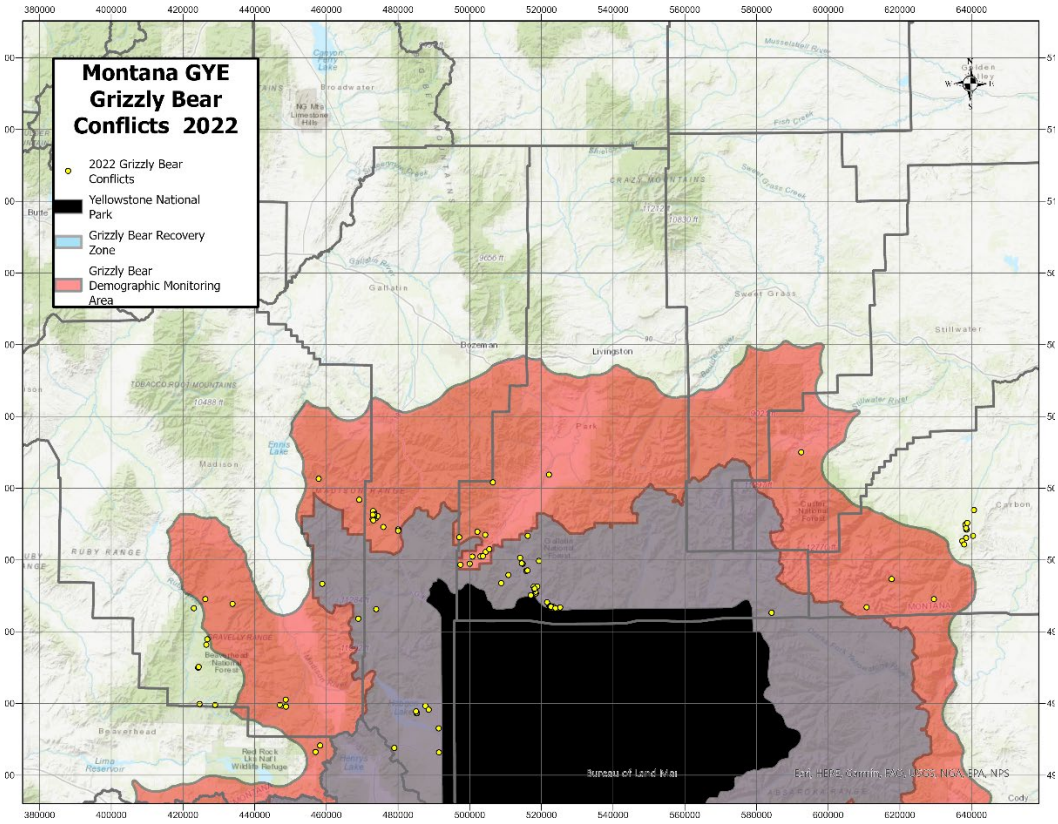

Fig. 38. Locations of all conflict types and grizzly bear mortalities in the Montana portion of the Greater Yellowstone Ecosystem, 2022. Base Map: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community.

Human-Grizzly Bear Conflicts in Wyoming *(Brian DeBolt, Luke Ellsbury, Michael Boyce, Scott Stingley, Kyle Garrett, Christoper Evans, Nathan Kluge, Clint Atkinson, Ken Mills, Phil Quick, Ryan Kindermann, Sean Ryder, Cade Bowlin, and Daniel J. Thompson; Large Carnivore Section, Wyoming Game and Fish Department)*

In Wyoming, grizzly bear conflicts are defined as "interactions between grizzly bears, people and their property, resulting in damage to pets, livestock or bees, non-natural food rewards, animal caused human injury or death, and human caused injury or death to an animal other than legal hunting or a management action." Human-grizzly bear interactions and conflicts in Wyoming are a result of an abundance of bears seeking unnatural foods in association with people and property, close encounters with humans, or when bears kill livestock. Proactive prevention is the goal of the WGFD in minimizing conflicts. The number and location of human-grizzly bear conflicts is influenced by the availability of unsecured, unnatural attractants (e.g., human foods and garbage), seasonal distribution and abundance of natural foods, grizzly bear density and distribution, and human and livestock use patterns on the landscape.

Management techniques used to reduce human-grizzly bear conflicts globally are deployed by the WGFD, including the capture and relocation of individual bears. Relocation achieves several social and conservation functions: 1) it reduces the chance of property damage, livestock damage, or human interactions in areas where the potential for conflict is high; 2) it reduces the potential for grizzly bears to become food conditioned and/or human habituated, which often results in destructive and/or dangerous behaviors; 3) it allows grizzly bears the opportunity to forage on natural foods and remain wary of people; and 4) it could prevent removing grizzly bears from the population that may be beneficial in maintaining recovery criteria and population management objectives.

In addition to capture and relocation, the WGFD also removes grizzly bears (lethally or by live placement in a zoo or other facility) in response to human-grizzly bear conflicts, when necessary, as part of routine management operations. All grizzly bear management actions were conducted in coordination with the USFS and USFWS. The decision to relocate or remove a grizzly bear is made after considering a number of factors including the age and sex of the animal, behavioral traits, health status, physical injuries or abnormalities, type of conflict, severity of conflict, known history of the animal, human safety concerns, availability of suitable relocation sites, and population management objectives. Grizzly bears are relocated or removed in accordance with Federal and State law, regulation, and policy.

In 2005, the Wyoming Legislature enacted House Bill 203, which created Wyoming Statute §23-1-1001 that requires the WGFD to:

a) Upon relocating a grizzly bear or upon receiving notification that a grizzly bear is being relocated, the Department shall provide notification to the county sheriff of the county to which the grizzly bear is relocated within 5 days of each grizzly bear relocation and shall issue a press release to the media and sheriff in the county where each grizzly bear is relocated;

b) The notice and press release shall provide the following information:

i) the date of the grizzly bear relocation;

ii) the number of grizzly bears relocated; and

iii) the location of the grizzly bear relocation, as provided by commission rule and regulation;

c) no later than January 15 of each year the Department shall submit an annual report to the Joint Travel, Recreation, Wildlife, and Cultural Resources Interim committee. The annual report shall include the total number and relocation area of each grizzly bear relocated during the previous calendar year. The Department shall also make available the annual report to the public.

Subsequently, the Wyoming Game and Fish Commission promulgated Chapter 58 Notification of Grizzly Bear Relocation Regulation to further direct the implementation of Wyoming Statute §23-1-1001.

Grizzly Bear Management Captures, Relocations, and Removals

During 2022, the Department captured 21 individual grizzly bears in an attempt to prevent or resolve conflicts (Table 36, Fig. 39). Of the 21 individual captures, 4 were female (3 adults and 1 two-year olds) and 17 were male (9 adults, 6 subadults, and 2 cubs) grizzly bears. Of the 21 capture events, 10 captures were a result of bears killing livestock (cattle, sheep, and chickens) and 10 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 bear was captured at a cattle

depredation site that was not implicated in the specific conflict (i.e., "non-target" capture). Some non-target bears are relocated to focus trapping efforts toward the "target" individual, or for human safety, and some are released on site. Of the 21 capture events, 10 (48%) were in Park County, 5 (23%) were in Hot Springs County, 4 (19%) were in Sublette County, and 1 (5%) each were in Fremont County and Teton County (Table 36).

Of the 21 capture events, 6 involved relocation (Table 36, Fig. 40). All relocated grizzly bears were released on USFS lands in or adjacent to the GBRZ. Of the 6 relocations, 4 were conducted in Park County and 1 each (17%) in Teton and Sublette counties (Table 36). In the Sublette County relocation, bear 1086 was transported a short distance from the capture site due to the lack of adequate relocation sites elsewhere.

Grizzly bears are removed from the population due to a history of previous conflicts, a known history of close association with humans, or if they are deemed unsuitable for release into the wild (e.g., orphaned cubs, poor physical condition, or human safety concern). Of the 21 grizzly bears captured, 15 bears were removed from the population. Of these 15, 9 (60%) were outside of the DMA, which is the area considered suitable for the long-term viability of grizzly bears in the GYE. Removal of grizzly bears in Wyoming is dependent on authorization from the USFWS after careful and thorough deliberation considering multiple factors unique to each conflict situation.

Notification to the County Sheriff and the Media

Within 5-days of releasing a grizzly bear, the county sheriff was notified by e-mail and a press release was distributed to all local media contacts in the county where the grizzly bear was released. The media release contained the date of the relocation, the number of grizzly bears relocated, the location of the grizzly bear relocation, the reason the grizzly bear was relocated, and additional bear safety and conflict avoidance information.

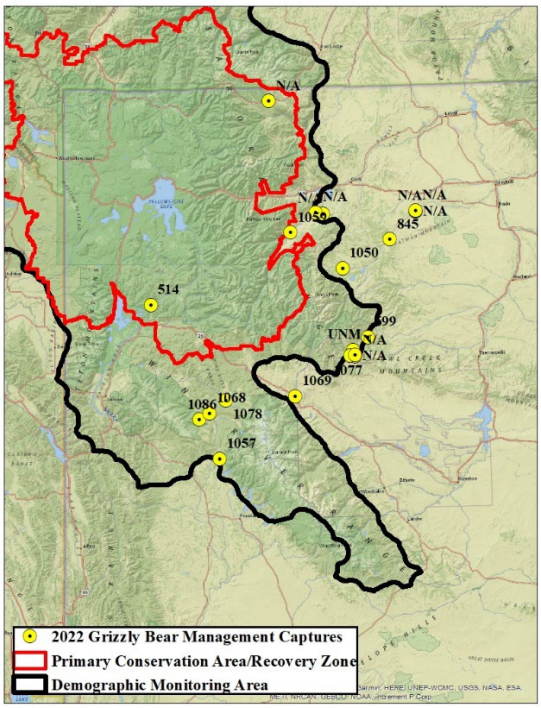

Fig. 39. Locations (n = 21) for grizzly bears captured in conflict management efforts in the Wyoming portion of the Greater Yellowstone Ecosystem, 2022. Because of the mapping scale, some locations are combined at one symbol. A complete list is provided in Table 36.

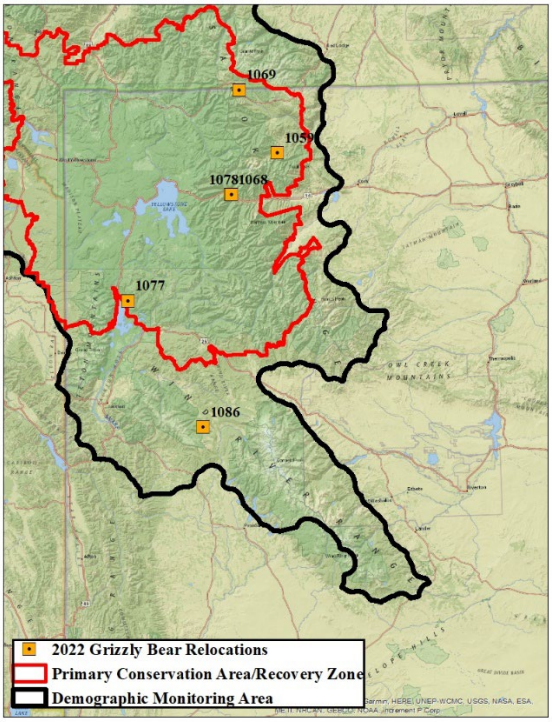

Fig. 40. Release locations (n = 6) for grizzly bears captured, relocated, or released on site in conflict management efforts in the Wyoming portion of the Greater Yellowstone Ecosystem, 2022. A complete list is provided in Table 36.

Table 36. Summary of grizzly bear conflict management captures in the Wyoming portion of the Greater Yellowstone Ecosystem, 2022. 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
4/25/2022	1050	Park			Captured and removed for cattle depredation.
5/4/2022	1059	Park	Gravel Bar Creek	Park	Captured and relocated for cattle depredation.
6/21/2022		Park			Captured and removed for extreme habituation and food conditioned behavior.
6/24/2022		Park			Captured and removed for cattle depredation.
7/8/2022	1068	Sublette	Five Mile Creek	Park	Captured and relocated for cattle depredation.
7/12/2022	1057	Sublette			Captured and removed for exhibiting very bold behavior, frequenting residential areas, actively gaining access to and seeking human foods, or food-conditioned behavior. These behaviors began in 2021 while still a dependent cub. Removed due to human safety concerns
7/13/2022		Hot Springs			Captured and removed for sheep depredation.
7/16/2022	1069	Fremont	Fox Creek	Park	Captured and relocated for obtaining unsecured garbage and pig slop.
7/27/2022		Hot Springs			Captured and removed for sheep depredation.
7/31/2022	1077	Hot Springs	Bailey Creek	Teton	Captured and relocated for sheep depredation.
8/1/2022	1078	Sublette	Five Mile Creek	Park	Captured and relocated for cattle depredation.
8/12/2022		Hot Springs			Captured and removed for sheep depredation.
8/30/2022	699	Hot Springs			Captured and removed for cattle depredation.
9/10/2022	514	Teton			Captured and removed for obtaining horse grain and dog food, failed prior relocation attempt from same location.
9/2/2022	1086	Sublette	Teepee Creek	Sublette	Captured for cattle depredation, fit with GPS collar and released near site due to limited relocation options.
9/27/2022	G190	Park			Captured and removed with 2 offspring for frequenting corn and bean field, human safety concerns.
9/27/2022		Park			Captured and removed with maternal female and sibling for frequenting corn and bean field, human safety concerns.
9/27/2022		Park			Captured and removed with maternal female and sibling for frequenting corn and bean field, human safety concerns.
10/5/2022		Park			Captured and removed for breaking into multiple chicken coops and obtaining food rewards.
10/8/2022		Park			Captured and removed for frequenting agricultural areas and crop damage.
12/5/2022	845	Park			Captured and removed for repeated crop damage, beehive damage, frequenting agricultural areas and prior failed relocation attempt.

Department personnel investigated and recorded 206 human-grizzly bear conflicts in 2022 (Table 37, Fig. 41). As a result of vigilant education and conflict prevention efforts, the general pattern of conflicts is relatively steady within currently occupied habitat (Fig. 42). The low number of conflicts in 2022 could have been due to a variety of the factors that cause seasonal variation. However, as occupied grizzly bear range has expanded, conflicts continue in areas farther from the GRBZ and outside the DMA, often on private lands. In areas where grizzly bears have not been present in recent history, bears are increasingly coming into conflict with people. This has resulted in more conflicts with bears causing significant damage to standing crops and sometimes making routine activities in working landscapes potentially dangerous. Although the joint efforts of the WGFD, USFS, 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 2022. This has been the trend for decades, simply because there is no effective method to reduce livestock depredation on large open-range areas. Although the annual variation in 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).

More than half of the grizzly bear conflicts in Wyoming occurred on private lands and the majority were outside of the GBRZ. 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 a growing interest in roadside bear viewing. Some people engage in unethical wildlife viewing practices, often resulting in habituated or food-conditioned grizzly bears. Bears are also anthropomorphized on social media, where some bears are elevated to celebrity status. These situations focus on individuals instead of all grizzly bears in the population and continue to present difficult challenges for bear managers. Based on evidence of density-dependent effects (van Manen et al. 2016, Corradini et al. 2023), the GYE grizzly bear population may have reached or exceeded its biological carrying capacity in portions of the ecosystem, individual bears continue to disperse into less suitable habitat. Therefore, 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 the WGFD. Nevertheless, conflict management is often reactive. Even with the most stringent food and attractant control, the increasing and expanding grizzly bear numbers will lead to conflicts between bears and people. Particularly in areas where females are teaching their young to be habituated to humans, there will be young bears venturing out and struggling to find food and survive. This situation emphasizes the importance of bears remaining wary of people and not becoming conditioned to human foods and other attractants, thus avoiding the need to be relocated or euthanized.

In general, there is less social tolerance and biological suitability for bear occupancy in areas farther from the GRBZ because of 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 37. Type and number of human-grizzly bear conflicts in the Wyoming portion of the Greater Yellowstone Ecosystem, 2022.		
Conflict type	**Number**	**Percent (%)**
Cattle	128	62
Other (crop damage and habituated or aggressive behavior)	15	7
Garbage	12	6
Aggression toward humans	11	5
Pets, livestock, birdfeed	10	4
Sheep	8	4
Animal death	6	3
Property damage	4	2
Poultry	3	1.5
Human injury	2	1
Beehive	2	1
Properly stored game	1	<1
Fruit trees	1	<1
Unsecured attractant	1	<1
Animal injury	1	<1
Pet or guard animal	1	<1
Grand total	206	100

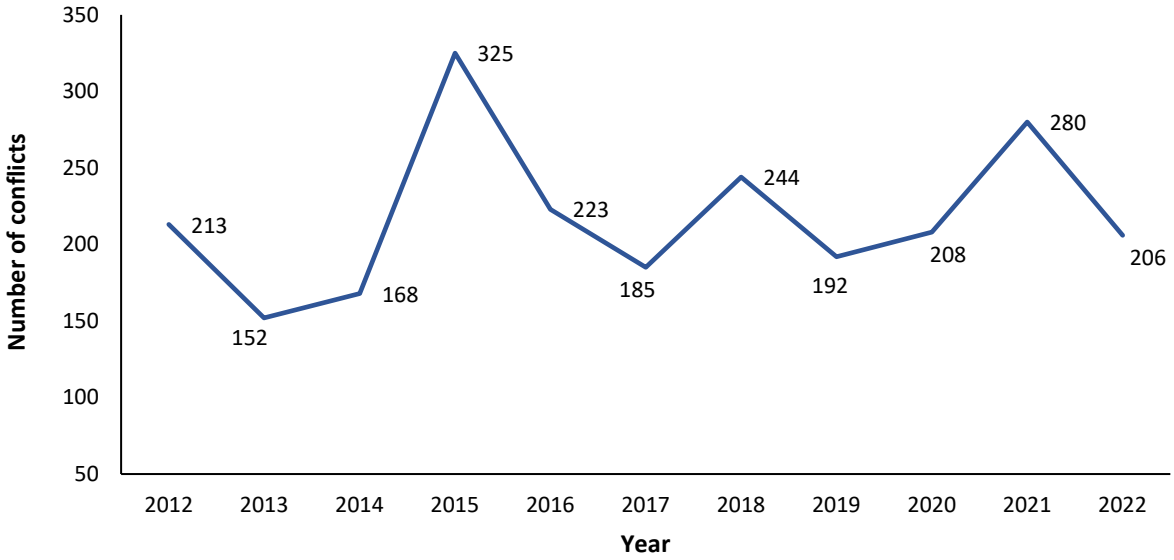

Fig. 41. Number of human-grizzly bear conflicts in the Wyoming portion of the Greater Yellowstone Ecosystem, 2012–2022.

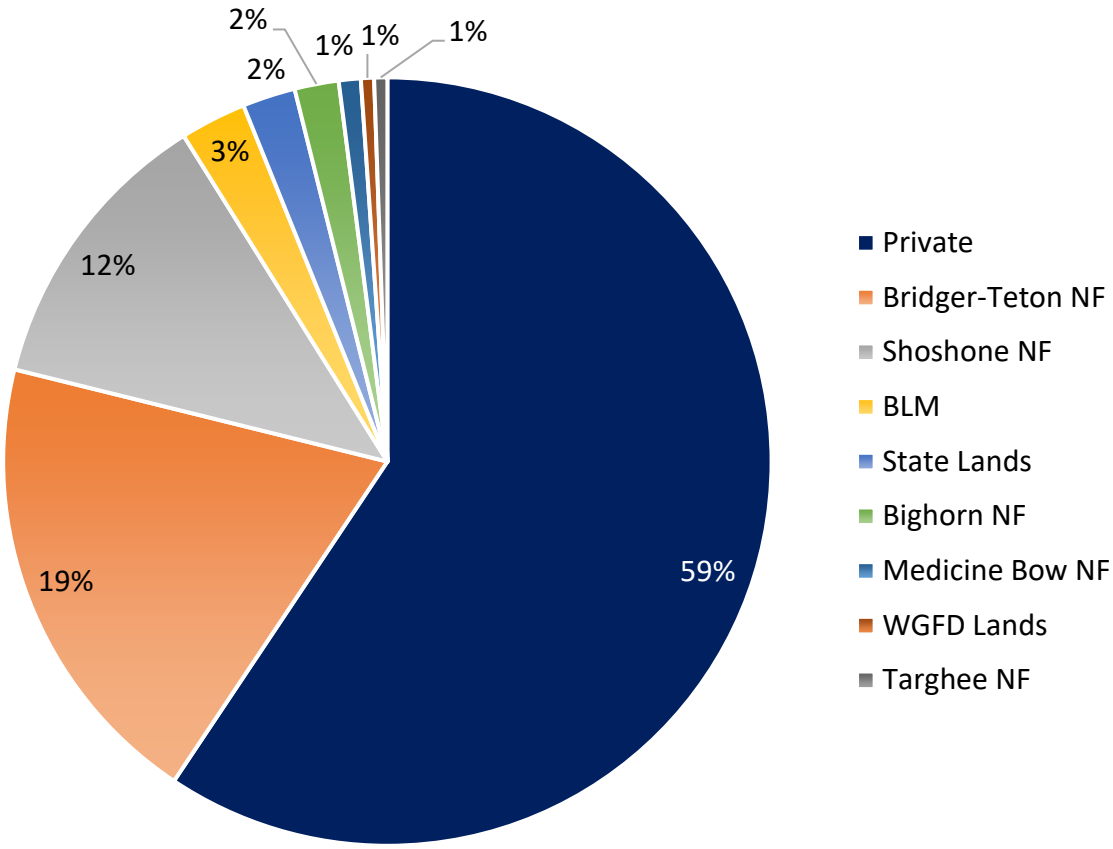

Fig. 42. Percent of human-grizzly bear conflicts on private and public lands in the Wyoming portion of the Greater Yellowstone Ecosystem, 2022.

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

No encounters were reported on the Wind River Reservation in 2022 (Fig. 43). Encounters occur when bears and people meet and are both aware of each other's presence, but with no ensuing conflict.

No conflicts were reported in 2022. 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.

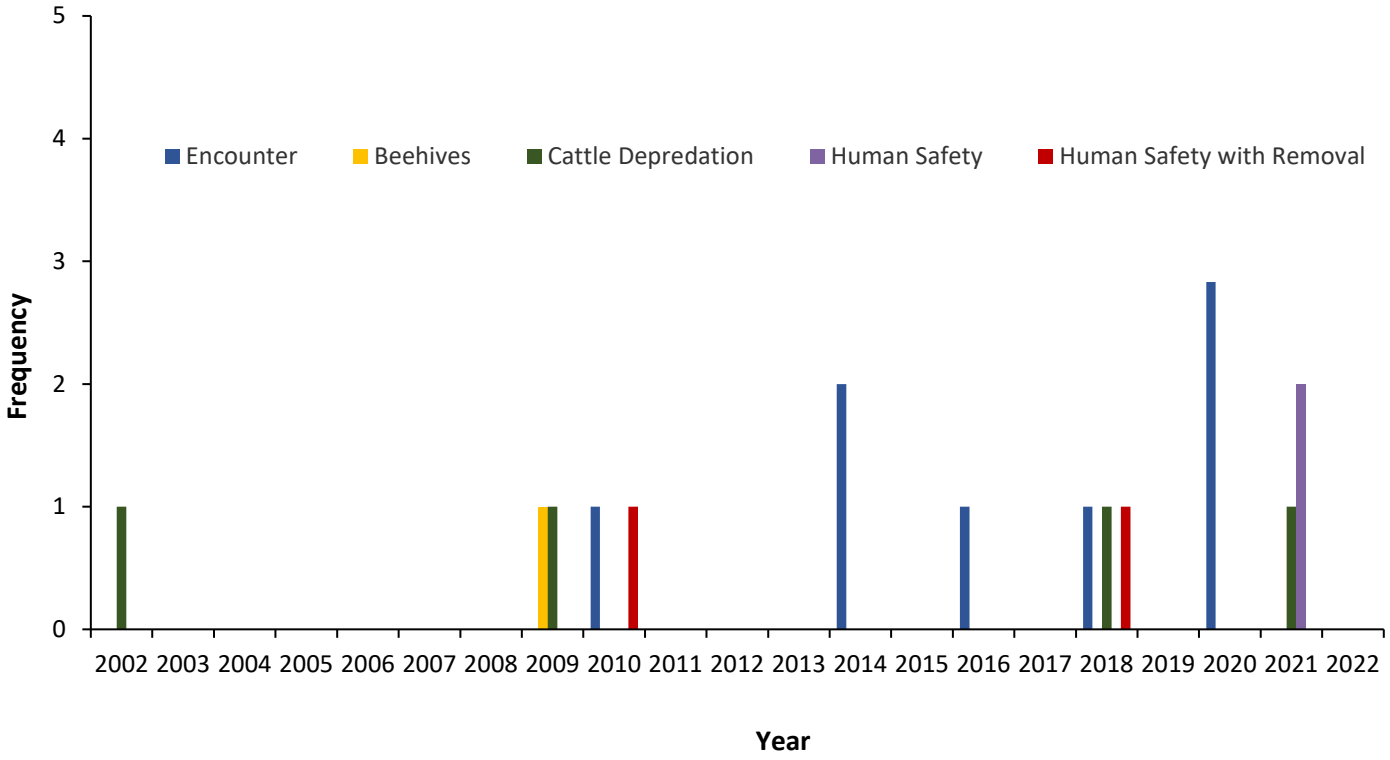

Fig. 43. Reported grizzly bear encounters and conflicts in the Wind River Reservation of the Greater Yellowstone Ecosystem, 2002-2022

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 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 began recording information on human-bear interactions in YNP in 1991. Because the risk of bear attack varies depending on visitor location and activity, we grouped human-bear interactions into 6 broad categories based on the locations where they occurred, including: 1) within front-country developments; 2) along road corridors; 3) along front-country trails; 4) within backcountry campsites; 5) along backcountry trails; and 6) in off-trail backcountry areas. We considered all human-grizzly bear encounters where the person involved believed the bear was mutually 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 removal of natural and anthropogenic attractants, hazing, capture and relocation, and capture and removal.

Activity of Bears in Front-country Developed Sites

In 2022, there were 40 incidents where grizzly bears entered park developments (Table 38). In 53% (n = 21) of the incidents, bears foraged for natural foods within developments and in 35% (n = 14) it appeared the bear was just traveling through the development. In 2 incidents bears were investigating anthropogenic foods but did not obtain food rewards and in 1 incident a bear investigated and obtained a food reward.

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

Grizzly bears were known to have encountered people in 25 of the 40 incidents where they entered developments (Table 39). Bears reacted with a flight response in 48% (n = 12) and neutral behaviors in 44% (n = 11) of the encounters. In 1 incident a bear charged toward the person it encountered. The person sprayed the bear with bear spray and the bear did not make contact. Grizzly bears did not injure any visitors within park developments in 2022. The last grizzly bear inflicted human injury within a park developed area occurred 20 years ago in 2002. In that incident, a woman initially reacted passively (stood still and looked up toward the sky) to a subadult grizzly that curiously approached her. After the bear bit her on the thigh, the woman changed her response, became aggressive toward the bear, and it left.

Human-Bear Interactions along Roads

Bears frequent habitats 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 after 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, 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 2022, 396 reports of grizzly bears frequenting habitat along park roads were recorded (Table 40). In most of these incidents, the bears primary activity was foraging for natural foods (72%, n = 286) or traveling (18%, n = 72). Other activities reported included courtship (1%, n = 5), swimming (1%, n = 5), sleeping (<1%, n = 2), and obtaining anthropogenic foods (<1%, n = 1).

Bear Reactions to the Presence of People Along Roadsides

Grizzly bears were noticeably aware of the presence of people in 240 of the 396 reports of bear activity along roads (Table 40). Bears reacted with neutral behaviors in 74% (n = 178) of the encounters and a flight response in 23% (n = 54). Grizzly bears displayed curious behavior and walked toward people in <1% (n = 2) of the roadside encounters. In 2 incidents (<1%) grizzly bears charged toward people without making contact. Grizzly bears did not injure any visitors along park roads in 2022. No park visitors have been injured by grizzly bears along park roads during our 32-year study period (1991–2022).

Human-Bear Interactions on Front-country Trails

Yellowstone National Park contains approximately 15 miles of front-country trails. Front-country trails are short trails located adjacent to roads and developments that contain interpretive signs providing visitors with information about geysers or other natural features. Front-country trails often have boardwalks to provide a stable walking surface with gentle grades or steps to get up and down hills, allowing use by visitors of wide-ranging ages, physical abilities, and hiking experience. During the peak visitor season, hundreds to thousands of visitors walk on front-country trails each day. Bears sometimes travel or forage on or adjacent to front-country trails.

In 2022, there were 2 incidents where people encountered grizzly bears on front-country trails. In 1 incident the bear turned and walked away and in 1 incident the bear had no noticeable overt reaction (Table 39). The last grizzly bear inflicted human injury on a front-country trail occurred 19 years ago in 2003. In that incident, a woman initially reacted passively (dropped to the ground and played dead) to a subadult grizzly that curiously approached her. After the bear pounced on and bit her, her husband aggressively ran at the bear while yelling loudly, which scared the bear away.

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, backcountry trails, campsites, and off-trail areas are sometimes temporarily closed to recreational use for short periods when human activities conflict with natural bear activities and behaviors.

Bears in Occupied Backcountry Campsites

Bears occasionally enter designated backcountry campsites while the campsites are occupied by recreational users. There were no reports of grizzly bears entering occupied backcountry campsites in 2022.

Bear Reactions to Encounters with People on Backcountry Trails

In 2022, there were 21 incidents reported where people encountered grizzly bears on backcountry trails (Table 39). Grizzly bears reacted to encounters with people on backcountry trails with flight behaviors (48%; n = 10), neutral behaviors (33%; n = 7), charging without making contact (10%; n = 2), curiously following people (5%; n = 1), and vocalizing (5%; n = 1). Grizzly bears did not injure any visitors during encounters along backcountry trails in 2022.

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

In 2022, there were 7 incidents reported where people encountered grizzly bears while traveling off-trail in backcountry areas (Table 39). Grizzly bear reactions to these encounters included fleeing (n = 4) and charging without making contact (n = 1). In 2 incidents the bear's reactions were not reported. Grizzly bears did not attack or injure any people during off-trail encounters in 2022.

Risk of Bear Attack

Because most attacks from 1991 to 2022 (93%, 25 of 27) occurred in backcountry areas, we evaluated the probability of being attacked and injured by a grizzly bear while recreating in the backcountry. We calculated the number of backcountry human-grizzly bear encounters that occurred per grizzly bear-inflicted human injury. From 1991 to 2022, there were 2,275 encounters between grizzly bears and backcountry recreationists reported. In 25 of those encounters, grizzly bears contacted people, causing injury in 24 of the incidents. In 1 incident a hiker climbed a tree during an encounter and the bear bit his boot and tried to pull him from the tree. The hikers boot came off and his foot was not injured. The risk of being attacked by a grizzly bear was approximately 1 attack for every 91 backcountry encounters and the risk of being injured by a grizzly was approximately 1 injury for every 95 backcountry encounters. These estimates are likely biased high, because benign encounters where bears fled or behaved in a neutral or unaggressive manner were less likely to be reported than injurious or

aggressive encounters, likely skewing the data toward more aggressive encounters.

Discussion

The grizzly bear-human interactions reported in 2022 (Table 41) were typical of those observed since 1991 (Table 42). In 7,379 encounters between grizzly bears and people reported during 1991–2022, grizzly bears reacted with neutral behaviors (no overt reaction) in 55% (n = 4,077) of instances, by fleeing (running or walking away) in 33% (n = 2,449), with curious behaviors (approaching or following) in 3% (n = 231), and with stress, agitation, bluster, threat, or warning behaviors (blowing, huffing, woofing, vocalizing, teeth clacking, paw-slap lunging, hop charging, and charging without contact) in 4% (n = 306). Grizzly bears attacked people in <1% (n = 27) of the encounters. Attacks occurred at a higher rate during off-trail backcountry interactions (1 attack for every 53 off-trail backcountry encounters) than during on-trail interactions (1 attack for every 99 on-trail backcountry encounters). Grizzly bears rarely attacked during encounters with people in front-country areas where human presence was frequent, spatially concentrated, and could be expected by bears, such as along primary roads (0 attacks in 4,377 encounters), within developments (1 attack in 749 encounters), and along front-country trails (1 attack in 78 encounters). The only 2 attacks in front-country areas both involved people that reacted passively to subadult grizzly bears that approached them in a curious manner. Neutral reactions to encounters with people were most common along roads (71%, 3,020 of 4,277 roadside encounters), whereas flight was the most common response during off-trail encounters in backcountry areas (54%, 254 of 473 off-trail backcountry encounters).

Despite their ferocious reputations, long-term monitoring of human-grizzly bear interactions in YNP indicates grizzly bears were tolerant of people in most encounters, especially those that occurred in areas where human activity was frequent, concentrated, and spatially predictable. Overall, grizzly bears reacted with neutral behaviors in more than half of reported encounters parkwide. Neutral responses to encounters may be more common in national parks where human-bear interactions are frequent and rarely result in the bear being harmed or killed, leading to higher levels of habituation to people in national parks compared to non-park areas (Herrero et al. 2005, Gunther et al. 2018). Grizzly bears seldom displayed threat or warning behaviors and only very rarely made contact or injured people during encounters in the park. However, in rare incidents where contact was made, injuries were sometimes severe or fatal. Most injuries involved people hiking in backcountry areas. To reduce the chances of grizzly bear attack, we recommend backcountry recreationists: 1) hike in groups of 3 or more people as bears rarely attack large groups; 2) stay on designated trails where bears are more likely to expect encounters with people; 3) make noise in areas with limited visibility to warn bears of their presence; 4) remain vigilant when hiking to reduce the chances of surprise encounters with bears; 5) not run from bears during encounters as running may trigger a chase response; 6) stand their ground when charged by bears during surprise encounters as most bears will stop short or veer off when hikers stand their ground when being charged; and, 7) play dead when grizzly bears make contact during surprise encounters because bears will generally stop the attack and leave once the perceived threat to themselves, their cubs, or their food has been neutralized (Herrero 2002, Gunther and Haroldson 2020). We also recommend that all backcountry recreationists in YNP and other areas inhabited by grizzly bears carry a bear deterrent. Although the type of deterrent to carry (bear spray, air horn, bear bells, firearm) is a personal choice (Smith et al. 2008, 2012), bear spray requires little training, has proven easy to use, and has been highly effective at stopping or reducing the length and severity of most grizzly bear attacks, while also conserving the lives of grizzly bears (Herrero and Higgins 1998, Herrero 2002, Smith et al. 2008, 2020).

Table 38. Primary activity of grizzly bears that entered front-country developments, Yellowstone National Park, 2022.

Activity of bear while inside development	Number of incidents
Not reported or unknown	2
Travel through	14
Forage for natural foods	21
Investigate anthropogenic foods but no food reward and no property damage	2
Investigate and damage property but no food reward	0
Investigate and obtain anthropogenic foods	1
Total	40

Table 39. Reactions of grizzly bears to 295 encounters with people reported in Yellowstone National Park, 2022.

Reaction of bear	Development	Along roadside	Front-country trail	Backcountry campsite	On trail	Off trail	Total
Not reported/not known	1	4	0	0	0	2	7
Flight response							
Run away	6	13	0	0	5	4	28
Walk away	6	41	1	0	5	0	53
Adult climb tree	0	0	0	0	0	0	0
Cubs climb tree/adult remain	0	0	0	0	0	0	0
Flight behavior subtotal	12	54	1	0	10	4	81
Neutral behaviors							
No overt reaction	11	177	1	0	7	0	196
Stand up on hind legs	0	1	0	0	0	0	1
Circle down wind	0	0	0	0	0	0	0
Neutral behavior subtotal	11	178	1	0	7	0	197
Curious behaviors							
Approach stationary person	0	1	0	0	0	0	1
Follow mobile person	0	0	0	0	1	0	1
Investigate vehicle	0	1	-	-	-	-	1
Curious behavior subtotal	0	2	0	0	1	0	3
Stress/agitation/warning signals							
Salivate	0	0	0	0	0	0	0
Sway head side to side	0	0	0	0	0	0	0
Make huffing noises	0	0	0	0	0	0	0
Pop jaws/teeth clacking noises	0	0	0	0	0	0	0
Stood ground watched/stared	0	0	0	0	0	0	0
Slap ground with paw	0	0	0	0	0	0	0
Flatten ears/erect spinal hairs	0	0	0	0	0	0	0
Stiff legged walk/hop	0	0	0	0	0	0	0
Stress/warning behavior subtotal	0	0	0	0	0	0	0
Aggressive behaviors							
Growl/vocalization	0	0	0	0	1	0	1
Stalk	0	0	0	0	0	0	0
Run toward/aggressive charge	1	2	0	0	2	1	6
Aggressive behavior subtotal	1	2	0	0	3	1	7
Attack behaviors							
Defensive attack	0	0	0	0	0	0	0
Predatory attack	0	0	0	0	0	0	0
Attack unknown cause	0	0	0	0	0	0	0
Attack behavior subtotal	0	0	0	0	0	0	0
Total	25	240	2	0	21	7	295

Table 40. Primary activity of grizzly bears observed along roadsides, Yellowstone National Park, 2022.

Activity of bear	Number of incidents
Not reported/unknown	17
Traveling	72
Foraging natural foods	286
Courtship	5
Swimming	5
Nursing young	0
Playing	0
Bedded/sleeping	2
Investigating vehicles/seeking anthropogenic foods; no food reward	0
Obtain anthropogenic foods	1
Damage property	0
Aggressive approach/posture toward people	0
Attack people	0
Other	8
Total	396

Table 41. Grizzly bear reactions reported in 295 interactions with people in different location settings, Yellowstone National Park, 2022.

Location of encounter	Reaction of bear											
	Reaction not reported		Flee		Neutral behavior		Curious		Stress, warning, agitation without contact		Attack	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Park development	1	4	12	48	11	44	0	0	1	4	0	0
Roadside corridor	4	2	54	23	178	74	2	1	2	1	0	0
Front-country trail	0	0	1	50	1	50	0	0	0	0	0	0
Backcountry campsite	0	0	0	0	0	0	0	0	0	0	0	0
Backcountry trail	0	0	10	48	7	33	1	5	3	14	0	0
Backcountry off-trail	2	29	4	57	0	0	0	0	1	14	0	0
Total	7	2	81	28	197	68	3	1	7	2	0	0

Table 42. Grizzly bear reactions to interactions with people (*n* = 7,379) in different location settings, Yellowstone National Park, 1991–2022.

Location of encounter	Reaction of bear											
	Reaction not reported		Flee		Neutral behavior		Curious behavior		Stress, warning, agitation		Attack	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Park development	26	3	346	46	346	46	17	2	13	2	1	<1
Roadside corridor	145	3	979	23	3,020	71	58	1	75	2	0	0
Front-country trail	32	41	32	41	1	1	6	8	6	8	1	1
Backcountry Campsite	10	5	88	40	89	41	20	9	11	5	0	0
Backcountry trail	63	4	750	47	481	30	114	7	160	10	16	1
Backcountry Off-trail	13	2	254	54	140	30	16	3	41	9	9	2
Total	289	4	2,449	33	4,077	55	231	3	306	4	27	<1

Despite their ferocious reputations, long-term monitoring of human-grizzly bear interactions in Yellowstone National Park indicates grizzly bears are tolerant of people in most encounters, particularly those that occur in areas where human activity is spatially predictable. Of 7,379 encounters reported from 1991 to 2022, grizzly bears reacted with neutral behaviors in 55% of instances, by fleeing in 33%, with curious behaviors in 3%, and with stress, threat, or warning behaviors in 4%. Grizzly bears attacked people in <1% of the encounters reported in the park. (Photo courtesy of J. Hadley, National Park Service)

Visitor Compliance with 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 human occupation and recreation, combined with increasing grizzly bear numbers and distribution in the GYE. Two human behaviors that can reduce the risk of bear attack include hiking with large party sizes that are rarely attacked by bears (Herrero 2002) and carrying bear deterrent spray to deter bears that react aggressively to encounters (Herrero and Higgins 1998, Smith et al. 2008). To reduce the risk of bear attack in YNP, park managers distribute safety information to visitors recommending that backcountry recreationists traveling by foot maintain group sizes of ≥3 people and carry bear spray and know how to use it. 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.

Data were collected by Bear Management Office staff and instructors and students from Ecology Project International. Due to time, budget, and staffing constraints, surveys are conducted opportunistically. While working on other bear research, monitoring, and management projects throughout the park, we recorded how many recreationists 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 2022, we surveyed 1,159 people in 408 groups at 17 different backcountry trails and 6 boardwalk trails. Our surveys included 460 people on boardwalk trails, 603 backcountry day hikers, 85 overnight backpackers, 5 stock day riders, 5 overnight stock riders, and 1 day-use bicyclist.

Day Hikers

Yellowstone National Park contains >1,600 km (1,000 miles) of backcountry hiking trails accessible from 92 trailheads located throughout the park. We surveyed 603 day hikers traveling in 200 groups on 16 different trails. Average party size was 3.0 people (Table 43). The most common (mode) group size and the median group size were 2 people per party. Fifty-six percent (n = 112) of day hiking parties had less than the recommended party size of 3 people and 17% (n = 34) hiked alone. Of the 603 day hikers, 183 (30%) carried bear spray, 7 (1%) had bear bells, and 5 (1%) carried firearms (Table 44). Of the 200 groups of day hikers, 107 (54%) had at least 1 member that carried bear spray, 7 groups (4%) had at least 1 person with bear bells, and 2 groups (1%) had at least 1 person carrying a firearm.

Overnight Backpackers

Yellowstone National Park has 300 designated backcountry campsites. We surveyed 85 backpackers in 32 groups on 5 different trails. Average party size was 2.7 people (Table 43). The most common group sizes (mode) and the median group size were 2 people per party. Seventy-two percent (n = 23) of the backpacking groups had fewer than the recommended party size of 3 people and 6% (n = 2) hiked alone. Of the 85 backpackers, 77 (91%) carried bear spray. One of the backpackers carried bear bells and 1 carried a firearm (Table 45). Of the 32 groups of backpackers, 31 (97%) had at least 1 person in the party that carried bear spray, 1 person in 1 group had bear bells, and 1 person in 1 group carried a firearm.

Stock Day Riders

We surveyed 5 stock day riders in 2 groups (Table 43) on 1 trail. Average party size was 2.5 people. Three of the day riders carried bear spray; none had bear bells or firearms (Table 44).

Stock Overnight Riders

We surveyed 5 people in 1 group on 1 trail that were riding stock on an overnight camping trip (Table 43). One of the overnight stock riders carried bear spray; none carried bear bells or firearms.

Day Use Bicycle Trail Riders

Yellowstone National Park contains 13 designated bike trails. We surveyed 1 person on 1 trail riding a bicycle on a day-trip. The bicyclist did not have bear spray, bear bells, or a firearm (Table 44).

Boardwalk Trails

Yellowstone National Park contains approximately 15 miles of boardwalk trails near park roads that contain interpretive signs providing visitors with information about geysers or other natural features. Park regulations prohibit stock animals and overnight camping on or along boardwalk trails. We surveyed 460 people in 172 groups on 6 boardwalk trails. Average party size was 2.7 people (Table 43). The most common group size (mode) and the median group size were 2 people per party. Sixty percent (n = 246) of the groups of boardwalk users had fewer than the recommended party size of 3 and 13% (n = 54) hiked alone. Only 1% (n = 6) of the individuals and 3% (n = 5) of the groups observed, carried bear spray (Table 47). None of the people observed walking on boardwalk trails carried bear bells or firearms.

Use of Bear Spray

In 2022, there were 8 incidents reported where people deployed bear spray during encounters with bears. Four of the incidents involved grizzly bears, 1 incident involved a black bear, and in 3 incidents the reporting parties were unsure of the species of bear they sprayed.

On July 10 at approximately 9:45 a.m. a group of 4 day hikers on the Howard Eaton trail observed an adult grizzly bear grazing in an opening in the forest 70 yards from the trail. While observing the adult bear the hikers noticed a yearling grizzly running toward them. The adult bear then responded by hop charging toward the hikers for a short distance, then charging at full speed toward the hikers who began backing away. When the charging bear was approximately 10 yards from the hikers, they discharged a cannister of bear spray at the bear. After being sprayed the adult bear turned, ran back to her yearling, then both bears ran away from the hikers.

On July 10 at approximately 11:00 a.m. a hiker on the Mallard Lake trail observed an adult grizzly bear walking into the forest at the northwest end of the lake, then noticed a slightly smaller subadult grizzly (likely a 2-year-old) coming down the trail toward them. The hiker stepped about 30–40 feet off the trail as the bear approached. As the bear walked past the hiker, the hiker sprayed the bear with bear spray. The bear did not appear to react and continued walking down the trail away from the hiker and did not return.

On August 29 at approximately 9:30 a.m. a grizzly bear walked past 2 fishermen standing in the shallow water at the edge of Grebe Lake. The bear was approximately 40 feet from the fishermen when they sprayed it. After being sprayed the bear ran off and did not return.

On September 28 at 1:59 a.m., a concession employee encountered a grizzly bear while walking from the parking area behind the Canyon Village General Store to his dormitory. The bear charged and he sprayed it with bear spray. The bear turned and ran away without making contact.

On June 10 a large black bear entered occupied backcountry campsite 2H9 and walked directly towards the core camp/fire-ring area. The occupants of the campsite yelled at the bear as it approached. When the bear walked to within 15 feet of the backpackers, they sprayed it with bear spray. The bear left the campsite and did not return.

On April 21, a hiker encountered a bear on the apex of the Beaver Ponds trail (approximate 1/2-way point). The bear acted aggressively. The hiker did not know what species of bear it was. The hiker sprayed the bear with bear spray. The bear did not make contact and the hiker was not injured.

On April 21, a hiker encountered 3 bears a short distance (1/4 mile) from the Beaver Ponds trailhead. The hiker sprayed the bears with bear spray and the bears left. The bears did not make contact and the hiker was not injured.

On August 12 at 7:45 a.m. a subadult grizzly bear curiously approached to within 10 feet of the flagger on a road construction crew at Kepler Cascades. The bear was walking past the flagger at an angle. The flagger sprayed bear spray toward the bear but did not think he hit it with the spray. The bear laid down nearby then got up and walked away after a visitor approached it.

Discussion

In 2022, overnight backpackers had the highest level of compliance with the park's bear spray recommendation; 91% of individual backpackers carried bear spray and 97% of backpacking groups had at least 1 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 12 years surveys have been conducted (Tables 46 and 47). 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 YNP, 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 YNP visitors retain verbal information from uniformed park staff better than written information from signs or brochures (Taylor et al. 2014). Although the average party size for backpackers was 2.7 people per group, 72% of the backpacking groups had fewer than the recommended party size of 3 people and 6% hiked alone. Therefore, a high proportion of observed 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 12 years of the study has been 2 people per party (Table 47).

Only 18% of day hikers carried bear spray in 2022, however, 41% of day hiking groups had at least 1 member that carried bear spray. Fewer than 25% of day hikers have carried bear spray in each of the 12 years surveys have been conducted (Table 47). 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 the park can seek and obtain bear safety information from the YNP 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 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 many day hikers did not comply with the recommended group size of ≥3 for hiking in bear country. Because most (68%) grizzly bear attacks in YNP involve day hikers (32 of 47 backcountry attacks since 1970), the low level of compliance with bear safety recommendations among day hikers is a concern of park managers.

Only a low proportion of the overnight stock riders and day riders observed in 2022 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 lunch and rest stops along the trail and when in camp.

The only bicyclist we encountered on our surveys did not have 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 YNP 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 12 years we conducted our surveys. Firearms were openly carried by <1% of the recreationists we observed in 2022. Backpackers and day hikers (1%) 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 1% of all recreationists surveyed in YNP in 2022. Backpackers and day hikers 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 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 observed for different types of recreational activities in Yellowstone National Park, 2022.

Type of recreational activity	Total people	Total groups	Average group size	Median group size	Mode group size
Boardwalk trail (foot travel walking)	460	172	2.7	2	2
Day hiker (e.g., day use foot travel–hiker, angler, photographer)	603	200	3.0	2	2
Overnight backpacker (foot travel camping overnight)	85	32	2.7	2	2
Stock–day use	5	2	2.5	3	2, 3
Stock–overnight use	5	1	5.0	5	5
Day bicycle trip	1	1	1.0	1	1
Total	1,159	408	2.8	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, 2022.

	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	460	603	1	85	5	5	1,159
(No. of parties surveyed)	172	200	1	32	2	1	408
People with bear spray							
Total	6	183	0	77	3	1	270
Percent	1.3	30.3	0	90.6	60.0	20.0	23.3
Parties with bear spray							
Total	5	107	0	31	2	1	146
Percent	2.9	53.5	0	96.9	100	100	35.5
People with firearms							
Total	0	5	0	1	0	0	6
Percent	0	0.8	0	1.2	0	0	0.5
Parties with firearms							
Total	0	2	0	1	0	0	3
Percent	0	1.0	0	3.1	0	0	0.7
People with bear bells							
Total	0	7	0	1	0	0	8
Percent	0	1.2	0	1.2	0	0	0.7
Parties with bear bells							
Total	0	7	0	1	0	0	8
Percent	0	3.5	0	3.1	0	0	2.0

Table 45. Percent (%) of people engaged in different types of backcountry recreational activities that carried bear spray, Yellowstone National Park, 2011–2022.

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
2021	53	23	7	0	0	18
2022	91	30	1	60	20	0
2011–2022 combined data	57	18	1	7	27	16

Table 46. Percent (%) of groups engaged in different types of backcountry recreational activities that had at least 1 member that carried bear spray, Yellowstone National Park, 2011–2022.

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
2021	83	52	10	0	0	33
2022	97	54	3	100	100	0
2011–2022 combined data	84	41	3	25	52	24

Table 47. Group size characteristics observed for different types of recreational activities, Yellowstone National Park, 2011–2022.

Type of recreational activity	Total people	Total groups	Average group size	Median group size	Mode group size
Boardwalk	10,223	3,652	2.8	2	2
Day hiker (e.g., day foot travel–hiker, angler, photographer)	19,819	6,657	3.0	2	2
Overnight backpacker (overnight-foot travel)	1,323	444	3.0	2	2
Horse–day use	142	28	5.1	4	3
Horse–overnight use	134	25	5.4	5	2
Day bicycle trip	122	50	2.4	2	2
Total	31,763	10,856	2.9	2	2

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Appendix A

2022 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 GYE to monitoring and reporting obligations established in the *2016 Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Area* (Conservation Strategy; Yellowstone Ecosystem Subcommittee 2016). The Conservation Strategy and 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. 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 2006a,b). Likewise, the Superintendents' Compendia incorporated the Conservation Strategy habitat standards into the legal plans for the 3 NPS units in the GYE. The legal status of the population has changed multiple times since the 2007 and 2017 delisting rules and subsequent litigation. However, 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 secure habitat (roadless areas), human development, and 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 sideboards 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 4.2–7.6% annual growth of the Yellowstone grizzly bear population observed between 1983 and 2001. Habitat standards apply only within the 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 Endangered Species Act. The same area is referred to as the Primary Conservation Area when the grizzly bear is de-listed or removed from federal protection. The GBRZ term is used in this 2022 report to reflect the current protected status of the Yellowstone grizzly bear population.

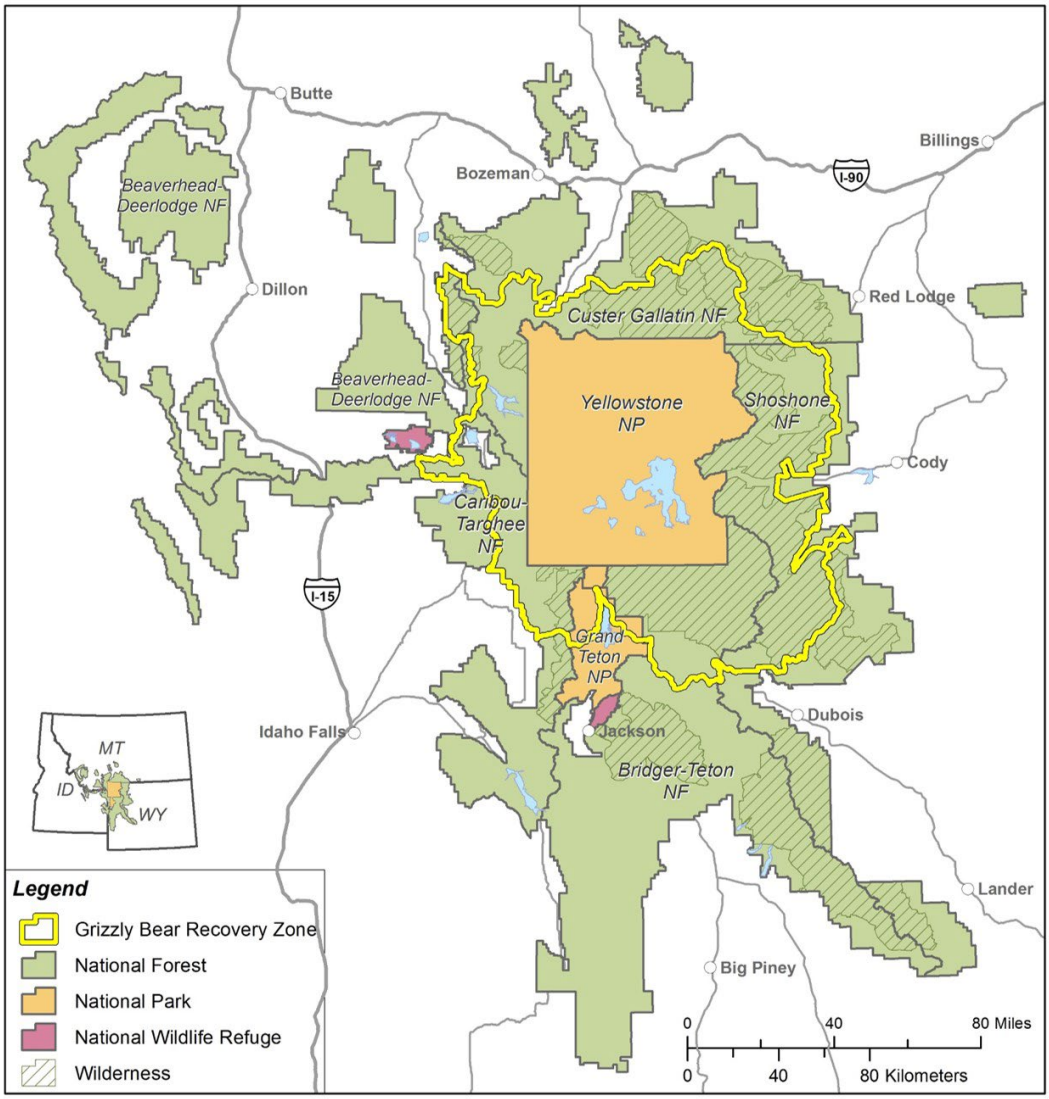

Figure A1. Federal lands comprising the Greater Yellowstone Ecosystem and the Grizzly Bear Recovery Zone.

Annual Monitoring Requirements inside the Grizzly Bear Recovery Zone

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 (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. National forest and park personnel continue to improve the quality of their information to reflect more accurately what was on the landscape in 1998.

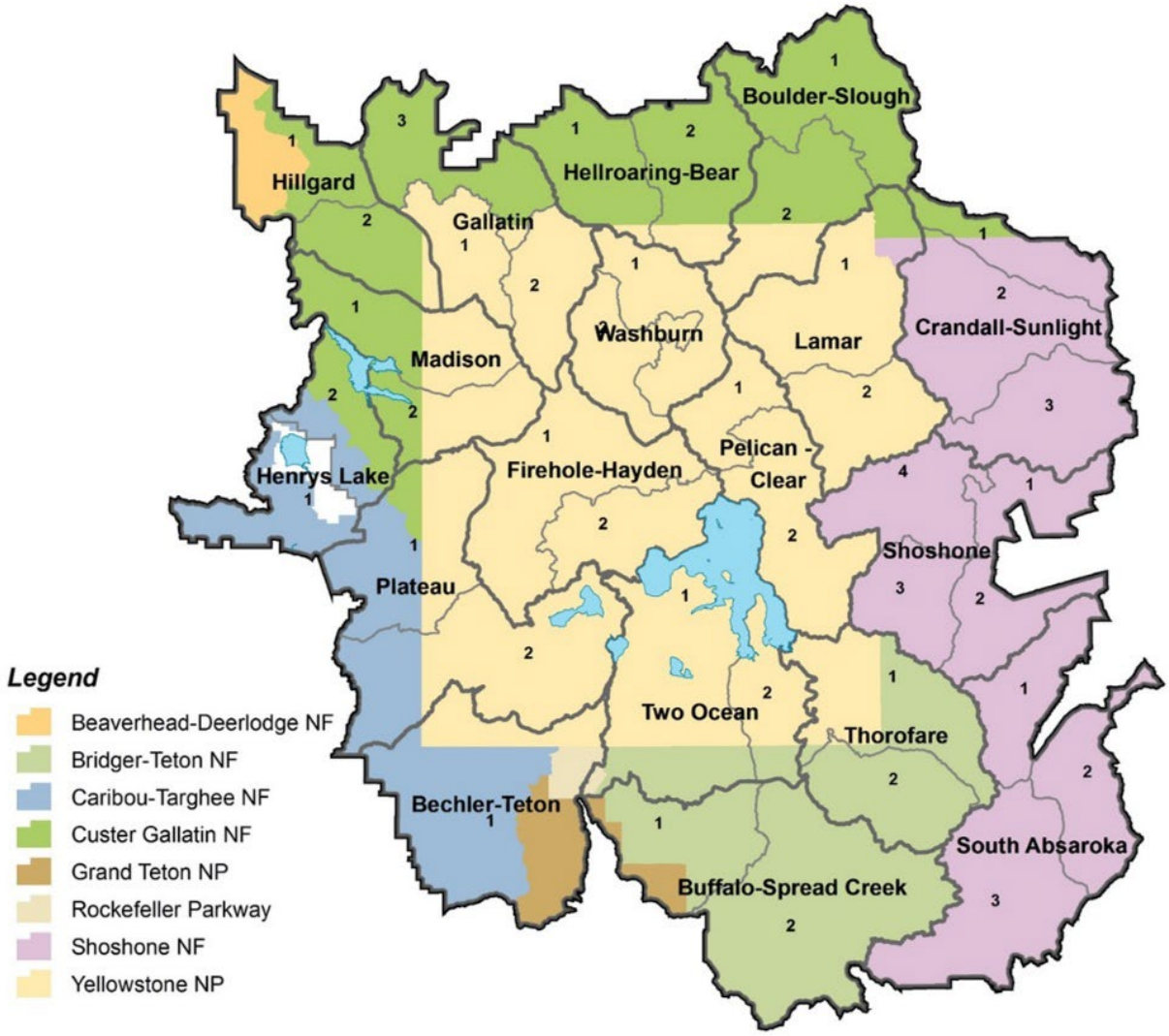

Figure A2. Bear Management Units and subunits comprising the Grizzly Bear Recovery Zone in the Greater Yellowstone Ecosystem. NF refers to national forest.

Biennial Monitoring Requirements outside the Grizzly Bear Recovery Zone

In addition to the annual monitoring requirements identified in the 2016 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 were more consistent with reporting protocols inside the GBRZ. Boundaries of these units 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 Bear Analysis Units (Fig. A3), each the approximate size of Bear Management Unit subunits inside the GBRZ.

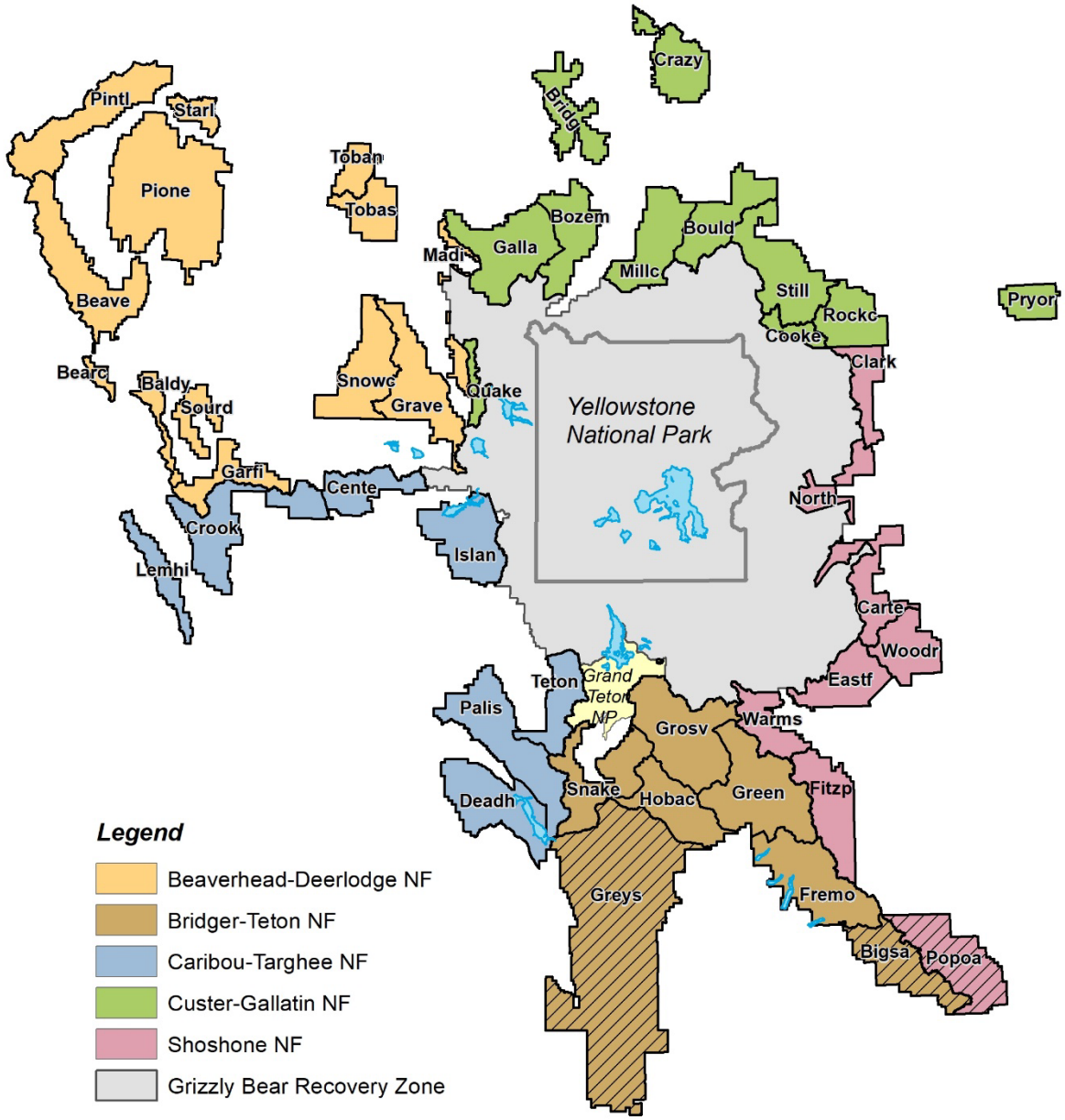

Figure A3. Bear Analysis Units outside the Grizzly Bear Recovery Zone on the 5 National Forests in the Greater Yellowstone Ecosystem. Hatched areas are currently not reported as they are determined socially unacceptable for grizzly bear occupancy.

Monitoring of Livestock Grazing

The habitat standard for livestock allotments identified in the 2016 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 "non-use" 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 associated term grazing 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 inside the GBRZ 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 the 2022 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 GTNP in 2011, there currently is no livestock grazing occurring on national park 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 U.S. Department of Agriculture Sheep Experiment Station. Although "active", the Myers Creek allotment 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 15 years (Table A1).

Change in livestock allotments during 2022

During 2022, there were no reported changes in livestock grazing allotments on federal lands inside the GBRZ.

In 2014, an effort was initiated for all GYE forests to correct errors in the 1998 allotment baseline and ensure the current configuration of allotments inside the GBRZ were identified as part of the larger Conservation Strategy revision that was completed in 2016. Several corrections were made to the 1998 baseline and the 2014 status of allotments inside the GBRZ as a result of that review. Those corrections were made to Table A1 in subsequent annual reports. In 2021, the Shoshone National Forest re-initiated consultation with the USFWS about their grazing program and re-examined their existing allotments relative to baseline reporting. They found several changes made in 2014 were incorrect. Additionally, at least one additional change has occurred since the 2014 review and additional errors were discovered in the original 1998 baseline. These include:

- The status of Burnt Mountain and Peat Beds Sheep/Goat allotments was changed from vacant to closed in 2014. A Decision Notice issued on January 9, 2003, specified these allotments would be held vacant rather than closed. These allotments should still be included on the current list of Shoshone National Forest allotments inside the GBRZ as vacant sheep/goat allotments.
- The status of the Dunoir allotment was reported as changed from active cattle/horse to closed in the 2009 IGBST annual report. In 2021, the USFS reviewed the 2008 decision to close the east and west pastures of the Dunoir allotment (the only portions of the allotment inside the GBRZ) and determined the 2008 decision was invalid. Instead, the USFS decided these pastures will remain vacant. The Dunoir allotment should be included as a vacant cattle/horse allotment on the current list of Shoshone National Forest allotments inside the GBRZ.
- The Beartooth allotment permitted cattle and sheep grazing until 2003. The 1998 baseline status should be active cattle/sheep.
- Ishawooa Hills was shown as combined with Bobcat in the 2014 list of allotments, but this was an error. These allotments have never been officially combined and continue to be managed separately.
- The Dunn Creek allotment, which has since been renamed the North Fork Winter Range allotment and is maintained as a forage reserve, is outside the GBRZ and should never have been included in the 1998 baseline.
- The Ramshorn, Parque Creek, and Horse Creek allotments on the Wind River Ranger District were again vacant during 2022. This temporary condition was a result of permit waivers and the USFS is working to re-issue term permit(s) through the grants process in 2023.

Table A1 has been updated to reflect these corrections.

Table A1. Number of commercial livestock grazing allotments and sheep animal months inside the GBRZ in 1998 and 2022.

Administrative unit	Cattle allotments				Sheep allotments				Sheep animal months	
	Active		Vacant		Active		Vacant			
	1998	2022	1998	2022	1998	2022	1998	2022	1998	2022
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	26	24	0	1	2	0	2	2	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 2022.

Livestock Conflicts throughout the Greater Yellowstone Ecosystem

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 lands 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 2022

In 2022, a total of 100 grizzly bear conflicts associated with livestock depredation on USFS lands were reported inside the GYE (Fig. A4). These conflicts occurred on 27 distinct commercial grazing allotments distributed throughout the ecosystem. All of the 100 incidents in 2022 involved cattle depredations. Conflicts were reported on 4 national forests in the GYE including the Beaverhead-Deerlodge (n = 18), Bridger-Teton (n = 58), Caribou-Targhee (n = 3), and Shoshone (n = 21). Approximately 92% (n = 93) of the conflicts occurred outside the GBRZ. Of the 100 livestock-related conflicts, 54% (n = 54) occurred on the Upper Green River cattle allotment located outside the GBRZ on the north portion of the Bridger-Teton National Forest. During 2022, no grizzly bears were removed in response to livestock depredations on USFS lands.

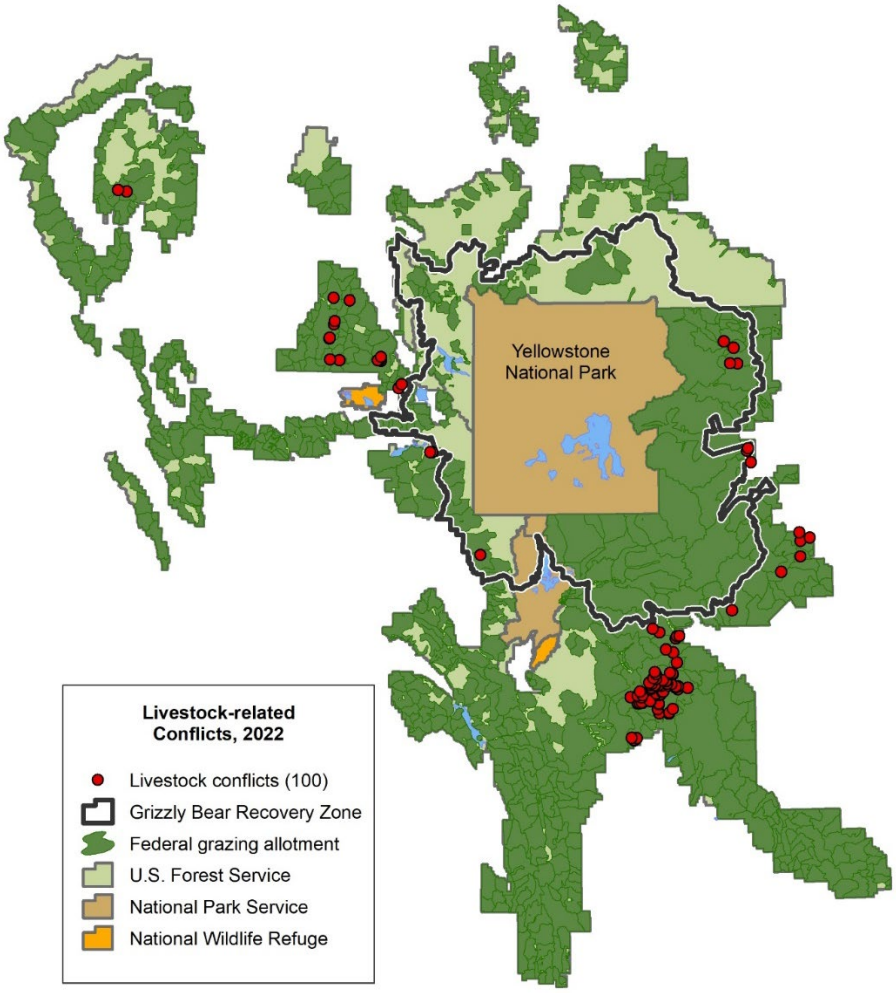

Figure A3. Grizzly bear conflicts related to commercial livestock grazing on federal lands in the Greater Yellowstone Ecosytem during 2022.

Recurring livestock conflicts 2018–2022

Livestock conflicts are considered recurring when cattle 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 2018–2022, 588 livestock conflict incidents were reported on grazing allotments on national forest lands inside the GYE (Table A2). Approximately 94% (n = 551) of these conflicts occurred outside the GBRZ. Of the 588 conflicts, 54% (n = 328) occurred on the Upper Green River cattle allotment located outside the GBRZ on the Bridger-Teton National Forest. Eighteen allotments experienced recurring conflicts, including 8 on the Beaverhead-Deerlodge, 3 on the Bridger-Teton, 0 on the Caribou-Targhee, 0 on the Custer Gallatin, and 9 on the Shoshone National Forest (Table A2). Over the past 5 years, 24 grizzly bears were removed from the population due to persistent livestock depredation on USFS allotments. These 24 management removals included 3 females (2 adult, 1 subadult), 20 males (17 adult, 3 subadult), and 1 adult of unknown gender. The subadult female was removed outside of the DMA, and no removals occurred within the GBRZ. Seventeen (71%) of the 24 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 (2018–2022)	Recurring conflicts
		2018	2019	2020	2021	2022		
Beaverhead–Deerlodge National Forest								
Anderson/cox	29,826	1	0	0	0	1	2	No
Antelope Basin	4,430	0	0	0	1	0	1	No
Barnett	6,454	0	0	1	0	0	1	No
Bear Wallow	8,761	0	0	0	0	1	1	No
Bufiox	13,077	1	0	3	5	2	11	Yes
Burnt Creek	2,992	0	1	0	2	1	4	Yes
Cliff Lake Bench	2,279	0	0	1	0	0	1	No
Clover Meadows	10,398	1	0	1	2	1	5	Yes
Coal Creek	5,186	0	0	0	1	0	1	No
Elk Mountain	4,415	0	0	1	0	1	2	No
Eureka Basin	11,617	5	1	0	7	0	13	Yes
Hidden Lake Bench	6,609	0	0	2	0	0	2	No
Lobo Cascade	11,941	1	0	0	0	0	1	No
Long-pole	9,603	0	0	0	1	0	1	No
Lyon Wolverine	16,188	1	0	0	0	0	1	No
Maverick Basin	4,161	0	0	0	1	0	1	No
North Saddle	3,454	1	1	0	0	1	3	Yes
Red Rock	3,909	0	0	1	1	0	2	No
Standard Creek	12,833	0	4	0	0	0	4	No
Upper Ruby	44,395	5	0	2	7	3	17	Yes
Warm Springs	22,518	0	0	1	3	1	5	Yes
West Fork	53,096	13	13	1	11	6	44	Yes
Wigwam Trail	12,742	1	0	0	0	0	1	No
Bridger-Teton National Forest								
Badger Creek	7,254	0	1	0	0	0	1	No
Beaver-Horse	25,389	0	0	0	1	0	1	No
Beaver-Twin	22,030	0	1	2	4	4	11	Yes
Fisherman Creek	47,629	0	1	1	1	0	3	Yes
Jack Creek	18,673	0	0	1	0	0	1	No
Noble Pasture	762	4	1	0	0	0	5	No
Roaring Fork	8,416	0	1	0	0	0	1	No
Salt Creek	10,005	0	0	1	0	0	1	No
Sherman C&H	8,287	0	0	0	1	0	1	No
Union Pass	23,800	0	0	2	0	0	2	No
Upper Green River	125,671	72	57	55	77	54	315	Yes
Upper Gros Ventre	67,497	3	0	2	0	0	5	No
Caribou-Targhee National Forest								
High Five	21,943	1	0	0	0	0	1	No
Ripley Butte	18,533	0	0	0	0	2	2	No
Squirrel Meadows	28,797	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 (2018–2022)	Recurring conflicts
		2018	2019	2020	2021	2022		
Teepee Creek	22,134	0	0	0	0	1	1	No
Custer Gallatin National Forest								
Hogan Creek	1,522	0	0	1	0	0	1	No
Tom Miner/ Ramshorn	14,609	0	0	0	2	0	2	No
Wigwam	2,762	0	2	0	0	0	2	No
Shoshone National Forest								
Basin	73,119	0	0	1	1	2	4	Yes
Bench (Clarks Fork)	28,751	4	0	0	0	0	4	No
Crandall	18,641	0	3	3	0	0	6	No
Dick Creek	9,569	0	0	2	0	1	3	No
Dunoir	52,875	1	1	0	0	0	2	No
Fish Lake	12,743	3	0	2	0	2	7	Yes
Ghost Creek	11,579	0	1	2	2	0	5	Yes
Greybull	34,641	0	0	0	1	0	1	No
Hardpan/Table Mountain	17,575	0	0	1	2	3	6	Yes
Horse Creek	29,980	0	0	0	0	0	0	No
Kirwin	17,588	0	0	1	0	1	2	No
Lake Creek	21,399	0	0	0	1	0	1	No
North Absaroka	146,766	0	0	2	0	0	2	No
Reef Creek	11,449	0	0	0	0	1	1	No
Rock Creek	16,833	0	0	0	1	0	1	No
Salt Creek	8,263	0	0	1	5	1	7	Yes
Sunshine	2,152	0	0	0	0	1	1	No
Table Mountain	13,895	3	4	0	1	1	9	Yes
Timber Creek	9,187	0	0	0	0	1	1	No
Union Pass	39,497	4	0	3	5	0	12	Yes
Warm Springs	16,875	2	3	1	8	1	15	Yes
Wiggins Fork	37,655	0	0	0	0	1	1	No
Wind River	44,158	1	5	1	3	4	14	Yes
Wood River	4,049	0	0	1	0	1	2	No
Total conflicts		**128**	**102**	**100**	**158**	**100**	**588**	

[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 2016 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 lands 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 is 594. 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 18 sites between 1998 and 2022. From 1998 to 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 Bear Management Unit, was moved from one side of a road to the other, placing it in subunit #2 of the Hilgard Bear Management Unit. 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 2022.

Changes in developed sites in 2022

Yellowstone National Park's Lower Blacktail Cabin was swept away by the flooding Yellowstone River on June 13th. This reduced the number of developed sites in Washburn #1 subunit to 24 from 25. Refer to Table A3 for 1998 and current counts of developed sites per Bear Management Unit and subunit.

Yellowstone National Park expanded a contractor Recreational Vehicle court inside the Grant Major Developed area in Two Ocean subunit #1 to address housing shortages inside and outside of the park. This added 49 individual sites along a new loop road, but the expansion was surrounded by existing roads within the already developed area.

The Custer Gallatin National Forest constructed the Cutler Sphinx non-motorized trail and the associated Cutler Lake trailhead in the Gallatin #3 subunit. This increased the number of developed sites in the subunit from 18 to 19.

In response to the massive influx of visitors camping on the Bridger-Teton Forest during the pandemic, the USFS made changes to 3 campgrounds inside the GBRZ in 2021. Many visitors were dispersed camping in parking areas and trailer turn-arounds within the developed areas of the campgrounds. To mitigate and contain the impact of this increased use, the USFS added designated camping sites and food storage infrastructure without constructing any new roads. This included adding 7 sites at the

Sheffield Campground (Two Ocean #1 Subunit), 4 sites at the Hatchet Campground (Buffalo-Spread Creek #2 Subunit), and 4 sites the Pacific Creek Campground (Buffalo-Spread Creek #1 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 YNP, annual visitation increased by more than 40% during the period 2008–2018, surpassing 4 million visitors per year since 2016 (NPS 2023). 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 Yellowstone Ecosystem Subcommittee of the Interagency Grizzly Bear Committee gathered public comment on the recommended changes to the habitat standard and application rules in 2021, and the committee voted to approve the changes in 2022. As of this reporting, the approved changes have not yet been published in a revised Conservation Strategy or formally amended to the land management plans of all of the GYE administrative units.

Table A3. *Number of developed sites in 1998 and 2022 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	2022	1998	2022	1998	2022	1998	2022	1998	2022	1998	2022	1998	2022	1998	2022
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	10	0	0	0	0	6	6	0	0	18	19
	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 2022 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	2022	1998	2022	1998	2022	1998	2022	1998	2022	1998	2022	1998	2022	1998	2022
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 2022 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	2022	1998	2022	1998	2022	1998	2022	1998	2022	1998	2022	1998	2022	1998	2022
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 Grizzly Bear Recovery Zone

Habitat standards identified in the 2016 Conservation Strategy require 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 meters from an open or gated motorized route. Lakes larger than 1 mi^2 (square mile; 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, and total motorized access route density be reported annually against baseline levels per subunit inside the GBRZ. Open motorized access route density 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). Total motorized access route density is a measure of the density of roads and trails that are open to the public 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 open motorized access route density is greater than 1 mi/mi^2 (mile per square mile; >0.62 km/km^2) and total motorized access route density is greater than 2 mi/mi^2 (>1.2 km/km^2). Thus, values of total motorized access route density are typically lower than open motorized access route density because the threshold density is at a higher level. Table A4 shows historic and current values of secure habitat and motorized route density. Routes that are gated closed to the public yearlong but accessible to administrative personnel detract from secure habitat and contribute to total motorized access route density 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 open or total motorized access route density.

Permanent changes in secure habitat since 1998 (inside the Grizzly Bear Recovery Zone)

The standard criterion 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 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 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; see 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 or open and total motorized access route density inside the GBRZ are reported with respect to baseline levels in Table A4.

Permanent changes in secure habitat during 2022 (inside the Grizzly Bear Recovery Zone)

The Custer Gallatin National Forest added 4 routes to their road system under special use permits to allow access to private land inholdings in the Gallatin #3 subunit (1 road, 541 feet), the Lamar #1 subunit (one 2-mile-long road which previously existed in the baseline but the GIS spatial alignment needed a slight correction), and in the Madison #1 subunit (2 roads, both <400 feet). These additions due to statutory rights are allowable under the 2016 Conservation Strategy application rules and will be adopted into the baseline.

The Custer Gallatin National Forest reconstructed the Yellowstone Shortline Non-motorized Trail 611 which extends from West Yellowstone to Reas Pass. It is open to the public for non-motorized use only, but the first 6 miles may be used as an administrative road. The administrative road intersects both Henry's Lake #2 and Madison #2 subunits, but because of the proximity of other existing roads secure habitat was unaffected in either subunit.

In June of 2022, a storm system dropped unprecedented amounts of rainfall on top of melting snow across the northern parts of YNP and the Absaroka/Beartooth area of the Custer Gallatin National Forest. This resulted in substantial flooding, mudslides, and washouts which severely damaged several roads and other infrastructure. Actions taken in YNP are currently considered temporary and addressed in the following section regarding temporary projects. Within the GBRZ on the Custer Gallatin National Forest, road repairs were made at the Yankee Jim river access and the Joe Brown trailhead in Hellroaring-Bear #1 subunit but these did not extend any road prisms or affect secure habitat.

Table A4. 1998 and 2022 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 / mile^2)			% TMARD (subunit % > 2 miles / mile^2)			% Secure Habitat			Area (miles^2) (excluding major lakes)		
										Subunit	Secure Habitat	
	1998	2022	% chg	1998	2022	% chg	1998	2022	% chg		1998	2022
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	12.6	-10.3	**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	28.1	-7.1	45.7	52.0	6.3	140.2	64.1	72.9
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	10.0	0.2	3.8	4.1	0.3	89.4	89.6	0.2	299.9	268.1	268.6
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	-9.1	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 2022 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 / mile^2)			% TMARD (subunit % > 2 miles / mile^2)			% Secure Habitat			Area (miles^2) (excluding major lakes)		
										Subunit	Secure Habitat	
	1998	2022	% chg	1998	2022	% chg	1998	2022	% chg		1998	2022
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	3.7	0.2	0.3	0.6	0.2	96.3	96.3	0.0	371.9	358.3	358.1
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**	**7,889**

**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 (mile^2) 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, 2022 (inside the Grizzly Bear Recovery Zone)

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 Bear Management Unit cannot exceed 1% of the total acreage of the largest subunit within that unit. Application rules allow only one temporary project to be active in a particular subunit at any given time. Five projects involving potential reductions in secure habitat within the GBRZ were operational in 2022 (Table A5). Below are brief summaries of these USFS projects.

Yale Creek Wildland-Urban-Interface: The Yale Creek Fuels Reduction Project was authorized to reduce hazardous fuels and produce a timber product on 3,161 acres of 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. Three temporary roads totaling 4.4 miles were used in 2022. The 3-year temporary project application rule for the secure habitat standard will not be met for one temporary road constructed in 2019. Use of this road will continue through 2024 because, through the contracting process, the government was legally obligated to allow timber harvest for six years instead of ceasing it at three years.

Black Mountain Salvage Project: Authorized by the Black Mountain Categorical Exclusion (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. Three temporary roads totaling 0.5 mile in length were used in 2023. Two of those roads totaling 0.26 mile were decommissioned in 2022, and the remaining road will be used in 2023. A contract extension was also granted to one of the contractors on this project so it will extend at least into its fourth year as well.

Budworm Response Project: This fuel reduction and salvage-sanitation silvicultural project was authorized under the Budworm Response Project Decision Notice. During FY2019, 13 temporary roads (20 total road segments ranging from 0.02 to 0.86 miles in length) were created to support the Sugarloaf Timber Sale on the Shoshone National Forest within the Crandall/Sunlight #2 subunit. All but one of these temporary roads were closed during 2019 and 2020. The remaining temporary road was closed in 2022. The Swamp Lake Timber Sale was also authorized under this Decision Notice, and 16 new temporary roads totaling 4.2 miles were installed during autumn 2022. It is unclear at this time when these roads will be reclaimed.

Wolf Creek Salvage Project: This timber sale was authorized under the 2015 Long Creek Project Decision Notice and is located within the South Absaroka #3 subunit near the Wolf Creek Trailhead on the Shoshone National Forest. The sale consists of live and dead sawtimber. Operations began in summer of 2020 and continued through 2022. The purchaser is using NFSR 513.3C, which is a gated administrative road and, therefore, already affects secure habitat. Three additional temporary roads totaling 0.6 mile were constructed in 2021, but due to the proximity of other existing roads they did not contribute to any reduction in secure habitat.

Knob Hill Salvage Project*:* Timber harvest for this project was authorized under the 2018 Lava Mountain Project Environmental Assessment and Decision Notice. This project on the Shoshone National Forest is outside of the GBRZ, but within 500 m of the Buffalo/Spread Creek #2 BMU subunit. Timber sale operations began in the autumn of 2020. The sale purchaser opened a decommissioned road, extended it, and constructed at least eight additional temporary roads for logging operations. The sale resumed operations in summer of 2022 and will likely conclude in 2023. All temporary roads will be reclaimed at that time.

Historic spring flood damage: Flooding during June of 2022 resulted in catastrophic damage to a significant portion of YNP's North Entrance Road along the Gardner River Canyon in the Gallatin #2 subunit. Sections of the road not destroyed in the flood have not been reclaimed but are currently closed to all traffic. Decisions on future uses of those areas have not yet been made. For the purposes of this report, the original road is considered temporarily decommissioned. A temporary main park entrance road was constructed by improving 4 miles of the existing Old Gardiner Road and adding 0.3 mile of new construction. These changes will be considered temporary until permanent solutions are implemented following the appropriate land management and National Environmental Policy Act processes. With the temporary road closure, the subunit gained 0.7 square mile of secure habitat.

Table A5. *Secure habitat affected by temporary projects inside the Grizzly Bear Recovery Zone, 2022.*

Project Name and National Forest	Bear Management Unit Subunit	Secure habitat (miles^2)					Project Status
		Allowed reduction below baseline[a]	Baseline	2022 (without project)	2022 (with project)	Reduction in secure habitat	
Knob Hill Salvage Shoshone N.F. outside the GBRZ	Adjacent to 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	261.2	0.1	Open
Yale Creek WUI Caribou-Targhee N.F.	Henry's Lake #1	1.9	86.8	88	87.2	0.8	Open
Black Mountain Salvage Caribou-Targhee N.F.	Plateau #1	3.7	197.0	202	202	0.05	Open
Wolf Creek Salvage Shoshone N.F.	South Absaroka #3	3.4	190.3	190.3	190.3	0	Open
Historic flood damage Yellowstone N.P.	Gallatin #2	1.4	90.2	90.2	90.9	+0.7	Open

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

Monitoring Secure Habitat outside the Grizzly Bear Recovery Zone

The 2006 Forest Plan Amendment requires monitoring and reporting on 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 (U.S. Department of Agriculture, USFS 2006a, b; p.45, 52). Table A6 represents the best estimates available for current values of percent secure habitat per Bear Analysis Unit outside the GBRZ (Fig. 3A).

Changes in secure habitat outside the Grizzly Bear Recovery Zone (2020–2022)

Several changes in motorized routes yielded changes in secure habitat on USFS lands outside the GBRZ (Table A6). Below is a list of changes to motorized routes and secure habitat that have occurred outside the GBRZ since last reported in 2020.

Crazy Mountains Bear Analysis Unit: The Custer Gallatin National Forest enacted a project in 2020 to relocate the Porcupine Ibex 267 trail, which involved decommissioning 10.8 miles the Porcupine Lowline 267 motorized trail and establishing 9.4 miles of non-motorized trail to the east of the old trail. About one third of the decommissioned route occurs off USFS lands and outside of the Bear Analysis Unit. The project was completed in 2022, and secure habitat in the unit increased by 0.16%.

Bridger Bear Analysis Unit: The Custer Gallatin National Forest added 4 roads to their road system to allow access to private land inholdings in the Bridger Mountains. Each of these roads is less than 200 feet in length.

Mill Creek Bear Analysis Unit: The Custer Gallatin National Forest added 1 road to their road system to allow access to a private land inholding. That road measures 540 feet long.

Historic flood damage: On the Custer Gallatin National Forest, repairs were conducted on major access routes in the Rock Creek, Stillwater, Boulder, Mill Creek, and Bozeman Bear Analysis Units as a result of damage from the historic floods that occurred during June 2022. There was no effect to secure habitat within these units because the repair work was done within the existing road prisms.

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

Bear Analysis Unit	Percent secure habitat			Analysis Unit Area * (miles^2)
	2020	2022	Change (2020 – 2022)	
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	38.1	38.1	0.0	333.9
Lemhi Mountains	70.0	70.0	0.0	143.1
Palisades Reservoir	59.8	59.8	0.0	472.5

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

Bear Analysis Unit	Percent secure habitat			Analysis Unit Area * (miles^2)
	2020	2022	Change (2020 – 2022)	
Teton	75.8	75.8	0.0	209.5
Mean secure / total area	**57.8**	**57.8**	**0.0**	**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	68.0	0.16	254.8
Gallatin	59.6	59.6	0.0	415.0
Mill Creek	83.8	83.8	0.0	312.2
Pryor Mountains	38.8	38.8	0.0	121.8
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	**73.3**	**73.3**	**0.0**	**1,545**

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Appendix B

Monitoring Whitebark Pine in the Greater Yellowstone Ecosystem – 2022 Annual Report

The 2022 whitebark pine monitoring report was not available at time of publication of the IGBST 2022 annual report. Once finalized, it can be obtained in digital format from the Greater Yellowstone Inventory & Monitoring 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

2022 Bear Wise Wyoming Program 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 safeguard human communities in northwest Wyoming. The overall objective of Bear Wise is to promote individual and community ownership of 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) deploy a public outreach and education campaign to reduce knowledge gaps about bears and the causes of conflicts; and 3) deploy a bear-resistant waste management system and promote bear-resistant waste management infrastructure.

This report provides a summary of program accomplishments in 2022. Past accomplishments are reported in the 2006–2021 annual reports of the IGBST and in the 2011–2021 Annual Job Completion Reports of the 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 GYE for the period of 1994–2003. The analysis identified that the majority of known, human-caused grizzly bear mortalities occurred because of 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 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 GYE. The North Fork of the Shoshone River west of Cody was chosen as the first area composed primarily of private land to have a multi-agency and public involvement approach to reducing conflicts at developed sites.

In 2005, the WGFD began implementation of the Bear Wise Community Program. Although the program's efforts were focused primarily in the Wapiti area, the WGFD 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 Area Update

The Cody Bear Wise Community Program continues to use 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 2022 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, 1,700 domestic livestock carcasses have been removed from private lands.

2. The Carcass Management program used 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.

3. Large Carnivore Section personnel maintained and built 15 permanent electric fences. The fences are around bee apiaries that have been in the same place long term. These projects were completed in cooperation with U.S. Department of Agriculture Wildlife Services non-lethal specialists and funding to do livestock conflict prevention.

Electric fence around bee apiary. (Photo courtesy of the Wyoming Game and Fish Department)

4. Large Carnivore Section personnel held a "Living in Large Carnivore Country" workshop in Cody that included inert bear spray demonstrations.

5. Numerous informational presentations were given that focused on human-bear conflict prevention to students at the following schools: Powell High School, Cody High, Middle, and Elementary schools, Basin Library, Worland Elementary School, Meeteetse School District, Burlington Middle School, and Northwest College in Powell, Wyoming.

6. With funding from the Western Bear Foundation and Safari Club International, 400 canisters of bear spray were purchased and provided free of charge to hunters and anglers in late August. Giveaways were held in Cody, Jackson, Lander, and Pinedale.

7. A “Working in Large Carnivore Country” workshop was conducted for the Park County Weed and Pest District, Park County Search and Rescue, and Rocky Mountain Power.

8. A permanent electric fence was erected in 2018 at the Park County Landfill. To ensure the fence is in good working order WGFD personnel spent several days repairing and maintaining the fence in 2022. 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.

9. Regional hunter education classes and numerous other public outreach events were held in Cody, Powell, Meeteetse, Thermopolis, Wapiti, and Burgess Junction, Newton Lakes, Basin, and Sunlight.

Lander Area Update

1. Participated in an annual "Bear Spray Giveaway" program, providing 100 bear spray canisters free of charge.

2. Large Carnivore Section personnel provided numerous educational opportunities including the Lander school system, Lander Child Development Services, open house at the Lander Regional office, and Coalter Loft.

3. Held hunter education classes that emphasized hunting safely in bear country.

4. Provided comments and information for numerous news releases for local and statewide newspapers.

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 2022 were:

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. Large Carnivore Section personnel provided range rider safety training to local cowboys and ranches that have a high potential of encounters with grizzly bears.

3. Bear safety presentations were given to the USFS and other groups throughout Sublette County.

4. Large Carnivore Section personnel provided training for local Sublette County Conservation District employees.

5. Large Carnivore Section personnel expanded bear spray giveaway programs to Pinedale for the first year and provided 100 canisters of bear spray.

Objectives for 2023 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 because of 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 Area Update

The Bear Wise Jackson Hole program continues educational and outreach initiatives to help minimize human-bear conflicts within the community of Jackson and surrounding areas. In 2022, 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 using our bear education trailer.

1. A bear education trailer was purchased in August 2010 with funding contributions from the WGFD, GTNP, Bridger Teton National Forest, and Jackson Hole Wildlife Foundation. The trailer was displayed and staffed at various events and locations including GTNP, Jackson Elk Fest, Fourth of July Parade, and the National Elk Refuge Visitor Center.

2. Public service announcements were broadcast on local radio stations in Jackson throughout the spring, summer, and fall of 2022. The announcements focused bear safety and conflict avoidance and advertising for a Large Carnivore workshop conducted in Jackson.

3. Numerous educational programs were presented to various groups including homeowner associations, guest ranches, youth camps, Jackson residents, tourists, school groups, Heart Six Ranch, Jackson Gun Club, and local government employees.

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

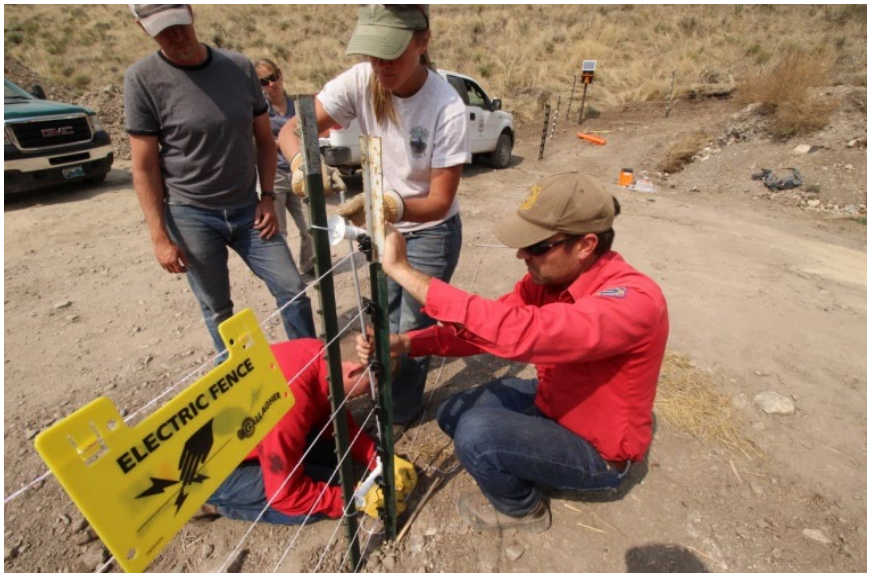
6. Large Carnivore Section personnel continued to work with a Jackson catering company, Roots Kitchen & Cannery. They have been involved in picking apples from trees that have been identified as a source of bear conflict by WGFD.

7. Numerous 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. Large Carnivore Section personnel assisted hunting outfitters 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 conflict potential between humans and grizzly bears.

10. Large Carnivore Section personnel worked extensively with apiarists in Teton County. They worked together to electrify bee yards and chicken coops to secure the potential attractants.



Installation of electric fencing is highly effective to secure potential bear attractants. (Photo courtesy of Wyoming Game and Fish Department)

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.

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

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

15. Educational black bear and grizzly bear identification materials were distributed to black bear hunters who registered bait sites with the WGFD in the Jackson region.

Objectives for the Bear Wise Jackson Hole program in 2022 were 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 Land Development Regulations. 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 Land Development Regulation has greatly reduced the amount 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 WGFD 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 Land Development Regulations through public outreach and education projects. 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

WGFD 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 WGFD 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

2022 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.

   b) Personnel issued multiple educational news releases throughout the year, 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 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 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.

4) Bear spray giveaway
   a) We expanded these efforts into Pinedale and had a successful first year, providing 100 bear spray canisters and training recipients on how to use it.

Publications

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

For information specific to the WGFD'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