Yellowstone Grizzly Bear Investigations 2019

Annual Report of the Interagency Grizzly Bear Study Team

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YELLOWSTONE GRIZZLY BEAR

INVESTIGATIONS

Annual Report of the Interagency Grizzly Bear Study Team

2019

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

2020

IGBST PARTNER WEBSITES

Interagency Grizzly Bear Study Team (U.S. Geological Survey):
http://www.usgs.gov/norock/igbst

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

United States Forest Service:
https://www.fs.usda.gov/

Yellowstone and Grand Teton National Parks (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:
http://fwp.mt.gov/fishAndWildlife/livingWithWildlife/grizzlyBears/default.html

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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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 2019. The research and monitoring program is focused on population estimation and demographics, food monitoring, and habitat monitoring. This report also contains a summary of grizzly bear management actions to address conflict situations and agency outreach efforts. This report is a summary of annual data collections. Data, analyses, and summaries presented in this report supersede those published previously and may be subject to change contingent on additional information, future publications, and the peer-review process.

Facts are Stubborn Things

> *"When you are studying any matter, or considering any philosophy, ask yourself only what are the facts and what is the truth that the facts bear out. Never let yourself be diverted either by what you wish to believe, or by what you think would have beneficent social effects if it were believed. But look only, and solely, at what are the facts."*
> – Bertrand Russell (1872-1970)

We occasionally hear or see comments from some stakeholders that the Yellowstone grizzly bear population is declining, that bears are leaving the core of the ecosystem, or the population is in some way not doing well. Our job as a study team is to collect and critically examine grizzly bear data regardless of what the implications for policy decisions may be, a notion that Bertrand Russell, a British philosopher, captured so well in the quote above.

Multiple sources of independent data indicate a healthy status of the GYE grizzly bear population. Our indices of population trend are stable to positive within the Demographic Monitoring Area (DMA), and long-term mortality rates are below thresholds specified in the *2016 Conservation Strategy*. Population reconstruction techniques using records of marked individuals and genetic records further support these interpretations. Expansion of occupied range continues and is now reaching well beyond the boundaries of the DMA. Additionally, documented mortalities outside the DMA are predominately younger males, as would be expected on the periphery of an expanding bear population. Males are generally the longer-distance dispersers in brown bear populations. Because of range expansion in the GYE and the Northern Continental Divide Ecosystem, the prospects of genetic linkage with other populations is now greater than it has been in decades. Extensive radio-monitoring data of adult females indicate they continue to show strong home-range fidelity and are not leaving established ranges in the core of the ecosystem. Females with young are also observed consistently and are well-distributed throughout the core of the ecosystem. Furthermore, member agencies of the IGBST collectively capture about 80–100 bears annually for monitoring and management purposes, and a steady 62% of those bears are new individuals that have not been captured previously; this is only possible with continued recruitment into the population. With this many data sources in agreement, the preponderance of evidence principle applies and instills confidence in our biological assessment of the population.

We recognize and respect the wide range of opinions from the many stakeholders involved in grizzly bear conservation. The tremendous amount of interest and support reflects how much the American people value this iconic grizzly bear population. That support and engagement has contributed significantly to this remarkable conservation success. Data collected by the IGBST member agencies and others have guided management decisions since the early 1970s. However, revisiting the quote from Bertrand Russell, twisting the science to fit what one wishes to believe for personal motivation, or for something that would have desired effects if it were believed, is not in the interest of grizzly bear conservation.

Population Monitoring

We followed monitoring protocols and recovery criteria established in the 2017 supplement to the Grizzly Bear Recovery Plan (U.S. Fish and Wildlife Service 2017) and as initially developed under the 2016 Conservation Strategy (Yellowstone Ecosystem Subcommittee 2016). In 2019, the model-averaged Chao2 estimate was 66 females with cubs within the DMA, from which we derived a total population estimate of 737 (see "***Estimating Number of Females with Cubs***"). These estimates are slightly higher than those of previous years.

Referencing the total population estimate of 737 against Table 2 of the 2016 Conservation Strategy, total mortality thresholds for independent-age (2 years or older) females, independent-age males, and dependent young are 9, 20 and 9%, respectively. Long-term

mortality rates are below these thresholds. For example, the mean mortality rate (total mortality/total population size) for the period 2002–2019 was 6.9% for independent females and 10.0% for independent males. These data, particularly when considering the conservative nature of the Chao2 estimates (see section "***Estimating Number of Females with Cubs"***) and additional demographic data, indicate the population status within the DMA remains stable to increasing.

Food Monitoring

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

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

Habitat Monitoring

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

History and Purpose of the IGBST

It was recognized as early as 1973 that a better understanding of the dynamics of grizzly bears in the GYE would best be accomplished by a centralized 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 cooperative effort among the U.S. Geological Survey, National Park Service, U.S. Forest Service, U.S. Fish and Wildlife Service, and the state wildlife agencies of Idaho, Montana, and Wyoming. The Eastern Shoshone and Northern Arapaho Tribes formally joined the study team in 2009.

Quantitative data on grizzly bear abundance, distribution, survival, mortality, nuisance activity, and bear foods are critical to formulating management strategies and decisions. Moreover, this information is necessary to evaluate the recovery process. The IGBST coordinates data collection and analysis on an ecosystem scale, prevents duplication of effort, and pools limited economic and personnel resources. Primary responsibilities of the IGBST are to: 1) conduct short- and long-term research projects addressing information needs for bear management; 2) monitor the bear population, including status and trend, numbers, reproduction, and mortality; 3) monitor grizzly bear habitats, foods, and impacts from humans; and 4) provide technical support to agencies and other groups responsible for the immediate and long-term management of grizzly bears in the GYE. Additional details can be obtained at our web site: http://www.usgs.gov/norock/igbst.

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 the importance of human dimensions in grizzly bear management. For example, a recent article examined the potential for grizzly bear recreational restrictions, as applied in Yellowstone National Park, to reduce human injuries resulting from grizzly bear encounters (Gunther and Haroldson 2020). Additional articles published in 2019 assessed patterns associated with grizzly bear depredation on federal grazing allotments (Wells et al.

2019) and grizzly bear responses to elk harvest (van Manen et al. 2019).

Development and enhancement of data collection and analysis techniques continues. As our summaries of longitudinal studies underscore, our long-term research and monitoring data support a variety of analyses and provide researchers and managers a comprehensive assessment of population dynamics. We are currently re-evaluating criteria for the technique used to identify unique females with cubs, which forms the basis for our derivation of total population size. We are also collaborating with researchers at the University of Montana to develop integrated population models, or IPMs, which will allow us to take advantage of the full suite of demographic data we collect on an annual basis, including data from radiomonitored bears with which we estimate vital rates. One key aspect of IPMs is that the integration of various data sources allows the simultaneous estimation of multiple demographic parameters with greater accuracy and precision. Additionally, these models will allow us to explicitly link changes in population size over time with variation in vital rates and associated environmental covariates, thus providing managers with better tools for decision making. Developing and testing enhancements to the grizzly bear monitoring program takes substantial effort and resources. We are nearing the final stages of this multi-year effort and anticipate that the initial reporting will take place in autumn of 2020. Any enhancements of the monitoring program may be reflected starting with the 2020 Annual Report.

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. **IDFG**: C. Anderson, K. Botzet, T. Boudreau, J. Brower, R. Cavallaro, K. Garrett, K. Guy, C. Hendricks, R. Howe, I. Hull, C. Johnson, L. Lane, B. Lewis, E. Lowrimore, A. McKarley, J. Nicholson, T. Nicholson, B. Panting, L. Peterson, M. Phander, A. Sorensen, T. Swearingen, S. Wesche, J. White: **MSU**: N. Bowersock, A. Hoegh, A. Litt, E. Loggers; **MTFWP**: S. Brozovich, K. Carson, C. Costello, J. Cunningham, D. Fagone, J. Feddes, K. Frey, M. Heaton, B. Lloyd, R. Pickens, R. Pohle, J. Ramsey, J. Smith, D. Scott, S. Stewart, M. Wemple, D. Waltee; **NPS**: B. Apel, L. Apel, T. Brasington, B. Bennett, J. Bennett, E. Boyd, C. Butler, C. Clapp, M.K. Clark, S. Consolo-Murphy, S. Dewey, R. Evans, C. Flaherty, S. Dewey, R. Evans, C. Greenbaum, S. Greenbaum, K. Gunther, D. Gustine, C. Hayden, T. Hayden, A. Hanna, D. Harris, S. Hegg, B. Helms, D. Houck, J. Jakicic, B. Johns, P. Kirchner, J. Lieb, C. Liesen, J. Lodge, E. Maki, T.J. Mascia, R. Mascia, S. Mayberry, J. Mills, J. Mohr, J. Moul, L. Muir, J. Potter, P. Navaille, E. Reinertson, T. Ritter, A. Rodriguez, A. Ryan, S. Ryan, D. Schneider, J. Schwabedissen, D. Stahler, P. Stalker, J. Stephenson, R. Swift, B. Tatu, T. Tatu, S. Stewart, L. Templin, J. Warren, G. White, A. Willemain, C. Willemain, J. Willemain, K. Wilmot, G. Wilson, B. Wold, M. Wrigley, T. Wyman, A. Zuckerman;

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BEAR MONITORING AND POPULATION TREND

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

During the 2019 field season, we captured 81 individual grizzly bears on 98 occasions (Table 1), including 23 females (13 adult), 55 males (34 adult) and 3 bears (1 cub and 2 subadults) of unknown sex (Table 1). All 3 bears of unknown sex were captured at research trap sites and were released without handling because their mothers were present and would not leave the site.

Forty-five (55.6%) of the 81 individual bears were not previously marked. The percent of previously unmarked individual grizzly bears captured annually has remained relatively constant during the period 1998–2019, averaging 62%, with no evidence ($F = 0.191$, 1 *df*, $P = 0.667$) of a trend (Fig. 1). As we have noted in previous reports, this finding continues to support the notion that in this closed population bears are recruiting into the population at a relatively constant rate. We would expect the number of new bears encountered annually to decline if individuals were not recruiting into the population.

We conducted research trapping efforts for a total of 600 trap days (1 trap day = 1 trap set for 1 day). During research trapping operations we had 59 captures of 46 individual grizzly bears for a trapping success rate of 1 grizzly capture every 10.2 trap days. All research captures were within the Demographic Monitoring Area (DMA).

There were 39 management captures of 37 individual bears during 2019 (Tables 1 and 2), including 9 females (3 adults), and 28 males (15 adults). Fifteen management captures of 14 individual bears (3 females, 11 males) occurred outside the DMA. Sixteen individual bears (5 females, 11 males) were relocated because of conflict situations (Table 1). One subadult female (#964, Table 1) was initially captured at a research trap site and was later captured and transported for frequenting a residential area and obtaining food rewards. Two bears (female #973, male #968) were removed after previous management capture and relocations attempts (Table 1). One adult female (#735, Table 1) was captured at a research trap site in May, and subsequently captured and removed for property damage and poultry depredation in October. In total, there were 21 management captures that resulted in removals (5 females, 16 males) during 2019 (Table 1). Additionally, a young adult male died from exertional myopathy when captured in a culvert trap at a conflict site (Unm201910, Table 1).

We radiomonitored 98 individual grizzly bears during the 2019 field season, including 51 females, 41 of which were adults (Tables 2 and 3). Fifty-eight grizzly bears entered their winter dens wearing active transmitters. Since 1975, 973 individual grizzly bears have been radiomarked in the Greater Yellowstone Ecosystem (GYE).

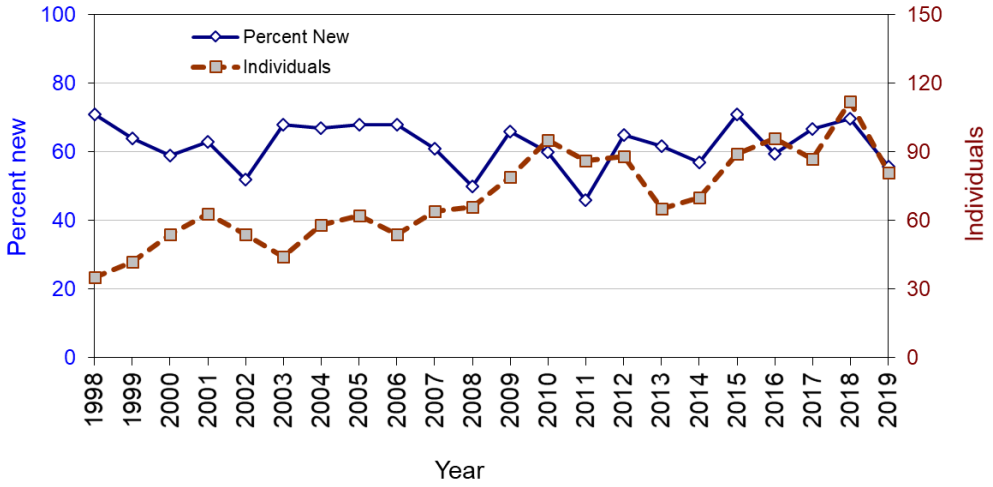


Fig. 1. Annual number of grizzly bears captured and percent previously unmarked individuals in the Greater Yellowstone Ecosystem, 1998–2019.

Table 1. Grizzly bears captured in the Greater Yellowstone Ecosystem, 2019.							
Bear	**Sex**	**Age**	**Date**	**General location[a]**	**Capture type**	**Release site[b]**	**Handler[c]**
697	Male	Adult	3/31/2019	South Fork Shoshone, PR-WY	Management	Removed (201901)	WGFD
944	Male	Subadult	4/16/2019	Carter Crk, PR-WY	Management	Removed (201904)	WGFD
G247	Male	Subadult	5/10/2019	Pat O'Hara Crk, PR-WY	Management	Removed (201907)	WGFD
Unm201901	Male	Subadult	5/11/2019	Carter Crk, PR-WY	Management	Removed (201908)	WGFD
735	Female	Adult	5/15/2019	Blacktail Deer Crk, YNP	Research	On site	IGBST
735	Female	Adult	10/30/2019	Bear Crk, PR-MT	Management	Removed (201938)	MTFWP/WS
958	Male	Adult	5/19/2019	Ghost Crk, PR-WY	Management	Transported	WGFD
480	Male	Adult	5/19/2019	Antelope Crk, YNP	Research	On site	IGBST
480	Male	Adult	9/6/2019	Bridge Crk, YNP	Research	On site	IGBST
Unm201902	Unk	Subadult	5/25/2019	Pilgrim Crk, GTNP	Research	On site	IGBST/GTNP
Unm201903	Male	Subadult	5/25/2019	Pilgrim Crk, GTNP	Research	On site	IGBST/GTNP
810	Male	Adult	5/27/2019	Snake River, GTNP	Research	On site	IGBST/GTNP
810	Male	Adult	5/30/2019	Snake River, GTNP	Research	On site	IGBST/GTNP
810	Male	Adult	6/12/2019	Pilgrim Crk, GTNP	Research	On site	IGBST/GTNP
960	Male	Subadult	5/30/2019	Timber Crk, SNF	Research	On site	WGFD
960	Male	Subadult	6/1/2019	Francs Fork, SNF	Research	On site	WGFD
959	Male	Adult	5/31/2019	Pilgrim Crk, GTNP	Research	On site	IGBST/GTNP
959	Male	Adult	6/9/2019	Pilgrim Crk, GTNP	Research	On site	IGBST/GTNP
G253	Male	Subadult	6/4/2019	Greybull River, PR-WY	Research	On site	WGFD
394	Male	Adult	6/5/2019	Antelope Crk, YNP	Research	On site	IGBST
961	Female	Adult	6/7/2019	Greybull River, PR-WY	Research	On site	WGFD
962	Female	Subadult	6/8/2019	Snake River, GTNP	Research	On site	IGBST/GTNP
962	Female	Subadult	10/18/2019	Pilgrim Crk, GTNP	Research	On site	GTNP
G254	Male	Subadult	6/8/2019	Francs Fork, SNF	Research	On site	WGFD
G254	Male	Subadult	6/11/2019	West Fork Timber Crk, SNF	Research	On site	WGFD
963	Male	Adult	6/11/2019	Francs Fork, SNF	Research	On site	WGFD
926	Female	Subadult	6/12/2019	Snake River, GTNP	Research	On site	IGBST/GTNP
964	Female	Subadult	6/12/2019	Snake River, GTNP	Research	On site	IGBST/GTNP
964	Female	Subadult	9/30/2019	Snake River, PR-WY	Management	Transported	WGFD
G255	Male	Adult	6/13/2019	Timber Crk, SNF	Research	On site	WGFD
Unm201904	Male	Adult	6/17/2019	Marquette Crk, PR-WY	Management	Removed (201911)	WGFD
965	Female	Adult	6/17/2019	Four Bears Crk, BLM	Research	On site	WGFD
G256	Male	Yearling	6/19/2019	Bear Crk, PR-MT	Management	On site	WS
966	Female	Subadult	6/20/2019	Francs Fork, SNF	Research	On site	WGFD
967	Male	Adult	6/20/2019	Four Bears Crk, SNF	Research	On site	WGFD
862	Male	Adult	6/23/2019	Flat Mountain Crk, YNP	Research	On site	IGBST
816	Male	Adult	6/25/2019	Long Crk, SNF	Management	Removed (201912)	WGFD
968	Male	Adult	6/30/2019	Bear Crk, PR-MT	Management	Transported	MTFWP/WS

Table 1. Continued

Bear	Sex	Age	Date	General location[a]	Capture type	Release site[b]	Handler[c]
968	Male	Adult	9/2/2019	Rock Crk, PR-MT	Management	Removed (201922)	MTFWP/WS
883	Female	Adult	7/3/2019	Flat Mountain Crk, YNP	Research	On site	IGBST
975	Male	Subadult	7/6/2019	Henrys Fork, CTNF	Research	On site	IDFG
975	Male	Subadult	8/17/2019	Bear Crk, CTNF	Research	On site	IDFG
706	Female	Adult	7/8/2019	Henrys Fork, CTNF	Research	On site	IDFG
706	Female	Adult	8/20/2019	Bear Crk, CTNF	Research	On site	IDFG
G258	Male	Subadult	7/9/2019	Henrys Fork, CTNF	Research	On site	IDFG
935	Male	Subadult	7/14/2019	Henrys Fork, CTNF	Research	On site	IDFG
935	Male	Subadult	8/18/2019	Bear Crk, CTNF	Research	On site	IDFG
653	Male	Adult	7/16/2019	Henrys Fork, CTNF	Research	On site	IDFG
G259	Male	Subadult	7/19/2019	Middle Fork Owl Crk, PR-WY	Management	Removed (201913)	WGFD
G229	Male	Adult	7/21/2019	Wagon Crk, BTNF	Management	Removed (201914)	WGFD
G260	Male	Subadult	7/21/2019	Wagon Crk, BTNF	Management	Transported	WGFD
913	Female	Adult	7/24/2019	Wyoming Crk, CTNF	Research	On site	IDFG
G261	Male	Adult	7/25/2019	Bridge Crk, YNP	Research	On site	IGBST
969	Female	Adult	7/25/2019	Arnica Crk, YNP	Research	On site	IGBST
969	Female	Adult	8/25/2019	Arnica Crk, YNP	Research	On site	IGBST
970	Male	Adult	7/26/2019	Arnica Crk, YNP	Research	On site	IGBST
971	Male	Adult	7/27/2019	Wyoming Crk, CTNF	Research	On site	IDFG
971	Male	Adult	8/24/2019	Bear Crk, CTNF	Research	On site	IDFG
972	Male	Adult	7/28/2019	Sheridan Crk, SNF	Management	Transported	WGFD
419	Male	Adult	7/29/2019	Boot Jack Crk, CTNF	Research	On site	IDFG
973	Female	Subadult	8/1/2019	Fish Crk, BTNF	Management	Transported	WGFD
973	Female	Subadult	10/22/2019	North Fork Shoshone, PR-WY	Management	Removed (201934)	WGFD
Unm201905	Male	Adult	8/8/2019	Green River, BTNF	Management	Removed (201915)	WGFD
974	Female	Subadult	8/8/2019	Owl Crk, PR-WY	Management	Transported	WGFD
G262	Male	Subadult	8/12/2019	Wagon Crk, BTNF	Management	Transported	WGFD
G245	Male	Subadult	8/18/2019	Jesse Crk, CTNF	Research	On site	IDFG
976	Female	Adult	8/21/2019	Slip and Slide Crk, CGNF	Research	On site	IGBST
Unm201906	Female	Adult	8/24/2019	Skull Crk, ST-WY	Management	Removed (201916)	WGFD
Unm201907	Female	Cub	8/24/2019	Skull Crk, ST-WY	Management	Removed (201917)	WGFD
Unm201908	Male	Cub	8/24/2019	Skull Crk, ST-WY	Management	Removed (201918)	WGFD
977	Female	Adult	8/24/2019	Trout Crk, SNF	Management	Transported	WGFD
637	Male	Adult	8/24/2019	Trout Crk, SNF	Management	Removed (201919)	WGFD
481	Female	Adult	8/25/2019	Arnica Crk, YNP	Research	On site	IGBST
792	Male	Adult	8/27/2019	Wagon Crk, BTNF	Management	Removed (201920)	WGFD
589	Male	Adult	8/27/2019	Arnica Crk, YNP	Research	On site	IGBST
G214	Female	Subadult	8/28/2019	Greybull River, PR-WY	Management	Removed (201921)	WGFD

Table 1. Continued							
Bear	**Sex**	**Age**	**Date**	**General location[a]**	**Capture type**	**Release site[b]**	**Handler[c]**
978	Male	Subadult	8/29/2019	Fish Crk, BTNF	Management	Transported	WGFD
695	Male	Adult	9/11/2019	Gibbon River, YNP	Research	On site	IGBST
979	Female	Subadult	9/13/2019	Gypsum Crk, BTNF	Management	Transported	WGFD
Unm201909	Unk	Subadult	9/13/2019	Gibbon River, YNP	Research	On site	IGBST
980	Female	Adult	9/15/2019	Gibbon River, YNP	Research	On site	IGBST
981	Female	Subadult	9/15/2019	Gibbon River, YNP	Research	On site	IGBST
G236	Male	Adult	9/19/2019	Clarks Fork River, PR-WY	Management	Removed (201924)	WGFD
982	Male	Subadult	9/20/2019	Meadow Crk, PR-WY	Management	Transported	WGFD
828	Male	Adult	9/21/2019	West Fork Madison, BDNF	Management	Removed (201925)	WS
983	Male	Adult	9/21/2019	Crandall Crk, PR-WY	Management	Transported	WGFD
984	Male	Yearling	9/22/2019	Dry Crk, PR-WY	Management	Transported	WGFD
985	Male	Adult	9/25/2019	Snake River, GTNP	Research	On site	GTNP
985	Male	Adult	10/11/2019	Snake River, GTNP	Research	On site	GTNP
G263	Male	Yearling	9/26/2019	Spring Crk, BLM-WY	Management	Transported	WGFD
Unm201910	Male	Subadult	9/30/2019	Grinnell Crk, SNF	Management	Mortality (201930)	WGFD
834	Male	Adult	10/1/2019	Jim Crk, PR-WY	Management	Transported	WGFD
986	Female	Adult	10/2/2019	Stephens Crk, YNP	Research	On site	IGBST
812	Male	Adult	10/2/2019	Stephens Crk, YNP	Research	On site	IGBST
804	Male	Adult	10/4/2019	Antelope Crk, YNP	Research	On site	IGBST
934	Male	Adult	10/8/2019	Pilgrim Crk, GTNP	Research	On site	GTNP
668	Male	Adult	10/13/2019	Belknap Crk, PR-WY	Management	Removed (201932)	WGFD
Unm201911	Unk	Cub	10/15/2019	Snake River, GTNP	Research	On site	GTNP

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

[b] Numbers in parentheses are assigned mortality numbers

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

Table 2. Annual number of grizzly bears monitored, captured, and transported in the Greater Yellowstone Ecosystem, 1980–2019.					
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

Table 3. Grizzly bears radiomonitored in the Greater Yellowstone Ecosystem, 2019.						
				Monitored		
Bear	Sex	Age	Offspring	Out of den	Into den	Current status
394	M	Adult		Yes	Yes	Active
419	M	Adult		No	Yes	Active
480	M	Adult		No	Yes	Active
481	F	Adult	None	No	Yes	Active
589	M	Adult		Yes	Yes	Active
653	M	Adult		No	Yes	Active
688	M	Adult		Yes	Yes	Active
695	M	Adult		No	Yes	Active
706	F	Adult	None seen	No	Yes	Active
712	M	Adult		Yes	No	Cast
734	F	Adult	1 yearling	Yes	Yes	Active
735	F	Adult	None	No	No	Removed
743	F	Adult	2 yearlings, 2 lost?	Yes		Unresolved
762	F	Adult	2 cubs	Yes	Yes	Active
773	F	Adult	None	Yes	Yes	Active
786	F	Adult	4 cubs, 1 lost	Yes	Yes	Active
791	M	Adult		Yes	Yes	Active
804	M	Adult		No		Missing
810	M	Adult		No	No	Cast
812	M	Adult		No	Yes	Active
834	M	Adult		No	Yes	Active
862	M	Adult		No	Yes	Active
863	F	Adult	2 cubs, 1 lost	Yes	Yes	Active
867	F	Adult	None	Yes	No	Cast
868	F	Adult	1 cub	Yes	No	Cast
869	F	Adult	Not seen	Yes		Missing
876	F	Adult	None	Yes	No	Cast
880	M	Adult		Yes	Yes	Active
883	F	Adult	None	No	Yes	Active
886	F	Adult	1 cub	Yes	No	Cast
887	M	Adult		Yes	No	Cast
893	F	Adult	None	Yes	No	Cast
895	F	Adult	3 yearlings	Yes	Yes	Active
896	F	Adult	None	Yes	Yes	Active
899	F	Adult	2 cubs, 1 lost	Yes	Yes	Active
905	F	Adult	3 cubs	Yes	No	Cast
906	F	Adult	2 cubs	Yes	No	Cast
907	F	Adult	None	Yes	No	Cast
911	F	Adult	None	Yes	Yes	Active
913	F	Adult	None	Yes	Yes	Active
914	F	Adult	1 cub, lost	Yes	Yes	Active
916	M	Adult		Yes	No	Cast

Table 3. Continued.

Bear	Sex	Age	Offspring	Monitored		Current status
				Out of den	Into den	
917	M	Adult		Yes	Yes	Active
922	M	Adult		Yes	No	Cast
924	F	Subadult	None	Yes	No	Cast
926	F	Subadult	None	Yes	Yes	Active
928	M	Adult		Yes	No	Cast
929	M	Subadult		Yes	No	Cast
930	F	Adult	None	Yes	Yes	Active
933	F	Adult	None	Yes	Yes	Active
934	M	Adult		Yes	No	Cast
935	M	Subadult		Yes	No	Cast
936	M	Adult		Yes	Yes	Active
938	M	Adult		Yes	No	Cast
939	M	Adult		No	No	Cast
941	M	Adult		Yes	No	Cast
942	F	Adult	2 yearlings	Yes	Yes	Active
944	M	Subadult		Yes	No	Removed
945	M	Adult		Yes	Yes	Active
946	M	Adult		Yes	No	Cast
947	F	Adult	2 cubs	Yes	Yes	Active
948	F	Adult	2 yearlings	Yes	Yes	Active
949	F	Subadult	None	Yes	Yes	Active
951	M	Subadult		Yes	No	Cast
952	F	Adult	None	Yes	Yes	Active
953	M	Adult		Yes	No	Cast
954	F	Adult	2 cubs, 1 lost	Yes	Yes	Active
956	F	Adult	None	Yes	Yes	Active
957	F	Adult	Not observed	Yes	No	Cast
958	M	Adult		No	No	Cast
959	M	Adult		No	No	Cast
960	M	Subadult		No	No	Active
961	F	Adult	None	No	Yes	Active
962	F	Subadult	None	No	Yes	Active
963	M	Adult		No	Yes	Active
964	F	Subadult	None	No	Yes	Active
965	F	Adult	None	No	No	Cast
966	F	Subadult	None	No	Yes	Active
967	M	Adult		No	Yes	Active
968	M	Adult		No	No	Cast/removed
969	F	Adult	None	No	Yes	Active
970	M	Adult		No	No	Cast
971	M	Adult		No		Missing
972	M	Adult		No	No	Cast

Table 3. Continued.

Bear	Sex	Age	Offspring	Monitored		Current status
				Out of den	Into den	
973	F	Subadult	None	No	No	Removed
974	F	Subadult	None	No	Yes	Active
975	M	Subadult		No	No	Cast
976	F	Adult	None	No	Yes	Active
977	F	Adult	None	No	Yes	Active
978	M	Subadult		No	Yes	Active
979	F	Subadult	None	No	Yes	Active
980	F	Adult	None	No	Yes	Active
981	F	Subadult	None	No	Yes	Active
982	M	Subadult		No	Yes	Active
983	M	Adult		No	Yes	Active
984	M	Yearling		No	Yes	Active
985	M	Adult		No	Yes	Active
986	F	Adult	2 cubs	No	Yes	Active

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

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

Background

Under the 2017 Revised Demographic Criteria for the Yellowstone Ecosystem, which were amended to the Grizzly Bear Recovery Plan (USFWS 1993, USFWS 2017), the IGBST is tasked with annually estimating the number of female grizzly bears with cubs in the GYE population, determining trend for this segment of the population, and estimating size of specific population segments to assess annual mortalities relative to population size. Here, we present our 2019 findings for counts of unique females with cubs, and the total population estimate derived from numbers of females with cubs observed within the DMA.

Methods

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

2019 Sightings of Females with Cubs

We documented 172 verified sightings of females with cubs during 2019 in the GYE. The majority of observations were obtained from aerial sources (59.9%, Table 4). We differentiated 50 unique females with cubs from the 172 sightings using the rule set of Knight et al. (1995). Five sightings (2.9%) of 4 unique females occurred outside the DMA (Fig. 2). Three of the 5 females were only observed (each with 1 sighting) outside the DMA; another female with cubs was observed twice outside the DMA with additional observations (n = 4) inside the DMA. Fifty (29.1%) observations from an estimated 7 unique females with cubs occurred within the boundary of Yellowstone National Park (YNP).

The total number of cubs observed during initial sightings of the 50 unique females with cubs was 97 and mean litter size was 1.94 (Table 5). There were 13 single cub litters, 28 litters of twins, and 8 litters of triplets, and 1 litter of quadruplets (Table 5). Using the initial sightings of all females with cubs observed within the DMA, total cubs was 91 and mean litter size remained 1.94.

2019 DMA Chao2 and Population Estimate

Excluding the 5 sightings (3 females) observed outside the DMA and sightings of 5 family groups based on telemetry only, which are not independent observations, we obtained 108 observations of 42 unique families (Table 6) within the DMA. Using the sighting frequencies, our estimate of the number of unique females with cubs within the DMA was $\hat{N}_{DMAChao2}$ = 66. Applying the linear and quadratic regressions produced a model-averaged estimate of $\hat{N}_{DMAChao2}$ = 58 (95% CI = 47–72). The 2017 Revised Demographic Criteria specify a minimum of 48 females with cubs within the DMA (USFWS 2017). Applying the updated

2002–2011 vital rates to $\hat{N}_{DMAChao2}$ produced a total population estimate for the DMA of 737 as well as estimates of population segments (Table 7).

We used the annual $\hat{N}_{Chao2}$ for the DMA during the period 1983–2019 (Table 6) to evaluate trend for the female with cubs segment of the population (Fig. 3). With the 2019 addition, AIC_c weights (Table 8) continue to support the quadratic (90.8%) over the linear (9.2%) model (Table 8). These data are similar to previous years and show a leveling off of this estimator of females with cubs for the geographically restricted area of the DMA.

Linear regression of $\hat{N}_{Chao2}$ with year for the period 2002–2019 shows some support for a positive trend (F = 4.060, 1 df, P = 0.061), but next year's data will be important to determine if this is a continuing trend.

Table 4. Method of observation for female grizzly bears with cubs sighted in the Greater Yellowstone Ecosystem, 2019.

Method of observation	Frequency	%	Cumulative %
Fixed wing aircraft – incidental	5	2.9	2.9
Fixed wing aircraft – observation flight	44	25.6	28.5
Fixed wing aircraft – telemetry flight	52	30.2	58.7
Fixed wing aircraft – ferry time	1	0.6	59.3
Helicopter – other researcher	1	0.6	59.9
Ground sighting	68	39.5	99.4
Trap	1	0.6	100
Total	172	100	

Table 5. Number of unique females with cubs ($\hat{N}_{Obs}$), litter frequencies, total number of cubs, and average litter size at initial observation, Greater Yellowstone Ecosystem, 1983–2019.

Year	$\hat{N}_{Obs}$	Total no. of sightings	Litter size				Total no. of cubs	Mean litter size
			1 cub	2 cubs	3 cubs	4 cubs		
1983	13	15	6	5	2	0	22	1.69
1984	17	41	5	10	2	0	31	1.82
1985	9	17	3	5	1	0	16	1.78
1986	25	85	6	15	4	0	48	1.92
1987	13	21	1	8	4	0	29	2.23
1988	19	39	1	14	4	0	41	2.16
1989	16	33	7	5	4	0	29	1.81
1990	25	53	4	10	10	1	58	2.32
1991[a]	24	62	6	14	3	0	43	1.87
1992	25	39	2	12	10	1	60	2.40
1993	20	32	4	11	5	0	41	2.05
1994	20	34	1	11	8	0	47	2.35
1995	17	25	2	10	5	0	37	2.18
1996	33	56	6	15	12	0	72	2.18
1997	31	80	5	21	5	0	62	2.00
1998	35	86	9	17	9	0	70	2.00
1999	33	108	11	14	8	0	63	1.91
2000	37	100	9	21	7	0	72	1.95
2001	42	105	13	22	7	0	78	1.86
2002	52	153	14	26	12	0	102	1.96
2003	38	60	6	27	5	0	75	1.97
2004	49	223	14	23	12	0	96	1.96
2005	31	93	11	14	6	0	57	1.84
2006	47	172	12	21	14	0	96	2.04
2007	50	335	10	22	18	0	108	2.16
2008	44	118	10	28	6	0	84	1.91
2009	42	117	10	19	11	2	89	2.12
2010	51	286	15	23	12	1	101	1.98
2011	39	134	13	17	9	0	74	1.90
2012	49	124	14	25	10	0	94	1.92
2013	58	183	8	35	14	3	126	2.17
2014	50	119	16	22	12	0	96	1.92
2015	46	156	15	17[b]	14[b]	0	91[b]	1.98[b]
2016	50	144	15	22	13	0	98	1.96
2017	58	180	15	30	12	1	115	1.98
2018	58	172	11	33	14	0	119	2.05
2019	50	172	13	28	8	1	97	1.94

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

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

Table 6. Annual Chao2 estimates for the numbers of female grizzly bears with cubs in the Greater Yellowstone Ecosystem, 1983–2019. Estimates in parenthesis for 2012–2019 are specific to the Demographic Monitoring Area (DMA). 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*	$n/\hat{N}_{Chao2}$
1983	13	10	8	2	19	12	0.6
1984	17	17	7	3	22	40	1.8
1985	9	8	5	0	18	17	0.9
1986	25	24	7	5	28	82	3
1987	13	12	7	3	17	20	1.2
1988	19	17	7	4	21	36	1.7
1989	16	14	7	5	18	28	1.6
1990	25	22	7	6	25	49	2
1991	24	24	11	3	38	62	1.6
1992	25	23	15	5	41	37	0.9
1993	20	18	8	8	21	30	1.4
1994	20	18	9	7	23	29	1.3
1995	17	17	13	2	43	25	0.6
1996	33	28	15	10	38	45	1.2
1997	31	29	13	7	39	65	1.7
1998	35	33	11	13	37	75	2
1999	33	30	9	5	36	96	2.7
2000	37	34	18	8	51	76	1.5
2001	42	39	16	12	48	84	1.7
2002	52	49	17	14	58	145	2.5
2003	38	35	19	14	46	54	1.2
2004	49	48	15	10	58	202	3.5
2005	31	29	6	8	31	86	2.8
2006	47	43	8	16	45	140	3.3
2007	50	48	12	12	53	275	5.1
2008	44	43	16	8	56	102	1.8
2009	42	39	11	11	44	100	2.3
2010	51	51	11	9	56	256	4.6
2011	39	39	14	10	47	123	2.6
2012	49 (48)	44 (43)	16 (15)	7 (7)	59 (56)	110 (108)	1.9 (1.9)
2013	58 (57)	53 (52)	13 (14)	11 (11)	60 (60)	160 (152)	2.6 (2.5)
2014	50 (47)	46 (44)	23 (21)	13 (13)	64 (59)	92 (90)	1.4 (1.5)
2015	46 (44)	43 (41)	14 (13) [a]	10 (11) [a]	51 (47) [a]	135 (131)	2.6 (2.8)
2016	50 (45)	50 (45)	15 (12)	15 (13)	56 (50)	129 (121)	2.3 (2.4)
2017	58 (57)	54 (53)	19 (19)	16 (15)	64 (64)	127 (125)	2.0 (1.9)
2018	58 (56)	52 (50)	16 (16)	23 (23)	57 (55)	123 (116)	2.2 (2.1)
2019	50 (47)	45 (42)	23 (20)	7 (7)	77 (66)	111 (108)	1.4 (1.6)

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

Table 7. Estimates and 95% confidence intervals (CI) for population segments and total grizzly bear population size derived using the Chao2 estimate for females with cubs within the Demographic Monitoring Area, 2019.

Segment	Estimate	95% CI	
		Lower[a]	Upper[a]
Independent females (≥2 years old)	257	205	309
Independent males (≥2 years old)	257	200	314
Dependent young (cubs and yearlings)	223	202	245
Total	737	657	818

[a]Calculated using the delta method.

Table 8. Parameter estimates and model selection results from fitting linear and quadratic models for $Ln(\hat{N}_{Chao2})$ (number of female grizzly bears with cubs) with year for the time period 1983–2019. During 2012–2019, Chao2 estimates were restricted to the Demographic Monitoring Area.

Model	Parameter	Estimate	Standard error	*t* value	*P*
Linear					
	β_0	3.02414	0.07455	40.56	<0.0001
	β_1	0.03279	0.00342	9.59	<0.0001
	SSE	1.72756			
	AIC_c	-106.648			
	AIC_c weight	0.092			
Quadratic					
	β_0	2.80518	0.10672	22.29	<0.0001
	β_1	0.06647	0.01295	5.13	<0.0001
	β_2	-0.00089	0.00033	-2.68	0.0112
	SSE	1.42592			
	AIC_c	-111.226			
	AIC_c weight	0.908			

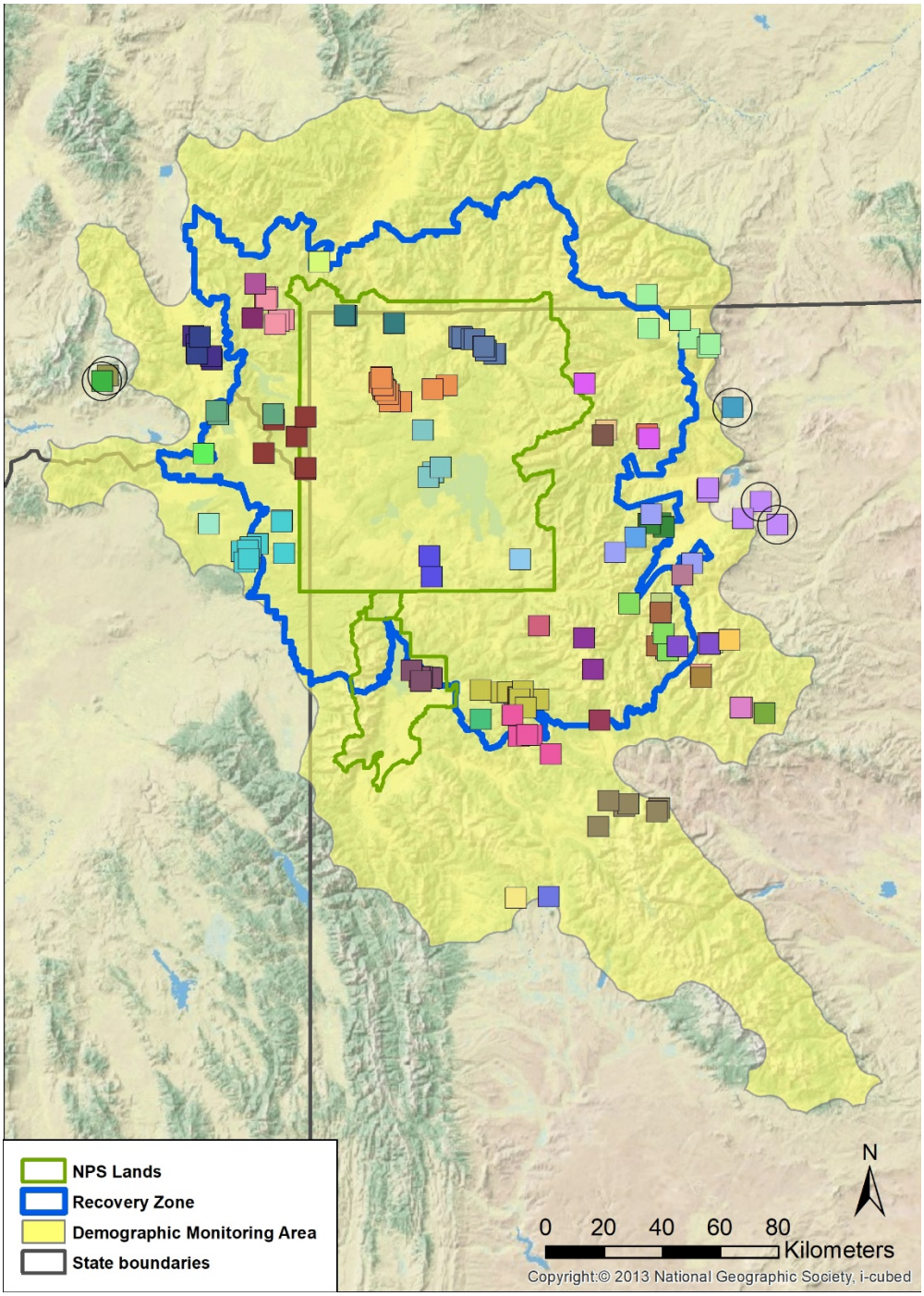


Fig. 2. Distribution of 172 sightings of 50 (indicated by unique colors) unduplicated female grizzly bears with cubs observed in the Greater Yellowstone Ecosystem, 2019. Only sightings from females with cubs occurring within the Demographic Monitoring Area (DMA) are used for population estimation. During 2019, 5 sightings (black circles around symbols) from 4 unique females with cubs occurred outside the DMA. Three of these females (1 observation each) were only observed outside the DMA.

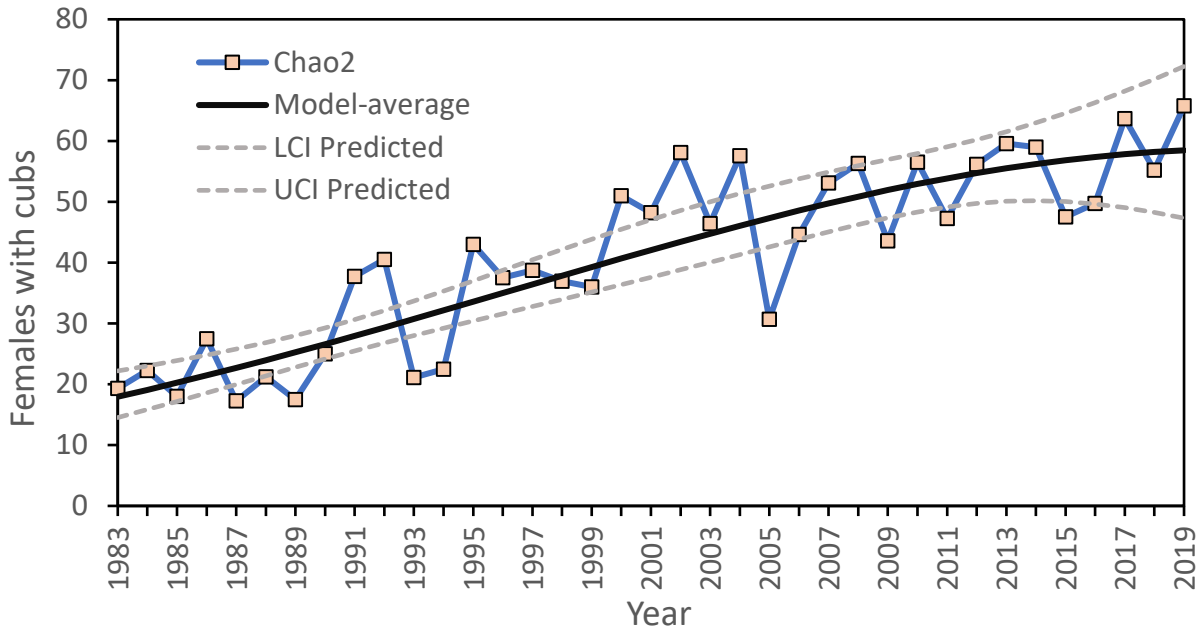


Fig. 3. Model-averaged estimates for the number of unique female grizzly bears with cubs, 1983–2019, where the linear and quadratic models of $Ln(\hat{N}_{Chao2})$ *were fitted. Estimates for 2012–2019 were restricted to the Demographic Monitoring Area (DMA). The inner set of gray solid lines represents a 95% confidence interval on the predicted population size.*

II. Mark-Resight Technique to Estimate Females with Cubs

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

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

Higgs et al. (2013) performed simulations based on a known population of 50 females with cubs and resighting frequencies and proportions of bears sighted 0, 1, and 2 times from the observation flight data to determine accuracy and precision of the mark-resight technique. Accuracy was high, indicating that this technique addressed the bias concerns associated with estimates based on the Chao2 estimator. However, the simulations also indicated that precision was low. In our 2015 annual report, Peck (2016, Appendix C) 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 moderately effectiveness to detect a 5% annual decline. Although the IGBST concluded that this was insufficient for effective monitoring of population trend, this method does provide relatively unbiased estimates and would likely detect large changes in numbers of females with cubs. Therefore, we continue to report these estimates.

2019 Mark-Resight Results

Eight female grizzly bears with cub(s) wore functioning radio-transmitters during June-August 2019 when aerial observation flights were conducted and were available for sighting. Two of these 8 families were observed once each during observation flights >500 m from a moth site. The 6 other radio-marked females with cubs were not sighted during observation fights. All 8 females were included in the mark-resight analysis. We

observed 16 unmarked females with cubs >500 m from moth sites (Table 9). Using the method of Higgs et al. (2013) with updated 1997–2019 data, and excluding observations at army cutworm moth aggregation sites, our 2019 mark-resight estimate for unique females with cubs was 68 (95% inter-quartile range = 37–114) with a low probability of ≤48 females with cubs ($P < 0.140$; Table 10). The mark-resight 3-year-moving average for 2018 (i.e., using 2017–2019 results) was 75 unique females with cubs (95% inter-quartile range = 49–112), with a $P = 0.020$ probability of ≤48 females with cubs (Table 11, Fig. 4). We did not conduct moth site-only flights to count females with cubs on army cutworm moth aggregation sites during 2019.

Table 9. Data used in mark-resight analysis on female grizzly bears with cubs, Greater Yellowstone Ecosystem, 1997–2019, including number of radio-marked female grizzly bears available for sighting during observation flights (m), the number seen zero time (Y_0), seen once (Y_1), the number seen twice (Y_2), and the number of unmarked females bears with cubs (S). Estimates exclude females with cubs observed <500 m of 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

[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.

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

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

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

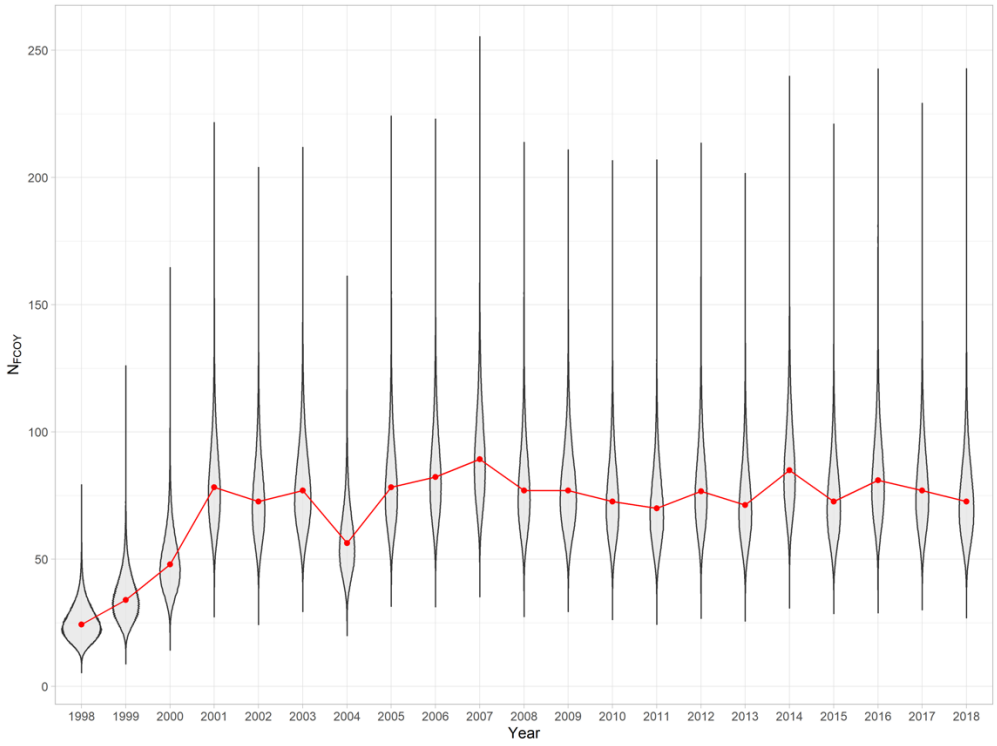


Fig. 4. Annual mark-resight estimates (3-year moving average [red dots], 95 % inter quartile [gray area]) of the number of female grizzly bears with cubs, Greater Yellowstone Ecosystem, 1998–2019. Estimates exclude females with cubs observed <500 m of army cutworm moth aggregation sites.

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

Dispersion of reproductive females throughout the ecosystem is assessed by verified observations of female grizzly bears with young (cubs, yearlings, 2-year-olds, or young of unknown age) by BMU. The requirements specified in the Demographic Recovery Criteria (USFWS 2007*b*) state that 16 of the 18 BMUs must be occupied by females with young on a running 6-year sum with no 2 adjacent BMUs unoccupied. All 18 BMUs had verified observations of female grizzly bears with young during 2019 (Table 12). Eighteen of 18 BMUs contained verified observations of females with young in at least 4 years of the last 6-year (2014–2019) period.

Table 12. Bear Management Units in the Greater Yellowstone Ecosystem occupied by females with young (cubs, yearlings, 2-year-olds, or young of unknown age), as determined by verified reports, 2014–2019.

Bear Management Unit	2014	2015	2016	2017	2018	2019	Years occupied
1) Hilgard	X	X	X	X	X	X	6
2) Gallatin	X	X	X	X	X	X	6
3) Hellroaring/Bear	X	X	X	X	X	X	6
4) Boulder/Slough	X	X	X	X	X	X	6
5) Lamar	X	X	X	X	X	X	6
6) Crandall/Sunlight	X	X	X	X	X	X	6
7) Shoshone	X	X	X	X	X	X	6
8) Pelican/Clear	X	X	X	X	X	X	6
9) Washburn	X	X	X	X	X	X	6
10) Firehole/Hayden	X	X	X	X	X	X	6
11) Madison	X	X	X	X	X	X	6
12) Henry's Lake	X	X	X	X	X	X	6
13) Plateau	X	X	X	X	X	X	6
14) Two Ocean/Lake	X	X	X	X	X	X	6
15) Thorofare	X	X	X	X	X	X	6
16) South Absaroka	X	X	X	X	X	X	6
17) Buffalo/Spread Creek	X	X	X	X	X	X	6
18) Bechler/Teton	X		X		X	X	4
Total	18	17	18	17	18	18	

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

Fifty-four Bear Observation Areas (BOAs, Fig. 5) were established in 2014. In 2019, two rounds of observation flights were conducted: 54 BOAs were surveyed during Round 1 (4 Jun–6 Aug) and 42 during Round 2 (4 Jul–28 Aug). Total duration of observation flight time was 107.8 hours for Round 1 and 91.0 hours for Round 2; average duration of individual flights was 2.1 hours (Table 13). Excluding dependent young, 493 bear sightings were recorded during observation flights. This includes 2 unique family groups (1 with 2 cubs, 1 with 3 cubs) where an adult female was not observed. Of the 493 sightings, 21 were radio-marked bears (5 females with young, 8 females without young, and 8 males), 371 were solitary unmarked bears, and 99 were unmarked females with young (Table 13). Our observation rate was 2.48 bears/hour for all bears. A total of 191 young (82 cubs, 98 yearlings, and 11 2-year-olds) were observed (Table 14). Observation rates for females with dependent young were 0.52 females with young/hour and 0.21 females with cubs/hour (Table 13).

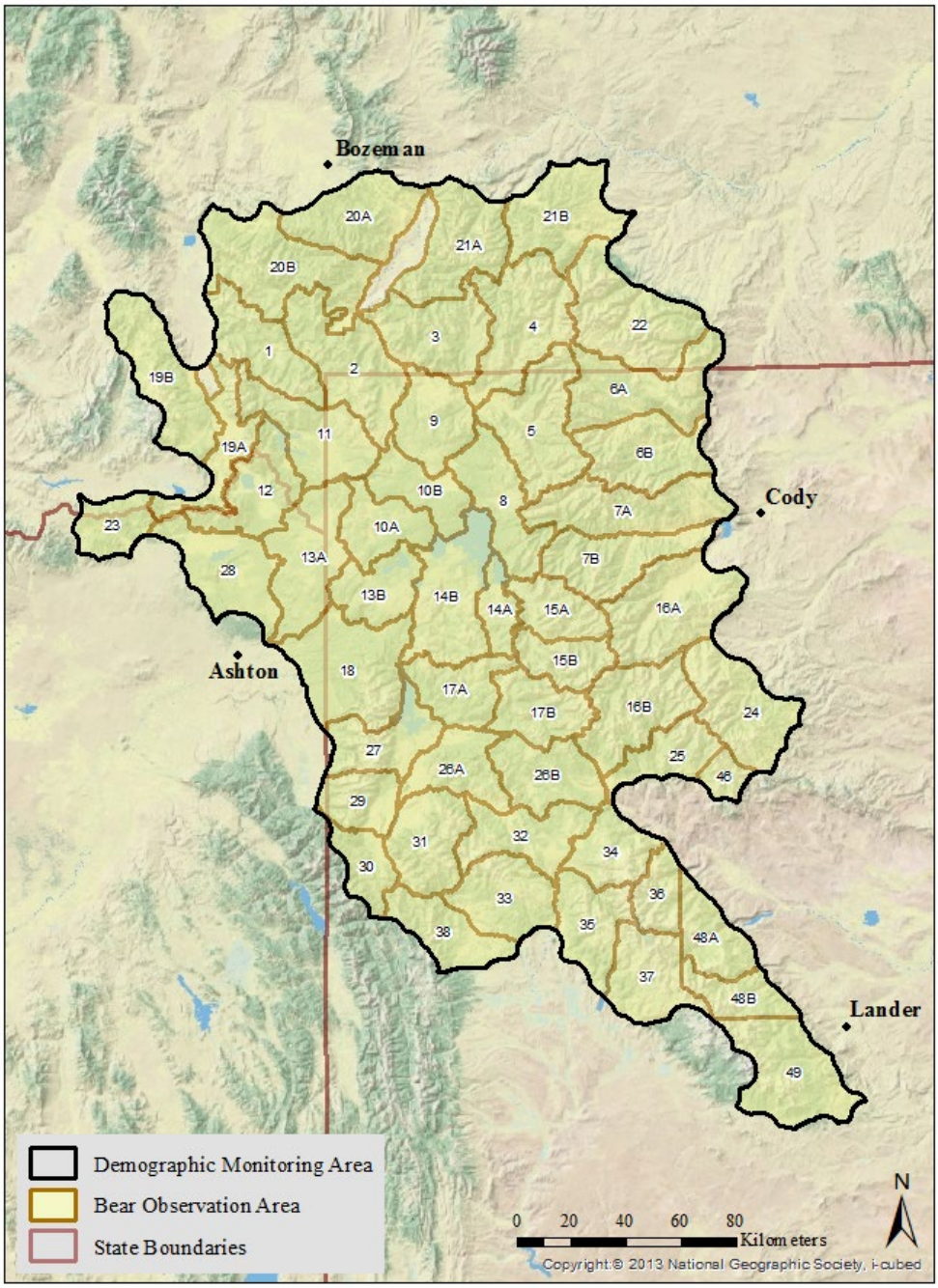


Fig. 5. Grizzly bear observation areas for aerial surveys, Greater Yellowstone Ecosystem, 2019. Numbers represent the 54 Bear Observation Areas, with several larger areas split into 2 subsections (A and B).

Table 13. Annual summary statistics for grizzly bear observation flights, Greater Yellowstone Ecosystem, 2005–2019.

Year	Observation period	Total hours	Number of flights	Average hours/flight	Bears seen					Observation rate (bears/hour)		
					Marked		Unmarked		Total number of groups	All groups	With young	With cubs
					Lone	With young	Lone	With young				
2005[a]	Round 1	86.3	37	2.3	1	0	70	20	91	1.05		
	Round 2	86.2	37	2.3	0	0	72	28	100	1.16		
	Total	172.5	74	2.3	1	0	142	48	191	1.11	0.28	0.13
2006[a]	Round 1	89.3	37	2.4	2	1	106	35	144	1.61		
	Round 2	77	33	2.3	3	1	76	24	104	1.35		
	Total	166.3	70	2.3	5	2	182	59	248	1.49	0.37	0.27
2007[a]	Round 1	99	44	2.3	2	1	125	53	181	1.83		
	Round 2	75.1	30	2.5	0	4	96	20	120	1.60		
	Total	174.1	74	2.4	2	5	221	73	301	1.73	0.45	0.29
2008[a]	Round 1	97.6	46	2.1	2	1	87	36	126	1.29		
	Round 2	101.5	45	2.3	2	3	185	53	243	2.39		
	Total	199.1	91	2.2	4	4	272	89	369	1.85	0.47	0.23
2009[a]	Round 1	90.3	47	1.9	1	0	85	21	107	1.18		
	Round 2	93.6	47	2	2	0	157	34	193	2.06		
	Total	183.9	94	2	3	0	242	55	300	1.63	0.3	0.15
2010[a]	Round 1	101.1	48	2.1	0	2	93	22	117	1.16		
	Round 2	93.3	46	2	0	0	161	41	202	2.17		
	Total	194.4	94	2.1	0	2	254	63	319	1.64	0.33	0.2
2011[a]	Round 1	88.9	47	1.9	2	1	153	31	187	2.10		
	Round 2	71	35	2	4	0	109	23	136	1.92		
	Total	159.8	82	1.9	6	1	262	54	323	2.02	0.34	0.18
2012[a]	Round 1	95.4	48	2	4	2	178	35	219	2.30		
	Round 2	73.7	35	2.1	2	1	117	30	150	2.04		
	Total	169.1	83	2	6	3	295	65	369	2.18	0.4	0.23
2013[a]	Round 1	97	48	2	2	1	152	44	199	2.05		
	Round 2	72.8	35	2.1	4	1	171	48	224	3.08		
	Total	169.8	83	2.1	6	2	323	92	423	2.49	0.55	0.39
2014[a]	Round 1	104	52	2	2	2	170	47	221	2.13		
	Round 2	88.6	43	2.1	3	1	188	60	252	2.84		
	Total	192.6	95	2	5	3	358	107	473	2.46	0.57	0.27
2015[a]	Round 1	104	52	2	4	1	126	34	165	1.59		
	Round 2	88.6	44	2	1	2	142	41	186	2.10		
	Total	192.7	96	2	5	3	268	75	351	1.82	0.4	0.23
2016[a]	Round 1	106.8	53	2	5	3	133	36	177	1.66		
	Round 2	86.5	42	2.1	1	2	95	32	130	1.50		
	Total	193.3	95	2	6	8	228	68	307	1.59	0.4	0.24
2017[a]	Round 1	105.5	54	1.95	7	2	153	36	198	1.88		
	Round 2	79	40	1.98	8	2	127	36	173	2.19		
	Total	184.5	94	1.97	15	4	280	72	371	2.00	0.4	0.27
2018[a]	Round 1	105.8	54	1.96	6	3	185	58	252	2.38		
	Round 2	73.6	40	1.84	1	1	105	35	142	1.93		
	Total	179.4	94	1.91	7	4	290	93	394	2.20	0.54	0.32
2019[a]	Round 1	107.8	54	2	7	4	183	56	251[b]	2.33		
	Round 2	91.0	42	2.17	9	1	188	43	242[c]	2.66		
	Total	198.8	96	2.07	16	5	371	99	493	2.48	0.52	0.21

[a] Dates of flights (Round 1, Round 2): 2005 (4 Jun–26 Jul, 1 Jul–31 Aug); 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).

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

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

Table 14. Size and age composition of grizzly bear family groups seen during observation flights, Greater Yellowstone Ecosystem, 2005–2019.

		Females with cubs (number of cubs)			Females with yearlings (number of yearlings)			Females with 2-year-olds or young of unknown age (number of young)		
Year	Round	1	2	3	1	2	3	1	2	3
2005[a]	Round 1	5	5	3	2	3	1	0	1	0
	Round 2	4	4	1	3	6	3	5	2	0
	Total	9	9	4	5	9	4	5	3	0
2006[a]	Round 1	8	12	7	4	2	2	1	0	0
	Round 2	5	11	2	2	1	0	2	2	0
	Total	13	23	9	6	3	2	3	2	0
2007[a]	Round 1	7	21	9	8	6	0	2	1	0
	Round 2	2	6	6	3	2	3	0	2	0
	Total	9	27	15	11	8	3	2	3	0
2008[a]	Round 1	3	10	0	9	5	2[b]	6	2	0
	Round 2	9	21	3	7	8	3	3	2	0
	Total	12	31	3	16	13	5[b]	9	4	0
2009[a]	Round 1	0	6	4	2	3	1	3	1	0
	Round 2	6	11	1	3	7	1	4	1	1
	Total	6	17	5	5	10	2	7	1	1
2010[a]	Round 1	2	7	2	2	6	1	4	0	0
	Round 2	10	10	7	5	4	3	1	4	3
	Total	12	17	9	7	10	4	5	4	3
2011[a]	Round 1	4	8	3	3	6	1	2	2	3
	Round 2	2	8	4	2	2	1	1	3	0
	Total	6	16	7	5	8	2	3	5	3
2012[a]	Round 1	5	19	1	2	3	4	0	2	1
	Round 2	5	9	0	4	6	2	1	3	1
	Total	10	28	1	6	9	6	1	5	2
2013[a]	Round 1	8	20	4	1	5	0	3	4	0
	Round 2	11	21	3[c]	2	7	0	0	5	0
	Total	19	41	7[c]	3	12	0	3	9	0
2014[a]	Round 1	8	17	3	6	14	0	1	0	0
	Round 2	1	15	8	11	18	3	2	2	1
	Total	9	32	11	17	32	3	3	2	1
2015[a]	Round 1	6	18	15	2	20	6	0	2	0
	Round 2	9	22	12	2	24	6	2	0	4[d]
	Total	15	40	27	4	44	12	2	2	4[d]
2016[a]	Round 1	3	16	2	5	8	1	2	2	0
	Round 2	8	11	6	2	4	1	1	1	0
	Total	11	27	8	7	12	2	3	3	0
2017[a]	Round 1	6	14	3	4	7	2	0	2	0
	Round 2	5	20	2	5	3	0	1	1	1
	Total	11	34	5	9	10	2	1	3	1
2018[a]	Round 1	7	24	10	5	7	2[b]	3	3	0
	Round 2	5	8	4	6	11	2	0	0	0
	Total	12	32	14	11	18	4	3	3	0
2019[a]	Round 1	11	10	2[c]	9	16	5	6	0	1
	Round 2	2	14	3	8	14	2	0	1	0
	Total	13	24	5	17	30	7	6	1	1

[a] Dates of flights (Round 1, Round 2): 2005 (4 Jun–26 Jul, 1 Jul–31 Aug); 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).

[b] Includes 1 female with 4 yearlings.

[c] Includes 1 female with 4 cubs.

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

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

Ninety-five telemetry location flights were conducted during 2019, resulting in 265.4 hours of search time (excluding ferry time to and from airports; Table 15). Flights were conducted at least once during all months, with 67% of telemetry flights in May–November. During telemetry flights, 914 locations of bears equipped with radio transmitters were collected, 294 (32%) of which included a visual sighting. Forty-five sightings of unmarked bears were also obtained during telemetry flights, including 41 solitary bears, 2 females with cubs, and 2 females with yearlings. No females with 2-year-olds were observed in 2019. Rate of observation for all unmarked bears during telemetry flights was 0.17 bears/hour; and 1.11 bears/hour for marked bears.

The observation rate during telemetry flights for unmarked females with cubs was 0.008 females with cubs/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. Only Iridium platforms were on the air in 2019. We deployed 27 Iridium GPS collars in 2019, obtaining over 104,200 GPS locations from 48 grizzly bears (newly and previously deployed GPS collars).

Table 15. Summary statistics for radio-telemetry flights to locate grizzly bears, Greater Yellowstone Ecosystem, 2019.

				Radioed 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	11.4	4	2.9	47	0	---	0	0	0	0	---	---
Feb	8.1	7	1.2	47	0	---	0	0	0	0	---	---
Mar	23.3	8	2.9	98	7	0.30	2	0	0	0	0.09	---
Apr	20.1	7	2.9	79	31	1.54	6	0	0	0	0.30	---
May	23.9	9	2.7	87	54	2.26	12	0	0	0	0.50	---
June	24.4	11	2.2	82	56	2.30	11	0	0	0	0.45	---
July	20.6	10	2.1	79	41	1.99	2	0	0	0	0.10	---
Aug	27.5	12	2.3	79	34	1.24	4	0	1	0	0.18	---
Sept	33.5	10	3.4	90	32	0.96	3	2	1	0	0.18	0.06
Oct	31.7	7	4.5	81	28	0.88	1	0	0	0	0.03	---
Nov	20.2	5	4.0	61	11	0.54	0	0	0	0	---	---
Dec	20.7	5	4.1	84	0	---	0	0	0	0	---	---
Total	265.4	95	2.8	914	294	1.11	41	2	2	0	0.17	0.008

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

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

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

2019 Mortality Results

We documented 47 known and probable mortalities in the GYE during 2019, of which 2, a female with cub (#201902, #201903), occurred during the fall of 2018 (Table 16). The 2 mortalities from 2018 were within the DMA and both are under investigation.

Of the 45 known and probable mortalities that occurred during 2019, 37 (82.2%) were attributable to human causes (Table 16, Fig. 6). Five of the 45 known and probable losses remain under investigation by U.S. Fish and Wildlife Service and state law enforcement agencies (Table 16). Specific information related to these mortalities is not provided because of ongoing investigations. However, these 5 mortalities are included in the following summaries.

Ten (27.0 %) of the 37 human-caused losses were hunting related, including 2 mistaken identity kills by black bear hunters and 8 losses from reported self-defense kills. Two of the self-defense kills involved females accompanied by 3 cubs. Fifteen (40.5 %) of the 37 human-caused losses were related to livestock depredations, including one event that remains under investigation. Seven (18.9%) were related to anthropogenic site conflicts. Other human-caused losses included 4 mortalities from vehicle strikes and 1 mortality attributed to capture myopathy during a management situation at a front country conflict site.

We documented 7 natural mortalities (Table 16). Five of the natural mortalities were cubs lost from 5 different radio-marked females. Evidence at the sites suggested the other 2 (1 subadult male, and 1 subadult of unknown sex) were likely killed and consumed by other bears.

We documented 3 incidents considered possible mortalities during 2019 (Table 16). All 3 events involved shots fired in self-defense at a charging bear resulting from surprise encounters at close range; one by a range rider and two by archery elk hunters. In all 3 of these instances, no evidence was found that a mortality was likely to have occurred.

We evaluated known and probable mortalities relative to population estimates only for the DMA. Of the 45 known and probable documented mortalities occurring in 2019, 27 occurred within the boundaries of the DMA and 18 occurred outside (Table 17, Fig. 6). Sex determination for 2 reported mortalities of independent-age bears from 2019 is pending DNA results. We used a random generator to attribute sex to these 2 incidents with results indicating female for both (#201927 and #201929; Table 16). During 2019, we documented 5 mortalities of independent-age female bears within the DMA (Table 17). There were 2 management removals, no radio-marked losses, and 3 reported losses, including the 2 bears of unknown sex that the random generator assigned as females (Table 18). Estimated total mortality for independent-age females was 3.5% of the 2019 estimate for this segment of the population (Table 18). Seventeen known and probable mortalities of independent-age males occurred within the DMA (Table 17). We documented 9 management removals (including one loss due to myopathy during a management action #201930, Table

16), no radio-marked losses, and 8 reported losses of independent-age males within the DMA (Table 17). Estimated total mortality for independent males was 11.7% of the 2019 estimate for this segment of the population (Table 18). There were no known or probable human-caused losses of dependent young documented in the DMA during 2019 (Table 18).

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

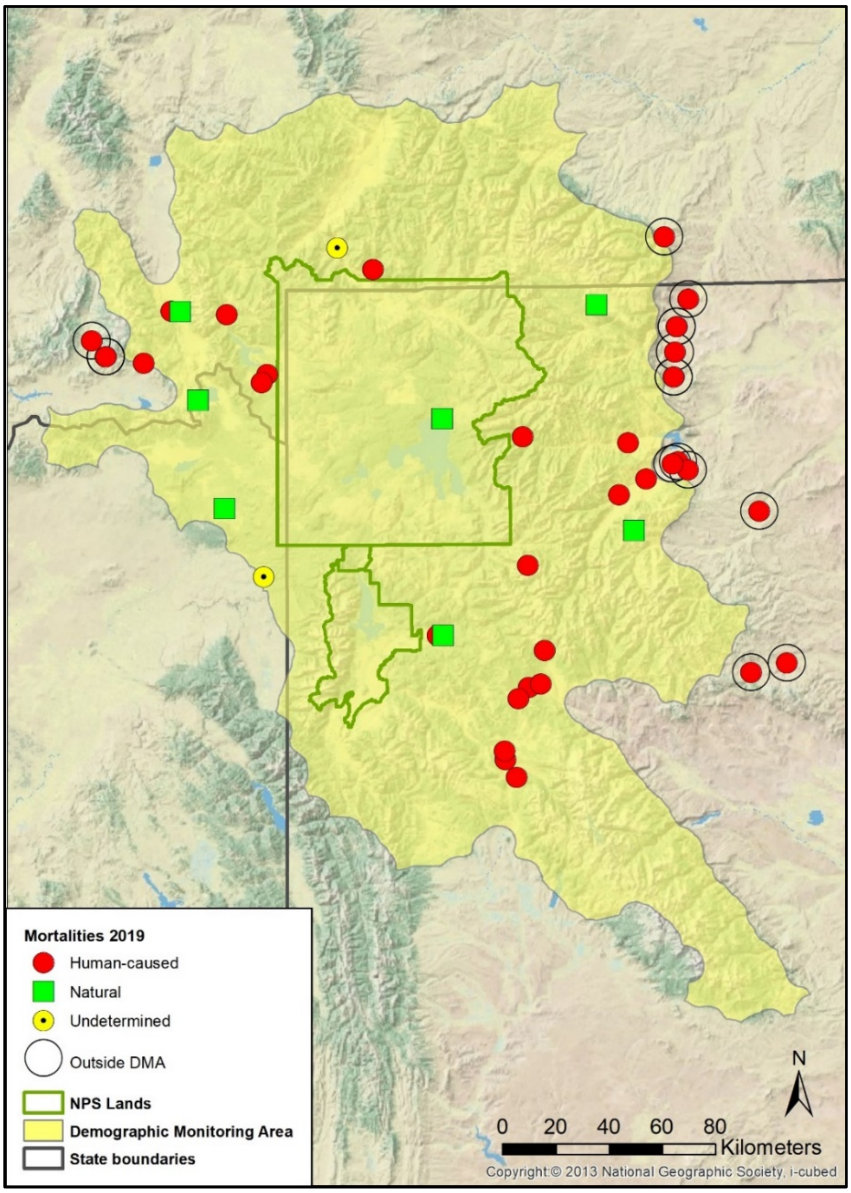


Fig. 6. Distribution of 47 known and probable grizzly bear mortalities documented in the Greater Yellowstone Ecosystem during 2019, including 2 mortalities (an adult female with a cub) that likely occurred during the fall of 2018. Twenty-seven of the documented mortalities occurring in 2019 were within the Demographic Monitoring Area (DMA), of which 19 were attributed to human causes. Eighteen mortalities occurred outside the DMA (black circles around symbols), all of which were attributed to human causes. Due to multiple bear mortalities at a specific location or separate mortalities occurring close to one another, not all 47 locations are visible on this map. Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

Table 16. Grizzly bear mortalities documented in the Greater Yellowstone Ecosystem, 2019.								
Unique #	**Bear [a]**	**Sex [b]**	**Age [c]**	**Date**	**Location [d]**	**Monitoring area [e]**	**Certainty**	**Description**
201901	697	M	Adult	3/31/2019	South Fork Shoshone, PR-WY	Inside DMA	Known	Human-caused, management capture and removal of bear #697 for cattle depredations.
201902				Fall 2018	MT	Inside DMA	Known	UNDER INVESTIGATION.
201903				Fall 2018	MT	Inside DMA	Probable	UNDER INVESTIGATION.
201904	944	M	Subadult	4/16/2019	Carter Crk, PR-WY	Outside DMA	Known	Human-caused, management capture and removal of bear #944 for cattle depredations.
201905	673	M	Adult	5/1/2019	Madison River, PR-MT	Inside DMA	Known	Human-caused, bear #673 killed by vehicle strike on US Highway 287.
201906	Unm	M	Subadult	5/4/2019	Wind River, SNF-WY	Inside DMA	Known	Human-caused, unmarked subadult killed by vehicle strike on US Highway 26/287.
201907	G247	M	Subadult	5/10/2019	Pat O'Hara Crk, PR-WY	Outside DMA	Known	Human-caused, management capture and removal of bear #G247 for obtaining food rewards, frequenting developed sites, and aggressive behavior.
201908	Unm	M	Subadult	5/11/2019	Carter Crk, PR-WY	Outside DMA	Known	Human-caused, management capture and removal of unmarked subadult male for cattle depredation.
201909	Unm	M	Subadult	5/25/2019	Madison River, CGNF-MT	Inside DMA	Known	Human-caused, unmarked subadult male severely injured by vehicle strike and euthanized.
201910				2019	WY	Outside DMA	Known	UNDER INVESTIGATION
201911	Unm	M	Adult	6/17/2019	Marquette Crk, PR-WY	Outside DMA	Known	Human-caused, management capture and removal of unmarked bear for cattle depredations
201912	816	M	Adult	6/25/2019	Long Crk, SNF-WY	Inside DMA	Known	Human-caused, management capture and removal of bear #816 for cattle depredations and prior conflict history of other conflicts with garbage and human habituations.
201913	G259	M	Subadult	7/19/2019	Middle Fork Owl Crk, PR-WY	Outside DMA	Known	Human-caused, management capture and removal of bear #G259 for obtaining multiple food rewards and bold behavior at a sheep camp.
201914	G229	M	Adult	7/21/2019	Wagon Crk, BTNF-WY	Inside DMA	Known	Human-caused, management capture and removal of bear #G229 for cattle depredations.

Table 16. Continued.

Unique #	Bear [a]	Sex [b]	Age [c]	Date	Location [d]	Monitoring area [e]	Certainty	Description
201915	Unm	M	Adult	8/8/2019	Green River, BTNF-WY	Inside DMA	Known	Human-caused, management capture and removal of unmarked bear for cattle depredations
201916	Unm	F	Adult	8/24/2019	Skull Crk, ST-WY	Outside DMA	Known	Human-caused, management capture and removal of female with 2 cubs for cattle depredations.
201917	Unm	F	Cub	8/24/2019	Skull Crk, ST-WY	Outside DMA	Known	Human-caused, management capture and removal cub with mother and sibling for cattle depredations.
201918	Unm	M	Cub	8/24/2019	Skull Crk, ST-WY	Outside DMA	Known	Human-caused, management capture and removal cub with mother and sibling for cattle depredations.
201919	637	M	Adult	8/24/2019	Trout Crk, SNF-WY	Inside DMA	Known	Human-caused, management capture and removal of bear #637 for cattle depredations.
201920	792	M	Adult	8/27/2019	Wagon Crk, BTNF-WY	Inside DMA	Known	Human-caused, management capture and removal of bear #792 for cattle depredations.
201921	G214	F	Subadult	8/28/2019	Greybull River, PR-WY	Outside DMA	Known	Human-caused, management capture and removal of bear #G214 for obtaining anthropogenic foods and habituated behavior.
201922	968	M	Adult	9/2/2019	Rock Crk, PR-MT	Outside DMA	Known	Human-caused, management capture and removal of bear #968 for cattle depredations.
201923	Unm	F	Adult	9/14/2019	Falls Crk, SNF-WY	Inside DMA	Known	Human-caused, self-defense kill of unmarked female with 1 yearling by elk hunter. Yearling unharmed.
201924	G236	M	Adult	9/19/2019	Clarks Fork River, PR-WY	Outside DMA	Known	Human-caused, management capture and removal of bear #G236 for repeated agricultural damage and human safety concerns
201925	828	M	Adult	9/21/2019	West Fork Madison River, BDNF-MT	Inside DMA	Known	Human-caused, management removal of bear #828 for cattle depredations.
201926	Unm	M	Adult	9/24/2019	Coal Crk, BDNF	Outside DMA	Probable	Human-caused, self-defense by archery elk hunter. Shots fired; bear was wounded but no carcass found. DNA results indicated male.
201927	Unm	Unk	Subadult	Spring 2019	Piney Crk, SNF-WY	Inside DMA	Known	Natural, likely killed during spring 2019, carcass had been cached and was nearly all consumed. Samples collected for DNA analysis. Random generated sex indicated female.
201928				2019	WY	Inside DMA	Known	UNDER INVESTIGATION
201929	Unm	Unk	Subadult	July 2019	Dry Crk, PR-ID	Inside DMA	Known	Undetermined cause, likely died July 2019, carcass had been scavenged. Samples collected for DNA analysis. Random generated sex indicated female.
201930	Unm	M	Subadult	9/30/2019	Grinnell Crk, SNF-WY	Inside DMA	Known	Human-caused, management capture, capture related exertional myopathy in trap before bear was drugged.

Table 16. Continued.

Unique #	Bear [a]	Sex [b]	Age [c]	Date	Location [d]	Monitoring area [e]	Certainty	Description
201931	Unm	M	Subadult	10/7/2019	Yellowstone River, YNP	Inside DMA	Known	Natural, killed and consumed by anther bear, probably bear #791 whose presences consuming the carcass was confirmed with telemetry.
201932	668	M	Adult	10/13/2019	Belknap Crk, PR-WY	Inside DMA	Known	Human-caused, management capture and removal of bear #668 for nuisance activity at residence and obtaining food rewards.
201933	Unm	M	Subadult	10/13/2019	Blackrock Crk, BTNF-WY	Inside DMA	Known	Human-caused, unmarked subadult male killed by vehicle strike on WY Highway 26.
201934	973	F	Subadult	10/22/2019	North Fork Shoshone, PR-WY	Inside DMA	Known	Human-caused, management capture and removal of bear #973 for obtaining anthropogenic foods and previous conflict history.
201935	G245	M	Subadult	10/22/2019	South Fork Madison, CGNF	Inside DMA	Known	Human-caused, mistaken identity of kill of bear #G245 by black bear hunter. Illegal take under MT state law.
201936	314	M	Adult	10/24/2019	Cub Crk, CGNF-MT	Inside DMA	Known	Human-caused, mistaken identity kill. Partial old tattoo suggest it was bear #314. Samples taken for DNA identification. Illegal take under MT state law.
201937	Unm	F	Adult	10/26/2019	West Fork Madison River, BDNF-MT	Outside DMA	Known	Human-caused, self-defense kill of an unmarked adult female by ungulate hunters.
201938	735	F	Adult	10/30/2019	Bear Crk, PR-MT	Inside DMA	Known	Human-caused, management capture and removal of bear #735 for multiple property damages and obtaining food rewards.
201939				2019	WY	Outside DMA	Known	UNDER INVESTIGATION.
201940				2019	WY	Outside DMA	Probable	UNDER INVESTIGATION.
201941				2019	WY	Outside DMA	Probable	UNDER INVESTIGATION.
201942	Unm	Unk	Cub	10/26/2019	West Fork Madison River, BDNF-MT	Outside DMA	Probable	Human-caused, cub whose mother (mort # 201937) was killed in self-defense by ungulate hunters.
201943	Unm	Unk	Cub	6/23/2019	Madison River, BDNF	Inside DMA	Probable	Natural, radiomarked female #786 lost one of her 4 cubs between 6/18 and 6/28.
201944	Unm	Unk	Cub	5/18/2019	Blackrock Crk, BTNF-WY	Inside DMA	Probable	Natural, radiomarked female #863 lost one of her 2 cubs between 5/10/2019 and 5/25/2019.

Table 16. Continued.

Unique #	Bear [a]	Sex [b]	Age [c]	Date	Location [d]	Monitoring area [e]	Certainty	Description
201945	Unm	Unk	Cub	5/18/2019	Henrys Fork, CTNF-ID	Inside DMA	Probable	Natural, radiomarked female #899 lost one of her 2 cubs between 5/10/2019 and 5/25/2019.
201946	Unm	Unk	Cub	5/2/2019	Duck Crk, CTNF-ID	Inside DMA	Probable	Natural, radiomarked female #914 lost one of her 2 cubs between 4/24/2019 and 5/10/2019.
201947	Unm	Unk	Cub	7/5/2020	Little Bear Crk, SNF-WY	Inside DMA	Probable	Natural, radiomarked female #954 lost one of her 2 cubs between 6/25/2019 and 7/15/2019.
201948	Unk	Unk	Adult	6/20/2019	Cottonwood Crk, BDNF-MT	Inside DMA	Possible	Human-caused, self-defense, shots fired at bear during close-range surprise encounter. Reported as a large adult, no evidence the bear was wounded.
201949	Unk	Unk	Adult	9/16/2019	Cottonwood Crk, BDNF-MT	Inside DMA	Possible	Human-caused, self-defense, archery elk hunter, shots fired at bear during close-range surprise encounter. Reported as a large adult. Bear was probably hit with at least 1 shot.
201950	Unk	Unk	Unk	9/17/2019	East Fork Crk, CGNF-MT	Inside DMA	Possible	Human-caused, self-defense, archery elk hunter, 1 shot fired at bear during close-range surprise encounter. Unknown if bear was hit.

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

[b] Unk = unknown sex.

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

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

[e] Location relative to Demographic Monitoring Area.

Table 17. Counts of documented known and probable grizzly bear mortalities that occurred in 2019 by sex, age class, and location relative to the Demographic Monitoring Area (DMA), Greater Yellowstone Ecosystem.

		Age class		
Area	Sex	Dependent (<2 years old)	Independent (≥2 years old)	Total
Inside DMA	Female	0	3	3
	Male	0	17	17
	Unknown	5	2	7
	Total	5	22	27
Outside DMA	Female	1	4	5
	Male	1	8	9
	Unknown	3	1	4
	Total	5	13	18

Table 18. Annual estimates ($\hat{N}$) and mortality statistics by population segment for grizzly bears in the Demographic Monitoring Area (DMA), Greater Yellowstone Ecosystem 2019. Population estimates for the DMA were derived using the most recent vital rates (IGBST 2012). Only human-caused losses are counted against the mortality threshold for dependent young.

Population segment	$\hat{N}$	Human-caused loss	Sanctioned removals (*a*)	Radio-marked loss (*b*)	Reported loss	Estimated [a] reported + unreported loss (*c*)	Estimated total mortality (*a* + *b* + *c*)	Annual % mortality
Dependent young	223	0						0.0
Females 2+	257	3	2	0	3[b]	7[b]	9[b]	3.5
Males 2+	257	16	9	0	8[b]	21[b]	30[b]	11.7

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

[b] Numbers may change pending DNA determination of sex for 2 reported mortality from 2019.

MONITORING OF GRIZZLY BEAR FOODS

Grizzly Bear Consumption of Ungulates in Yellowstone National Park *(Kerry A. Gunther, Travis C. Wyman, 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.

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

In 2019, we recorded 721 opportunistic sightings of grizzly bears in Yellowstone National Park. In 109 (15%) of these sightings, the observed grizzly bears were feeding on ungulate carcasses (Table 19). Grizzly bears were observed consuming ungulate carcasses from March through December (Fig. 7), with most occurring in May (n = 21) and August (n = 28). Bison (56%, n = 61) and elk (30%, n = 33) were the species of ungulates most often consumed by grizzly bears. In contrast, black bears fed on ungulate carcasses in only 26 (3%) of 1,053 opportunistic observations (Table 19). Black bears generally consumed smaller ungulate species including elk (42%, n = 11), mule deer (23%, n = 6), and pronghorn (15%, n = 4). Interference competition from grizzly bears likely inhibits black bear use of many ungulate carcasses, particularly larger ungulate species.

The number of opportunistic observations of grizzly bears feeding on ungulates in 2019 (n = 109), was greater than in 2018 (n = 76) and greater than the long-term average of 75.9 (± 31.4 SD) recorded during 1983–2019 (Fig. 8). The proportion of the total number of opportunistic sightings where grizzly bears fed on ungulate carcasses in 2019 (15%) was also slightly higher than the long-term average of 9.2% recorded during 1983–2019 (Fig. 9).

When available, grizzly bears select ungulate carcasses over most other foods. In 2019, grizzly bears scavenged ungulate carcasses in 109 (15%) of 721 opportunistic grizzly bear sightings in Yellowstone National Park. (photo courtesy of NPS)

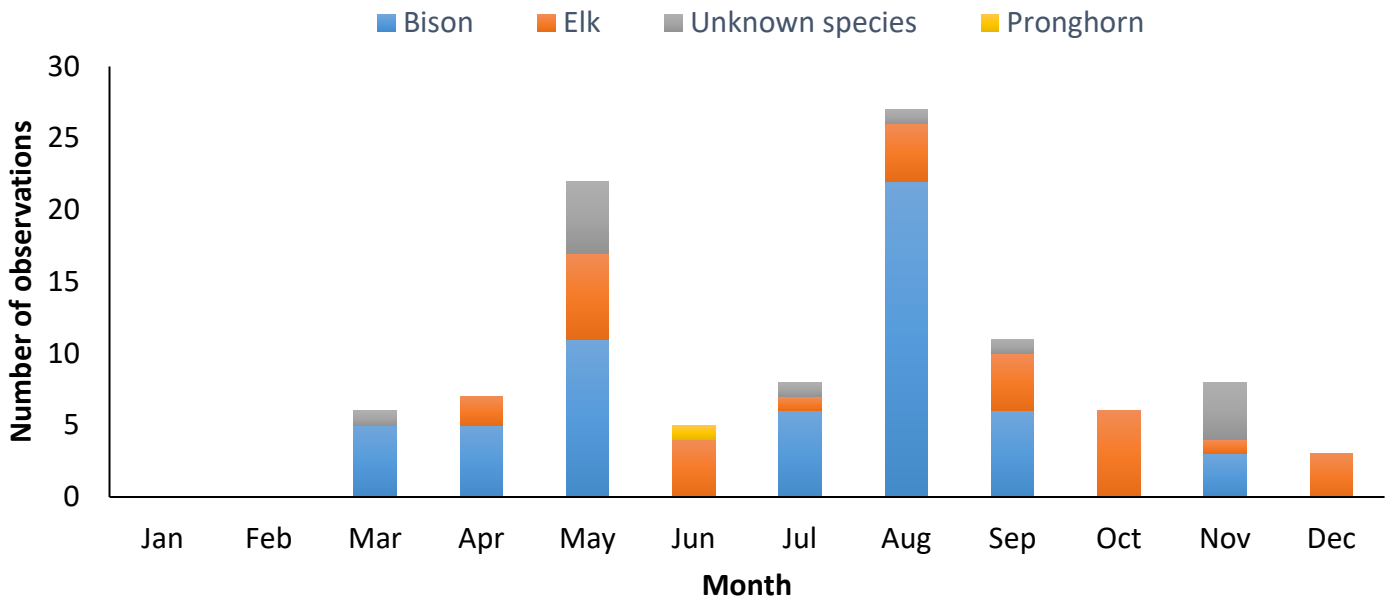


Fig. 7. Number of opportunistic observations of grizzly bears consuming ungulate meat by month in Yellowstone National Park, 2019.

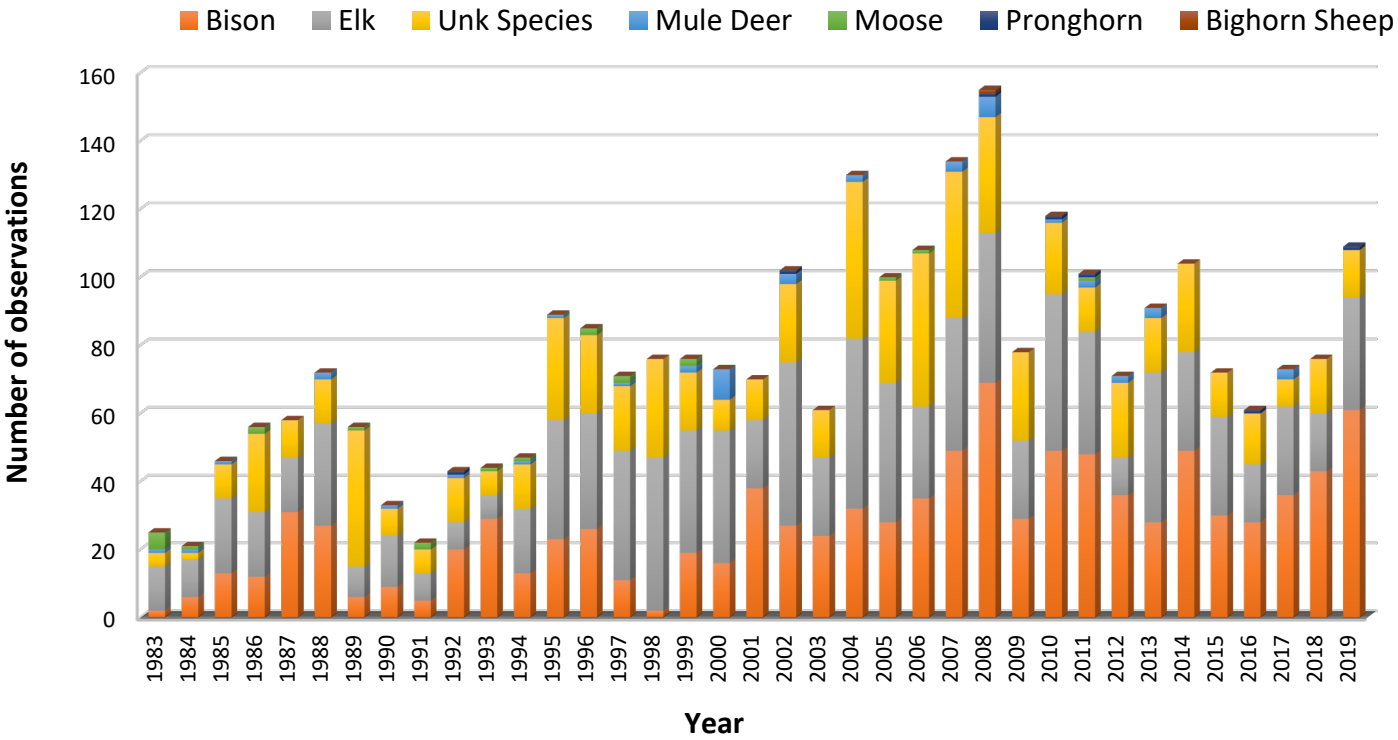


Fig. 8. Number of opportunistic observations of grizzly bears feeding on ungulate carcasses in Yellowstone National Park, 1983–2019.

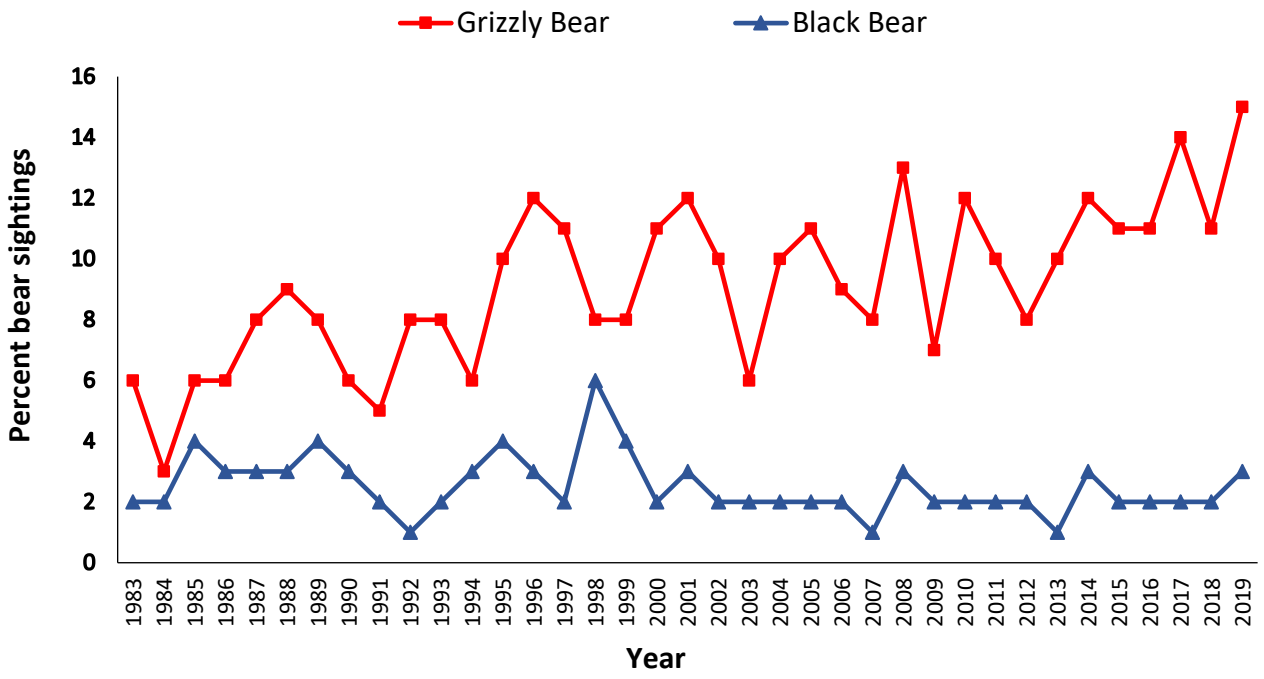


Fig. 9. Proportion of the total number of opportunistic observations of grizzly bears where the observed bears were feeding on ungulate carcasses, Yellowstone National Park, 1983–2019.

Table 19. Number of opportunistic observations of grizzly bears and black bears where the observed bear fed on ungulate carcasses, Yellowstone National Park, 2019.

Species of bear	Species of ungulate consumed									
	Bison	Moose	Elk	Mule Deer	White-tailed deer	Bighorn sheep	Mountain goat	Pronghorn	Unknown ungulate	Total
Grizzly	61	0	33	0	0	0	0	1	14	109
Black	0	1	11	6	0	0	0	4	4	26

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

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

Non-native Lake Trout (*Salvelinus namaycush*), whirling disease caused by an exotic parasite (*Myxobolus cerebralis*), and drought have substantially reduced the native YCT population in Yellowstone Lake (Koel et al. 2005, 2006, 2019). The combined effect of all these factors has reduced the YCT population by 90% (Koel et al. 2005) and resulted in a noticeable decrease in bear fishing activity (Haroldson et al. 2005). Because of the YCT decline, the trophic changes the decline has caused, and use of YCT as a food source by grizzly bears in the Yellowstone Lake watershed, monitoring of the YCT population is a component of the habitat monitoring program of the 2016 Conservation Strategy for the Grizzly Bears in the Greater Yellowstone Ecosystem (USFWS 2016). The YCT population has been monitored through counts at a fish trap located on Clear Creek on the east shore of Yellowstone Lake and through visual stream surveys conducted along North Shore and West Thumb tributaries of the lake (Fig. 10). Visual stream surveys are also conducted along the Trout Lake inlet creek in the northeast section of the park. In 2014, we added 4 Yellowstone Lake backcountry spawning streams to our YCT monitoring program, including 3 streams (Flat Mountain Creek, #1138, and #1141) on the west shore and 1 stream (Columbine Creek) on the east side of Yellowstone Lake. High turbidity and waters levels in Columbine Creek prevented accurate surveys most years, so this stream was dropped from backcountry surveys beginning in 2017.

Yellowstone Lake

Fish Trap Surveys

Historically, the number of spawning YCT migrating upstream were counted most years from a weir with a fish trap located at the mouth of Clear Creek on the east side of Yellowstone Lake (Fig. 11; Koel et al. 2005). The fish trap was generally installed in May, the exact date depending on winter snow accumulation, weather conditions, and spring snow melt. Fish were counted by dip netting trout that entered the upstream trap box or visually as they swam through wooden chutes attached to the trap, or by swimming through an electronic counting box. In 2008, unusually high spring run-off damaged the Clear Creek weir and necessitated its removal. Due to removal of the weir, counts of the number of spawning cutthroat trout ascending Clear Creek were not obtained during 2008–2014. In the fall of 2012, the remnants of the weir were removed, stream banks stabilized, and a suitable platform for an electronic sonar fish counter was installed. Installation and calibration of the sonar fish counter began in the summer 2013 and continued through 2014. In 2015, the sonar fish counter near the mouth of Clear Creek became operational. The sonar is installed mid to late-April and operates through mid-July annually. The sonar fish counter functioned properly in 2015 and 2016 providing reliable estimates of the number of spawning fish those years. However, the sonar fish counter malfunctioned in 2017 and 2018 making counts unreliable those years. No sonar data were collected in 2019.

Front Country Visual Stream Surveys

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

survey conducted during the spawning season is used to identify annual trends in the number of cutthroat trout spawning in Yellowstone Lake tributaries.

The ice went off Yellowstone Lake on May 26, 2019. Data collected in 2019 continued to show low numbers of spawning YCT in North Shore and most West Thumb tributary streams (Table 20). In North Shore streams, only 32 spawning YCT were counted. Twenty-four spawning YCT were counted in Bridge Creek, 6 in Hatchery Creek, and 2 in Lodge Creek. No spawning YCT were observed in Incinerator Creek or Wells Creek. No grizzly bear tracks and no evidence of bear fishing activity (i.e., observations of bears fishing, fish parts, bear scats containing fish parts) was observed along any of the monitored North Shore streams in 2019.

On West Thumb streams, 174 spawning YCT were counted, including 164 in Little Thumb Creek, 9 in Sandy Creek, and 1 in Sewer Creek. No spawning YCT were observed in stream #1167. Grizzly bear tracks were observed along Sandy Creek and Sewer Creek. A trail camera set up on Little Thumb Creek captured photos of 1 grizzly bear and 1 brown colored black bear fishing unsuccessfully in the creek. Fish parts thought to be associated with bear predation were also found on Little Thumb Creek. No bear scats containing fish parts were found along any of the West Thumb streams.

The number of spawning YCT counted in North Shore (Fig. 12) and West Thumb (Fig. 13) streams has decreased significantly since 1989. Although the increased spawning activity observed in Little Thumb Creek in recent years is promising, very few spawning YCT have been observed in all other North Shore and West Thumb streams.

Backcountry Visual Stream Surveys

In 2019, we surveyed 3 backcountry tributary streams including Flat Mountain Creek, unnamed stream #1138, and unnamed stream #1141. Backcountry stream surveys followed the same methods used on frontcountry streams. In backcountry streams, we counted 25 spawning YCT, 24 in stream #1138 and 1 in stream #1141. We did not observe any spawning YCT in Flat Mountain Creek. We observed grizzly bear tracks along Flat Mountain Creek and stream #1141. We did not observe any grizzly bear tracks along stream #1138 and did not observe any black bear tracks along any of the backcountry streams. Although fish parts were observed along streams #1138 and #1141, there were no bear tracks associated with the fish parts and no bear scats containing fish parts were observed along any of the backcountry streams.

Trout Lake

Visual Stream Surveys

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

We observed the first movement of spawning trout from Trout Lake into the inlet creek on June 12. The spawn lasted approximately 30 days with the last spawning trout observed in the inlet creek on July 11. During the once per week visual surveys, 437 spawning cutthroat trout (and cutthroat trout × rainbow trout hybrids) were counted, an average of 87 per visit during the spawning season (Table 20). We observed no evidence of grizzly bear or black bear fishing activity along Trout Lake or the inlet creek during the surveys. The number of fish observed per survey in the Trout Lake inlet creek has ranged from a low of 31 in 2004, to a high of 306 in 2010 (Fig. 14).

Outlook for Cutthroat Trout

The number of spawning YCT counted in all surveyed tributary streams of Yellowstone Lake reached an all-time low in approximately 2004 (Figs. 11–13). A Native Fish Conservation Plan/Environmental Assessment was completed in 2010 (Koel et al. 2010). The plan outlines an adaptive management program designed to protect the native YCT population through suppression of Lake Trout and other methods. As part of these management efforts, park fisheries biologists and private-sector (contracted) netters caught and removed 282,960 Lake Trout from Yellowstone Lake in 2019. Since Lake Trout suppression efforts began in 1994, 3.4 million Lake Trout have been removed from the lake through suppression gillnetting. Population models indicate the removal program has slowed Lake Trout population growth and likely started to send the population into decline (Syslo et al. 2011, Gresswell et al. 2015). Juveniles are again recruiting into the YCT population (Koel et al. 2019). Spawning adult cutthroat trout are returning to some tributaries and bears are once again preying on YCT in a few streams. If the removal program results in a significant long-term reduction in predatory Lake Trout, native YCT will likely reestablish at higher numbers than at present in Yellowstone Lake and its tributary streams and once again become a more important diet item for grizzly bears in the Yellowstone Lake watershed.

Table20. Summary statistics for spawning cutthroat trout surveys, Yellowstone National Park, 2019.

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
North Shore						
Lodge Creek	06/12/2019	06/12/2019	1	1	2	2.0
Hatchery Creek	05/20/2019	06/04/2019	16	3	6	2.0
Incinerator Creek			No spawn			
Wells Creek			No spawn			
Bridge Creek	05/19/2019	06/04/2019	17	3	24	8.0
#1090			Not surveyed			
West Thumb						
1167 Creek			No spawn			
Sandy Creek	05/28/2019	06/03/2019	7	2	9	4.5
Sewer Creek	05/28/2019	05/28/2019	1	1	1	1.0
Little Thumb Creek	06/11/2019	06/26/2019	16	3	164	54.7
Total frontcountry[a]				13	206	15.8
Backcountry						
Flat Mountain Creek			No spawn			
#1141 Creek	06/02/2019	06/02/2019	1	1	1	1.0
#1138 Creek	06/02/2019	06/02/2019	1	1	24	24.0
Columbine Creek			Not surveyed			
Total backcountry				2	25	12.5
Northern Range						
Trout Lake Inlet	06/12/2019	07/11/2019	30	5	437	87.4

[a] Total for North Shore and West Thumb streams that had a spawn.

Fig. 10. Locations of Yellowstone Lake cutthroat trout spawning streams surveyed in 2019. Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

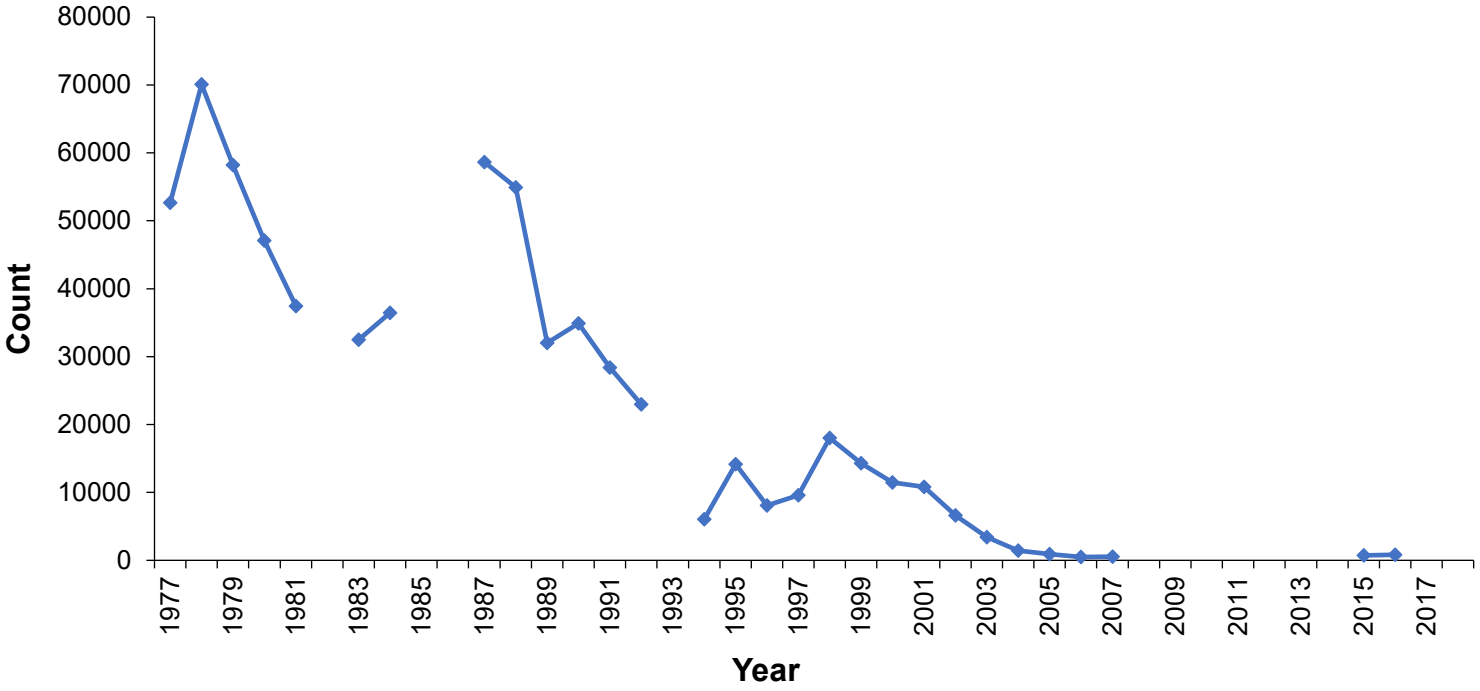


Fig. 11. Number of spawning Yellowstone Cutthroat Trout counted at the Clear Creek fish weir on the east shore of Yellowstone Lake, Yellowstone National Park, 1977–2019.

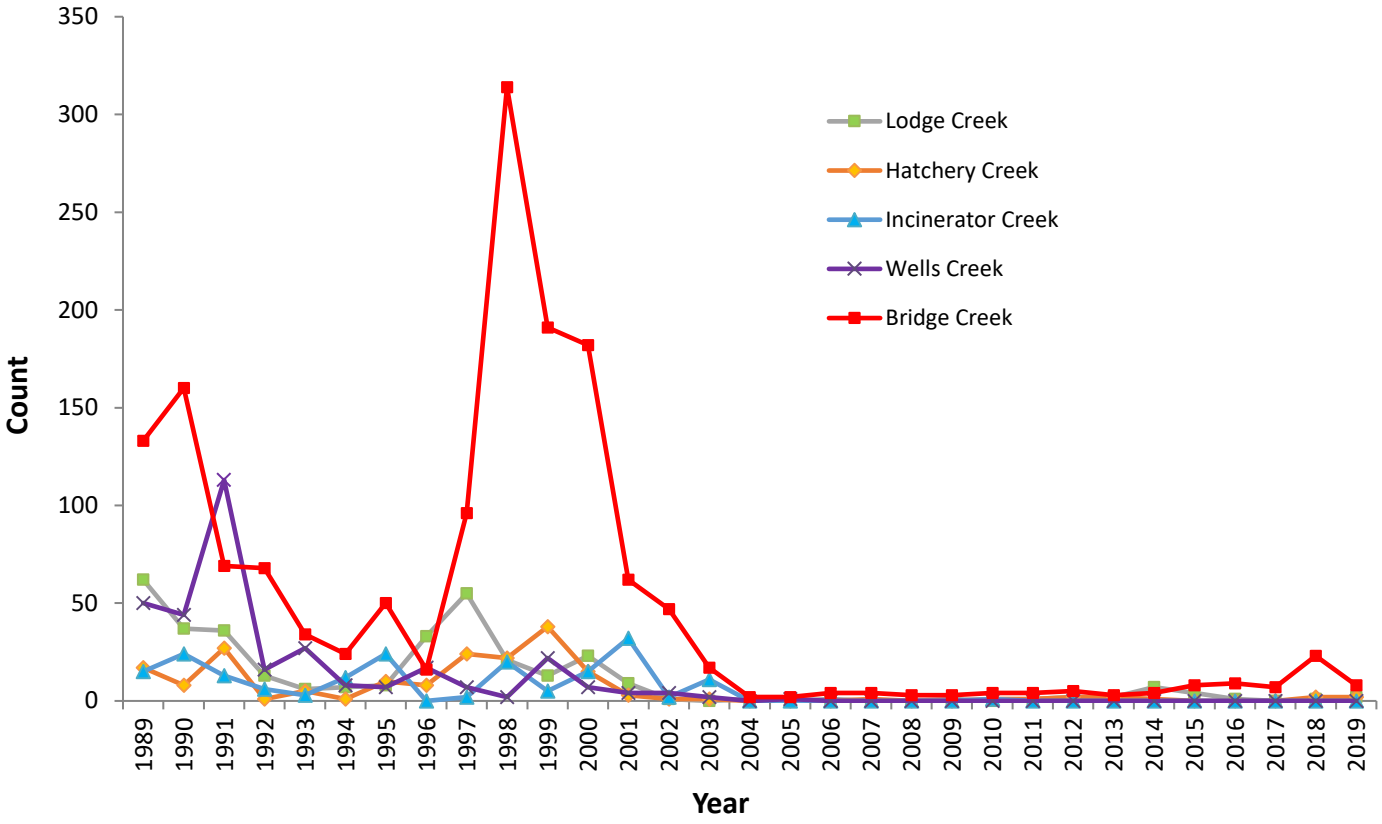


Fig. 12. Mean number of spawning Yellowstone Cutthroat Trout observed during weekly visual surveys of 5 North Shore spawning stream tributaries to Yellowstone Lake, Yellowstone National Park, 1989–2019.

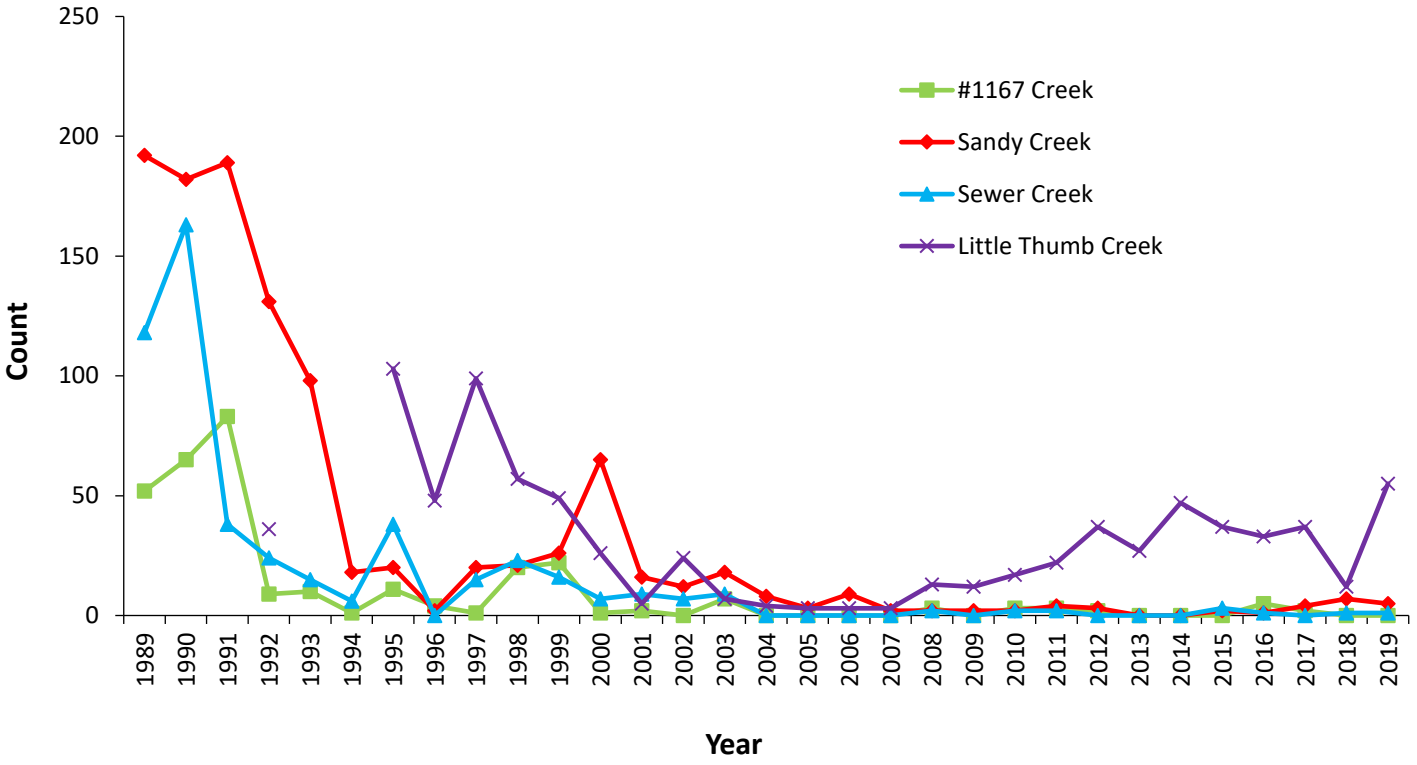


Fig. 13. Mean number of spawning Yellowstone Cutthroat Trout observed during weekly visual surveys of 4 West Thumb spawning stream tributaries to Yellowstone Lake, Yellowstone National Park, 1989–2019.

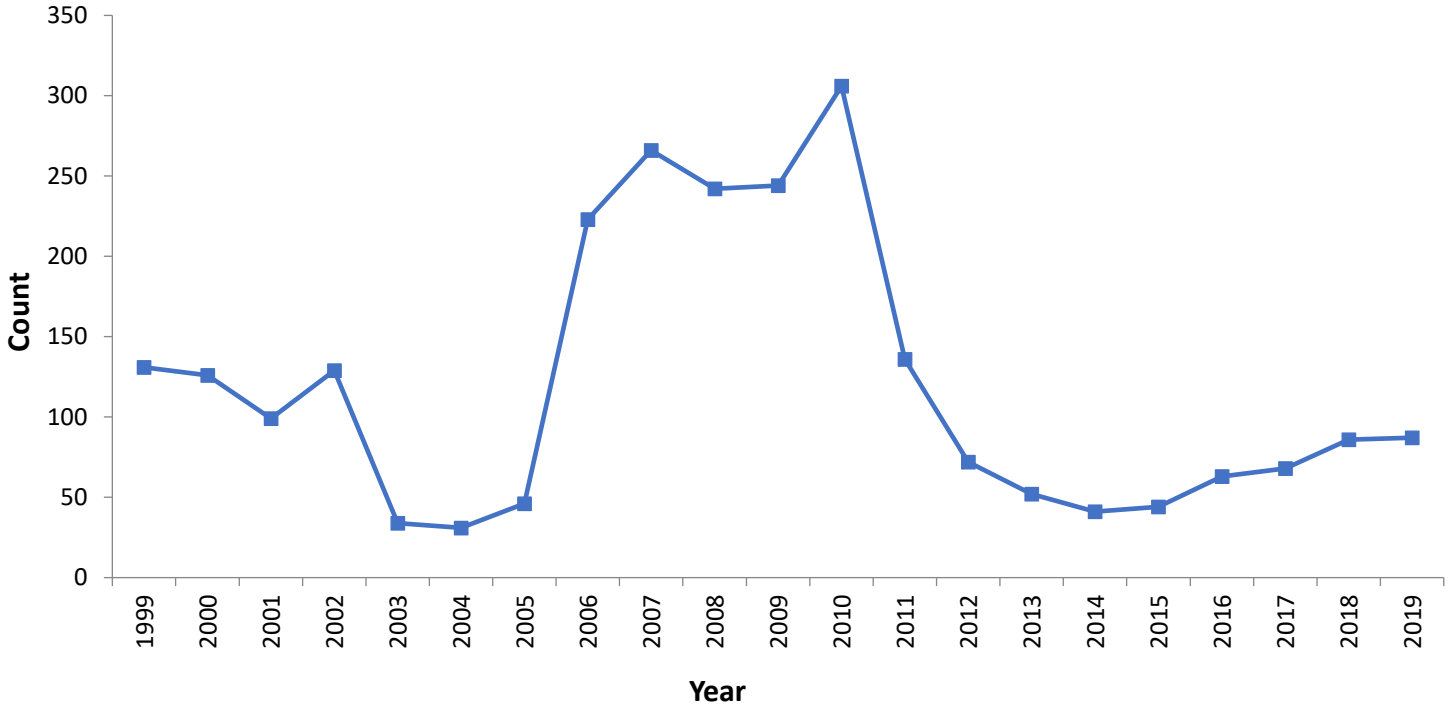


Fig. 14. Mean number of spawning Yellowstone Cutthroat Trout (including Cutthroat × Rainbow Trout hybrids) observed during weekly visual surveys of the Trout Lake inlet creek, Yellowstone National Park, 1999–2019.

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

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

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

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

Analysis of grizzly bear use of insect aggregation sites in 2019 resulted in an additional 267 observations of actively feeding grizzly bears on previously identified confirmed sites. In addition, there were observations of actively feeding grizzly bears at 2 sites previously classified as possible and 2 observations of actively feeding grizzly bears at a previously undocumented site. Thus, 2 possible sites were reclassified as confirmed and 1 new possible site was added in 2019, bringing the number of sites to 33 confirmed and 20 possible.

Overall insect aggregation site use by grizzly bears in 2019 (n = 355) was the highest recorded since the beginning of the monitoring period in 1986 (Table 21). The number of grizzly bears observed 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. 15), which may be due to variable snow conditions or the number of moths migrating from the plains. In 1993, a year with unusually high snowpack, the percentage of confirmed sites used by bears (Fig. 15) and the number of observations recorded at insect sites were very low (Table 21). In all other years, the percentage of insect aggregation sites used by grizzly bears varied between 47 and 88% (Fig. 15).

However, when we control for the amount of observation effort by including only bears observed during regularly conducted observation flights (see "***Observation Flights***"), bears observed using insect aggregation sites increased from 2018 (n = 250 observations, 8.7 locations/hour flown) to 2019 (n = 322 observations, 9.0 observations/hour flown) (Fig. 16). Because effort, as measured by hours flown, in the bear management units containing all confirmed insect aggregation sites has remained consistent since 1997, the change in the number of grizzly bears using insect aggregation sites suggests the increasing trend in grizzly

bear use of these sites is not due to change in observation effort (Fig. 16). The increase in reported observations of grizzly bears using insect aggregation sites from ground-based observers and our increased use of GPS collars with satellite technology has resulted in the need to censor these locations to prevent a bias in comparisons with previous years. The number of aerial telemetry locations and observations from Table 21 reflect this change and may differ from previous annual reports.

The IGBST maintains an annual list of unique females observed with cubs (see Table 5 in "***Estimating Number of Females with Cubs***"). Since 1986, 1,276 initial sightings of unique females with cubs have been recorded, of which 364 (28.5%) have occurred at (<500 m, n = 338) or near (<1,500 m, n = 26) insect aggregation sites (Table 22). In 2019, 15 of the 49 (30.6%) initial sightings of unique females with cubs were observed at insect aggregation sites; slightly higher than the mean of 28.7% for the previous five years (2014–2018, Table 22).

Survey flights at or near (<1,500 m) insect aggregation sites contribute to the count of unique females with cubs. However, the contribution from these flights is typically low, with a 10-year mean of 14.6 initial sightings/year since 2010 (Table 22). If these sightings are excluded, a similar trend in the annual number of unique sightings of females with cubs is still evident (Fig. 17), suggesting that other factors besides observation effort at insect aggregation sites are responsible for the increase in sightings of females with cubs over time.

Grizzly bear family group sighted near a lone grizzly, on an insect aggregation site, July 2019. (photo courtesy of J.Westerhold)

Table 21. Summary statistics for grizzly bear use of confirmed insect aggregation sites, Greater Yellowstone Ecosystem, 1986–2019.

Year	Number of confirmed sites[a]	Number of sites used[b]	Number of aerial telemetry locations	Number of ground or aerial observations
1986	4	2	7	5
1987	5	3	3	17
1988	5	3	11	28
1989	9	7	9	41
1990	14	11	9	77
1991	16	12	12	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	48	97
2001	28	18	23	128
2002	29	20	30	251
2003	29	20	9	163
2004	29	16	2	134
2005	31	19	16	198
2006	31	17	15	147
2007	31	19	19	161
2008	31	23	16	181
2009	33	23	11	170
2010	33	18	4	134
2011	33	20	9	163
2012	33	23	17	252
2013	33	22	26	295
2014	33	24	11	343
2015	33	21	13	210
2016	33	20	11	208
2017	33	21	20	278
2018	33	20	18	267
2019	33	29	20	335
Total			477	5,127

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

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

Table 22. Initial sightings of unique females with cubs on or near insect aggregation sites, Greater Yellowstone Ecosystem, 1986–2019.

Year	Number of unique females with cubs[a]	Number of sites with an initial sighting[b]	Initial sightings			
			Within 500 m[b]		Within 1,500 m[c]	
			n	%	*n*	%
1986	25	0	0	0.0	0	0.0
1987	13	0	0	0.0	0	0.0
1988	19	1	2	10.5	2	10.5
1989	16	1	1	6.3	1	6.3
1990	25	4	4	16.0	5	20.0
1991	24	7	13	54.2	14	58.3
1992	25	5	7	28.0	9	36.0
1993	20	1	1	5.0	1	5.0
1994	20	3	5	25.0	5	25.0
1995	17	2	2	11.8	2	11.8
1996	33	7	7	21.2	8	24.2
1997	31	8	11	35.5	11	35.5
1998	35	10	13	37.1	13	37.1
1999	33	3	6	18.2	7	21.2
2000	37	6	9	24.3	10	27.0
2001	42	7	13	31.0	13	31.0
2002	52	11	18	34.6	18	34.6
2003	38	11	20	52.6	20	52.6
2004	49	11	17	34.7	17	34.7
2005	31	5	7	22.6	8	25.8
2006	47	11	15	31.9	16	34.0
2007	50	10	17	34.0	17	34.0
2008	44	7	11	25.0	14	31.8
2009	42	4	6	14.3	7	16.7
2010	51	7	9	17.6	9	17.6
2011	39	6	7	17.9	7	17.9
2012	49	6	13	26.5	13	26.5
2013	58	8	14	24.1	15	25.9
2014	50	11	21	42.0	23	46.0
2015	46	7	11	23.9	13	28.3
2016	50	7	13	26.0	17	34.0
2017	58	7	12	20.7	12	20.7
2018	58	8	18	31.0	20	34.5
2019	49	8	15	30.6	17	34.7
Total	1,276		338		364	
Mean	37.5	6.2	9.9	24.4	10.7	26.2

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

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

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

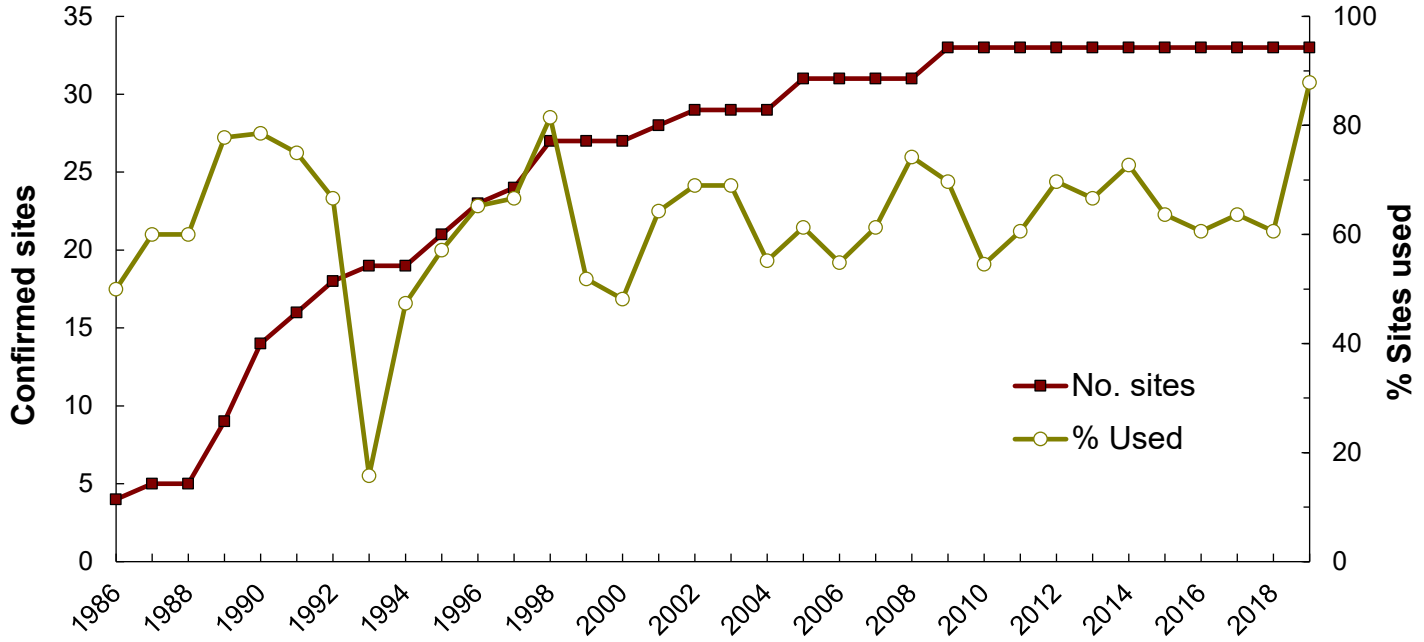


Fig. 15. Annual number of confirmed insect aggregation sites and percent of those sites at which telemetry relocations of marked bears or visual observations of unmarked bears were recorded, Greater Yellowstone Ecosystem, 1986–2019.

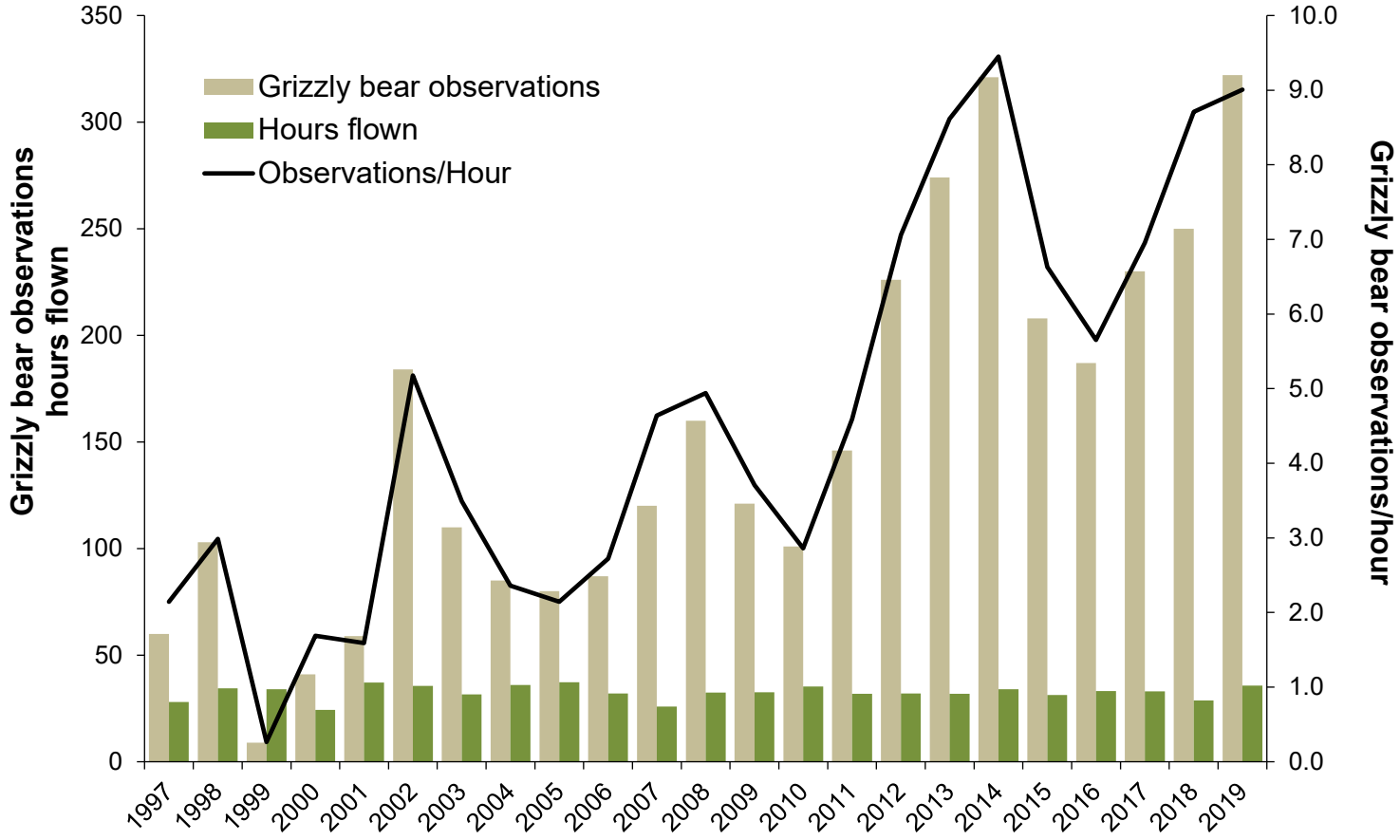


Fig. 16. Number of grizzly bears observed (tan bars) on insect aggregation sites during observation flights only, hours flown (green bars) for these bear management units (BMU), and grizzly bear observations per hour (black line) during observation flights of BMUs containing all known insect aggregation sites, Greater Yellowstone Ecosystem, 1997–2019.

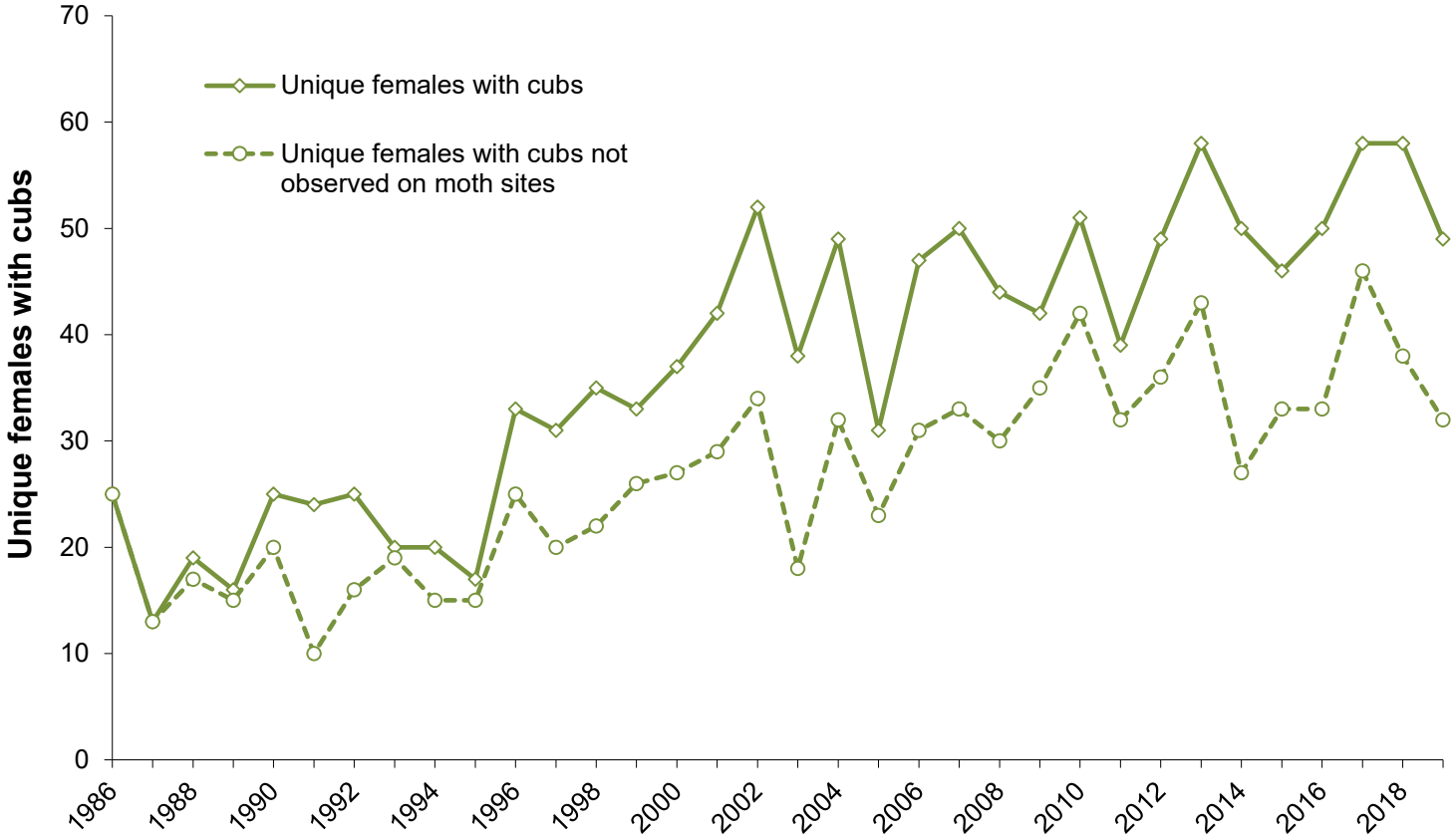


Fig. 17. Total number of unique females with cubs observed annually in the Greater Yellowstone Ecosystem and the number of unique females with cubs not found within 1,500 m of known insect aggregation sites, 1986–2019.

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

Whitebark pine (*Pinus albicaulis*) surveys on 21 established transects indicated above-average cone production during 2019 (Fig. 18). Overall, the mean number of observed cones/tree was 19.6 (Table 23), which was close to the overall average of 17 for the period 1980–2019 (Fig. 19). Cone production was at or above average on 7 transects and below average on 14 (Table 24).

We continue to monitor tree mortality caused by mountain pine beetle (*Dendroctonus ponderosae*) in stands that contain our cone production transects. During 2019 we did not observe any additional beetle-caused mortality among individual trees surveyed since 2002. Total mortality on these transect trees since 2002 remains at 75.8% (144/190) with 100% (19/19) of transects containing beetle-killed trees. Although tree mortality from mountain pine beetle is still occurring, the rate of loss among our cone production transects has slowed (Fig. 20). These findings continue to suggest that at least in the vicinity of these transects, the current beetle outbreak has run its course. Six of the 7 transects established during 2007 also exhibited beetle-caused mortality among transect trees.

Table 23. Summary statistics for whitebark pine cone production surveys, Greater Yellowstone Ecosystem, 2019.

Total			Trees				Transect			
Cones	Trees	Transects	Mean cones	SD	Min	Max	Mean cones	SD	Min	Max
3,644	186	21	19.6	44	0	409	173.5	266	0	1,106

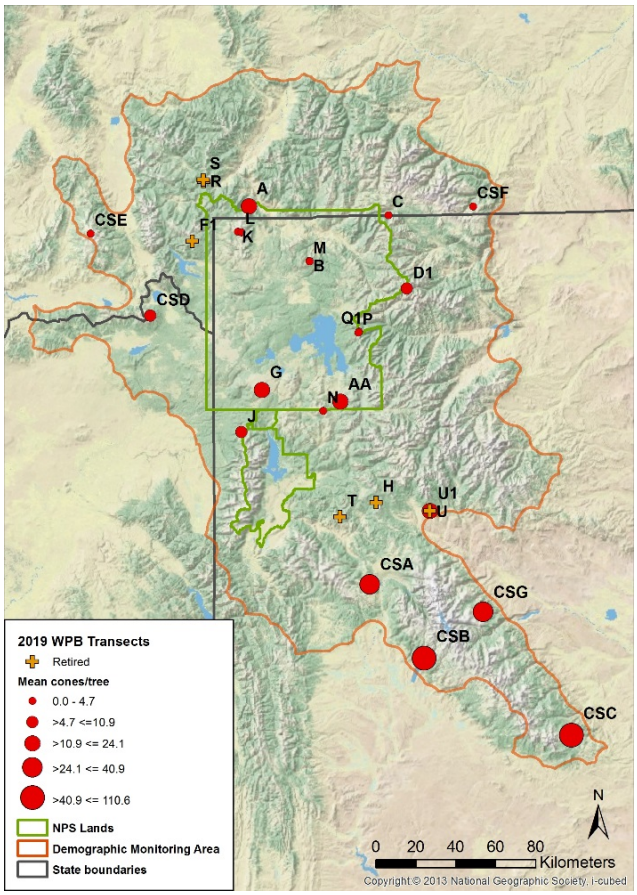


Fig. 18. Locations and mean number of cones/tree for 21 whitebark pine cone production transects, Greater Yellowstone Ecosystem, 2019. Labels reflect transect identifiers (see Table 23). Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

Table 24. Results of whitebark pine cone production surveys, Greater Yellowstone Ecosystem, 2019.

Transect	Number of cones	Number of trees	Mean number of cones/tree	SD
A	65	4	16.3	30.5
B	47	10	4.7	5.3
C	20	10	2.0	3.0
D1	109	10	10.9	10.1
F1		-----Transect retired in 2008-----		
G	165	10	16.5	16.7
H		-----Transect retired in 2008-----		
J	75	10	7.5	8.9
K	18	7	2.6	3.3
L	15	10	1.5	2.0
M	3	10	0.3	0.5
N	24	10	2.4	3.6
P	38	10	3.8	3.7
Q1	40	10	4.0	4.7
R		-----Transect retired in 2009-----		
S		-----Transect retired in 2010-----		
T		-----Transect retired in 2008-----		
U		-----Transect retired in 2016-----		
U1	241	10	24.1	18.9
AA	169	10	16.9	10.3
CSA	368	9	40.9	31.5
CSB	718	10	71.8	56.7
CSC	1106	10	110.6	129.0
CSD	105	10	10.5	8.9
CSE	0	2	0.0	0.0
CSF	13	4	3.3	4.3
CSG	305	10	30.5	34.4

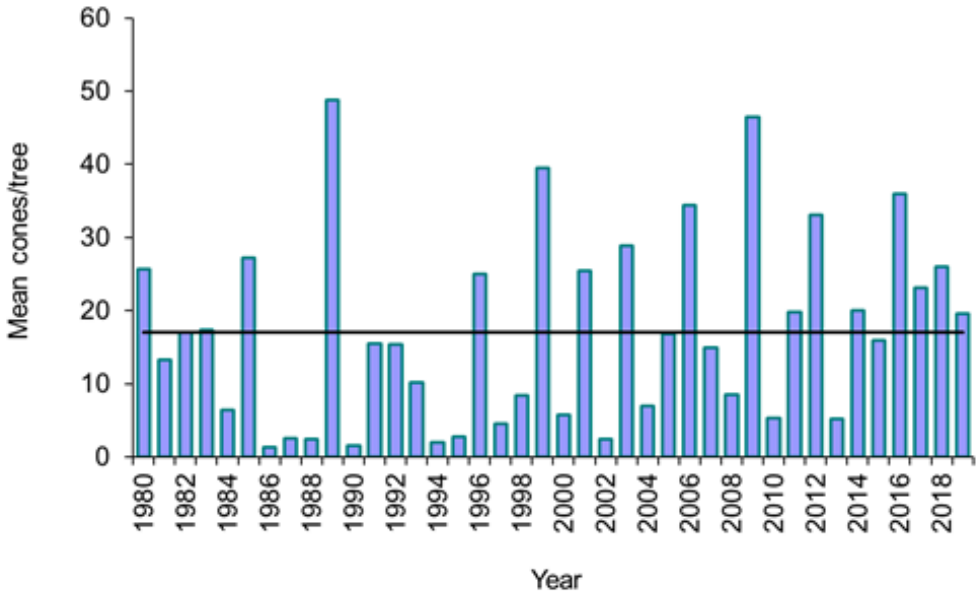


Fig. 19. Annual mean number of cones/tree observed along whitebark pine cone production transects, Greater Yellowstone Ecosystem, 1980–2019. The overall average for the time period (17 cones/tree) is shown as a solid line.

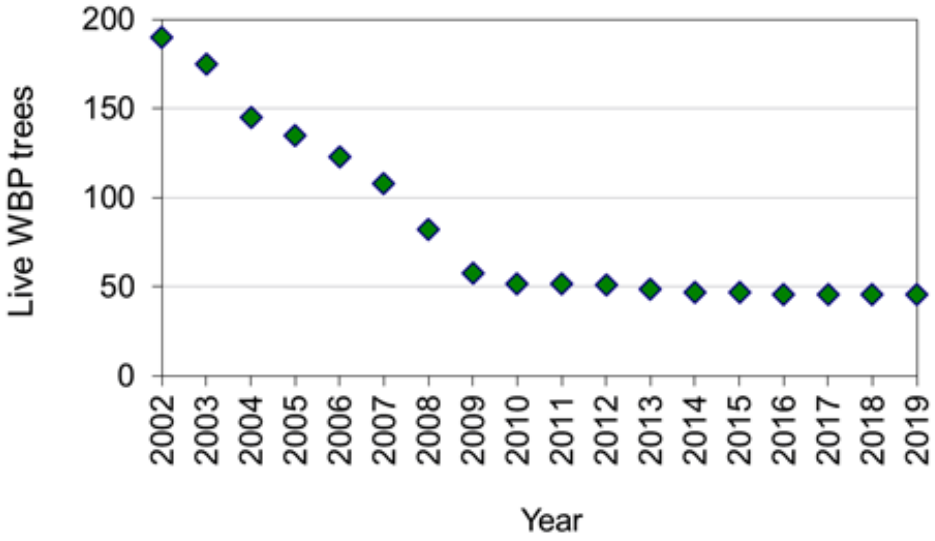


Fig. 20. Number of live whitebark pine (WBP) trees on cone production transects among 190 individual trees monitored since 2002, Greater Yellowstone Ecosystem, 2002–2019.

RECREATION MONITORING

Grand Teton National Park Recreational Use
(Katharine R. Wilmot, Grand Teton National Park)

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

GRTE manages visitors and bears in the same manner as Yellowstone National Park, using 3 broad zones: developed areas, road corridors, and backcountry (see section "***Yellowstone National Park Recreational Use***", page 55, Table 27). Backcountry camping in GRTE requires a permit and is managed by a quota system.

In 2019, total visitation in GRTE was 5,015,702 people, including recreational, commercial (e.g., Jackson Hole Airport), and incidental (e.g., traveling through the Park on U.S. Highway 191, but not recreating) use. Recreational visits alone totaled 3,405,614, which is the second busiest on record behind 2018 (Table 25). Visitor use numbers in this report may differ from previous reports. The data in this report is consistent with publicly available data (found at: https://irma.nps.gov/STATS/Reports/Park/GRTE).

In 2019, GRTE recorded 36,292 backcountry user nights and 312,292 overnight stays in roadside campgrounds. Similar to Yellowstone National Park, most of GRTE's recreational visitation occurred from May through October. Since 2008, total annual visitation to GRTE has increased by 28%. Long- and short-term trends of recreational visitation and backcountry user nights are shown in Table 26 and Fig. 21.

Table 25. Ten highest years for recreational visitation to Grand Teton National Park, 1979–2019.

Rank	Year[a]	Visitation
1	2018	3,491,151
2	2019	3,405,614
3	2017	3,317,000
4	2016	3,270,076
5	2015	3,149,921
6	2014	2,791,392
7	1998	2,757,060
8	1996	2,733,439
9	1995	2,731,015
10	2012	2,705,256

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

Table 26. Average annual recreational visitation and average annual backcountry use nights in Grand Teton National Park by decade from 1951 through 2019.		
Decade	**Average annual recreational visits[a]**	**Average annual backcountry use nights**
1950s	1,012,518	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
2010–2019	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 is not strictly comparable between years of different counting methodology.

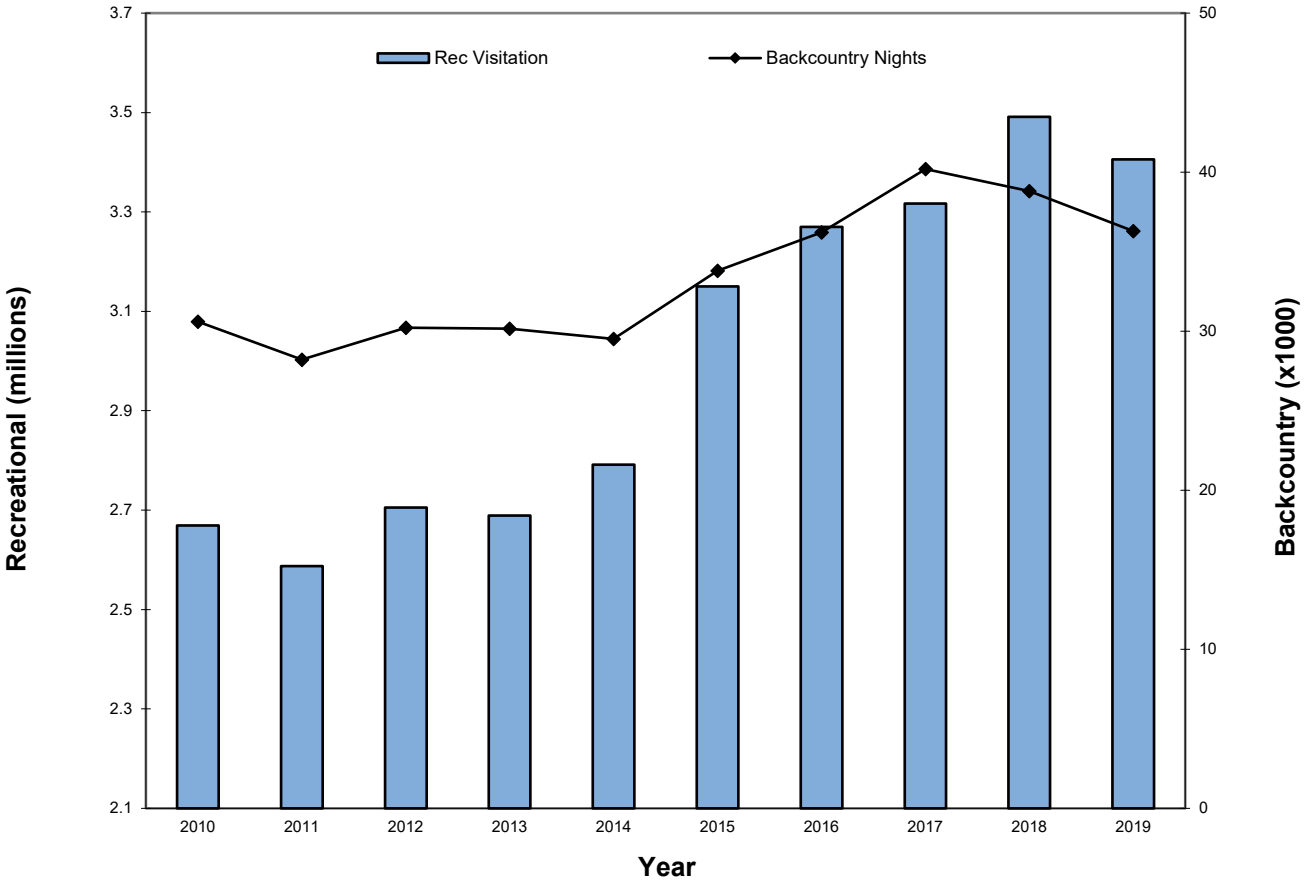


Fig. 21. Trends in recreational visitation and backcountry user nights in Grand Teton National Park, 2010–2019.

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 YNP is relatively pristine, undeveloped land; 92% of the park has been recommended for wilderness designation, and by National Park Service policy is managed so as not to preclude that designation in the future (National Park Service, 2006). Only ~1% of the park's habitat has been significantly altered through construction of roads and developments.

Visitors and bears in Yellowstone National Park are managed in 3 broad zones: developed areas, road corridors, and backcountry/proposed wilderness. Each zone has different strategies for managing the human-bear interface (Table 27). Human activities are prioritized in developed areas, road corridors are managed for use by both bears and people, and bears are given priority in backcountry areas.

Total visitation to Yellowstone National Park was 5,207,816 visits in 2019 (https://irma.nps.gov/Stats/SSRSReports/Yell/Yellowstone) including recreational and non-recreational use. Recreational visits in 2019 totaled 4,020,288, the fifth busiest year on record and the fifth straight year that recreational visitation has topped the 4 million mark (Table 28). Since 2008, annual visitation to Yellowstone has increased by ~34%. Most of the park's recreational visitation occurred during the 6-month period from May through October, the same period that all sex and age classes of grizzly bears are out of their winter dens and active on the landscape. In 2019, there were 3,836,763 recreational visits (95%) during those peak months, an average of 20,852 recreational visits per day. Park visitors spent 645,878 overnight stays in roadside campgrounds and 37,827 overnight stays in remote backcountry campsites in Yellowstone Park.

Average annual recreational visitation has increased each decade from an average of 7,378 visits/year during the late 1890s to 3,012,653 visits/year in the 1990s (Table 28, Fig. 22). Average annual recreational visitation decreased slightly during 2000–2009, to an average of 2,968,037 visits/year. The decade 2000–2009 was the first in the history of the park that visitation did not increase from the previous decade. However, the decade of 2010–2019 set a new park record for visitation, with 9 of 10 years ranking in the top 10 highest years for visitation (Table 28). The average number of overnight stays in roadside campgrounds in the park has also increased considerably in recent years (Table 29, Fig. 23). Although total park recreational visitation has increased steadily over time, the average number of overnight stays in backcountry campsites has been relatively stable, ranging from 39,280 to 45,615 overnight stays per year per decade (Table 29, Fig. 24). The number of overnight stays in the backcountry is limited by both the number and capacity of designated backcountry campsites in the park.

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

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

Table 28. Ten highest years for visitation to Yellowstone National Park, 1895–2019.		
Rank	**Year**	**Visitation**
1	2016	4,257,177
2	2017	4,116,525
3	2018	4,114,999
4	2015	4,097,710
5	2019	4,020,287
6	2010	3,640,184
7	2014	3,513,484
8	2012	3,447,727
9	2011	3,394,321
10	2009	3,295,187

Table 29. Average annual recreational visitation, auto campground overnight stays, and backcountry campsite overnight stays by decade, Yellowstone National Park, 1895–2019.

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

[a] Data from 1895–1899. During 1872–1894, visitation was estimated to be not fewer than 1,000 and no more than 5,000 each year.

[b] Data from 1930–1934.

[c] Average does not include data from 1940 and 1942.

[d] Data from 1960–1964.

[e] Data from 1975–1979.

[f] Backcountry use data available for 1972–1979.

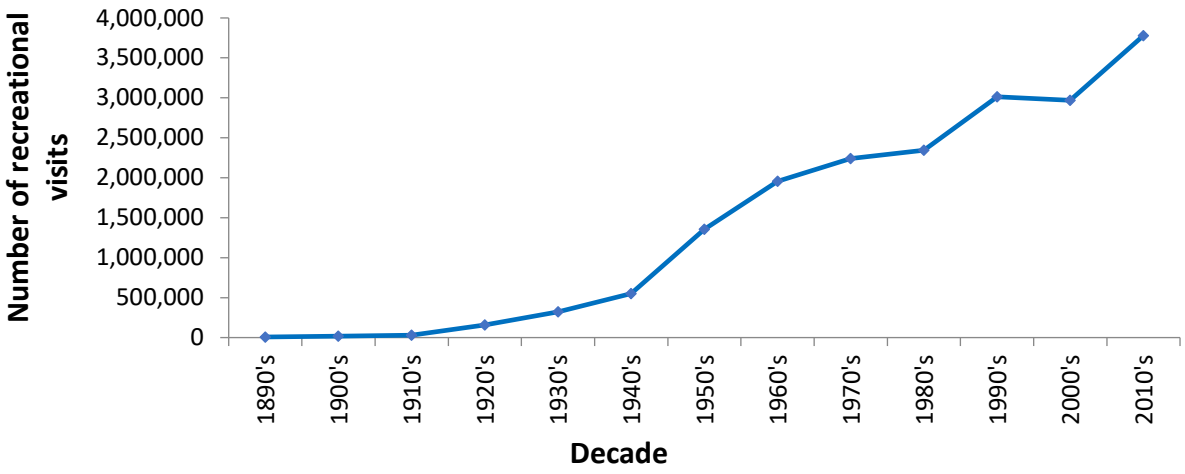


Fig. 22. Average annual number of recreational visits by decade, Yellowstone National Park, 1895–2019.

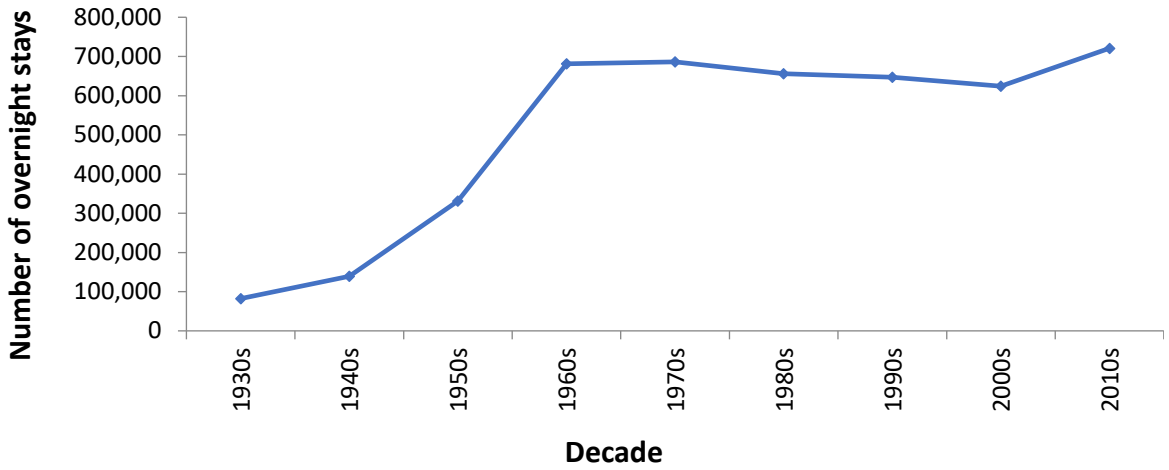


Fig. 23. Average annual number of overnight stays in roadside campgrounds by decade, Yellowstone National Park, 1930–2019.

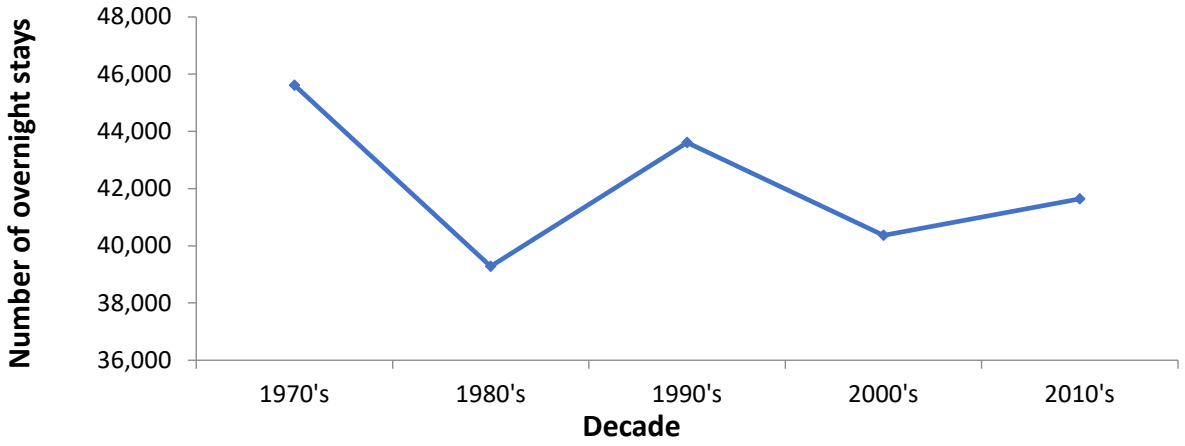


Fig. 24. Average annual number of overnight stays in backcountry campsites by decade, Yellowstone National Park, 1972–2019.

HUMAN-GRIZZLY BEAR CONFLICTS IN THE GREATER YELLOWSTONE ECOSYSTEM

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

No management actions were taken on grizzly bears in Grand Teton National Park (GRTE) or the John D. Rockefeller, Jr. Memorial Parkway (JODR) in 2019, however, one human-grizzly bear conflict was recorded. On November 12, 2019, in Moran, Wyoming, a grizzly bear knocked over 3 pallets of insulation and bit into several packages.

Management of nonfood-conditioned, human-habituated bears required considerable effort to prevent conflicts from occurring. Grizzly bears were hazed out of a developed area 2 times and off park roads 17 times. GRTE/JODR recorded a minimum of 361 bear jams (188 grizzly, 163 black, 10 species not recorded). Bear jams are created when onlookers view habituated bears that frequent roadsides. Grizzly bear jams peaked in June and black bear jams peaked in September. The park's Wildlife Brigade managed most of these jams, as well as enforced food storage regulations at campgrounds, picnic areas, and other developments. Wildlife Brigade volunteers contributed over 7,300 hours towards this important bear conservation and public education program.

In 2019, interpretive staff in GRTE altered the way they presented bear information to visitors by using "table talk" style programs at the Jenny Lake Visitor Center and at the Laurence S. Rockefeller Preserve. Table talk programs are shorter in duration, but they have the benefit of reaching more visitors. Traditional, formal bear safety presentations continued at the Craig Thomas Discovery and Colter Bay Visitor Centers. In all, these efforts totaled 261 bear safety programs reaching 14,322 visitors. Programs highlighted safety in bear country and formal presentations concluded with a bear spray (inert) demonstration. GRTE continued its partnership with the Grand Teton National Park Foundation to cost-share expenses for the purchase and installation of bear-resistant food storage lockers. One-hundred and four bear boxes (30 ft^3) were installed in 2019, bringing the total number of bear boxes in campgrounds and other developed sites to 859. Four of the 6 roadside campgrounds in GRTE/JODR, including Jenny Lake, Signal Mountain, Colter Bay, and Lizard Creek Campground, have a food storage locker in each site.

Radio-collared female with her cub of the year May, 2019. (photo courtesy of Megan Riley)

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

To effectively allocate resources for implementing management actions to prevent human-grizzly bear conflicts, Yellowstone National Park managers need baseline information regarding the types, causes, locations, and recent trends of conflicts. To address this need, all reported human-grizzly bear conflicts are recorded annually. Conflicts are grouped into broad categories using standard definitions described by Gunther et al. (2012).

One (1) human-grizzly bear conflict was reported in Yellowstone National Park in 2019 (Table 30, Fig. 25). On October 22 at approximately 10:00 a.m., park staff observed an adult grizzly bear digging through the snow to feed on soy-gluten pellets at the Grant Village helipad. The parks fisheries management program uses soy-gluten pellets to kill non-native Lake Trout eggs in Yellowstone Lake (see ***"Spawning Cutthroat Trout Availability and Use by Grizzly Bears in Yellowstone National Park"***). The pellets are scattered by helicopter over Lake Trout spawning beds. The decomposing pellets use up the dissolved oxygen, thereby killing the eggs. The bear ate pellets spilled on October 3 during the process of loading 40,000 pounds of pellets into the hoppers used to scatter the pellets over the spawning beds. The helicopter rotor-wash blew thousands of pellets off the paved helipad and into the meadow at the edge of the helipad and along the helicopters route from the helipad to the lake. Fisheries crews swept up and removed all of the pellets from the paved helipad the day of the operation. However, it was impossible to clean up all of the pellets from the vegetation in the meadow adjacent to the helipad.

Many factors influence the annual number of bear-human conflicts in Yellowstone National Park, including the availability of natural bear foods, grizzly bear population numbers, park visitation, and park staffing levels. 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. 26).

During 2019, there was 1 known grizzly bear mortality in the Yellowstone National Park portion of the Greater Yellowstone Ecosystem (GYE). The mortality was due to predation by an adult male grizzly bear. On October 7, at 7:30am, 8-year-old, radio-collared male grizzly bear #791 was observed feeding on a 2- to 3 year-old male grizzly bear. The dead bears' zygomatic arches and mandible articulations were broken and there were large canine punctures to both dorsal orbits. The dead bear had multiple bites with 65–75 mm canine widths on the head and down the dorsal back with associated subcutaneous hemorrhages indicating the bite wounds occurred while the bear was alive.

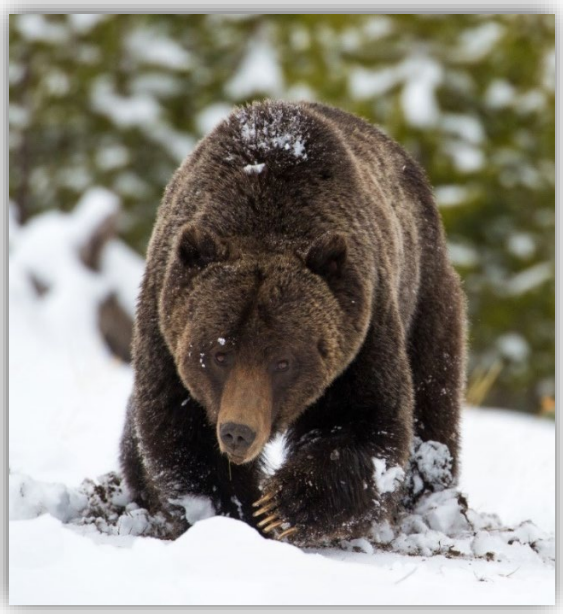
Trends in causes of grizzly bear mortality inside Yellowstone National Park have changed over time. From the late 1950s through the 1970s, most grizzly mortality in the park was due to human causes (Fig. 27), primarily management removals of bears involved in human-bear conflicts. In recent decades (1980–2019), most grizzly mortality in the park is from natural causes, primarily old age and intra- and inter-specific strife and predation.

Although grizzly bears caused few conflicts in the park in 2019, park staff dedicated considerable management effort toward conflict prevention (Table 31). In response to grizzly bear activity in visitor use areas, park staff posted bear warning signs at 12 locations and temporary trail or area closure signs at 25 locations. To prevent grizzly bears from being attracted into visitor use areas, park staff removed 101 large mammal wildlife carcasses from developments, roadside campgrounds, roadsides, trails, and backcountry campsites. Wildlife carcasses removed from visitor use areas included 28 bison, 27 elk, 25 mule deer, 8 pronghorn, 4 bighorn sheep, 3 wolves, 2 black bears, 2 mountain lions, 1 white-tailed deer, and 1 coyote. In an effort to prevent the need to capture and relocate or remove bears, park staff hazed grizzly bears out of human use areas 33 times. Staff hazed grizzly bears off paved roads 26 times, out of park developments 5 times, and out of picnic areas and away from backcountry trails 1 time each. In addition, as part of the park's strategy to prevent bears from obtaining human foods, 125 bear-proof food storage lockers were purchased with donations raised by the Yellowstone Forever Foundation and installed in roadside campgrounds and backcountry campsites. With the installation of 118 food storage lockers in roadside campgrounds in 2019, 943 (49%) of the park's 1,907 roadside campground campsites now have bear-proof food storage lockers. Seven of the parks 11 campgrounds, including Pebble Creek, Slough Creek, Tower Falls, Mammoth, Indian Creek, Norris, and Lewis Lake, have food storage lockers in every campsite. As part of this program, some food storage lockers have also been installed in the Canyon Village (56% of sites), Madison (54% of sites), Bridge Bay (34% of sites), and Grant Village (7% of sites) campgrounds. It is the park's goal to provide visitors with bear-proof food storage lockers in every roadside campsite in the park. In addition, 7 food storage lockers were installed in backcountry campsites in 2019 to replace broken food hanging poles. All 301 designated backcountry campsites in Yellowstone National Park currently have a

food storage device (food hanging pole or bear-proof food storage locker). When camping in non-designated sites, backcountry campers are required to use an IGBC approved hard-sided food storage canister or rig their own food-hanging device.

Although there were few conflicts in Yellowstone National Park, management of non-food conditioned, human-habituated grizzly bears required considerable effort. Habituation is a bear's diminishing overt response to people following frequent benign encounters (McCullough 1982, Jope 1985, Herrero et al. 2005, Smith et al. 2005, Hopkins et al. 2010). Habituation allows bears to access and use habitat in areas with high levels of human activity, thereby increasing habitat effectiveness (Herrero et al. 2005). The presence of large areas of non-forested habitat in Yellowstone National Park, combined with habituation of bears to park visitors has created exceptional bear viewing opportunities, resulting in significant growth of bear viewing as a local industry. Bear viewing is now one of the primary activities of visitors to Yellowstone National Park (Taylor et al. 2014, Richardson et al. 2015), and contributes millions of dollars to the economies of gateway communities annually (Richardson et al. 2014). In 2019, staff and visitors reported 333 roadside traffic-jams caused by visitors stopping to view habituated grizzly bears along roadsides. Thousands of visitors viewed bears at these bear jams. Park staff responded to 226 (68%) of the grizzly bear jams and spent 1,041 personnel hours managing habituated grizzly bears, the traffic associated with the bear jams, and the visitors that stopped to view and photograph the habituated grizzly bears. On average, park personnel spent 4.6 staff-hours managing each grizzly bear jam in 2019.

Visitation to Yellowstone National Park exceeded 4 million visits for the first time in 2015 and has exceeded that number each year thereafter (see "***Yellowstone National Park Recreational Use***"). Since 2008, annual visitation to Yellowstone has increased by almost 40%. As visitation increases, park managers should expect an increasing number of bears to become habituated to people and a higher level of habituation among those bears, thereby causing more bear jams and jams of longer duration (Haroldson and Gunther 2013). As the level of habituation increases, the distance at which bears allow visitors to approach before fleeing will also become shorter, resulting in interactions at closer distances. The most formidable challenge for managing roadside bear viewing in Yellowstone National Park is not managing the bears, but sustaining and expanding as necessary the people management programs that have made bear management successful to date.



A grizzly bear digs through the snow to consume soy-wheat pellets in a meadow adjacent to the Grant heli-pad in the only incident where a grizzly obtained anthropogenic foods in Yellowstone National Park in 2019. The soy-wheat pellets were inadvertently spilled during helicopter operations to spread the pellets over Lake Trout spawning beds in Yellowstone Lake. The decomposing pellets use up the dissolved oxygen in the spawning beds thereby killing the eggs of non-native Lake Trout. Lake Trout have decimated the native Cutthroat Trout population in Yellowstone Lake. (photo courtesy of J. Hadley, NPS)

Table 30. Number of incidents of human-grizzly bear conflict reported in Yellowstone National Park, 2019.

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

[a]There are no cattle or sheep grazing allotments inside of Yellowstone National Park. Horses, mules, and llamas used as riding or pack stock are the only domestic livestock in the park that can potentially be killed by grizzly bears. Forty-one commercial outfitters have contracts to provide stock day-rides and overnight pack trips in the park. Stock animals are most vulnerable to grizzly depredations while on overnight backcountry pack trips. In 2019, 1,216 stock animals (horses, mules, llamas) spent 3,843 nights in the park's backcountry.

Table 31. Number of management actions taken to reduce the potential for conflicts with grizzly bears in Yellowstone National Park, 2019.

Management action	Number of incidents
Bear warnings posted	12
Temporary area closures	25
Wildlife carcass removal from visitor use areas	101
Bear-jam management	226
Management hazing	33
Attempt capture – unsuccessful	0
Capture, mark, and release on site	0
Capture and relocate	0
Capture and remove (euthanize or send to zoo)	0
Capture for humane reasons	0
Total management actions	397

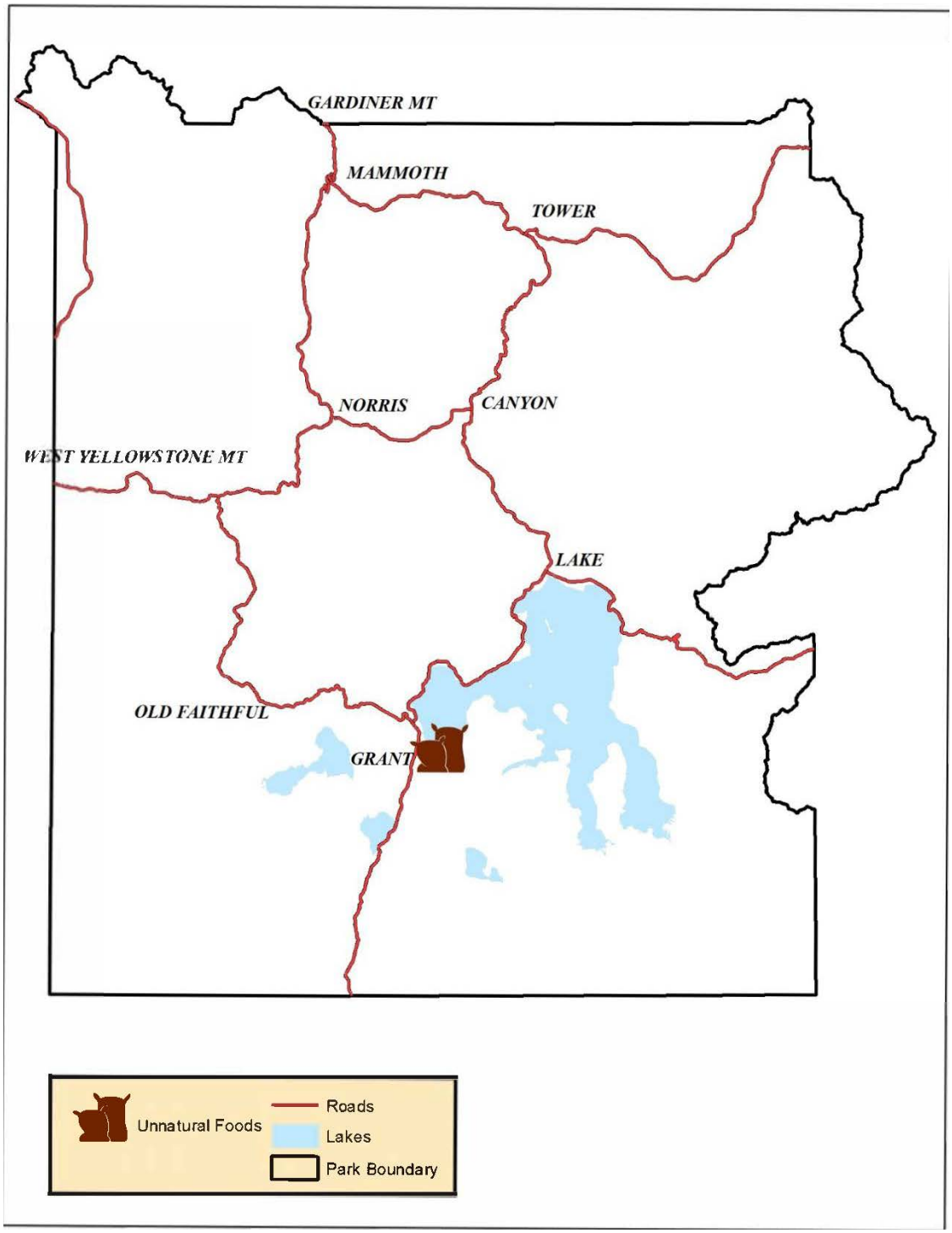


Fig. 25. Locations of human-grizzly bear conflicts, Yellowstone National Park, 2019.

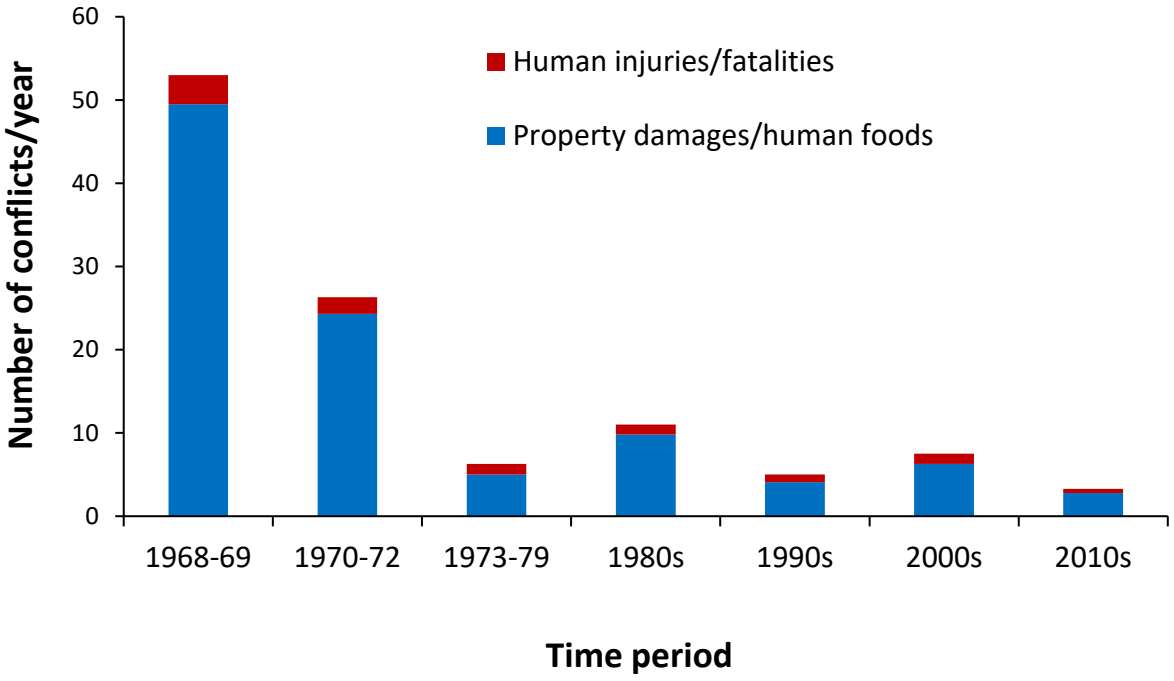


Fig. 26. Number of human-grizzly bear conflicts, Yellowstone National Park, 1968–2019.

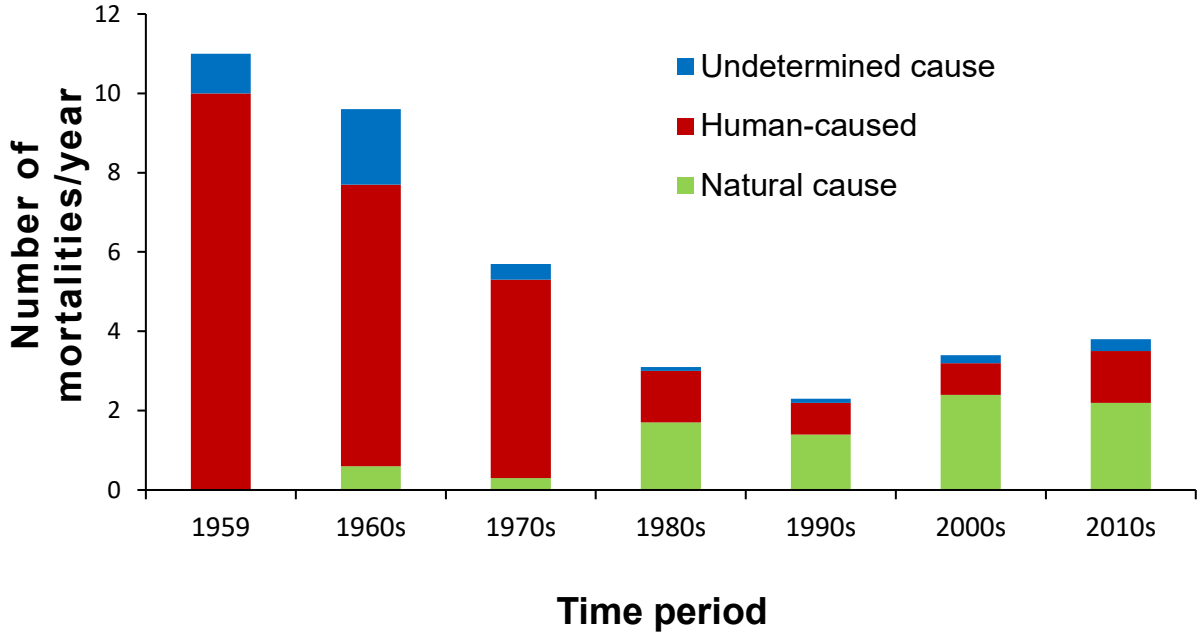


Fig. 27. Number of known and probable grizzly bear mortalities, Yellowstone National Park, 1959–2019.

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

The Idaho Department of Fish and Game (IDFG) responded to 21 human-grizzly bear conflicts in 2019 (Table 32, Fig. 28). Conflicts are incidents where bears injure people, cause public safety concern, damage property, obtain anthropogenic foods, kill or injure livestock and require an agency response. Human-grizzly bear conflicts have occurred consistently in Idaho's portion of the GYE since 2005 (Fig. 29 and 30). All conflicts in 2019 were inside the Demographic Monitoring Area (DMA). Since 1992, 91% of the conflicts in Idaho were within the DMA (Fig. 30). The average annual number of conflicts since 2005 is 15, but varies greatly from year to year and is dependent on natural food abundance, livestock use patterns, availability of unsecured anthropogenic foods, individual bear behavior, outreach and education effort, and other factors. The number of conflicts in 2019 (21) was less than the number of conflicts in 2018 (32), but higher than our annual average and substantially higher than the number of conflicts in 2016 (2) and 2017 (6). As was the case in 2018, the majority of conflicts in 2019 were attributed to a small number of bears that were involved in multiple incidents.

The majority of conflicts in 2019 involved bears exhibiting signs of habituation and spending time near developed areas (Table 32). We had 8 incidents of bears obtaining anthropogenic foods and 3 incidents of bears causing property damage. There were multiple reports of livestock depredation by grizzly bears, but we did not have any confirmed incidents in 2019. No grizzly bears were captured, relocated, or euthanized due to conflicts, although attempts were made to capture a repeat offender.

A female with cubs was responsible for 13 conflicts in 2019. She caused property damage and obtained anthropogenic food multiple times. The female learned how to flip bear-resistant dumpsters, causing them to open and allowing her to get a food reward. We attempted to capture the family group multiple times but were not successful. Another female grizzly was involved in multiple conflicts. The female had attempted to break into a garage where an animal was processed a few days before. The bear caused property damage to a garage door, siding, and the structure of the garage as she attempted to gain access to the carcass remains.We set up an electric mat in front of the area where the damage was done. She returned to the scene, received a shock, and did not return.

From 1992 to 2017, 68% of conflicts occurred on private land and the remainder on public or state land. In 2018, 59% of the conflicts occurred on public land and 41% on private land. The increased percentage of conflicts on public land was a result of increased bear activity at campsites within the Caribou-Targhee National Forest, particularly in dispersed camping areas. Dispersed campsites are not as closely monitored as traditional campgrounds and do not have campground hosts to address improperly stored attractants. In 2019, increased monitoring effort on Forest Service land, particularly in dispersed camping areas, seemed to have a positive effect, as only 3 conflicts occurred on public land, which represented only 14% of the conflicts.

The IDFG performs outreach and education efforts throughout the Upper Snake River region. We attended 15 outreach events, reaching approximately 2,600 people and provided presentations to 15 groups, totaling approximately 750 participants. One of our most successful outreach efforts this year was spearheaded by a volunteer, Becky Lewis. She applied for and received a grant to purchase over 550 cans of bear spray. With the increase in hunter-bear conflicts, the cans were given to men and women who presented an Idaho hunting or fishing license. We gave away 189 at an Island Park event, 169 in Driggs, and 189 in Ashton. The events were well received by sportsmen.

We work closely with the Forest Service, patrolling campgrounds, looking for improperly stored attractants, and educating visitors. On private land, the IDFG canvasses neighborhoods, teaching homeowners and renters about living in bear country and securing attractants. One of the most difficult challenges we face in our education program is trying to contact rental property owners who are seldom at their property. Attractants left at rental homes are an ongoing problem, with additional rental homes being built every year. Making contact with rental property owners is often difficult but imperative to resolving the issue. In 2019, we made progress in several neighborhoods by reaching out and building relationships with members of homeowner associations (HOAs). We attended and spoke at multiple HOA meetings and sent emails to members unable to attend, including rental property owners. This approach allowed us to contact almost everyone in the neighborhood, even reaching the residents that are not regularly at their home.

The IDFG continues to try to build relationships with local business owners in an effort to increase the amount of bear resistant dumpsters used at local establishments. In the last several years, the number of bear-resistant dumpsters has increased, and we expect this trend to continue with additional effort. Many business owners are willing to purchase a bear- resistant

dumpster if we help them find a provider with reasonably priced equipment that provides good service. In particular, new businesses are generally open to purchasing bear-resistant dumpsters if approached in the early stages of their operation.

Table 32. Human-grizzly bear conflicts in the Idaho portion of the Greater Yellowstone Ecosystem, 2019.

Conflict type	Number of conflicts
Encounter situations	0
Public safety threat (habituated, near developed site, etc.)	10
Anthropogenic foods	8
Property damage – without food reward	1
Property damage – with food reward	2
Livestock – cattle	0
Livestock – poultry	0
Livestock – sheep	0
Beehives/orchards	0
Total	21

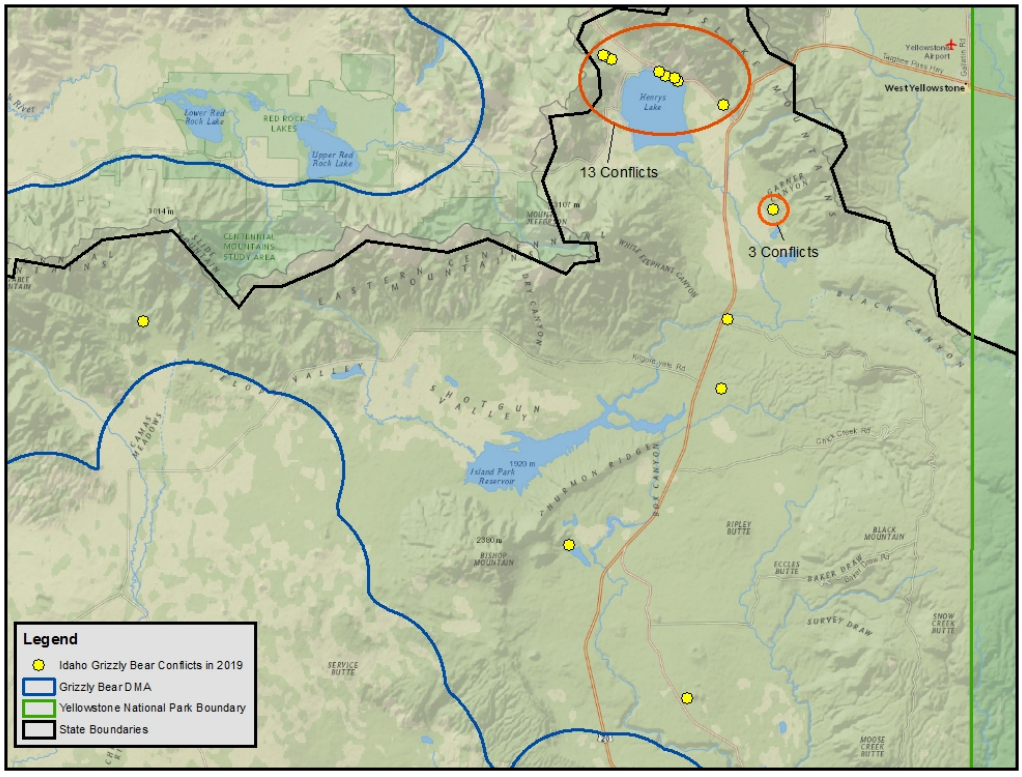


Fig.28. Locations of human-grizzly bear conflicts in the Idaho portion of the Greater Yellowstone Ecosystem, 2019. Base map source: National Geographic World Map, ESRI, Redlands, California.

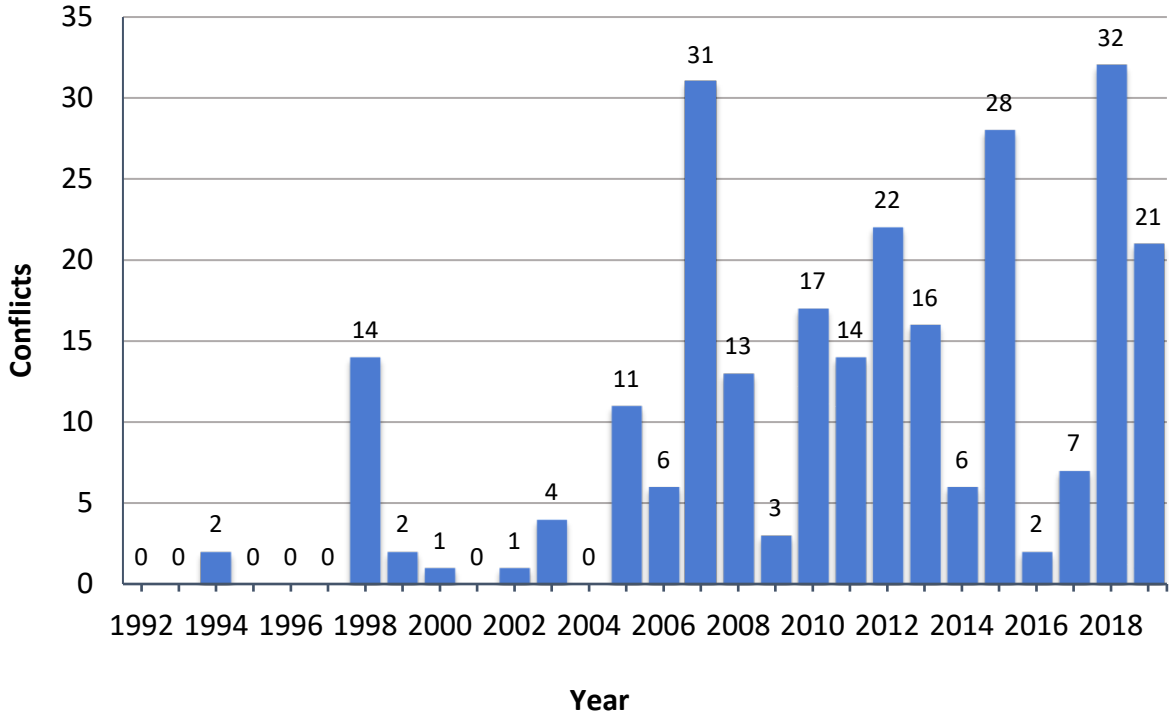


Fig. 29. Number of documented human-grizzly bear conflicts in the Idaho portion of the Greater Yellowstone Ecosystem, 1992–2019.

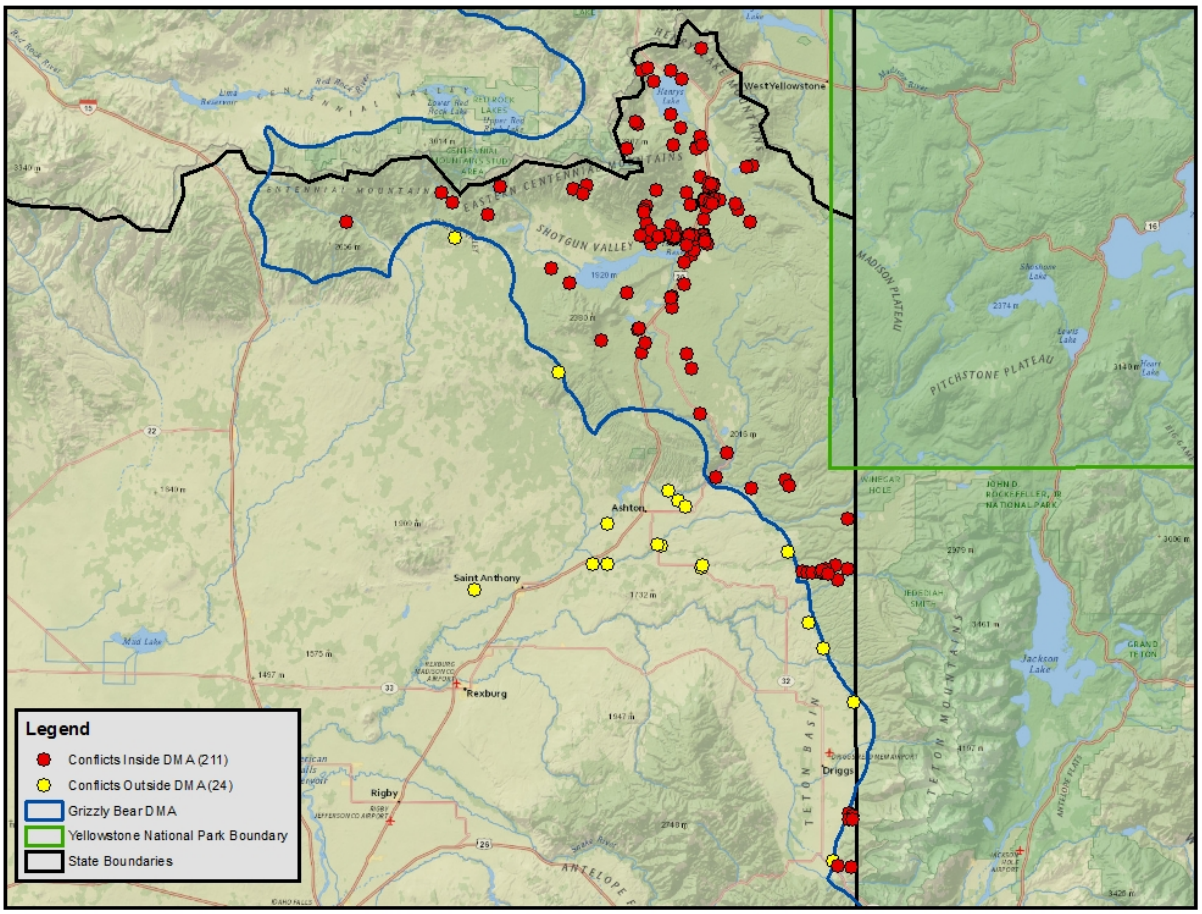


Fig. 30. Documented human-grizzly bear conflicts inside (red circles) and outside (yellow circles) the Demographic Monitoring Area in the Idaho portion of the Greater Yellowstone Ecosystem, 1992–2019. Base map source: National Geographic World Map, ESRI, Redlands, California.

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

During 2019, 111 human-grizzly bear conflicts were investigated by Montana Fish, Wildlife & Parks (MFWP) and United States Department of Agriculture/ Wildlife Services (USDA/WS) in Montana's portion of the Great Yellowstone Ecosystem (GYE). Most (63%) of the conflicts occurred on private land, and 52% of the private land conflicts occurred outside the DMA. The 10-year variation of conflicts and mortalities are displayed in Fig. 31. Approximate locations of the 2019 conflicts in MFWP Region 3 are shown in Fig. 32 and the 2019 conflicts in MFWP Region 5 are shown in Fig. 33. There were an additional 3 conflicts investigated well beyond the Yellowstone Ecosystem distinct population segment (DPS) boundary line. Two of the conflicts were in Meagher County and 1 was in Silver Bow County. Those 3 conflicts are not included in Figs. 33 and 34. Conflict types and frequencies are shown in Table 33.

During 2019, we documented a total of 10 known or probable human-caused grizzly bear mortalities. An additional adult female mortality of unknown cause was investigated during early spring of 2019. The carcass was heavily decomposed as this bear had obviously died during the fall of 2018. This female bear was captured on a trail camera with one cub during 2018. Therefore, the cub was also recorded as a probable mortality for 2018, both assigned in 2019. Human-caused grizzly bear mortalities during 2019 were from various causes (Fig. 34). The main causes were self-defense, depredations, and illegal/mistaken ID. Seven of the mortalities were male bears, 2 were adult females and one was a cub of unknown sex, which was an assumed probable mortality. Of the 7 male mortalities, 1 was a subadult male that was euthanized after being discovered injured and in very poor health condition on a U.S. Forest Service road. Of the10 known or probable human-caused bear mortalities (Fig. 35), 4 were outside the DMA.

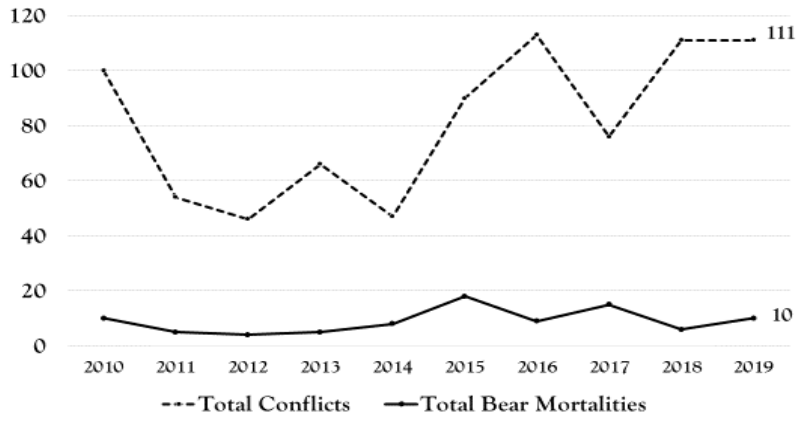


Fig. 31. Human-grizzly bear conflicts and bear mortalities in the Montana portion of the Greater Yellowstone Ecosystem, 2010–2019. Frequencies are indicated for 2019.

Table 33. Human-grizzly bear conflicts in Montana portion of the Greater Yellowstone Ecosystem, 2019.

Conflict type	Number of conflicts
Encounter situations	18 (5 human injuries)
Livestock – cattle	49 (53 cattle killed or injured)
Livestock – sheep	1 (5 sheep and 2 dogs killed)
Livestock – poultry	6
Property loss	1
Anthropogenic foods	8
Anthropogenic foods with property damage	
Near developed site – safety concerns	25
Management removal	3 (2 adult males, 1 adult female)
Total	111

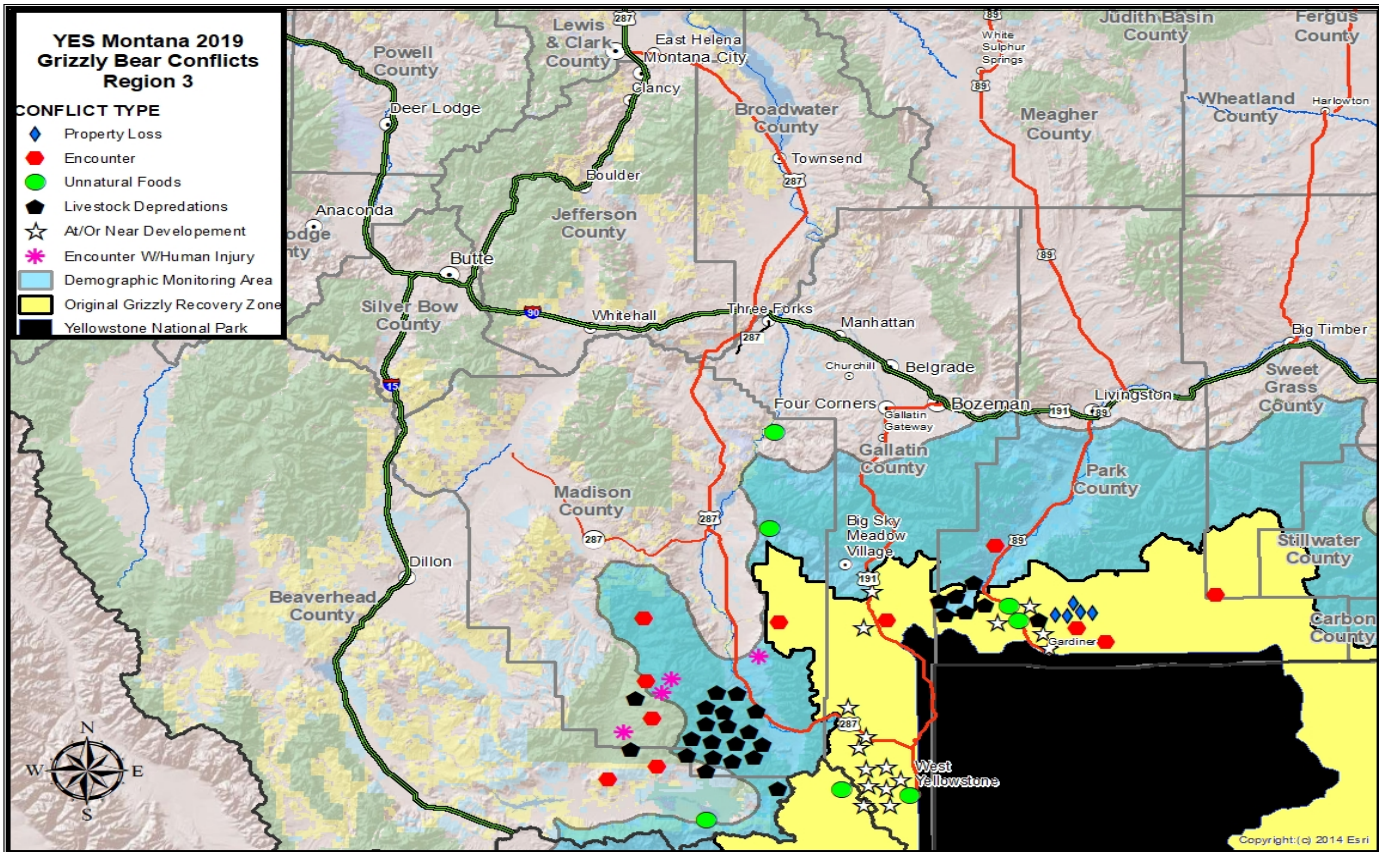


Fig. 32. Human-grizzly bear conflict locations in Montana Fish, Wildlife and Parks Region 3, 2019. Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

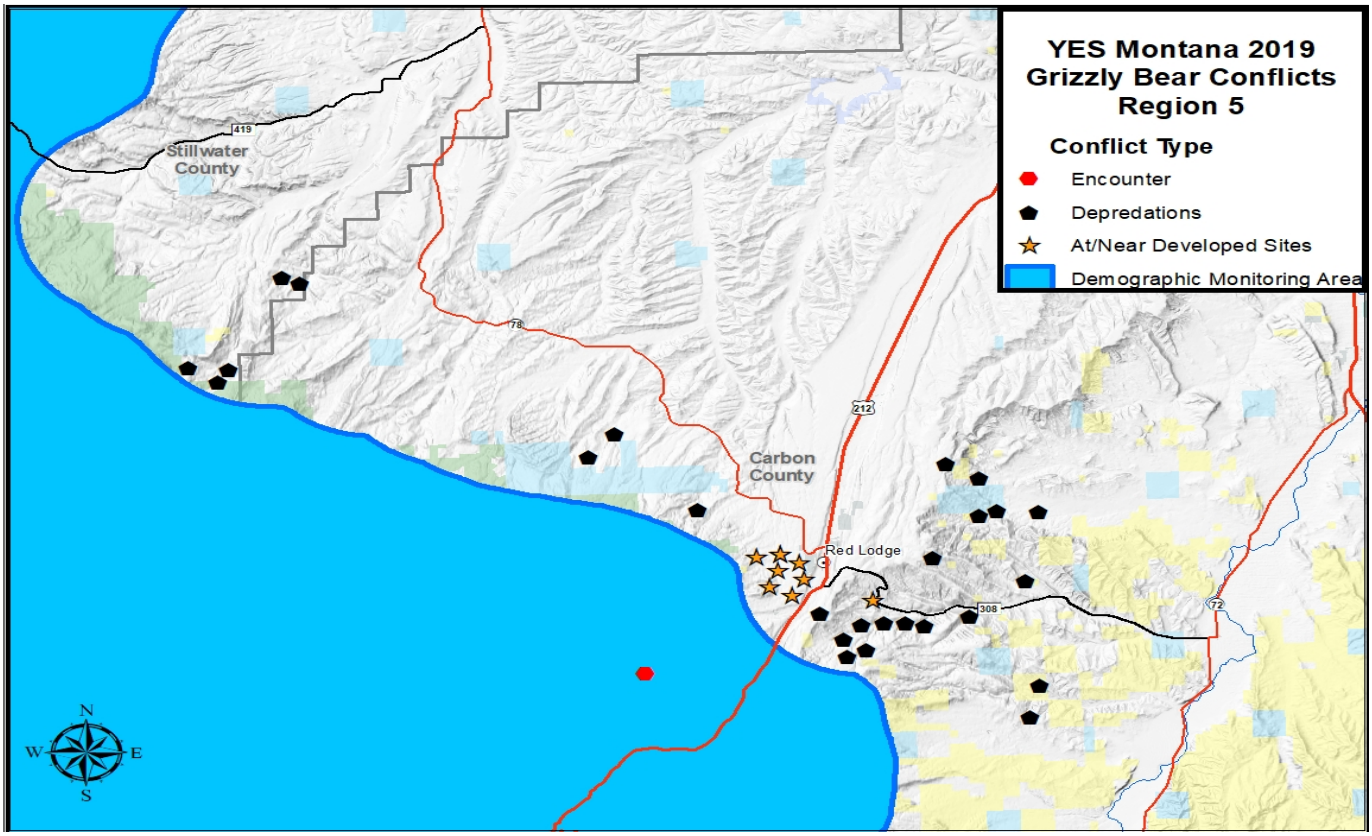


Fig. 33. Human-grizzly bear conflict locations in Montana Fish, Wildlife and Parks Region 5, 2019. Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

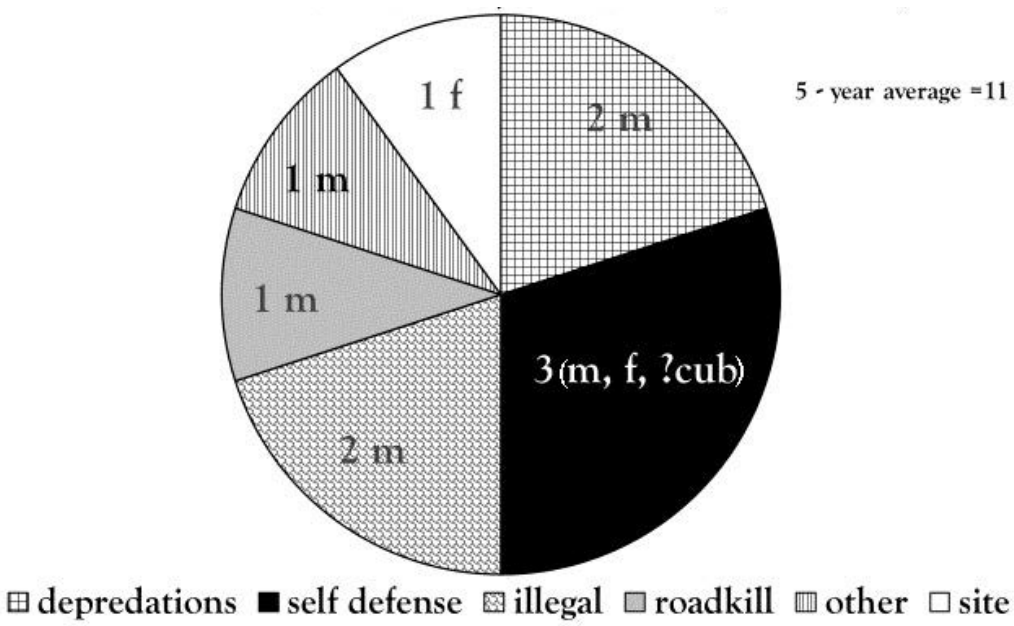


Fig. 34. Grizzly bear mortalities (n = 10; 2 from 2018) by cause in the Montana portion of the Greater Yellowstone Ecosystem, 2019 (f = female, m = male).

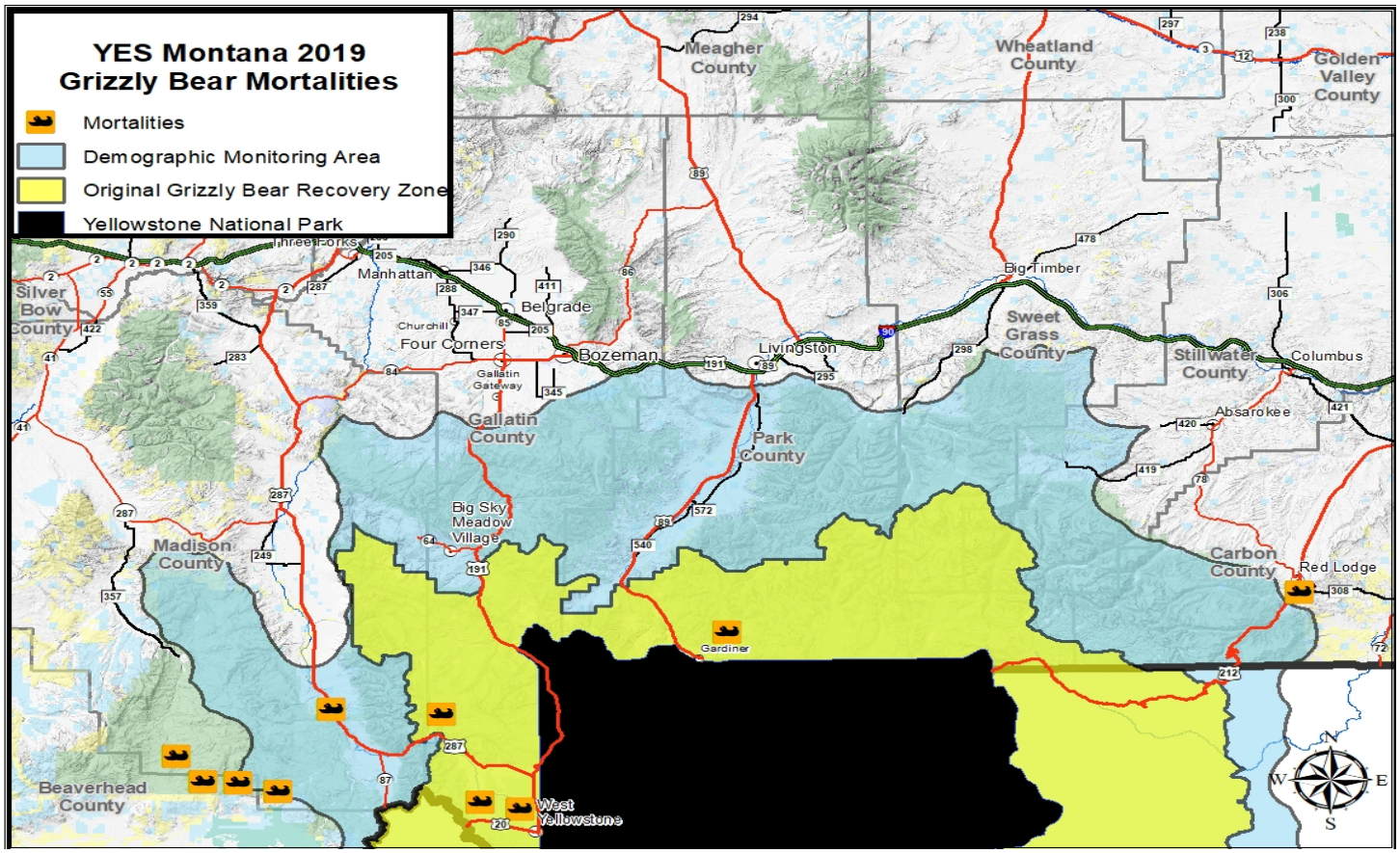


Fig. 35. Locations of grizzly bear mortalities in the Montana portion of the Greater Yellowstone Ecosystem, 2019. Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

There were 6 management captures (Fig. 36) during 2019. Livestock depredations accounted for 5 of the 6 captures, with 2 of those 5 captures being non-target (1 male cub, 1 male yearling) captures at or near livestock depredation sites. The 5-year average is 6 management captures per year. Capture locations are shown in Fig. 37.

Encounters, the sometimes associated human injuries, and self-defense bear mortalities fluctuate on an annual basis and are always of great concern to managing agencies and the public. There were 16 reported and investigated close encounters during 2019 that resulted in 5 human injuries with 1 known bear mortality and 2 probable mortalities (Fig. 38). One of the injuries occurred with an individual who was hiking and the other 4 injuries were associated with hunters during early fall archery season.

With greater geographic distribution and increased bear densities, livestock (cattle) depredations are increasing on public and private land inside and outside the DMA in Montana. Depending on geographic area, all age classes of cattle are depredated upon and depredation rates fluctuate annually in these geographic areas. There were 49 confirmed or probable depredations investigated by USDA-WS, assisted by MFWP personnel. There were 53 cattle depredations associated with the 49 sites investigated (Fig. 39). The most depredations occurred in MFWP Region 5, near Red Lodge. These depredations were all on private land and occurred outside the DMA. There were 21 cattle depredations in the western portion of MFWP Region 3, mainly on public land inside the DMA, and 6 depredations in the eastern portion of Region 3 on public and private land and within the DMA.

Of the 49 investigated cattle depredation sites in the Montana portion of the GYE, 28 were outside the DMA with 24 of those on private land and 4 on public land. Twenty-one depredation sites were inside the DMA with 16 of those on public land and 5 on private land.

Property loss associated with conflicts caused by grizzly bears was lower during 2019. In Fig. 40, property loss is shown as structural or vehicle damage and other livestock (e.g., poultry, sheep, swine, dogs) types. Structural damage has been declining through knowledge and preventative efforts. On an annual basis, other livestock type losses or depredations are generally low (Fig. 40). Other livestock loss types did increase mainly due to one bear preying on poultry at multiple residences and an event that a presumed bear(s) caused loss (probable depredation) to 5 sheep and 2 guard dogs in MFWP Region 3.

Human-grizzly bear conflicts at developed sites fluctuate depending on natural food availability, bear density in area, and age class of the involved bears. Site conflicts are those involving bears approaching human developed sites because of unnatural food attractants that may or may not be obtained. Site conflicts represent a major human safety concern for managers and the public. Conflicts of bears involved with site conflicts increased during 2019 from the previous 2 years, but were not at the highest level during 10-year period (Fig. 41). Situations where bears obtained unnatural foods were lower than 2018 and those during 2019 were predominantly related to fruit trees. Historically, unsecured garbage has been the predominant cause of site conflicts on private and public lands, but sanitation efforts to address site conflicts have reduced annual management actions and subsequent bear mortalities to a much lower level.

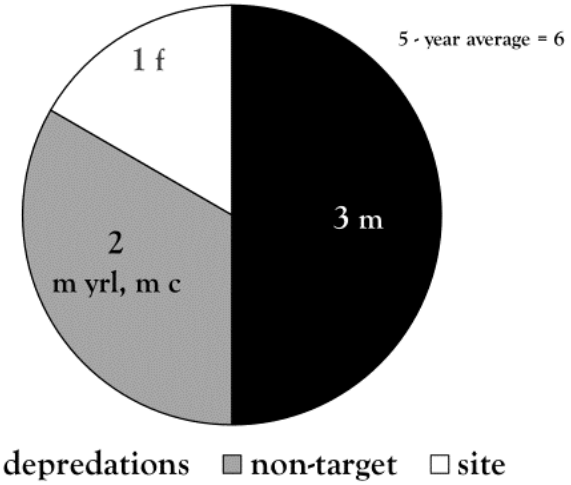


Fig. 36. Grizzly bear management captures (n = 6) by type in the Montana portion of the Greater Yellowstone Ecosystem, 2019 (f = female, m = male, yrl = yearling, c = cub).

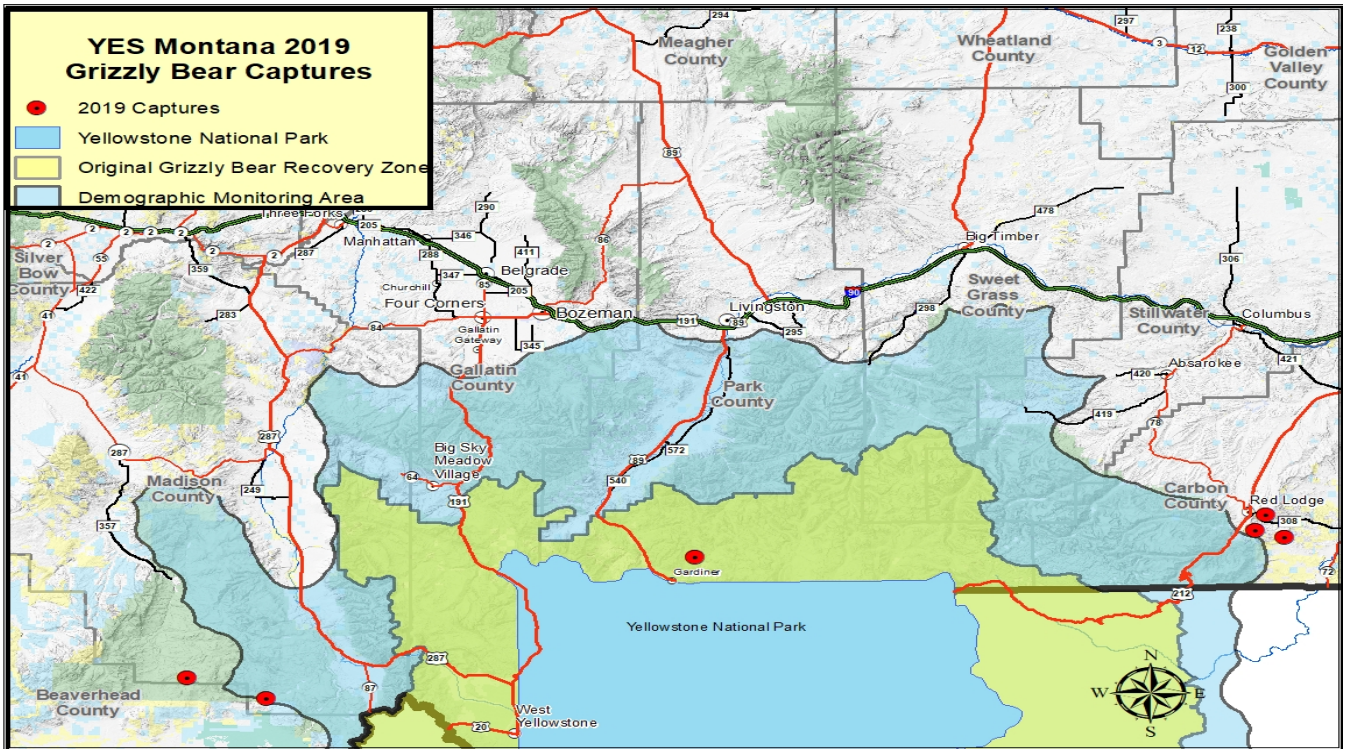


Fig. 37. Locations of management captures in the Montana portion of the Greater Yellowstone Ecosystem, 2019 Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

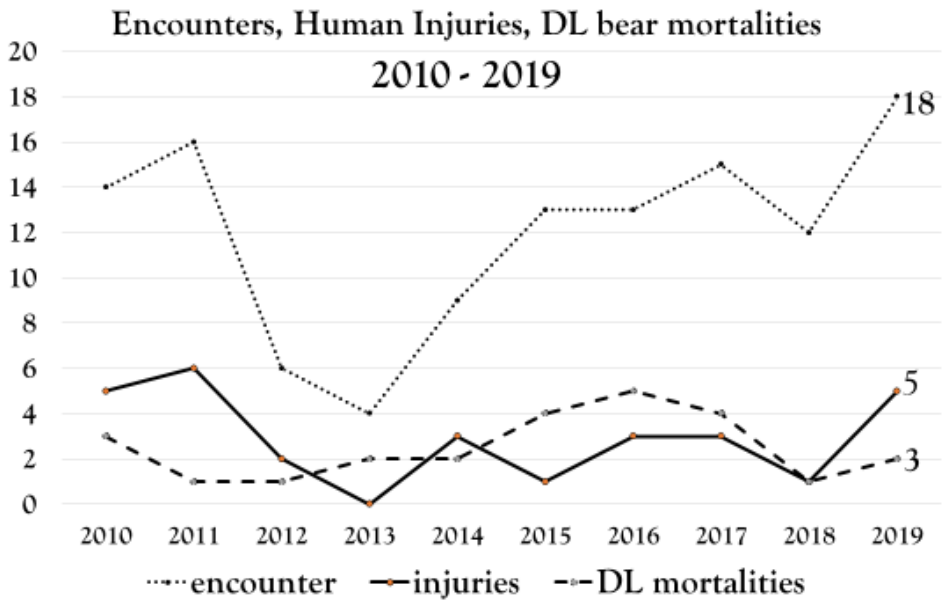


Fig. 38. Encounters, human injuries and self-defense (DL) grizzly bear mortalities in the Montana portion of the Greater Yellowstone Ecosystem, 2010–2019. Frequencies are indicated for 2019.

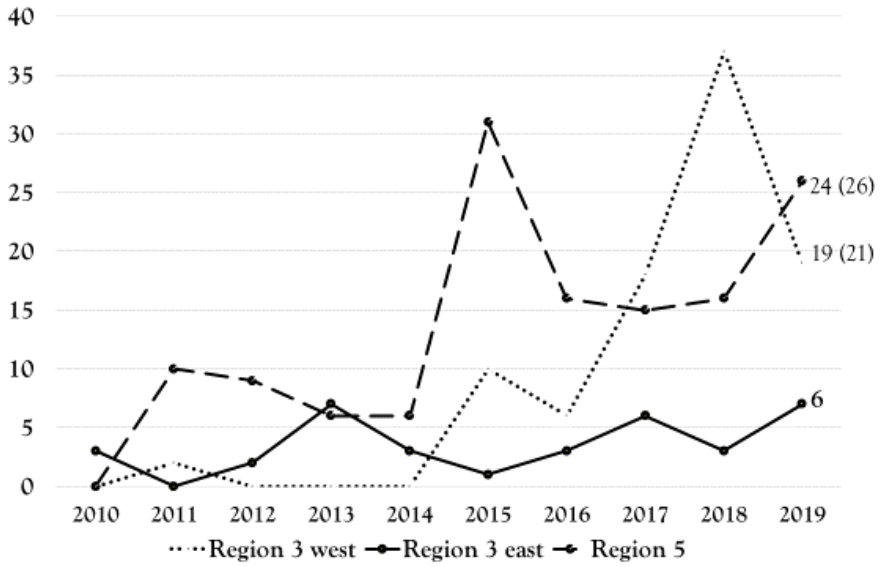


Fig. 39. Grizzly bear caused cattle depredations in the Montana portion of the Greater Yellowstone Ecosystem, 2010–2019. Frequencies are indicated for 2019.

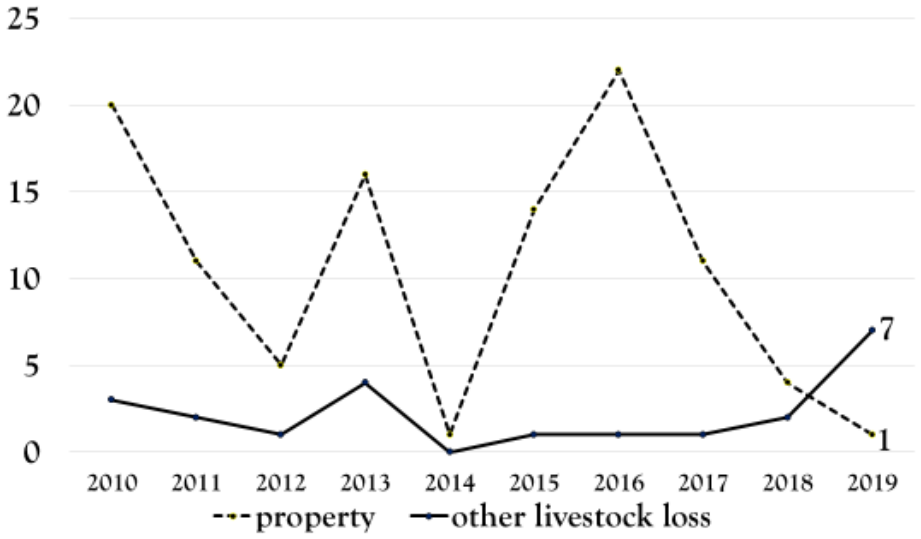


Fig. 40. Grizzly bear caused property loss in the Montana portion of the Greater Yellowstone Ecosystem, 2010–2019. Frequencies are indicated for 2019.

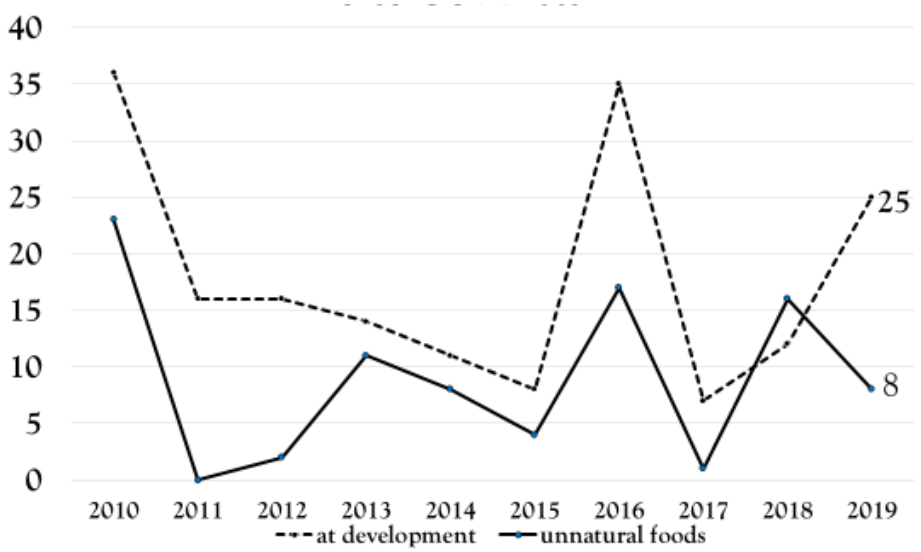


Fig. 41. Grizzly bear site conflicts in the Montana portion of the Greater Yellowstone Ecosystem, 2010–2019. Frequencies are indicated for 2019.

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

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

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

During 2019, the WGFD captured 33 individual grizzly bears in 34 capture events in an attempt to prevent or resolve conflicts (i.e., 1 bear was captured twice) (Fig. 42 and Tables 38 and 39). Most captures were adult males. Of the 34 capture events, 20 captures were a result of bears killing livestock (primarily cattle), 11 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. Three events were non-target captures at livestock depredation sites. Of the 34 capture events, 18 (53%) were in Park County, 8 (23%) were in Sublette County, 4 (12%) were in Fremont County, 3 (9%) were in Hot Springs County, and one (3%) was in Teton County (Table 34 and Fig. 42).

Of the 34 capture events, 15 involved relocation. All relocated grizzly bears were released on U.S. Forest Service lands in or adjacent to the Recovery Zone (Fig. 39). Of the 15 relocations, 9 were conducted in Park County (60%), 5 (33%) were in Teton County, and one (8%) was in Fremont County (Fig. 43 and Table 34).

Grizzly bears are removed (lethally or through live placement in an approved facility) from the population due to a history of previous conflicts, a known history of close association with humans, or they were deemed unsuitable for release into the wild (e.g., orphaned cubs, poor physical condition, or human safety concern). Of the 33 individual bears captured, 18 bears were removed from the population, and one bear died during capture. Of these 19 human-caused mortalities associated with management captures, 10 were outside of the DMA. Removal of grizzly bears in Wyoming is dependent upon authorization from the U.S. Fish and Wildlife Service, after careful and thorough deliberation taking into account multiple factors unique to each conflict situation.

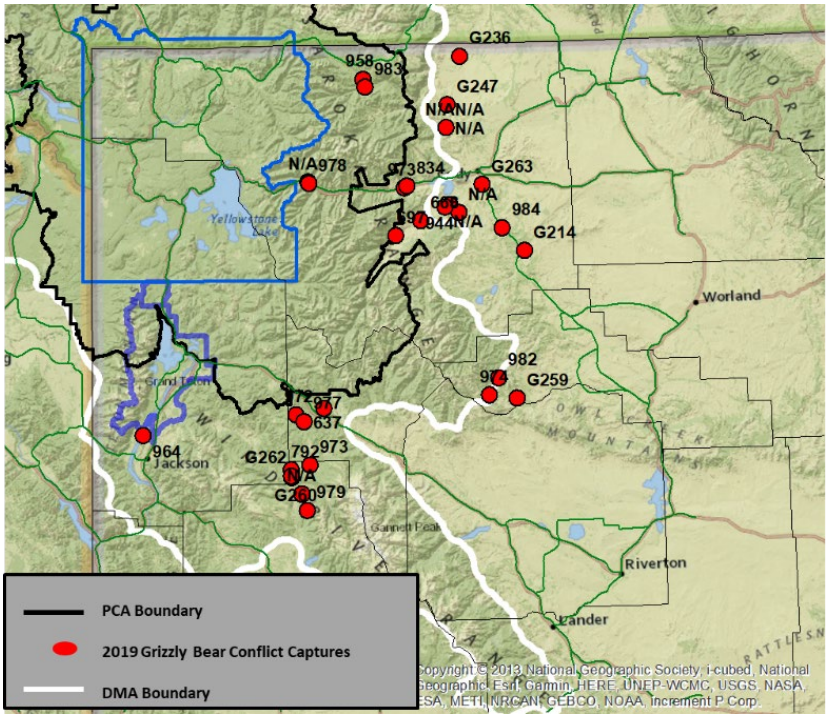


Fig. 42. Capture locations (n = 34) for grizzly bears captured in conflict management efforts in Wyoming portion of the Greater Yellowstone Ecosystem, 2019. Grizzly bears with "G" in front of their number were marked but not fitted with radio collars typically because they were too young to be collared. Because of the mapping scale, some locations are combined at one symbol. A complete list is provided in Table 34. Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

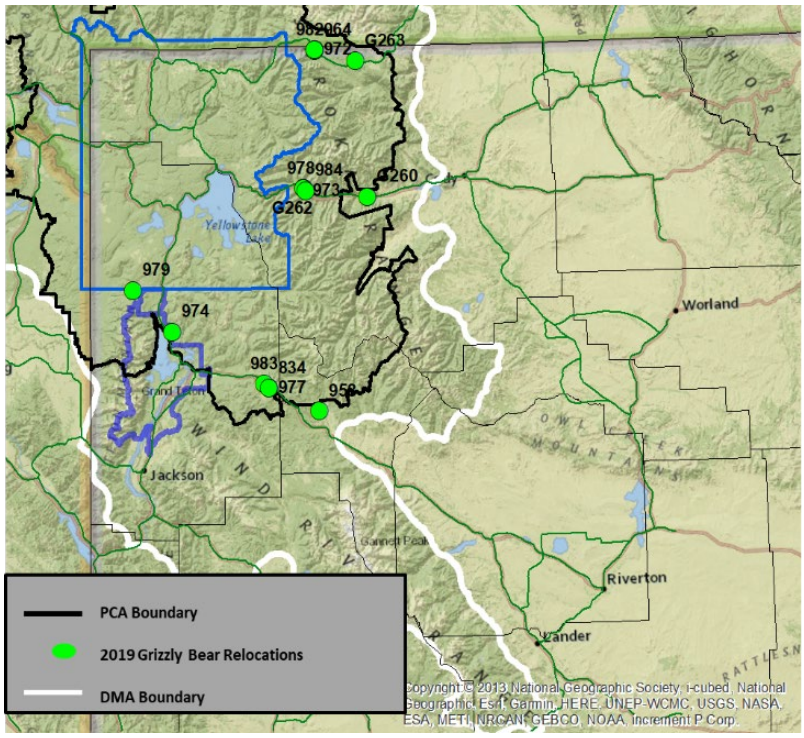


Fig. 43. Release locations (n = 15) for grizzly bears captured, relocated, or released on site in conflict management efforts in Wyoming portion of the Greater Yellowstone Ecosystem, 2019. Grizzly bears with "G" in front of their number were ear-marked but not fitted with a radio collar upon release, typically because they were too young to be collared. Because of the mapping scale, some locations are combined at one symbol. A complete list is provided in Table 34. Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

Table 34. Summary of grizzly bear conflict management captures in Wyoming portion of the Greater Yellowstone Ecosystem, 2019. 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
3/31/2019	697	Park			Captured for cattle depredation; removed for repeated conflict history
4/16/2019	944	Park			Removed for multiple livestock depredations
5/10/2019	G247	Park			Removed for frequenting ranch houses, food rewards of grain, and aggression towards humans
5/11/2019	N/A	Park			Removed for cattle depredation
5/19/2019	958	Park	Long Creek	Fremont	Captured for frequenting developed areas and getting into bear-resistant trash cans, property damage, and bird feeders
6/17/2019	N/A	Park			Removed for cattle depredation
6/25/2019	816	Fremont			Removed for multiple garbage conflicts/food rewards in town and other developed areas and a cattle depredation
7/19/2019	G259	Hot Springs			Removed for multiple food rewards and ongoing bold behavior at a sheep camp, habituation, and food-conditioned behavior
7/21/2019	G229	Sublette			Removed for cattle depredation
7/21/2019	G260	Sublette	Clocktower Creek	Park	Relocated for cattle depredation
7/28/2019	972	Fremont	Fox creek	Park	Relocated for cattle depredation
8/1/2019	973	Sublette	Mormon Creek	Park	Relocated for cattle depredation
8/8/2019	974	Hot Springs	Bailey Creek	Teton	Relocated for sheep depredation
8/8/2019	N/A	Sublette			Removed for multiple livestock/cattle depredations
8/12/2019	G262	Sublette	Mormon Creek	Park	Relocated for cattle depredation
8/24/2019	637	Fremont			Removed for cattle depredation
8/24/2019	977	Fremont	Lost Lake	Teton	Non-target capture at cattle depredation site-relocated
8/24/2019	N/A	Park			Removed for cattle depredation
8/24/2019	N/A	Park			Removed with mother and sibling for cattle depredations
8/26/2019	N/A	Park			Removed with mother and sibling for cattle depredation
8/27/2019	792	Sublette			Removed for cattle depredation
8/28/2019	G214	Park			Removed for multiple food rewards of garbage and pet food
8/29/2019	978	Sublette	Mormon Creek	Park	Relocated due to association with multiple cattle depredations
9/13/2019	979	Sublette	Fall Creek	Teton	Non-target capture at depredation site-relocated
9/19/2019	G236	Park			Removed for agricultural property damage and human safety concerns

Table 34. Continued.

Date	ID	Capture county	Relocation site	Release county	Reason for capture
9/20/2019	982	Hot Springs	Fox Creek	Park	Relocated for cattle depredation
9/21/2019	983	Park	Togwotee Pass	Teton	Relocated for killing a previously injured horse
9/22/2019	984	Park	Mormon Creek	Park	Relocated for frequenting the roadside south of Cody, feeding on roadkill
9/26/2019	G263	Park	Clay Butte	Park	Relocated for frequenting the Cody landfill
9/30/2019	N/A	Park			Captured for frequenting a guest lodge, bold behavior, and food rewards; died as a result of capture myopathy
9/30/2019	964	Teton	Fox Park	Park	Relocated for frequenting residential areas. Known to have damaged bird feeders; bear relocated without handling
10/1/2019	834	Park	Blackrock Creek	Teton	Non-target capture-relocated
10/13/2019	668	Park			Removed for multiple food rewards; increasingly bold behavior around people
10/22/2019	973	Park			Captured for obtaining garbage; removed for conflict history

WGFD personnel investigated and recorded 192 human-grizzly bear conflicts in 2019 (Table 34, Fig. 44). As a result of numerous and diligent education and conflict prevention efforts, the general pattern of conflicts is relatively steady within currently occupied habitat (Figs. 45 and 46). However, as occupied grizzly bear range has expanded, conflicts continue to occur in areas farther from the Recovery Zone and outside the DMA, often on private lands. Bears are increasingly coming into conflict with people in areas where grizzly bears have not been present in recent history. Although the joint efforts of the WGFD, U.S. Forest Service, non-governmental organizations, and particularly the public, have resulted in reducing conflicts through education and attractant storage in many areas, the distribution of grizzly bear conflicts in Wyoming continues to expand with the population. Bears frequent lower elevations and developed areas regularly during the non-denning period. Grizzly bear-cattle depredation was the most frequent type of conflict documented in 2019. The annual variation in livestock depredation incidents is not easily explained. Although most human-bear conflicts are correlated with natural food abundance, the number 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).

The majority of conflicts in Wyoming occurred on public lands outside of Recovery Zone (Figs. 46 and 47). The increasing distribution of grizzly bears is reflected in the annual documentation of conflicts farther from this area 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.

Table 35. Type and number of human-grizzly bear conflicts in Wyoming portion of the Greater Yellowstone Ecosystem, 2019.

Conflict type	Number	Percent (%)
Cattle	126	65
Garbage	19	10
Pet/livestock/birdfeed	13	7
Property damage	13	7
Other	6	3
Sheep	3	2
Poultry	3	2
Animal death	3	2
Unsecured Attractant	2	1
Aggression toward humans	2	1
Beehive	1	<1
Horse	1	<1
Total	192	100

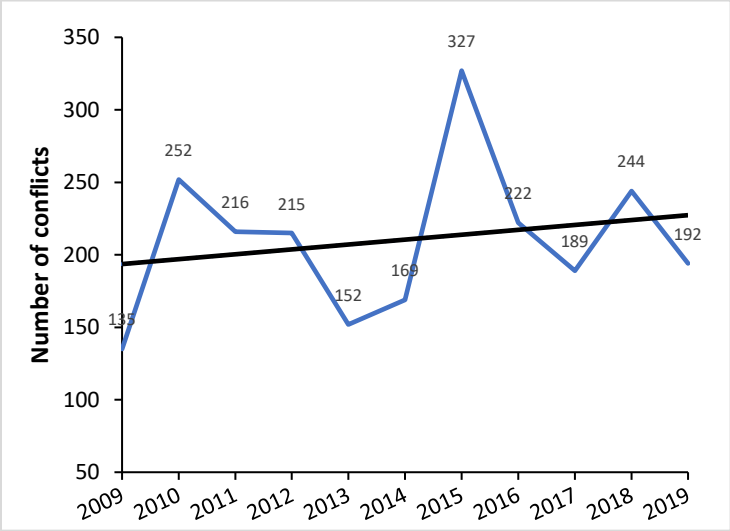


Fig. 44. Number of human-grizzly bear conflicts in Wyoming portion of the Greater Yellowstone Ecosystem, 2009–2019.

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

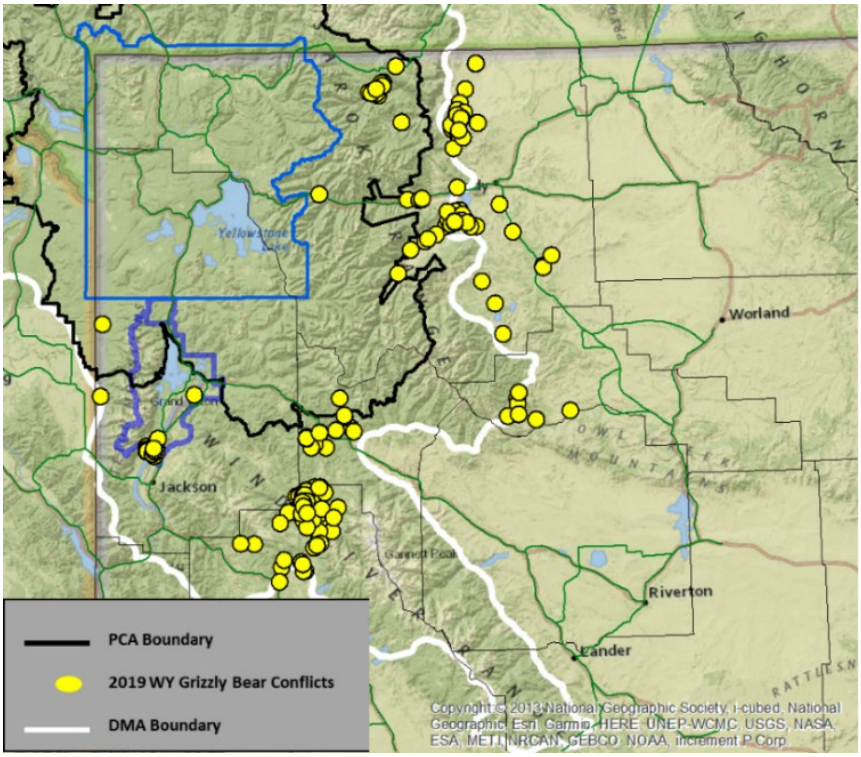


Fig. 45. Location of human-grizzly bear conflicts in Wyoming portion of the Greater Yellowstone Ecosystem outside of National Parks (n = 192) in relation to the Recovery Zone and the Demographic Monitoring Area, 2019. Base map source: 2013 National Geographic Society, i-cubed, Washington, D.C.

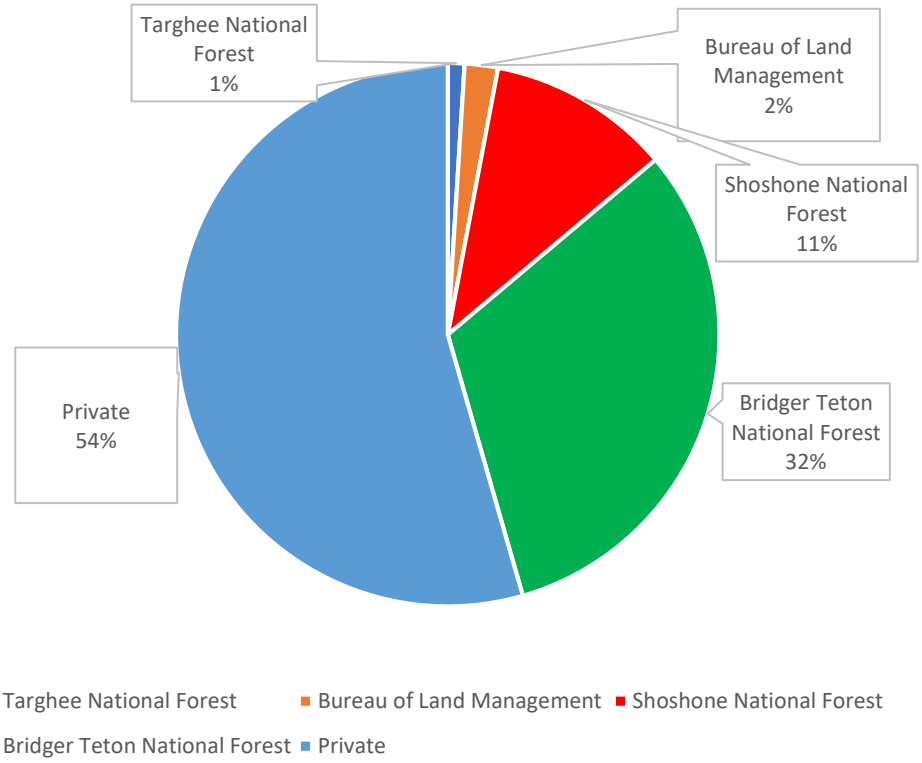


Fig. 46. Percent of human-grizzly bear conflicts on private and public lands in Wyoming portion of the Greater Yellowstone Ecosystem, 2019.

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

No depredations of livestock were reported or documented on Wind River Reservation in 2019. No grizzly bears were removed or transported to or from Wind River Reservation in 2019 for any purpose, including human conflicts.

A radio-collared grizzly bear captured on trail camera, September 2019. (Photo courtesy of C. Whitman, USGS)

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

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

Human-Bear Interactions within Developed Frontcountry Sites

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

Activity of Bears in Frontcountry Developed Sites

In 2019, there were 28 reported incidents where grizzly bears entered park developments (Table 36). The bear's primary activity was recorded in all 28 incidents. In 32% (n = 9) it appeared that the bears were just traveling through the development, and in 54% (n = 15) of the incidents the bears foraged for natural foods within developments. Other activities of bears in developments included courtship (n = 1), rubbing on a tree (n = 1), and curiously approaching a work crew (n = 1). In 1 incident, a bear investigated and obtained minor food rewards from soy-wheat pellets spilled at the Grant Helipad.

Reactions of Bears to the Presence of People in Frontcountry Developments

Grizzly bears were known to have encountered people in 24 of the 28 incidents where they entered developments and the bears' reaction was recorded in 23 of these incidents (Table 37). Bears reacted with a flight response in 35% (n = 8) of the incidents and in a neutral manner in 65% (n = 15). Bears did not display warning signals, aggressive behavior, or attack people in any of the 23 encounters that occurred within developments.

Human-Bear Interactions along Roads

Bears frequent habitat adjacent to roads in the park for many reasons including traveling, foraging for natural foods, avoiding more dominant bears, and occasionally seeking discarded food scraps or human food handouts. In the past (1910–1969), bears commonly panhandled along park roads for food handouts from visitors (Schullery 1992). Strict enforcement of regulations prohibiting the hand feeding of bears since 1970 has mostly eliminated this behavior in park bears. However, bears are still regularly observed near park roads traveling and foraging for native foods. Unlike park developments that are managed solely for people and bears are actively excluded, under the park's bear management philosophy, 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.

Bear Activity along Roadsides

In 2019, 333 reports of grizzly bears using habitat adjacent to park roads were recorded (Table 38). The primary activity of roadside bears was recorded in 329 of these reports. In the majority of these incidents, the roadside bears' primary activity was foraging for natural foods (75%, n = 247) or traveling (22%, n = 73). Other activities reported included courtship (1%, n = 3), bedded/sleeping (1%, n = 3), swimming (1%, n = 2), and aggressive approach/posturing towards people (<1%, n = 1).

Bear Reactions to the Presence of People Along Roadsides

Bears were noticeably aware of the presence of people in 217 of the 333 reports of bear activity along roads. The reaction of bears to people was reported for 212 of these 217 roadside encounters (Table 37) and were classified as neutral in 68% (n = 145) and as a flight response in 30% (n = 64) of the incidents. Grizzly bears displayed curious behavior and walked towards people in <1% (n = 1) of the roadside encounters and exhibited stress/warning behavior in <1% (n = 1). In 1 incident a grizzly bear charged toward people during a roadside encounter but did not make contact. Grizzly bears did not injure any visitors along park roads in 2019.

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 (YNP) implements seasonal closures and restrictions on recreational use of backcountry areas during periods when bear activity is concentrated on specific foods in predictable locations. In addition, trails, campsites, and off-trail areas are closed to recreational use for short periods when human activities conflict with natural bear activities and behaviors in backcountry areas.

Activity of Bears in Occupied Backcountry Campsites

Bears occasionally enter designated backcountry campsites while the campsites are occupied by recreational users. In 2019, there were 6 incidents reported where grizzly bears entered occupied backcountry campsites (Table 39). The bears' primary activity in the core camp was reported for all 6 incidents. Reported activities of bears in occupied campsites included walking through the core campsite (n = 4), foraging on native foods (n = 1), and investigating the food storage pole without getting a food reward (n = 1).

Bear Reactions to the Presence of People in Backcountry Campsites

In 4 of the 6 incidents where grizzly bears entered occupied backcountry campsites, the campers believed that the bear knew people were present in the campsite. The bears' reaction was reported in all 4 of these incidents. Grizzly bears had no overt response in 1 incident, a flight response in 2 of the encounters, and were curious and approached people during 1 encounter (Table 37). Grizzly bears did not injure any visitors in backcountry campsites in 2019.

Bear Reactions to Encounters with People on Backcountry Trails

In 2019, there were 28 reported incidents where people encountered grizzly bears on backcountry trails (Table 37). Reactions of bears to the encounters were reported for all 28 incidents. Grizzly bears reacted to encounters with people along backcountry trails with neutral behaviors in 39% (n = 11), flight behaviors in 36% (n = 10), curiously approaching in 14% (n = 4), charging without making contact in 7% (n = 2), and stress/warning behaviors in 4% (n = 1). Grizzly bears did not injure any visitors on backcountry trails in 2019.

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

In 2019, there were 15 reported incidents where people encountered grizzly bears while traveling off-trail in backcountry areas (Table 37). The reaction of the bears to the encounters were reported in 13 of the incidents and included fleeing (69%; n = 9), charging without making contact in 15% (n = 2), neutral behaviors (8%; n = 1), and with stress/warning behaviors (huffing noises, 8%, n = 1). Grizzly bears did not attack people in any of the off-trail encounters in YNP in 2019.

Summary

Grizzly bears instill fear in many YNP visitors and when they attack people in the park, it generates world-wide media attention further enforcing their ferocious reputation. However, grizzly bears rarely reacted aggressively toward people during encounters in YNP in 2019 (Table 40). Results in 2019 are similar to overall results from the entire period we have monitored human-bear interactions in the park (1991–2019, Table 41). In the 6,542 encounters between grizzly bears and people from 1991 to 2018 where the bear's reaction was reported, bears reacted with neutral behaviors in 58% (n = 3,781), by fleeing in 34% (n = 2,252), curious behaviors in 3% (n = 211), and with stress, bluster, or warning behaviors in 1% (n = 39) of the incidents. Grizzly bears reacted with aggression without contact in 4% (n = 237) of the encounters. Less than 1% (n = 22) of the 6,542 reported encounters between people and

grizzly bears in YNP from 1991–2018 resulted in an attack. Most attacks occurred in backcountry areas. Attacks occurred at a higher rate during off-trail interactions (2%, 7 attacks in 433 reported encounters) than during on-trail interactions (1%, 15 attacks in 1,459 encounters). During the study period, there were no grizzly bear attacks during interactions in areas where human presence was expected and predictable, such as along primary roads (0 attacks in 3,779 encounters), within developments (0 attacks in 664 encounters), and in designated backcountry campsites (0 attacks in 207 encounters). Despite their ferocious reputations, 29 years of human-bear interactions data from YNP suggest that grizzly bears are tolerant of people in most encounters. Grizzly bears injured people in <1% of all encounters occurring in the park. However, in the rare incidents where contact was made, injuries were sometimes severe or fatal.

Table 36. Activity of bears that entered frontcountry developments, Yellowstone National Park, 2019.

Activity of bear while inside development	Number of incidents
Not reported or unknown	0
Travel through	9
Forage for natural foods	15
Investigate anthropogenic foods but no food reward and no property damage	0
Investigate and damage property but no food reward	0
Investigate and obtain anthropogenic foods	1
Attack people	0
Other	3
Total	28

Table 37. Reactions of grizzly bears to encounters with people, Yellowstone National Park, 2019.

Reaction of bear	Development	Along roadside	Backcountry campsite	On trail	Off trail	Total
Not reported/not known	1	5	0	0	2	8
Flight response						
Run away	0	12	1	7	6	26
Walk away	8	52	1	3	3	67
Adult climb tree	0	0	0	0	0	0
Cubs climb tree/adult remain	0	0	0	0	0	0
Flight behavior subtotal	8	64	2	10	9	93
Neutral behaviors						
No overt reaction	15	145	1	11	1	173
Stand up on hind legs	0	0	0	0	0	0
Circle down wind	0	0	0	0	0	0
Neutral behavior subtotal	15	145	1	11	1	173
Curious behaviors						
Walk towards-curious	0	1	1	4	0	6
Follow mobile person	0	0	0	0	0	0
Investigate vehicle	0	0	0	0	0	0
Curious behavior subtotal	0	1	1	4	0	6
Stress/agitation/warning signals						
Salivate	0	0	0	0	0	0
Sway head side to side	0	0	0	0	0	0
Make huffing noises	0	0	0	0	1	1
Pop jaws/teeth clacking noises	0	1	0	0	0	1
Stood ground watched/stared	0	0	0	1	0	1
Slap ground with paw	0	0	0	0	0	0
Flatten ears/erect spinal hairs	0	0	0	0	0	0
Stiff legged walk/hop	0	0	0	0	0	0
Stress/warning behavior subtotal	0	1	0	1	1	3
Aggressive behaviors						
Growl	0	0	0	0	0	0
Aggressive approach	0	0	0	0	0	0
Stalk	0	0	0	0	0	0
Run towards/aggressive charge	0	1	0	2	2	5
Aggressive behavior subtotal	0	1	0	2	2	5
Attack behaviors						
Defensive attack	0	0	0	0	0	0
Predatory attack	0	0	0	0	0	0
Attack unknown cause	0	0	0	0	0	0
Attack behavior subtotal	0	0	0	0	0	0
Total	14	217	4	28	15	278

Table 38. Primary activity of grizzly bears along roadsides, Yellowstone National Park, 2019.

Activity of bear	Number of incidents
Not reported/unknown	4
Traveling	73
Foraging natural foods	247
Courtship	3
Swimming	2
Nursing young	0
Playing	0
Bedded/sleeping	3
Investigating vehicles/seeking anthropogenic foods; no food reward	0
Obtain anthropogenic foods	0
Damage property	0
Aggressive approach/posture towards people	1
Attack people	0
Total	333

Table 39. Primary activity of grizzly bears that entered occupied backcountry campsites, Yellowstone National Park, 2019.

Activity of bear	Number of incidents
Not reported/unknown	0
Walked past edge of campsite	0
Walked through core camp	4
Forage native foods	1
Investigate tent without damage/no food reward	0
Investigate food pole without food reward	1
Investigate food storage locker without food reward	0
Attempt to get human foods (not successful)	0
Damage property	0
Obtain anthropogenic foods	0
Investigate latrine (buried human feces/toilet paper)	0
Lay down/rest in campsite	0
Aggressive approach/posture towards people in campsite	0
Attack people	0
Total	6

Table 40. Grizzly bear reactions to interactions with people (*n* = 280) in different location settings, Yellowstone National Park, 2019.

Location of encounter	Reaction of bear											
	Flee		Neutral behavior		Curious		Stress/agitation		Aggression without contact		Attack	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Park development	8	35	15	65	0	0	0	0	0	0	0	0
Roadside corridor	64	30	145	68	1	<1	1	<1	1	<1	0	0
Backcountry campsite	2	50	1	25	1	25	0	0	0	0	0	0
Backcountry trail	10	36	11	39	4	14	1	4	2	7	0	0
Backcountry off-trail	9	69	1	8	0	0	1	8	2	15	0	0
Total	93	33	173	62	6	2	3	1	5	2	0	0

Table 41. Grizzly bear reactions to interactions with people (*n* = 6,542) in different location settings, Yellowstone National Park, 1991–2019.

Location of encounter	Reaction of bear											
	Flee		Neutral behavior		Curious		Stress/agitation		Aggression without contact		Attack	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Park development	320	48	316	48	17	3	3	<1	8	1	0	0
Roadside corridor	880	23	2,778	74	51	1	10	<1	60	2	0	0
Backcountry campsite	85	41	94	45	18	9	1	<1	9	4	0	0
Backcountry trail	725	50	458	31	111	8	23	2	127	9	15	1
Backcountry off-trail	242	56	135	31	14	3	2	<1	33	8	7	2
Total	2,252	34	3,781	58	211	3	39	1	237	4	22	<1

There were 47 human-grizzly bear encounters in Yellowstone National Park's backcountry in 2019, 28 on designated trails, 15 in off-trail areas, and 4 in designated backcountry campsites. None of these encounters resulted in grizzly bear attacks. (photo courtesy of D. Schneider, NPS)

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

From an early age most people are taught behaviors that decrease the risk of injury in an urban setting (Penteriani et al. 2016). However, relatively few people are taught methods to safely enjoy outdoor activities in a wilderness environment (Penteriani et al. 2016). Improvements in information and education efforts aimed at recreational safety in bear country are paramount in the face of significant increases in visitation to YNP, concurrent with grizzly bear recovery in the GYE.

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

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

In 2019, we surveyed 4,201 people in 1,357 groups at 31 different backcountry trails and 5 boardwalk trails. Our surveys included 2,195 backcountry day hikers, 1,834 people walking boardwalk trails, 133 overnight backpackers, 22 stock day-riders, 7 overnight stock-riders, and 10 day-use bicyclists.

Day Hikers

Yellowstone National Park contains >1,000 miles of backcountry hiking trails accessible from 92 trailheads located throughout the park (Yellowstone National Park 2014). We surveyed 2,195 day-hikers traveling in 698 groups on 28 different trails. Average party size was 3.1 people (Table 42). The most common group size (mode) and the median group size were 2 people per party. Fifty-three percent (n = 371) of day hiking parties had less than the recommended party size of 3 people and 12% (n = 82) hiked by themselves. Of the 2,195 day hikers, 454 (21%) carried bear spray, 21 (1%) had bear bells, and 2 (<1%) carried firearms (Table 43). Of the 698 groups of day hikers, 356 (51%) had at least 1 member that carried bear spray, 16 groups (2%) had at least 1 person wearing bear bells, and 1 group (<1%) had at least one person carrying a firearm.

Overnight Backpackers

Yellowstone National Park has 301 designated backcountry campsites (Yellowstone National Park 2014). We surveyed 133 backpackers in 47 groups on 10 different trails. Average party size was 2.8 people (Table 42). The most common group size (mode) and the median group size were 2 people per party. Sixty-six percent (n = 31) of the backpacking groups had less than the recommended party size of 3 people and 17% (n = 8) hiked alone. Of the 133 backpackers, 100 (75%) carried bear spray, 3 (2%) carried firearms, and none had bear bells (Table 43). Of the 47 groups of backpackers, 43 (92%) had at least 1 person in the party that carried bear spray, 3 groups (6%) had at least one person carrying a firearm, no groups had anyone carrying bear bells.

Stock Day-Riders

We surveyed 22 stock day-riders in 4 groups (Table 42) on 3 different trails. Three (14%) of the day-riders carried bear spray and 1 openly carried a firearm. None of the day-riders carried bear bells (Table 43). Of the 4 groups of stock day-riders, 2 (50%) had at least 1 person in the party that carried bear spray, 1 group (25%) had at least one person carrying a firearm.

Stock Overnight-Riders

We surveyed 7 people in 2 groups that were riding stock and camping overnight (Table 42) on 2 different trails. None of the overnight stock riders carried bear spray or bear bells. One (14%) of the overnight stock riders openly carried a firearm (Table 43).

Day Use Bicycle Trail Riders

Yellowstone National Park contains 13 designated bike trails. One of the 13 trails has access to a designated backcountry campsite. We surveyed 10 people in 5 groups riding bicycles on day trips (Table 42) on 4 different trails. Five (50%) of the bicyclists carried bear spray, none of them had bear bells or carried firearms (Table 43). Three of the 5 (60%) groups of bicyclists had at least 1 member that carried bear spray.

Boardwalk Trails

Yellowstone National Park contains approximately 15 miles of boardwalk trails (Yellowstone National Park 2014). Boardwalk trails are short trails found near park roads that contain interpretive signs providing visitors with information about geysers or other natural features. Boardwalks provide a stable walking surface with gentle grades or steps to get up and down hills, allowing use by visitors of a wide-range of ages, physical abilities, and hiking experience. Park regulations prohibit stock animals and overnight camping on or along boardwalk trails. We surveyed 1,834 people in 601 groups on 5 different boardwalk trails. Average party size was 3.1 people per party (Table 42). The most common group size (mode) and the median group size were both 2 people. Fifty-three percent (n = 317) of the groups of boardwalk users had fewer than the recommended party size of 3 and 14% (n = 85) hiked alone. Only 2% (n = 29) of the individuals surveyed carried bear spray (Table 43). Four percent of the groups (n = 26) surveyed had at least one person in the party that carried bear spray. One (<1%) person walking on a boardwalk trail carried bear bells. None of the people observed on boardwalk trails carried firearms.

Use of Bear Spray

Bear spray was deployed in 1 incident in YNP in 2019. On June 11, 3 fisheries technicians had a surprise encounter with an adult grizzly bear while hiking off-trail in the Red Grass Creek drainage. The bear was approximately 75 yards away when first encountered. The bear charged at an angle and the lead person deployed their bear spray, but hit the bear in the side and rump as the bear ran toward the second person in line. The second person deployed their bear spray hitting the bear directly in the face. After being hit in the face with bear spray the bear veered off and ran away.

Discussion

In 2019, overnight backpackers had the highest level of compliance with the park's bear spray recommendation; 75% of individual backpackers carried bear spray; 92% of backpacking groups had at least one member that carried bear spray. Overnight backpackers have had the highest proportion of individuals and groups traveling on foot that carried bear spray during all 9 years surveys have been conducted (Table 44 and 49). 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 that YNP visitors retain verbal information from uniformed park staff better than written information from signs or brochures (Taylor et al. 2014). In addition, we speculate that many backpackers may have a higher level of experience in bear country than many day hikers.

The most common party size observed (mode) among backpackers was 2 people per party, indicating that many backpackers did not follow the park's recommended group size of 3 or more people for hiking in bear country. The most common party size (mode) for overnight backpackers during all 9 years of the study has been 2 people per party (Table 46).

Only 21% of day hikers carried bear spray, however, 51% of day hiking groups had at least one member that carried bear spray. Fewer than 25% of day hikers have carried bear spray in each of the 9 years surveys have been conducted (Table 44). Permits are not required for day hiking so day hikers may not receive the same level of bear safety information as backpackers, such as the verbal safety information from a park ranger. Visitor's day hiking in YNP 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 that many day hikers that arrive at trailheads without bear spray are unlikely to go obtain bear spray before starting their hikes even after reading the sign. We also suspect that many day hikers in YNP may have a lower level of experience in bear country than many backpackers have. The most frequently observed group

size (mode) among day hikers was 2 people per group indicating that many day hikers did not comply with the recommended group size of ≥3 for hiking in bear country. Since most (67%) grizzly bear attacks in YNP involve day hikers (30 of 45 backcountry attacks since 1970), getting more day hikers to carry bear spray or hike in groups of ≥3 people is a priority for park managers.

In 2019, the most common group size encountered on boardwalk trails was 2 people per party and only 2% of boardwalk hikers carried bear spray. Recreationists on boardwalk trails have had very low compliance with bear safety recommendations each year surveys have been conducted (Tables 47–49). However, only 2 grizzly bear attacks in the last 49 years have occurred on or near boardwalk trails, therefore the risk of attack during this type of recreational activity is very low.

Three of the day-use and none of the overnight stock riders surveyed in 2019 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 a horse and rider 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 as long as the rider can stay in the saddle. Although stock users are less likely to have surprise encounters with bears, bear spray is useful and encouraged for carry by stock groups for use during rest stops along the trail and when in camp.

Five of the 10 bicyclists we encountered on our surveys were carrying 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 9 years we conducted our surveys. Firearms were openly carried by <1% of the recreationists we observed in 2019. Overnight stock-riders (14%) 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 panniers 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 2019. Day-hikers (1%) 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 1982), they are generally not considered effective at preventing surprise encounters when hiking in strong winds, near rushing water, or in dense brush or forest which muffles the bells sound (Herrero 2002).

Table 42. Group size characteristics for different types of recreational activities in Yellowstone National Park, 2019.

Type of recreational activity	Total people	Total groups	Average group Size	Median group size	Mode group size
Boardwalk trail (foot travel walking)	1,834	601	3.1	2	2
Day hiker (e.g., day use foot travel-hiker, angler, photographer)	2,195	698	3.1	2	2
Overnight backpacker (foot travel camping overnight)	133	47	2.8	2	2
Stock – day use	22	4	5.5	4	1, 3, 5, 13
Stock – overnight use	7	2	3.5	3, 5	2, 5
Day bicycle trip	10	5	2.0	2	1, 3
Total	4,201	1,357	3.1	2	2

Table 43. Number and percent (%) of people and groups of recreationists surveyed that carried bear spray, firearms, or bear bells, Yellowstone National Park, 2019.

	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	1,834	2,195	10	133	22	7	4,201
(# of parties surveyed)	601	698	5	47	4	2	1,357
People with bear spray							
Total	29	454	5	100	3	0	591
Percent	1.6	20.7	50.0	75.2	12.5	0.0	14.2
Parties with bear spray							
Total	26	356	3	43	2	0	430
Percent	4.3	51.0	60.0	91.5	50.0	0.0	31.7
People with firearms							
Total	0	2	0	3	1	1	7
Percent	0	0.1	0	2.3	4.5	14.3	0.2
Parties with firearms							
Total	0	1	0	3	1	1	6
Percent	0	0.1	0	6.4	25.0	50.0	0.4
People with bear bells							
Total	1	21	0	0	0	0	22
Percent	0.1	1.0	0	0	0	0	0.5
Parties with bear bells							
Total	1	16	0	0	0	0	17
Percent	0.2	2.3	0	0	0	0	1.3

Table 44. Percent (%) of people engaged in different types of backcountry recreational activities that carried bear spray, Yellowstone National Park, 2011–2019.

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	13	<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	100
2019	75	21	2	14	0	50
2011–2019 combined data	55	17	1	6	32	20

Table 45. Percent (%) of groups engaged in different types of backcountry recreational activities that had at least one member that carried bear spray, Yellowstone National Park, 2011–2019.

Year	Overnight backpackers	Day hiker	Boardwalk	Stock day use	Stock overnight use	Bicycle day use
2011	64	33	Not surveyed	0	50	Not surveyed
2012	73	27	0	67	50	0
2013	82	33	0	33	67	0
2014	73	28	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	100
2019	92	51	4	50	0	60
2011–2019 combined data	82	39	2	25	52	24

Table 46. Group size characteristics for different types of recreational activities, Yellowstone National Park, 2011–2019.

Type of recreational activity	Total people	Total groups	Average group size	Median group size	Mode group size
Boardwalk	9,375	3,323	2.8	2	2
Day hiker (e.g., day foot travel- hiker, angler, photographer)	15,934	5,367	3.0	2	2
Overnight backpacker (overnight-foot travel)	1,168	387	3.0	2	2
Horse – day use	113	20	5.7	5	3
Horse – overnight use	104	21	5.0	5	2
Day bicycle trip	61	29	2.1	2	2
Total	22,623	7,821	2.9	2	2

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Appendix A

2019 Grizzly Bear Habitat Monitoring Report

Grizzly Bear Habitat Modeling Team, Greater Yellowstone Ecosystem

Background

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

The Conservation Strategy and the habitat standards therein provide management direction for a recovered grizzly bear population once it has been removed from federal protection under the Endangered Species Act (ESA). Grizzly bears in the lower 48 states were listed in 1975 as threatened under the ESA. Habitat standards and monitoring protocol identified in the Conservation Strategy went into effect in 2007 when federal protections for the Yellowstone population were first removed (Federal Register 2007) and again following a second delisting in 2017 (Federal Register 2017). The 2007 and 2017 rules to delist were challenged in court and in both instances they were vacated and remanded back to the U.S. Fish and Wildlife Service. Regardless of the legal status of the Yellowstone grizzly bear, land managers throughout the GYE are committed to abiding by habitat standards identified in the Conservation Strategy for the long-term protection and health of the grizzly bear population.

Introduction

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

[1]The Recovery Zone is a term used when the Yellowstone grizzly bear population is protected as a threatened species under the ESA. The same area is referred to as the Primary Conservation Area (PCA) when the population is removed from federal protection. The term Recovery Zone is used in this 2019 report to reflect the current protected status of the Yellowstone grizzly bear population.

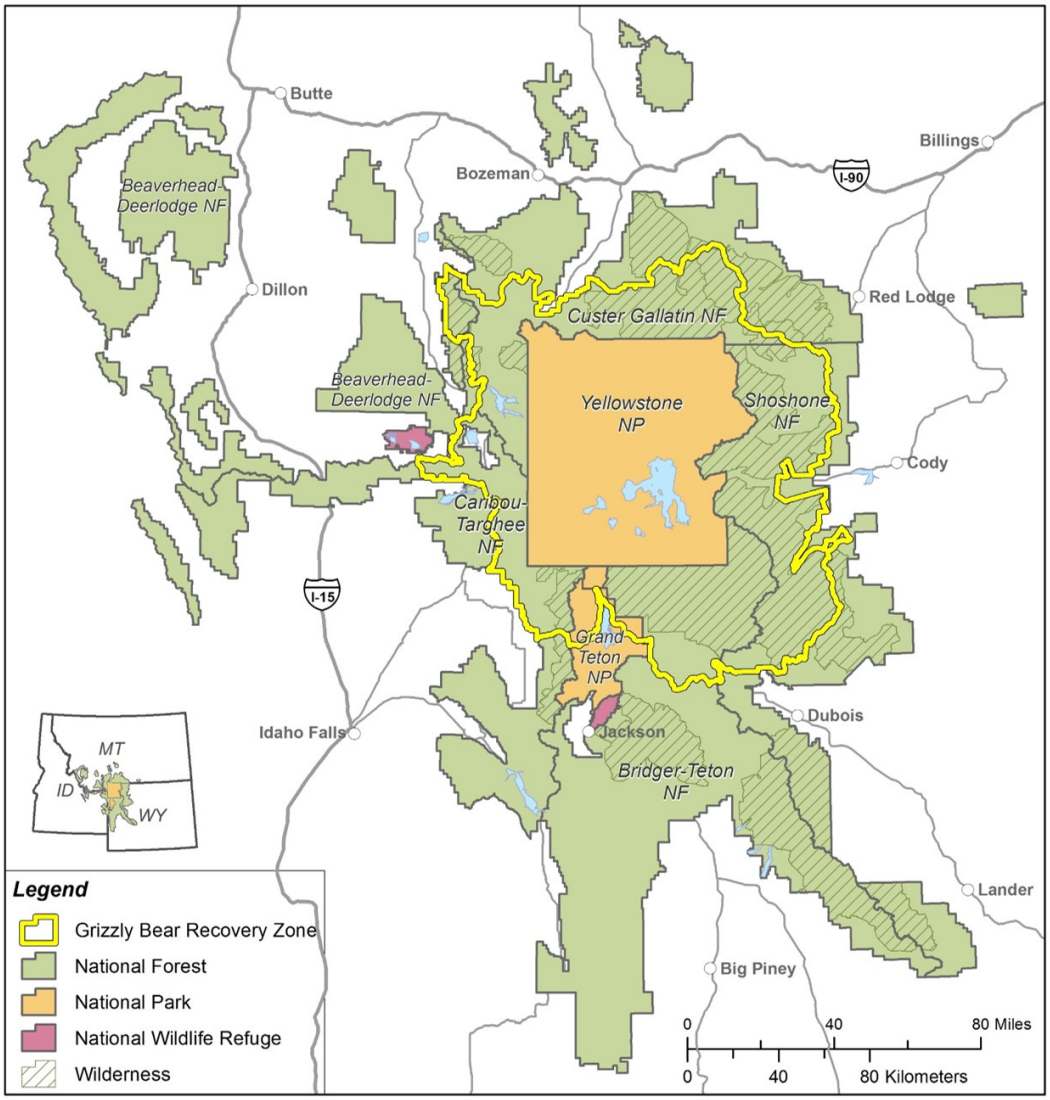

Fig. A1. Federal lands and the designated Recovery Zone for grizzly bears in the Greater Yellowstone Ecosystem.

Annual Monitoring Requirements Inside the Recovery Zone

In compliance with annual habitat monitoring protocol, this report summarizes habitat changes incurred annually inside the Recovery Zone 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 Recovery Zone. Current status of secure habitat and motorized route densities are evaluated, summarized, and reported against 1998 levels annually for each of the 40 subunits within the 18 Bear Management Units (BMU, Fig. A2). The number and status of livestock allotments is annually reported against 1998 levels for each National Forest and National Park unit inside the Recovery Zone. The 1998 habitat baseline represents the most current and accurate information available documenting habitat conditions inside the Recovery Zone during 1998. U.S. Forest Service and National Park Service personnel continue to improve the quality of their information to more accurately reflect what was on the landscape in 1998.

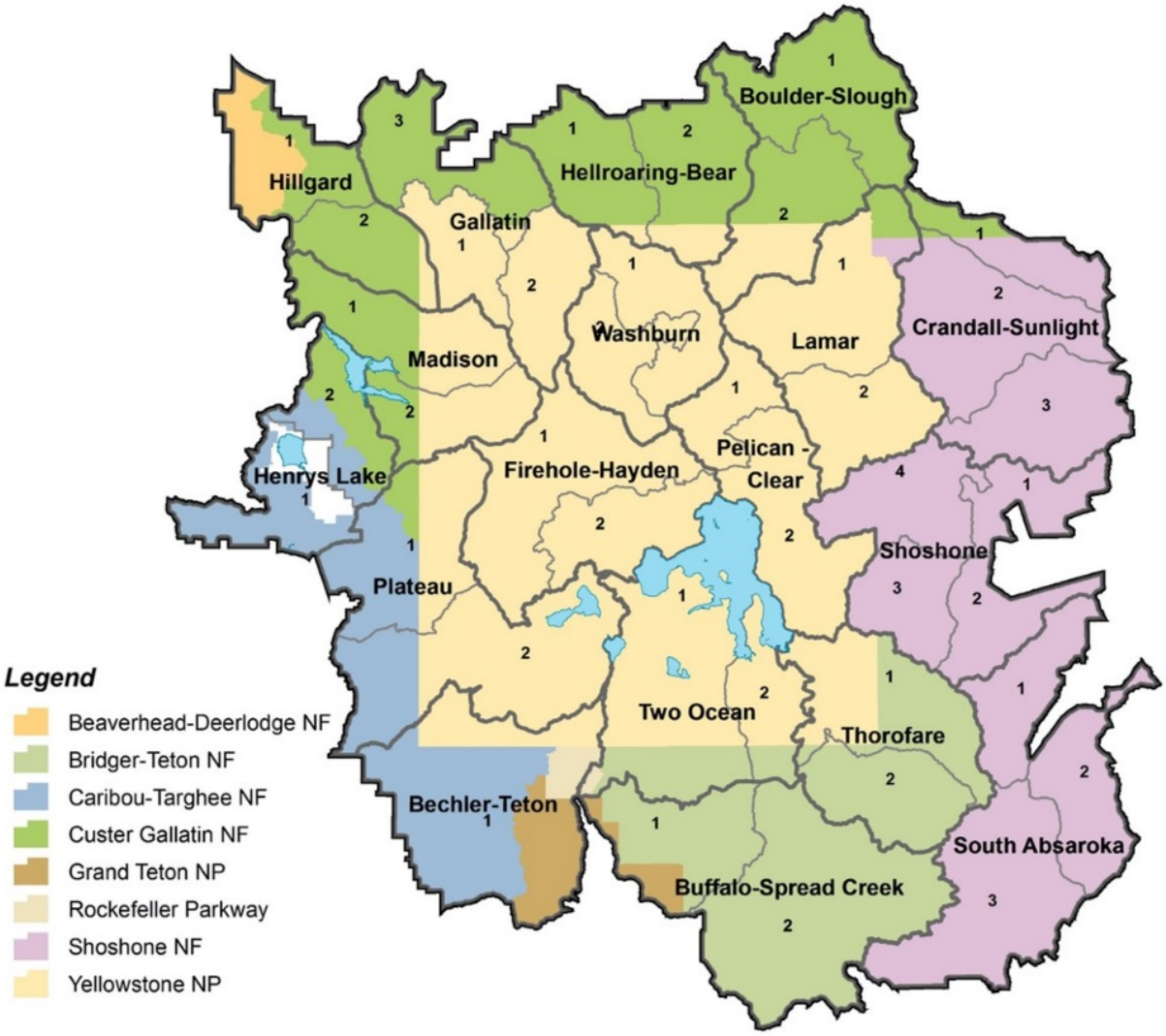

Fig. A2. Bear Management Units and subunits comprising the Recovery Zone for grizzly bears in the Greater Yellowstone Ecosystem.

Monitoring of Livestock Grazing

The habitat standard for livestock allotments identified in the Conservation Strategy requires there be no net increase in the number or acreage of active commercial livestock grazing allotments and no increase in permitted sheep animal months on federal lands inside the Recovery Zone 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 Recovery Zone. 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, non-use can be granted for an active allotment on a year-by-year basis under certain circumstances. Vacant allotments are those without an active permit, but which may be grazed periodically at the discretion of the land management agency. Stocking of vacant allotments is typically on a temporary basis to resolve resource issues or other management concerns. Vacant allotment are assumed to be un-stocked unless otherwise specified. A closed allotment is one that is not stocked and where commercial grazing cannot be permitted. Sheep animal months are derived by multiplying the number of permitted sheep by the number of months of permitted grazing on a given allotment. Existing sheep allotments are to be phased out as opportunity arises with willing permittees.

Commercial grazing allotments on public lands inside the Recovery Zone 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 2019 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 Recovery Zone has been reduced by 32% (213,673 acres, 865 km^2). Approximately 93% of this net reduction was the result of permanent closures and 7% was from active allotments that were vacated. With closure of the only cattle allotment inside Grand Teton National Park in 2011, there currently is no livestock grazing occurring on National Park lands inside the GYE (Table A1).

Change in sheep allotments since 1998

Domestic sheep allotments on public lands inside the Recovery Zone have largely been phased out since 1998. During 1998 there was a total of 11 active sheep allotments on public lands inside the Recovery Zone, 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 Recovery Zone. 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 Recovery Zone today is the Meyers Creek allotment located on the Caribou-Targhee National Forest and part of the USDA Sheep Experiment Station (USSES). Although “active,” the Myers Creek has not been issued a grazing permit since the Willow Creek fire in 2008. Consequently, there has been no domestic sheep grazing on public lands inside the Recovery Zone for the past 12 years (Table A1).

Change in livestock allotments during 2019

During 2019 there were no reported changes in livestock grazing allotments on federal lands inside the Recovery Zone.

Table A1. Number of commercial livestock grazing allotments and sheep animal months (AMs) inside the Recovery Zone in 1998 and 2019.

Administrative unit	Cattle allotments				Sheep allotments				Sheep animal months	
	Active		Vacant		Active		Vacant			
	1998	2019	1998	2019	1998	2019	1998	2019	1998	2019
Beaverhead-Deerlodge National Forest	3	3	2	0	0	0	0	0	0	0
Bridger-Teton National Forest	9	6	0	1	0	0	0	0	0	0
Caribou-Targhee National Forest [a]	11	7	1	1	7	1	4	0	14,163	1,970[a]
Custer-Gallatin National Forest	23	14	10	5	2	0	4	0	3,540	0
Shoshone National Forest	25	25	0	0	2	0	2	0	5,387	0
Grand Teton National Park	1	0	0	0	0	0	0	0	0	0
Total count in Recovery Zone	72	55	13	7	11	1	10	0	23,090	1.970
Total acres in Recovery Zone	661,770	456,040	67,846	31,679	148,368	3,504	77,066	0		
Total area in Recovery Zone (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 Recovery Zone, did not request a permit in 2019.

Livestock Conflicts Throughout the GYE

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

Livestock conflicts in 2019

In 2019, a total of 102 grizzly bear conflicts associated with livestock depredation on U.S. Forest Service lands were reported inside the GYE (Fig. A3). These conflicts occurred on 19 distinct commercial grazing allotments distributed throughout the ecosystem. All but 1 of the 102 incidents in 2019 involved cattle depredations and accounted for the injury or mortality of at least 3 cows and 64 calves or yearlings. A bear was involved in the mortality of 5 sheep and 2 guard dogs outside of the Recovery Zone in an incident where wolf predation was also noted. Conflicts were reported on 5 National Forests in the GYE including the Beaverhead-Deerlodge (n = 20), Bridger-Teton (n = 62), Caribou-Targhee (n = 1), Custer Gallatin (n = 2), and the Shoshone (n = 17). Approximately 89% (n = 91) of the conflicts occurred outside the Recovery Zone. Of the 102 livestock-related conflicts, 56% (n = 57) occurred on the Upper Green River cattle allotment located outside the Recovery Zone on the north portion of the Bridger-Teton National Forest. During 2019, management actions in direct response to livestock depredations on public lands led to the removal of 6 adult male grizzly bears. Three of the six grizzly bear management removals were due to persistent cattle depredations on the Upper Green River allotment. One removal was due to cattle depredations on the West Fork allotment on the Beaverhead-Deerlodge National Forest, and two were due to cattle depredations on the Wind River and Warm Springs allotments on the Shoshone National Forest.

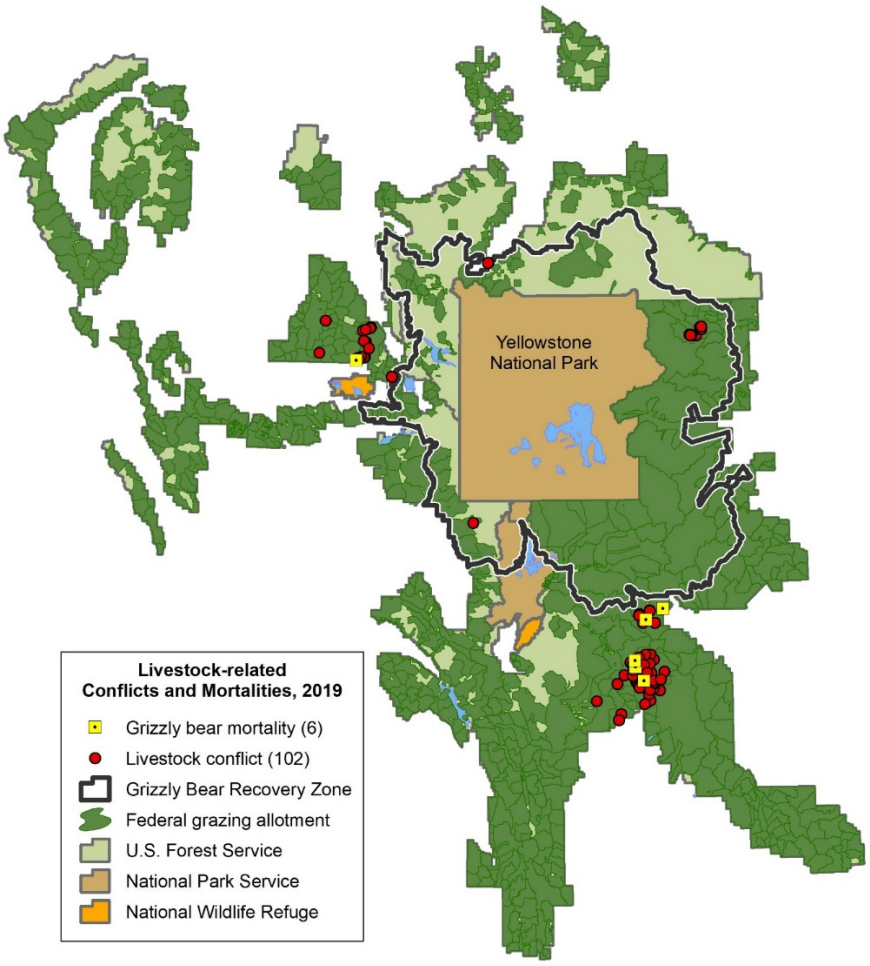

Fig. A3. Grizzly bear conflicts and mortalities related to commercial livestock grazing on federal lands in the Greater Yellowstone Ecosytem during 2019.

Recurring livestock conflicts 2015–2019

Livestock conflicts are considered 'recurring' when cattle and/or sheep depredation incidents involving grizzly bears are reported on a given allotment in 3 or more years during the preceding 5-year period. During 2015–2019, 556 livestock-related conflicts were reported on grazing allotments on National Forest lands inside the GYE (Table A2). Approximately 94% (n = 520) of these conflicts occurred outside the Recovery Zone. Of the 556 conflicts, 59% (n = 330) occurred on the Upper Green River cattle allotment located outside the Recovery Zone on the Bridger-Teton National Forest. Fourteen allotments experienced recurring conflicts: 3 on the Beaverhead-Deerlodge, 4 on the Bridger-Teton, and 7 on the Shoshone National Forest (Table A2). Over the past 5 years, 32 grizzly bears were removed from the population due to persistent livestock depredation on U.S. Forest Service allotments. These 32 management removals included 3 females (2 adult, 1 subadult) and 28 males (23 adult, 4 subadult, 1 cub) and 1 adult of unknown gender. Twenty-two (69%) of the 32 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 (2015–2019)	Recurring conflicts
		2015	2016	2017	2018	2019		
Beaverhead–Deerlodge National Forest								
Anderson/Cox	29,826	0	0	0	1	0	1	No
Antelope Basin	4,430	2	0	0	0	0	2	No
Bufiox	13,077	0	0	3	1	0	4	No
Burnt Creek	2,992	0	0	0	0	1	1	No
Clover Meadows	10,398	1	0	0	1	0	2	No
Conklin	3,654	0	0	1	0	0	1	No
Eureka Basin	11,617	0	0	1	5	1	7	Yes
Hidden Lake Bench	6,609	0	0	1	0	0	1	No
Lobo Cascade	11,941	0	0	0	1	0	1	No
Lyon Wolverine	16,188	0	0	0	1	0	1	No
North Saddle	3,454	0	1	2	1	1	5	Yes
Poison Basin	6,863	0	1	0	0	0	1	No
Standard Creek	12,833	0	0	0	0	4	4	No
Upper Ruby	44,395	0	0	2	5	0	7	No
Warm Springs	22,518	0	0	1	0	0	1	No
West Fork	53,096	4	2	9	13	13	41	Yes
Wigwam Trail	12,742	0	0	0	1	0	1	No
Bridger-Teton National Forest								
Badger Creek	7,254	0	0	0	0	1	1	No
Beaver-Twin	22,030	0	0	0	0	1	1	No
Fish Creek [a]	76,217	0	1	0	0	0	1	No
Fisherman Creek	47.629	0	0	0	0	1	1	No
Green River (Drift)	1,003	0	0	1	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 (2015–2019)	Recurring conflicts
		2015	2016	2017	2018	2019		
Lime Creek	4,973	5	1	0	0	0	6	No
Noble Pasture	762	1	0	0	4	1	6	Yes
North Cottonwood	28,177	0	0	0	2	0	2	No
Roaring Fork	8,416	0	0	1	0	1	2	No
Salt Creek	10,005	0	0	1	0	0	1	No
Sherman C&H	8,287	0	1	1	0	0	2	Yes
Tosi Creek	14,090	0	1	0	0	0	1	No
Upper Green River	131,94	78	54	69	72	57	330	Yes
Upper Gros Ventre	67,497	5	0	4	3	0	12	Yes
Wagon Creek	182	1	0	0	0	0	1	No
Caribou-Targhee National Forest								
Ching Creek	3,911	0	1	0	0	0	1	No
Grandview	43,478	2	0	0	0	0	2	No
High Five	21,943	0	0	0	1	0	1	No
Squirrel Meadows	28,797	0	1	1	0	1	3	No
Custer-Gallatin National Forest								
Wigwam	2,762	0	1	2	0	2	3	No
Shoshone National Forest								
Basin	73,119	1	0	0	0	0	1	No
Bear Creek	33,672	1	0	1	0	0	2	No
Beartooth	30,317	1	0	0	0	0	1	No
Bench (Clarks Fork)	28,751	3	4	0	4	0	11	Yes
Crandall	18,641	0	0	0	0	3	3	No
Dick Creek	9,569	1	0	0	0	0	1	No
Dunn Creek	4,520	0	1	0	0	0	1	No
Dunoir	52,875	0	0	0	1	1	2	No
Fish Lake	12,743	0	0	2	3	0	5	Yes
Ghost Creek	11,579	0	3	0	0	1	4	No
Horse Creek	29,980	0	2	1	0	0	3	Yes
Parque Creek	13,528	4	0	0	0	0	4	No
Piney	14,287	0	1	0	0	0	1	No
Ramshorn	16,005	1	0	0	0	0	1	No
Reef Creek	11,449	0	3	0	0	0	3	No
Salt Creek	8,263	0	5	1	0	0	6	No
Sunshine	2,152	1	0	0	0	0	1	No
Table Mountain	13,895	0	4	1	3	4	12	Yes
Trout Creek	12,799	0	1	0	0	0	1	No
Union Pass	39,497	0	0	1	4	0	5	No
Warm Springs	16,875	2	3	3	2	3	13	Yes
Wiggins Fork	37,653	2	1	0	0	0	3	Yes

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

U.S. Forest Service allotment name	Total acres	Livestock-related conflicts					Total conflicts (2015–2019)	Recurring conflicts
		2015	2016	2017	2018	2019		
Wind River	44,158	4	1	0	1	5	11	Yes
Total conflicts		**122**	**94**	**110**	**128**	**102**	**556**	

[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 Recovery Zone

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

Changes in developed sites since 1998

The number of distinct developed sites known to exist in 1998 is 593. In the intervening years, a number of sites have been condemned or permanently closed and dismantled. New sites that were built have been mitigated for by closing one or more sites of equivalent human use within the same subunit. Today, the number of known developed sites on public lands inside the Recovery Zone is 576, accounting for a net decrease of 17 sites between 1998 and 2019. From 1998 to the present, the number of developed sites have remained at or below 1998 counts for all subunits inside the Recovery Zone except for the Hilgard #2 subunit, which increased by a count of one. This increase occurred in 2005 when the Taylor Falls/Lightning trailhead, originally located in subunit #1 of the Hilgard BMU, was moved from one side of a road to the other, placing it in subunit #2 of the Hilgard BMU. In this case, the loss in one subunit yielded a gain in the other. Although this transfer technically accounted for an increase in developed sites on Hilgard #2, it was determined to have no detrimental effect on grizzly bears and did not violate the intent of the developed site standard. Table A3 shows a comparison of developed site counts between 1998 and 2019.

Changes in developed sites in 2019:

During 2019 there were no changes in the number of developed sites on federal lands inside the Recovery Zone.

Future review of developed sites

Since 2007, when the grizzly bear habitat standards were first implemented, the number of visitors on public lands throughout the GYE has increased significantly. In Yellowstone National Park alone, annual visitation increased by more than 40% during the period 2008–2018, surpassing 4 million visitors per year since 2016 (National Park Service website). 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 proposed revisions will be made available for public comment prior to final approval by the Yellowstone Ecosystem Subcommittee.

Table A3. *Number of developed sites in 1998 and 2019 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 Recovery Zone	
		1998	2019	1998	2019	1998	2019	1998	2019	1998	2019	1998	2019	1998	2019	1998	2019
Bechler-Teton #1	CTNF	0	0	1	1	5	5	2	2	4	4	16	16	0	0	58	58
	GTNP	0	0	8	8	3	3	1	1	3	3	9	9	0	0		
	YNP	0	0	0	0	2	2	0	0	2	2	2	2	0	0		
Boulder-Slough #1	CGNF	0	0	1	1	7	7	0	0	1	1	3	3	8	2	20	14
Boulder-Slough #2	CGNF	0	0	0	0	0	0	0	0	2	2	0	0	0	0	9	9
	YNP	0	0	1	1	3	3	0	0	2	2	1	1	0	0		
Buffalo-Spread Creek #1	BTNF	0	0	1	1	1	1	0	0	0	0	2	2	0	0	18	18
	GTNP	0	0	1	1	7	7	2	2	1	1	3	3	0	0		
Buffalo-Spread Creek #2	BTNF	1	1	4	2	3	5	3	3	5	5	5	3	1	1	22	20
Crandall-Sunlight #1	CGNF	0	0	2	2	2	2	0	0	0	0	5	5	0	0	23	23
	SNF	0	0	2	2	5	5	1	1	1	1	5	5	0	0		
Crandall-Sunlight #2	CGNF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	18
	SNF	0	0	5	5	4	4	1	1	2	2	5	5	1	1		
Crandall-Sunlight #3	SNF	0	0	2	2	3	3	0	0	1	1	2	2	0	0	11	11
	WG&F	0	0	2	2	0	0	0	0	1	1	0	0	0	0		
Firehole-Hayden #1	YNP	0	0	1	1	5	5	1	1	6	6	13	13	0	0	26	26
Firehole-Hayden #2	YNP	0	0	1	1	3	3	1	1	2	2	8	8	0	0	15	15
Gallatin #1	YNP	0	0	0	0	3	3	0	0	1	1	0	0	0	0	4	4
Gallatin #2	YNP	0	0	2	2	5	5	1	1	12	12	1	1	0	0	21	21
Gallatin #3	CGNF	0	0	2	2	9	9	0	0	0	0	6	6	0	0	18	18
	YNP	0	0	0	0	0	0	0	0	1	1	0	0	0	0		
Hellroaring-Bear #1	CGNF	0	0	4	4	11	11	0	0	3	3	8	8	8	8	36	36
	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		
Henrys Lake #1	CTNF	2	2	3	3	1	1	0	0	3	3	11 [4]	11	1	0	21	20

Table A3. *Number of developed sites in 1998 and 2019 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 Recovery Zone	
		1998	2019	1998	2019	1998	2019	1998	2019	1998	2019	1998	2019	1998	2019	1998	2019
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
South Absaroka #2	SNF	0	0	0	0	0	0	0	0	2	2	0	0	0	0	2	2

Table A3. *Number of developed sites in 1998 and 2019 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 Recovery Zone	
		1998	2019	1998	2019	1998	2019	1998	2019	1998	2019	1998	2019	1998	2019	1998	2019
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**	**160**	**161**	**28**	**28**	**117**	**114**	**169**	**164**	**28**	**21**	**593**	**576**

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 Big Springs Boat Takeout site was appended in 2018 as a correction to the 1998 Baseline. This baseline correction added 1 count to the CTNF, Henrys Lake subunit #1, "Other" Category, causing the total baseline counts to go from 592 to 593 (1998) and 575 to 576 (2018). The boat site existed prior to 1998 and is visible in 1994 photo imagery.

Monitoring Secure Habitat and Motorized Access Inside the Recovery Zone

Habitat standards identified in the Conservation Strategy require that there be no net loss in grizzly bear secure habitat with respect to levels that existed in 1998 for each of the 40 subunits inside the Recovery Zone. 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 (2.59 km^2) in size are excluded from habitat calculations.

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

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

Permanent changes in secure habitat since 1998 inside Recovery Zone

The standard calling for "no net loss" in secure habitat with respect to 1998 baseline levels has been consistently met in all 40 subunits inside the Recovery Zone since it was initially formalized in the 2007 Conservation Strategy. For the 3 subunits identified in the 2007 Conservation Strategy as in need of improvement above 1998 levels (Gallatin #3, Henrys Lake #2, and Madison #2), new baseline thresholds ensure that secure habitat will be maintained well into the future at levels higher than what was attained in 1998. Since 1998, a net gain of approximately 131 $miles^2$ (339 km^2) in secure habitat has been attained inside the Recovery Zone. This gain is comparable in size to the area of Yellowstone Lake. The greatest improvement in secure habitat is the 17.2 % increase occurring on the Gallatin #3 Bear Management

Subunit (BMS) on the Custer-Gallatin National Forest. The gain in secure habitat for this subunit, as well as Henrys Lake #2 (6 %) and Madison #2 (1.0%) was achieved by road closures commissioned for implementation of the Gallatin Travel Management Plan. Values achieved with full implementation of the Gallatin Travel Management Plan constitute new baselines against which future change will be measured (Table A4 footnote). Other notable gains in secure habitat range from 3.4% on the Hellroaring-Bear #1 subunit to 13.4% on the Hilgard #1 subunit. Changes in secure habitat, when averaged over all 40 subunits, account for a mean gain of 1.4% since 1998. All gains in secure habitat throughout the Recovery Zone were achieved by the decommissioning of motorized routes on public lands. Permanent changes in secure habitat, OMARD, and TMARD inside the Recovery Zone are reported with respect to baseline levels in Table A4.

Permanent changes in secure habitat during 2019 inside Recovery Zone

During 2019 there was one change in the status of motorized access on public land which yielded a minor change to secure habitat.

- *Buffalo Spread Creek #2*: Approximately 1 mi (1.6 km) of motorized road located in the Skull Creek drainage on the Blackrock Ranger District in the Bridger-Teton National Forest was decommissioned. This road closure led an increase in secure habitat of 0.05% for the subunit.

Table A4. *1998 and 2019 percent areas of open motorized access route density (OMARD, total motorized access route density (TMARD), and secure habitat per bear management subunit inside the Grizzly Bear Recovery Zone of the Greater Yellowstone Ecosystem.*

Bear management subunit	% OMARD (subunit % > 1 miles / mile²)			% TMARD (subunit % > 2 miles / mile²)			% Secure Habitat			Area (miles²) (excluding major lakes)		
										Subunit	Secure Habitat	
	1998	2019	% chg	1998	2019	% chg	1998	2019	% chg		1998	2019
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	11.0	-0.5	5.3	5.8	0.5	88.3	88.9	0.6	219.9	194.1	195.5
Buffalo/Spread Creek #2	15.6	15.9	0.4	12.7	8.9	-3.8	74.3	74.4	0.1	507.6	377.2	377.5
Crandall/Sunlight #1	19.3	18.5	-0.8	7.2	6.3	-0.9	81.1	81.9	0.8	129.8	105.2	106.2
Crandall/Sunlight #2	16.6	16.0	-0.6	11.7	9.8	-1.9	82.3	82.7	0.4	316.2	260.3	261.4
Crandall/Sunlight #3	19.2	18.5	-0.6	10.6	9.1	-1.5	80.4	81.2	0.8	221.8	178.3	180.1
Firehole/Hayden #1	10.4	10.5	0.1	1.7	1.7	0.0	88.3	88.3	0.0	339.2	299.7	299.6
Firehole/Hayden #2	9.0	9.0	0.0	1.5	1.5	0.0	88.4	88.4	0.0	172.2	152.3	152.3
Gallatin #1	3.6	2.5	-1.0	0.5	0.1	-0.4	96.3	97.0	0.7	127.7	122.9	123.9
Gallatin #2	9.5	9.1	-0.4	4.5	4.5	0.0	90.2	90.2	0.0	155.2	139.9	139.9
Gallatin #3 *	46.0	27.4	-18.5	22.9	12.5	-10.4	**55.3**	72.5	17.2	217.6	120.2	157.7
Hellroaring/Bear #1	23.1	18.4	-4.7	15.8	12.1	-3.7	77.0	80.4	3.4	184.7	142.2	148.5
Hellroaring/Bear #2	0.1	0.0	-0.1	0.0	0.0	0.0	99.5	99.6	0.1	228.9	227.8	228.0
Henry's Lake #1	49.0	49.2	0.2	31.2	31.3	0.1	45.4	46.0	0.6	191.2	86.8	88.0
Henry's Lake #2 *	49.9	40.6	-9.4	35.2	28.3	-6.9	**45.7**	51.8	6.1	140.2	64.1	72.6
Hilgard #1	29.0	13.3	-15.7	15.3	4.4	-10.9	69.8	83.1	13.4	201.2	140.3	167.2
Hilgard #2	21.0	16.1	-4.9	13.6	4.6	-8.9	71.4	80.2	8.8	140.5	100.4	112.7
Lamar #1	9.9	9.7	-0.1	3.8	4.0	0.2	89.4	89.9	0.5	299.9	268.1	269.6
Lamar #2	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0	180.8	180.8	180.8
Madison #1	29.5	20.3	-9.2	12.5	7.5	-5.0	71.5	80.7	9.2	227.9	162.9	183.9
Madison #2 *	33.7	32.0	-1.7	24.0	21.6	-2.4	**66.5**	67.5	1.0	149.4	99.4	100.9
Pelican/Clear #1	2.0	2.0	0.0	0.5	0.5	0.0	97.8	97.8	0.0	108.4	106.0	106.0

Table A4. *1998 and 2019 percent areas of open motorized access route density (OMARD, total motorized access route density (TMARD), and secure habitat per bear management subunit inside the Grizzly Bear Recovery Zone of the Greater Yellowstone Ecosystem.*

Bear management subunit	% OMARD (subunit % > 1 miles / mile²)			% TMARD (subunit % > 2 miles / mile²)			% Secure Habitat			Area (miles²) (excluding major lakes)		
										Subunit	Secure Habitat	
	1998	2019	% chg	1998	2019	% chg	1998	2019	% chg		1998	2019
Pelican/Clear #2	5.4	5.4	0.0	0.4	0.4	0.0	94.1	94.1	0.0	251.6	236.7	236.7
Plateau #1	22.2	19.0	-3.3	12.9	10.3	-2.7	68.8	70.6	1.8	286.3	197.0	202.1
Plateau #2	8.5	8.5	0.0	3.5	3.2	-0.2	88.7	88.8	0.1	419.9	372.3	372.7
Shoshone #1	1.5	1.5	0.0	1.1	1.0	-0.1	98.5	98.5	0.1	122.2	120.3	120.4
Shoshone #2	1.3	1.1	-0.2	0.7	0.6	-0.2	98.8	99.0	0.1	132.4	130.9	131.0
Shoshone #3	3.9	2.8	-1.1	2.1	1.5	-0.6	97.0	97.8	0.8	140.7	136.5	137.6
Shoshone #4	5.3	5.3	0.0	2.9	2.7	-0.2	94.9	94.9	0.0	188.8	179.1	179.1
South Absaroka #1	0.6	0.6	0.0	0.1	0.1	0.0	99.2	99.2	0.0	163.2	161.9	161.9
South Absaroka #2	0.0	0.0	0.0	0.0	0.0	0.0	99.9	99.9	0.0	190.6	190.3	190.3
South Absaroka #3	2.4	2.4	0.0	2.7	1.7	-1.1	96.8	96.8	0.0	348.3	337.1	337.2
Thorofare #1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0	273.4	273.4	273.4
Thorofare #2	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0	180.1	180.1	180.1
Two Ocean/Lake #1	3.5	3.6	0.2	0.3	0.5	0.2	96.3	96.3	0.0	371.9	358.3	358.2
Two Ocean/Lake #2	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0	124.9	124.9	124.9
Washburn #1	16.1	16.1	0.0	4.2	4.2	0.0	83.0	83.0	0.0	178.3	147.9	147.9
Washburn #2	7.4	7.4	0.0	1.1	1.1	0.0	92.0	92.0	0.0	144.1	132.6	132.6
GBRZ mean / total area	**12.7**	**10.9**	**-1.8**	**6.7**	**5.2**	**-1.5**	**85.6**	**87.0**	**1.4**	**9,025**	**7,724**	**7,855**

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

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

Temporary Changes to Secure Habitat Inside the Recovery Zone, 2019

Reductions in secure habitat below baseline levels are allowed on a temporary basis inside the Recovery Zone when associated with authorized federal projects. In these cases, adherence to the "one percent" application rule and other provisions must be met. The one percent rule states that any temporary loss of secure habitat below baseline values within a given BMU cannot exceed 1% of the total acreage of the largest subunit within that BMU. Application rules allow only one temporary project to be active in a particular subunit at any given time. During 2019 one project involving temporary reductions in secure habitat was operational inside the Recovery Zone (Table A5). Below is a brief summary of this Forest Service project.

Sugarloaf Timber Sale: This fuel reduction and salvage-sanitation silvicultural project in the Crandall-Sunlight #2 subunit was authorized under the Budworm Response Project Environmental Assessment and Decision Notice. Implementation for the Budworm project will span 2018–2025. The Sugarloaf timber sale was initiated in 2018 with the construction of 13 temporary roads adding to a collective length of 3.3 mi (5.3 km). All but 1 of the project roads extended directly from the Chief Joseph Highway. Project road construction resulted in an initial temporary reduction of 0.24 mi^2 (0.62 km^2) in secure habitat. The reduced level in secure habitat due to project road construction remained above the 1998 baseline threshold for the Crandall-Sunlight #2 subunit. By the end of 2019, all but 4 of the temporary roads were closed and barricaded to preclude motorized access. At that time, the reduction in secure habitat amounted to 0.048 mi^2 (0.13 km^2). The remaining temporary roads will close by 2021. All new temporary roads will be decommissioned and rehabilitated upon sale completion. No other temporary roads are in use on the entire Budworm Response Project.

Table A5. *Secure grizzly bear habitat affected by temporary projects inside the Recovery Zone, 2019*

Project Name and National Forest	Bear Management Unit Subunit	Secure habitat (miles^2)					Project status
		Allowed reduction below Baseline [a]	Baseline	2018 (without project)	2019 (with project)	Reduction in Secure Habitat	
Sugarloaf Timber Sale Bridger-Teton N.F.	Crandall-Sunlight #2	3.2	260.3	261.5	261.45	0.02%	Closed

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

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Appendix B

This report is available in digital format from the Greater Yellowstone Network website (https://www.nps.gov/im/gryn/reports-publications.htm) and the Natural Resource Publications Management website (https://www.nps.gov/im/publication-series.htm). If you have difficulty accessing information in this publication, particularly if using assistive technology, please email irma@nps.gov.

National Park Service

U.S. Department of the Interior

Monitoring Whitebark Pine in the Greater Yellowstone Ecosystem

2019 Annual Report

Natural Resource Data Series NPS/GRYN/NRDS—2020/1273

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U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols. This report received formal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data, and whose background and expertise put them on par technically and scientifically with the authors of the information.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

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NPS 960/168317, April 2020

Appendix C

2019 Wyoming Bear Wise Wyoming Project Update

Introduction

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

This report provides a summary of program accomplishments in 2019. Past accomplishments are reported in the 2006–2018 annual reports of the Interagency Grizzly Bear Study Team (IGBST) and in the 2011–2018 Annual Job Completion Reports of the Wyoming Game and Fish Department (WGFD).

Background

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

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

In 2005, the 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 15 years, the Bear Wise Community Programs in northwest Wyoming have deployed a multi-faceted education and outreach campaign in an effort to minimize human-bear conflicts and promote proper attractant management. Although a wide array of challenges remain and vary between communities, many accomplishments have been made and progress is expected to continue as Bear Wise efforts gain momentum. In an effort to broaden the scope of the program, this work was rebranded as the Bear Wise Wyoming Program.

Cody Project Update

The Cody Bear Wise Community Program continues to use radio, television and print media, mass mailings, and the use of signing on private and public lands to convey 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 2019 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 Park County Commissioners, Wyoming Outdoorsmen, and the Memorial Bear Fund. 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, 1,232 domestic livestock carcasses have been removed from private lands.

2. Recommendations concerning the proper storage of garbage and other attractants are provided to the Park County Planning and Zoning Commission for new developments within the greater Cody area. The Coordinator reviews proposed developments on a case-by-case basis, attends monthly meetings, and contacts applicants directly to discuss conflict prevention measures. To date, these comments have been adopted as either formal recommendations or as a condition of approval for 24 new developments within Park County.

3. In the Cody Region, Large Carnivore Section (LCS) personnel erected 16 temporary electric fences around bee apiaries to minimize conflicts. There were also several electric fences temporarily placed around apple orchards to deter bear conflicts.

4. In the spring, LCS personnel put on a “Living in Large Carnivore Country” presentation on Facebook Live. This was a new technique used to try and reach constituents that may not be able to attend a workshop in person. This is a new format that will continue to be used to better serve the public.

5. A public service announcement (PSA) was recorded by WGFD personnel on “Staying Safe in Bear Country” and broadcast over the radio in the spring of 2019 on the Bighorn Basin Radio Network. LCS personnel also took part in several radio interviews.

6. Funding was secured from the Rocky Mountain Elk Foundation to purchase three (3) collapsible bear boxes to be placed at backcountry campsites in the Beartooth Mountains. These bear boxes will be used by many outdoor recreationalists who travel from all over the country and world to visit the Beartooth Mountains. Although, there are food storage regulations on these Forest Service lands, backcountry campsites lack infrastructure for campers. Providing bear boxes will send a clear message that the area is occupied grizzly bear habitat.

7. Numerous informational presentations were given that focused on human-bear conflict prevention to audiences including the Park, Fremont, Hot Springs, and Big Horn County public school systems, Cody Outdoor camp, Powell Rec. District, Boy Scouts, 4-H members, DANO Youth Camp, Paint Rock Hunter Management Program, guest ranches, and college students (Fig. C1).

Fig. C1. Human-bear conflict prevention presentation to school group. (Photo courtesy of Dustin Lasseter, WGFD)

8. Frequent one-on-one contacts were made during the 2019 conflict season in areas where the occurrence of human-bear conflicts has historically been high. This is an effective way to let the community know what is really happening instead of them speculating and demonstrating our personnel's dedication to being on the ground and reducing conflict potential.

9. A "Working Safely in Bear Country" workshop was conducted for the Park County Weed and Pest District, Bureau of Land Management, and Rocky Mountain Power employees.

10. A booth containing information on bear identification, attractant storage, hunting and recreating safely in bear country, and the proper use of bear spray was staffed at the Lander Winter Fair, Cody Outdoor Expo, Casper Expo, Dubois Museum Days, Powell Outdoor Safety Day, Wyoming Outdoorsmen Banquet, and Greater Yellowstone Coalition Bears and Bikes Event (Fig. C2).

11. 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 2019.The partnerships with Wyoming Outdoorsmen, BLM, Park County Commissioners, Western Bear Foundation, and Greater Yellowstone Coalition were vital in making this project a reality.

Fig. C2. Bear booth and bear trailer at an outdoor event. (Photo courtesy of Dustin Lasseter, WGFD)

12. By utilizing the bear trailer, informational booths, workshops, and giving 52 presentations upon request, the Bear Wise Wyoming program directly reached approximately 7,800 people in northwest Wyoming. Although the level of interaction differed from person to person, it is certain that the added awareness to bears lessened conflicts. The picture below shows a heat map of the presentations given in Wyoming, with the highest density of interactions showing in orange and red (Fig. C3).

13. The new 2019 Antelope, Deer, and Elk hunting regulations have a section on being *Bear Aware*. Specifically, there is information regarding game retrieval and handling, how to react to an aggressive/defensive bear encounter, how to properly use bear spray, and what to do if a bear comes into camp.

Pinedale Area Update

In 2011, a Bear Wise Community effort was initiated targeting residential areas north of Pinedale, Wyoming, where the occurrence of human-bear conflict has increased in recent years. Accomplishments for the Pinedale area in 2019 are as follows:

1. Presented bear safety and carnivore biology information at two Pinedale Science Camps at the DC Bar Ranch in Kendall Valley.

2. 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.

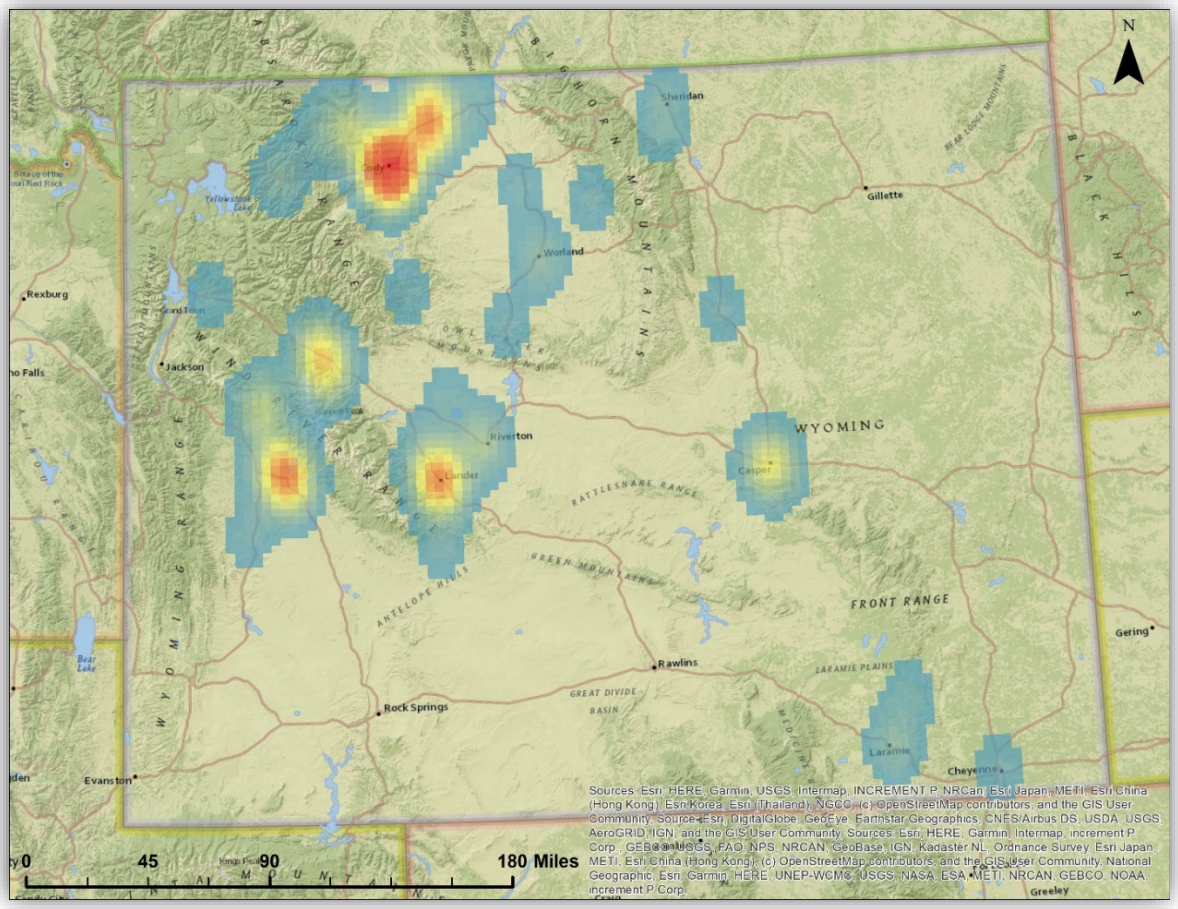

Fig. C3. Heat map showing the density of presentations given by the Bear Wise Wyoming Program. The highest density of presentations and interactions are show in orange and red. Base map source: National Geographic World Map, ESRI, Redlands, California.

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

4. Bear safety presentations were given to the Pinedale and Big Piney Ranger Districts of the U.S. Forest Service, and the Sublette County Weed and Pest employees and volunteers. These personnel have the potential to encounter grizzly bears during the course of their work activities.

5. The WGFD hosted a bear safety booth at Pinedale's Rendezvous Days Celebration, contacting hundreds of participants over a 3-day period. Pinedale's Rendezvous Days attracts approximately 10,000 people over the 4-day event and WGFD employees contact an estimated 1,000 constituents. This year's booth featured a "bear charger" that helps visitors practice using bear spray under more realistic conditions (Fig. C4).

6. The WGFD hosted a bear safety booth at Pinedale's Wind River Mountain Festival for the fourth year. The festival draws a diverse crowd and over 700 people visited the booth.

7. LCS personnel manned a bear booth at the Sublette County Conservation District's "Spring Expo" and reached approximately 200 people.

8. LCS personnel presented bear safety information to Sublette County's Tip Top Search and Rescue. Tip Top members were able to practice using inert bear spray on the "bear charger".

9. LCS personnel traveled to the Madison Valley of Montana at the request of local producers to participate in a workshop aimed at reducing livestock conflicts with large carnivores.

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

11. Personnel provided bear biology and bear safety information at a Pinedale middle school field day at Fremont Lake.

12. Personnel participated in field tours for visiting agriculture extension agents from Clemson University and the state of South Carolina.

Objectives for 2020 include continued expansion of the program into the other areas of the state where human-bear conflicts continue to be a chronic issue and the continuation of current educational and outreach efforts in the Cody area with specific focus on areas that have not adopted proper attractant management methods.

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

Jackson Hole Project Update

The Bear Wise Jackson Hole program continues educational and outreach initiatives in an effort to minimize human-bear conflicts within the community of Jackson and surrounding areas. In 2019, 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, Grand Teton National Park, Bridger Teton National Forest, and Jackson Hole Wildlife Foundation. Two bear mounts (1 grizzly bear, 1 black bear) have been placed in the trailer along with other educational materials. The bear mounts were donated to the WGFD through a partnership with the United States Taxidermist Association and the Center for Wildlife Information. The trailer was displayed and staffed at various events and locations including Grand Teton National Park, Jackson Elk Fest, Fourth of July Parade, and the National Elk Refuge Visitor Center.

2. Public service announcements were broadcast on 4 local radio stations in Jackson for a total of 6 weeks throughout the spring, summer, and fall of 2018. The announcements focused on storing attractants so they are unavailable to bears and hunting safely in bear country.

Fig. C4. Bear charger interactive display that allows people to practice using bear spray safely under more realistic conditions. (Photo courtesy of Dustin Lasseter, WGFD)

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

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

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

6. LCS personnel continued to work with a Jackson catering company, Roots Kitchen & Cannery. They have been involved in picking apples from trees that have been identified as a source of bear conflict by WGFD. In 2018, they harvested fruit from 161 trees removing 13,000 lbs of apples which was made into cider.

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

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

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

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

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

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

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

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

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

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

Objectives for the Bear Wise Jackson Hole program in 2020 will be focused on supporting Teton County and local waste management companies with projects that will help disseminate information and achieve compliance with the recently adopted Teton County Bear Conflict Mitigation and Prevention LDR. In addition, more work will be done to identify areas within the city limits of Jackson and Star Valley communities where better attractant management and sanitation infrastructure is needed.

The recent implementation of the Teton County Bear Conflict Mitigation and Prevention LDR has greatly reduced the 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 LDR through public outreach and education projects. In order for the Jackson program to be successful, the program must continually identify information and education needs within the community while being adaptive to changing situations across different geographic areas. This will require the 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

2019 Accomplishments

1) Electronic and Print Media

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

2) Grizzly Bear Management Web Page

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

3) Hunter Education

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

Publications

Primary links to other publications, annual reports, peer-reviewed literature, maps, media, and data for the Yellowstone population of grizzly bears are available on the U.S. Geological Service web site: http://www.usgs.gov/norock/igbst.

For information specific to the Wyoming Game and Fish Department's grizzly bear management program, including links to publications, reports, updates, and plans visit: https://wgfd.wyo.gov/Wildlife-in-Wyoming/More-Wildlife/Large-Carnivore.

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